

	CENTRIFUGAL LIQUID CHILLERS WITH OPTIVIEW™ CONTROL CENTER	
SERVICE INSTRUCTIONS	Supersedes: 160.76-M1 (1015)	Form 160.76-M1 (917)

OPTIVIEW™ CONTROL CENTER MODEL YK (STYLE H)



Issue Date:
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IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During rigging, installation, operation, maintenance, or service, individuals may be exposed to certain components or conditions including, but not limited to: heavy objects, 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 rigging, installation, and 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 rigging, installation, and 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 the on-product labels, this document and any referenced materials. This individual shall also be familiar with and comply with all applicable industry and 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:



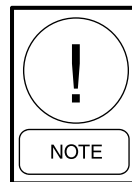
Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.



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 OptiView™ cabinet. Devices such as relays, switches, transducers and controls and any external wiring must not be installed inside the micropanel. 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 or product 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>.

It is the responsibility of rigging, lifting, and operating/service personnel to verify the applicability of these documents to the equipment. If there is any question

regarding the applicability of these documents, rigging, lifting, and operating/service personnel 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
Solid State Starter (Mod B) – Operation and Maintenance	160.00-O2
Medium Voltage Solid State Starter – Service	160.00-M5
Variable Speed Drive – Operation	160.00-O1
Variable Speed Drive – Service Instructions	160.00-M1
Medium Voltage Variable Speed Drive – Service	160.00-M6
Variable Speed Oil Pump Drive	160.52-M2
Installation	160.76-N1
OptiView™ Control Panel – Operation	160.76-O2
Wiring Diagram – Unit (Style H) With Electro-Mechanical Starter	160.76-PW1
Wiring Diagram – Unit (Style H) With Mod B Solid State Starter	160.76-PW2
Wiring Diagram – Unit (Style H) With Variable Speed Drive	160.76-PW3
Renewal Parts – OptiView™ Control Center	160.76-RP1
Wiring Diagram – Field Control Modifications for YK Chiller (Style H)	160.76-PW4
Wiring Diagram – YK Chiller (Style H) OptiView™ Control Center with Remote Low or Medium Voltage EMS	160.76-PW5
Wiring Diagram – YK Chiller (Style H) OptiView™ Control Center with Unit Mounted Low or Medium Voltage SSS, Unit Mounted Low Voltage with Modbus, or Remote Medium Voltage VSD	160.76-PW6

NOMENCLATURE

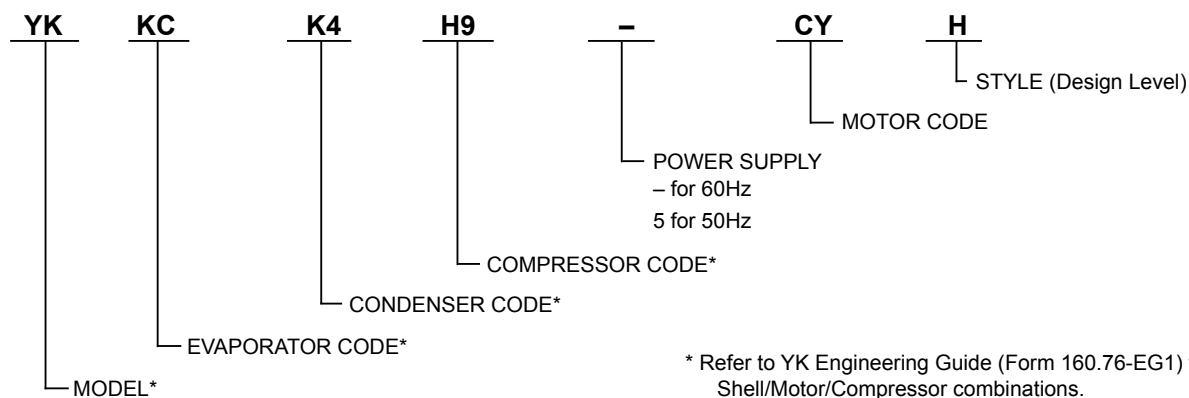


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PART NUMBER	DESCRIPTION
371-06975-101	Electro-Mechanical Starter – NEMA 1
371-06975-104	Electro-Mechanical Starter with VGD - NEMA 1
371-06975-107	Electro-Mechanical Starter with VGD & J7 Compressor - NEMA 1
371-06975-110	Modbus Solid State Starter or VSD - NEMA 1
371-06975-111	Modbus Solid State Starter or VSD with VGD - NEMA 1
371-06975-112	Modbus Solid State Starter or VSD with VGD and J7 Compressor - NEMA 1

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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, which describes the general function of each component and provides the system interface and signal flow, which must be understood before effective troubleshooting can begin.

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 a reference of items to be performed during chiller commissioning.

Chillers that are equipped with *P* compressors have certain component variances, which are noted in the appropriate sections of this manual.

In addition to this document, several supporting documents are required to service the system. *OptiView™ Control Panel – Operation (Form 160.76-O2)* explains the operation of the OptiView™ Control Center keypad, how to enter setpoints and explains all the messages displayed on the OptiView™ Control Cen-

ter display. The appropriate diagrams for each chiller are shown in the associated literature table in the front of this manual. These wiring diagrams provide component interconnections within the OptiView™ Control Center and the connections between these components and the motor starter and chiller components.

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 FeRAM memory. This history data can be displayed or printed using an optional printer. The *OptiView™ Control Panel – Operation (Form 160.76-O2)* 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 *OptiView™ Control Panel – Operation (Form 160.76-O2)* 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 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 to 10VDC, 2 to 10VDC, 0 to 20mA, 4 to 20mA, 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 compressor motor starter and contains a printed circuit board logic that supports Electro-Mechanical Starters, Solid State Starters and YORK Variable Speed Drives.

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 pressures are sensed by pressure transducers. The output of each transducer is a DC voltage that is analogous to the pressure input. System 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 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 orifice 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

In addition to the standard components, the OptiView™ Control Center contains a printed circuit board that provides certain control and interface functions for the starter type applied. Each starter type requires a different board as follows:

- Electro-Mechanical Starter – CM-2 Current Module.
- Solid State Starter (Style B) – None.
- Variable Speed Drive - None
- *Figure 1 on Page 19 through 4* are OptiView™ Control Center block diagrams of the three starter types. On each block diagram, the standard components are shown, along with the printed circuit board that supports the applied starter type. *Figure 6 on Page 24 and Figure 7 on Page 24* are Operation Sequence timing diagrams of the different starter applications.

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. The analog inputs are connected directly to the microboard. The Digital inputs are received via the I/O Board (see description below). Under Program control, the microboard operates the relays and triacs that are located on the I/O Board.

The control center will be equipped with the following Microboard:

- 031-03630-001 – Shipped in new production chillers after June 2015. This new design microboard has additional features that will be enabled in future software revisions. It is a service replacement for all previous OptiView microboards.

Since the newer versions microboard are backward compatible to earlier vintage OptiView™ Control Centers, earlier chillers could be equipped with a later version microboard due to service replacement.

The software versions Y.OPT.01.xx.yzz are alphanumeric codes that are interpreted as follows. Each time the controls section or language section is revised, the respective revision level increments.

- Y – Commercial chiller
- OPT – Used on Microboard 031-03630-001
- 01 – YK 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)

Throughout this manual, reference is made to functions and features that are only available in certain program revision levels. Software upgrades should only be performed by a qualified JCI Service technician.

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.

Chillers equipped with the Variable Geometry Diffuser (VGD) are supplied with and require 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 *SECTION 22 - VARIABLE GEOMETRY DIFFUSER*.

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 an Emergency Stop switch that is used to stop the chiller in an emergency situation. Normal Start and Stop functions are initiated using the "Soft" Start and Stop keys on the display.

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.

The condenser High Pressure Safety Cutout Switch (HPCO) is mounted on the condenser shell. For more information refer to *SECTION 4 - I/O BOARD* of this manual.

Compressors are equipped with a High Speed Thrust Bearing Limit Switch. This device detects abnormal bearing position through probe contact.

The chillers are equipped with variable speed oil pumps.

The 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 tempera-

ture. 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 the SECTION 3 - MICROBOARD 031-03630-001 for a detailed explanation of this flow sensor and interface.

The chiller style/compressor combination must be entered using the Chiller Style/Compressor setpoint (Refer to SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001). Once the applicable chiller style/compressor combination is entered, the program automatically bundles the functionality and chiller control per the entered chiller style/compressor requirements. The various chiller style/compressor combinations are equipped differently and have different control requirements. The variables include:

- High Speed Thrust Bearing proximity sensing – Limit Switch.
- Flow Sensor – Paddle type or factory mounted Thermal type. The paddle type applies 115VAC to the I/O Board Digital inputs TB4-12 (evaporator) and TB4-11 (condenser) (Refer to Figure 16 on Page 50). The factory mounted thermal type applies +5VDC to the microboard Analog Inputs at J14-4 (evaporator) and J14-7 (condenser).

Thermal-type or the optional Paddle-type flow sensors are used on Style "H" and later chillers. The actual flow sensor type present must be entered using the Flow Switch Setpoint. For more information refer to SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001.

When the compressor motor is driven by an Electro-Mechanical Starter, the OptiView™ Control Center is equipped with a CM-2 current module. This printed circuit board provides current overload and power fault protection for the compressor motor. Current transformers, located in the compressor motor terminal box, along with rectifying and calibration circuitry, provide an analog voltage representing compressor motor current to the CM-2 module. This signal is further conditioned and provided to the microboard.

When the compressor motor is driven by a YORK solid state starter, one of three different starters could be applied. Later production chillers are equipped with either the Style B liquid cooled solid state starter (LCSSS) or the medium voltage solid state starter (MVSSS).

The Style B LCSSS (Figure 2 on Page 20) contains a combination logic/trigger board in the starter cabinet that has a serial Modbus communications interface to the microboard.

The medium voltage solid state starter (Figure 3 on Page 21) serially communicates with the microboard using RS-485 Modbus Protocol.

When the compressor motor is driven by a YORK Variable Speed Drive, there could be a Variable Speed Drive (VSD) or a Medium Voltage Variable Speed Drive (MV VSD) applied.

With VSD units (Figure 4 on Page 22), the ACC functionality resides in the microboard, the ACC Board is not present and the VSD logic board directly interfaces to the microboard using RS-485 Modbus protocol serial communications.

The MV VSD (Figure 5 on Page 23) is also interfaced to the microboard with RS-485 Modbus serial communications.

Serial data interface to the Building Automation System (BAS) is through the optional E-Link Gateway. This printed circuit board retrieves the required data from the microboard and makes it available for the BAS network. When BAS or ISN communications is selected as the control source, the microboard will follow the E-Link Gateway commands as well.

Compressors are equipped with a VGD, which 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, which 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. A pre-rotation vanes position potentiometer is required to support this feature.

If the chiller is provided with a compressor motor VSD or the optional hot gas bypass, the PRV potentiometer for those features is used. Otherwise, a PRV potentiometer is provided interfaced to the microboard.

Chillers that are equipped for the hot gas bypass, heat recovery or head pressure control options are equipped with a Large Tonnage Chiller (LTC) I/O board. This board provides for analog and digital inputs and outputs for these features and it communicates with the microboard COM3 RS-485 serial port using Modbus protocol.

Chillers can be equipped with an optional motor monitoring feature. Motor winding temperature sensors and bearing temperature and vibration sensors are interfaced to the motor monitoring board (located in a separate box). The motor monitoring board communicates the winding and bearing temperatures and bearing vibration values to the microboard COM3 RS-485 serial port using Modbus protocol. These parameters are displayed. Warning messages are displayed and safety shutdowns occur in response to high temperature and vibration conditions.

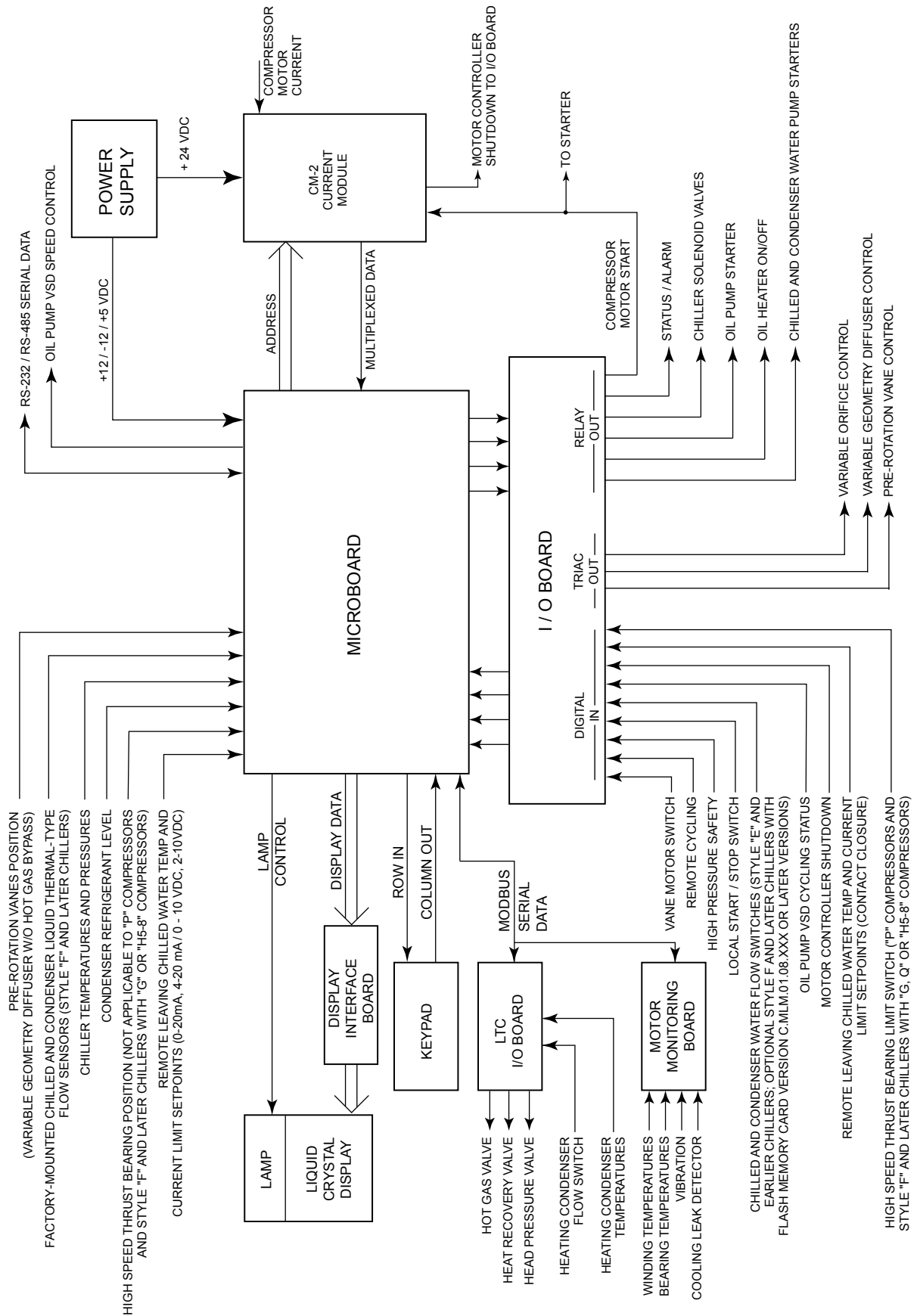
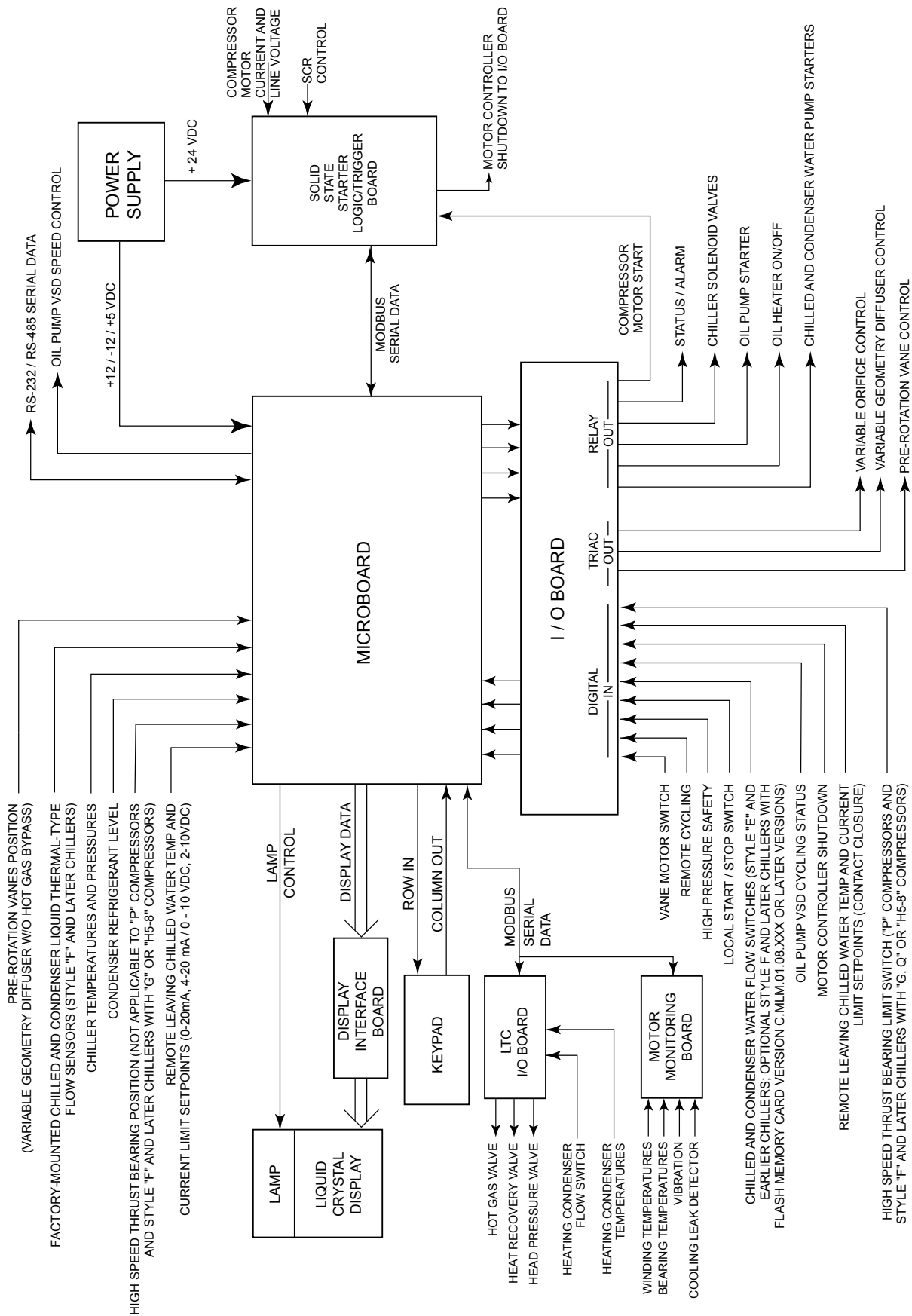
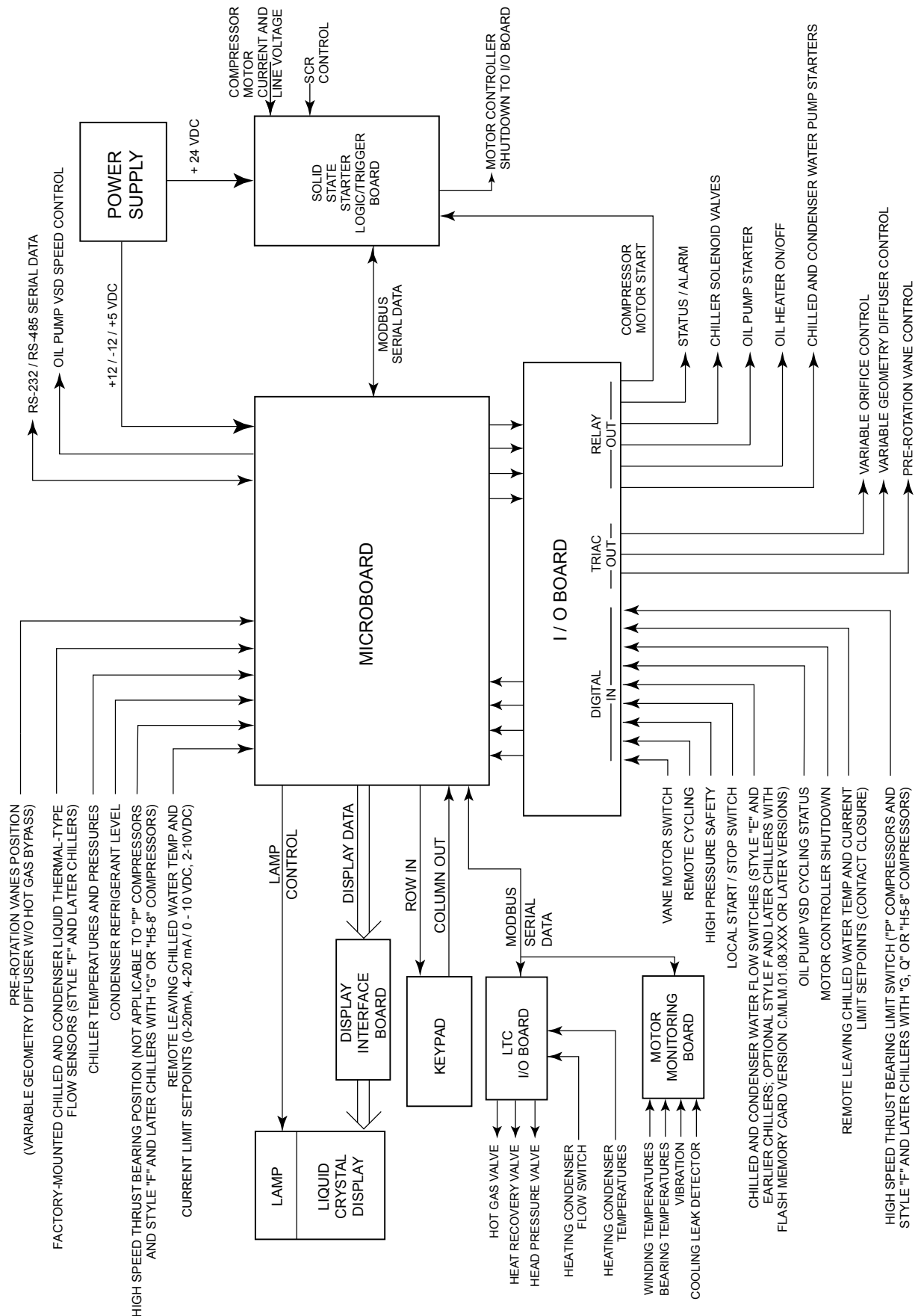


FIGURE 1 - OPTIVIEW™ CONTROL CENTER - ELECTRO-MECHANICAL STARTER APPLICATIONS



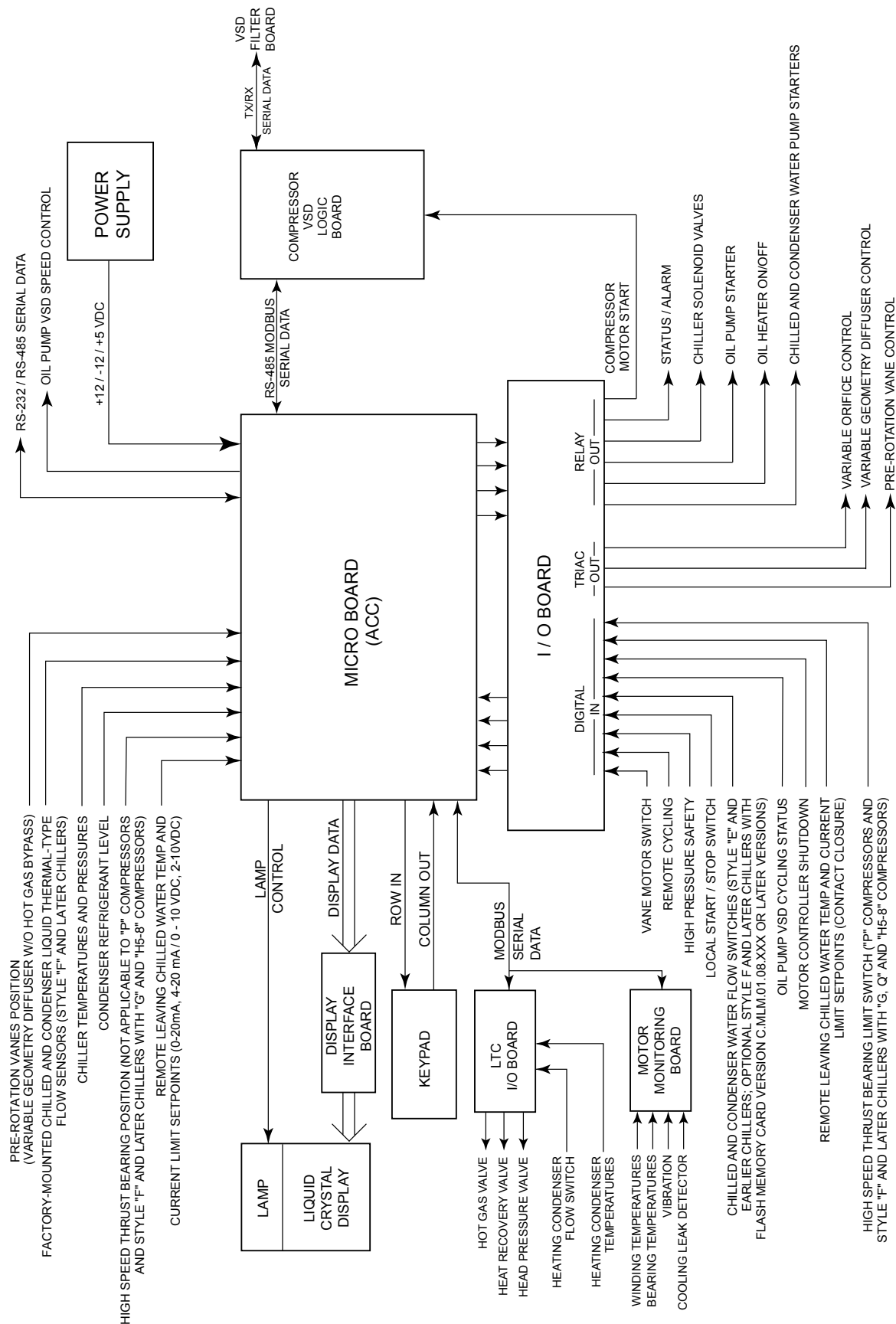
LD09560d1

FIGURE 2 - OPTIVIEW™ CONTROL CENTER - MOD B SOLID STATE STARTER APPLICATIONS



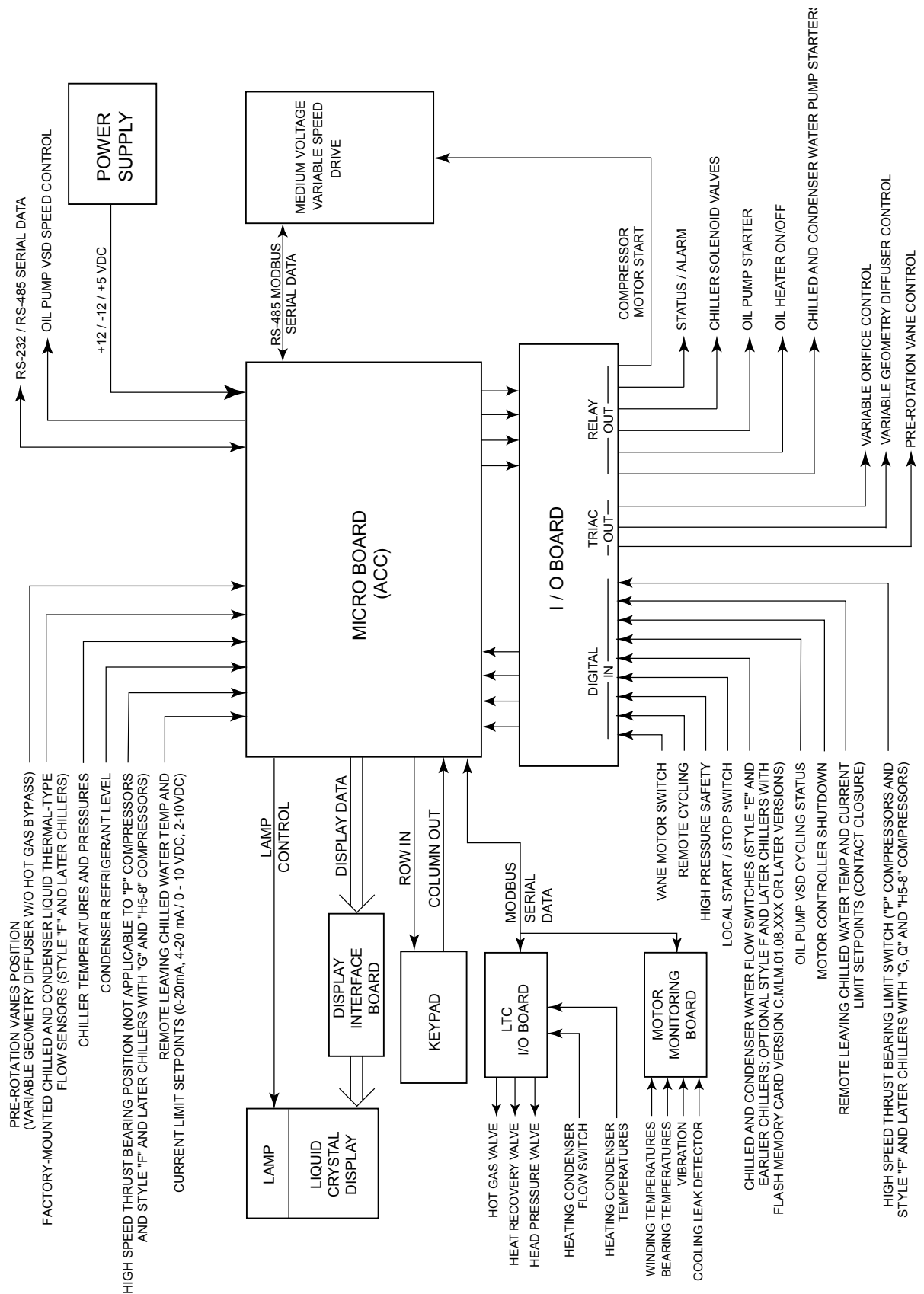
LD09560f

FIGURE 3 - OPTIVIEW™ CONTROL CENTER - MEDIUM VOLTAGE SOLID STATE STARTER APPLICATIONS



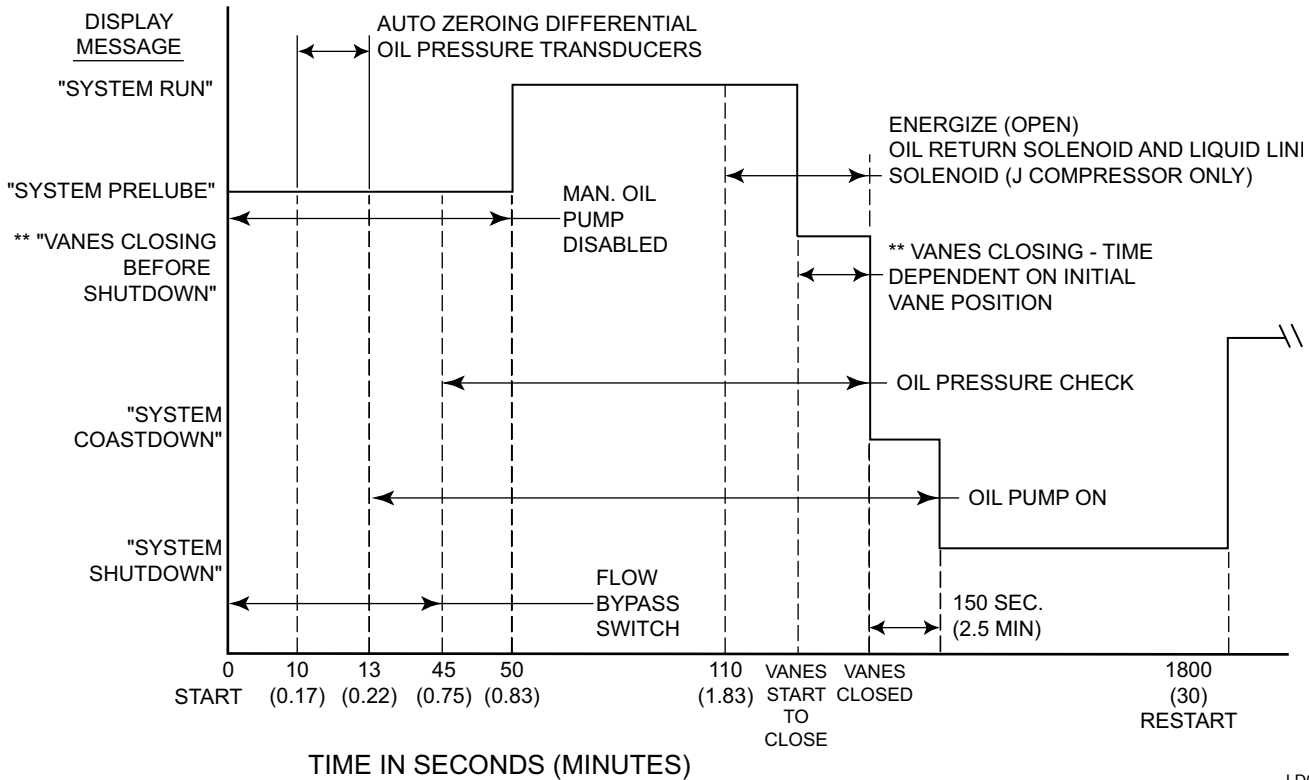
LD095611

FIGURE 4 - OPTIVIEW™ CONTROL CENTER - COMPRESSOR MOTOR VARIABLE SPEED DRIVE (MODBUS SERIAL COMMUNICATIONS PROTOCOL)

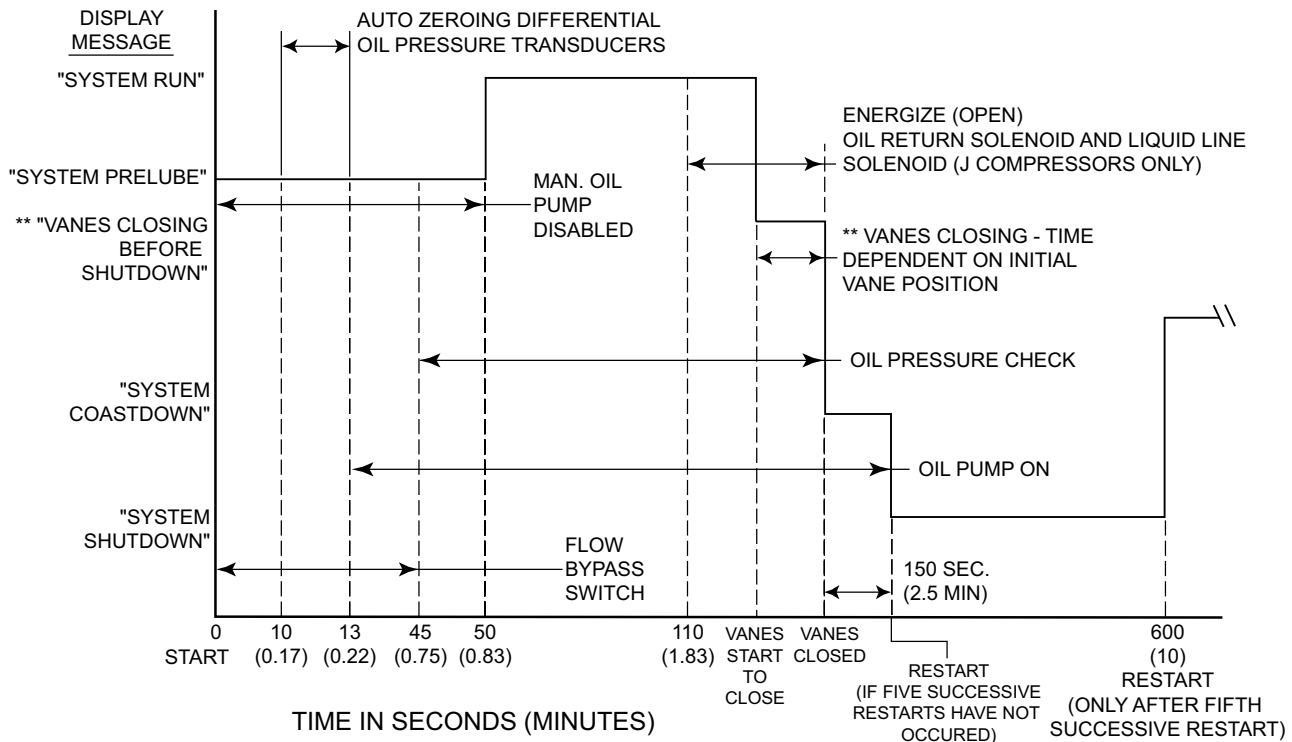


LD09561g1

FIGURE 5 - OPTIVIEW™ CONTROL CENTER - COMPRESSOR MOTOR MEDIUM VOLTAGE VARIABLE SPEED DRIVE

TIMING DIAGRAM – CHILLERS EQUIPPED WITH E-M or SSS Drive

LD06502

FIGURE 6 - OPERATION SEQUENCE TIMING DIAGRAM (ELECTRO-MECHANICAL AND SOLID STATE STARTER APPLICATIONS)**TIMING DIAGRAM – CHILLERS EQUIPPED WITH VARIABLE SPEED DRIVE**

LD06504

FIGURE 7 - OPERATION SEQUENCE TIMING DIAGRAM (COMPRESSOR MOTOR VARIABLE SPEED DRIVE APPLICATIONS)

SECTION 3 - MICROBOARD 031-03630-001

Microboard 031-03630-001 is supplied in new production YK chillers starting in June of 2015. Although this board uses a different microprocessor and supporting components, the chiller control and operator interface are the same as the previous 031-01730-000, 031-02430-000 and 031-02430-001 Microboards. It uses the same mounting hole pattern and has the same interface connectors as the previous boards except for the improved power supply connections and the VSOP cables uses a removable screw terminal plugs.

Service replacement for these boards is kit 331-03630-601 which contains the microboard and an SD card with the program.

The new 031-03630-001 microboard consists of a base board with a small daughter board mounted on the base board. This daughter board is the SMARC processor board. **The two boards are mated in the factory and cannot be replaced separately.**

The SW1 DIP switch settings are the same as the SW1 switch positions on the 02430. Position SW1-4 on the 03630 is now used in place of JP6 on the 02430 to initiate a program update.

A FeRAM chip stores the configurable setpoints, sales data and history files. A separate battery backed up Real Time Clock maintains the time during power outages. The RTC Battery is a CR2032 button cell Lithium battery which can last over 10 years and is readily available at local stores.

The board is supplied with +12VDC (J1-5), -12VDC (J1-6), +5VDC (J1-1 and J1-2), +24VDC (J1-7) and ground (J1-3 and J1-4) from the Power Supply (Refer to *Figure 10 on Page 40*). The +5VDC (fused by F1) can be monitored at TP12 and TP3. It is used by the microboard circuits and applied to a +3.3VDC regulator. The outputs of this regulator is applied to Microboard circuits.

The +12VDC (fused by F2) can be monitored at TP5 and TP4 in reference to TP1 GND. It is applied to a +5VDC regulator and the output of the regulator is the +5VDC (Analog) supply that powers all analog circuits and is the source voltage for all of the transducers and thermistors. The +5VA can be monitored at TP10 referenced to TP1 GND.

Test Points and LED Indicators

The primary power supplies have LEDs to indicate the presence of power. The voltages can be measured at the following test points in reference to TP1 or TP11 GND.

VOLTAGE	TEST POINT	VOLTAGE RANGE	FUSE	LED
+5VDC	TP3	+4.92 to +5.28VDC	F1 (5A)	CR56
+12VDC	TP4	+11.58 to +12.5VDC	F2 (5A)	CR57
-12VDC	TP33	-11.5 to -12.5VDC	F3 (5A)	CR58
+24VDC	TP35	+22.4 to +26.7VDC	F4 (4A)	CR59
+3.3VDC	TP2	+3.25 to +3.43VDC	n/a	CR62
VCC	TP15	+4.92 to +5.28VDC	n/a	n/a
+5VA	TP10	+4.95 to +5.05	n/a	CR61
+2.5VDC	TP18	-2.44 to -2.55VDC	n/a	n/a
Battery	n/a	+2.95 to +3.45	n/a	n/a

Boot-up Program

The Boot-up Program is stored in Flash memory. It may be updated along with a new version of the operating program by inserting an SD card containing the new program into the SD card slot on the 03630 board, setting DIP Switch SW1 position 4 to ON and then applying power to the chiller. The Boot-up Program version is displayed on the DIAGNOSTICS Screen in SERVICE access level.

TABLE 2 - DIAGNOSTIC DISPLAY CODES

LED DISPLAY CODE (NORMAL BOOT UP)	DESCRIPTION
00	DIP 4 OFF - Booting from internal Flash program
CH	Flash Checksum Test in progress
AP	Application program setup in progress
∞	Application program is running
LED DISPLAY CODE (OTHER)	
01	DIP 4 ON - Booting from SD card [Normal when loading a program]
02	DIP 4 ON - Booting from USB port
05	DIP 4 ON - PIC application is being configured
F0	DIP 4 OFF - Boot from internal Flash Failed [Try to reload the program]
F1	DIP 4 ON - Boot from SD card Failed [Bad SD card or Bad microboard]
F3	DIP 4 ON - Microboard Internal error [Bad Microboard]
F4	DIP 4 ON - Checksum Failed [Try to reload program, Bad microboard]
FF	DIP 4 ON - Boot from SD card Failed

NOTE: If the display stops at a 01 display, this may be an indication that the SD card reader is defective. If the display stops at the YORK logo with a white screen, this indicates that the board has no program to boot from.

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 Boot-up program in the Flash Memory 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 *Table 2 on Page 26*. The progress and pass/fail status of each step is displayed on the microboard 7-segment LED Display (U25 and U26). 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.

The chiller operating program is stored in non-removable Flash Memory 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 SD format card which is 1-5/16" X 1". It is a portable Flash memory storage device that is programmed with the chiller operating program. The program card part number for YK chillers is 031-03601-002 and is available from the Baltimore

Parts Distribution Center (PDC). There is a Program card for each chiller type (YT, YK, YS, YR, YD, etc) and each has a unique part number. 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 YK chillers has English, Simplified and Traditional Chinese, French, Portuguese, Spanish, Italian, German, Japanese, Korean and Hungarian languages.

The program version that is currently residing in the microboard Flash Memory Chip is displayed as the “Controls” Software Version 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 YK Program card. A single YK card can be carried to different locations to re-program other YK OptiView™ Control Centers.

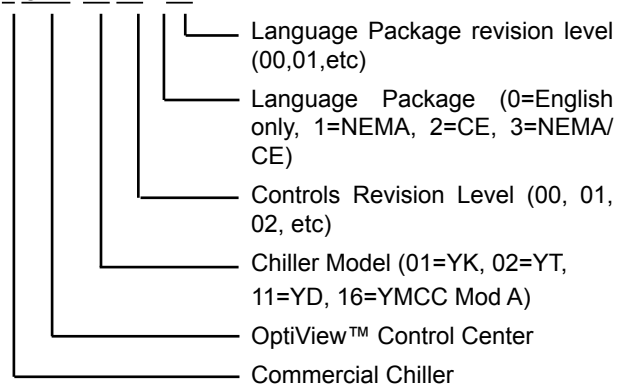
A Write Protect Switch on the edge of the Program card prevents inadvertent writing to the Card during program downloading.

Handling precautions for the Program card include:

- Do not allow dirt or water to enter the connector
- Operating temperature range for Commercial grade SD cards is -25°C to 85°C (-13°F to 185°F)

A label on the Program card contains the version and JCI 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:

Y.OPT.nn.nn



Program Download Connector J26

The SD Program card is inserted into connector J26 to download a program. Refer to instructions under Service Replacement.

FeRAM

The FeRAM (Ferroelectric Random Access Memory) preserves the stored data during power failures. All of the programmed Setpoints, Sales Order Data and History Data is stored here. This memory does not require a battery.

Real Time Clock

The RTC (Real Time Clock) uses a common CR2032 button-cell lithium battery to maintain the time and date during power outtages. The battery life is over 10 years. This type of battery is used in watches and is readily available at drug stores and appliance stores.

SMARC Module

The SMARC Module is the processor card for the 031-03630-001 microboard. The SMARC Module and the baseboard are assembled as a pair in the board manufacturing factory and can not be swapped in the field. SMARC (Smart Mobility ARChitecture) is a relatively new standard to enable multiple vendors to provide high performance embedded processor cards. This will allow using future processors if the current ones become obsolete without having to re-design the microboard.

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 (+4.44VDC to +4.68VDC) or the +3.3VDC decreases to the threshold of (+2.84VDC to +3.04VDC), 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 to 1.204 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 the 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. 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 reboot, WATCHDOG – SOFTWARE REBOOT is displayed on the graphic screen.

Program Jumpers/Program Switches

The Program Jumpers and Program Switches 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. 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 YORK 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.

PROGRAM JUMPERS

JP2 – Display power and logic levels Determines the power supply voltage applied to the display.

Pins 1-2: +5VDC SHARP - Not Used

Pins 2-3: +3.3VDC SHARP LQ104V1DG81 display.

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 – Not used.

Pins 2-3: +12VDC or +5VDC - SHARP LQ104V1DG81 display.

JP4 – Display Backlight enable signal logic levels. Determines the logic levels of the Backlight Enable signal.

Pins 1-2: +12/0VDC–SHARPLQ104V1DG81.

Pins 2-3: +5VDC/0VDC SHARP - Not Used

JP5 – Display Backlight power. Determines the power supply voltage applied to the Display Backlight Inverter Board.

Pins 1-2: +12VDC. SHARP LQ104V1DG81 display.

Pins 2-3: +5VDC.- Not used.

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 to 5.0VDC). SHARP LQ104V1DG81 display.

OUT: Variable resistance – Not used.

JP9 – Not Used

JP10 – Factory mounted thermal flow sensor – evaporator. Heat recovery chillers and new production chillers.

Pins 1-2: Not used.

Pins 2-3: Heat Recovery chillers and new production chillers.

JP11 – Factory mounted thermal flow sensor condenser. Heat recovery chillers and new production chillers.

Pins 1-2: Not used.

Pins 2-3: Heat Recovery chillers and new production chillers.

JP12 – Factory mounted thermal flow sensor – heating condenser water. Heat Recovery chillers.

Pins 1-2: Not used.

Pins 2-3: Heat Recovery chillers.

JP14 – Applies a 120 Ohm terminating resistor across the COM3 RS-485 port.

IN: Not used.

OUT: Normal position - no bias applied.

JP15 – Applies a pull-up voltage to the COM3 + terminal.

IN: Not used.

OUT: Normal position.

JP16 – Applies a pull-down voltage to the COM2 - terminal.

IN: Not used.

OUT: Normal position.

JP18 – Applies a 120 Ohm terminating resistor across the COM2 RS-485 port.

IN: Not used.

OUT: Normal position - no bias applied.

JP19 – Applies a pull-up voltage to the COM2 + terminal.

IN: Not used.

OUT: Normal position.

JP20 – Applies a pull-down voltage to the COM3 - terminal.

IN: Not used.

OUT: Normal position.

JP21 – Not Used

JP22 – Not Used

JP23 – Remote Current Limit setpoint (J22) type. Configures Analog Input for 0 to 10VDC, 2 to 10VDC, 0 to 20mA or 4 to 20mA.

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

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

Pins 2-3: 2-3: Not used.

JP24 – Remote Leaving Chilled Liquid Temperature setpoint (J22) type. Configures Analog Input for 0 to 10VDC, 2 to 10VDC, 0 to 20mA or 4 to 20mA.

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

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

Pins 2-3: Not used.

JP25 – DC Undervoltage signal.

Pins 1-2: Correct position for YK

Pins 2-3: Not used

JP27 – Applies a pull-up voltage to the COM5B + terminal.

IN: Not used.

OUT: Normal position.

JP28 – Applies a 120 Ohm terminating resistor across the COM5B RS-485 port.

IN: Not used.

OUT: Normal position - no bias applied.

JP29 – Applies a pull-down voltage to the COM5B - terminal.

IN: Not used.

OUT: Normal position.

PROGRAM SWITCHES

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

ON – R-134a

OFF – None

Note that with Version 03 software and later the refrigerant selection is performed on the SETUP screen because a third choice of R-513A has been added. When this is the case, position 1 of SW-1 has no effect.

SW1-2 – Liquid Type. Must be set according to whether the chiller is cooling water or brine solution.

ON – Brine. Leaving Chilled setpoint range is 10°F to 70°F.

OFF – Water. Leaving Chilled setpoint range 38°F (36°F if Smart Freeze enabled) to 70°F.

SW1-3 – Diagnostics. Enables or Disables the software diagnostics.

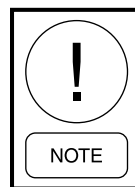
ON – Enables diagnostics. Disables normal chiller operation.

OFF – Disables diagnostics. Enables normal chiller operation.

SW1-4 – Boot from SD Card/Flash (This performs the same function as the JP6 jumper on the 02430 board.

ON – Enables boot from SD card to load a new program.

OFF – Boot the program stored in memory.



*The software for the 03630 uses the data entered on the Sales Order screen to determine proper control settings. After the Sales Order screen is fully entered, navigate: **HOME>SETPOINTS>SETUP>DIAGNOSTIC** and then press the **Default Unit Setpoints** button on the Diagnostic Screen to set the correct control parameters. Failure to do this will result in improper control.*

Keypad Interface

The keypad is read via J18. The keypad is a matrix of conductors arranged in rows and columns (Refer to *Figure 25 on Page 64* and *Figure 26 on Page 65*). 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 pull-up on all other rows. The microprocessor 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 microprocessor 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 7 - KEYPAD* of this manual for details of the keypad.

CM-2 Board or Style A Solid State Starter Interface

The microboard retrieves certain operating parameters (via J10) from the compressor motor starter control board (CM-2 Current Board for the Electro-Mechanical Starter). Refer to the appropriate section of this manual for a detailed explanation. The CM-2 contains an 8 channel multiplexer. The microprocessor sequentially and continually reads channels 0 through 7. It reads each channel by applying a 3-bit binary address to the multiplexer.

A 0 to 5VDC analog value is returned from each channel. The function of each is in *Table 3 on Page 31*.

The microprocessor determines which starter is present, by the value returned from channel 0. Since channels 0 through 6 are ground-ed, the CM-2 board returns a 0VDC value. If the value is less than 0.4VDC, it indicates the starter is an Electro-mechanical (EM) starter and the microprocessor then reads channel 7 to retrieve the peak motor current value.

TABLE 3 - MULTIPLEXER CHANNELS

	0	1	2	3	4	5	6	7
CM-2	GND	GND	GND	GND	GND	GND	GND	Peak Motor Current (%FLA)

Style B Solid State Starter Interface

Style B Solid State Starters communicate with the 031-03630-001 Microboard via the COM 2 serial port (J13) using RS-485 Modbus protocol.

When SSS-Mod B is selected as the motor drive type on the SETUP Screen, no additional setpoints must be entered on the screen. The appropriate serial port COM 2-Modbus is enabled. The Motor Node ID setpoint must be set to match the setting of the Starter Logic/Trigger Board Modbus Address Switch SW1. They must be both be set to “1”.

Refer to *Figure 32 on Page 76* and *SECTION 10 - SOLID STATE STARTERS* for details of the solid state starter interface.

Variable Speed Drive Interface

Variable Speed Drives communicate with Microboard 031-03630-001 via the COM2 serial data port (J13) using RS-485 Modbus protocol.

With Microboard 031-03630-001 when “VSD-60Hz” or “VSD-50Hz” is selected on the SETUP Screen as the Motor Drive Type, additional setpoints must be entered on this Screen. The appropriate serial port COM2-Modbus is enabled. The Motor Node ID setpoint must be set to match the setting of the VSD Logic Board Modbus Address Switch SW3. They must be both set to “1”.

There are two different types of Modbus protocol used. Modbus ASCII for Mod D/Vyper and Modbus RTU for Rapter. When VSD – 60Hz or 50Hz is selected for the Motor Drive Type setpoint on the SETPOINTS Screen, the microboard will poll on COM 2 alternating between the two protocols until one of them responds or until an initialization fault occurs. Once a valid response is received from either VSD type, the microboard will “remember” this, even after a power failure. This allows the correct screens to be displayed after a power failure, without repeating the poll interrogation as long as the Motor Drive Type is not changed. Once the microboard determines which VSD type is connected, it will not poll for the other.

Refer to *SECTION 11 - ADAPTIVE CAPACITY CONTROL BOARD* for details of the variable speed drive interface.

Medium Voltage Solid State Starter (MV SSS) and Medium Voltage Variable Speed Drive Interface (MV VSD)

These drives communicate with the microboard via the COM2 RS-485 Modbus serial port (J13). Refer to *Figure 12 on Page 42* and Medium Voltage Solid State Starter – Service (Form 160.00-M5) and Medium Voltage Variable Speed Drive – Service (Form 160.00-M6) for details of this interface. When the MV SSS or MV VSD is selected on the SETUP Screen, the COM2 serial port with Modbus protocol is automatically enabled.

Printer Interface

An optional printer can be connected to COM1 RS-232 serial data port (J2). TX data to the printer is at J2-4. The DSR (Data Set Ready or busy) signal from the printer is at J2-2. 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 OptiView™ Control Panel - Operation (Form 160.76-O2) for details of available printers and printer setup instructions.

SC-Equip Gateway Interface

An optional SC-Equip Gateway printed circuit board can be connected to the COM 4B RS-232 serial data port (J2). TX data to the SC-Equip Gateway is at J2-7. RX data from the SC-Equip Gateway is at J2-6. Signal levels are standard RS-232. The SC-Equip Gateway polls system pressures, temperatures and status from the microboard. It holds it for retrieval the BAS System. Refer to *SECTION 15 - COMMUNICATIONS* of this manual.

Digital Inputs

The I/O Board converts the 115VAC inputs to logic level inputs for the microboard at J19. A 115VAC input to the I/O Board is converted to a logic low (less than 1VDC). A 0VAC input to the I/O Board is converted to a logic high (greater than 4VDC). Refer to *SECTION 4 - I/O BOARD* of this manual for details of the 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 115VAC 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 115VAC to system relays and solenoids. The outputs that control the chilled liquid pump and compressor motor starter 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 (less than 1VDC) to the Triac driver on the I/O Board. It turns it OFF by applying a logic high (greater than 4VDC). Refer to *SECTION 4 - I/O BOARD* of this manual for details of the I/O Board.

Analog Inputs

System pressures, in the form of analog DC voltages, are input from Pressure Transducers. Refer to *SECTION 16 - PRESSURE TRANSDUCERS* of this manual. Formulas and graphs are included to calculate the expected transducer output voltage for a given pressure input.

System temperatures, in the form of analog DC voltages, are input from thermistors. Refer to *SECTION 17 - TEMPERATURE THERMISTORS* of this manual. Included are tables to convert the expected output voltage for any temperature applied to the thermistor.

Flow Switch

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.

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 (pin 4) is connected to +5VDC on the microboard and the other side (pin 2) is connected to an Analog Input of the microboard. 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 greater than +4VDC to the microboard input. 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 less than 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 between the microboard TP1 (GND) and the respective flow sensor input to the microboard.

The software accommodates either the Paddle type sensors connected to TB4 of the I/O Board or the Thermal type sensors connected to J14 on the microboard. To assure the program reads the correct input, the Flow Switch setpoint on the OPERATIONS Screen must be set appropriately as explained in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES*.

Serial Data Ports

Microboard 031-03630-001 is equipped with 6 serial ports. Each port is dedicated for a specific function as follows:

- A. COM1 (J2) – RS-232. Printer.
- B. COM2 (J13) – RS-485. Modbus communications to the Liquid Cooled Solid State Starter, Medium Voltage Solid State Starter, Medium Voltage Variable Speed Drive and Variable Speed Drives.

- C. COM3 (J12) – RS-485. Hot gas bypass, Heat Recovery, Head Pressure Control, Motor Monitoring.
- D. COM4 (J2) – RS-232. SC-Equip Gateway.
- E. COM5A (J15) – CM-2 interface.
- F. COM5B (TB4) – RS-485. Future VGD actuator.

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 0VDC and +5VDC logic levels. COM5A logic levels are 0VDC and +5VDC. A diagnostic test can be performed on each serial port to confirm proper operation. Refer to *SECTION 29 - DIAGNOSTICS AND TROUBLESHOOTING* of this manual.

The LED's and their functions are as follows:

- CR41 RX1 – COM1 serial port receive data.
- CR42 TX1 – COM1 serial port transmit data.
- CR40 RX2 – COM2 serial port receive data.
- CR37 TX2 – COM2 serial port transmit data.
- CR38 RX3 – COM3 serial port receive data.
- CR35 TX3 – COM3 serial port transmit data.
- CR39 RX4 – COM4 serial port receive data.
- CR36 TX4 – COM4 serial port transmit data.
- CR44 RX3 – COM5A serial port receive data.
- CR43 TX3 – COM5A serial port transmit data.
- CR47 RX5B – COM5B serial port receive data.
- CR45 TX5B – COM5B 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 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 FeRAM 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 FeRAM 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. *SECTION 3 - MICROBOARD 031-03630-001* 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 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 OFF 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. 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 11 on Page 41*). The Lamp Dimmer controls the position of the potentiometer. The Lamp Dimmer varies the brightness of the backlight by applying a variable voltage (0 to 5.0VDC) or a variable resistance (0 to 10K ohms) to the Back-

light. 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. 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 ohms (0% brightness) to 10K ohms (100% brightness). Refer to *SECTION 5 - LIQUID CRYSTAL DISPLAY*, *SECTION 6 - DISPLAY INTERFACE BOARD*, of this manual for details of the display interface.

Remote Setpoints

Remote Leaving Chilled Liquid Temperature and Current Limit setpoints can be input via the RS-232 E-Link Gateway interface at J22 or directly to the microboard at J22. The inputs at J22 are configured with Program Jumpers JP23 and JP24 to accept these inputs in either 0 to 10VDC, 2 to 10VDC, 0 to 20mA or 4 to 20mA form. Refer to Program Jumper configurations and *SECTION 18 - 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 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual.

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, MULTI-UNIT CYCLING- CONTACTS OPEN and SYSTEM CYCLING – CONTACTS OPEN. On these shutdowns, they remain closed, causing the pumps to continue to run while the chiller is shutdown.

Motor Drive Type – Configures the program for the applicable compressor motor drive type. Selections are:

1. *EM* – Electromechanical Starter
2. *SSS-Mod B* – Style B Solid State Starter
3. *VSD-60Hz* – Variable Speed Drive, 60Hz
4. *VSD-50Hz* – Variable Speed Drive, 50Hz
5. *MVVSD-60Hz* – Medium Voltage VSD, 60 Hz
6. *MVVSD-50Hz* – Medium Voltage VSD, 50 Hz
7. *MVSSS* – Medium Voltage Solid State Starter

Anti-Recycle – Enables or Disables the Anti-recycle timer. Selections are:

1. *Enabled* – Enables the anti-recycle timer. Solid State Starters and electromechanical starter applications cannot be started at intervals shorter than once every 30 minutes. VSD applications can be started at the completion of System Coastdown up to 5 times. On the 5th shutdown, a 10-minute timer is started and restart is inhibited until the timer has elapsed.
2. *Disabled* – Disables the anti-recycle timer. Chiller can be started at the completion of System Coastdown, regardless of how long the chiller had been running.



The Anti-recycle timer must never be disabled unless advised by JCI-YORK factory.

Heat Recovery – Enables or Disables Heat Recovery mode for chillers that have this option.

Isolation Valves – Enables or Disables Isolation Valve-control for chillers that have this option.

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 rocker switch to the stop/reset position.
2. *Auto* – Chiller will automatically restart when power is restored.

Coastdown – Determines the “Coastdown” duration (oil pump run duration after shutdown) and whether the “Motor Controller – Loss of Current” check and anti-recycle function is performed while the chiller is running. Selections are:

1. *Standard* – Electric motor applications. When STANDARD is selected, the Coastdown Time setpoint appears. (Refer to Coastdown Time on page 85). This setpoint is used to set the duration over the range of 240 (default) to 900 seconds or 150 (default) to 900 seconds as determined by the selection made for the Chiller Style/Compressor setpoint (on the OPERATIONS Screen).
2. *Enhanced* – “Coastdown” is 15 minutes in duration. Steam Turbine applications. “Motor Controller - Loss of Current” check and anti-recycle function is not performed since there is no motor current.

Pre-run – Determines the duration of the “System Pre-lube” period. Selections are:

1. *Standard* – “System Pre-lube” is 50 seconds in duration.
2. *Extended* – “System Pre-lube” is 180 seconds in duration.

Oil Pump – 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 Program controlled Oil Heater and a different complement of solenoid valves than chillers equipped with a Fixed Speed Oil Pump. A description of the two Oil Pumps is as follows:

1. *Variable Speed* – configures the program to operate the Variable Speed Drive Oil Pump, the Oil Heater (maintains oil temperature 50°F above condenser saturation temperature) and the Oil Return and Liquid Line solenoid valve is connected to TB1-61.
2. *Fixed Speed* (style C) – Configures the program to operate the fixed speed Oil Pump and the following solenoid valves:
 - TB1-34 Liquid Line
 - TB1-61 Oil Return and Vent Line connected in parallel
 - TB1-62 High Speed Thrust

Coastdown Time – Only appears when STANDARD is selected for the Coastdown setpoint. Sets the duration of the coastdown period. The time is programmable over the range of 240 (default) to 900 seconds or 150 (default) to 900 seconds.

Condenser Temperature Range – Special order chillers that operate at higher than standard condenser temperatures require higher condenser high pressure warning and safety thresholds. This setpoint allows the software to be used in either standard or high temperature applications. This setpoint is set at the factory at time of manufacture and requires an ADMIN password to change it. It is only visible when set to Extended. The selections are:

1. *Standard* – Uses standard high pressure warning and safety shutdown thresholds as follows:
 - “Warning – High Pressure Limit” – Maximum allowable value is 162.5 PSIG
 - “Condenser – High Pressure” – Trip/reset threshold is 180/120 PSIG
 - “Condenser – High Pressure – Stopped” – Trip/reset threshold 160 PSIG.
2. *Extended* – Uses higher high pressure warning and safety shutdown thresholds as follows:
 - Warning – High Pressure Limit” – Maximum allowable value is 193.0 PSIG
 - “Condenser – High Pressure” – Trip/reset threshold is 200/140 PSIG
 - “Condenser – High Pressure – Stopped” – Trip/reset threshold is 170 PSIG

PRV Feedback New production chillers can be equipped with an optional Pre-rotation Vanes potentiometer, regardless of other options. This setpoint allows the software to be used in all YK chillers, whether equipped with the potentiometer or not. The PRV position will be shown on respective screens when Enabled; not shown when Disabled. When installed it is connected to the microboard J7 plug.

1. *Enabled* – Set to this position when equipped with a PRV potentiometer.
2. *Disabled* – Set to this position when not equipped with a PRV potentiometer.

- **Motor Monitoring**
The Motor Monitoring feature to be enabled or disabled. Motor Monitoring can not be used with the 371-02514-000 since the Motor Monitoring and the Frick Analog board use different protocols.
- **Heat Recovery**
Allows the Heat Recovery feature to be enabled or disabled.
- **Head Pressure Control**
Allows the Head Pressure feature to be enabled or disabled.
- **Heat Pump Duty**
Allows the Heat Pump Duty to be enabled or disabled.

Microboard Service Replacement

If the microboard is replaced within the warranty period, the defective board must be returned to YORK per the warranty return procedure. Use the return instructions and return address label provided with the replacement board.

To order a replacement Microboard for a YK Chiller, order part number 331-03630-601. This part number provides a 031-03630-001 Microboard and an SD card 031-03601-002 that have been programmed with the latest version of the YK “Controls” software. Refer to Renewal Parts – OptiView™ Control Center (Form 160.76-RP1).

Program Card Service Replacement

Since one YK SD Program card can be used to re-program other YK chillers, it is not necessary for an individual Service technician to have more than one YK Program card. Program cards can be shared among Service technicians where appropriate.

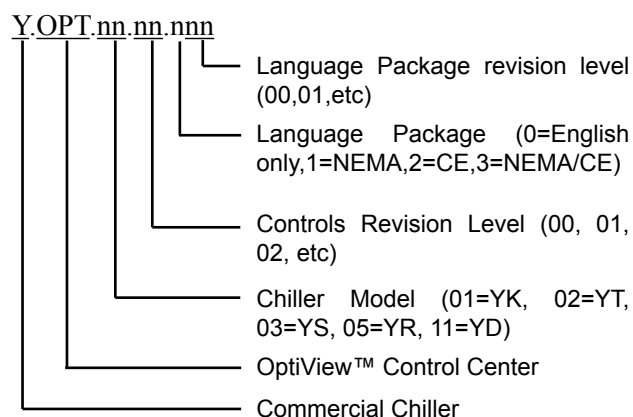
However, since chiller operating programs are occasionally revised, the Service technician could have a Program card that does not contain the latest program. Program cards (031-03601-002) for YK chillers are available from the Baltimore Parts Distribution Center (PDC). The card received from the PDC 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



*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 YK chiller, the Program card used **MUST** be for a YK chiller. If a YS chiller program is downloaded into a YK 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:



Download the program as follows:

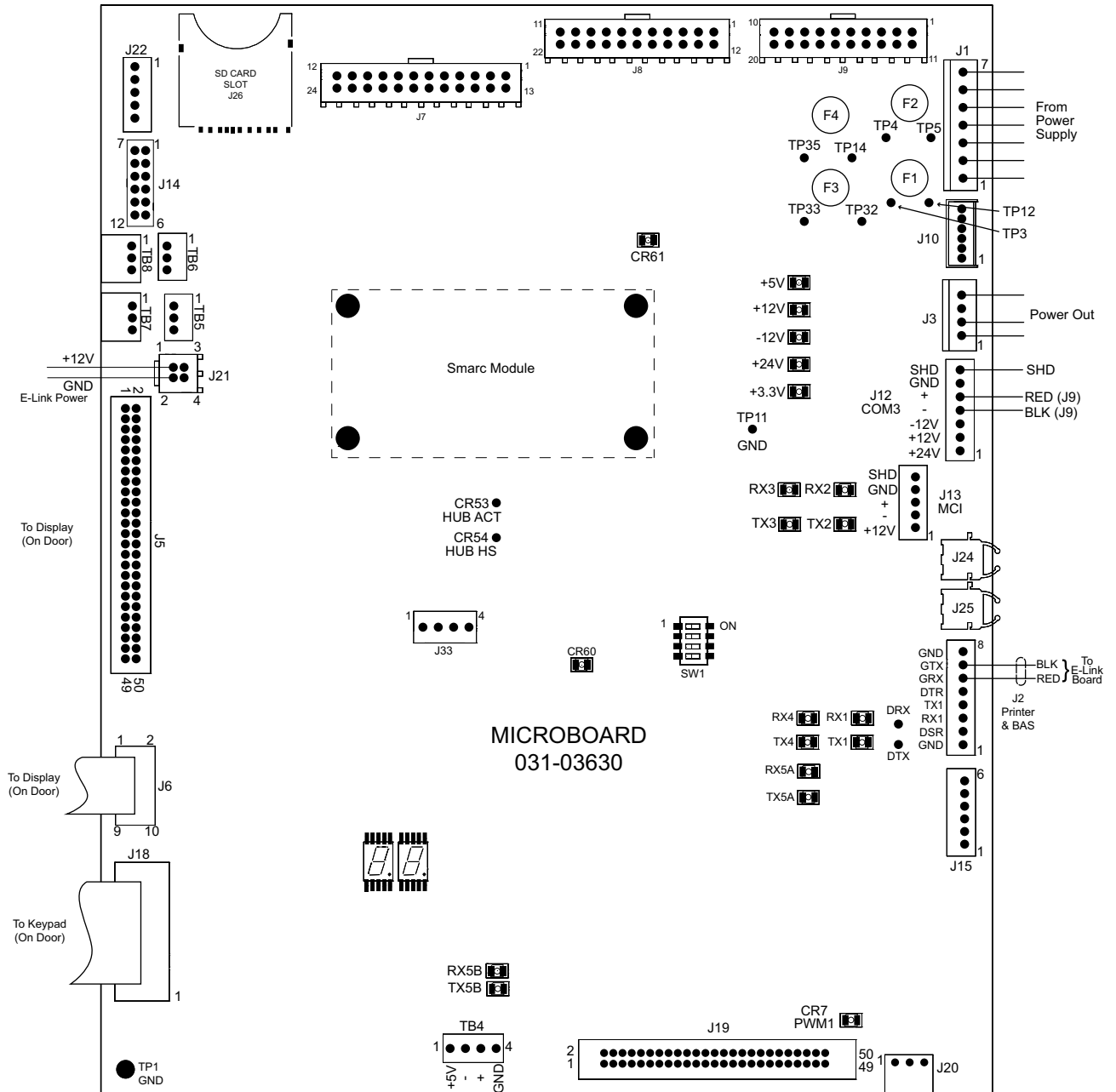
1. Remove power to OptiView™ Control Center.
2. Reposition Microboard DIP switch SW1 position 4 to ON.
3. Insert Program card into Microboard connector J26.

4. Restore power to OptiView™ Control Center. A white screen appears displaying “Flash Checksum Test” and the microboard 7-segment LEDs (U25 and U26) 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.
5. 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!**
6. Use the ► key to scroll to YES.
7. 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 Displays (U25 and U26) display 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.

8. Remove power from OptiView™ Control Center.
9. Remove Program card from Microboard connector J26 by lightly pushing the SD card in and then releasing pressure. The SD card should pop out slightly allowing for removal.
10. Reposition Microboard DIP Switch SW1 position 4 to OFF.
11. Apply power to the OptiView™ Control Center. The re-programming procedure is now complete.



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FIGURE 8 - MICROBOARD 031-03630-001

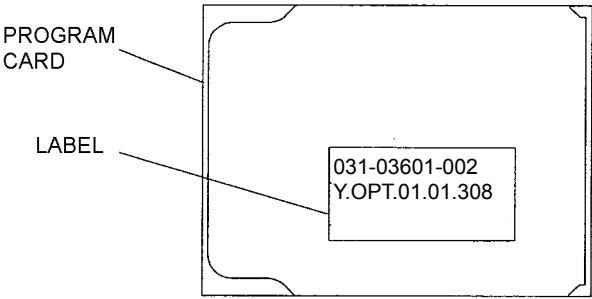
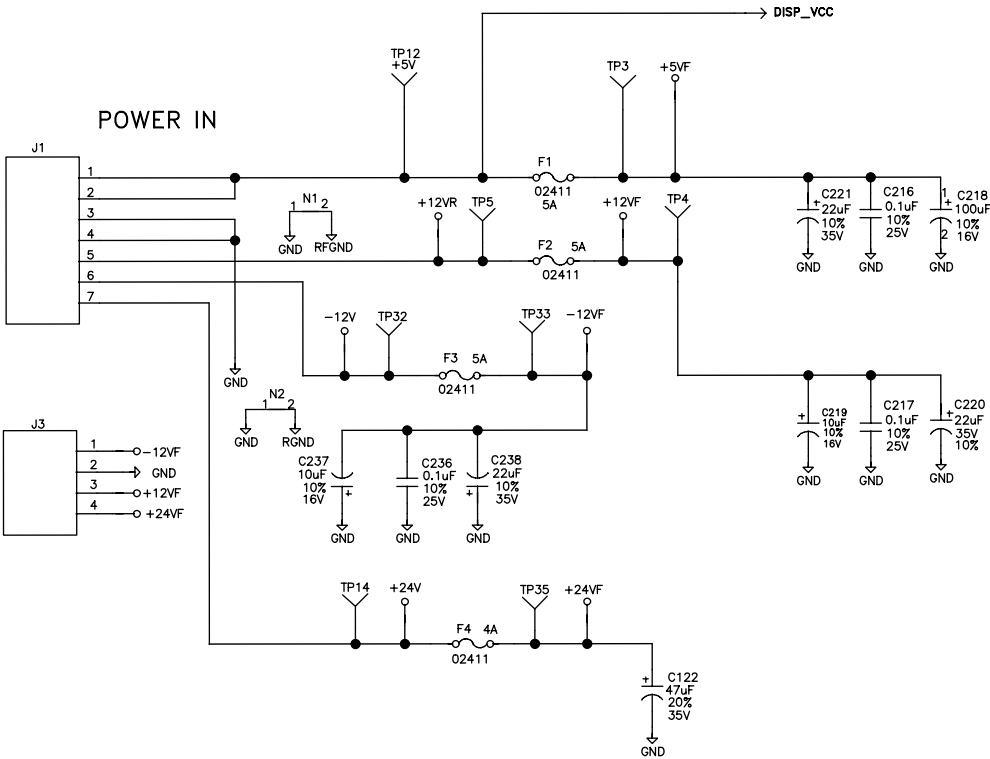
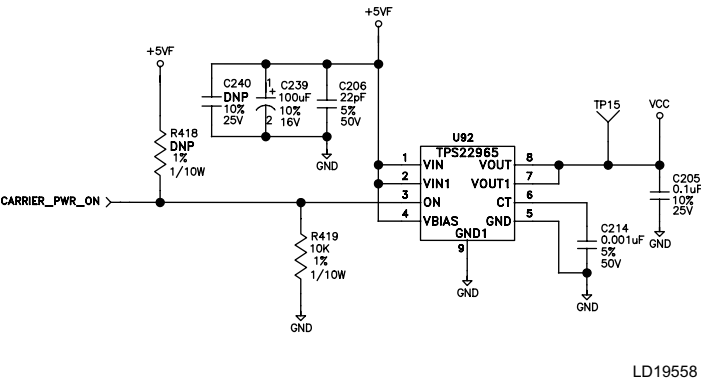


FIGURE 9 - PROGRAM CARD 031-03601-001



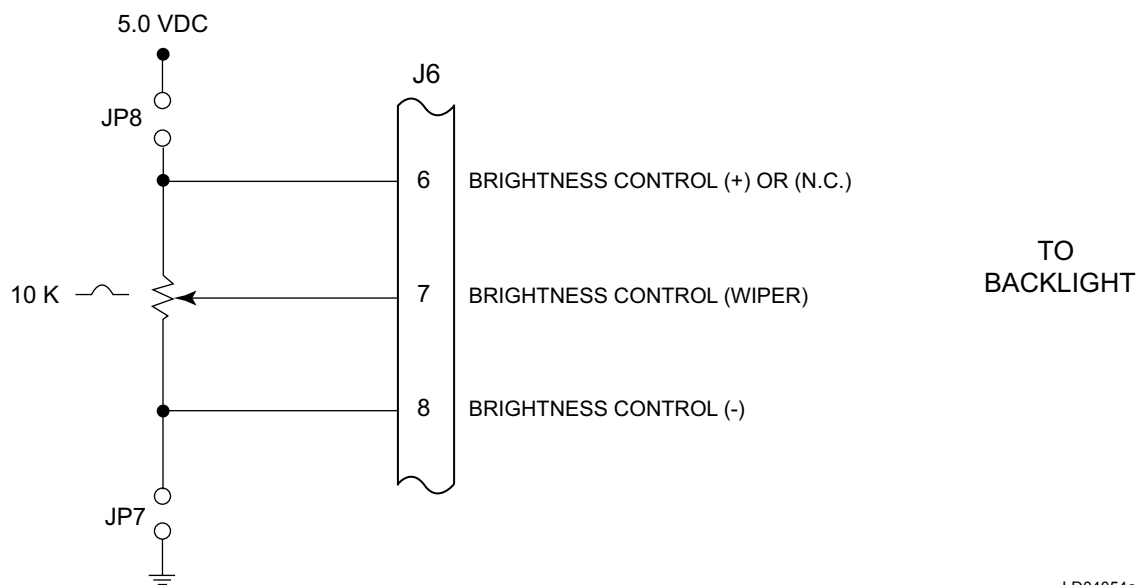
+5.0V Load to Switch Baseboard



Measure the power supply voltages with a Digital Volt Meter in reference to Ground at TP1 or TP11.

VOLTAGE	TEST POINT	VOLTAGE RANGE	FUSE	LED
+5VDC	TP3	+4.92 to +5.28VDC	F1 (5A)	CR56
+12VDC	TP4	+11.58 to +12.5VDC	F2 (5A)	CR57
-12VDC	TP33	-11.5 to -12.5VDC	F3 (5A)	CR58
+24VDC	TP35	+22.4 to +26.7VDC	F4 (4A)	CR59
+3.3VDC	TP2	+3.25 to +3.43VDC	n/a	CR62
VCC	TP15	+4.92 to +5.28VDC	n/a	n/a
+5VA	TP10	+4.95 to +5.05	n/a	CR61
Battery	n/a	+2.95 to +3.45	n/a	n/a

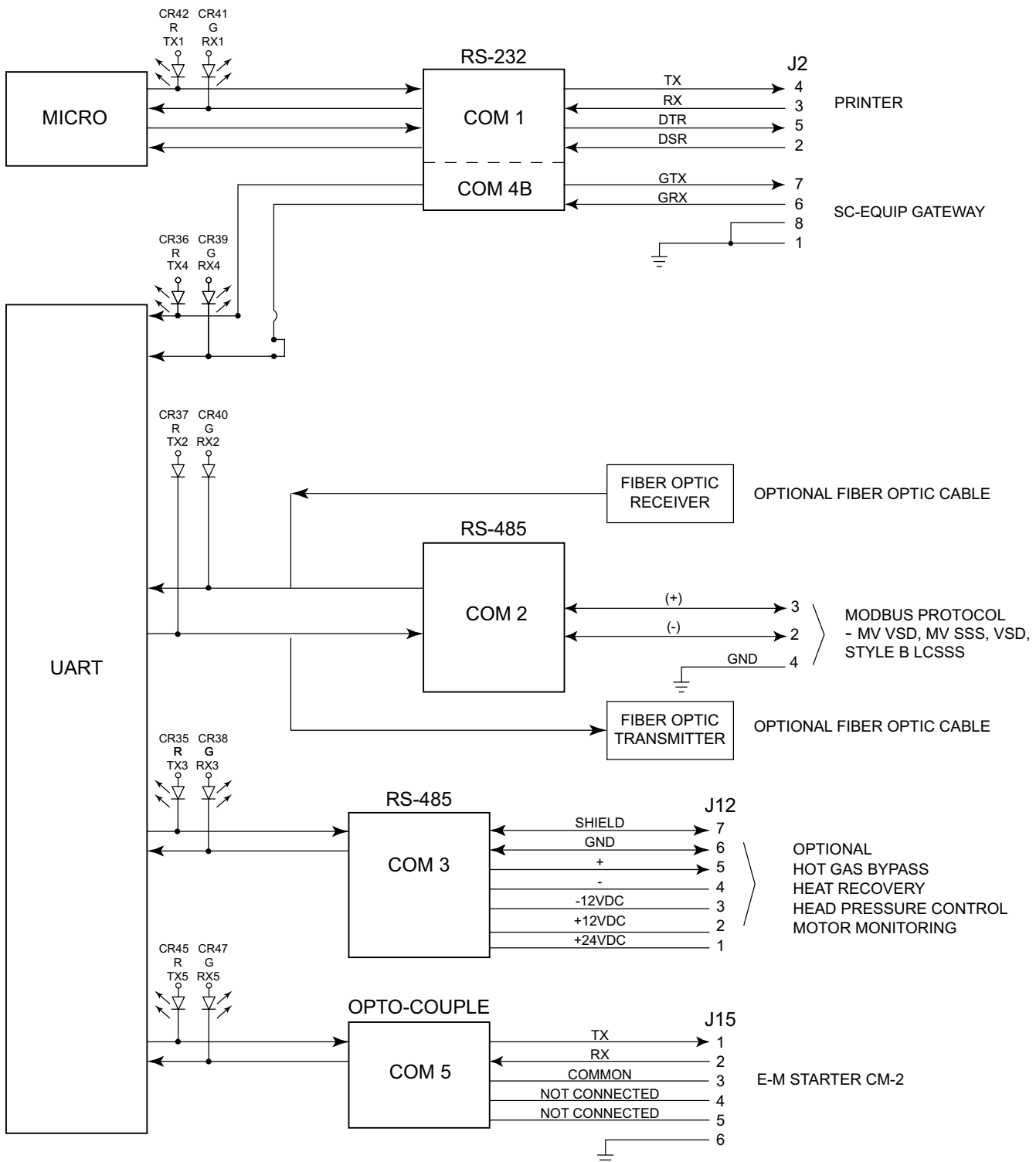
FIGURE 10 - MICROBOARD (031-03630-001)DC POWER SUPPLY TEST POINTS



NOTES:

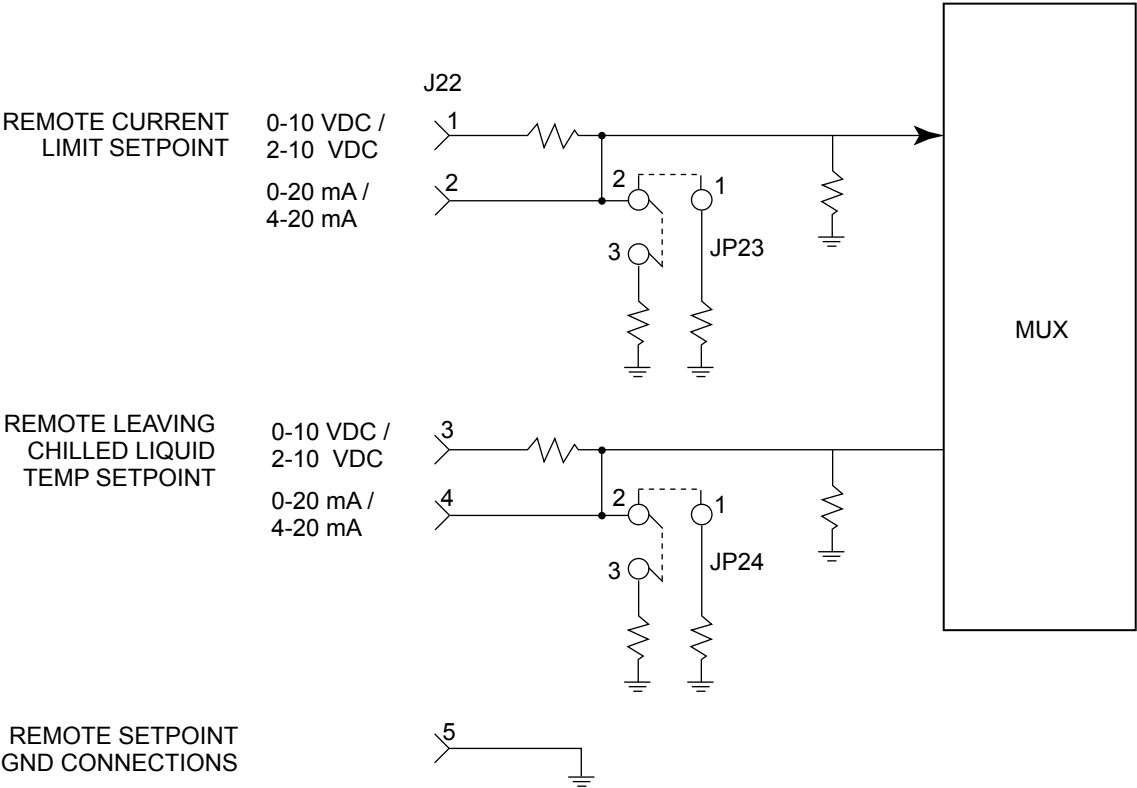
1. The LED backlight is never dimmed.
2. The position of Program Jumpers JP7 and JP8 determine the output at J6-7; In = Variable Voltage; Out = Variable Resistance. Refer to Program Jumper Listing for applications.
3. Potentiometer is actually an integrated circuit that is the electrical equivalent of a 10K Ω potentiometer.

FIGURE 11 - MICROBOARD LAMP CIRCUIT



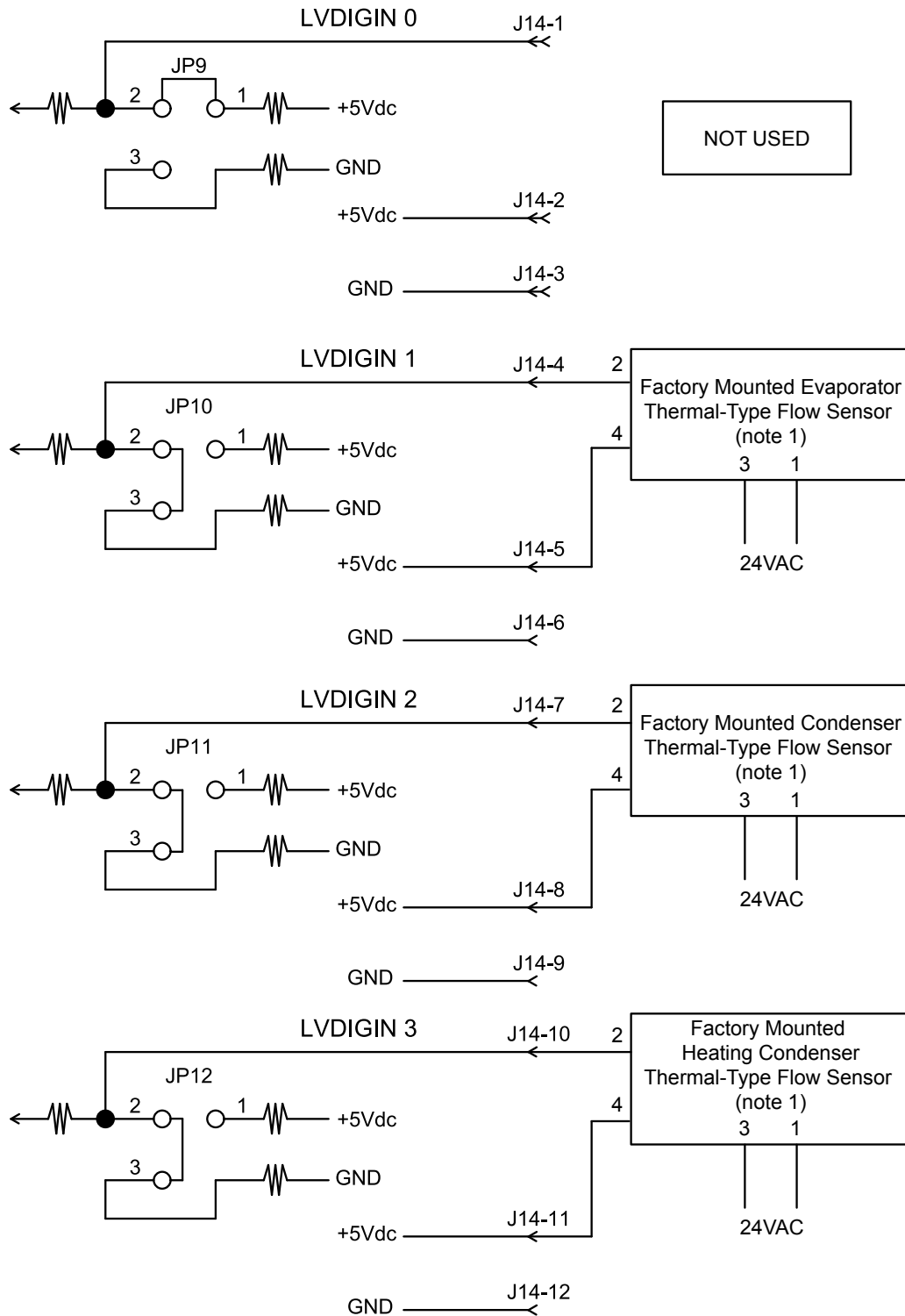
LD19587

FIGURE 12 - MICROBOARD SERIAL DATA COMMUNICATION PORTS



LD15436a

FIGURE 13 - CONFIGURABLE REMOTE SETPOINT INPUTS



LD12827b

NOTE:

1. Thermal type flow sensors are connected to Microboard J14 as shown above. Program Jumpers JP10 through JP12 must be positioned on pins 2-3.

FIGURE 14 - LOW VOLTAGE DIGITAL INPUTS FLOW SWITCHES

SECTION 4 - I/O BOARD

I/O BOARD

The I/O (input/output) Board conditions the Digital inputs for the microboard and conditions the microboard's Digital Outputs 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 Outputs function. Refer to *Figure 15 on Page 49*.

DIGITAL INPUTS

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 16 on Page 50*). The microprocessor reads the state of these contacts and reacts per the Program instructions. The contact voltage is 115VAC 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 *Figure 17 on Page 51*) 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 16 on Page 50*). These inputs are in the form of dry contacts connected as shown in *Figure 18 on Page 51*. 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 15 on Page 49* and *Figure 16 on Page 50*.

DIGITAL OUTPUTS

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 *Figure 19 on Page 52*). 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 mi-

croboard. The Digital Outputs 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 (greater than +10VDC) when the microboard is commanding a relay to de-energize; logic low (less than +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 Compressor Motor Starter and provides **Compressor Run** status to remote devices (Refer to *Figure 19 on Page 52*). Relay K18 is controlled by DC relays K13 (start) and K14 (stop). To start the compressor motor, 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 stop the compressor motor, 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 motor controller contacts CM are closed and the circuit between external Terminal Strip TB6-15 and TB6-53 is closed. The CM are located on the CM-2 Board (relay K1), Electro-Mechanical Starter applications, the Solid State Starter Logic Board (relay K1), Solid State Starter applications or a relay mounted on the Variable Speed Drive Logic Board on Variable Speed Drive applications. The High Pressure safety switch "HPCO", must also be closed.

TRIACS

Triacs are used to control the Pre-rotation Vanes actuator, Refrigerant Level Variable Orifice actuator and Variable Geometry Diffuser actuator (certain compressors only) (Refer *Figure 19 on Page 52* and *Figure 44 on Page 138*).

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 (less than +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 less than 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 previously in this section, Triacs control the current through the open and close windings.

The Refrigerant Level Variable Orifice Actuator on new production chillers is manufactured by Belimo. This actuator has two windings; open and close. One winding produces clockwise rotation and one produces counterclockwise rotation. This actuator operates from 24VAC. As described previously in this section, Triacs

are turned ON to allow current to flow through the appropriate winding to produce the desired rotation. If the OptiView™ Control Center is retrofit to an existing chiller, it could be equipped with a Barber-Coleman Level Actuator that operates as described above.

Chillers equipped with the Variable Geometry Diffuser are supplied with and require 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 *SECTION 22 - VARIABLE GEOMETRY DIFFUSER*.

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 Water Pump Starter (TB2-44/45)

Dry closure contacts are used. When the chiller is started, the Contacts close 13 seconds after the start of System Pre-lube. Normally, they open coincident with the completion of System Coastdown with the following exceptions:

- A. 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 display STOP soft key is pressed where-upon they open.
- B. If the chilled Liquid Pump is set to the Enhanced setting in the Setup screen, they do not open at the completion of System Coastdown when the chiller shuts down on a LEAVING CHILLED LIQUID - LOW TEMPERATURE, MULTIUNIT CYCLING - CONTACTS OPEN or SYSTEM CYCLING - CONTACTS OPEN cycling shutdown. They remain closed for the duration of the shutdown or until the display Soft Stop button is pressed-whereupon they open.
- C. While "Leaving Chilled Liquid – Flow Switch Open" cycling shutdown is active, the contacts remain closed until the chiller is given a stop command or has another fault.

On those chiller shutdowns as per above where the contacts remain closed during shutdown, when a chiller restart occurs the contacts remain closed into and throughout the Pre-lube period and the Transducer Auto Zeroing is not performed.

K1 - Warning Alarm (TB2-55/56)

Dry closure contacts which close when one of the warning messages listed below are 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.

- Real Time Clock Failure
- Condenser or Evaporator Transducer Error*
- Refrigerant Level Out of Range
- Standby Lube-Low Oil Pressure*
- Setpoint Override*
- Condenser-High Pressure limit
- Evaporator-Low Pressure Limit
- Vanes Uncalibrated-Fixed Speed
- Harmonic Filter-Operation Inhibited
- Harmonic Filter-Data Loss
- Harmonic Filter-Input Frequency Out Of Range.
- Excess Surge Detected*
- Surge Detected – Excess Surge Limit

K2 - Remote Mode Ready to Start (only operational in Digital, Analog or PWM) (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 display Soft Stop or panel E-Stop buttons are pressed. 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 with the Clear Fault key.

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

Dry closure status contacts which close coincident with a safety shutdown. They remain closed until the safety condition clears and a manual reset is performed with the Clear Fault key, whereupon they open.

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

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

K5 - Condenser Motor Pump Starter (TB2-150/151)

Dry closure contacts which close coincident with beginning of System run. They open coincident with the beginning of System Coastdown with the following exceptions:

- If equipped with a Mod B solid state starter, the contacts remain closed at shutdown until all SCR Heat sink temperatures are less than or equal to 105°F or a maximum of 45 minutes.
- While “Condenser – Flow Switch Open” cycling shutdown is active, the contacts remain closed until the chiller is given a stop command or has another fault.

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-K 9 - Not Used

K10 - Oil Heater (TB1-64/17)

Contacts are open whenever the Oil Pump is operating. When the Oil Pump is not operating, 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.

On Liquid Line Solenoid (Style "C" (and earlier) chillers, fixed speed oil pump) the contacts function as follows:

K11 - Not Used

K12 - Oil Return Solenoid (all styles, fixed or variable speed oil pump). Liquid Line Solenoid - J compressor only, variable speed oil pump)). (TB1-61)

Contacts close 1 minute after System run is initiated. They open on chiller shutdown coincident with the beginning of System Coastdown.

To avoid an OIL – LOW TEMPERATURE DIFFERENTIAL condition from preventing a chiller start after running at low load conditions for extended periods, the solenoid is cycled as follows while the chiller is running for P, Q and H9 compressors only:

- When the Oil Sump Temperature is less than the Oil Return Min setpoint, close (de-energize) the Oil Return Solenoid by de-energizing K12 relay.
- When the Oil Sump Temperature is greater than the Oil Return Min setpoint + 7°F, open (energize) the Oil Return Solenoid by energizing K12 relay.
- During coastdown and when not running, the solenoid operation is not changed from standard logic, it remains closed.
- During startup the operation is not changed from standard logic, it remains closed for 1 minute after System run.

K13 - Compressor Motor Starter (start) (TB1-6/16)

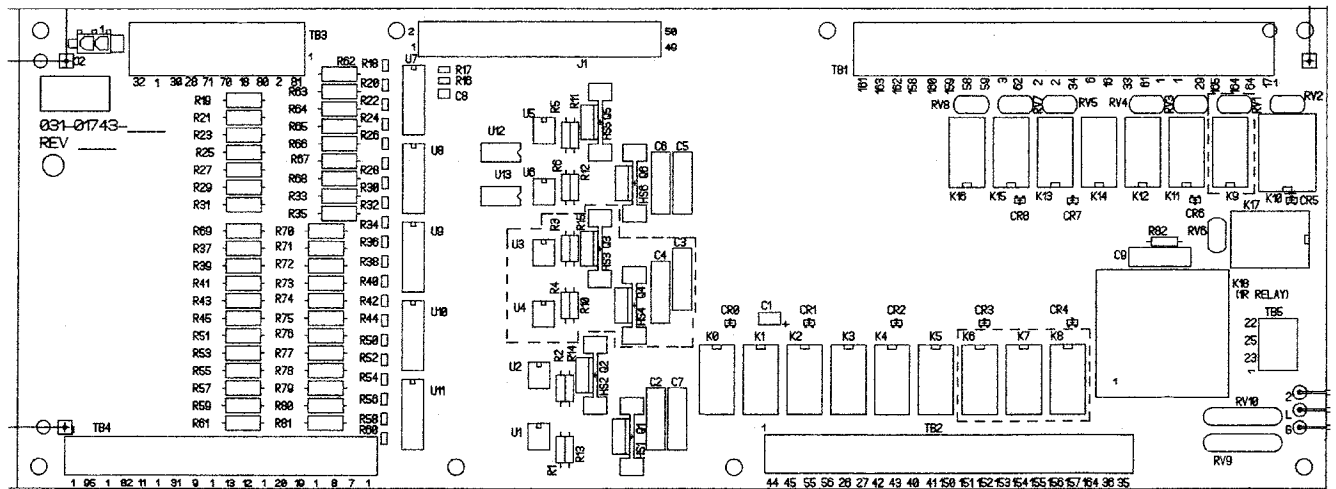
Contacts close coincident with the beginning of System run. They remain closed for 0.2 seconds and then open.

K14 - Compressor Motor Stop (stop) (TB 1-6/16)

Contacts close coincident with the beginning of System run. They remain closed for the duration of System run. They open coincident with the beginning of System Coastdown.

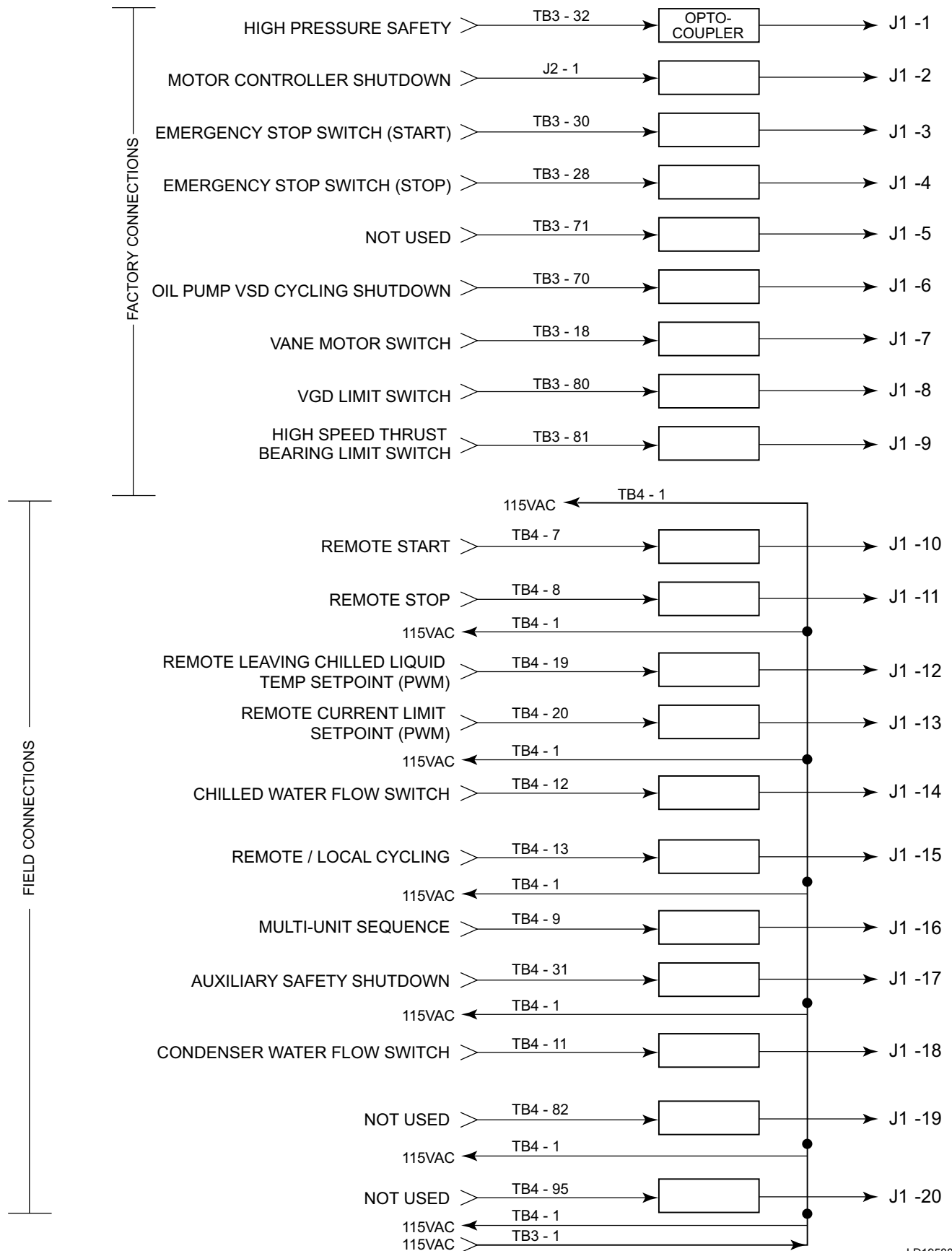
K15 - Not Used**K16 - Not Used****K17 - Not Used****K18 - Compressor Motor Starter (TB5-22/25) Run Status (TB2-35/36)**

Contacts operate the same as K14.



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FIGURE 15 - I/O BOARD

**FIGURE 16 - I/O BOARD DIGITAL INPUTS**

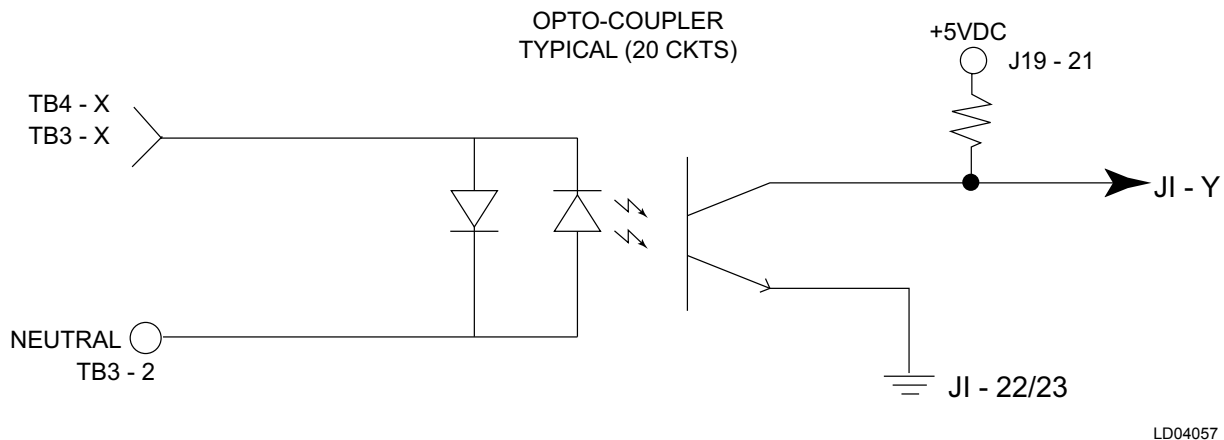


FIGURE 17 - I/O BOARD TYPICAL OPTO-COUPLER CIRCUIT

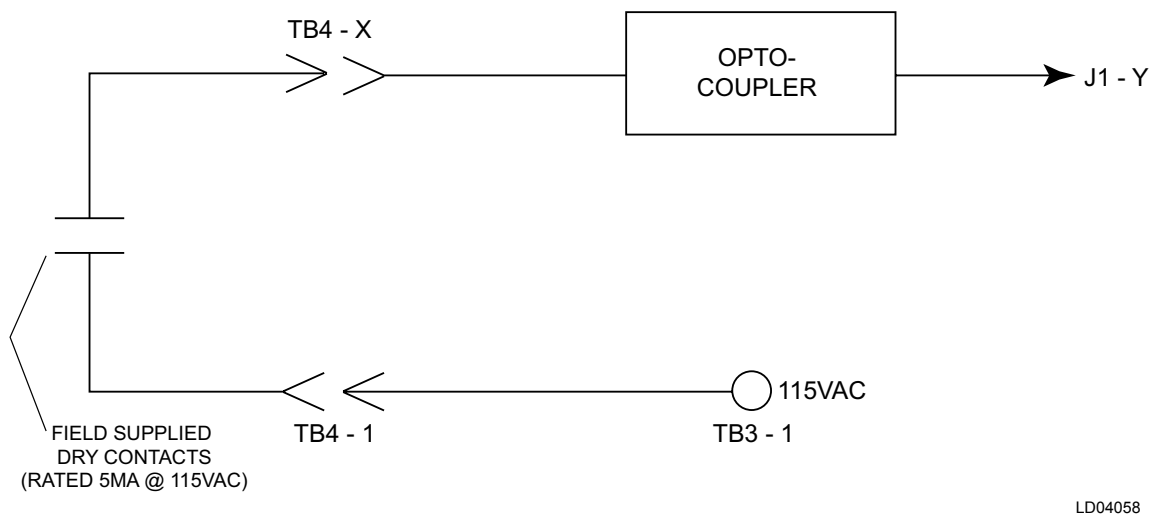
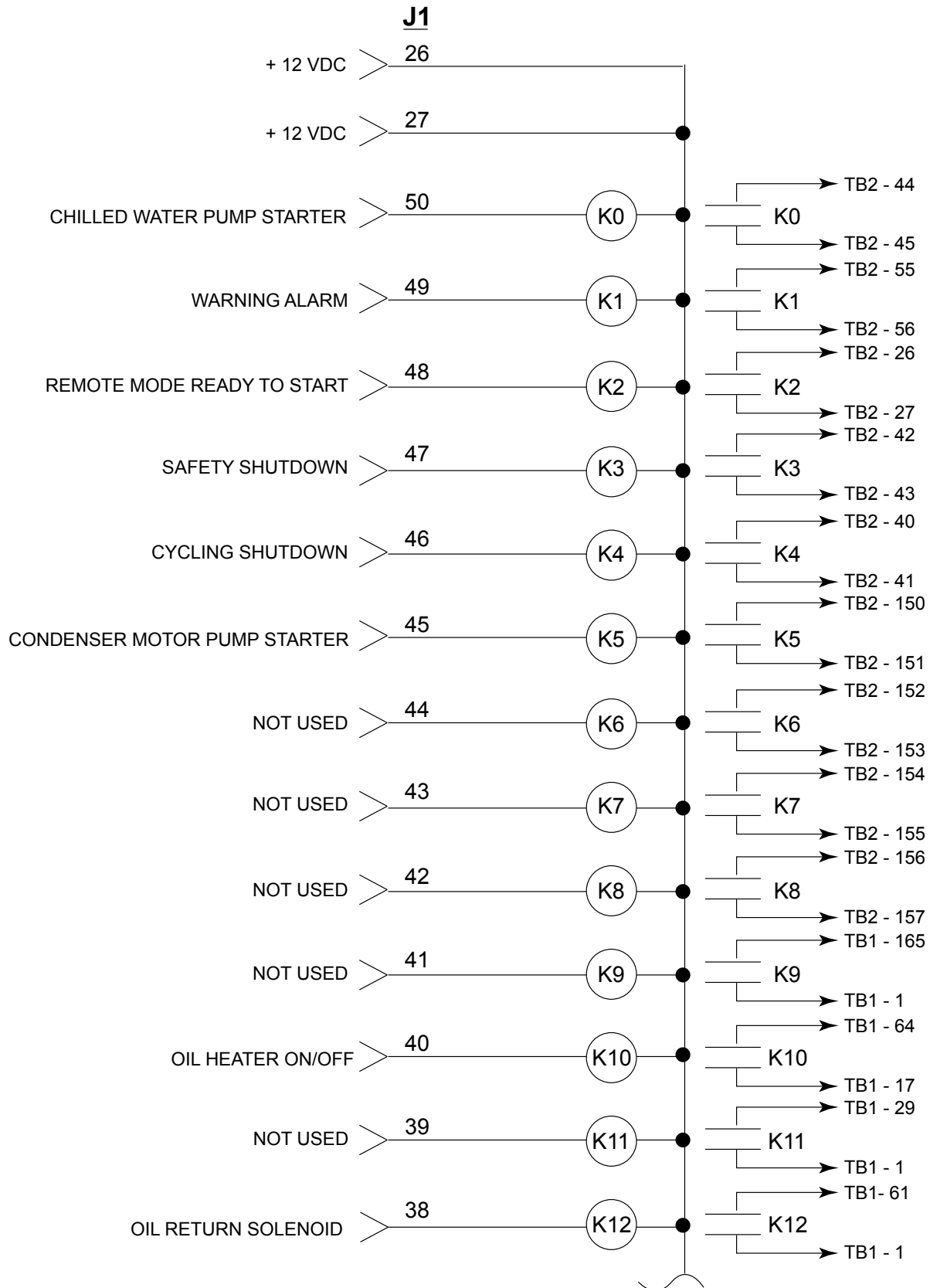
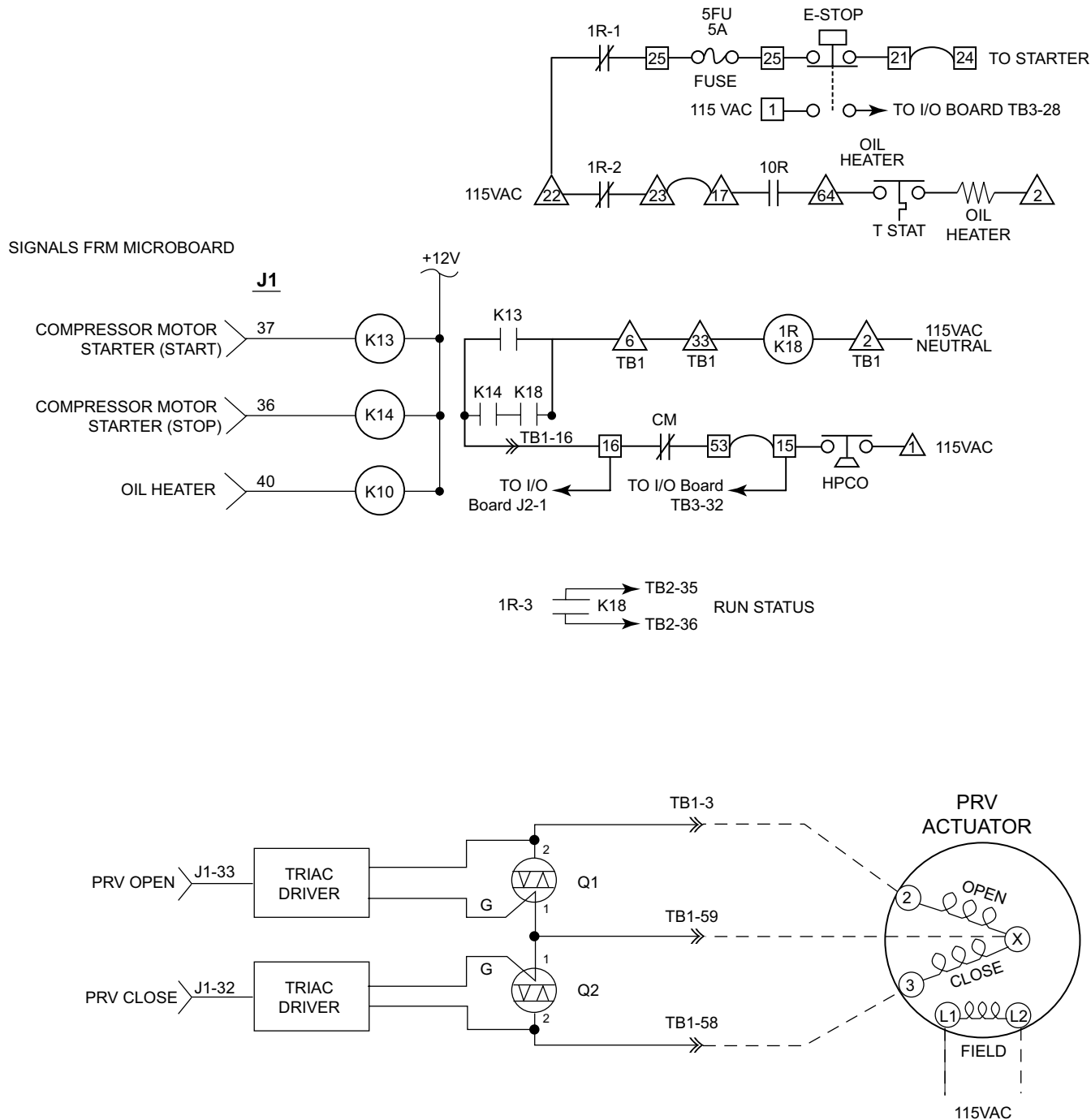


FIGURE 18 - I/O BOARD TYPICAL FIELD CONNECTIONS



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FIGURE 19 - J1 I/O BOARD DIGITAL OUTPUTS

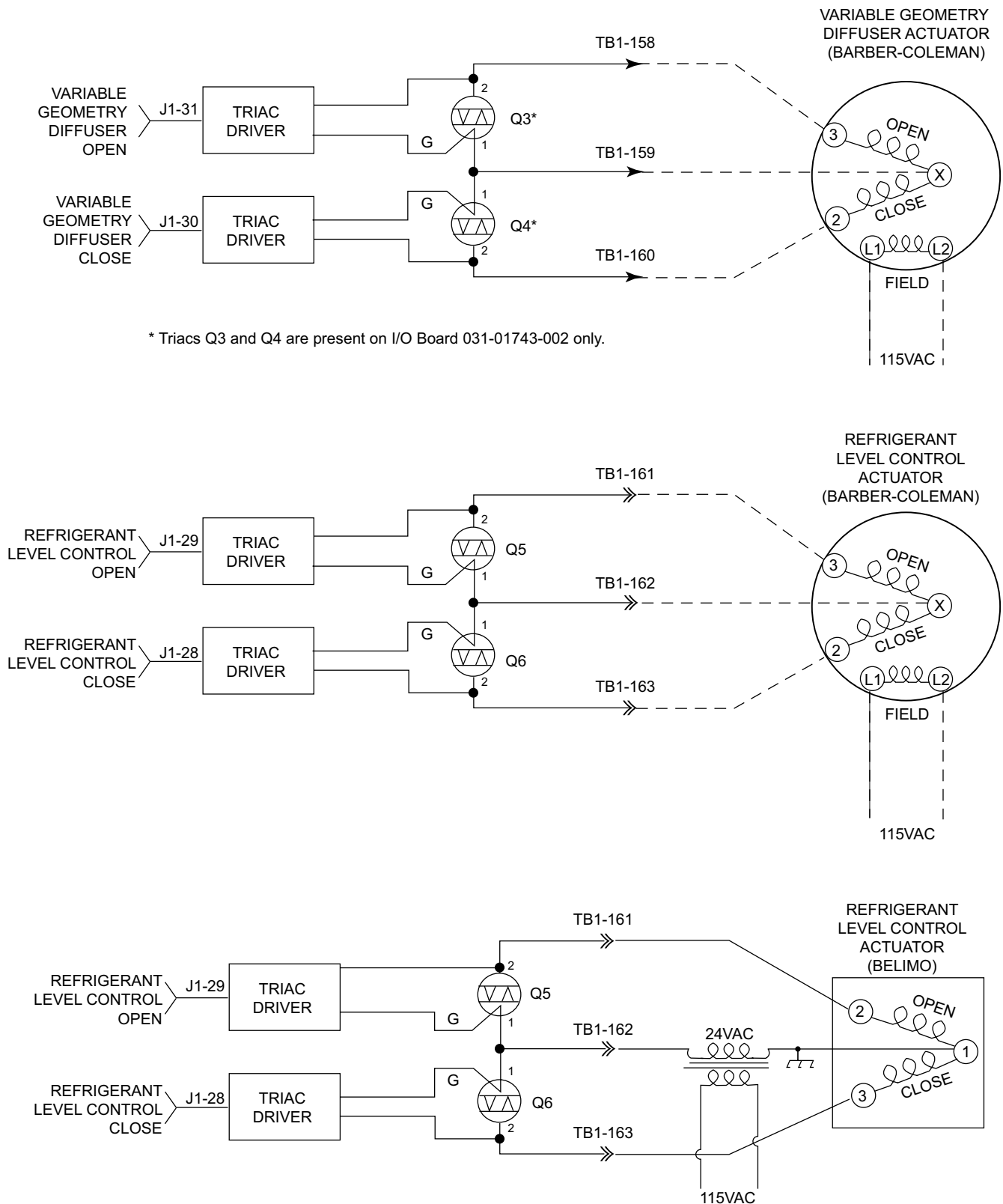


NOTES:

1. ----- indicates wiring external to I/O Board.
2. CM – Contacts of relay K1 on Current Module (EM Starter Applications) or Solid State Starter Logic Board (Solid State Starter Applications) or VSD Logic Board (Compressor Motor Variable Speed Drive Applications).

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FIGURE 19 - J1 I/O BOARD DIGITAL OUTPUTS (CONT'D)



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FIGURE 19 - J1 I/O BOARD DIGITAL OUTPUTS (CONT'D)

SECTION 5 - LIQUID CRYSTAL DISPLAY

A 10.4 inch color Liquid Crystal Display, and Display Interface Board and Backlight Inverter Board are mounted on a plate that is attached to the OptiView™ Control Center door. A clear plexiglass 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 *SECTION 6 - DISPLAY INTERFACE BOARD* and *SECTION 3 - MICROBOARD 031-03630-001* that follow this section. Displays that could be provided from YORK in new chillers or as replacement parts are:

- SHARP LQ104V1DG81 (031-03441-000)

The YORK part numbers of the Display Interface 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 on page 61. 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 J1.

Although there are variations in control signal timing between different display manufacturers, 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 25.18MHz, 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 to 48 CLKS after the end of the HSYNC pulse and 2 to 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 LQ104V1DG81 (031-03441-000) When ENABLE maintained “low”, display operates in Fixed Mode.

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 Scan Mode is determined by the configuration of wire jumpers on the Display Interface Board (Refer to *SECTION 6 - DISPLAY INTERFACE BOARD*).

Displays by different manufacturers 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 Program Jumpers.

The Backlight Lamp provides the illumination for the display. Average lamp life is 50,000 hours (5.7 years).

The LQ104V1DG81 has and LED backlight and does not use a Backlight Inverter Board.

The ribbon cable that connects the microboard to the Backlight Inverter Board also varies according to the Display manufacturer's requirements. Refer to *Figure 24 on Page 62*. Microboard Program Jumpers JP3, 4, 5, 7 and 8 determine the voltage levels of the control signals sent to the Backlight Board and must be configured per the Display manufacturer's requirements as listed.

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 and Backlight 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. Display Replacement Kit 331-01771-000 consists of the following items mounted on a display mounting plate:

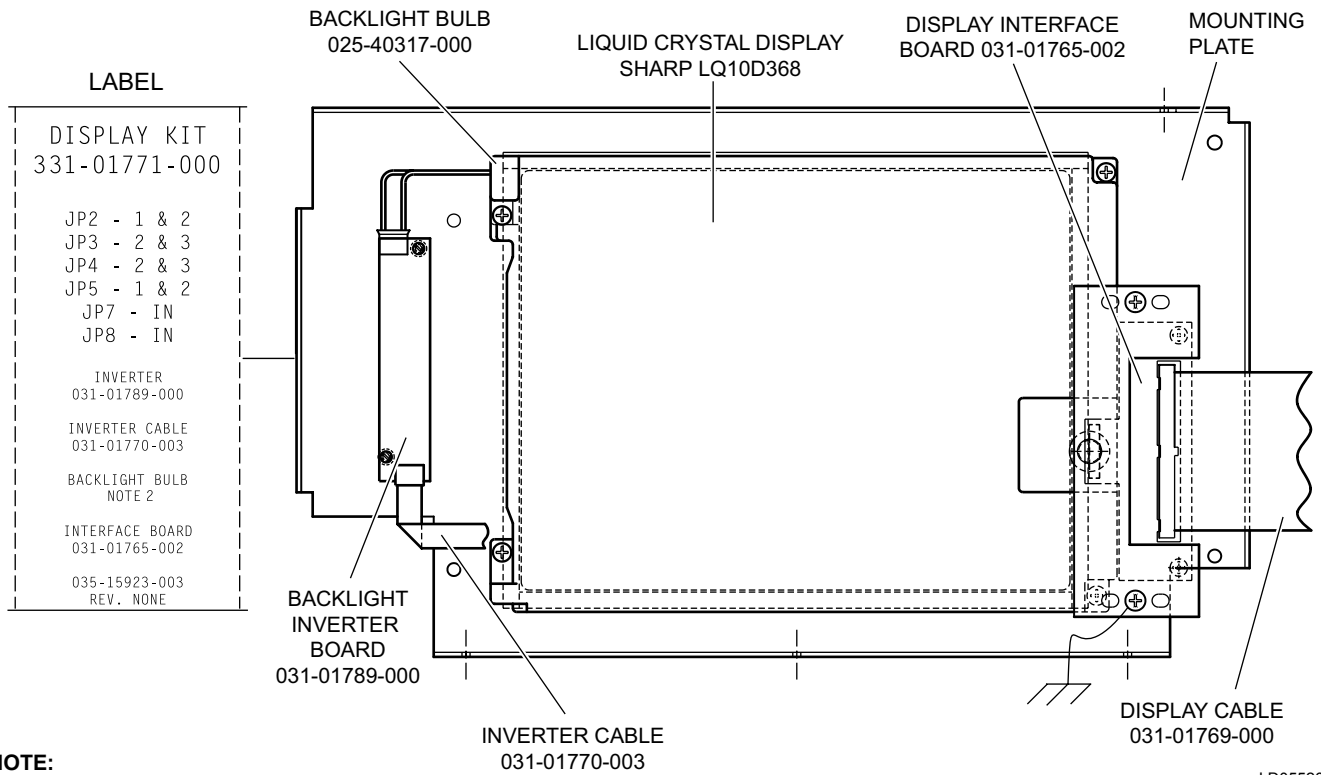
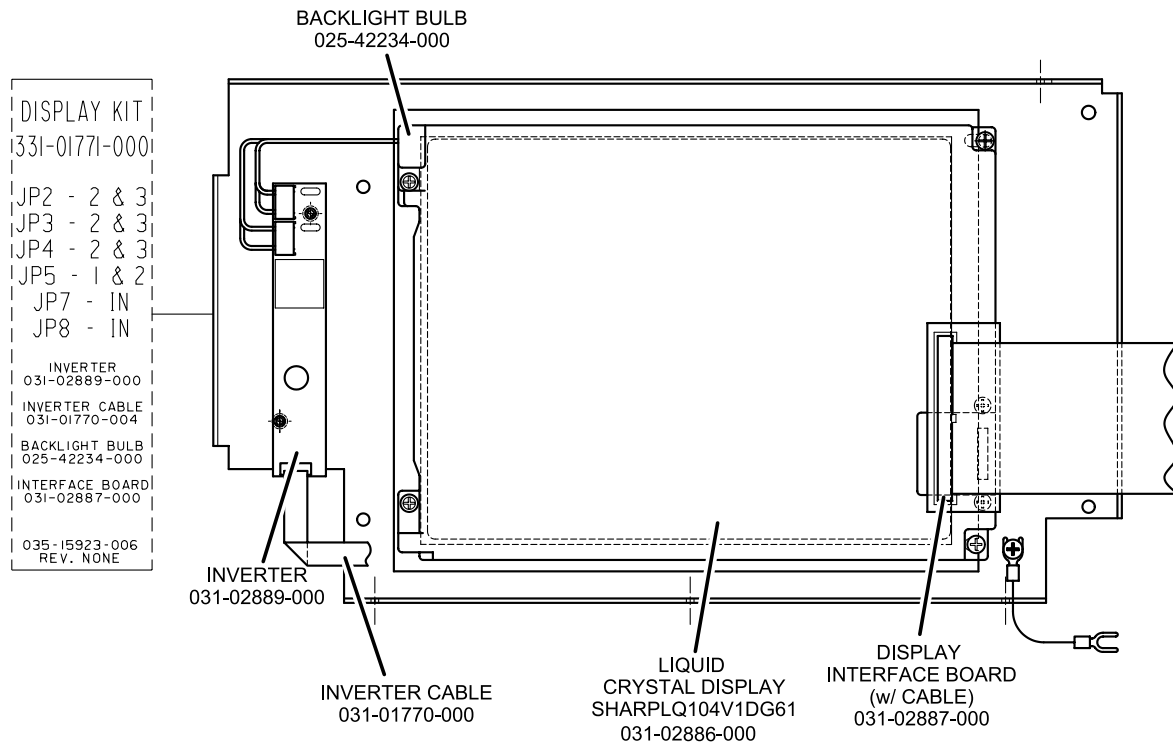
1. Liquid Crystal Display with Lamp
2. Appropriate Display Interface Board for item 1
3. Appropriate ribbon cable (Backlight Board to Microboard) for item 1
4. Ribbon cable (Display Interface Board to Microboard)
5. All mounting hardware
6. Installation instructions. A label attached to the display mounting 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 through 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!!!

**FIGURE 20 - LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ10D367/368 (031-01774-000) DISPLAY****FIGURE 21 - LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ104V1DG61 (031-02886-000) DISPLAY**

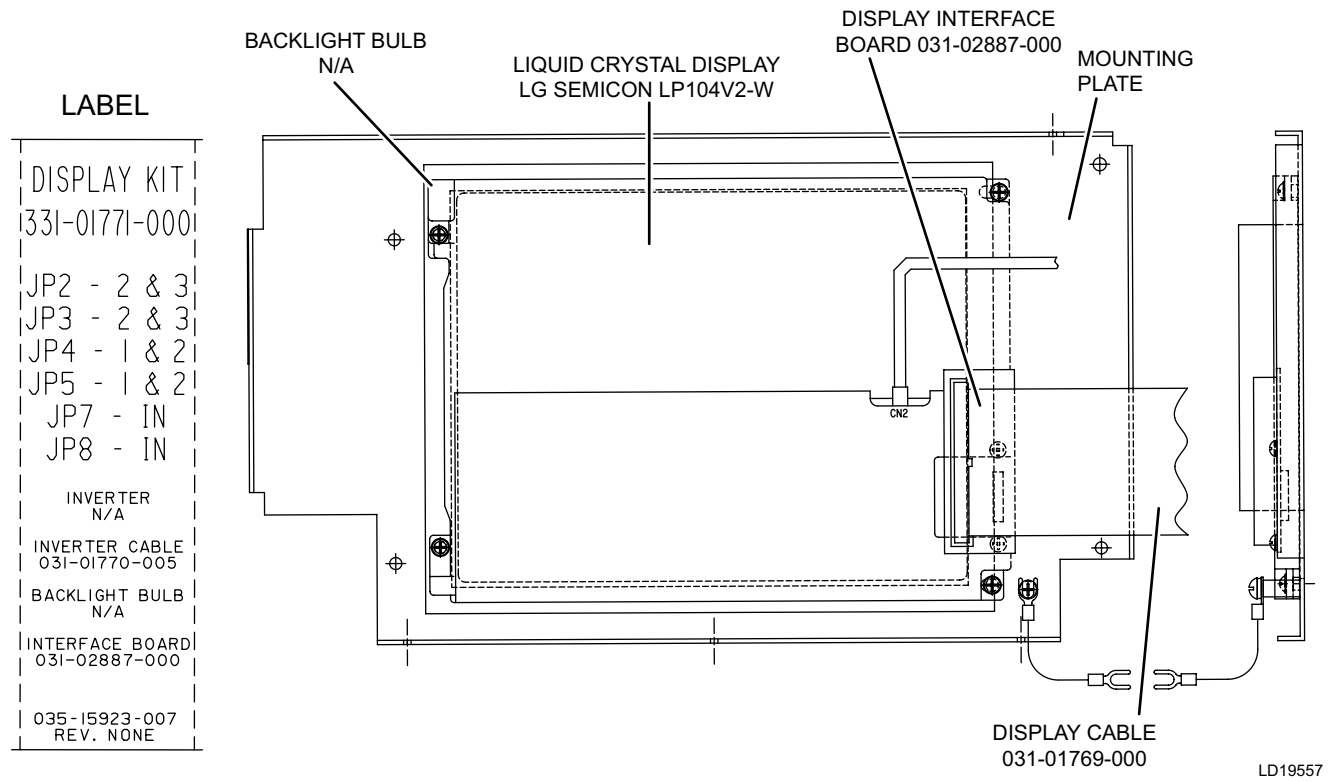


FIGURE 22 - LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ104V1DG81 (031-01771-000)

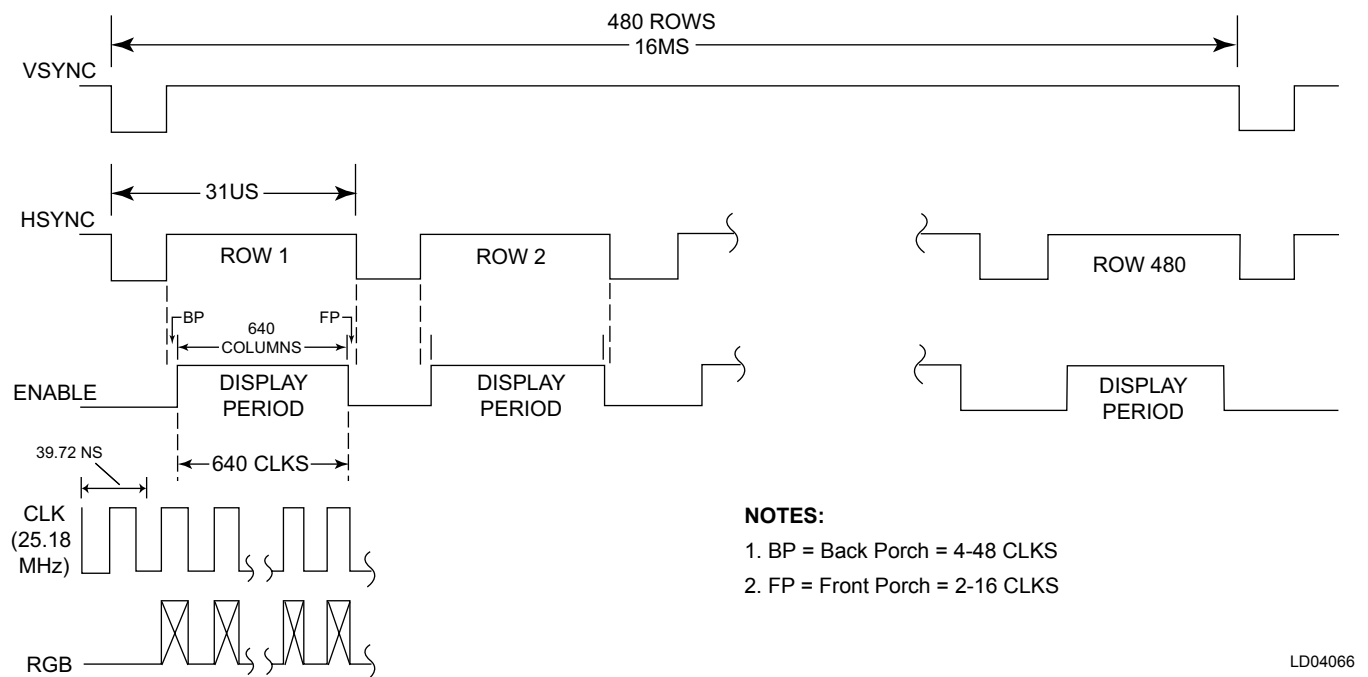


FIGURE 23 - LIQUID CRYSTAL DISPLAY TYPICAL CONTROL SIGNAL TIMING

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SECTION 6 - DISPLAY INTERFACE BOARD

The Display Interface Board is located on the Liquid Crystal Display 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 microboard Display Controller must be configured to meet the requirements of the actual display installed. When AC power is applied to the OptiView™ Control Center, the microboard reads the panel identification (PID0 thru PID3) voltage levels on the display interface board during the power-up sequence to determine which display is present. These voltage levels indicate the actual display installed and the Display Controller is automatically configured appropriately. To provide the appropriate Panel ID voltage levels for the different displays, there are different Display Interface Boards. These boards have permanent wire jumpers that provide the voltage levels to the microboard for Panel ID signals (PID0 thru PID3). These jumpers connect these signals to either ground or open-circuit. When connected to ground, the voltage level for that signal is 0VDC. When open, the voltage level is the VCC logic level, which is either 3.3VDC or 5.0VDC, depending on the display (refer to Microboard Program Jumper JP2).

The following are the different Display Interface Boards and the Panel ID signals they provide to the microboard.

- Display Interface Board 031-02887-000

Display Applicability:

SHARP LQ104V1DG81 (031-03441-000)

PID0 – OUT (VCC)

PID1 – IN (pin 45 is tied to 44) (GND)

PID2 – No Connection Open (VCC)

PID3 – No Connection Open (VCC)

The Displays can operate in either Normal or Reverse Mode for the Right/Left (R/L) and Up/Down (U/D) scan. Normal for the R/L scan is left to right. Normal for the U/D scan is top to bottom. As used in the OptiView™ Control Center, it is configured to operate in Normal Mode for both of these scans. The Reverse Mode for R/L is right to left. Reverse Mode for U/D is bottom to top. The Display Interface Board provides the appropriate signals to the display to put it in Normal Scan Mode. By hard wired jumper or wiring configuration, the signal is either tied to ground, VCC (+3.3VDC or +5VDC, as determined by Microboard Program Jumper JP2) or left open as follows:

- Display Interface Board 031-02887-000

Display Applicability:

SHARP LQ104V1DG81 (031-03441-000)

J1-30 – (VCC)

J1-31 – (GND)

Display Interface Boards are available individually for service replacement. The part number of the Display Interface Board for the installed display is listed on a label attached to the display mounting plate. The appropriate board is also supplied with display kit 331-01771-000.

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.

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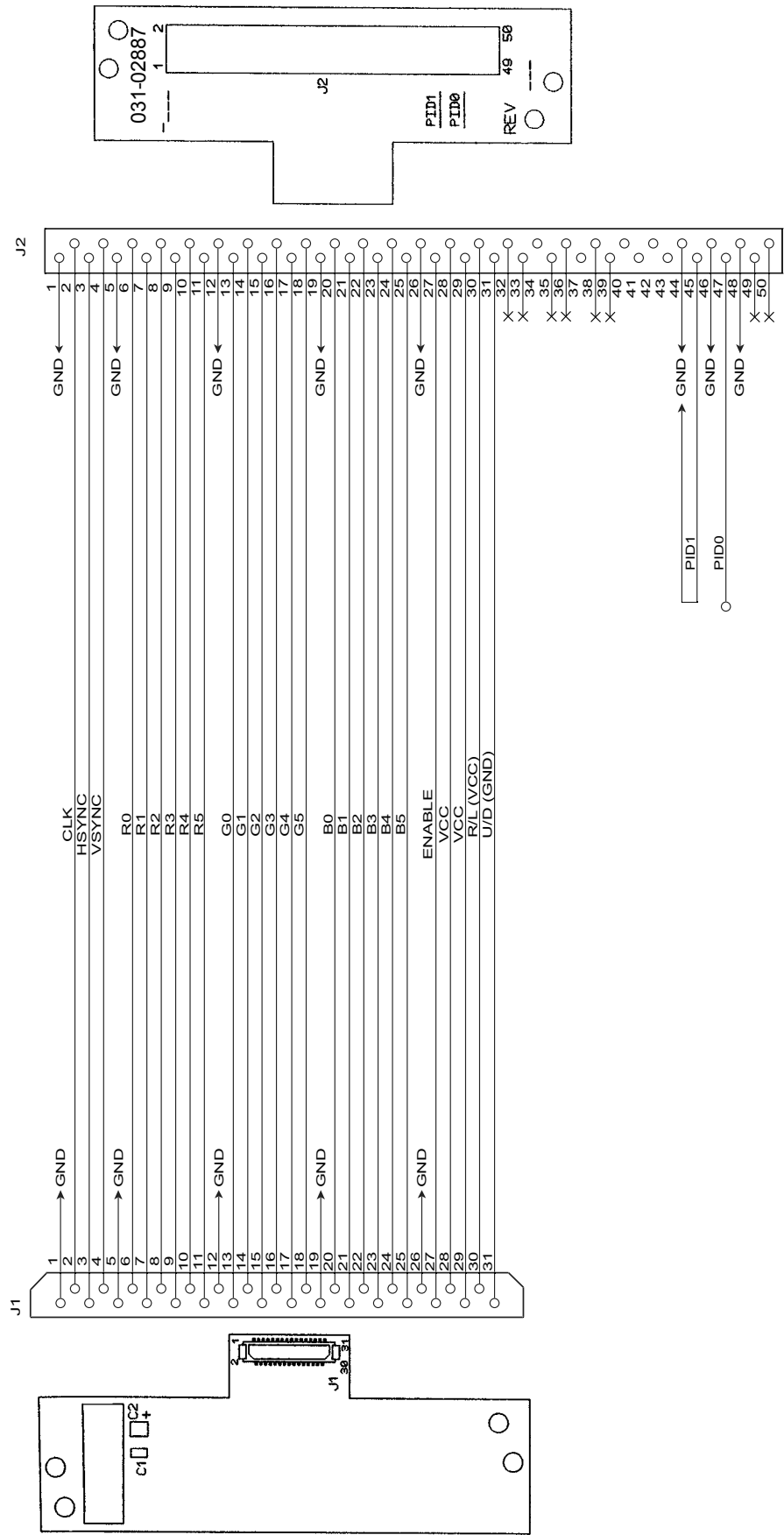


FIGURE 24 - DISPLAY INTERFACE BOARD 031-02887-000

SECTION 7 - KEYPAD

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 25 on Page 64*. 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” (less than 1VDC) on a row, a “logic high” (more than 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 microprocessor 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 less than 100 Ohms. When a key is not pressed, the contact resistance must be more than 1Meg 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 29 - 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 rocker switch openings and apply the keypad to the door.

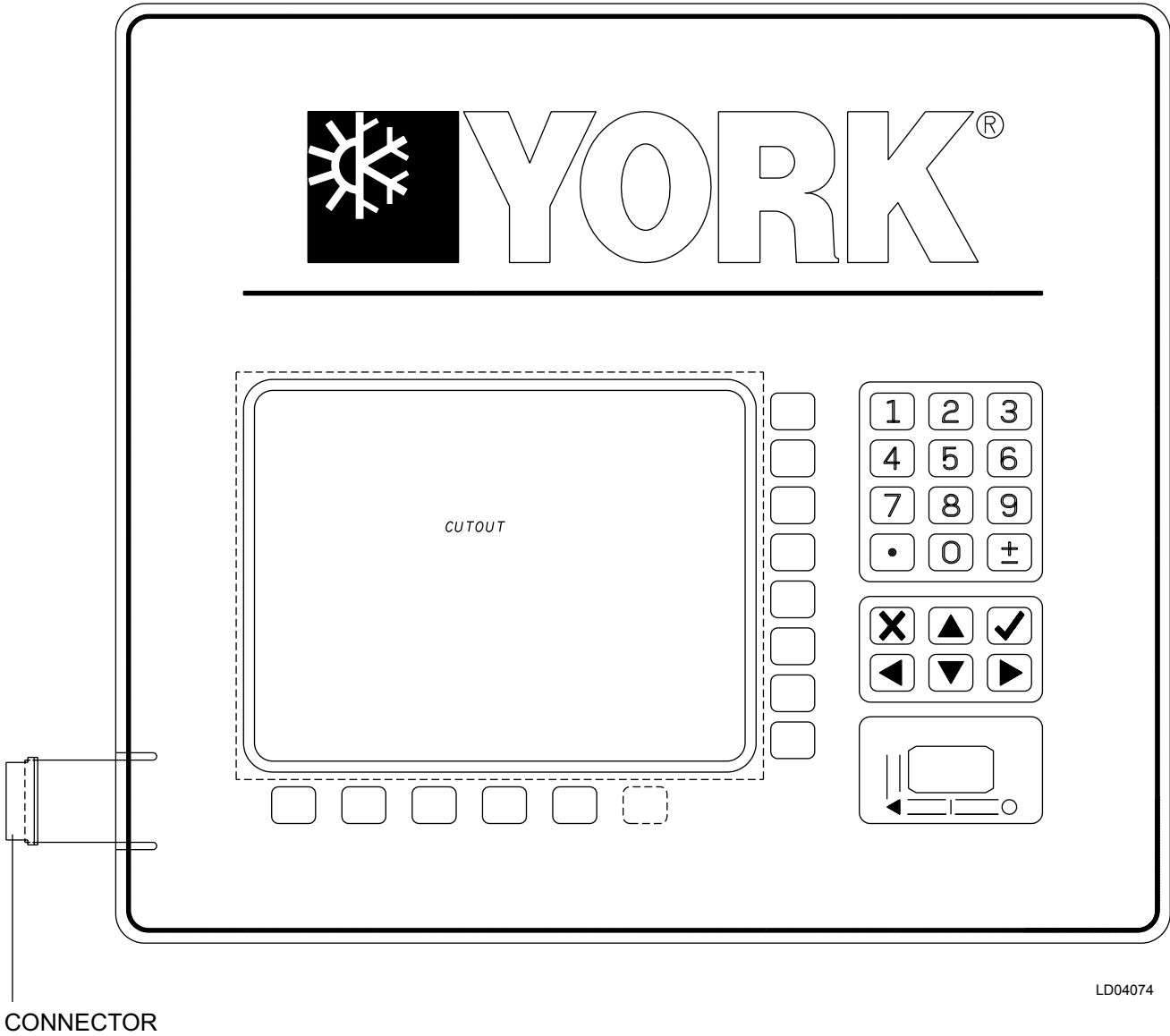
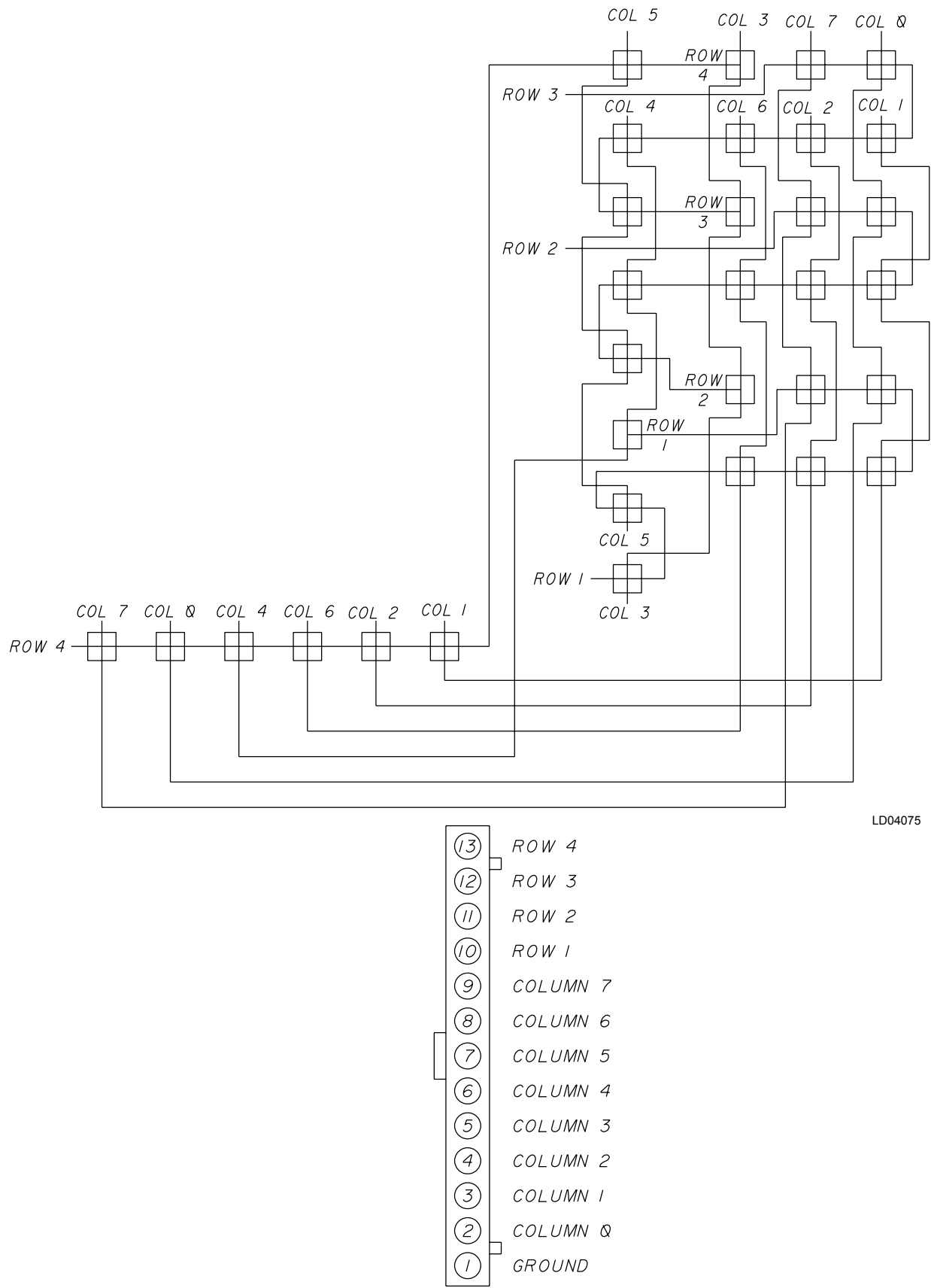


FIGURE 25 - KEYPAD



CONNECTOR PIN OUT

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FIGURE 26 - KEYPAD

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SECTION 8 - POWER SUPPLY

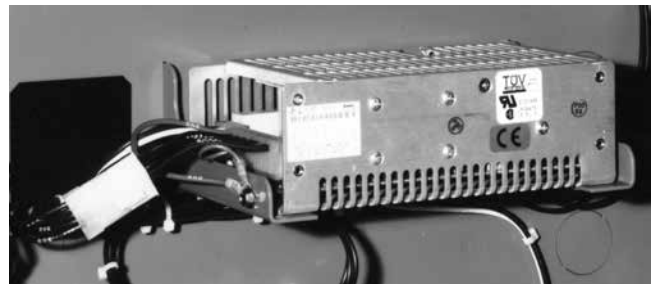
The Power Supply provides the DC power for the LCD Display and all the printed circuit boards in the OptiView™ Control Center. It receives a 102 to 132VAC input from an external power source and provides the following DC outputs:

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

The +24VDC output provides power to the CM-2 Board (Electro-Mechanical Starter applications), Solid State Starter Logic/Trigger Board (Mod B Solid State Starter). If the Chiller is equipped with Proximity probe Part number 025-30961-000 or 025-35900-000, the Probe is also powered by this +24VDC.

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 SC-Equip Gateway, Proximity probe (025-xxxxx-000 only), I/O Board,

VSD Oil Pump, LCD Display and Display Backlight Inverter Board. The Condor Power Supply allows adjustment of the +5VDC output. To account for losses in wiring and connections and assure sufficient voltage level at the microboard input, the “V AdJ” (R51) potentiometer is adjusted to achieve +5.1VDC at the input to the microboard J1-1.



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FIGURE 27 - POWER SUPPLY

The 031-03630-001 Microboard has a different J1 power connector and therefore requires a different power supply wiring harness than what was used with the 02430 microboard. The wiring harness part number is 571-06765-272.

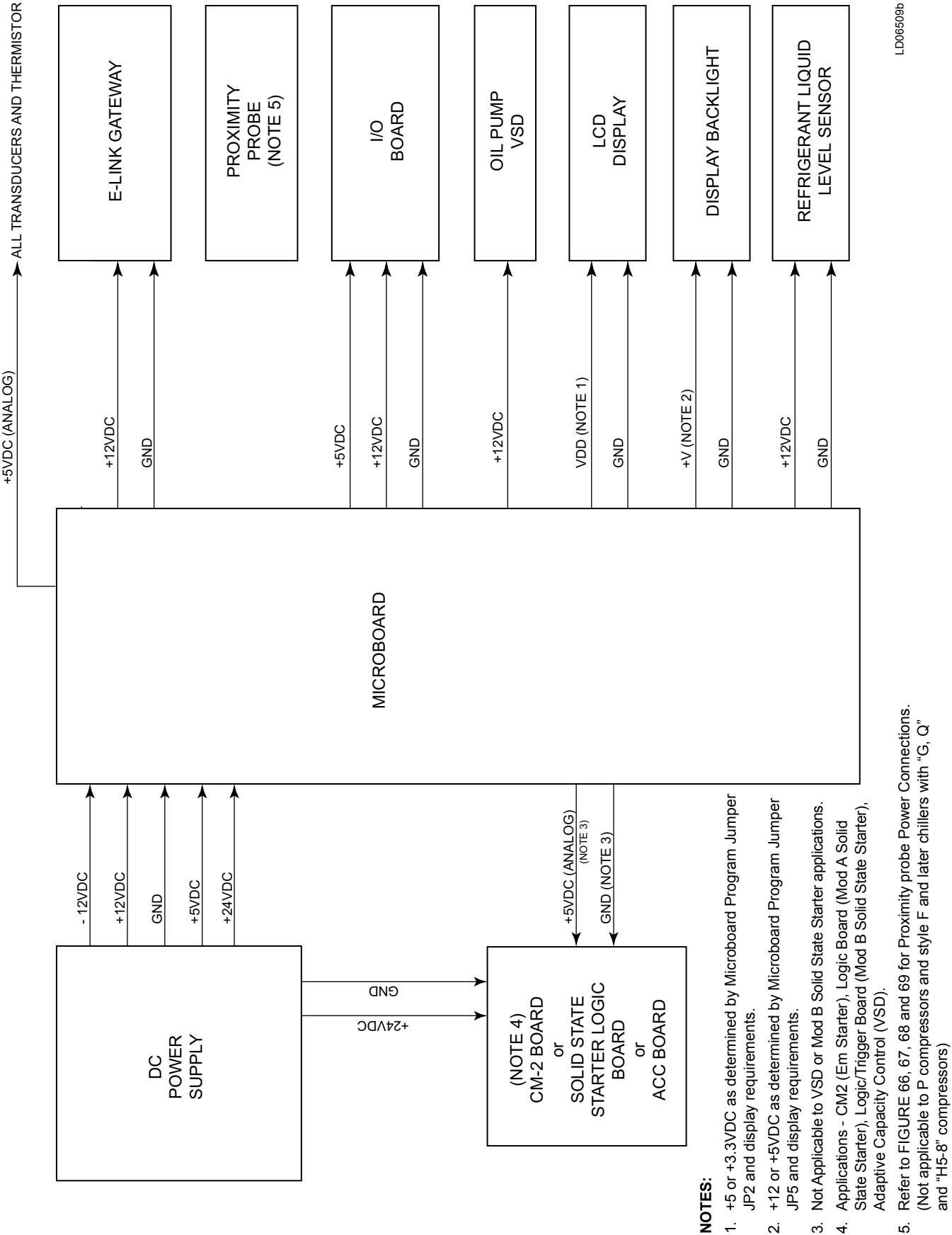


FIGURE 28 - POWER SUPPLY – DC POWER DISTRIBUTION (REFER TO OPTIVIEW™ CONTROL CENTER WIRING DIAGRAM FOR WIRE CONNECTIONS)

SECTION 9 - CURRENT MODULE (CM-2)

On applications where the Compressor Motor is controlled by an Electro-Mechanical Starter, the OptiView™ Control Center is equipped with a current module. The Current Module provides compressor motor Overload and Power Fault protection. The Current Module also provides an analog voltage representing the compressor motor current to the microboard for display and current limit control. While the chiller is running, the microboard controls the Pre-rotation Vane (PRV) position to limit the motor current to the system 100% Full Load Amp (FLA) value.

The contacts of Current Module K1 relay (identified as CM contacts on the OptiView™ Control Center wiring diagram) are interfaced into the Motor Controller initiated shutdown circuit that is located between OptiView™ Control Center TB6-53 and I/O Board TB1-16 (Refer to *Figure 19 on Page 52 and Figure 30 on Page 71*). They are also connected as a Digital Input to I/O Board J2-1. Relay K1 is normally energized, maintaining its contacts in a closed position. Whenever the Current Module initiates a chiller shutdown, it de-energizes K1, opening its contacts. This interrupts the circuit to I/O Expansion Board RUN relay coil 1R (K18), de-energizing it and causing the Starter to shutdown. Simultaneously, the microboard reads the opening of these contacts via I/O Board J2-1, initiates a System Coastdown and displays the appropriate message as described below.

Three current transformers in the compressor motor terminal box (Refer to *Figure 31 on Page 72*) provide 3 phase motor current signals to the Diode Bridge (DB). The required turns ratio of the Current Transformers is determined by the system 100% FLA. The Diode Bridge rectifies and combines the three signals into one DC signal that is applied to the parallel Variable Resistors (RES). These are factory adjusted (field adjusted on service replacements) to provide a nominal 1.0VDC (0.15 to 1.10VDC) signal to the Current Module at J1-1 and J1-2 when the compressor motor current is at 100% FLA. *Figure 31 on Page 72* contains a formula to calculate the resistance of RES required to achieve 1.0VDC at 100%FLA. The 100% FLA value is located on a label adhered to the inside of the OptiView™ Control Center door.

The motor current signal input at J1-1 and J1-2 is applied to potentiometer R8. This is factory adjusted (field adjusted on service replacements) to illuminate the 105% CURR indicator (CR6) when the compressor

motor current reaches 105% FLA. This calibrated voltage is applied to the Power Fault detector, Overload detectors and Multiplexer (MUX).

The power fault circuit protects the compressor motor and driveline from transient torque damage. It anticipates the transient torque condition by detecting a momentary interruption in motor current and de-energizing the starter before damage can occur. If the chiller has been running for greater than 75 seconds and the motor current decreases to less than or equal to 10% FLA, a Power Fault shutdown is initiated. The Power Fault indicator (CR5) is illuminated and remains illuminated until manually reset with RESET switch S2. Relay K1 is de-energized for 1 second and then returned to the energized state. Relay K1 contacts (CM) open for 1 second and then return to the closed state. A System Coastdown is initiated and POWER FAULT is displayed on the Display. The chiller will automatically restart upon completion of System Coastdown.

If the motor current remains continuously at greater than or equal to 105% FLA for 50 seconds (Nominal), an OVERLOAD shutdown is initiated. The Overload indicator (CR4) is illuminated and remains illuminated until manually reset with RESET switch S2. Relay K1 is de-energized, opening K1 contacts (CM). Relay K1 remains de-energized until manually reset with RESET switch S2. A System Coastdown is initiated and MOTOR CONTROLLER - CONTACTS OPEN is displayed. The chiller cannot be started until RESET switch S2 is manually pressed.

If the motor current remains continuously at 245% FLA for 40 seconds, 290% FLA for 20 seconds or 360% FLA for 10 seconds, an OVERLOAD shutdown is initiated. Relay K1 and Overload indicator CR4 operate as described immediately above. A System Coastdown is initiated and MOTOR CONTROLLER - CONTACTS OPEN is displayed. The chiller cannot be restarted until RESET switch is manually pressed. LRA/FLA potentiometer R16 is factory adjusted (field adjusted on service replacements) to the ratio of Locked Rotor Amps to Full Load Amps. The correct setting is determined by dividing the LRA by the FLA. If Switch S1 is in the "Y-Delta/57%" position, there is no 245% FLA threshold. Switch S1 must be positioned according to the type of Electro-Mechanical Starter present; UP for Y-delta or 57% Autotransformer starters, DOWN for all other starters.

The Multiplexer (MUX) is an electronic switch with 8 inputs and 1 output. The address applied to it determines the position of the switch (i.e., which input is routed to the output). The inputs to channel 0 through 6 are grounded (0VDC). The input to channel 7 is a 0 to 4.0VDC analog signal, representing motor current over the range of 0 to 100% FLA. It is factory calibrated by potentiometer R34 to be 4.0VDC when the compressor motor current is at 100% FLA. Under Program control, the microboard commands the MUX to route the inputs to the MUX output by applying 3-bit Binary addresses to the MUX address inputs at J5-1,2,3. The voltage level for a logic 1 is +12VDC and logic 0 is 0VDC. The microboard reads the MUX outputs at J5-6. It first addresses channel 0 to determine the type of starter applied. The 0VDC at channel 0 indicates to the microboard that this is an Electro-Mechanical Starter application. In all starter applications, the microprocessor reads channel 0 to determine the type starter applied:

- 0VDC = EM starter

It then addresses channel 7 (ignoring channels 1 through 6) to read the analog motor current voltage. The microboard interprets this analog value in terms of % FLA and displays it upon operator keypad request. It also uses this value to invoke compressor motor Current Limit at 100% FLA and 104% FLA. When motor current rises to 100% FLA, the microboard prevents any further current rise by inhibiting further Pre-rotation Vanes (PRV) opening until it decreases to 98% FLA. If the motor current continues to rise to 104% FLA, the microboard applies a close signal to the PRV until the motor current decreases to 102% FLA. While Current Limit is in effect, MOTOR - HIGH CURRENT LIMIT is displayed.

As detailed in the *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual, to field calibrate potentiometer R8, the PRV must be manually operated to achieve 105% FLA compressor motor current. Therefore, during this procedure, Current Limit is not invoked until 107% FLA and 110% FLA. The first time the PRV OPEN key is pressed on the COMPRESSOR Screen after logging in at SERVICE access level, a 10 minute window is opened, allowing the current to rise to 107% FLA before further PRV opening is inhibited. This inhibit is released when the current decreases to 106% FLA. If the current continues to rise to 110%, manual control is overridden and a close signal is applied to the PRV until the current decreases to 109% FLA. After 10 minutes, the normal current limit thresholds of 100% FLA and 104% FLA are applied.

The MUX address inputs along with respective outputs are as shown in the following table:

TABLE 4 - MUX ADDRESS

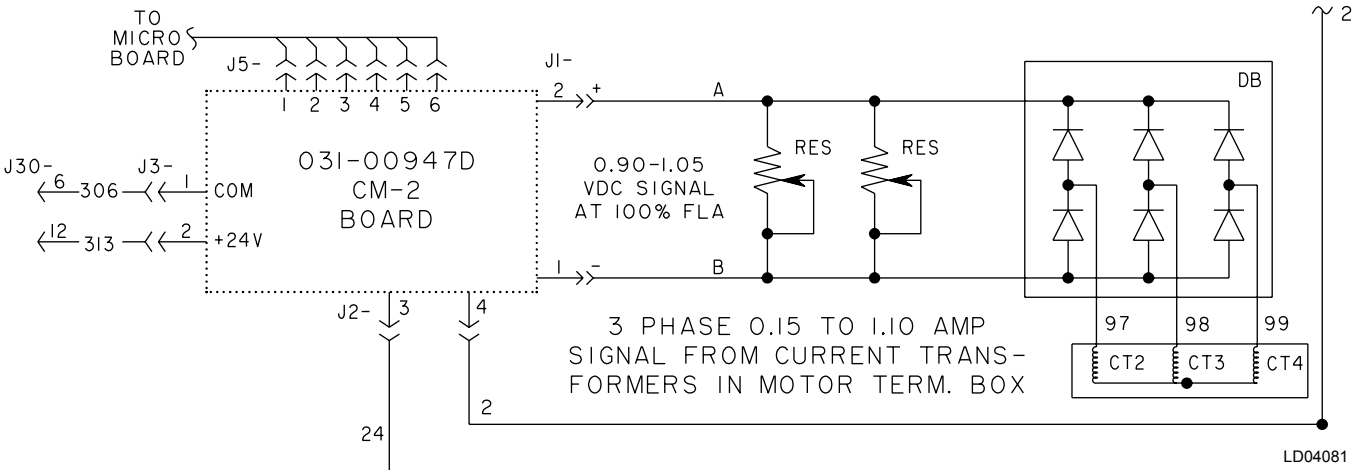
BINARY			DECIMAL	OUTPUT
J5-1	J5-2	J5-3		
0	0	0	0	Ground
0	0	1	1	Ground
0	1	0	2	Ground
0	1	1	3	Ground
1	0	0	4	Ground
1	0	1	5	Ground
1	1	0	6	Ground
1	1	1	7	0 to 5.0VDC motor current analog signal calibrated on CM-2 board to be +4.0VDC at 100% FLA.



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FIGURE 30 - CM-2 CURRENT MODULE (ELECTRO-MECHANICAL STARTER APPLICATIONS)



MOTOR VOLTAGE	FLA	CT RATIO	RES ^D (OHMS)
208-600	65-111 ^A	200:1	$R = 1.282 \frac{(\text{CT RATIO})}{\text{FLA}}$
	112-224 ^A	350:1	
	225-829 ^A	700:1	
	830-1790 ^A	1400:1	
2300-4160	11-18 ^C	200:1	$R = 0.247 \frac{(\text{CT RATIO})}{\text{FLA}}$
	19-37 ^B	200:1	$R = 0.370 \frac{(\text{CT RATIO})}{\text{FLA}}$
	38-123 ^A	200:1	$R = 0.740 \frac{(\text{CT RATIO})}{\text{FLA}}$
	124-264 ^A	350:1	
	265-518 ^A	700:1	

- NOTES:
- A. Requires passing motor lead through current transformer (CT) once before connecting to power supply.
 - B. Requires passing motor lead through CT twice before connecting to power supply.
 - C. Requires passing motor lead through CT three times before connecting to power supply.
 - D. Calculates resistance of "RES" to achieve 1.0VDC at FLA.

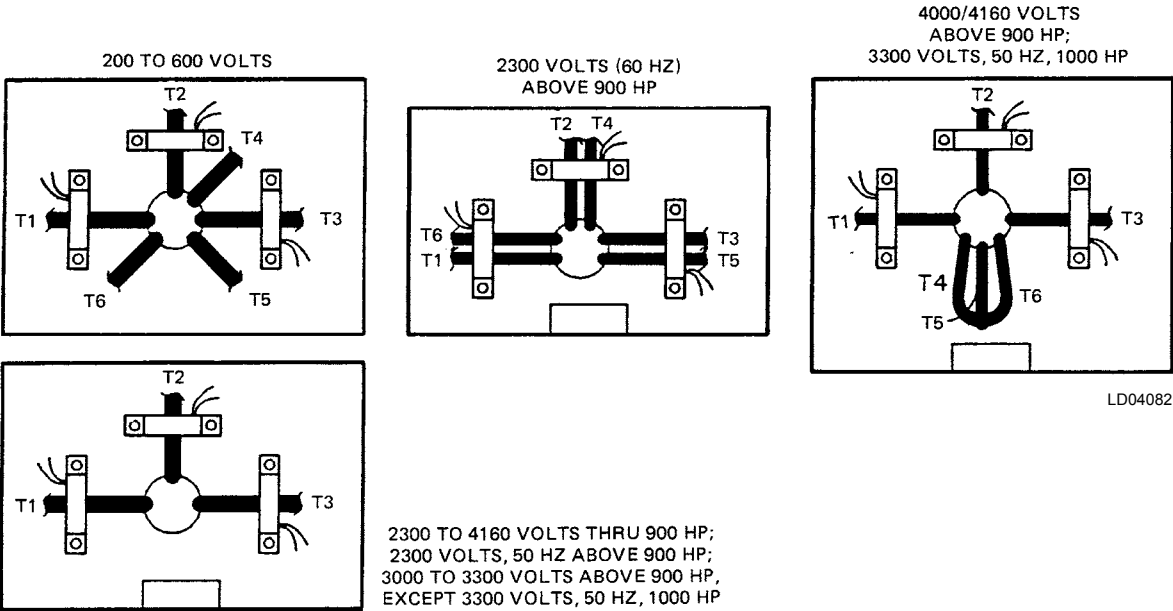


FIGURE 31 - CM-2 CURRENT MODULE – INTERFACE, CURRENT TRANSFORMERS AND VARIABLE RESISTORS

SECTION 10 - SOLID STATE STARTERS

SOLID STATE STARTERS

The OptiView™ Control Center will accommodate several different Solid State Starters. Chillers are equipped with either the Medium Voltage Solid State Starter (MV SSS) or the Style B Liquid Cooled Solid State Starter (LCSSS). Both the MV SSS and the LCSSS communicate with the microboard using RS-485 serial data with Modbus protocol.

The starter selection is performed on the SETUP Screen (Refer to *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES*).

MEDIUM VOLTAGE SOLID STATE STARTER

The Medium Voltage Solid State Starter (MV SSS) communicates with the microboard J13 COM 2 port with RS-485 serial data using Modbus protocol. This communication link transfers start/stop commands to the starter and receives status and operation data from the starter. A hard-wired 115VAC start signal is also applied to the starter via relay 1R (K18) contact closure. A Starter Initiated STOP relay, located in the starter, opens its contacts whenever the starter initiates a shutdown. The communications link and relay contact interface operate in the same way as described below for the Style B LCSSS.

The 031-03630-001 microboard COM 2 is designed as a RS-485 port so no jumper settings are needed.

The MV SSS MOTOR Screen contains information pertinent to the starter. A complete description, theory and operation of this starter are contained in *Medium Voltage Solid State Starter – Service (Form 160.00-M5)*.

Style B Serial Interface LCSSS

A complete description, theory of operation and troubleshooting instructions of this LCSSS are contained in *Solid State Starter (Mod B) – Operation and Maintenance (Form 160.00-O2)*. The following describes the interface and interaction of the LCSSS with the OptiView™ Control Center.

The LCSSS contains a single Logic/Trigger printed circuit board. This board performs the following functions:

- Generates the SCR trigger pulses.
- Receives start/stop commands from the microboard.
- Transmits status and fault data to the microboard.
- Generates all LCSSS initiated Safety and Cycling shutdowns.

The Logic/Trigger Board is powered by +24VDC from the OptiView™ Control Center Power Supply. The OptiView™ Control Center Microboard (J15) communicates with this board via a 1200 baud 0 to +5VDC serial data communications link. If this communications link does not operate properly, correct Microboard J15 serial port operation can be verified using the Serial Inputs and Outputs diagnostic procedure in *SECTION 29 - DIAGNOSTICS AND TROUBLESHOOTING* of this manual. The STOP relay contacts on the Logic/Trigger Board assure a positive shutdown on all LCSSS initiated shutdowns.

After power has been applied to the system, the microboard will attempt to establish communications with the Logic/Trigger Board. If unsuccessful within 10 attempts, the microboard initiates a cycling shutdown and displays LCSSS INITIALIZATION FAILED on the System Details line of the OptiView™ Control Center display. The microboard will continue to establish communications until successful. Also, at power-up, the Logic/Trigger Board reads wire jumpers in its connector J1 to determine the LCSSS model applied (Refer to *Solid State Starter (Mod B) – Operation and Maintenance (Form 160.00-O2)*). If an invalid jumper configuration is read, the Logic/trigger Board initiates a cycling shutdown and LCSSS - INVALID CURRENT SCALE SELECTION is displayed on the System Details line of the OptiView™ Control Center Display. The model designation is transmitted to the microboard for display on the MOTOR Screen. This designation determines the allowable range for the Full Load Amps (FLA) setpoint and Start Current setpoint. There are 4 LCSSS models: 7L, 14L, 26L and 33L. Each model has an allowable Full Load Amps (FLA) range and Start Current range as listed later in this section.

Communications between the microboard and Logic/Trigger Board are in the form of master/slave. The microboard is the master and the Logic/Trigger Board is the slave. The Logic/Trigger Board sends two types of data to the microboard, Status data and Fault data.

After successful initialization, the microboard sends a data request every 2 seconds. Normally, the Logic/Trigger Board responds to each request. However, if the microboard does not receive a response to 10 consecutive requests, the microboard initiates a cycling shutdown and displays LCSSS - SERIAL COMMUNICATIONS on the System Details line of the OptiView™ Control Center display. In addition, the Logic/Trigger Board will

initiate the same cycling shutdown if it does not receive a data request from the microboard after 10 successive attempts to send data.

Microboard 031-03630-001 COM 2 (J13) serial port communicates with the LCSSS Logic/Trigger Board 031-02505 (J14) using RS-485 Modbus protocol (Refer to *Figure 32 on Page 76*). The Motor Node ID setpoint must be set to "1" to match the Modbus Address assigned to the starter. The Modbus Address is set to "1" in the starter by placing Logic/Trigger Board switch SW1 position 1 to ON. If the Motor Node ID does not match the Modbus Address assigned to the Logic/Trigger Board, the Logic/Trigger Board will not communicate with the microboard.

Anytime the Logic/Trigger Board initiates a Cycling or Safety shutdown, it opens its STOP contacts that are connected in series with the OptiView™ Control Center's 1R (K18) RUN relay coil. The contacts remain open as long as the condition exists. The open STOP contacts interrupt the circuit to 1R causing it to de-energize, removing the run signal to the LCSSS. Simultaneously, the microboard reads the opening of the LCSSS STOP contacts via the I/O Board J2- 1. This signals the microboard that the LCSSS has initiated a shutdown. The Logic/Trigger Board sends the cause of the shutdown in response to the next data request. This is logged on the HISTORY Screen as the LAST FAULT WHILE RUNNING. A snapshot of the LCSSS operating parameters valid at the instant of the fault are also sent. Any additional faults that occur within the 2 second transmission time are also sent and logged on the HISTORY Screen under LAST TEN FAULTS. Refer to Operation Manual (Form 160.54-O1) for description of all Cycling and Safety shutdown messages.

While this data is being sent, LCSSS - SHUTDOWN - REQUESTING FAULT DATA is displayed on the System Details line of the OptiView™ Control Center display. If fault data is not returned within 2 seconds, the microboard will continue to send a request at 2 second intervals until the fault data is returned. If none is returned within 10 consecutive requests, it assumes it is not forthcoming and it displays LCSSS - STOP CONTACTS OPEN on the System Details line of the display.

The chiller can be started if there are no Safety and Cycling conditions. If the temperature of any of the SCR modules are greater than 110°F, the LCSSS cooling pump will run and the chiller will be inhibited from starting until the temperature has decreased below 109°F. While this Start Inhibit is in effect, LCSSS - HIGH TEMPERATURE PHASE X - STOPPED

(where X is phase A, B, or C) is displayed on the System Details line of the display. When the chiller is started, the OptiView™ Control Center sends two start signals simultaneously to the Logic/Trigger Board. One is transmitted via the serial communications link. The other is the closure of 1R (K18) Start relay, applying 115VAC to Logic/Trigger Board TB1-24. If these two signals are not received within 5 seconds of one another, the Logic/Trigger Board initiates a cycling shutdown and LCSSS - RUN SIGNAL is displayed on the System Details line of the display.

The Logic/Trigger Board transmits the following parameters over the serial communications link for display on the MOTOR Screen:

- Three phase motor current
- Three phase line-to-line motor supply voltage
- Input Power (KW)
- Three phase SCR module temperature
- Starter model designation

The following are the programmable setpoints associated with the LCSSS. They are programmed on the MOTOR Screen. Refer to programming instructions in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual.

- **Full Load Amps** - This is the maximum allowed motor current at which this chiller is permitted to operate to achieve maximum design capacity. It is the Full Load Amps (FLA) of the chiller, as listed on the SALES ORDER Screen. Each starter model has a permissible range over which this setpoint can be programmed as follows:

LCSSS MODEL	PERMISSIBLE FLA
7L-46, 58 and 50	35 to 260 Amps
14L-17, 28, 46, 58 and 50	65 to 510 Amps
26L-17, 28, 46, 58 and 50	125 to 850 Amps
33L-17, 28, 46 and 50	215 to 1050 Amps

- **Starting Current** - The Logic/Trigger Board will limit inrush motor current to this value during starting. The programmed value is sent to the Logic/Trigger Board over the serial communications link. This setpoint should be programmed to (0.45 x motor Delta Locked Rotor Amps) as listed on the SALES ORDER Screen. Each model starter has a permissible range over which this setpoint can be programmed as follows:

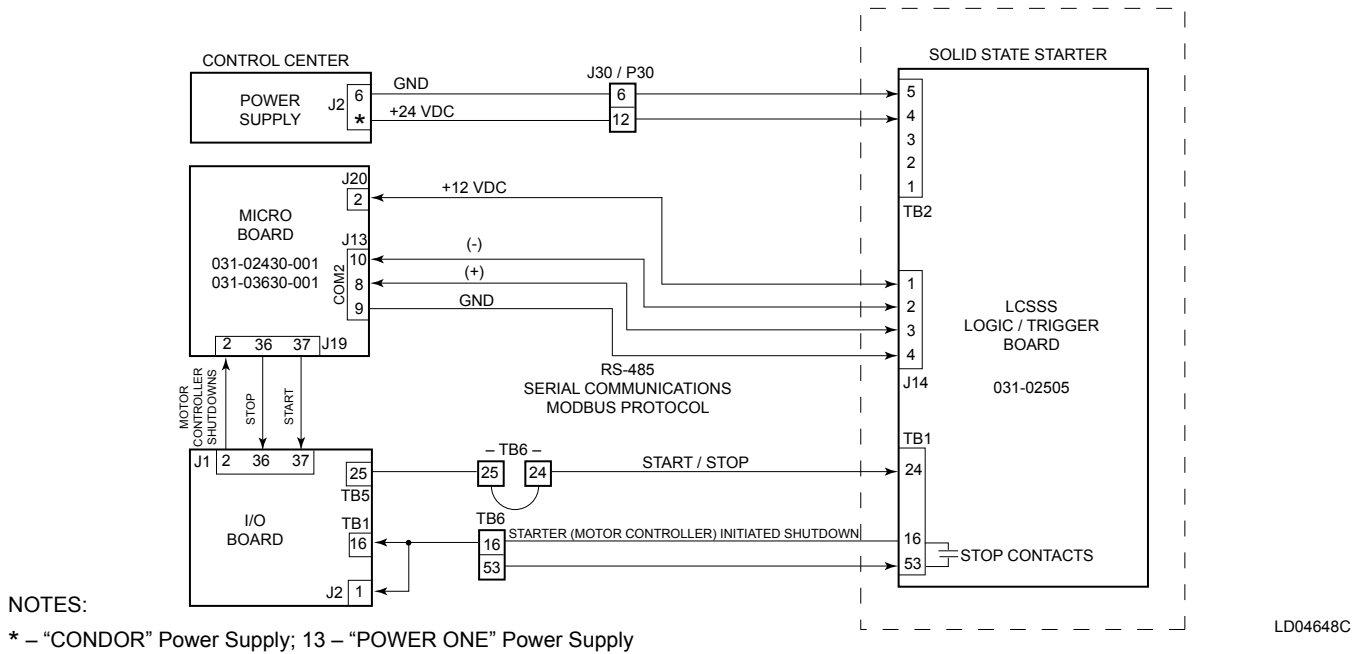
LCSSS MODEL	PERMISSIBLE START CURRENT RANGE
7L-46, 58 and 50	310 to 700 Amps
14L- 17, 28, 46, 58 and 50	620 to 1400 Amps
26L- 17, 28, 46, 58 and 50	1150 to 2600 Amps
33L-17, 28, 46 and 50	1460 to 3300 Amps

- **Supply Line Voltage Range** - This setpoint is the line voltage application and establishes the high and low line voltage shutdown thresholds. Shutdown and restart thresholds are contained in *Operation Manual* (Form 160.76-O2) under the messages LCSSS - LOW SUPPLY LINE VOLTAGE and LCSSS - HIGH SUPPLY LINE VOLTAGE.
- **Open SCR Enable/Disable** - This enables or disables the Open SCR detection Safety protection performed by the Logic/Trigger Board. This protection must **never** be disabled unless advised by the YORK factory.
- **Kilowatt Hours (KWH) Reset** - This allows the accumulated KWH to be set to a desired starting value in the event the BRAM has to be field replaced. This must **never** be arbitrarily performed.

To assure the chiller is not permitted to run for extended periods with the supply line voltage outside of acceptable limits, the Logic/Trigger Board compares the actual 3-phase line voltage to the thresholds established with the Supply Line Voltage Range setpoint. Each supply voltage application has an allowable upper and lower limit. If the supply voltage goes above

or below these limits continuously for 20 seconds, the Logic/Trigger Board initiates a cycling shutdown and displays LCSSS - HIGH SUPPLY LINE VOLTAGE or LCSSS - LOW SUPPLY LINE VOLTAGE as appropriate. The chiller will automatically restart when the line voltage is within the acceptable range.

While the chiller is running, the microboard will close or inhibit opening of the Pre-rotation Vanes (PRV), as required, to limit the compressor motor current to the Current Limit or Pulldown Demand Limit setpoint (30% to 100% FLA) that is in effect. The microboard calculates the “% Full Load Amps” (FLA) by dividing the highest phase of the 3-phase motor current, received from the Logic/Trigger Board, by the value programmed for the Full Load Amps setpoint. The message % FULL LOAD AMPS is displayed on the MOTOR Screen. If the motor current increases to the extent that the % FULL LOAD AMPS reaches 100% of the Current Limit setpoint, the Pre-rotation Vanes (PRV) are inhibited from further opening until the motor current decreases to less than or equal to 98% of the Current Limit setpoint. If the motor current increases to the extent that the % FULL LOAD AMPS is 104% of the Current Limit setpoint, the PRV will be driven closed until the % FULL LOAD AMPS decreases to 102% of the Current Limit setpoint. The PRV opening will then be inhibited until the % FULL LOAD AMPS decreases to less than or equal to 98% of the Current Limit setpoint.

**FIGURE 32 - STYLE B LIQUID COOLED SOLID STATE STARTER (LCSSS) – INTERFACE (MODBUS PROTOCOL)****FIGURE 33 - SOLID STATE STARTER LOGIC BOARD**

This board provides Overload, Power Fault, Fault Current, Phase Rotation/Loss, and Half Phase Protection for the Compressor Motor. It also receives SCR High Temp and Trigger Out Of Lock (OOL) shutdown signals from the Starter Trigger Board. Finally, it provides analog voltages representing Compressor Motor Current, Power Line Voltage, Current Limit commands and a Starter Model code to the microboard.

The contacts of Logic Board relay K1 (identified as CM contacts on the OptiView™ Control Center wiring diagram) are interfaced into the Motor Controller initiated shutdown circuit that is located between OptiView™ Control Center TB6-53 and I/O Board TB1-16 (Refer to *Figure 18 on Page 51* and *Figure 30 on Page 71*). They are also connected as a Digital Input to I/O Board J2-1. Relay K1 is normally energized, maintaining its contacts in a closed position. Whenever the Logic Board initiates a chiller shutdown, it de-energizes K1, opening its contacts. This interrupts the circuit to I/O Board RUN relay coil 1R (K18), de-energizing it and causing the Starter to de-energize. Simultaneously, the microboard reads the opening of these contacts via I/O Board J2-1, initiates a System Coastdown and displays the appropriate message as described below.

When the Logic Board detects an Overload condition, relay K1 contacts open and the Overload LED illuminates. MOTOR CONTROLLER – CONTACTS OPEN is displayed. The contacts remain open and the LED remains illuminated until manually reset with the Logic Board's S1 RESET switch. After S1 is pressed, the chiller can be restarted.

When a Power Fault, Fault Current or Half Phase condition is detected, relay K1 contacts open for 1 second and then close. The Power Fault LED illuminates and will remain illuminated until manually reset with the S1 RESET switch. POWER FAULT is displayed. At the completion of System Coastdown, the chiller will automatically restart.

When a Power Line Phase Rotation/Loss or Trigger Board Out of Lock (OOL) condition is detected, relay K1 contacts open and remain open for as long as the condition exists. If the contacts remain open for more than 3 seconds, MOTOR CONTROLLER – CONTACTS OPEN is displayed; if less than 3 seconds, POWER FAULT is displayed. The respective Phase Rotation/Loss or Trigger Board Out of Lock (OOL) LED illuminates and remains illuminated until manually reset with the S1 RESET switch. The chiller will automatically restart when the contacts close.

The Starter Trigger Board monitors the Starter's Silicon Controlled Rectifier (SCR) Heat sink temperature. Whenever the heat sink temperature increases to 212°F, the Trigger Board signals the Logic Board. MOTOR CONTROLLER – CONTACTS OPEN is displayed. The Logic Board illuminates the High Temp LED and opens relay K1 contacts. The LED remains illuminated and the contacts remain open until the temperature decreases to less than 110°F and manually reset with the Logic Board's S1 RESET switch. After S1 is pressed, the chiller can be restarted. In routine operation, each time the chiller is shutdown for any reason, it is prevented from restarting until the heat sink temperature decreases to less than 110°F. While it is waiting for the temperature to decrease to this threshold, the HIGH TEMP LED is illuminated, relay K1 contacts are open, and MOTOR CONTROLLER – CONTACTS OPEN is displayed. When the temperature is below 110°F, K1 contacts will open, the LED is extinguished, MOTOR CONTROLLER – CONTACTS OPEN message is cleared and the chiller will automatically restart.

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SECTION 11 - ADAPTIVE CAPACITY CONTROL BOARD

The optional YORK Variable Speed Drive (refer to *Variable Speed Drive – Service Instructions (Form 160.00-M1)*), uses an Adaptive Capacity Control (ACC) function to control the speed of the compressor motor at the optimum speed avoiding conditions that caused a surge in the past.

The 031-03630-001 Microboard COM2 (J13) serial port communicates with the VSD Logic Board 031-02506-xxx using RS-485 Modbus protocol (Refer to Figure 56 on Page 128). COM 2 is fixed at RS-485 on the 03630 and requires no jumper settings. When using Modbus protocol, the ACC functionality is contained in the 031-03630-001 Microboard.

The VSD Logic Board Modbus Address Switch SW3. Must be set to “1”.

With the Medium Voltage VSD (MV VSD), the ACC functionality also resides in the 031-03630-001 Microboard. The COM2 serial port of this board communicates with the MV VSD using Modbus protocol. Refer to *Medium Voltage Variable Speed Drive – Service (Form 160.00-M6)* for details of the MV VSD.

The VSD consists of a Power Electronics Section, Logic Board and an optional Harmonic Filter with Harmonic Filter Logic Board, all mounted in a cabinet that is either mounted to the compressor motor or floor standing (retrofit applications). The ACC Board is mounted inside the OptiView™ Control Center. In operation, the VSD Logic Board:

- A. Controls the VSD power electronics to drive the compressor motor at the speed designated by the ACC Board.
- B. Monitors power electronics parameters and initiates chiller shutdowns when safety thresholds are exceeded.
- C. Transmits the parameters to the ACC Board for transfer to the microboard for display.

The optional Harmonic Filter reduces the power line harmonics produced by the VSD. The Harmonic Filter Logic Board:

- A. Controls the filter.
- B. Monitors filter parameters and initiates chiller shutdowns when safety thresholds are exceeded.
- C. Transmits these parameters to the ACC Board for transfer to the microboard for display.

Complete operation and service details of the VSD and ACC Board is contained in *Variable Speed Drive – Service Instructions (Form 160.00-M1)* and *Medium Voltage Variable Speed Drive – Service (Form 160.00-M6)*.

The microboard communicates with the VSD Logic Board and the optional Harmonic Filter Logic Board via a 0 to +5VDC 1200 baud serial communications. The communications is in master/slave form. The VSD Logic Board and Harmonic Filter Logic Boards act as slaves to the microboard. The microboard initiates all communications by sending a command to the VSD Logic Board. The VSD Logic Board responds to the command by returning the requested data to the microboard and passes the command to the Harmonic Filter Logic Board. The Harmonic Filter Logic Board returns the requested data to the microboard.

There are three different commands issued from the microboard:

- Test and Initialize
- Fault Data Request
- Status Data Request

When power is first applied to the OptiView™ Control Center, the microboard establishes serial communications with the VSD Logic and Harmonic Filter Logic Boards. To establish communications, it sends a Test and Initialize command to the VSD Logic Board. The VSD Logic Board relays the command to the Harmonic Filter Logic Board. If the VSD Logic and Harmonic Filter Boards respond appropriately to the microboard communications are established. If any of these boards fail to respond to the first command, the microboard sends the command again 4 seconds later. It will continue to send this command at 4 second intervals until a response is received. If, after 10 attempts, no response is received, a cycling shutdown is performed and VSD –INITIALIZATION FAULT is displayed. The microboard will continue to attempt to establish communications until successful. Anytime communications have been established and then lost, the microboard will repeat this process to re-establish communications.

After communications have been established, the microboard sends a Fault Data Request command. If there have been any faults detected by the VSD Logic or Harmonic Filter Boards since communications were lost, they are returned to the microboard at this time. If there is no response within 2 seconds, this command is

sent at 2 second intervals until a response is received. If no response is received in 10 attempts, a cycling shutdown is performed and VSD – SERIAL COMMUNICATIONS is displayed.

The microboard then begins normal communications with the VSD Logic and Harmonic Filter Boards. During normal communications, commands and data are exchanged every 2 seconds on the serial communications link. The microboard sends a Status Data Request command every 2 seconds to the VSD Logic Board and Harmonic Filter Logic Boards as described above. It expects to receive the data listed below in response to each of these commands. If a response is not received to 10 consecutive commands, a cycling shutdown is performed and VSD – SERIAL COMMUNICATIONS is displayed. The VSD Logic and Harmonic Filter Boards send the data listed below to the microboard in one response. This continues until the VSD Logic or Harmonic Filter Boards detect a fault condition.

As stated above, if communications are lost with the VSD Logic Board, a cycling shutdown is performed and VSD – SERIAL COMMUNICATIONS is displayed. However, if communications are lost with the Harmonic Filter Logic Board, no shutdown is performed, only WARNING – HARMONIC FILTER – DATA LOSS is displayed.

When a VSD fault condition is detected, the VSD Logic Board opens its VSD Stop Contacts that are connected in series with the OptiView™ Control Center's 1R (K18) RUN RELAY coil. This interrupts the circuit to 1R causing it to de-energize, removing the run signal to the VSD. Simultaneously, the microboard reads the opening of the VSD Stop Contacts via its interface to the OptiView™ Control Center's I/O Board input J2-1. This notifies the microboard that a VSD shutdown has occurred. The microboard requests the cause of the shutdown by sending a Fault Data Request command. While this request is being processed, the microboard displays VSD SHUTDOWN – REQUESTING FAULT DATA. When the cause of the shutdown is received, the microboard displays a message describing the shutdown (Refer to OptiView™ Control Panel – Operation (Form 160.76-O2) for complete listing of messages) and begins sending normal Status Data Request commands. If the fault data is not returned to the microboard within 2 seconds, it sends the command every 2 seconds until fault data is returned. If none is returned within 10 requests, it assumes it is not forthcoming and displays VSD – STOP CONTACTS OPEN.

The following VSD status data is transmitted from the VSD Logic Board to the microboard for display:

- Output Frequency
- Output Voltage
- Output Current - three phase
- Input Power KW
- KWH
- 100% Job FLA
- DC Link Voltage
- DC Link Current
- Internal Ambient Temperature
- Inverter Heat sink Temperature – phase A, B, and C
- Converter Heat sink Temperature
- Pre-charge Relay energized/de-energized
- SCR Gate Drivers enabled/disabled
- Water (cooling) Pump ON/OFF
- VSD running/stopped
- VSD Software Version
- Motor HP

The following Harmonic Filter status data is transmitted from the Harmonic Filter Logic Board to the microboard for display:

- Input KVA
- Total Power Factor
- Filter DC Link Voltage
- Input Voltage- phase A, B and C
- Input Voltage THD – phase A, B and C
- Input Peak Voltage – phase A, B and C
- Input Current – phase A, B and C
- Input Current TDD – phase A, B and C
- Filter Current – phase A, B and C
- Filter Heat sink Temperature
- Filter Operation- running/stopped
- Filter Pre-charge Relay – energized/de-energized
- Filter Supply Relay - energized/de-energized
- Input Phase Rotation – ABC/CBA
- Harmonic Filter – present/not present

The following status data is displayed from the microboard for display.

- Delta P/P (head pressure)
- Pre-rotation Vanes position
- Surge count

The compressor motor speed can be controlled either manually in Manual Mode or automatically in Auto Mode.

In Manual Speed Control Mode, the speed can be controlled from the VSD TUNING Screen using Keypad keys. The speed can be set to a pre-selected frequency over the range of 10 to 60 (50)Hz, using the SET key. Or, it can be increased or decreased over the range of 0.0 to 60 (50)Hz in increments of 0.1 to 10Hz using the RAISE/LOWER keys. Or, it can be set to full speed using the FIXED key.

Instructions for manual control are included in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. This is displayed as COMMAND FREQUENCY on the VSD TUNING Screen. Via Serial communications, the speed command is sent from the microboard to the VSD Logic Board. The VSD Logic Board controls the VSD to operate the motor at this frequency. While Manual control is selected, MAPPING INHIBITED LED is illuminated, indicating that surges will not be mapped in the Surge Map. Anytime this LED is illuminated, surges are not mapped, as explained below. In making the transition from Manual to Auto Mode, if the speed was manually set to less than 30Hz, it will automatically be set to 30Hz and automatically adjusted from this value. If not in Current Limit and the actual speed is less than 60 (50)Hz, and 60 (50)Hz is selected, the speed will be increased as follows. If the Leaving Chilled Liquid Temperature is within 0.2°F, the PRV will simultaneously be driven closed per the following:

Speed Increase

- 0.2Hz every second if Leaving Chilled Liquid Temperature greater than 0.2°F below the setpoint and motor current is less than 80%FLA.
- 0.2Hz every 1 + (% FLA-80) second if Leaving Chilled Liquid Temperature is greater than 0.2°F below the setpoint and the motor current is greater than 80% but less than 98%FLA.
- 0.2Hz every 19 seconds if none of the above conditions are present.

PRV Close

A close signal of the following durations is applied every 4.5 seconds:

- 3.9 seconds if PRV position greater than 50%.
- 3.0 seconds if PRV position greater than 25% but less than 50%.
- 1.5 seconds if PRV position less than 25%.

In Auto Speed Control Mode, the ACC logic controls the speed. It determines the optimum compressor motor speed (frequency) over the range of 30 to 60 (50)Hz and sends this value to the VSD Logic Board via the serial communications link. The VSD logic Board controls the VSD to operate the motor at this frequency. The optimum speed is the slowest speed possible that will avoid compressor surge conditions but still allow the chiller to meet capacity requirements. This speed is found in an adaptive sense as explained below.

In determining the optimum motor speed, the ACC logic employs the following:

- **Delta P/P** – This is the chiller Head pressure. It is calculated as (Condenser Pressure minus Evaporator Pressure) divided by Evaporator Pressure. It ranges from 0.00 to 3.60. The ACC Board calculates this value from Evaporator and Condenser Pressure Values.
- **Pre-rotation Vanes (PRV) position** – The Pre-rotation Vanes position, as used by the VSD control, is provided by a potentiometer mounted to the PRV control arm and. connected to the microboard.

The PRV position (0 to 100%) is displayed on the OptiView™ display as 0% when fully closed, 100 % when fully open and whole percentage points in between.

The potentiometer must be calibrated by a qualified Service technician using a procedure in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. No speed reduction is permitted if this calibration has not been performed.

- **Motor Speed** – This is the actual drive frequency of 30 to 60 (50)Hz.
- **Surge Map** – This contains the Delta P/P, PRV position and motor speed that existed at the instant of each previously encountered surge condition. These parameters are stored as a 3-dimensional ar-

ray for each surge. The surge map is stored in the memory. The following procedures are detailed in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. The entire Surge Map can be printed by pressing the Surge Map Print keypad key. Surge Map Points can be automatically printed to an external printer as they are plotted. The Surge Map can be cleared.



The Surge Map must never be cleared unless advised by the YORK factory.

The following conditions must be met before speed reduction is permitted:

- The PRV calibration procedure must have been performed.
- Auto Speed Control Mode must be selected at the keypad.
- Current Limit must not be in effect. When current limit is in effect, LED is illuminated.
- The Chiller must have been running for greater than 2 minutes.
- The Leaving Chilled Liquid Temperature must be within $+0.3^{\circ}\text{F}$ and -0.6°F of the Leaving Chilled Liquid setpoint. The Leaving Chilled Liquid Temperature must be stable. Lowering the speed while this temperature is unstable, would tend to increase the instability. The microboard calculates the stability by comparing the Leaving Chilled Liquid Temperature to the Leaving Chilled Liquid Temperature setpoint to arrive at a rate of change value.

When the chiller is started, the speed is brought to 60Hz. After it has been running for greater than 2 minutes and the Leaving Chilled Liquid Temperature is within $+0.3$ and -0.6°F of the Leaving Chilled Liquid Temperature setpoint, the ACC logic evaluates if the speed can be reduced. If there are no conditions above that would inhibit speed reduction, the ACC logic compares the real-time Delta P/P, PRV Position and Motor Speed to the 3-dimensional arrays stored in the Surge Map. If the real-time array does not match any previous surge condition, the speed will be decreased 0.1Hz every 6 seconds until it is within 1Hz of previously plotted surge condition array in the Surge Map. It will then be decreased 0.1Hz every 9 seconds until it's to the lowest value allowed by

the Surge Map. If no plotted points are encountered, the speed is lowered until a surge is encountered or a minimum of 30Hz is reached.

The ACC logic uses two different methods of **Surge Detection**; Delta P method and DC Link method. Surge detection is only enabled while the chiller is running. In detecting a surge using the Delta P method, the outputs of the Evaporator and Condenser Pressure transducers are monitored to detect when the difference between these pressures (Delta P) drops transiently toward Zero. This would be indicative of a surge. A Surge Detected by the Delta P method must have all of the following conditions occur within 5 seconds to be considered a valid surge:

- Delta P must make a negative transition and exceed 3.4 PSIG for 100 milliseconds.
- Delta P must also exceed 3.5 PSIG for at least 340 milliseconds.
- Delta P must make at least 2 positive transitions.

When this criteria is met, ACC Surge Detected LED illuminates for 2 seconds, indicating a valid surge has been detected. In detecting a surge using the DC Link method, the VSD's DC Link Current is monitored to detect when the current drops transiently toward zero. This, as the case with Delta P method, is indicative of a surge. A Surge Detected by this method must also meet the following requirements to be considered a valid surge:

- At least 6 DC Link surges must occur within 2 minutes, and
- At least 3 Delta P surges have occurred within the 2 minute interval.

When both these criteria have been met, the ACC Surge LED illuminates for 2 seconds, indicating a valid surge has been detected. The value displayed as ACC SURGE COUNT on the ACC DETAILS Screen. Each time the ACC Board detects a surge, the ACC logic increments the count, whether running at maximum or less than maximum frequency.

Each time a Valid Surge is detected, the ACC Board increases the motor speed (up to a maximum of 60 (50) HZ) to take the compressor out of surge. It also evaluates other chiller conditions to determine if the surge should be plotted on the Surge Map. Surges that occur during certain operating conditions are not plotted, as explained below. Whenever Valid Point LED CR8 is illuminated, surges are not plotted.

After each surge, the speed is increased either 1.0Hz or 0.8Hz, depending on operating conditions, in the following increments:

- 0.1Hz every 2 seconds if motor current less than 80%FLA.
- 0.1Hz every 2 seconds + (%FLA-80) if motor current greater than 80% FLA but less than 98%FLA.
- 0.1Hz every 20 seconds if motor current greater than 98% FLA.

If Current Limit is in effect, or the Stability Timer is running when a surge occurs, the speed is increased 1.0Hz but the surge is not plotted on the Surge Map since these conditions would produce an erroneous value. ACC surge detected LED is illuminated as a visual indication that one or both of these conditions are in effect.

Otherwise, the speed is increased 0.8Hz and the surge event is plotted on the Surge Map. The Surge Margin Adjust setpoint can be used to add an extra margin of surge prevention. It is programmed over the range of 0.0 to 25.0Hz following instructions in *SECTION 31 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. The Default value of 0 should provide proper operation in most applications.

When the speed has been increased either 1.0Hz or 0.8Hz, as described above, this speed is maintained for the next 15 seconds. During this period, new surges are ignored. When the 15 seconds have elapsed, a 5 minute time period is entered where the speed is inhibited from decreasing, but increases are allowed. If a surge is detected within this 5 minute period, it is not plotted on the Surge Map, but the speed is increased by the amount as described above. This is repeated as long as the compressor continues to surge. The compressor must be surge free for 5 minutes before a speed decrease is permitted or another surge can be plotted on the Surge Map.

The ACC logic counts the surges as they occur and sends a total count on the ACC DETAILS Screen (note that the Total Surge Count displayed on the SURGE PROTECTION Screen and the Hot gas bypass Screen is that which is accumulated by the Surge Protection feature). The total surge count is not incremented if a different surge type occurs within 10 seconds of the previous surge. A surge that occurs within 10 seconds of the previous surge is only counted if it is of the same surge type. For example, if a Delta P surge is detected

and a DC Link surge is detected within 10 seconds, the DC Link surge is not counted. If the DC Link surge occurred greater than 10 seconds after the Delta P surge, it would be counted.

A surge point can be manually inserted into the Surge Map using the Manual Surge Point keypad key on the ACC DETAILS Screen as described in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. This is only to be used for situations in which the automatic surge detection described above does not respond to surge events. This is usually not required and is to be used only by qualified Service technicians as a method of plotting a surge event that the ACC logic does not find on its own. At the instant the condition is identified as a surge event, the ACC Surge LED illuminates for 2 seconds. The motor speed, Delta P/P and PRV Position at the instant the point is established, is unconditionally plotted as a 3-dimensional array in the Surge Map as a surge condition, regardless of whether or not Valid Point LED is illuminated. The motor speed will be automatically increased as described above. Once plotted, the ACC logic will respond to this point in exactly the same way it responds to automatically plotted surge points, as described above.

Surge points can be printed from the ACC DETAILS Screen. The entire stored Surge Map can be printed using the Surge Map Print keypad key. Also, the surge points can be printed in real-time as they occur, using the Auto Print keypad key. Since the maximum rate at which new surges can be plotted is every five minutes, the rate at which new points are printed is also every five minutes.

When the PRV's approach their 100% open position, there is very little PRV movement remaining to compensate for an increasing load condition. Therefore, in Auto Speed Control Mode, if there is no Current Limit in effect, and the PRV position reaches greater than 98%, the speed is automatically increased at a rate based on the Delta T between the Leaving Chilled Liquid Temperature and the Leaving Chilled Liquid Temperature setpoint as follows:

- 0.1Hz every 10 seconds if Delta T is greater than 0.2 and less than 0.5°F.
- 0.1Hz every 8 seconds if Delta T is greater than 0.5 and less than 0.9°F.
- 0.1Hz every 6 seconds if Delta T is greater than 0.9°F.

If Delta P/P ever increases to greater than 3.60, the speed will be slowly increased to 60Hz. If this were to occur, Delta P/P would have to decrease to less than 3.55 before a speed decrease would be allowed.

The microprocessor is the center point of the hardware architecture. It coordinates the serial data communications between the OptiView™ Control Center Microboard and the VSD Logic Board and Harmonic Filter Logic Board. This serial data is in 0 to 5VDC form. LED's YM XMT (CR7) and YM RCV (CR6) LED's illuminate during serial communications with the OptiView™ Control Center Microboard. Similarly, VS XMT (CR5) and VS RCV (CR4) LED's illuminate during serial communications with the VSD Logic Board. Serial communications with the Harmonic Filter Logic Board take place through the microprocessor via the Digital Signal Processor. This data is accompanied by a Framing pulse and a CLK signal. Although Evaporator and Condenser Pressures are transmitted to the ACC Board via the serial communications link for Delta P/P calculation, these pressures are also applied directly from the microboard to the MUX (multiplexer) for Delta P surge detection.

Also applied to the MUX, is the output of the PRV position potentiometer. Under Program control, these values are input to the microprocessor. The EPROM contains the operating program for the ACC Board. The RAM serves as the scratch pad memory. The BRAM is a battery backed memory device where the Surge Map is stored. The Watchdog circuit maintains the microprocessor in a reset state during low voltage conditions. This prevents the microprocessor from reading/writing or processing data until it and supporting circuits have sufficient supply voltage. The Watchdog also assures that the entire Program is executed and that no Program latch-ups occur. Surge LED CR9 illuminates for 2 seconds when a valid surge condition has been detected as explained above. Valid Point LED CR8 illuminates whenever there is a condition in effect that prevents a Surge from being plotted on the Surge Map. These conditions are:

- Current Limit is in effect.
- Leaving Chilled Liquid Temperature Stability Timer is running, indicating an unstable control condition.
- Speed control is in Manual Mode.

Switch SW1 is used to manually insert (plot) a surge point in the Surge Map.

Test points are provided as follows:

- TPA: +5VDC supply voltage.
- TPB: supply voltage ground.
- TPC: Watchdog power failure detected. Normally greater than +4.5VDC. Transitions to logic low (less than 3.5VDC) during low voltage conditions.
- TPD: Harmonic Filter Logic Board 0 to +5VDC 1200 baud serial data.
- TPE: Harmonic Filter Logic Board Frame pulse.

MODBUS PROTOCOL CONFIGURATION

In Modbus Protocol configuration (Microboard 031-02430-001 with software version C.OPT.01.16.307 and later), the ACC function is in the microboard and the ACC Board is not present. The microboard communicates directly with the VSD Logic Board through the Modbus serial communications (Refer to *Figure 34 on Page 87*). All the commands to the VSD and data from the VSD are via this communications link. Generally, the serial communications and data transfer and shutdown status is as described in "YORK Protocol configuration".

The ACC DETAILS Screen displays the pertinent ACC parameters as shown in *OptiView™ Control Panel – Operation (Form 160.54-01) FIGURE 35*. (Software version C.OPT.01.19.307 (and later) provides the parameters in this description). The ACC function in the microboard performs the ACC surge detection. ACC surges are detected only when the drive is running at less than maximum frequency. With software version C.OPT.01.19.307 (and later), the surge detection and reaction routine is disabled until 5 seconds after the start frequency (25Hz for 50Hz applications/30Hz for 60Hz applications) is achieved. This prevents false surge conditions from being logged or reacted to.

The VSD Start Frequency setpoint (software version C.OPT.01.21.307 and later) allows the Service technician to enter the starting frequency from which the speed ramp-up will begin. This setpoint is programmable over the following range:

- A. 60Hz units – 30Hz to 60Hz (default 45Hz)
- B. 60Hz units with Quick Restart- 30Hz to 45Hz (default 45Hz)
- C. 50Hz units – 25Hz to 50Hz (default 37.5Hz)
- D. 50Hz units with Quick Restart – 25Hz to 37.5Hz (default 37.5Hz)

The Surge Sensitivity setpoint is used to adjust the sensitivity of the ACC surge detection. It is programmable over the range of 1.5 to 2.5 (default 2.0); smaller values increase the sensitivity. Whenever an ACC surge is detected, the “ACC Surge Detected” LED momentarily illuminates and the “ACC Surge Count” increments (The “Surge Avoidance Surge Detected” LED is shown for reference only. It momentarily illuminates when the Surge Protection feature (Refer to *SECTION 21 - SURGE PROTECTION*) detects a surge. These are only those surges that occur while the drive is running at maximum frequency. This LED should not be confused with ACC detected surge events).

The ACC Mapping Enable setpoint 0.5°F to 20.0°F (default 1.0°F). 0.5°F to 4.0°F (software version C.OPT.01.22.307 and earlier) allows the Service technician to set the Delta T (Leaving Chilled Liquid Temperature minus setpoint) needed to be met to enable surge mapping and speed reduction initially on startup.

Software version C.OPT.01.19.307 (and later) has increased noise filtering on the surge detection. Valid ACC surge points are stored in the Surge Map in the microboard BRAM, as displayed on the SURGE MAP Screen (see below). “Surge Map Point Count” displays the total number of data points contained in the surge map. Based on this surge detection, the speed command is sent to the VSD Logic Board and displayed on the ACC DETAILS Screen as “Command Frequency”. The “Speed Decrease Inhibit – Surge Map Point” LED illuminates when the speed cannot be reduced due to a mapped point. The “Mapping Inhibited” LED illuminates while a point is not allowed to be mapped (not allowed to slow down as well) due to unstable leaving chilled liquid temperature, manual speed control or current limit in effect.

With software version C.OPT.01.21.307 (and later), Surge Mapping is inhibited while a Soft Shutdown is in effect. In software versions C.OPT.01.20.307 (and earlier), if 2 surges are detected during the initial ramp (ramp towards maximum frequency after reaching start frequency), the command frequency is set to the maximum frequency regardless of motor current. This can result in motor current rising sharply and forcing vanes to have to close hard and even possibly a trip on high current or overload. In software version C.OPT.01.21.307 (and later), for every 2 surges that are detected during the initial ramp, increase the command frequency (no higher than the maximum frequency) by the amount listed in the following table. After increasing the command frequency, the initial ramp surge

count is reset so it can react to another 2 surges and the initial ramp shall be continued. This logic shall be in effect during the entire initial ramp and take action as many times as necessary.

FREQUENCY COMMAND INCREASE	MOTOR CURRENT
1Hz	> 90% FLA
1.5Hz	>75% FLA
2Hz	>60% FLA
4Hz	> or = 60% FLA

The Pre-rotation Vanes Position potentiometer is connected to the microboard (Refer to *Figure 34 on Page 87*). It must be calibrated by a Service technician using the procedure in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual.

With software version C.OPT.01.19.307 (and later), to assure that frequency increases do not cause excessive motor current resulting in overload shutdowns, frequency increase limitations are imposed based upon how close the actual motor current is to the chiller full load amps. In Automatic Frequency Control Mode, anytime the microboard ACC function increases the VSD or MV VSD output frequency, the frequency increase is limited by the motor current as follows. Although the incremental frequency increases can be less than allowed, they will never be greater than allowed. These limitations also apply to the frequency ramp that occurs at chiller start while ramping from start frequency 30Hz (60Hz applications) or 25Hz (50Hz applications) to maximum frequency. These limitations are not imposed in Manual Frequency Control:

- When motor current is less than or equal to 80% FLA - No Limiting
- When motor current is more than 80% FLA and less than or equal to 98% FLA - Increase 0.1Hz every $\{2 + (\%FLA - 80)\}$ seconds
- When Motor Current more than 98% FLA - Increase 0.1Hz every 20 seconds

If heat pump duty is enabled and operating in Heating Mode, the VSD is commanded to run at maximum speed at all times. When Heat Pump Duty is set to Cooling Mode, the VSD operates.

With software version C.OPT.01.21.307 (and later) if motor current is greater than or equal to 101% FLA, the VSD speed command is decreased 0.1Hz every 3.0 seconds until the motor current is less than 101% FLA.

The Surge Map takes priority over current limiting. Thus if there is a mapped surge point in the present sector, ACC current limiting shall not be allowed to decrease the frequency below the mapped point.

In previous software versions, the initial ramp is complete when either of the following conditions occur:

- Delta T is less than ACC Mapping Enable
- VSD Speed Command equals Maximum

In this version, the initial ramp will be complete when any of the following occur:

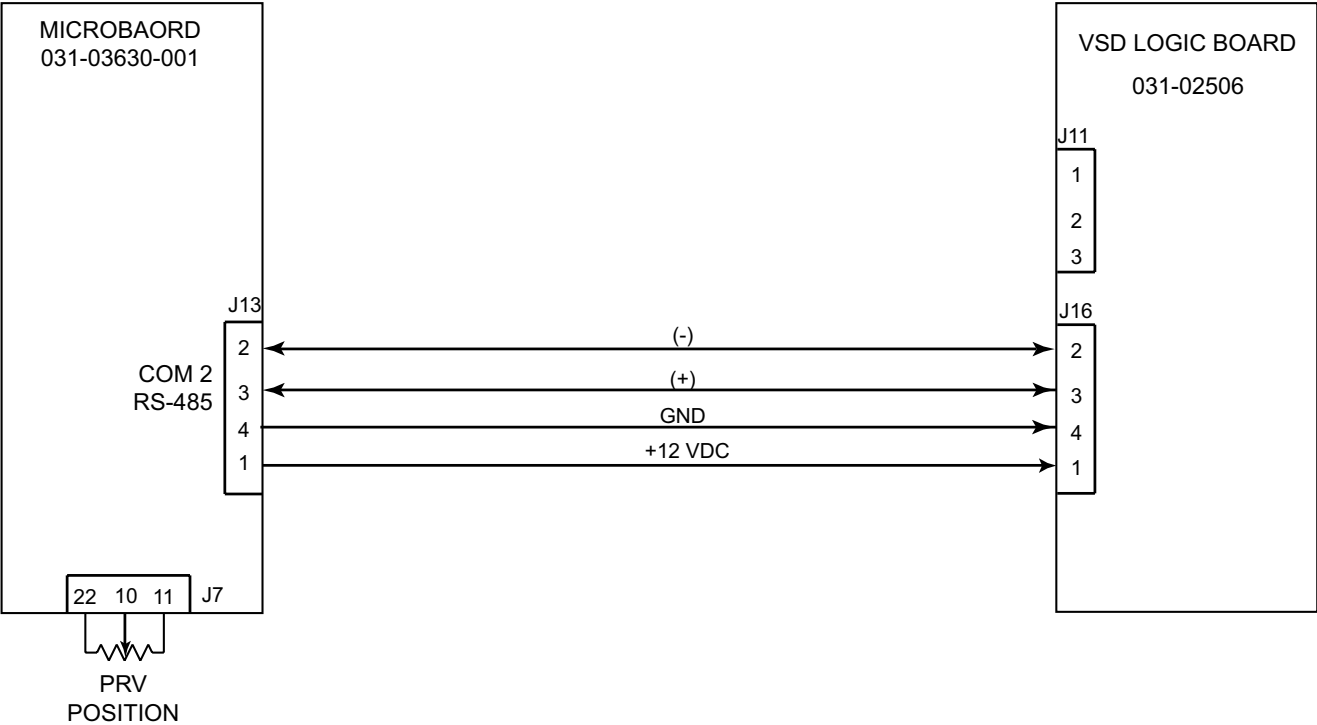
- Delta T less than ACC Mapping Enable
- VSD Speed Command equals Maximum
- Motor Current is more than or equal to 100 %FLA

When the VSD initiates a fault shutdown, it opens the VSD stop contacts on the VSD logic board, notifying the microboard as described above in YORK Protocol configuration.

The SURGE MAP screen displays the surge map in TABLE or LIST form, as shown in *OptiView™ Control Panel – Operation (Form 160.54-01), FIGURE 37 and 38*. When set to TABLE, the map is shown graphically. The X-Axis is Delta P/P and the Y-Axis is PRV position. Each VSD frequency point is represented by an X in the table. The present operating conditions are indicated with an * and are detailed at the bottom of the screen under PRESENT.

If the present condition is the same as a mapped point, the * will be replaced by an O. To view the details of any mapped point, position the green box (□) over the desired X using the arrow keys (▲▼◀▶). The VSD Output Frequency, Pre-rotation Vanes Position and Delta P/P of the selected point is displayed at the bottom of the screen under SELECTED. Surge points can be inserted manually using the MANUAL SURGE POINT key, while the chiller is running. They can be deleted manually using the REMOVE SURGE POINT key by positioning the □ over the desired X. When set to LIST, the Delta P/P, PRV Position and VSD Output Frequency of each mapped point are listed in rows. This is the same report that is generated when the surge map is sent to a printer. The PAGE UP and PAGE DOWN keys are used to scroll to the previous or next listing.

The stability limit programming button was removed from the ACC DETAILS screen in a previous software version. The stability limit default and maximum values are presently set to 7000. If a new version of software were installed in a chiller with stability limit set below 7000, the old value would be retained. The only way to clear it is to clear the BRAM. To prevent this from happening, this value is no longer programmable. It is now always set to 7000.



LD19800

FIGURE 34 - SERIAL COMMUNICATIONS INTERFACE – MODBUS PROTOCOL

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SECTION 12 - HIGH SPEED THRUST BEARING LIMIT SWITCH

Chillers that are equipped with P compressors and style "F" and later chillers with G or "H5-8" compressors have a High Speed Thrust Bearing Limit Switch (025-34535-000) instead of the Proximity probe used on older model chillers. This device detects abnormal bearing position through probe contact.

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 greater than 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 greater than 15 to 25 PSIG. One side of these contacts is connected to 115VAC. The other side connects to I/O Board TB3-81. The microboard reads the state

of these contacts through the I/O Board and when they open, a safety shutdown is performed and 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 must be performed by a qualified Service technician. The reset procedure and Bearing inspection criteria is listed in on Page 185 of this manual.

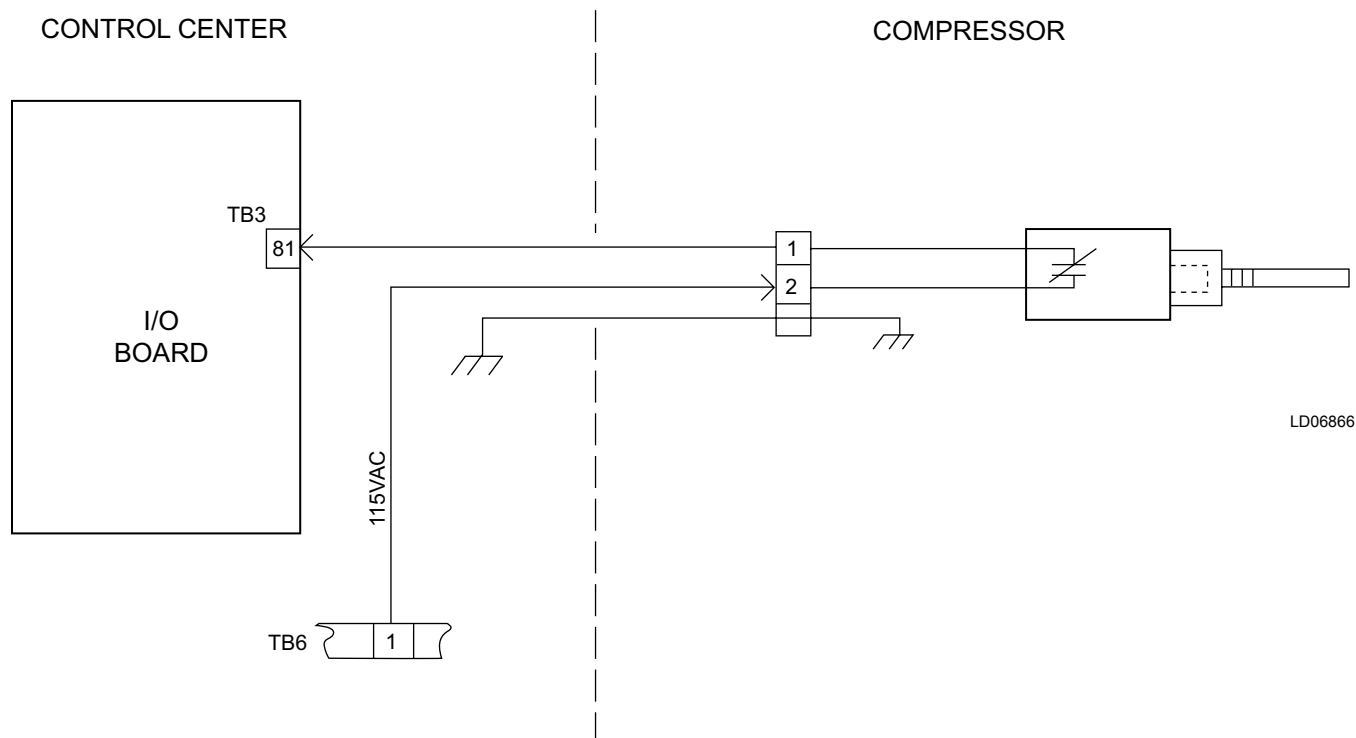
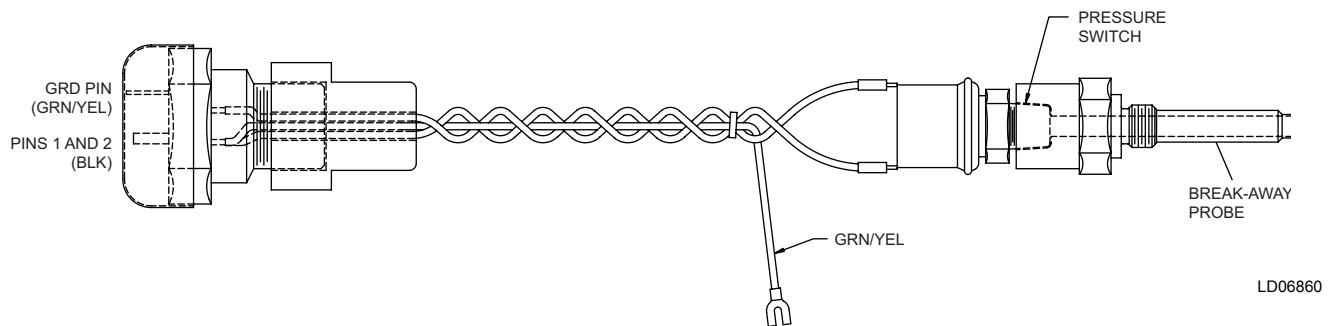


FIGURE 35 - HIGH SPEED THRUST BEARING LIMIT SWITCH – INTERFACE

**FIGURE 36 - HIGH SPEED THRUST BEARING LIMIT SWITCH**

SECTION 13 - REFRIGERANT LEVEL CONTROL

The chiller is provided with a Condenser Refrigerant Level Control. A Variable Orifice, located in the refrigerant liquid line between the Evaporator and Condenser, is used to control the refrigerant level in the Condenser. It is modulated by an Actuator that is driven by a 0-10VDC (signal) from the 03630 microboard. This signal positions the valve over the range of 0% (fully closed) to 100% (fully opened) from 0 to 10VDC, respectively. Positions between these extremes are linearly scaled (a 50% position would be achieved with a 5VDC signal). The power for the actuator is 24VAC. Automatic or Manual level control is allowed. If Automatic control is selected, the Program modulates the Variable Orifice to maintain the Condenser refrigerant to a programmable Setpoint level. If Manual control is selected, the Variable Orifice can be manually controlled with the Keypad keys. This Manual control can also be used to place the Orifice in a fixed position.

Programming of Setpoints described below, is performed on the Refrigerant Level Control/ Tuning Screen using instructions in SECTION 33 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES of this manual.

A Liquid Level Sensor (LLS) detects the Refrigerant Level in 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 and the Refrigerant Level Control Screen as the "CONDENSER REFRIGERANT LEVEL = XX.X%". 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 orifice 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 calibration procedure is in SECTION 33 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES of this manual.

The desired refrigerant level to be maintained in the condenser is the Refrigerant Level Setpoint and is displayed as "ACTIVE LEVEL SETPOINT" on the Condenser Screen and "LEVEL SETPOINT" on the Refrigerant Level Control Screen.

The operating Level Setpoint is programmed by a Service Technician at chiller commissioning using the Refrigerant Level Control Screen. It is programmable over the range of 20% to 80%.

AUTOMATIC OPERATION

While the chiller is shut down, a fixed signal is applied to the Actuator, driving the Orifice to the startup position which may be set between (50% and 100%, default 50%) on the Refrigerant Level Control Screen. With the chiller shutdown, the compressor is NOT driving any gas flow. This causes the Condenser refrigerant level to be subject to shutdown pressure difference.

At startup the Variable Orifice Valve is held in the startup position until the programmed Condenser Level Control Startup Delay Time has elapsed (0 to 120 sec, default 15 sec) or refrigerant level is greater than the Refrigerant Level Setpoint. During this period, the Level Control State displays "STARTUP HOLD" and the "STARTUP DELAY REMAINING" displays the time remaining in the countdown timer. After the timer elapses if the level is greater than or equal to the Refrigerant Level Setpoint, it begins controlling to the Setpoint.

However, if level is less than the programmed Refrigerant Level Setpoint, a linearly increasing ramp limit, is applied to the Refrigerant Level Setpoint. This ramp limit allows the level to go from the present level to the Refrigerant Level Setpoint over a period of time programmed as the Ramp Time setpoint (1 to 5 minutes; default 1). During this ramp-up period, the Active Setpoint, which is used to control the refrigerant level in the condenser is based on the ramp. While the ramp is in effect, "Ramp Time Remaining" displays the time remaining to ramp to the programmed Setpoint. After the ramp period has elapsed, the refrigerant level is controlled by the programmed Refrigerant Level Setpoint for the remainder of chiller run.

The Program applies a position signal, as required, from the Microboard to the actuator to maintain the level to the Active Level Setpoint. When the chiller is given a soft shutdown command, the Variable Orifice is given a 100% open command.

The control PID gains are applied in two different zones, as determined by the error relationship between the actual refrigerant level and the Level Setpoint as shown below. Zone 1 parameters are used when the error is less than the Zone Transition Delta (1.0%-20.0%; default 5.0%). Zone 2 parameters are used when the error is greater than the Zone Transition Delta. When transitioning from Zone 2 to Zone 1, the error must be less than the Zone transition Delta for the Zone Transition Time (1-60s; default 10 sec) before the Zone 1 parameters are used. If the error is greater than the Zone Transition Delta, the Zone 2 parameters are immediately implemented.

On the Refrigerant Level Control Screen, the Level Control State status box displays which zone of control is being used: “Zone 1”, “Zone 2”, “Inactive” (if chiller shutdown). When transitioning from Zone 2 to Zone 1, the “Transition Time Remaining” status box displays the amount of time remaining in the countdown timer, and Level Control State displays “Zone 2 to Zone 1”.

The following are the control PID ranges:

		Range	Default
Zone 1	Proportional	0.00-5.00	0.5
	Integral	0.00-5.00	1.0
	Derivative	0.00-5.00	0.00
		Range	Default
Zone 2	Proportional	0.00-5.00	0.7
	Integral	0.00-5.00	2.50
	Derivative	0.00-5.00	0.00

The orifice valve movement is animated on the Refrigerant Level Control Screen as follows:

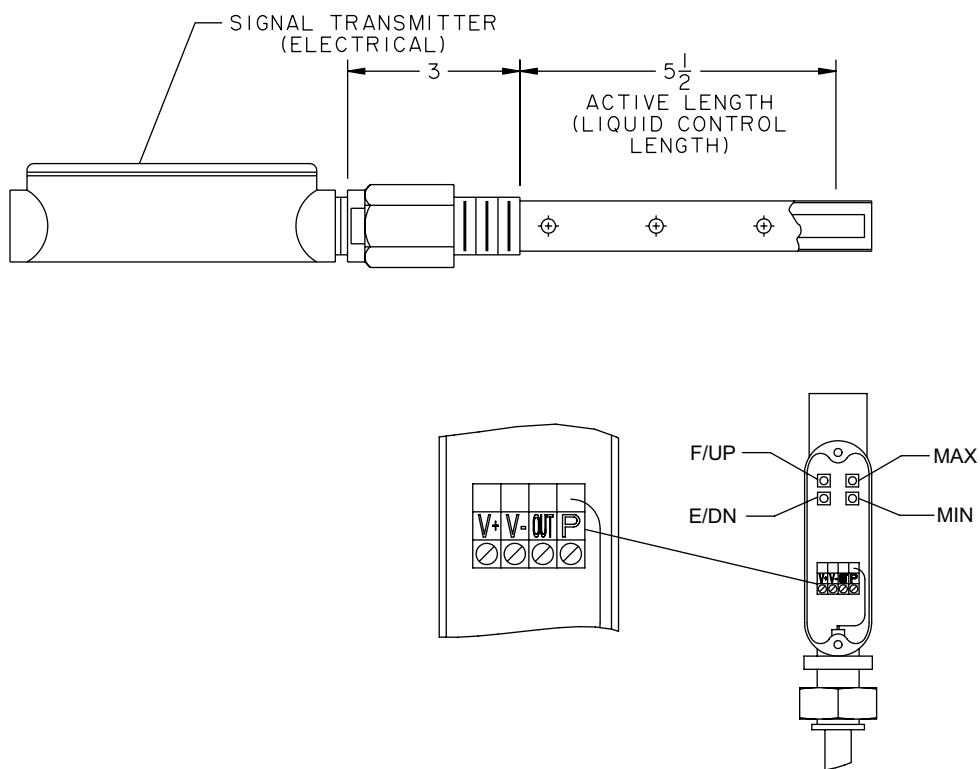
- when 0-20% open, shown fully closed
- 20 - 40% open, shown as 20% open
- 40 - 60% open, shown as 40% open
- 60 - 80% open, shown as 80% open
- 80 - 100% open, shown as 100% open.

MANUAL OPERATION

The Orifice Actuator can be manually controlled from the Keypad using the Refrigerant Level Control Screen after logging in at SERVICE access level. Open, Close, Set and Auto keys are used to control the Variable Orifice. Using the Open, Close or Set keys, the Variable Orifice can be placed in a fixed position. Pressing the Auto key returns Level Control to Automatic operation.

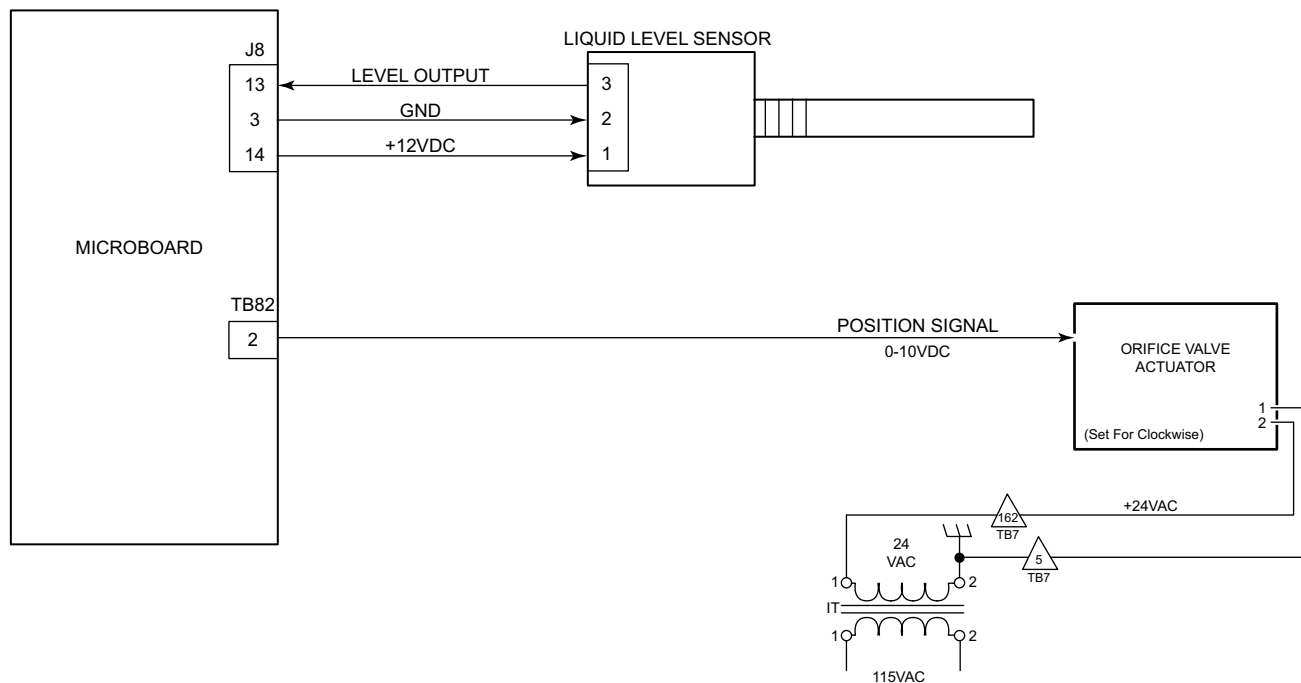
ACTUATORS

Units use an actuator that operates from 24VAC and is controlled by a 0-10VDC positioning input. 0VDC commands full closed and a 10VDC commands full open. Actuator should be set for clockwise opening. The interface for the actuator is shown in *Figure 37 on Page 93*. The description of the operation of the control signal is in SECTION 9 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001 of this manual.



LD19801

FIGURE 37 - REFRIGERANT LIQUID LEVEL SENSOR



LD19802

FIGURE 38 - REFRIGERANT LIQUID LEVEL CONTROL - INTERFACE

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SECTION 14 - OIL PUMP VARIABLE SPEED DRIVE

The oil pump is driven by a Variable Speed Drive (VSD) (Refer to *Variable Speed Oil Pump Drive (Form 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.

The VSD operation is ENABLED On the setup Screen.

The programming of the setpoints referred to below is performed on the OIL SUMP Screen using instructions in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. These setpoints should not be programmed by anyone other than a qualified Service technician. Operation Sequence Timing Diagrams in *Figure 6 on Page 24* and *Figure 7 on Page 24* depict chiller operation with the Oil Pump VSD. The microboard, under Program control, controls the Oil Heater to maintain a specific oil temperature as described in the “Oil Heater” section below.

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 System Pre-lube period and the first 15 seconds of System run, the Program operates the Oil Pump VSD over the range of 25Hz to 60Hz to maintain the oil pressure to the target value of 45 PSID. For the remainder of System run and the 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 System start is initiated, the microboard (J20-3) starts the oil pump by driving the EN (enable) input of the oil pump VSD to a Logic Low level (less than 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 45Hz.

When first starting, it is held at 45Hz for eight 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 = XXHz. The speed com-

mand to the VSD is modulated as required to maintain the 45 PSID target oil pressure for the remainder of system pre-lube and the first 15 seconds of system run. While this target is in effect, the OIL SUMP screen displays as SETPOINT OIL PRESSURE = 45 PSID. After the compressor has been running for 15 seconds, VSD speed is controlled to maintain the programmed oil pressure setpoint (20 to 45 PSID default 30 PSID), which 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 the following conditions occur, a safety shutdown is performed and OIL - VARIABLE SPEED PUMP - PRESSURE SETPOINT NOT ACHIEVED is displayed. These conditions are not checked in MANUAL operation.
 - a. If the oil pressure is less than 35 PSID for five continuous seconds during the last 10 seconds of system pre-lube or during the first 15 seconds of system run.
 - b. If the oil pressure is less than the programmed oil pressure setpoint and the speed command is at 60Hz for 5 continuous seconds, any time after the first 30 seconds of System run.
2. During automatic operation, if the oil pressure decreases to less than 15 PSID, a safety shutdown is performed and OIL - LOW DIFFERENTIAL PRESSURE is displayed. If it increases to greater than 120.0 PSID, a safety shutdown is performed and 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 (less than 1VDC) and logic high (+12VDC) level determines the VSD output frequency between 25 and 60Hz. If it remains at a logic high for the entire 0.7 second period, it is commanding the VSD output frequency to be 25Hz. If it is low for the entire 0.7 second period, it is commanding the VSD output frequency to be 60Hz.

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 60Hz, or 42.5Hz. The resolution, or smallest increment of change is 0.01 seconds. This allows the output frequency to be changed in 0.5Hz 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 less than plus or minus 6 PSID, the frequency is increased or decreased 0.5Hz to increase or decrease the oil pressure. However, if the error is greater than plus or minus 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 0.5Hz 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 initiate a chiller cycling shutdown, displaying 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 60Hz. When the chiller is not running, 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 0.5Hz increments. Each time the RAISE key is pressed, the frequency is increased 0.5Hz. Each time the LOWER key is pressed, the frequency is decreased 0.5Hz. 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 *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* 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

The Oil Heater is controlled by the microboard via the I/O Board TB1-64.

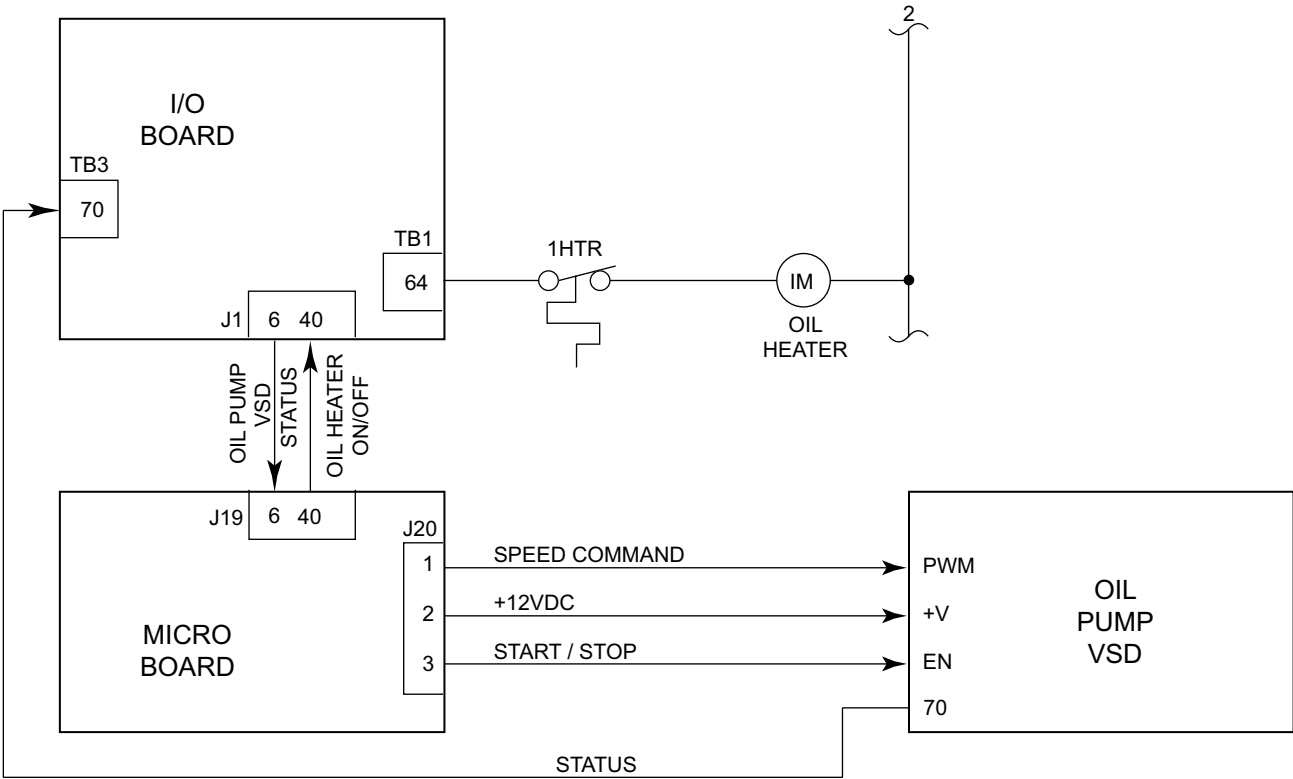
When the oil pump is not operating, the heater is turned ON and OFF to maintain a target value of 50°F above the Condenser Saturation Temperature. If the calculated target value is greater than 160°F, the target value defaults to 160°F. If the calculated target value is less than 110°F, it defaults to 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 1HTR opens at 180°F.



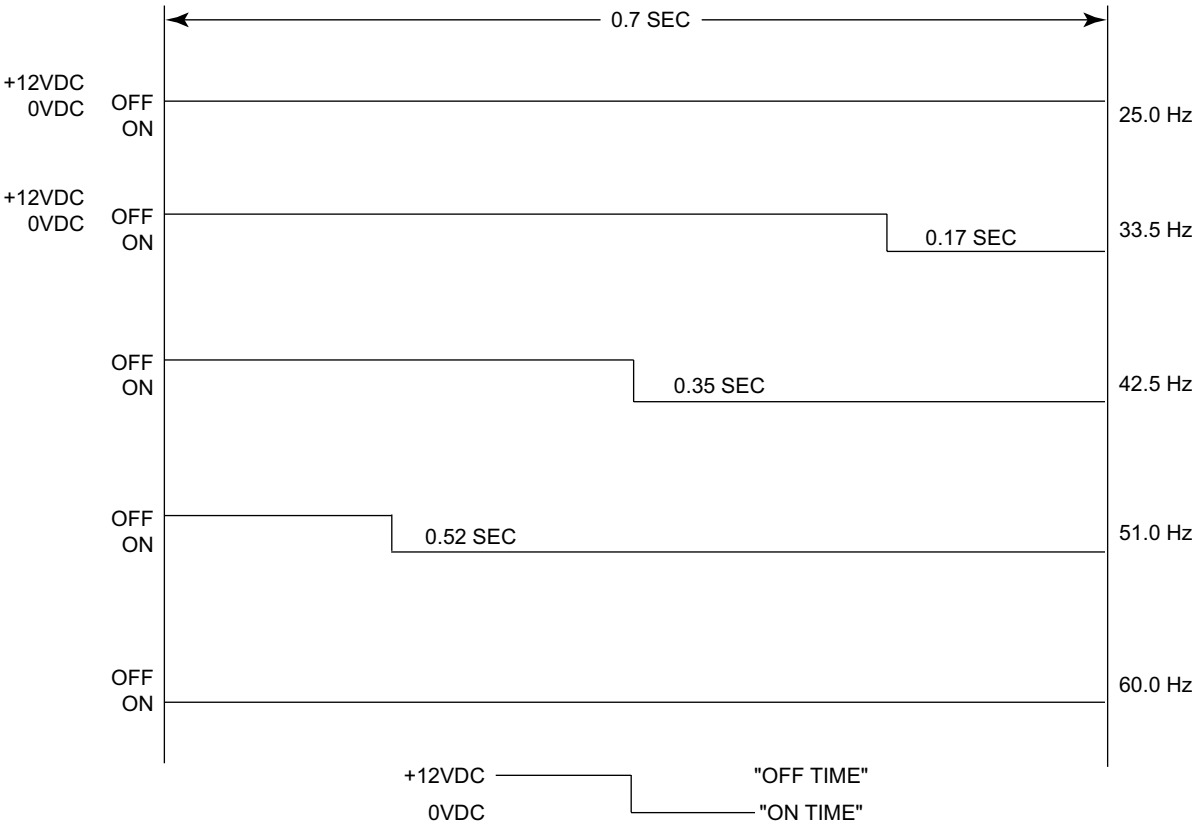
LD19837

FIGURE 39 - VARIABLE SPEED OIL PUMP CONTROL



LD19803

FIGURE 40 - OIL PUMP VSD / OIL HEATER CONTROL – INTERFACE



LD04094

FIGURE 41 - OIL PUMP VSD SPEED CONTROL SIGNAL

SECTION 15 - COMMUNICATIONS

The complete description of the SC-Equip Gateway Installation Instructions are available in form 450.50-N1. This form can be obtained from the Johnson Controls Portal under Equipment Communications and Integration in the Documents Library or ordered from Baltimore Parts Center.

The SC-Equip Gateway is an optional printed circuit board that provides an interface between the OptiView™ Control Center and the BAS 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 E-Link Gateway is powered by +12VDC from the microboard.

The SC-Equip Gateway communicates with the microboard COM 4B communications port via an RS-232 interface.

If the remote device that is connected to the SC-Equip Gateway is going to provide remote Start/Stop signals, Remote Leaving Chilled Liquid Temperature and/

or Remote Current Limit Setpoint Resets, the Control Source must be set to ISN on the OPERATIONS Screen. Communications of the chiller parameters will take place in any Control Source Mode.

In operation, the microboard provides chiller pressures, temperatures and status to the SC-Equip Gateway in response to requests from the SC-Equip Gateway. Microboard status LED's illuminate when the microboard transmits and receives data on COM 4B. Green LED CR39 (RX4) illuminates when data is being received from the SC-Equip Gateway. Red LED CR36 (TX4) illuminates when data is being transmitted to the SC-Equip Gateway. The EQ BUS LED in the SC-Equip Gateway annunciates good data transfer to/from the microboard.

If there is a communications problem between the microboard and E-Link Gateway, use the LED's described above to analyze the problem. The COM 4B Loop-back test can be used to verify operation of the microboard COM 4B communications port. Refer to *SECTION 29 - DIAGNOSTICS AND TROUBLE-SHOOTING* of this manual.

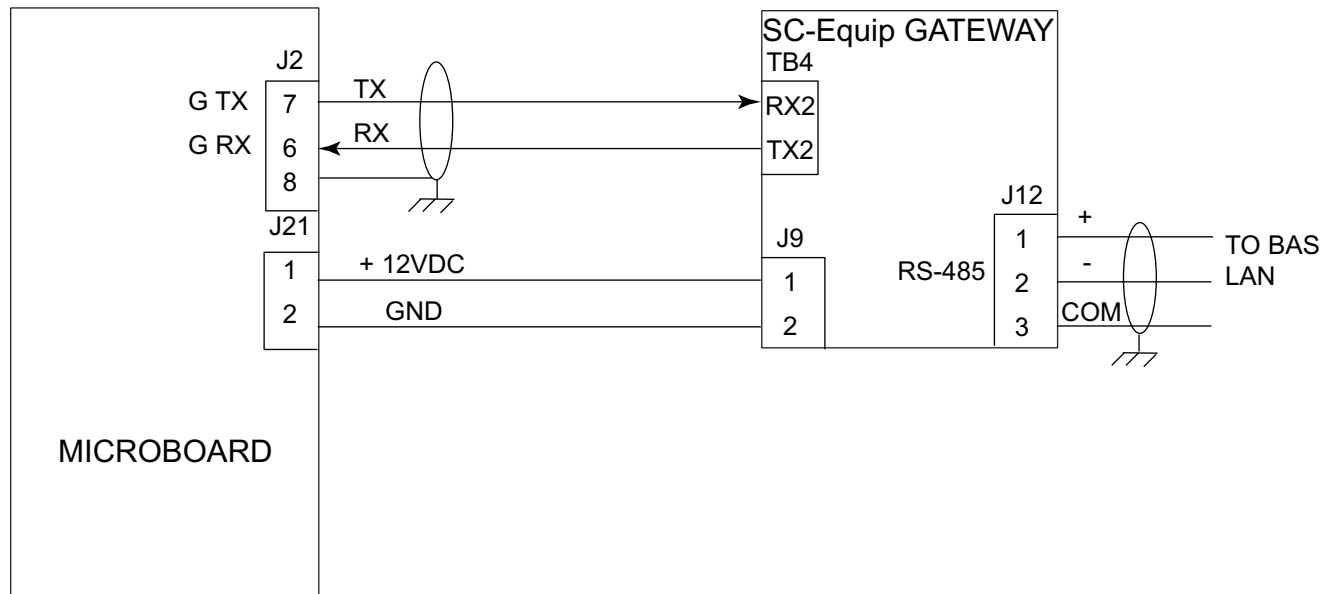


FIGURE 42 - E-LINK GATEWAY INTERFACE BLOCK DIAGRAM

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SECTION 16 - PRESSURE TRANSDUCERS

System 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 (VGD), a stall detection transducer is located in the discharge scroll of the compressor (Refer to *SECTION 22 - VARIABLE GEOMETRY DIFFUSER* 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 the pressure range over which they operate. Each transducer has a different YORK part number. *Figure 43 on Page 102* 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 43 on Page 102*. 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.

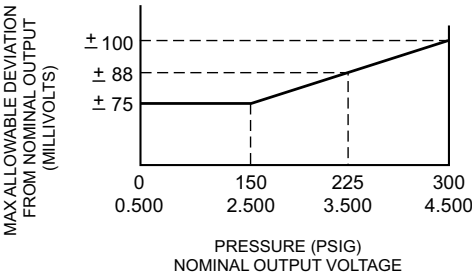
The outputs of the Sump and Pump Oil Pressure transducers are displayed individually as PSIG values. However, the System Oil Pressure is displayed as a differential value in terms of PSID (pounds per square inch differential in gauge). This PSID value is arrived at by subtracting the Sump Oil Pressure transducer value from the Pump Oil Pressure transducer value. During the System Pre-lube 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 System Pre-lube period are compared to determine the off-

set 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 43 on Page 102*. If the pressure is known, the transducer output can be predicted with the appropriate formula in *Figure 43 on Page 102*.

If any of the displayed pressures do not appear to be correct, refer to *SECTION 29 - DIAGNOSTICS AND TROUBLESHOOTING* of this manual.



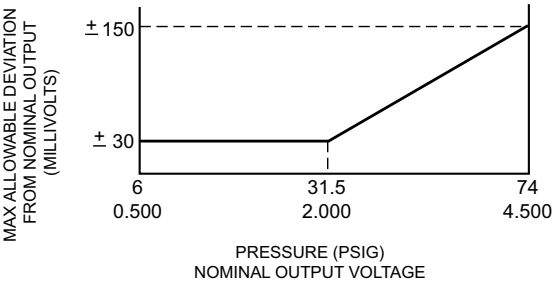
PRESSURE TRANSDUCER
YORK PART NO. 025-28678-001
025-28678-006

$$V = \frac{P + 37.5}{75}$$

V = VOLTS DC

$$P = (75 \times V) - 37.5$$

P = PRESSURE (PSIG) LD05537A



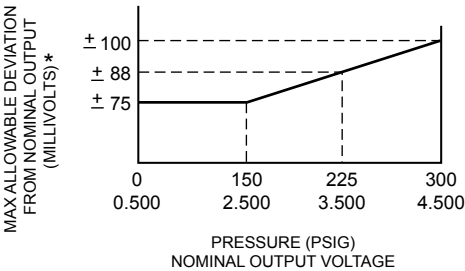
EVAPORATOR TRANSDUCER
R134a WATER AND BRINE APPLICATIONS
YORK PART NO. 025-28678-112
025-28678-104

$$V = \frac{P + 2.5}{17}$$

V = VOLTS DC

$$P = (17 \times V) - 2.5$$

P = PRESSURE (PSIG) LD09969A



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

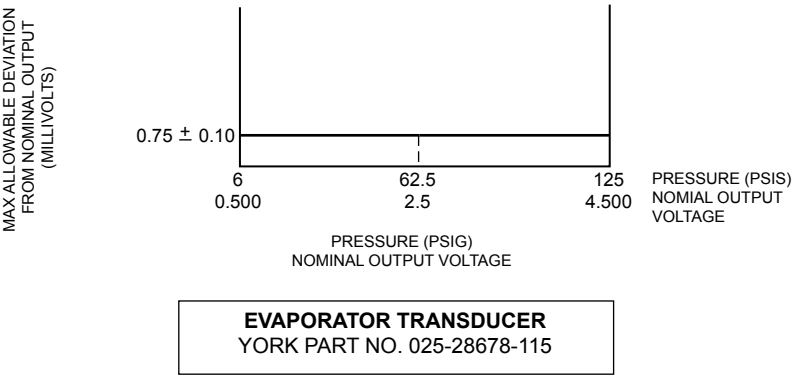
$$V = \frac{P + 37.5}{75}$$

V = VOLTS DC

$$P = (75 \times V) - 37.5$$

P = PRESSURE (PSIG) LD09569a

FIGURE 43 - PRESSURE TRANSDUCERS



$$V = \frac{P + 15.63}{31.25} \qquad P = (31.25 \times V) - 15.63$$

V = VOLTS DC P = PRESSURE (PSIG)

LD15644

FIGURE 43 - PRESSURE TRANSDUCERS (CONT'D)

TABLE 5 - PRESSURE TRANSDUCER APPLICATIONS

TRANSDUCER PART NUMBER*	FUNCTION	APPLICATION	
		WATER	BRINE
		R-134a	
025-28678-006	Condenser, Hi and Lo Oil	X	X
025-28678-112	Evaporator	X	X
025-28678-104	Evaporator	X	X
025-28678-115	Evaporator (Heat Pump Duty)	X	X
025-39464-000 025-40088-000	Stall Detection	X	X

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SECTION 17 - TEMPERATURE THERMISTORS

System 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 (Form 160.54-RP2)* or the unit renewal parts manual. The Return and Leaving Chilled Liquid, Return and Leaving Condenser Liquid, Drop Leg Refrigerant and Evaporator Temperatures are sensed by 3K Ohm thermistors. The 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 J9-10 (input signal) to Microboard TP1 (GND). To convert this voltage to a temperature, refer to the appropriate volts/temperature tables as follows:

- Leaving Chilled Liquid Temperature – *Table 6*
- Leaving Chilled Liquid Temperature (Heat Pump applications) – *Table 7*
- Return Chilled Liquid Temperature – *Table 8*
- Return Chilled Liquid Temperature (Heat Pump Applications) – *Table 9*
- Return and Leaving Condensing Water – *Table 10*
- Oil and Discharge Temperature – *Table 11*
- Drop Leg Refrigerant Sensor – *Table 12*
- Evaporator Refrigerant Sensor – *Table 13*
- Leaving and Return Heating Condenser Water Temperature Sensor – *Table 14*

If any of the displayed pressures do not appear to be correct, refer to *SECTION 29 - DIAGNOSTICS AND TROUBLESHOOTING* of this manual.

TABLE 6 - LEAVING CHILLED LIQUID TEMPERATURE

TEMP (°F)	TEMP (°C)	VIN
9.90	-12.28	1.4280
10.00	-12.22	1.4310
10.09	-12.17	1.4341
10.19	-12.12	1.4371
10.29	-12.06	1.4402
10.39	-12.01	1.4432
10.48	-11.96	1.4463
10.58	-11.90	1.4493
10.68	-11.85	1.4423
10.77	-11.80	1.4554
10.87	-11.74	1.4584
10.97	-11.68	1.4615
11.06	-11.63	1.4645
11.16	-11.58	1.4676
11.25	-11.53	1.4706
11.35	-11.47	1.4737
11.45	-11.42	1.4767
11.54	-11.37	1.4798
11.64	-11.31	1.4828
11.73	-11.26	1.4859
11.83	-11.21	1.4889
11.93	-11.15	1.4920
12.02	-11.10	1.4950
12.12	-11.05	1.4981
12.21	-11.00	1.5011
12.31	-10.94	1.5042
12.40	-10.89	1.5072
12.50	-10.83	1.5103
12.59	-10.78	1.5133
12.69	-10.73	1.5164
12.78	-10.68	1.5194
12.88	-10.62	1.5225
12.97	-10.57	1.5255
13.07	-10.52	1.5286
13.16	-10.47	1.5316
13.26	-10.41	1.5347
13.35	-10.36	1.5377
13.45	-10.31	1.5408
13.54	-10.26	1.5438
13.64	-10.20	1.5469
13.73	-10.15	1.5499
13.83	-10.10	1.5530
13.92	-10.05	1.5560
14.01	-10.00	1.5591
14.11	-9.94	1.5621
14.20	-9.89	1.5652
14.29	-9.84	1.5682
14.39	-9.78	1.5713
14.48	-9.73	1.5743
14.57	-9.68	1.5774
14.67	-9.63	1.5804
14.76	-9.58	1.5835
14.85	-9.53	1.5865
14.95	-9.47	1.5896
15.04	-9.42	1.5926

TEMP (°F)	TEMP (°C)	VIN
15.13	-9.37	1.5957
15.22	-9.32	1.5987
15.32	-9.27	1.6018
15.41	-9.22	1.6048
15.50	-9.17	1.6079
15.60	-9.11	1.6109
15.69	-9.06	1.6140
15.78	-9.01	1.6170
15.87	-8.96	1.6201
15.97	-8.91	1.6231
16.06	-8.86	1.6262
16.15	-8.81	1.6292
16.24	-8.76	1.6322
16.34	-8.70	1.6353
16.43	-8.65	1.6383
16.52	-8.60	1.6414
16.61	-8.55	1.6444
16.70	-8.50	1.6475
16.80	-8.45	1.6505
16.89	-8.40	1.6536
16.98	-8.35	1.6566
17.07	-8.30	1.6597
17.16	-8.25	1.6627
17.26	-8.19	1.6658
17.35	-8.14	1.6688
17.44	-8.09	1.6719
17.53	-8.04	1.6749
17.63	-7.98	1.6780
17.72	-7.93	1.6810
17.81	-7.88	1.6841
17.90	-7.83	1.6871
17.99	-7.78	1.6902
18.08	-7.73	1.6932
18.17	-7.68	1.6963
18.26	-7.63	1.6993
18.35	-7.58	1.7024
18.44	-7.53	1.7054
18.54	-7.48	1.7085
18.63	-7.43	1.7115
18.72	-7.38	1.7146
18.81	-7.33	1.7176
18.90	-7.28	1.7207
18.99	-7.23	1.7237
19.08	-7.18	1.7268
19.17	-7.13	1.7298
19.26	-7.08	1.7329
19.36	-7.02	1.7359
19.45	-6.97	1.7390
19.54	-6.92	1.7420
19.63	-6.87	1.7451
19.72	-6.82	1.7481
19.81	-6.77	1.7512
19.90	-6.72	1.7542
19.99	-6.67	1.7573
20.08	-6.62	1.7603

TEMP (°F)	TEMP (°C)	VIN
20.17	-6.57	1.7634
20.26	-6.52	1.7664
20.35	-6.47	1.7695
20.44	-6.42	1.7725
20.53	-6.37	1.7756
20.62	-6.32	1.7786
20.71	-6.27	1.7817
20.80	-6.22	1.7847
20.89	-6.17	1.7878
20.98	-6.12	1.7908
21.07	-6.07	1.7939
21.16	-6.02	1.7969
21.25	-5.97	1.8000
21.34	-5.92	1.8030
21.43	-5.87	1.8060
21.52	-5.82	1.8091
21.61	-5.77	1.8121
21.70	-5.72	1.8152
21.79	-5.67	1.8182
21.88	-5.62	1.8213
21.97	-5.57	1.8243
22.06	-5.52	1.8274
22.15	-5.47	1.8304
22.24	-5.42	1.8335
22.33	-5.37	1.8365
22.42	-5.32	1.8396
22.51	-5.27	1.8426
22.60	-5.22	1.8457
22.69	-5.17	1.8487
22.78	-5.12	1.8518
22.87	-5.07	1.8548
22.96	-5.02	1.8579
23.04	-4.98	1.8609
23.13	-4.93	1.8640
23.22	-4.88	1.8670
23.31	-4.83	1.8701
23.40	-4.78	1.8731
23.49	-4.73	1.8762
23.58	-4.68	1.8792
23.67	-4.63	1.8823
23.75	-4.58	1.8853
23.84	-4.53	1.8884
23.93	-4.48	1.8914
24.02	-4.43	1.8945
24.11	-4.38	1.8975
24.20	-4.33	1.9006
24.29	-4.28	1.9036
24.37	-4.24	1.9067
24.46	-4.19	1.9097
24.55	-4.14	1.9128
24.64	-4.09	1.9158
24.73	-4.04	1.9189
24.82	-3.99	1.9219
24.91	-3.94	1.9250
24.99	-3.89	1.9280

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

TEMP (°F)	TEMP (°C)	VIN
25.08	-3.84	1.9311
25.17	-3.79	1.9341
25.26	-3.74	1.9372
25.35	-3.69	1.9402
25.43	-3.65	1.9433
25.52	-3.60	1.9463
25.61	-3.55	1.9494
25.70	-3.50	1.9524
25.79	-3.45	1.9555
25.87	-3.41	1.9585
25.96	-3.36	1.9616
26.05	-3.31	1.9646
26.14	-3.26	1.9677
26.23	-3.21	1.9707
26.31	-3.16	1.9738
26.40	-3.11	1.9768
26.49	-3.06	1.9798
26.58	-3.01	1.9829
26.67	-2.96	1.9859
26.76	-2.91	1.9890
26.84	-2.87	1.9920
26.93	-2.82	1.9951
27.02	-2.77	1.9981
27.11	-2.72	2.0012
27.20	-2.67	2.0042
27.28	-2.62	2.0073
27.37	-2.57	2.0103
27.46	-2.52	2.0134
27.55	-2.47	2.0164
27.64	-2.42	2.0195
27.73	-2.37	2.0225
27.81	-2.33	2.0256
27.90	-2.28	2.0286
27.99	-2.23	2.0317
28.08	-2.18	2.0347
28.17	-2.13	2.0378
28.25	-2.08	2.0408
28.34	-2.03	2.0439
28.43	-1.98	2.0469
28.52	-1.93	2.0500
28.61	-1.88	2.0530
28.69	-1.84	2.0561
28.78	-1.79	2.0591
28.87	-1.74	2.0622
28.96	-1.69	2.0652
29.04	-1.64	2.0683
29.13	-1.59	2.0713
29.22	-1.54	2.0744
29.31	-1.49	2.0774
29.39	-1.45	2.0805
29.48	-1.40	2.0835
29.57	1.35	2.0866
29.66	-1.30	2.0896
29.75	-1.25	2.0927
29.83	-1.21	2.0957

TEMP (°F)	TEMP (°C)	VIN
29.92	-1.16	2.0988
30.01	-1.11	2.1018
30.10	-1.06	2.1049
30.18	-1.01	2.1079
30.27	-0.96	2.1110
30.36	-0.91	2.1140
30.45	-0.86	2.1171
30.53	-0.82	2.1201
30.62	-0.77	2.1232
30.71	-0.72	2.1262
30.79	-0.67	2.1293
30.88	-0.62	2.1323
30.97	-0.57	2.1354
31.06	-0.52	2.1384
31.14	-0.48	2.1415
31.23	-0.43	2.1445
31.32	-0.38	2.1476
31.41	-0.33	2.1506
31.49	-0.28	2.1536
31.58	-0.23	2.1567
31.67	-0.18	2.1597
31.76	-0.13	2.1628
31.84	-0.09	2.1658
31.93	-0.04	2.1689
32.02	0.01	2.1719
32.10	0.06	2.1750
32.19	0.11	2.1780
32.28	0.16	2.1811
32.37	0.21	2.1841
32.45	0.25	2.1872
32.54	0.30	2.1902
32.63	0.35	2.1933
32.72	0.40	2.1963
32.81	0.45	2.1994
32.89	0.49	2.2024
32.98	0.54	2.2055
33.07	0.59	2.2085
33.16	0.64	2.2116
33.24	0.69	2.2146
33.33	0.74	2.2177
33.42	0.79	2.2207
33.51	0.84	2.2238
33.59	0.88	2.2268
33.68	0.93	2.2299
33.77	0.98	2.2329
33.86	1.03	2.2360
33.94	1.08	2.2390
34.03	1.13	2.2421
34.12	1.18	2.2451
34.21	1.23	2.2482
34.29	1.27	2.2512
34.38	1.32	2.2543
34.47	1.37	2.2573
34.56	1.42	2.2604
34.64	1.47	2.2634

TEMP (°F)	TEMP (°C)	VIN
34.73	1.52	2.2665
34.82	1.57	2.2695
34.91	1.62	2.2726
34.99	1.66	2.2756
35.08	1.71	2.2787
35.17	1.76	2.2817
35.26	1.81	2.2848
35.34	1.86	2.2878
35.43	1.91	2.2909
35.52	1.96	2.2939
35.51	1.95	2.2970
35.70	2.06	2.3000
35.78	2.10	2.3031
35.87	2.15	2.3061
35.96	2.20	2.3092
36.05	2.25	2.3122
36.13	2.29	2.3153
36.22	2.34	2.3183
36.31	2.39	2.3214
36.40	2.44	2.3244
36.48	2.49	2.3274
36.57	2.54	2.3305
36.66	2.59	2.3335
36.75	2.64	2.3366
36.83	2.68	2.3396
36.92	2.73	2.3427
37.01	2.78	2.3457
37.10	2.83	2.3488
37.18	2.88	2.3518
37.27	2.93	2.3549
37.36	2.98	2.3579
37.45	3.03	2.3610
37.54	3.08	2.3640
37.62	3.12	2.3671
37.71	3.17	2.3701
37.80	3.22	2.3732
37.89	3.27	2.3762
37.98	3.32	2.3793
38.07	3.37	2.3823
38.15	3.42	2.3854
38.24	3.47	2.3884
38.33	3.52	2.3915
38.42	3.57	2.3945
38.51	3.62	2.3976
38.60	3.67	2.4006
38.69	3.72	2.4037
38.77	3.76	2.4067
38.86	3.81	2.4098
38.95	3.86	2.4128
39.04	3.91	2.4159
39.13	3.96	2.4189
39.22	4.01	2.4220
39.30	4.06	2.4250
39.39	4.11	2.4281
39.48	4.16	2.4311

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

TEMP (°F)	TEMP (°C)	VIN
39.57	4.21	2.4342
39.66	4.26	2.4372
39.74	4.30	2.4403
39.83	4.35	2.4433
39.92	4.40	2.4464
40.01	4.45	2.4494
40.10	4.50	2.4525
40.19	4.55	2.4555
40.27	4.59	2.4586
40.36	4.64	2.4616
40.45	4.69	2.4647
40.54	4.74	2.4677
40.63	4.79	2.4708
40.71	4.84	2.4738
40.80	4.89	2.4769
40.89	4.94	2.4799
40.98	4.99	2.4830
41.07	5.04	2.4860
41.16	5.09	2.4891
41.24	5.13	2.4921
41.33	5.18	2.4952
41.42	5.23	2.4982
41.51	5.28	2.5012
41.60	5.33	2.5043
41.69	5.38	2.5073
41.78	5.43	2.5104
41.87	5.48	2.5134
41.96	5.53	2.5165
42.05	5.58	2.5195
42.14	5.63	2.5226
42.23	5.68	2.5256
42.31	5.73	2.5287
42.40	5.78	2.5317
42.49	5.83	2.5348
42.58	5.88	2.5378
42.67	5.93	2.5409
42.76	5.98	2.5439
42.85	6.03	2.5470
42.94	6.08	2.5500
43.03	6.13	2.5531
43.12	6.18	2.5561
43.21	6.23	2.5592
43.30	6.28	2.5622
43.39	6.33	2.5653
43.48	6.38	2.5683
43.57	6.43	2.5714
43.65	6.47	2.5744
43.74	6.52	2.5775
43.83	6.57	2.5805
43.92	6.62	2.5836
44.01	6.67	2.5866
44.10	6.72	2.5897
44.19	6.77	2.5927
44.28	6.82	2.5958
44.37	6.87	2.5988

TEMP (°F)	TEMP (°C)	VIN
44.46	6.92	2.6019
44.55	6.97	2.6049
44.64	7.02	2.6080
44.73	7.07	2.6110
44.82	7.12	2.6141
44.91	7.17	2.6171
45.00	7.22	2.6202
45.09	7.27	2.6232
45.18	7.32	2.6263
45.27	7.37	2.6293
45.36	7.42	2.6324
45.46	7.48	2.6354
45.55	7.53	2.6385
45.64	7.58	2.6415
45.73	7.63	2.6446
45.82	7.68	2.6476
45.91	7.73	2.6507
46.00	7.78	2.6537
46.09	7.83	2.6568
46.18	7.88	2.6598
46.27	7.93	2.6629
46.36	7.98	2.6659
46.45	8.03	2.6690
46.55	8.08	2.6720
46.64	8.13	2.6751
46.73	8.18	2.6781
46.82	8.23	2.6811
46.91	8.28	2.6842
47.00	8.33	2.6872
47.09	8.38	2.6903
47.18	8.43	2.6933
47.27	8.48	2.6964
47.36	8.53	2.6994
47.45	8.58	2.7025
47.55	8.64	2.7055
47.64	8.69	2.7086
47.73	8.74	2.7116
47.82	8.79	2.7147
47.91	8.84	2.7177
48.00	8.89	2.7208
48.09	8.94	2.7238
48.18	8.99	2.7269
48.27	9.04	2.7299
48.37	9.10	2.7330
48.46	9.15	2.7360
48.55	9.20	2.7391
48.64	9.25	2.7421
48.74	9.30	2.7452
48.83	9.35	2.7482
48.92	9.40	2.7513
49.01	9.45	2.7543
49.11	9.51	2.7574
49.20	9.56	2.7604
49.29	9.61	2.7635
49.38	9.66	2.7665

TEMP (°F)	TEMP (°C)	VIN
49.48	9.71	2.7696
49.57	9.76	2.7726
49.66	9.81	2.7757
49.75	9.86	2.7787
49.84	9.91	2.7818
49.94	9.97	2.7848
50.03	10.02	2.7879
50.12	10.07	2.7909
50.22	10.12	2.7940
50.31	10.17	2.7970
50.40	10.22	2.8001
50.50	10.28	2.8031
50.59	10.33	2.8062
50.68	10.38	2.8092
50.78	10.43	2.8123
50.87	10.48	2.8153
50.96	10.53	2.8184
51.06	10.59	2.8214
51.15	10.64	2.8245
51.24	10.69	2.8275
51.34	10.75	2.8306
51.43	10.80	2.8336
51.52	10.85	2.8367
51.62	10.90	2.8397
51.71	10.95	2.8428
51.80	11.00	2.8458
51.90	11.06	2.8458
51.99	11.11	2.8519
52.09	11.16	2.8549
52.18	11.21	2.8580
52.28	11.27	2.8610
52.37	11.32	2.8641
52.46	11.37	2.8671
52.56	11.42	2.8702
52.65	11.47	2.8732
52.75	11.53	2.8763
52.84	11.58	2.8793
52.94	11.63	2.8824
53.03	11.68	2.8854
53.13	11.74	2.8885
53.22	11.79	2.8915
53.32	11.85	2.8946
53.41	11.90	2.8976
53.51	11.95	2.9007
53.60	12.00	2.9037
53.70	12.06	2.9068
53.79	12.11	2.9098
53.89	12.16	2.9129
53.98	12.21	2.9159
54.08	12.27	2.9190
54.17	12.32	2.9220
54.27	12.37	2.9251
54.36	12.42	2.9281
54.46	12.48	2.9312
54.55	12.53	2.9342

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

TEMP (°F)	TEMP (°C)	VIN
54.65	12.58	2.9373
54.74	12.63	2.9403
54.84	12.69	2.9403
54.93	12.74	2.9464
55.03	12.80	2.9495
55.12	12.85	2.9525
55.22	12.90	2.9556
55.32	12.96	2.9586
55.41	13.01	2.9617
55.51	13.06	2.9647
55.61	13.12	2.9678
55.70	13.17	2.9708
55.80	13.22	2.9739
55.90	13.28	2.9769
56.00	13.33	2.9800
56.09	13.38	2.9830
56.19	13.44	2.9861
56.29	13.50	2.9891
56.39	13.55	2.9922
56.48	13.60	2.9952
56.58	13.66	2.9983
56.68	13.71	3.0013
56.78	13.77	3.0044
56.87	13.82	3.0074
56.97	13.87	3.0105
57.07	13.93	3.0135
57.17	13.98	3.0166
57.26	14.03	3.0196
57.36	14.09	3.0227
57.46	14.15	3.0257
57.56	14.20	3.0287
57.66	14.26	3.0318
57.76	14.31	3.0348
57.86	14.37	3.0379
57.96	14.42	3.0409
58.06	14.48	3.0440
58.15	14.53	3.0470
58.25	14.58	3.0501
58.35	14.64	3.0531
58.45	14.70	3.0562
58.55	14.75	3.0592
58.65	14.81	3.0623
58.75	14.86	3.0653
58.85	14.92	3.0684
58.95	14.97	3.0714
59.05	15.03	3.0745
59.15	15.08	3.0775
59.25	15.14	3.0806
59.35	15.20	3.0836
59.45	15.25	3.0867
59.55	15.31	3.0897
59.65	15.36	3.0928
59.75	15.42	3.0958
59.85	15.47	3.0989
59.95	15.53	3.1019

TEMP (°F)	TEMP (°C)	VIN
60.05	15.58	3.1050
60.15	15.64	3.1080
60.25	15.70	3.1111
60.36	15.76	3.1141
60.46	15.81	3.1172
60.56	15.87	3.1202
60.66	15.92	3.1233
60.76	15.98	3.1263
60.86	16.03	3.1294
60.96	16.09	3.1324
61.06	16.15	3.1355
61.17	16.21	3.1385
61.27	16.26	3.1416
61.37	16.32	3.1446
61.47	16.37	3.1477
61.57	16.43	3.1507
61.67	16.48	3.1538
61.78	16.55	3.1568
61.88	16.60	3.1599
61.98	16.66	3.1629
62.08	16.71	3.1660
62.18	16.77	3.1690
62.28	16.82	3.1721
62.39	16.88	3.1751
62.49	16.94	3.1782
62.59	17.00	3.1812
62.69	17.05	3.1843
62.80	17.11	3.1873
62.90	17.17	3.1904
63.01	17.23	3.1934
63.11	17.28	3.1965
63.22	17.35	3.1995
63.32	17.40	3.2025
63.43	17.46	3.2056
63.53	17.52	3.2086
63.63	17.57	3.2117
63.74	17.63	3.2147
63.84	17.69	3.2178
63.95	17.75	3.2208
64.05	17.81	3.2239
64.16	17.87	3.2269
64.26	17.92	3.2300
64.37	17.98	3.2330
64.47	18.04	3.2361
64.58	18.10	3.2391
64.68	18.16	3.2422
64.79	18.22	3.2452
64.90	18.28	3.2483
65.00	18.33	3.2513
65.11	18.40	3.2544
65.21	18.45	3.2574
65.32	18.51	3.2605
65.43	18.57	3.2635
65.53	18.63	3.2666
65.64	18.69	3.2696

TEMP (°F)	TEMP (°C)	VIN
65.75	18.75	3.2727
65.85	18.81	3.2757
65.96	18.87	3.2788
66.06	18.92	3.2818
66.17	18.98	3.2849
66.28	19.05	3.2879
66.39	19.11	3.2910
66.49	19.16	3.2940
66.60	19.22	3.2971
66.71	19.28	3.3001
66.82	19.35	3.3032
66.93	19.41	3.3062
67.03	19.46	3.3093
67.14	19.52	3.3123
67.25	19.58	3.3154
67.36	19.65	3.3184
67.47	19.71	3.3215
67.58	19.77	3.3245
67.68	19.82	3.3276
67.79	19.88	3.3306
67.90	19.95	3.3337
68.01	20.01	3.3367
68.12	20.07	3.3398
68.23	20.13	3.3428
68.34	20.19	3.3459
68.45	20.25	3.3489
68.56	20.31	3.3520
68.67	20.37	3.3550
68.78	20.43	3.3581
68.90	20.50	3.3611
69.01	20.56	3.3642
69.12	20.62	3.3672
69.23	20.68	3.3703
69.34	20.75	3.3733
69.45	20.81	3.3763
69.56	20.87	3.3794
69.67	20.93	3.3824
69.78	20.99	3.3855
69.89	21.05	3.3885
70.01	21.12	3.3916
70.12	21.18	3.3946
70.24	21.25	3.3977
70.35	21.31	3.4007
70.46	21.37	3.4038
70.58	21.44	3.4068
70.69	21.50	3.4099
70.80	21.56	3.4129
70.92	21.62	3.4160
71.03	21.69	3.4190
71.15	21.75	3.4221
71.26	21.81	3.4251
71.37	21.87	3.4282
71.49	21.94	3.4312
71.60	22.00	3.4343
71.72	22.07	3.4373

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

TEMP (°F)	TEMP (°C)	VIN
71.83	22.13	3.4404
71.95	22.20	3.4434
72.06	22.26	3.4465
72.18	22.32	3.4495
72.29	22.39	3.4526
72.41	22.45	3.4556
72.52	22.51	3.4587
72.64	22.58	3.4617
72.75	22.64	3.4648
72.87	22.71	3.4678
72.98	22.77	3.4709
73.10	22.84	3.4739
73.21	22.90	3.4770
73.33	22.96	3.4800
73.44	23.02	3.4831
73.56	23.09	3.4861
73.68	23.16	3.4892
73.80	23.22	3.4922
73.92	23.29	3.4953
74.04	23.36	3.4983
74.16	23.42	3.5014
74.28	23.49	3.5044
74.40	23.56	3.0575
74.52	23.62	3.5105
74.64	23.69	3.5136
74.75	23.75	3.5166
74.87	23.82	3.5197
74.99	23.89	3.5227
75.11	23.95	3.5258

TEMP (°F)	TEMP (°C)	VIN
75.23	24.02	3.5288
75.35	24.09	3.5319
75.47	24.15	3.5349
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
78.42	25.79	3.6081
78.55	25.86	3.6111
78.67	25.93	3.6142

TEMP (°F)	TEMP (°C)	VIN
78.80	26.00	3.6172
78.93	26.07	3.6203
79.05	26.14	3.6233
79.18	26.21	3.6264
79.31	26.29	3.6294
79.44	26.36	3.6325
79.57	26.43	3.6355
79.69	26.50	3.6386
79.82	26.57	3.6416
79.95	26.64	3.6447
80.08	26.71	3.6477
80.20	26.78	3.6508
80.33	26.85	3.6538
80.46	26.92	3.6569
80.59	27.00	3.6599
80.72	27.07	3.6630
80.85	27.14	3.6660
80.98	27.21	3.6691
81.11	27.29	3.6721
81.24	27.36	3.6752
81.37	27.43	3.6782
81.50	27.50	3.6813
81.63	27.57	3.6843
81.76	27.65	3.6874
81.89	27.72	3.6904
82.02	27.79	3.6935
82.15	27.86	3.6965
82.28	27.94	3.6996
82.41	28.01	3.7026

TABLE 7 - LEAVING CHILLED LIQUID TEMPERATURE (HEAT PUMP APPLICATIONS)

TEMP (°F)	TEMP (°C)	VIN
0.04	-17.76	1.0107
3.02	-16.10	1.0889
5.87	-14.52	1.1670
8.63	-12.98	1.2451
11.30	-11.50	1.3232
13.89	-10.60	1.4014
16.42	-8.66	1.4795
18.89	-7.29	1.5576
21.32	-5.93	1.6357
23.71	-4.61	1.7139
26.07	-3.29	1.7920
28.40	-2.00	1.8701
30.71	-0.72	1.9482
33.01	0.56	2.0264
35.30	1.83	2.1045

TEMP (°F)	TEMP (°C)	VIN
37.58	3.10	2.1826
39.87	4.37	2.2607
42.15	5.64	2.3389
44.45	6.92	2.4170
46.76	8.20	2.4951
49.09	9.49	2.5732
51.44	10.80	2.6514
53.82	12.12	2.7295
56.23	13.46	2.8076
58.69	14.83	2.8857
61.19	16.61	2.9639
63.74	17.64	3.0420
66.35	19.08	3.1201
69.02	20.57	3.1982
71.78	22.10	3.2764

TEMP (°F)	TEMP (°C)	VIN
74.62	23.68	3.3545
77.56	25.31	3.4326
80.61	27.00	3.5107
83.77	28.76	3.5889
87.10	30.61	3.6670
90.57	32.54	3.7451
94.23	34.57	3.8232
98.13	36.74	3.9014
102.28	39.04	3.9795
106.72	41.51	4.0576
111.53	44.18	4.1357
116.76	47.09	4.2139
122.56	50.31	4.2920
129.02	53.90	4.3701
136.37	57.98	4.4482

TABLE 8 - ENTERING CHILLED LIQUID TEMPERATURE

TEMP (°F)	TEMP (°C)	VIN
15.01	-9.44	1.5918
15.16	-9.36	1.5967
15.31	-9.27	1.6016
15.46	-9.19	1.6064
15.61	-9.11	1.6113
15.76	-9.02	1.6162
15.91	-8.94	1.6211
16.05	-8.86	1.6260
16.20	-8.78	1.6309
16.35	-8.70	1.6357
16.50	-8.61	1.6406
16.64	-8.53	1.6455
16.79	-8.45	1.6504
16.94	-8.37	1.6553
17.09	-8.28	1.6602
17.23	-8.21	1.6650
17.38	-8.12	1.6699
17.53	-8.04	1.6748
17.68	-7.96	1.6797
17.82	-7.88	1.6846
17.97	-7.80	1.6895
18.11	-7.72	1.6943
18.26	-7.63	1.6992
18.41	-7.55	1.7041
18.55	-7.47	1.7090
18.70	-7.39	1.7139
18.84	-7.31	1.7188
18.99	-7.23	1.7236
19.13	-7.15	1.7285
19.28	-7.07	1.7334
19.43	-6.98	1.7383
19.57	-6.91	1.7432
19.71	-6.83	1.7480
19.86	-6.74	1.7529
20.00	-6.67	1.7578
20.15	-6.58	1.7627
20.29	-6.51	1.7676
20.44	-6.42	1.7725
20.58	-6.34	1.7773
20.73	-6.26	1.7822
20.87	-6.18	1.7871
21.01	-6.11	1.7920
21.16	-6.02	1.7969
21.30	-5.94	1.8018
21.45	-5.86	1.8066
21.59	-5.78	1.8115
21.73	-5.71	1.8164
21.88	-5.62	1.8213
22.02	-5.54	1.8262
22.17	-5.46	1.8311
22.31	-5.38	1.8359
22.45	-5.31	1.8408
22.60	-5.22	1.8457
22.74	-5.14	1.8506
22.88	-5.07	1.8555

TEMP (°F)	TEMP (°C)	VIN
23.03	-4.98	1.8604
23.17	-4.91	1.8652
23.31	-4.83	1.8701
23.45	-4.75	1.8750
23.60	-4.67	1.8799
23.74	-4.59	1.8848
23.88	-4.51	1.8896
24.02	-4.43	1.8945
24.16	-4.36	1.8994
24.31	-4.27	1.9043
24.45	-4.19	1.9092
24.59	-4.12	1.9141
24.73	-4.04	1.9189
24.87	-3.96	1.9238
25.01	-3.88	1.9287
25.16	-3.80	1.9336
25.30	-3.72	1.9385
25.44	-3.64	1.9434
25.58	-3.57	1.9482
25.72	-3.49	1.9531
25.86	-3.41	1.9580
26.00	-3.33	1.9629
26.14	-3.26	1.9678
26.28	-3.18	1.9727
26.42	-3.10	1.9775
26.56	-3.02	1.9824
26.71	-2.94	1.9873
26.85	-2.86	1.9922
26.99	-2.78	1.9971
27.13	-2.71	2.0020
27.27	-2.63	2.0068
27.41	-2.55	2.0117
27.55	-2.47	2.0166
27.70	-2.39	2.0215
27.84	-2.31	2.0264
27.98	-2.23	2.0313
28.12	-2.16	2.0361
28.26	-2.08	2.0410
28.40	-2.00	2.0459
28.54	-1.92	2.0508
28.68	-1.84	2.0557
28.82	-1.77	2.0605
28.96	-1.69	2.0654
29.10	-1.61	2.0703
29.24	-1.53	2.0752
29.38	-1.46	2.0801
29.52	-1.38	2.0850
29.66	-1.30	2.0898
29.80	-1.22	2.0947
29.94	-1.14	2.0996
30.08	-1.07	2.1045
30.22	-0.99	2.1094
30.36	-0.91	2.1143
30.50	-0.83	2.1191
30.64	-0.76	2.1240

TEMP (°F)	TEMP (°C)	VIN
30.78	-0.68	2.1289
30.92	-0.60	2.1338
31.06	-0.52	2.1387
31.20	-0.44	2.1436
31.34	-0.37	2.1484
31.48	-0.29	2.1533
31.62	-0.21	2.1582
31.76	-0.13	2.1631
31.90	-0.06	2.1680
32.04	0.02	2.1729
32.18	0.10	2.1777
32.32	0.18	2.1826
32.46	0.26	2.1875
32.60	0.33	2.1924
32.74	0.41	2.1973
32.88	0.49	2.2021
33.02	0.57	2.2070
33.16	0.64	2.2119
33.30	0.72	2.2168
33.44	0.80	2.2217
33.59	0.88	2.2266
33.73	0.96	2.2314
33.87	1.04	2.2363
34.01	1.12	2.2412
34.15	1.19	2.2461
34.29	1.27	2.2510
34.43	1.35	2.2559
34.57	1.43	2.2607
34.71	1.51	2.2656
34.85	1.58	2.2705
34.99	1.66	2.2754
35.13	1.74	2.2803
35.27	1.82	2.2852
35.41	1.89	2.2900
35.55	1.97	2.2949
35.69	2.05	2.2998
35.83	2.13	2.3047
35.97	2.21	2.3096
36.11	2.28	2.3145
36.25	2.36	2.3193
36.39	2.44	2.3242
36.53	2.52	2.3291
36.67	2.59	2.3340
36.81	2.67	2.3389
36.95	2.75	2.3438
37.09	2.83	2.3486
37.23	2.91	2.3535
37.37	2.98	2.3584
37.51	3.06	2.3633
37.66	3.14	2.3682
37.80	3.22	2.3730
37.94	3.30	2.3779
38.08	3.38	2.3828
38.22	3.46	2.3877
38.36	3.53	2.3926

TABLE 8 – ENTERING CHILLED LIQUID TEMPERATURE (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
38.51	3.62	2.3975
38.65	3.69	2.4023
38.79	3.77	2.4072
38.93	3.85	2.4121
39.07	3.93	2.4170
39.21	4.01	2.4219
39.35	4.08	2.4268
39.50	4.17	2.4316
39.64	4.24	2.4365
39.78	4.32	2.4414
39.92	4.40	2.4463
40.06	4.48	2.4512
40.20	4.56	2.4561
40.34	4.63	2.4609
40.48	4.71	2.4658
40.62	4.79	2.4707
40.76	4.87	2.4756
40.91	4.95	2.4805
41.05	5.03	2.4854
41.19	5.11	2.4902
41.33	5.18	2.4951
41.48	5.27	2.5000
41.62	5.34	2.5049
41.76	5.42	2.5098
41.90	5.50	2.5146
42.05	5.58	2.5195
42.19	5.66	2.5244
42.33	5.74	2.5293
42.48	5.82	2.5342
42.62	5.90	2.5391
42.76	5.98	2.5439
42.90	6.06	2.5488
43.05	6.14	2.5537
43.19	6.22	2.5586
43.33	6.29	2.5635
43.48	6.38	2.5684
43.62	6.46	2.5732
43.76	6.53	2.5781
43.91	6.62	2.5830
44.05	6.69	2.5879
44.19	6.77	2.5928
44.34	6.86	2.5977
44.48	6.93	2.6025
44.62	7.01	2.6074
44.77	7.10	2.6123
44.91	7.17	2.6172
45.06	7.26	2.6221
45.20	7.33	2.6270
45.35	7.42	2.6318
45.49	7.50	2.6367
45.64	7.58	2.6416
45.79	7.66	2.6465
45.93	7.74	2.6514
46.08	7.82	2.6563
46.22	7.90	2.6611

TEMP (°F)	TEMP (°C)	VIN
46.37	7.98	2.6660
46.51	8.06	2.6709
46.66	8.15	2.6758
46.80	8.22	2.6807
46.95	8.31	2.6855
47.09	8.38	2.6904
47.24	8.47	2.6953
47.39	8.55	2.7002
47.53	8.63	2.7051
47.68	8.71	2.7100
47.82	8.79	2.7148
47.97	8.87	2.7197
48.11	8.95	2.7246
48.26	9.03	2.7295
48.41	9.12	2.7344
48.56	9.20	2.7393
48.70	9.28	2.7441
48.85	9.36	2.7490
49.00	9.45	2.7539
49.15	9.53	2.7588
49.30	9.61	2.7637
49.44	9.69	2.7686
49.59	9.77	2.7734
49.74	9.86	2.7783
49.89	9.94	2.7832
50.04	10.02	2.7881
50.19	10.11	2.7930
50.34	10.19	2.7979
50.48	10.27	2.8027
50.63	10.35	2.8076
50.78	10.43	2.8125
50.93	10.52	2.8174
51.08	10.60	2.8223
51.23	10.68	2.8271
51.38	10.77	2.8320
51.53	10.85	2.8369
51.68	10.93	2.8418
51.83	11.02	2.8467
51.98	11.10	2.8516
52.13	11.18	2.8564
52.28	11.27	2.8613
52.44	11.36	2.8662
52.59	11.44	2.8711
52.74	11.52	2.8760
52.89	11.61	2.8809
53.04	11.69	2.8857
53.19	11.77	2.8906
53.34	11.86	2.8955
53.50	11.95	2.9004
53.65	12.03	2.9053
53.80	12.11	2.9102
53.95	12.20	2.0150
54.11	12.28	2.9199
54.26	12.37	2.9248
54.41	12.45	2.9297

TEMP (°F)	TEMP (°C)	VIN
54.56	12.53	2.9346
54.72	12.62	2.9395
54.87	12.71	2.9443
55.02	12.79	2.9492
55.17	12.87	2.9541
55.33	12.96	2.9590
55.48	13.05	2.9639
55.64	13.13	2.9688
55.79	13.22	2.9736
55.95	13.31	2.9785
56.11	13.40	2.9834
56.26	13.48	2.9983
56.42	13.57	2.9932
56.57	13.65	2.9980
56.73	13.74	3.0029
56.89	13.83	3.0078
57.04	13.91	3.0127
57.20	14.00	3.0176
57.36	14.09	3.0225
57.51	14.17	3.0273
57.67	14.26	3.0322
57.83	14.35	3.0371
57.99	14.44	3.0420
58.15	14.53	3.0469
58.31	14.62	3.0518
58.47	14.71	3.0566
58.62	14.79	3.0615
58.78	14.88	3.0664
58.94	14.97	3.0713
59.10	15.06	3.0762
59.26	15.15	3.0811
59.42	15.23	3.0859
59.59	15.33	3.0908
59.75	15.42	3.0957
59.91	15.51	3.1006
60.07	15.60	3.1055
60.23	15.68	3.1104
60.39	15.77	3.1152
60.55	15.86	3.1201
60.72	15.96	3.1250
60.88	16.05	3.1299
61.04	16.13	3.1348
61.20	16.22	3.1396
61.37	16.32	3.1445
61.53	16.41	3.1494
61.69	16.50	3.1543
61.85	16.58	3.1592
62.02	16.68	3.1641
62.18	16.77	3.1689
62.34	16.86	3.1738
62.51	16.95	3.1787
62.67	17.04	3.1836
62.84	17.13	3.1885
63.01	17.23	3.1934
63.17	17.32	3.1882

TABLE 8 – ENTERING CHILLED LIQUID TEMPERATURE (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
63.34	17.41	3.2031
63.51	17.51	3.2080
63.68	17.60	3.2129
63.84	17.69	3.2178
64.01	17.78	3.2227
64.18	17.88	3.2275
64.34	17.97	3.2324
64.51	18.06	3.2373
64.68	18.16	3.2422
64.85	18.25	3.2471
65.02	18.35	3.2520
65.19	18.44	3.2568
65.36	18.53	3.2617
65.53	18.63	3.2666
65.70	18.72	3.2715
65.87	18.82	3.2764
66.04	18.91	3.2813
66.21	19.01	3.2861
66.39	19.11	3.2910
66.56	19.20	3.2959
66.73	19.30	3.3008
66.91	19.40	3.3057
67.08	19.49	3.3105
67.25	19.58	3.3154
67.43	19.68	3.3203
67.60	19.78	3.3252
67.77	19.87	3.3301
67.95	19.97	3.3350
68.12	20.07	3.3398
68.30	20.17	3.3447
68.48	20.27	3.3496
68.66	20.37	3.3545
68.83	20.46	3.3594
69.01	20.56	3.3643
69.19	20.66	3.3691

TEMP (°F)	TEMP (°C)	VIN
69.36	20.76	3.3740
69.54	20.86	3.3789
69.72	20.96	3.3838
69.90	21.06	3.3887
70.08	21.16	3.3936
70.26	21.26	3.3984
70.45	21.36	3.4033
70.63	21.46	3.4082
70.81	21.56	3.4131
70.99	21.66	3.4180
71.17	21.76	3.4229
71.36	21.87	3.4277
71.54	21.97	3.4326
71.72	22.07	3.4375
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
73.01	22.79	3.4717
73.20	22.89	3.4766
73.38	22.99	3.4814
73.57	23.10	3.4863
73.76	23.20	3.4912
73.95	23.31	3.4961
74.14	23.41	3.5010
74.33	23.52	3.5059
74.53	23.63	3.5107
74.72	23.74	3.5156
74.91	23.84	3.5205
75.10	23.95	3.5254
75.29	24.05	3.5303
75.48	24.16	3.5352
75.68	24.27	3.5400

TEMP (°F)	TEMP (°C)	VIN
75.87	24.37	3.5449
76.07	24.49	3.5498
76.26	24.59	3.5547
76.46	24.70	3.5596
76.65	24.81	3.5645
76.84	24.91	3.5693
77.04	25.02	3.5742
77.24	25.14	3.5791
77.44	25.25	3.5840
77.64	25.36	3.5889
77.84	25.47	3.5938
78.04	25.58	3.5986
78.24	25.69	3.6035
78.44	25.80	3.6084
78.64	25.91	3.6133
78.84	26.02	3.6182
79.04	26.14	3.6230
79.25	26.25	3.6279
79.45	26.36	3.6328
79.66	26.48	3.6377
79.86	26.59	3.6426
80.07	26.71	3.6475
80.27	26.82	3.6523
80.48	26.94	3.6572
80.68	27.05	3.6621
80.89	27.16	3.6670
81.10	27.28	3.6719
81.31	27.40	3.6768
81.52	27.51	3.6816
81.72	27.62	3.6865
81.93	27.74	3.6914
82.14	27.86	3.6963
82.35	27.97	3.7012
82.56	28.09	3.7061

TABLE 9 - ENTERING CHILLED LIQUID TEMPERATURE (HEAT PUMP APPLICATIONS)

TEMP (°F)	TEMP (°C)	VIN
0.04	-17.76	1.1353
2.79	-16.23	1.2134
5.44	-14.76	1.2915
8.02	-13.32	1.3696
10.53	-11.93	1.4478
12.98	-10.57	1.5259
15.39	-9.23	1.604
17.75	-7.92	1.6821
20.08	-6.62	1.7603
22.38	-5.34	1.8384
24.66	-4.08	1.9165
26.92	-2.82	1.9946
29.17	-1.57	2.0728
31.41	-0.33	2.1509
33.66	0.92	2.229

TEMP (°F)	TEMP (°C)	VIN
35.9	2.17	2.3071
38.15	3.42	2.3853
40.41	4.67	2.4634
42.69	5.94	2.5415
44.99	7.22	2.6196
47.31	8.51	2.6978
49.67	9.82	2.7759
52.06	11.14	2.854
54.49	12.49	2.9321
56.96	13.87	3.0103
59.5	15.28	3.0884
62.1	16.72	3.1665
64.77	18.21	3.2446
67.51	19.73	3.3228
70.35	21.31	3.4009

TEMP (°F)	TEMP (°C)	VIN
73.29	22.94	3.479
76.36	24.64	3.5571
79.55	26.42	3.6353
82.89	28.28	3.7134
86.41	30.23	3.7915
90.12	32.29	3.8696
94.07	34.49	3.9478
98.31	36.84	4.0259
102.87	39.37	4.104
107.81	42.12	4.1821
113.26	45.14	4.2603
119.3	48.50	4.3384
126.1	52.28	4.4165
133.93	56.63	4.4946

TABLE 10 - ENTERING AND LEAVING CONDENSING WATER

TEMP (°F)	TEMP (°C)	VIN
40.12	4.51	1.8408
40.27	4.59	1.8457
40.42	4.68	1.8506
40.58	4.77	1.8555
40.73	4.85	1.8604
40.88	4.93	1.8652
41.03	5.02	1.8701
41.18	5.10	1.8750
41.33	5.18	1.8799
41.48	5.27	1.8848
41.64	5.36	1.8896
41.79	5.44	1.8945
41.94	5.52	1.8994
42.09	5.61	1.9043
42.24	5.69	1.9092
42.39	5.77	1.9141
42.54	5.86	1.9189
42.70	5.94	1.9238
42.85	6.03	1.9287
43.00	6.11	1.9336
43.15	6.19	1.9385
43.30	6.28	1.9434
43.45	6.36	1.9482
43.60	6.44	1.9531
43.75	6.53	1.9580
43.90	6.61	1.9629
44.05	6.69	1.9678
44.20	6.78	1.9727
44.35	6.86	1.9775
44.50	6.95	1.9824
44.65	7.03	1.9873
44.80	7.11	1.9922
44.95	7.20	1.9971
45.10	7.28	2.0020
45.25	7.36	2.0068
45.40	7.45	2.0117
45.55	7.53	2.0166
45.70	7.61	2.0215
45.85	7.70	2.0264
46.00	7.78	2.0313
46.15	7.86	2.0361
46.30	7.95	2.0410
46.45	8.03	2.0459
46.60	8.11	2.0508
46.75	8.20	2.0557
46.90	8.28	2.0605
47.05	8.36	2.0654
47.20	8.45	2.0703
47.35	8.53	2.0752
47.50	8.61	2.0801
47.65	8.70	2.0850
47.79	8.77	2.0898
47.94	8.86	2.0947
48.09	8.94	2.0996
48.24	9.02	2.1045

TEMP (°F)	TEMP (°C)	VIN
48.39	9.11	2.1094
48.54	9.19	2.1143
48.69	9.27	2.1191
48.84	9.36	2.1240
48.99	9.44	2.1289
49.14	9.52	2.1338
49.29	9.61	2.1387
49.44	9.69	2.1436
49.59	9.77	2.1484
49.74	9.86	2.1533
49.89	9.94	2.1582
50.03	10.02	2.1631
50.18	10.10	2.1680
50.33	10.18	2.1729
50.48	10.27	2.1777
50.63	10.35	2.1826
50.78	10.43	2.1875
50.93	10.52	2.1924
51.08	10.60	2.1973
51.23	10.68	2.2021
51.38	10.77	2.2070
51.53	10.85	2.2119
51.68	10.93	2.1268
51.83	11.02	2.2217
51.97	11.10	2.2266
52.12	11.18	2.2314
52.27	11.26	2.2363
52.42	11.35	2.2412
52.57	11.43	2.2461
52.72	11.51	2.2510
52.87	11.60	2.2559
53.02	11.68	2.2607
53.17	11.76	2.2656
53.32	11.85	2.2705
53.47	11.93	2.2754
53.62	12.01	2.2803
53.77	12.10	2.2852
53.92	12.18	2.2900
54.07	12.26	2.2949
54.21	12.34	2.2998
54.36	12.42	2.3047
54.51	12.51	2.3096
54.66	12.59	2.3145
54.81	12.67	2.3193
54.96	12.76	2.3242
55.11	12.84	2.3291
55.26	12.92	2.3340
55.41	13.01	2.3389
55.56	13.09	2.3438
55.71	13.17	2.3486
55.86	13.26	2.3535
56.01	13.34	2.3584
56.16	13.42	2.3633
56.31	13.51	2.3682
56.46	13.59	2.3730

TEMP (°F)	TEMP (°C)	VIN
56.61	13.67	2.3779
56.76	13.76	2.3828
56.91	13.84	2.3877
57.06	13.92	2.3926
57.21	14.01	2.3975
57.36	14.09	2.4023
57.51	14.17	2.4072
57.66	14.26	2.4121
57.81	14.34	2.4170
57.97	14.43	2.4219
58.12	14.51	2.4268
58.27	14.60	2.4316
58.42	14.68	2.4365
58.57	14.76	2.4414
58.72	14.85	2.4463
58.87	14.93	2.4512
59.02	15.01	2.4561
59.17	15.10	2.4609
59.33	15.18	2.4658
59.48	15.27	2.4707
59.63	15.35	2.4756
59.78	15.43	2.4805
59.93	15.52	2.4854
60.09	15.61	2.4902
60.24	15.69	2.4951
60.39	15.77	2.5000
60.54	15.86	2.5049
60.69	15.94	2.5098
60.85	16.03	2.5146
61.00	16.11	2.5195
61.15	16.20	2.5244
61.30	16.28	2.5293
61.45	16.36	2.5342
61.61	16.45	2.5391
61.76	16.53	2.5439
61.91	16.62	2.5488
62.06	16.70	2.5537
62.21	16.78	2.5586
62.36	16.87	2.5635
62.52	16.96	2.5684
62.67	17.04	2.5732
62.82	17.12	2.5781
62.98	17.21	2.5830
63.13	17.30	2.5879
63.29	17.38	2.5928
63.44	17.47	2.5977
63.59	17.55	2.6025
63.75	17.64	2.6074
63.90	17.72	2.6123
64.06	17.81	2.6172
64.21	17.90	2.6221
64.36	17.98	2.6270
64.52	18.07	2.6318
64.52	18.07	2.6367
64.83	18.24	2.6416

TABLE 10 - ENTERING AND LEAVING CONDENSING WATER (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
64.98	18.32	2.6465
65.14	18.41	2.6514
65.29	18.50	2.6563
65.45	18.58	2.6611
65.60	18.67	2.6660
65.76	18.76	2.6709
65.91	18.84	2.6758
66.07	18.93	2.6807
66.22	19.01	2.6855
66.38	19.10	2.6904
66.54	19.19	2.6953
66.69	19.27	2.7002
66.85	19.36	2.7051
66.00	18.89	2.7100
67.16	19.53	2.7148
67.32	19.62	2.7197
67.47	19.71	2.7246
67.63	19.80	2.7295
67.78	19.88	2.7344
67.94	19.97	2.7393
68.10	20.06	2.7441
68.26	20.15	2.7490
68.41	20.23	2.7539
68.57	20.32	2.7588
68.73	20.41	2.7637
68.89	20.50	2.7686
69.05	20.58	2.7734
69.21	20.67	2.7783
69.36	20.76	2.7832
69.52	20.85	2.7881
69.68	20.94	2.7930
69.84	21.02	2.7979
70.00	21.11	2.8027
70.16	21.20	2.8076
70.32	21.29	2.8125
70.48	21.38	2.8174
70.64	21.47	2.8223
70.80	21.56	2.8271
70.96	21.65	2.8320
71.12	21.74	2.8369
71.28	21.82	2.8418
71.44	21.91	2.8467
71.61	22.01	2.8516
71.77	22.10	2.8564
71.93	22.19	2.8613
72.09	22.27	2.8662
72.25	22.36	2.8711
72.41	22.45	2.8760
72.57	22.54	2.8809
72.73	22.63	2.8857
72.89	22.72	2.8906
73.05	22.81	2.8955
73.22	22.90	2.9004
73.38	22.99	2.9053
73.54	23.08	2.9102

TEMP (°F)	TEMP (°C)	VIN
73.71	23.17	2.9150
73.87	23.26	2.9199
74.04	23.36	2.9248
74.20	23.45	2.9297
74.37	23.54	2.9346
74.53	23.63	2.9395
74.70	23.72	2.9443
74.86	23.81	2.9492
75.03	23.91	2.9541
75.19	24.00	2.9590
75.36	24.09	2.9639
75.52	24.18	2.9688
75.69	24.27	2.9736
75.85	24.36	2.9785
76.02	24.46	2.9834
76.19	24.55	2.9883
76.35	24.64	2.9932
76.52	24.74	2.9980
76.69	24.83	3.0029
76.85	24.92	3.0078
77.02	25.01	3.0127
77.19	25.11	3.0176
77.36	25.20	3.0225
77.53	25.30	3.0273
77.70	25.39	3.0322
77.86	25.48	3.0371
78.03	25.57	3.0420
78.20	25.67	3.0469
78.37	25.76	3.0518
78.54	25.86	3.0566
78.71	25.95	3.0615
78.88	26.05	3.0664
79.05	26.14	3.0713
79.22	26.24	3.0762
79.40	26.34	3.0811
79.57	26.43	3.0859
79.74	26.52	3.0908
79.91	26.62	3.0957
80.08	26.71	3.1006
80.26	26.81	3.1055
80.43	26.91	3.1104
80.60	27.00	3.1152
80.77	27.10	3.1201
80.95	27.20	3.1250
81.12	27.29	3.1299
81.29	27.39	3.1348
81.47	27.49	3.1396
81.64	27.58	3.1445
81.81	27.67	3.1494
81.99	27.77	3.1543
82.16	27.87	3.1592
82.33	27.96	3.1641
82.51	28.06	3.1689
82.69	28.16	3.1738
82.86	28.26	3.1787

TEMP (°F)	TEMP (°C)	VIN
83.04	28.36	3.1836
83.22	28.46	3.1885
83.39	28.55	3.1934
83.57	28.65	3.1982
83.75	28.75	3.2031
83.93	28.85	3.2080
84.10	28.95	3.2129
84.28	29.05	3.2178
84.46	29.15	3.2227
84.65	29.25	3.2275
84.83	29.35	3.2324
85.01	29.45	3.2373
85.19	29.55	3.2422
85.37	29.65	3.2471
85.55	29.75	3.2520
85.73	29.85	3.2568
85.92	29.96	3.2617
86.10	30.06	3.2666
86.28	30.16	3.2715
86.47	30.26	3.2764
86.65	30.36	3.2813
86.84	30.47	3.2861
87.02	30.57	3.2910
87.21	30.67	3.2959
87.39	30.77	3.3008
87.58	30.88	3.3057
87.76	30.98	3.3105
87.95	31.09	3.3154
88.13	31.19	3.3203
88.32	31.29	3.3252
88.51	31.40	3.3301
88.70	31.50	3.3350
88.88	31.60	3.3398
89.07	31.71	3.3447
89.26	31.81	3.3496
89.44	31.91	3.3545
89.63	32.02	3.3594
89.82	32.12	3.3643
90.01	32.23	3.3691
90.20	32.34	3.3740
90.39	32.44	3.3789
90.59	32.55	3.3838
90.78	32.66	3.3887
90.97	32.76	3.3936
91.16	32.87	3.3984
91.35	32.97	3.4033
91.54	33.08	3.4082
91.74	33.19	3.4131
91.93	33.30	3.4180
92.13	33.41	3.4229
92.32	33.51	3.4277
92.52	33.62	3.4326
92.72	33.74	3.4375
92.91	33.84	3.4424
93.11	33.95	3.4473

TABLE 10 - ENTERING AND LEAVING CONDENSING WATER (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
93.31	34.06	3.4521
93.51	34.17	3.4570
93.70	34.28	3.4619
93.90	34.39	3.4668
94.10	34.50	3.4717
94.30	34.61	3.4766
94.50	34.73	3.4814
94.70	34.84	3.4863
94.90	34.95	3.4912
95.11	35.06	3.4961
95.31	35.18	3.5010
95.52	35.29	3.5059
95.72	35.40	3.5107
95.93	35.52	3.5156
96.13	35.63	3.5205
96.34	35.75	3.5254
96.54	35.86	3.5303
96.75	35.98	3.5352
96.96	36.09	3.5400
97.17	36.21	3.5449
97.38	36.33	3.5498
97.59	36.44	3.5547
97.80	36.56	3.5596
98.01	36.68	3.5645
98.22	36.79	3.5693
98.43	36.91	3.5742
98.64	37.03	3.5791
98.86	37.15	3.5840
99.07	37.26	3.5889
99.29	37.39	3.5938
99.50	37.50	3.5986

TEMP (°F)	TEMP (°C)	VIN
99.71	37.62	3.6035
99.93	37.74	3.6084
100.14	37.86	3.6133
100.36	37.98	3.6182
100.58	38.10	3.6230
100.79	38.22	3.6279
101.01	38.34	3.6328
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
105.04	40.58	3.7207
105.27	40.71	3.7256
105.50	40.84	3.7305
105.73	40.96	3.7354
105.96	41.09	3.7402
106.20	41.23	3.7451
106.44	41.36	3.7500

TEMP (°F)	TEMP (°C)	VIN
106.67	41.49	3.7549
106.91	41.62	3.7598
107.14	41.75	3.7646
107.38	41.88	3.7695
107.62	42.01	3.7744
107.86	42.15	3.7793
108.11	42.29	3.7842
108.35	42.42	3.7891
108.59	42.55	3.7939
108.84	42.69	3.7988
109.08	42.83	3.8037
109.32	42.96	3.8086
109.57	43.10	3.8135
109.82	43.24	3.8184
110.06	43.37	3.8232
110.31	43.51	3.8281
110.56	43.65	3.8330
110.81	43.79	3.8379
111.05	43.92	3.8328
111.31	44.06	3.8477
111.36	44.09	3.8525
111.82	44.35	3.8574
112.08	44.49	3.8623
112.34	44.64	3.8672
112.59	44.78	3.8721
112.85	44.92	3.8770
113.11	45.06	3.8818
113.37	45.21	3.8867
113.63	45.35	3.8916
113.88	45.49	3.8965
114.14	45.64	3.9014

TABLE 11 - OIL AND DISCHARGE TEMPERATURE

TEMP (°F)	TEMP (°C)	VIN
31.99	-0.01	0.2637
32.63	0.35	0.2686
33.27	0.71	0.2734
33.90	1.06	0.2783
34.51	1.39	0.2832
35.12	1.73	0.2881
35.73	2.07	0.2930
36.32	2.40	0.2979
36.91	2.73	0.3027
37.49	3.05	0.3076
38.05	3.36	0.3125
38.61	3.67	0.3174
39.18	3.99	0.3223
39.72	4.29	0.3271
40.26	4.59	0.3320
40.80	4.89	0.3369
41.33	5.18	0.3418
41.85	5.47	0.3467
42.37	5.76	0.3516
42.89	6.05	0.3564
43.39	6.33	0.3613
43.89	6.61	0.3662
44.39	6.88	0.3711
44.88	7.16	0.3760
45.36	7.42	0.3809
45.84	7.69	0.3857
46.32	7.96	0.3906
46.79	8.22	0.3955
47.25	8.47	0.4004
47.72	8.73	0.4053
48.18	8.99	0.4102
48.63	9.24	0.4150
49.07	9.48	0.4199
49.52	9.73	0.4248
49.97	9.98	0.4297
50.40	10.22	0.4346
50.83	10.46	0.4395
51.26	10.70	0.4443
51.69	10.94	0.4492
52.11	11.17	0.4541
52.53	11.41	0.4590
52.94	11.63	0.4639
53.36	11.87	0.4688
53.77	12.10	0.4736
54.17	12.32	0.4785
54.57	12.54	0.4834
54.97	12.76	0.4883
55.37	12.98	0.4932
55.76	13.20	0.4980
56.15	13.42	0.5029
56.54	13.63	0.5078
56.92	13.85	0.5127
57.31	14.06	0.5176
57.68	14.27	0.5225
58.06	14.48	0.5273
58.43	14.68	0.5322
58.81	14.90	0.5371
59.18	15.10	0.5420
59.54	15.30	0.5469

TEMP (°F)	TEMP (°C)	VIN
59.90	15.50	0.5518
60.26	15.70	0.5566
60.63	15.91	0.5615
60.98	16.10	0.5664
61.33	16.30	0.5713
61.69	16.50	0.5762
62.04	16.69	0.5811
62.39	16.88	0.5859
62.73	17.07	0.5908
63.07	17.26	0.5957
63.41	17.45	0.6006
63.75	17.64	0.6055
64.09	17.83	0.6104
64.43	18.02	0.6152
64.76	18.20	0.6201
65.09	18.38	0.6250
65.42	18.57	0.6299
65.75	18.75	0.6348
66.08	18.93	0.6396
66.40	19.11	0.6445
66.72	19.29	0.6494
67.04	19.47	0.6543
67.36	19.65	0.6592
67.68	19.82	0.6641
68.00	20.00	0.6689
68.31	20.17	0.6738
68.62	20.35	0.6787
68.93	20.52	0.6836
69.24	20.69	0.6885
69.55	20.86	0.6934
69.86	21.04	0.6982
70.17	21.21	0.7031
70.47	21.37	0.7080
70.77	21.54	0.7129
71.07	21.71	0.7178
71.37	21.87	0.7227
71.67	22.04	0.7275
71.96	22.20	0.7324
72.26	22.37	0.7373
72.55	22.53	0.7422
72.84	22.69	0.7471
73.14	22.86	0.7520
73.43	23.02	0.7568
73.72	23.18	0.7617
74.00	23.34	0.7666
74.29	23.50	0.7715
74.57	23.65	0.7764
74.86	23.81	0.7813
75.14	23.97	0.7861
75.42	24.12	0.7910
75.70	24.28	0.7959
75.98	24.44	0.8008
76.25	24.59	0.8057
76.53	24.74	0.8105

TEMP (°F)	TEMP (°C)	VIN
76.81	24.90	0.8154
77.09	25.05	0.8203
77.36	25.20	0.8252
77.63	25.35	0.8301
77.90	25.50	0.8350
78.17	25.65	0.8398
78.44	25.80	0.8447
78.71	25.95	0.8496
78.98	26.10	0.8545
79.24	26.25	0.8594
79.50	26.39	0.8643
79.77	26.54	0.8691
80.03	26.69	0.8740
80.30	26.84	0.8789
80.56	26.98	0.8838
80.82	27.12	0.8887
81.08	27.27	0.8936
81.33	27.41	0.8984
81.59	27.55	0.9033
81.85	27.70	0.9082
82.11	27.84	0.9131
82.37	27.99	0.9180
82.62	28.12	0.9229
82.87	28.26	0.9277
83.12	28.40	0.9326
83.37	28.54	0.9375
83.62	28.68	0.9424
83.88	28.82	0.9473
84.13	28.96	0.9521
84.38	29.10	0.9570
84.62	29.24	0.9619
84.87	29.37	0.9668
85.11	29.51	0.9717
85.36	29.65	0.9766
85.61	29.79	0.9814
85.85	29.92	0.9863
86.10	30.06	0.9912
86.34	30.19	0.9961
86.58	30.32	1.0010
86.82	30.46	1.0059
87.06	30.59	1.0107
87.30	30.72	1.0156
87.54	30.86	1.0205
87.78	30.99	1.0254
88.02	31.12	1.0303
88.25	31.25	1.0352
88.49	31.39	1.0400
88.72	31.51	1.0449
88.96	31.65	1.0498
89.20	31.78	1.0547
89.43	31.91	1.0596
89.67	32.04	1.0645

TABLE 11 - OIL AND DISCHARGE TEMPERATURE (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
89.90	32.17	1.0693
90.13	32.30	1.0742
90.36	32.42	1.0791
90.59	32.55	1.0840
90.82	32.68	1.0889
91.05	32.81	1.0938
91.28	32.94	1.0986
91.51	33.06	1.1035
91.74	33.19	1.1084
91.96	33.31	1.1133
92.19	33.44	1.1182
92.42	33.57	1.1230
92.64	33.69	1.1279
92.87	33.82	1.1328
93.10	33.95	1.1377
93.32	34.07	1.1426
93.54	34.19	1.1475
93.77	34.32	1.1523
93.99	34.44	1.1572
94.21	34.56	1.1621
94.43	34.69	1.1670
94.65	34.81	1.1719
94.88	34.94	1.1768
95.10	35.06	1.1816
95.32	35.18	1.1865
95.53	35.30	1.1914
95.75	35.42	1.1963
95.97	35.54	1.2012
96.19	35.66	1.2061
96.41	35.79	1.2109
96.63	35.91	1.2158
96.84	36.03	1.2207
97.06	36.15	1.2256
97.27	36.26	1.2305
97.49	36.39	1.2354
97.70	36.50	1.2402
97.92	36.63	1.2451
98.13	36.74	1.2500
98.35	36.86	1.2549
98.56	36.98	1.2598
98.77	37.10	1.2646
98.98	37.21	1.2695
99.20	37.34	1.2744
99.41	37.45	1.2793
99.62	37.57	1.2842
99.83	37.69	1.2891
100.04	37.80	1.2939
100.25	37.92	1.2988
100.46	38.04	1.3037
100.67	38.15	1.3086
100.88	38.27	1.3135
101.09	38.39	1.3184
101.29	38.50	1.3232
101.50	38.61	1.3281
101.71	38.73	1.3330

TEMP (°F)	TEMP (°C)	VIN
101.92	38.85	1.3379
102.13	38.96	1.3428
102.33	39.08	1.3477
102.54	39.19	1.3525
102.74	39.30	1.3574
102.95	39.42	1.3623
103.15	39.53	1.3672
103.36	39.65	1.3721
103.56	39.76	1.3770
103.77	39.88	1.3818
103.97	39.99	1.3867
104.18	40.10	1.3916
104.38	40.21	1.3965
104.58	40.33	1.4014
104.78	40.44	1.4063
104.99	40.55	1.4111
105.19	40.66	1.4160
105.39	40.78	1.4209
105.59	40.89	1.4258
105.80	41.00	1.4307
105.99	41.11	1.4355
106.19	41.22	1.4404
106.39	41.33	1.4453
106.59	41.44	1.4502
106.79	41.55	1.4551
106.99	41.66	1.4600
107.19	41.78	1.4648
107.39	41.89	1.4697
107.59	42.00	1.4746
107.79	42.11	1.4795
107.99	42.22	1.4844
108.18	42.33	1.4893
108.38	42.44	1.4941
108.58	42.55	1.4990
108.78	42.66	1.5039
108.97	42.76	1.5088
109.17	42.88	1.5137
109.37	42.99	1.5186
109.56	43.09	1.5234
109.76	43.20	1.5283
109.95	43.31	1.5332
110.15	43.42	1.5381
110.34	43.53	1.5430
110.54	43.64	1.5479
110.73	43.74	1.5527
110.93	43.85	1.5576
111.12	43.96	1.5625
111.32	44.07	1.5674
111.51	44.18	1.5723
111.70	44.28	1.5771
111.90	44.39	1.5820
112.09	44.50	1.5869
112.28	44.60	1.5918
112.48	44.71	1.5967
112.67	44.82	1.6016

TEMP (°F)	TEMP (°C)	VIN
112.86	44.93	1.6064
113.06	45.04	1.6113
113.25	45.14	1.6162
113.44	45.25	1.6211
113.63	45.35	1.6260
113.82	45.46	1.6309
114.01	45.56	1.6357
114.20	45.67	1.6406
114.40	45.78	1.6455
114.59	45.89	1.6504
114.78	45.99	1.6553
114.97	46.10	1.6602
115.16	46.20	1.6650
115.35	46.31	1.6699
115.54	46.41	1.6748
115.73	46.52	1.6797
115.92	46.63	1.6846
116.11	46.73	1.6895
116.30	46.84	1.6943
116.49	46.94	1.6992
116.67	47.04	1.7041
116.86	47.15	1.7090
117.05	47.25	1.7139
117.24	47.36	1.7188
117.43	47.46	1.7236
117.62	47.57	1.7285
117.80	47.67	1.7334
117.99	47.78	1.7383
118.18	47.88	1.7432
118.37	47.99	1.7480
118.56	48.09	1.7529
118.74	48.19	1.7578
118.93	48.30	1.7627
119.12	48.40	1.7676
119.31	48.51	1.7725
119.49	48.61	1.7773
119.68	48.72	1.7822
119.87	48.82	1.7871
120.05	48.92	1.7920
120.24	49.03	1.7969
120.43	49.13	1.8018
120.61	49.23	1.8066
120.80	49.34	1.8115
120.98	49.44	1.8164
121.17	49.54	1.8213
121.35	49.64	1.8262
121.54	49.75	1.8311
121.72	49.85	1.8359
121.91	49.95	1.8408
122.10	50.06	1.8457
122.28	50.16	1.8506
122.47	50.27	1.8555
122.65	50.37	1.8604
122.84	50.47	1.8652
123.02	50.57	1.8701

TABLE 11 - OIL AND DISCHARGE TEMPERATURE (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
123.21	50.68	1.8750
123.39	50.78	1.8799
123.58	50.88	1.8848
123.76	50.98	1.8896
123.94	51.08	1.8945
124.13	51.19	1.8994
124.31	51.29	1.9043
124.50	51.39	1.9092
124.68	51.49	1.9141
124.86	51.59	1.9189
125.05	51.70	1.9238
125.23	51.80	1.9287
125.42	51.90	1.9336
125.60	52.00	1.9385
125.78	52.10	1.9434
125.97	52.21	1.9482
126.15	52.31	1.9531
126.33	52.41	1.9580
126.52	52.52	1.9629
126.70	52.62	1.9678
126.88	52.72	1.9727
127.07	52.82	1.9775
127.25	52.92	1.9824
127.43	53.02	1.9873
127.62	53.13	1.9922
127.80	53.23	1.9971
127.98	53.33	2.0020
128.17	53.43	2.0068
128.35	53.53	2.0117
128.53	53.63	2.0166
128.71	53.73	2.0215
128.90	53.84	2.0264
129.08	53.94	2.0313
129.26	54.04	2.0361
129.44	54.14	2.0410
129.63	54.24	2.0459
129.81	54.34	2.0508
129.99	54.44	2.0557
130.17	54.54	2.0605
130.36	54.65	2.0654
130.54	54.75	2.0703
130.72	54.85	2.0752
130.90	54.95	2.0801
131.09	55.05	2.0850
131.27	55.15	2.0898
131.45	55.25	2.0947
131.63	55.35	2.0996
131.82	55.46	2.1045
132.00	55.56	2.1094
132.18	55.66	2.1143
132.36	55.76	2.1191
132.54	55.86	2.1240
132.73	55.97	2.1289
132.91	56.07	2.1338
133.09	56.17	2.1387

TEMP (°F)	TEMP (°C)	VIN
133.27	56.27	2.1436
133.46	56.37	2.1484
133.64	56.47	2.1533
133.82	56.57	2.1582
134.00	56.67	2.1631
134.18	56.77	2.1680
134.37	56.88	2.1729
134.55	56.98	2.1777
134.73	57.08	2.1826
134.91	57.18	2.1875
135.09	57.28	2.1924
135.28	57.38	2.1973
135.46	57.48	2.2021
135.64	57.58	2.2070
135.82	57.68	2.2119
136.01	57.79	2.2168
136.19	57.89	2.2217
136.37	57.99	2.2266
136.55	58.09	2.2314
136.73	58.19	2.2363
136.92	58.29	2.2412
137.10	58.39	2.2461
137.28	58.49	2.2510
137.46	58.59	2.2559
137.65	58.70	2.2607
137.83	58.80	2.2656
138.01	58.90	2.2705
138.19	59.00	2.2754
138.37	59.10	2.2803
138.56	59.20	2.2852
138.74	59.30	2.2900
138.92	59.40	2.2949
139.11	59.51	2.2998
139.29	59.61	2.3047
139.47	59.71	2.3096
139.65	59.81	2.3145
139.84	59.92	2.3193
140.02	60.02	2.3242
140.20	60.12	2.3291
140.39	60.22	2.3340
140.57	60.32	2.3389
140.75	60.42	2.3438
140.94	60.53	2.3486
141.12	60.63	2.3535
141.30	60.73	2.3584
141.49	60.83	2.3633
141.67	60.93	2.3682
141.85	61.03	2.3730
142.04	61.14	2.3779
142.22	61.24	2.3828
142.40	61.34	2.3877
142.59	61.44	2.3926
142.77	61.54	2.3975
142.95	61.64	2.4023
143.14	61.75	2.4072

TEMP (°F)	TEMP (°C)	VIN
143.32	61.85	2.4121
143.51	61.95	2.4170
143.69	62.05	2.4219
143.87	62.15	2.4268
144.06	62.26	2.4316
144.24	62.36	2.4365
144.43	62.47	2.4414
144.61	62.57	2.4463
144.80	62.67	2.4512
144.98	62.77	2.4561
145.17	62.88	2.4609
145.35	62.98	2.4658
145.54	63.08	2.4707
145.72	63.18	2.4756
145.91	63.29	2.4805
146.09	63.39	2.4854
146.28	63.49	2.4902
146.46	63.59	2.4951
146.65	63.70	2.5000
146.84	63.81	2.5049
147.02	63.91	2.5098
147.21	64.01	2.5146
147.39	64.11	2.5195
147.58	64.22	2.5244
147.77	64.32	2.5293
147.95	64.42	2.5342
148.14	64.53	2.5391
148.32	64.63	2.5439
148.51	64.73	2.5488
148.70	64.84	2.5537
148.88	64.94	2.5586
149.07	65.04	2.5635
149.26	65.15	2.5684
149.45	65.26	2.5732
149.63	65.36	2.5781
149.82	65.46	2.5830
150.01	65.57	2.5879
150.20	65.67	2.5928
150.38	65.77	2.5977
150.57	65.88	2.6025
150.76	65.98	2.6074
150.95	66.09	2.6123
151.14	66.19	2.6172
151.33	66.30	2.6221
151.51	66.40	2.6270
151.70	66.51	2.6318
151.89	66.61	2.6367
152.08	66.72	2.6416
152.27	66.82	2.6465
152.46	66.93	2.6514
152.65	67.03	2.6563
152.84	67.14	2.6611
153.03	67.24	2.6660
153.22	67.35	2.6709
153.41	67.46	2.6758

TABLE 11 - 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 11 - OIL AND DISCHARGE TEMPERATURE (CONT'D)

TEMP (°F)	TEMP (°C)	VIN
188.71	87.07	3.4863
188.96	87.21	3.4912
189.21	87.35	3.4961
189.46	87.48	3.5010
189.71	87.62	3.5059
189.96	87.76	3.5107
190.21	87.90	3.5156
190.46	88.04	3.5205
190.71	88.18	3.5254
190.96	88.32	3.5303
191.22	88.46	3.5352
191.47	88.60	3.5400
191.73	88.75	3.5449
191.98	88.88	3.5498
192.23	89.02	3.5547
192.49	89.17	3.5596
192.75	89.31	3.5645
193.01	89.46	3.5693
193.27	89.60	3.5742
193.53	89.75	3.5791
193.79	89.89	3.5840
194.05	90.03	3.5889
194.31	90.18	3.5938
194.57	90.32	3.5986
194.84	90.47	3.6035
195.10	90.62	3.6084
195.37	90.77	3.6133
195.63	90.91	3.6182
195.90	91.06	3.6230
196.16	91.21	3.6279
196.43	91.36	3.6328
196.70	91.51	3.6377
196.97	91.66	3.6426
197.24	91.81	3.6475
197.51	91.96	3.6523
197.78	92.11	3.6572
198.06	92.26	3.6621

TEMP (°F)	TEMP (°C)	VIN
198.33	92.41	3.6670
198.61	92.57	3.6719
198.88	92.72	3.6768
199.15	92.87	3.6816
199.43	93.02	3.6865
199.71	93.18	3.6914
199.99	93.34	3.6963
200.27	93.49	3.7012
200.55	93.65	3.7061
200.83	93.80	3.7109
201.11	93.96	3.7158
201.39	94.11	3.7207
201.68	94.27	3.7256
201.97	94.44	3.7305
202.25	94.59	3.7354
202.54	94.75	3.7402
202.82	94.91	3.7451
203.11	95.07	3.7500
203.40	95.23	3.7549
203.69	95.39	3.7598
203.99	95.56	3.7646
204.28	95.72	3.7695
204.57	95.88	3.7744
204.86	96.04	3.7793
205.16	96.21	3.7842
205.46	96.37	3.7891
205.76	96.54	3.7939
206.05	96.70	3.7988
206.35	96.87	3.8037
206.65	97.04	3.8086
206.96	97.21	3.8135
207.26	97.37	3.8184
207.57	97.55	3.8232
207.87	97.71	3.8281
208.17	97.88	3.8330
208.48	98.05	3.8379
208.79	98.22	3.8428

TEMP (°F)	TEMP (°C)	VIN
209.10	98.40	3.8477
209.42	98.57	3.8525
209.73	98.75	3.8574
210.04	98.92	3.8623
210.35	99.09	3.8672
210.67	99.27	3.8721
210.99	99.45	3.8770
211.31	99.62	3.8818
211.62	99.80	3.8867
211.94	99.97	3.8916
212.27	100.16	3.8965
212.59	100.34	3.9014
212.92	100.52	3.9063
213.24	100.70	3.9111
213.57	100.88	3.9160
213.90	101.06	3.9209
214.23	101.25	3.9258
214.56	101.43	3.9307
214.89	101.61	3.9355
215.23	101.80	3.9404
215.56	101.99	3.9453
215.90	102.17	3.9502
216.24	102.36	3.9551
216.58	102.55	3.9600
216.92	102.74	3.9648
217.26	102.93	3.9697
217.60	103.12	3.9746
217.95	103.31	3.9795
218.30	103.51	3.9844
218.65	103.70	3.9893
219.00	103.90	3.9941
219.35	104.09	3.9990
219.70	104.29	4.0039
220.06	104.49	4.0088

TABLE 12 - 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 13 - 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

TABLE 14 - LEAVING AND ENTERING HEATING CONDENSER WATER TEMPERATURE SENSOR

TEMP (°F)	TEMP (°C)	VIN
32.63	0.35	1.713
37.47	3.03	1.870
42.23	5.68	2.026
46.96	9.97	2.182
51.68	10.93	2.338
56.44	13.57	2.495
61.28	16.26	2.651
66.23	19.01	2.807
71.36	21.86	2.963
76.70	24.61	3.120
82.32	27.955	3.276
88.31	31.28	3.432
94.74	34.85	3.588
101.8	38.77	3.745
109.6	43.11	3.901
118.5	48.05	4.057
128.9	53.83	4.213
141.7	60.94	4.370
158.2	70.11	4.526

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SECTION 18 - REMOTE SETPOINTS

REMOTE OPERATING MODES

There are three different Remote operating Modes that can be selected at the keypad: Analog Remote Mode, Digital Remote Mode or ISN(BAS) Remote Mode.

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

Analog Remote Mode

Analog Remote Mode has the following Analog Inputs:

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

Software filtering is applied to these inputs. This stabilizes the remote setpoint values under electrical noise conditions and when the inputs are unstable.

The Analog Inputs are connected to the microboard J22 as shown in *Figure 13 on Page 43*. Microboard Program Jumpers JP23 and JP24 must be positioned appropriately to receive either a 0 to 10VDC, 2 to 10VDC, 0 to 20mA or a 4 to 20mA signal. Refer to Microboard Program Jumpers and explanation below for required configurations.

Digital Remote Mode

Digital Remote Mode has a Pulse Width Modulation (PWM) Input.

The PWM inputs are in the form of a 1 to 11 second re-lay contact closure that applies 115VAC to the I/O Board TB4-19 (Leaving Chilled Liquid Temp) and TB4-20 (Remote Current Limit) for 1 to 11 seconds. Refer to *Figure 16 on Page 50*. The source of 115VAC 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 Current Limit setpoint to 100% and the Leaving Chilled Liquid Temperature setpoint to the locally programmed Local BASE value.

ISN(BAS) Remote Mode

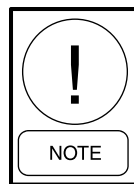
ISN Remote Mode uses RS-232 serial port via the SC-Equip Gateway.

The microboard COM 4B RS-232 (J2) receives the setpoints in serial data form from the SC-Equip Gateway located inside the OptiView™ Control Center enclosure. The SC-Equip Gateway receives setpoints from the BAS system and transfers them to the microboard.

CURRENT LIMIT

Remote Current Limit setpoint with 0 to 10VDC, 2 to 10VDC, 0 to 20mA, 4 to 20mA or Pulse Width Modulation Signal – The Remote Current Limit setpoint can be reset over the range of 100% to 30% Full Load Amps (FLA) by supplying (by others) a 0 to 10VDC, 2 to 10VDC, 0 to 20mA, 4 to 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 to 10VDC or 2 to 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 Current 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 to 10VDC signal is being used for Remote Leaving Chilled Liquid Temperature Reset, then a 0 to 10VDC signal must be used for Remote Current Limit Reset.

0 to 10VDC

As shown in *Figure 13 on Page 43*, Connect input to Microboard J22-1 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% FLA 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 to 10 VDC 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 to 10VDC

As shown in *Figure 13 on Page 43*, Connect input to Microboard J22-1 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% FLA 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 to 10 VDC 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 to 20mA

As shown in *Figure 13 on Page 43*, Connect input to Microboard J22-2 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% FLA 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 to 10VDC 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 to 20mA

As shown in *Figure 13 on Page 43*, Connect input to Microboard J22-2 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% FLA 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 to 10VDC 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 *Figure 16 on Page 50*, connect dry closure relay contacts between I/O Board TB4-20 (signal) and TB4-1 (115VAC). 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:

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

RS-232

A setpoint can be received in serial data form at Microboard J2 from the SC-Equip Gateway.

LEAVING CHILLED LIQUID TEMPERATURE

Remote Leaving Chilled Liquid Temperature setpoint with 0 to 10VDC, 2 to 10VDC, 0 to 20mA, 4 to 20mA or Pulse Width Modulation Signal – Remote Leaving Chilled Liquid Temperature setpoint reset can be accomplished by supplying (by others) a 0 to 10VDC, 2 to 10VDC, 0 to 20mA, 4 to 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 any of the following ranges:

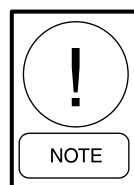
- 38°F to 70°F (water applications)
- 36°F to 70°F (water applications with Smart Freeze protection enabled)
- 10°F to 70°F (brine applications)

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 the value programmed for the Remote Reset Temperature Range setpoint (10, 20, 30, or 40°F).

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:
 - a. Analog Remote Mode must be selected when using a voltage or current signal input.
 - b. 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 to 10VDC or 2 to 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.



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

0 to 10VDC

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 above the Local setpoint value (as allowed by the Remote Reset Temperature Range setpoint). 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 to 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 Temperature 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 to 10VDC

As shown in *Figure 13 on Page 43*, 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 above the Local Setpoint value (as allowed by the Remote Reset Temperature Range setpoint). 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 to 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 Temperature 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.

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

0 to 20mA

As shown in *Figure 13 on Page 43*, 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 above the Local setpoint value (as allowed by the Remote Reset Temperature Range setpoint). The setpoint is changed linearly between these extremes as the input varies over the range of 0 to 20mA. This input will only be accepted when Analog Remote Mode is selected, the Remote Analog Input Range setpoint is set for 0 to 10VDC and Microboard Program Jumper J24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

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

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

For example, if the input is 8mA, the Remote Reset Temperature 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:

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

4 to 20mA

As shown in *Figure 13 on Page 43*, 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 above the Local Setpoint value (as allowed by the Remote Reset Temperature Range setpoint). The setpoint is changed linearly between these extremes as the input varies over the range of 4 to 20mA. This input will only be accepted when Analog Remote Mode is selected, the Remote Analog Input Range setpoint is set for 2 to 10VDC and Microboard Program Jumper JP24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

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

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

For example, if the input is 8mA, and the Remote Reset Temperature 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:

$$\begin{aligned}\text{Offset (°F)} &= \frac{(8-4)(10)}{16} \\ &= \frac{(4)(10)}{16} \\ &= \frac{40}{16} \\ &= 2.5^\circ\text{F} \\ \text{Setpoint (°F)} &= 40 + 2.5 \\ &= 42.5\end{aligned}$$

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 TB4-19 for 1 to 11 seconds. As shown in *Figure 16 on Page 50*, 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 above the Local Setpoint value (as allowed by the Remote Reset Temperature Range setpoint). 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:

$$\begin{aligned}\text{Offset (°F)} &= \\ &\frac{(\text{pulse width in seconds} - 1)(\text{Remote Reset Temp Range})}{10} \\ \text{Setpoint (°F)} &= \text{Local Setpoint} + \text{Offset}\end{aligned}$$

For example, if the relay contacts close for 5 seconds and the Remote Reset Temperature 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

A setpoint can be received in serial data form at the microboard COM 4B serial port (J2) from the SC-Equip Gateway.

LEAVING CONDENSER LIQUID TEMPERATURE (HEAT PUMP MODE)

Heat Pump is an available option for certain models of YK chillers. On a Heat Pump equipped chiller, with Heat Pump Duty enabled, the chiller control can be switched between Cooling and Heating Mode using the Heat Pump Operational setpoint. In Cooling Mode, the chiller controls the Leaving Chilled Liquid to the leaving Chilled Liquid Temperature setpoint. In Heating Mode, the chiller controls the Leaving Condenser Liquid Temperature to the Leaving Condenser Liquid Temperature setpoint. These two setpoints share a single remote input that resets the appropriate setpoint based on the Heat Pump Operational Mode. When in Cooling Mode, the signal on this input sets the Leaving Chilled Liquid Temperature setpoint. When in Heating Mode, this signal sets the Leaving Condenser Liquid Temperature setpoint.

The Cooling Mode remote reset of the Leaving Chilled Liquid Temperature setpoint is explained under “Leaving Chilled Liquid Temperature” above.

The Heating Mode remote reset of the Leaving Condenser Liquid Temperature setpoint can be accomplished by supplying (by others) a 0 to 10VDC, 2 to 10 VDC, 0 to 20mA, 4 to 20mA or a Pulse Width modulated (PWM) signal to the same inputs as used for the Leaving Chilled Liquid Temperature setpoint inputs as explained above. The Leaving Condenser Liquid Temperature setpoint is programmable over the range of 65°F to 122°F. The remote input signal chang-

es the setpoint by creating an offset “below” the locally programmed Leaving Condenser Liquid setpoint value. The setpoint can be remotely changed over the range of the value programmed for the Leaving Condenser Liquid Remote Reset Temperature Range (10, 20, 30, or 40°F). The remote setpoint received through the COM4B RS-232 serial port is not an offset that is applied to the Local Setpoint. Rather, it’s an actual setpoint value.

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

- The appropriate Remote Mode must be selected:
 1. Analog Remote Mode must be selected when using a voltage or current signal input.
 2. Digital Remote Mode must be selected when using a PWM input. ISN must be selected when using a serial communications input.
- If Analog Remote Mode is selected, the Remote Analog Input Range setpoint must be set to 0 to 10VDC or 2 to 10VDC as detailed below, regardless of the whether the signal is a voltage or current signal type.
- The Remote Reset Temperature Range in the following descriptions is the Leaving Condenser Remote Reset Range.

0 to 10VDC

As shown in *Figure 13 on Page 43*, the input is connected to Microboard J22-3 (signal) and J22-5 (GND). A 0VDC signal produces a 0VDC offset. A 10VDC signal produces the maximum offset below the Local Setpoint value (as allowed by the Remote Reset Temperature Range setpoint). Select Analog Remote Mode. The Remote Analog Input Range setpoint must be set to 0 to 10VDC and Microboard JP24 must be removed. The setpoint is calculated as follows:

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

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

2 to 10VDC

As shown in *Figure 13 on Page 43*, the input is connected 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 below the Local setpoint value (as allowed by the Remote Reset Temperature Range setpoint). Select Analog Remote Mode. The Remote Analog Input Range setpoint must be set to 2 to 10VDC and Microboard JP24 must be removed. The setpoint is calculated as follows:

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

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

0 to 20mA

As shown in *Figure 13 on Page 43*, the input is connected 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 below the Local setpoint value (as allowed by the Remote Reset Temperature Range setpoint). Select Analog Remote Mode. The Remote Analog Input Range setpoint must be set to 0 to 10VDC and Microboard JP24 must be placed on pins 1 and 2. The setpoint is calculated as follows:

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

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

4 to 20mA

As shown in *Figure 13 on Page 43*, the input is connected 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 below the Local Setpoint value (as allowed by the Remote Reset Temperature Range setpoint). Select Analog Remote Mode. The Remote Analog Input Range setpoint must be set to 2 to 10VDC and Microboard JP24 must be placed on pins 1 and 2. The setpoint is calculated as follows:

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

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

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 *Figure 16 on Page 50*, connect dry closure contacts between I/O Board TB4-19 (signal) to TB4-1 (115VAC). A 1 second closure produces a 0°F offset. An 11 second closure produces the maximum allowed offset above the Local Setpoint (as allowed by the Remote Reset Temperature Range setpoint). Select Digital Remote Mode. The relay contact closure should occur at least once every 30 minutes to maintain the setpoint to the desired value. If a contact 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. The setpoint is calculated as follows:

$$\text{Offset}(\text{°F}) = \frac{(\text{PW} - 1)(\text{Remote Reset Temp Range})}{10}$$

Where PW = Pulse Width in seconds

Setpoint (°F) = Local Setpoint - Offset

RS-232

A setpoint can be received in serial form at the microboard COM4B serial port (J2) from the SC-Equip Gateway when the panel is set to ISN Remote Mode.

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SECTION 19 - HOT GAS BYPASS

With the optional hot gas bypass feature, the control center modulates a valve located in the hot gas bypass connection between the condenser and the evaporator to control the flow of gas to the evaporator. The valve is modulated in response to load and surging conditions.

A hot gas bypass Screen, accessed from the COMPRESSOR Screen displays all the applicable parameters and allows a Service technician to program the applicable settings and manually control the Hot gas valve. If the chiller is equipped with the optional Hot gas bypass Control, it must be enabled from the OPERATIONS Screen using a procedure in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. If disabled, the valve is driven to the fully closed position.

The microboard controls the hot gas valve by sending a 0 to 10VDC positioning signal out TB8-2 of the microboard to the hot gas valve actuator. The valve position is displayed on the Hot gas bypass Screen as 0% (closed) to 100% (fully open).

A potentiometer mounted on the Pre-rotation Vanes provides PRV position for this feature, as explained later in this section). It is displayed on the hot gas bypass screen as 0% (closed) to 100% (fully open).

The evaporator and condenser pressure transducers provide these pressure values to the microboard. The microboard uses these values to calculate the Delta P/P parameter as follows:

$$\frac{\text{Condenser Pressure} - \text{Evaporator Pressure}}{\text{Evaporator Pressure}}$$

Although this parameter is not used in the Hot gas Control, it represents compressor “Head” and is displayed on the Hot gas bypass Screen for reference only. These pressures are also used to detect when a surge occurs.

The hot gas valve is modulated in response to certain load conditions and surge events as described below under Operations. The load conditions are represented by the value “Temperature Differential (Leaving Chilled Liquid Temperature minus setpoint)” on the hot gas screen. The surge events it reacts to are detected by the surge protection feature (Refer to *SECTION 21 - SURGE PROTECTION*). For reference, surge detect indicators and the total surge count are displayed on the Hot gas Screen as follows.

Each time a surge is detected, the Surge Avoidance Surge Detected indicator illuminates momentarily (if equipped with a VSD or MV VSD, this feature only detects surges while the drive is running at maximum frequency).

If equipped with a VSD (in Modbus Protocol configuration) or a MV VSD, the ACC Surge Detected indicator illuminates momentarily when a surge is detected by the ACC function in the microboard, while the drive is running at less than maximum frequency.

SETPOINTS

Hot gas bypass setpoints are as follows:

- **Hold Period** (30 to 120 minutes; default 30) – This is the period of time after no more surges are detected that the Hot gas valve closing will begin. It will be driven toward the closed position in increments equal to the Close Percentage setpoint at 10 minute intervals until fully closed. Programmable in 1 minute increments.
- **Close Percentage** (5 to 15%; default 5%) – This is the incremental amount that the Hot gas valve will be closed at 10 minute intervals after the Hold Period has elapsed. Refer to Hold Period above.
- **Minimum Load** – Enabled or Disabled

OPERATION

While the chiller is shutdown, the Hot gas valve is driven to the fully closed position. While the chiller is running, the valve is modulated in response to low load, high load or surge conditions. However, manual control can override this operation.

In standard operation or with Heat Pump Duty enabled and operating in Cooling Mode, if the Leaving Chilled Liquid Temperature decreases to less than the Minimum Load setpoint, the valve is opened to the maximum allowed by the Maximum Open setpoint and MINIMUM LOAD (OVERRIDE in software version C.OPT.01.18.307 (and earlier)) is displayed as the Hot gas bypass Control Mode on the Hot gas bypass Screen. For example, if the Minimum Load is set for 4°F and the Maximum Open is set for 80%, the valve will be positioned to 80% open when the Leaving Chilled Liquid Temperature decreases to more than 4°F below the Leaving Chilled Liquid Temperature

setpoint. After this Minimum Load Override is initiated, as the Leaving Chilled Liquid Temperature rises to the Leaving Chilled Liquid Temperature setpoint, the valve is closed by an amount proportional to the difference between the temperature delta and the Minimum Load setpoint. In this example, when the Leaving Chilled Liquid Temperature increases to 2°F below the Leaving Chilled Liquid Temperature setpoint, the valve will be positioned to 40% open. The valve is closed accordingly until the temperature delta is 0°F.

If Heat Pump Duty is enabled, the Hot gas operates as it does in a standard YK chiller without Heat Pump ability. However, in Heating Mode, Hot gas operation is the same as Cooling Mode except for the operation during low load conditions, which is as follows.

When the Leaving Condenser Liquid Temperature exceeds the Minimum Load setpoint (1 to 4°F above the Leaving Condenser Liquid Temperature Setpoint) the Hot gas valve is opened to the position allowed per the Maximum Open setpoint (25 to 100%). For example, if the Minimum Load setpoint equals 4°F, Maximum Open setpoint equals 100%, Heating setpoint equals 105°F, and leaving Condenser Liquid Temperature is greater than 109°F, the Hot gas valve would be opened to the 100% position. When the leaving Condenser Liquid Temperature falls to 107°F, the valve closes to 50% and finally to 0% when this temperature falls back to 105°F. All other aspects of Hot gas control remain unchanged in Heating Mode.

If the Pre-rotation Vanes are more than 95% open and the Leaving Chilled Liquid Temperature is at least 5°F above the Leaving Chilled Liquid Temperature setpoint, the valve is set to one-half of its present position for 10 minutes. After the 10 minutes have elapsed, the valve is driven fully closed.

If none of the above conditions are in effect, the Hot gas bypass Valve is driven to the fully closed position, until a surge condition is detected. When a surge is detected, the Hot gas valve is opened a certain percentage every few minutes until the surging stops or the valve is fully opened as follows:

- If Hot gas valve is fully closed, it is driven to the 50% position. There will be no valve response to surge events for the next 5 minutes.
- If Hot gas valve position is less than 35%, it is driven to the 50% position. There will be no valve response to surge events for the next 3.5 minutes.

- If Hot gas valve position is greater than 35% but less than 50%, it is driven to the 50% position. There will be no valve response to surge events in the next 2 minutes.
- If Hot gas valve position is greater than 50%, it is driven open another 10%. There will be no valve response to surge events in the next 2 minutes.

After the chiller has not surged for the period of time programmed as the Hold Period setpoint, the valve is driven toward the closed position at 10 minute intervals by incremental amounts determined by the Close Percentage setpoint. After it is fully closed, it remains there until another surge is detected.

Whenever the Hot gas valve is partially or fully open, the existing safety check that subtracts the evaporator saturation temperature from the leaving chilled liquid temperature changes the range from standard range of (-2.5°F to +25°F) to (-5.0°F to +25°F). Whenever the Hot gas bypass Valve is closed or not used, this safety check uses the standard values.

If RS-485 serial communications between the microboard and the Analog I/O Board are lost continuously for 20 seconds, WARNING – EXTERNAL I/O – SERIAL COMMUNICATIONS is displayed on the System Details line of the Display and the Hot gas valve will remain at the position when communications were lost.

HOT GAS OPERATION WITH VARIABLE GEOMETRY DIFFUSER (VGD)

Since the VGD operates by pulsing the diffuser ring open until stall is detected, there are some conditions where this probing can actually cause a surge. Therefore, to eliminate unnecessary Hot gas valve movement, the Hot gas valve is not opened on the first surge or when the VGD is closing. When a surge is detected, the Hot gas valve will not be opened until a second surge is detected. This gives the VGD a chance to close and stabilize the chiller without opening the Hot gas valve. While the VGD operation is inhibiting Hot gas operation, VGD OVERRIDE is displayed as the Hot gas Control Mode.

Whenever the Hot gas valve is not closed, the VGD is maintained at the last position. This keeps the VGD at a position of similar surge stability when the system head is later lowered and the Hot gas valve closes.

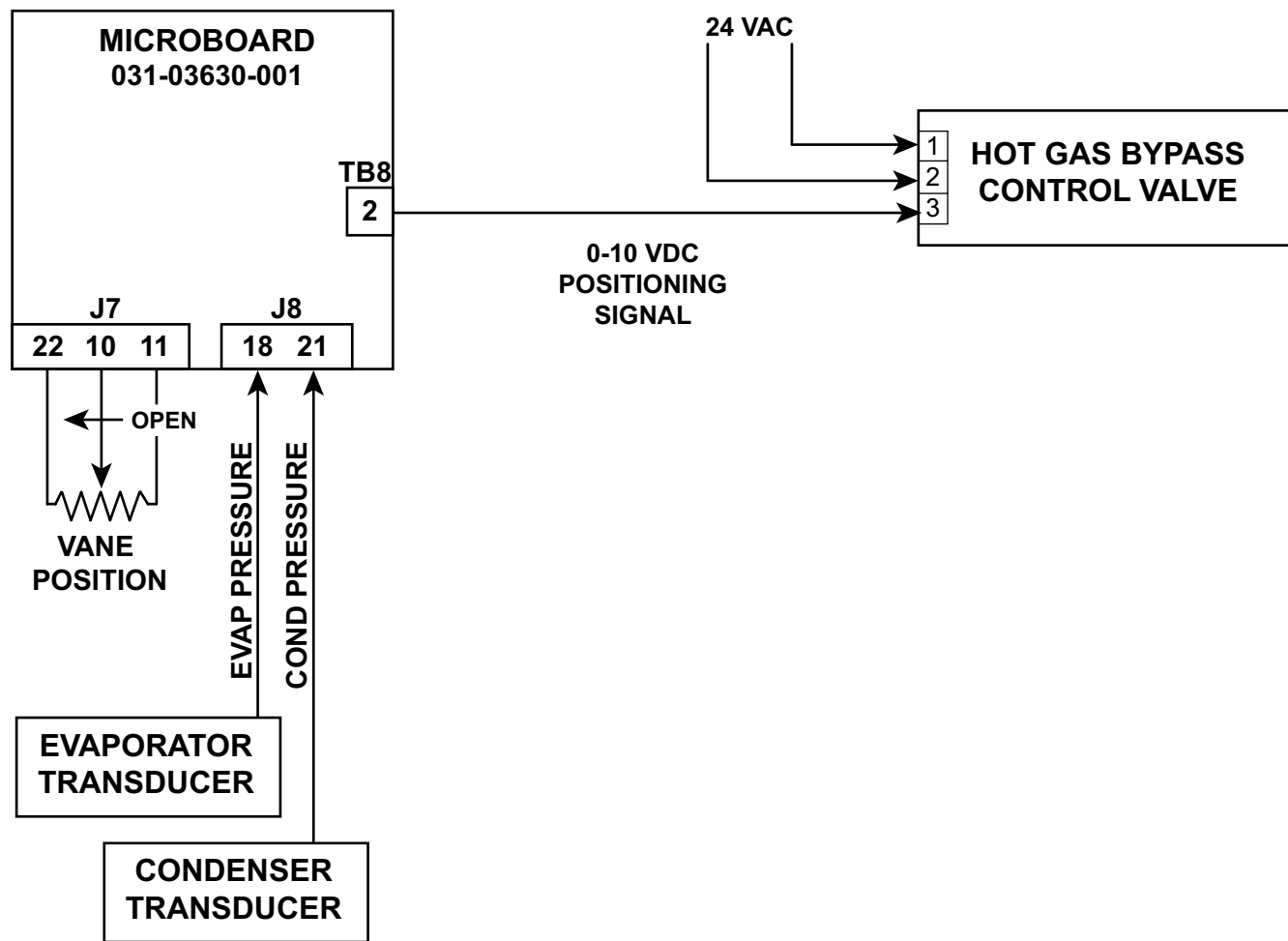
MANUAL CONTROL

The Hot gas bypass Valve can be manually controlled from the Capacity Control Screen in SERVICE access level. Manual control has priority over Minimum Load Override, Variable Speed Drive Override and Automatic Control.

When the Increase or Decrease key is pressed, the valve position will be increased or decreased by 5% to a maximum of 100% or minimum of 0%. Each time either key is pressed, the LED in the respective key will illuminate for 2 seconds. The Hot gas bypass Control state will display MANUAL.

PRE-ROTATION VANES POTENTIOMETER

A 2.5K ohm potentiometer, mounted on the Pre-rotation Vanes control arm, provides a 0 to 5VDC voltage that represents a PRV position of 0% (fully closed) to 100% (fully open) as displayed on the Hot gas bypass Screen. To assure accuracy, a PRV calibration procedure must be performed as detailed in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual. The potentiometer is connected to the Microboard 031-0630-001 J7.



LD19805

FIGURE 44 - INTERFACE, HOT GAS BYPASS (I/O BOARD 031-02895-000)

SECTION 20 - 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 *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* 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 (RT7), and the sensor is enabled using *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* 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 less than 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 (R-134a – 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 less than 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 temperature sensor RT7) or 34.0° (evaporator saturation temperature 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 greater than or equal 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:

$$A = \frac{4053.7}{B}$$

Where: A = Number of seconds to freezing
B = (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 Pre-Rotation Vanes Load Inhibit still occurs at the same thresholds as with normal operation; inhibit at 27.0 PSIG (R-134a). As in normal operation, loading will be allowed when the pressure increases to 28.0 PSIG (R-134a).

The following is a summary of the operation with Smart Freeze disabled and enabled.

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 Temperature setpoint, as programmed, or a minimum of 36.0°F.
- Low Evaporator Pressure safety shutdown threshold
R-134a – 25.0 PSIG (28.7°F)
- PRV Load Inhibit
R-134a – 27.0 PSIG
- Load Inhibit disable
R-134a – 28.0 PSIG

SMART FREEZE ENABLED

- Minimum Leaving Chilled Liquid setpoint - 36.0°F
- If the Leaving Chilled Liquid Temperature setpoint is greater than or equal to 38.0°F:
 1. The Low Leaving Chilled Liquid Temperature cycling shutdown threshold is 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 less than 38.0°F:
 1. The Low Leaving Chilled Liquid Temperature cycling shutdown threshold is 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 is determined by how far the Evaporator Refrigerant Temperature is below the freeze threshold of 32.8°F (refrigerant temperature sensor RT7) or 34.0°F (Evaporator Saturation Temperature. See Note 1 below.) and the total number of seconds it remains there. Refer to explanation above.
 - PRV Load Inhibit is the same as Smart Freeze Disabled above.
 - Load Inhibit Disable is the same as Smart Freeze Disable above.

SECTION 21 - SURGE PROTECTION

The surge protection feature detects surge events. It provides a running count of the surges detected over the lifetime of the chiller. It allows the user to define how many surges are excessive and how the control will react to an excess surge condition. When excessive surging is detected, it can be configured to shutdown the chiller.

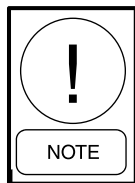
The Surge Protection Screen, accessible from the Compressor Screen, displays all parameters relevant to this feature. All setpoints for this feature are maintained on this screen.

SURGE DETECTION

Surge events are detected by monitoring the relationship between the Condenser pressure and Evaporator pressure while the chiller is running.

The Evaporator pressure transducer output is subtracted from the Condenser pressure output to determine the differential. If either of the following negative transitions occur in the differential followed by a 0.061VDC positive differential transition within 15 seconds a surge event is detected:

- If the differential decreases greater than or equal to 0.6VDC for greater than or equal to 0.260 seconds.
- If the differential decreases greater than or equal to x.xVDC for greater than or equal to 0.390 seconds.



x.xVDC calculated as [(surge sensitivity setpoint x 300) x 1.22] ÷ 1000

The surge detection sensitivity for the Surge Protection feature is set with the SURGE SENSITIVITY setpoint on the Surge protection Screen. It is adjustable over the range of 0.1 to 20 (default 2.5). Smaller values increase the sensitivity.

Each time a surge is detected by the Surge Protection feature, the SURGE AVOIDANCE SURGE DETECTED indicator illuminates momentarily.

The SURGE AVOIDANCE SURGE COUNT is the total number of surges detected by the Surge Protection feature. The SURGE AVOIDANCE SURGE COUNT can be cleared using an ADMIN password following procedure in SECTION 33- SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES of this manual.

The SURGE WINDOW COUNT accumulates the number of surges that occur within the SURGE WINDOW TIME. This time is programmable over the range of 1 to 5 (default 3) minutes using the COUNT WINDOW setpoint. The number of surges that occur within the SURGE WINDOW TIME are compared to the COUNT LIMIT setpoint (4 – 20, default 15) to determine if an excess surge condition exists, as explained below.

EXCESS SURGE DETECTION

An excess surge condition is detected by comparing the number of surge events that occur in a selectable time period to a selectable threshold.

If the number of surge events (Surge Window Count) detected in the time period programmed as the COUNT WINDOW setpoint (1 to 5 minutes; default 5) exceed the threshold programmed as the COUNT LIMIT setpoint (4 to 20, default 4) an excess surge condition has been detected.

Unless the SHUTDOWN features have been enabled, as explained below, the chiller will continue to run under the same conditions displaying “WARNING – EXCESS SURGE DETECTED”. This message will be displayed until manually reset with the Warning Reset key in Operator access level.

SURGE PROTECTION

If the SHUTDOWN setpoint is Enabled, when an excess surge condition has been detected a safety shutdown will be performed and “SURGE PROTECTION - EXCESS SURGE” is displayed.

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SECTION 22 - VARIABLE GEOMETRY DIFFUSER

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) to narrow the diffuser gap. It is opened (retracted) to open the diffuser gap. An internal actuator end switch prevents travel beyond the fully open or closed positions. The VGD limit switch indicates when the VGD is fully closed. The switch closes when the VGD is in the fully closed position. The switch status is displayed on the VGD screen and VGD SETPOINTS Screen. It's displayed as Closed when the VGD is in the full closed position. Otherwise, it is displayed as Open. 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 diffuser ring is also closed in response to surge conditions as described below.

The VARIABLE GEOMETRY DIFFUSER screen displays all parameters relevant to this feature. All setpoints are maintained on the VARIABLE GEOMETRY DIFFUSER SETPOINTS screen. The VGD must be enabled on the Operations Screen.

STALL DETECTION

Stall noise in the compressor discharge is detected as gas pressure pulsations. (Refer to *Figure 45 on Page 147*. A Stall Pressure Transducer (025-40088-000), mounted in the discharge scroll of the compressor, detects the pressure pulsations and outputs DC voltage pulsations to the Stall Detector Board (031-2418-001). 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 YK chiller, a signal below 0.5VDC indicates little or no stall. A signal above 0.8VDC indicates stall noise is present.

SURGE DETECTION

Surge events are sensed as described in *SECTION 19 - HOT GAS BYPASS* and *SECTION 21 - SURGE PROTECTION* of this manual.

AUTOMATIC OPERATION

The VGD operation is illustrated in the State Diagram illustrated in *Figure 46 on Page 148*. The "States" are shown in circles. They are Stall Waiting, Stall Reacting, Probing, Surge Reacting, Surge Waiting and Hot gas Override. Arrows on the diagram indicate actions that move the control from one "State" to another. For clarity, different arrow line styles are used for Stall (—), Surge (— . —) and Hot gas (— —) response actions. 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. 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. In response to a surge, it is driven toward the close position for a selectable period of time. After a wait period, it is again pulsed open unless another surge occurs, whereupon Hot gas operation overrides VGD operation and the VGD is held in place.

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 sections describes the operating states:

Chiller Off, Pre-lube or Coastdown

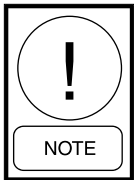
The VGD diffuser gap is driven fully open.

Stall Waiting

This state is entered on startup, after a Stall Reaction, or Hot gas valve closure. The VGD is held in last position until one of the following occurs:

- The PROBE WAIT time period (0.5 to 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.
- A surge is detected and enters Surge Reacting State.
- The compressor Pre-rotation Vanes (PRV) position increases more than the PRV Offset (1 to 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).



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 to 9 seconds; default 2). This probing continues until the Stall Detector Board output exceeds the High Limit setpoint (0.5 to 1.2VDC; default 0.8) to indicate stall is present or a surge is detected. Typically, at lower loads below 70%, stall will be sensed and controlled before a surge occurs. At higher loads and very high heads or lift, a surge can occur while probing which may be momentary in nature and not evidenced as stall noise.

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 the Probing, Stall Waiting or Surge Waiting (software version C.OPT.01.23.307 and later) 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 to 0.8VDC; default 0.6). After Stall Reacting, the state returns to Stall Waiting, or Surge Waiting depending on the state it was previously in. If it entered Stall Reacting from Stall Waiting, it returns to

Stall Waiting. It also could have entered from Surge Waiting. If this is the case, it will return to Surge Waiting only if there is still time remaining on the Surge Waiting Timer. If no time remaining, it transitions out of Stall Reacting as it normally does.

If equipped with the optional Hot gas bypass feature and the Hot gas valve position is greater than 0% when the stall is detected, the VGD is held in its last position. It is not driven closed.

Surge Reacting

The VGD is closed for a specific time period, defined by the Surge React Time setpoint (1 to 30 seconds; default 5). A surge is detected as detailed in *SECTION 19 - HOT GAS BYPASS* and *SECTION 21 - SURGE PROTECTION* of this manual. The Surge Detected LED on the VARIABLE GEOMETRY DIFFUSER Screen illuminates for 5 seconds each time a surge is detected. The program looks at a change in the condenser minus evaporator pressures over a short time period to detect a back flow or surge condition of the compressor. A surge is generally of more concern and potentially damaging to the compressor than stall. So, if a surge is detected, this overrides any of the Stall action states. Opening the diffuser gap may lower the lift capability of the machine. Therefore, there are some conditions where the Probing can actually cause a surge. In this case it is likely that simply closing the diffuser gap some amount will stabilize the compressor. Therefore, for units with VGD and Hot gas options, the Hot gas bypass Valve will not be opened on the first surge or during the time the VGD is closing.

Surge Waiting

The VGD is held in last position for a wait time, defined by the Probe Wait Time setpoint (0.5 to 15 minutes; default 10). During this period, the controls will look for a second surge. If a second surge occurs, normal Hot gas bypass Control takes over and Hot gas bypass Override state is entered. If there are no other surges detected during this period, the VGD returns to Probing.

The time remaining in the PROBE WAIT time period is displayed on the VARIABLE GEOMETRY DIFFUSER Screen as TIME REMAINING.

If a stall is detected while in Surge Waiting, the control transitions to Stall Reacting, where the VGD is driven closed until stall is no longer detected. Then if the Surge Waiting Timer is still active, it transitions back to Surge Waiting, otherwise it transitions out of Stall Reacting as it normally does.

Hot gas bypass Override

Applies for units with optional Hot gas bypass. Whenever the Hot gas bypass Valve position is greater than 0%, the VGD mechanism will be kept at its last position. This keeps the VGD at a position of similar surge stability when the system head is later lowered and the hot gas valve closes. This state remains in effect until the Hot gas valve position returns to 0% or if detected, whereupon it returns to the Stall Reacting State.

Hot gas bypass operates as described in *SECTION 19 - HOT GAS BYPASS* of this manual. Except that on surge response, the Hot gas valve will not be opened until a second surge is detected. The Hot gas Minimum Load Override function is not affected by VGD operation.

PRV-VGD Inhibit

If the Pre-rotation Vanes position exceeds the PRV-VGD Inhibit setpoint (40% to 100%), the VGD is pulsed open per the Open Pulse setpoint. While this is in effect, Control Status displays PRV POSITION OVERRIDE.

STALL SENSOR VALIDATION

This feature verifies the operation of the Stall Pressure Transducer 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 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 0.28VDC for 3 continuous minutes, the VGD is driven to the full open 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 unprocessed DC voltage output passes through the Stall Detector Board J2-2 and is connected to the microboard at J8-1. This value is then used for comparison to the condenser transducer.

EXTREME STALL MONITOR

The Variable Geometry Diffuser 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 (10 to 20 minutes; default 10), the VGD is driven to the full open 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 (VGD Limit Switch closed).
- While the Pre-rotation Vanes position is greater than the PRV VGD Inhibit setpoint.

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.

- Surge React Time (1-30 seconds; default 5) - Specifies the duration of the close pulse applied to the VGD in response to a surge.

- 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 Time (0.5-15 minutes; default 10) – Specifies how long the VGD control remains in the Stall Waiting or Surge Waiting states before entering the Probing state.
- Open Pulse (1-5 seconds; default 1) – Specifies the length of the open pulse applied to the VGD during 10 second periods while in the Probing state.
- High Limit (0.35 to 1.2VDC; default 0.6V – 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 0.01VDC. If a Low Limit setpoint is entered which is less than 0.01VDC below the High Limit setpoint, the High Limit setpoint is adjusted so that it is 0.01VDC above the newly entered Low Limit value.

- Low Limit (0.3-0.8VDC; default 0.5V – 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 0.01VDC. If a Low Limit setpoint is entered which is less than 0.01VDC below the High Limit setpoint, the High Limit setpoint is adjusted so that it is 0.01VDC above the newly entered Low Limit value.

- 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.
- PRV VGD Inhibit (40% -100%; default 100% - While the re-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.

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 connects to the microboard J7.

STALL TRANSDUCER

Detects stall noise as high frequency pressure fluctuations in the discharge scroll of the compressor. It converts the pressure pulsations to DC voltage pulsations and applies them to the Stall Detector Board. Chillers are shipped with Stall Transducer 025-40088-000. Connections at the transducer connector are as follows:

Transducer 025-40088-000

pin 1 - +5VDC supply voltage - RED

pin 2 - ground - BLK

pin 3 - signal out - WHT

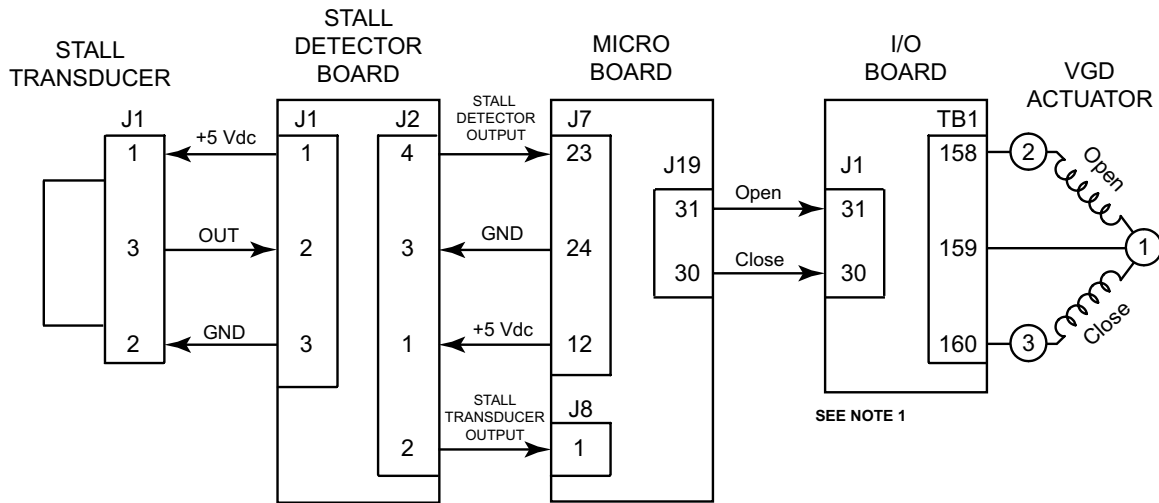
STALL DETECTOR BOARD

The Stall Detector Board (031-02418-000) converts the Stall Transducer DC voltage pulsations to an analog DC voltage output (J2-4) that represents the magnitude of stall noise and applies it to the microboard (J7-23). This board also provides a path for the Stall Transducer unprocessed DC voltage pulsations output to be connected from J2-2 to the microboard (J8-1). This output is used for the Stall Sensor Validation feature.

031-02418-001

This board contains a filter that removes the noise associated with high gas flow/low head conditions and thus prevents VGD closing in response to conditions that are not true stall conditions.

- The Stall Detector Board outputs an analog voltage (displayed as STALL DETECTOR VOLTAGE on the VGD Screen) that represents the magnitude of stall noise present. When it reaches the value programmed as the High Limit setpoint (typically set to 0.6VDC), the VGD closes until the voltage decreases to the Low Limit setpoint (typically set to 0.5VDC). It may be necessary to lower the High Limit and Low Limit setpoints if valid stall conditions are not being detected or surge occurs before stall is detected. Ideally, stall should be detected before surge occurs, allowing the VGD to react prior to surge. Also, since the PRV Position – VGD Inhibit Setpoint was the original vehicle to avoid VGD reaction to high gas flow/low head conditions, this setpoint should be set to 95% or 100% to avoid interference.



NOTES:

1. Requires I/O Board 031-01743-001

LD19806

FIGURE 45 - VARIABLE GEOMETRY DIFFUSER BLOCK DIAGRAM

[illegible]

1. Software version C.OPT.01.23.307 (and later),

JOHNSON CONTROLS

SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001

New chillers equipped for the Heat Recovery Control option will be equipped with Input/Output Board 031-02895-000. It provides both Analog and Digital Input/Output capability to the microboard from external devices. *Figure 47 on Page 150* is a top level block diagram of this board. *Figure 48 on Page 150 through Figure 54 on Page 153* show details of the I/O circuits and should be referred to while reading the following description of the board operation. *Figure 55 on Page 154* is a board layout showing component identification.

The board is manufactured with either a -000 or -001 part number suffix. The -000 board is only populated with the components required for options requiring small additional I/O counts. The -001 board is for future use.

This board operates from +12VDC (TP3) and +24VDC (TP4) power supply voltages. The +12VDC applied to the +5VDC regulator produces a +5VDC regulated output (TP2), which causes the POWER LED (CR3) to illuminate. These voltages are referenced to GND (TP1).

Power fail circuits detect low DC voltage and put the processor into a reset state as long as the voltage is below a threshold. This prevents the processor from processing data while the DC Voltage is below the minimum required for stable circuit operation. The low voltage reset thresholds are:

- +5VDC supply @ 4.41VDC-4.87VDC
- +12VDC supply @ 9.6VDC-11.2VDC

When the I/O Board is operating, the STATUS LED (CR8) flashes at a regular interval (1/sec) indicating that the board is functional.

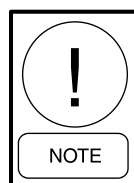
This board communicates with the microboard COM 3 serial port (J12) using Modbus Protocol RS-485 serial communications. When a read/write request is sent from the microboard, the microboard's TX3 (CR15) LED illuminates. When that request is received at the I/O Board, the I/O Board's RX (CR4) LED illuminates. When the I/O Board responds, the I/O Board's TX (CR5) LED illuminates. When the response is received at the microboard, the microboard's RX3 (CR16) illuminates.

Each read/write request from the microboard contains a Modbus Net address. In order for the I/O Board to respond to the microboard's requests, the Modbus Net address of the I/O Board must match the one sent from the microboard. The Modbus Net address of the I/O Board is set with 4 position DIP switch SW1, labeled NET ADDRESS. This should be set to "1" by setting SW1-1 to ON and the other segments to OFF.

The operating program is stored in the processor. The program is downloaded into the processor through the J1 programming port at the time of board manufacture. Service replacement boards are provided preloaded with the proper software. It is not necessary to field load software into the board.

Refer to the following sections of this manual for a description of how this board is interfaced for these applications:

- **Hot gas bypass** - *SECTION 19 - HOT GAS BYPASS*
- **Heat Recovery** - *SECTION 24 - HEAT RECOVERY*
- **Head Pressure Control** - *SECTION 25 - HEAD PRESSURE CONTROL*



Important! *These are not general purpose I/O points available for field use. Unless specifically listed in above referenced sections of this manual, the I/O point cannot be used.*

DIGITAL INPUTS

120VAC Digital inputs

These inputs accept a 120VAC input. *Figure 48 on Page 150* is a detail of this input and is representative of all of these inputs. Each input is applied to the respective (+) and (-) input. Each input is applied to an opto-coupler circuit that converts the AC voltage to a DC voltage. Each input has an LED associated with it. The respective LED illuminates when the 120VAC input is present. Otherwise, it is extinguished. The -000 board is component populated for 2 inputs. The -001 board is populated for 6 inputs.

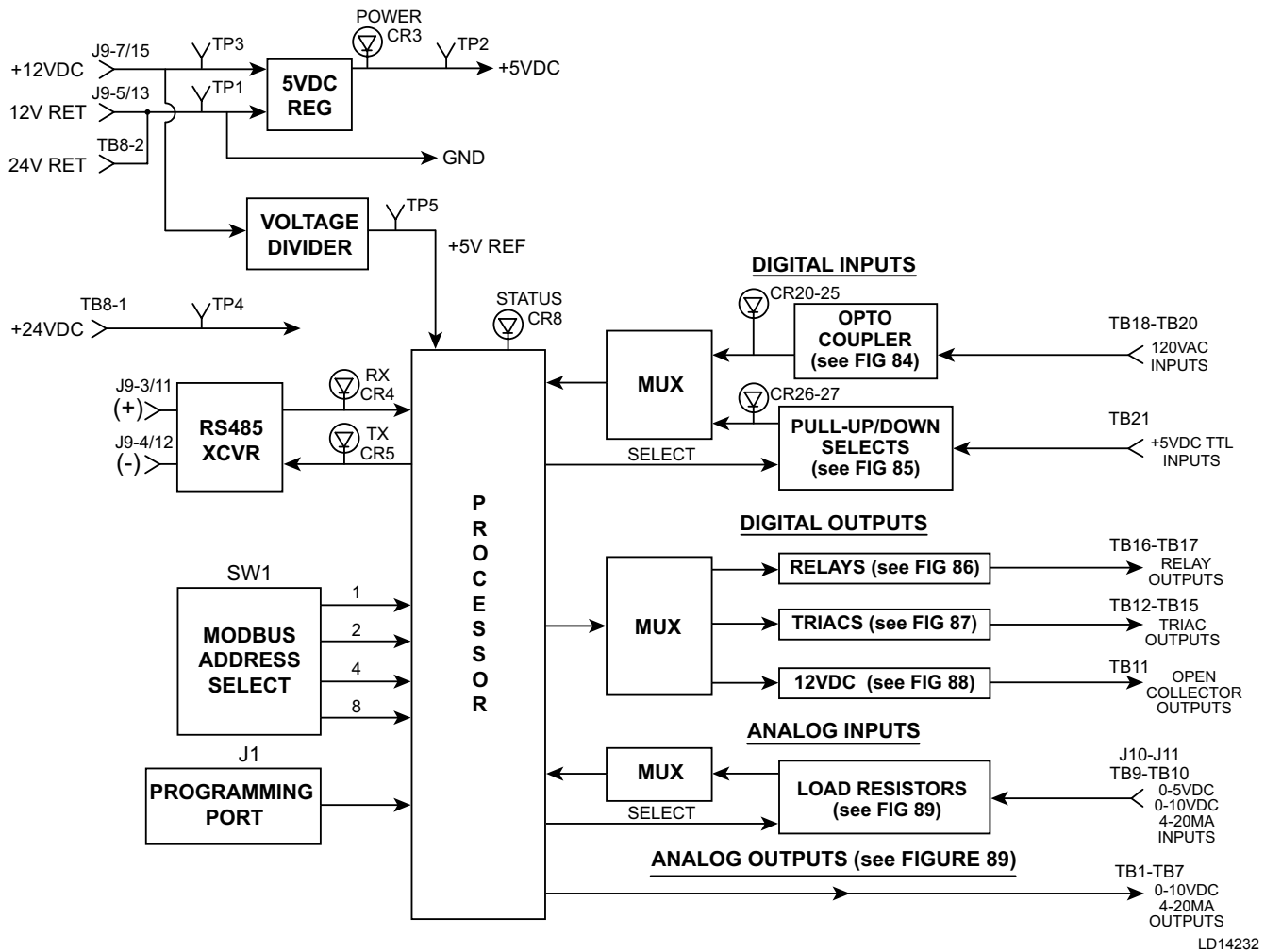


FIGURE 47 - LTC I/O BOARD BASIC BLOCK DIAGRAM

INPUT	CONNECTION	LED
DI1	TB20-1(+) -2(-)	CR20
DI2	TB20-3(+) -4(-)	CR21
DI3	TB19-1(+) -2(-) (-001 board only)	CR22
DI4	TB19-3(+) -4(-) (-001 board only)	CR23
DI5	TB18-1(+) -2(-) (-001 board only)	CR24
DI6	TB18-3(+) -4(-) (-001 board only)	CR25

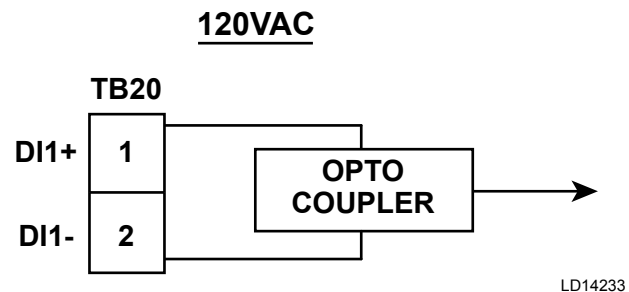


FIGURE 48 - 120VAC DIGITAL INPUT

+5VDC Digital inputs (-001 Board only)

There are 2 each +5VDC TTL inputs. *Figure 49 on Page 151* is a detail of an input and is representative of all of these inputs. Each input accepts an open/close input that can be configured in either pull-up configuration (+5VDC when open/0VDC when closed) or pull-down configuration (0VDC when open/+5VDC when closed). It is connected between the +5VDC and the DI input for a pull-up configuration; between the GND and DI input for a pull-down configuration. Under Program control, the pull-up/pull-down selector switch connects the input load resistor to either +5VDC (pull-up) or ground (pull-down) per the requirements of the input.

INPUT	CONNECTION	LED
DI7	TB21-1 +5VDC -2 DI7 -3 GND	CR26
DI8	TB21-4 +5VDC -5 DI8 -6 GND	CR27

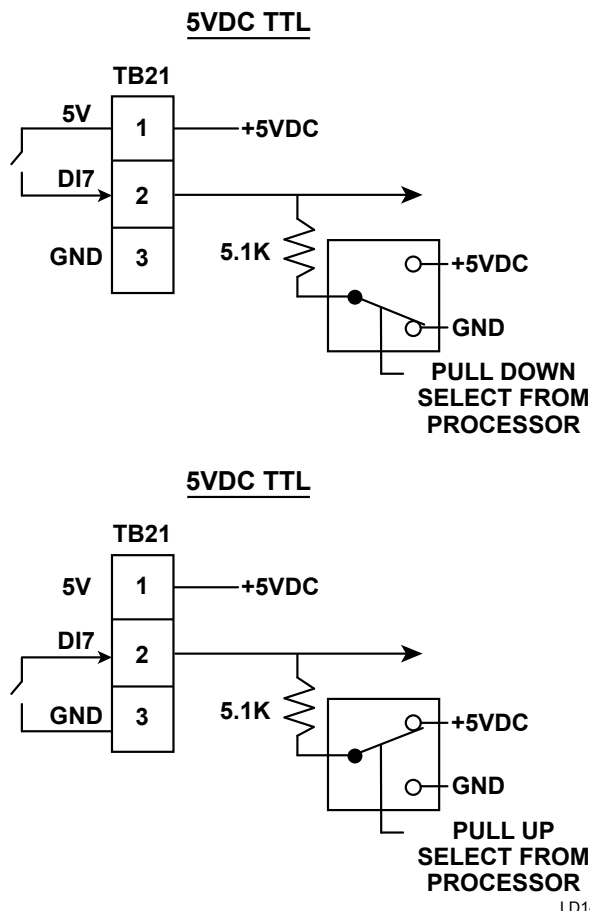


FIGURE 49 - +5VDC DIGITAL INPUT

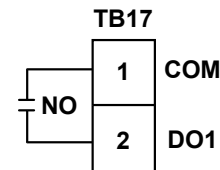
DIGITAL OUTPUTS

Relay Outputs (-001 Board only)

There are 2 each 120/240VAC relay contact outputs. *Figure 50 on Page 151* is a detail of an output and is representative of all these outputs. Each relay has one set of normally open contacts that are closed and opened under Program control. The relay contact rating is 250VAC, 5 amps resistive, 2 amps inductive. Each output is connected between the respective COM(X) and NO(X) terminals.

OUTPUT	CONNECTION
DO1	TB17-1 COM1 -2 NO1
DO2	TB16-1 COM2 -2 NO2

RELAY OUTPUTS



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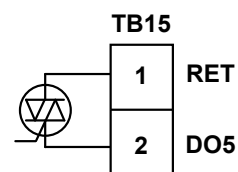
FIGURE 50 - RELAY OUTPUTS

Triac Outputs (-001 Board only)

There are 4 each 24/120VAC triac outputs. *Figure 51 on Page 151* is a detail of an output and is representative of all these outputs. Each output can switch 2 amps at 17-132VAC. Each output is connected between the respective RET and DO(X) connection.

OUTPUT	CONNECTION
DO5	TB15-1 Ret -2 DO5
DO6	TB14-1 Ret -2 DO6
DO7	TB13-1 Ret -2 DO7
DO8	TB12-1 Ret -2 DO8

TRIAC OUTPUTS



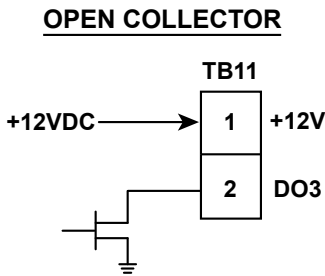
LD14234

FIGURE 51 - TRIAC OUTPUTS

Open Collector Outputs (-001 Board only)

There are 2 each open collector outputs. *Figure 52 on Page 152* is a detail of an output and is representative of all these outputs. Each output switches a ground connection through an onboard solid state device to an external load connected to the board supplied +12VDC power source. Each output is connected between the respective +12VDC and DO(X) terminals.

OUTPUT	CONNECTION
DO3	TB11-1 +12VDC -2 DO3
DO4	-3 +12VDC -4 DO4



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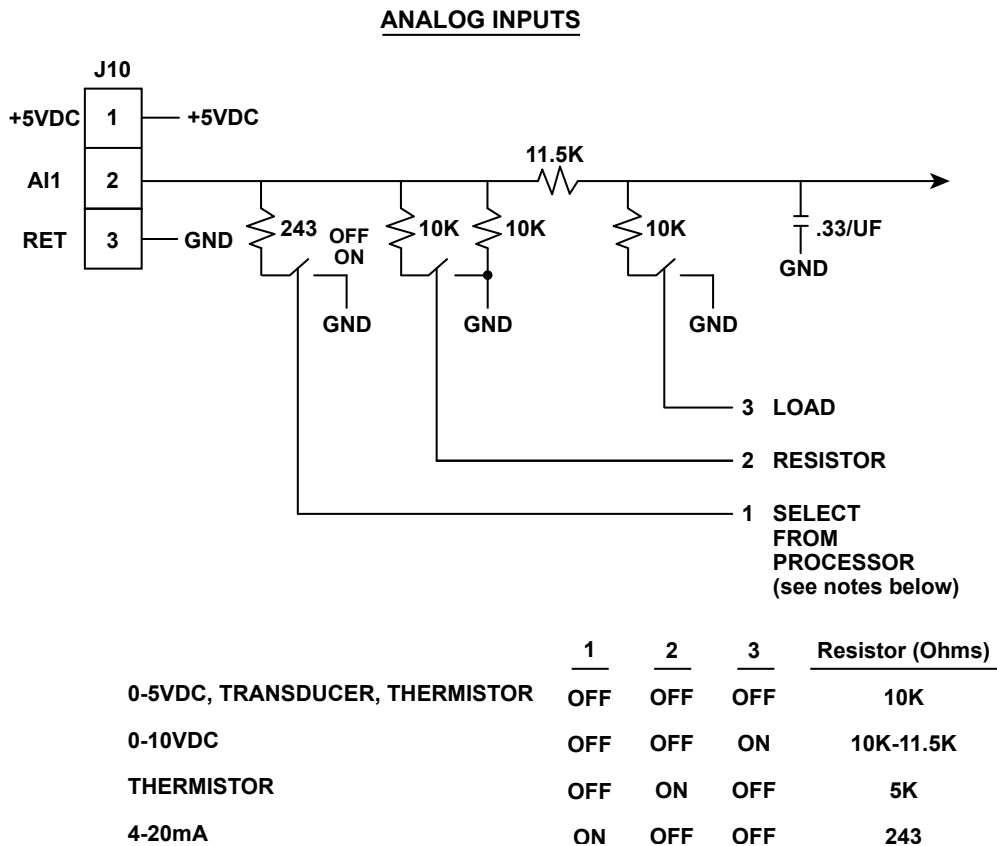
FIGURE 52 - OPEN COLLECTOR

ANALOG INPUTS

There are 8 each Analog Inputs on the -000 board and 16 each on the -001 board. *Figure 53 on Page 152* is a detail of this input and is representative of all these inputs. Each input accepts either a 0 to 5VDC, 0 to 10VDC, 4 to 20mA, Transducer or Thermistor input. The on-board software configures each input per the requirements of the input type. The configuration consists of selecting the appropriate input series resistor to ground. The software closes the appropriate switch(s) (1, 2, 3), selecting the appropriate input resistor. *Figure 53 on Page 152* shows the switch settings and resistance values for each input type.

Inputs AI7 and AI8 have dual input connectors that allow either a pin/socket connection or screw terminal connection as shown below.

Thermistors and transducers operate from the board supplied +5VDC supply voltage. To compensate for a varying +5VDC supply voltage, this voltage is compared to a precise +5VDC reference. The output of the device is adjusted according to any difference.



LD14235A

FIGURE 53 - ANALOG INPUTS

INPUT CONNECTION

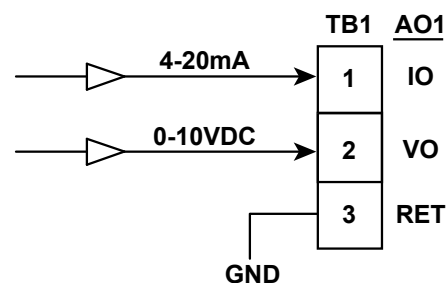
AI1	J10-1 +5VDC -2 AI1 -3 Ret
AI2	J10-4 +5VDC -5 AI2 -6 Ret
AI3	J10-7 +5VDC -8 AI3 -9 Ret
AI4	J10-10 +5VDC -11 AI4 -12 Ret
AI5	J10-13 +5VDC -14 AI5 -15 Ret
AI6	J10-16 +5VDC -17 AI6 -18 Ret
AI7	J10-19 +5VDC -20 AI7 or TB9-1 -21 Ret TB9-2
AI8	J10-22 +5VDC -23 AI8 or TB9-3 -24 Ret TB9-4
AI9	J11-1 +5VDC (-001 board only) -2 AI9 -3 Ret
AI10	J11-4 +5VDC (-001 board only) -5 AI10 -6 Ret
AI11	J11-7 +5VDC (-001 board only) -8 AI11 -9 Ret
AI12	J11-10 +5VDC (-001 board only) -11 AI12 -12 Ret
AI13	J11-13 +5VDC (-001 board only) -14 AI13 -15 Ret
AI14	J11-16 +5VDC (-001 board only) -17 AI14 -18 Ret
AI15	J11-19 +5VDC (-001 board only) -20 AI15 -21 Ret
AI16	J11-22 +5VDC (001 board only) -23 AI16 -24 Ret

ANALOG OUTPUTS

There are five analog outputs on the -000 board and seven on the -001 board. *Figure 54 on Page 153* is a detail of this input and is representative of all these inputs. Each output can provide a 0 to 10VDC output (between terminals 2 and 3) or 4 to 20mA output (between terminals 1 and 3).

OUTPUT	CONNECTION
AO1	TB1-1 4 to 20mA -2 0-10V -3 Ret
AO2	TB2-1 4 to 20mA -2 0-10V -3 Ret
AO3	TB3-1 4 to 20mA -2 0-10V -3 Ret
AO4	TB4-1 4 to 20mA -2 0-10V -3 Ret
AO5	TB5-1 4 to 20mA -2 0-10V -3 Ret
AO6	TB6-1 4 to 20mA (-001 board only) -2 0-10V -3 Ret
AO7	TB7-1 4 to 20mA (-001 board only) -2 0-10V -3 Ret

ANALOG OUTPUTS



LD14236

FIGURE 54 - ANALOG OUTPUTS

DIAGNOSTIC SCREEN

The DIAGNOSTIC Screen (Refer to *Figure 69 on Page 210*), accessible from the MAIN DIAGNOSTICS Screen, is used to analyze the analog and Digital inputs and outputs. It is also used to manually control the digital outputs and set analog output voltages.

There are two versions of this screen available as follows:

Service Access level

The voltage value of each analog input at the board input terminals/pins, as interpreted by the I/O Board and transmitted to the microboard, is displayed as ANALOG INPUTS.

The voltage value sent from the microboard to the I/O board for analog output displays as ANALOG OUTPUTS.

The ON/OFF status of the Digital inputs and Digital Outputs are indicated with an LED. It is illuminated when the input or output is on; extinguished when it is off.

Modbus communication error counters are displayed as follows, along with the ability to reset the counters:

- ID faults – This is the number of packets received with an incorrect slave ID.
- Checksum errors – This is the number of checksum errors encountered in communication.
- Error packets – This is the number of error packets received.
- Timeout Faults – Number of timeout faults encountered. A timeout is registered when no valid response is received for a poll within two seconds.

SERVICE access level plus Microboard DIP Switch 1-3 to ON.

In addition to the displays above, the following can be performed.

The digital outputs can be individually turned on or off. Use the SELECT DIGITAL OUTPUTS key to select the desired output, then use the ENABLE and DISABLE keys to turn it on or off.

The analog outputs can be individually set to a desired voltage value. Use the SELECT ANALOG OUTPUT key to select the desired output, then use the numeric keys to set it to the desired value.

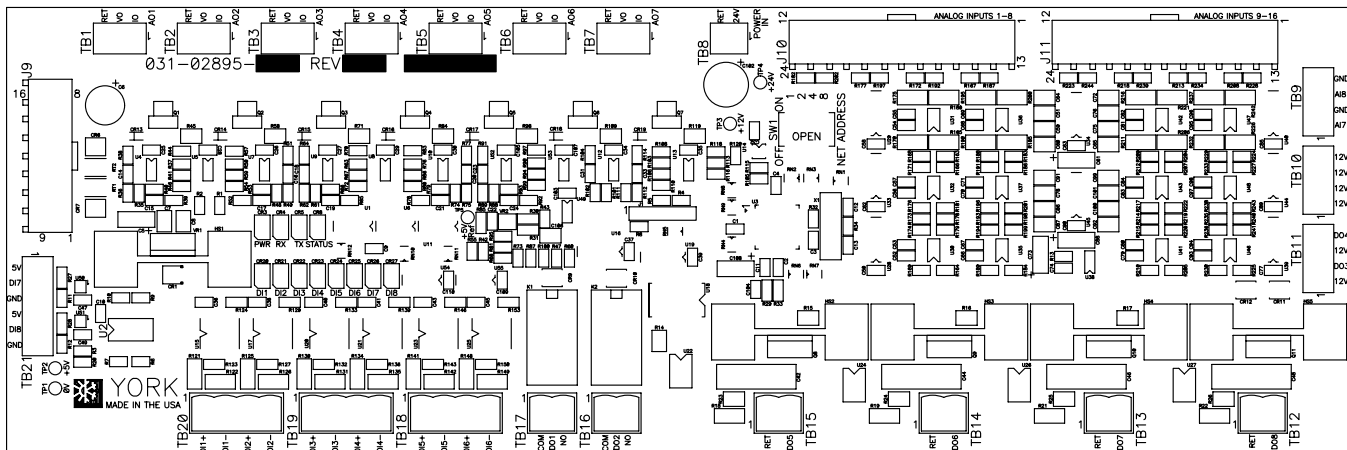


FIGURE 55 - I/O BOARD (031-02895-XXX)

LD14349

SECTION 24 - HEAT RECOVERY

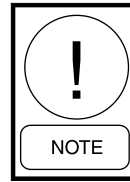
This option uses two tube bundles in the condenser. The lower bundle is the standard condenser bundle and is piped to the cooling tower water source. The upper tube bundle is used to recover waste heat rejection for use in a closed loop heating circuit. Chillers equipped with this feature are also equipped with the Hot gas bypass feature.

On a heat recovery chiller, the chiller primary control remains the cooling load. So, the compressor capacity is still functioning according to the Leaving Chilled Water Temperature setpoint.

The desired hot water temperature leaving the heating bundles is obtained by regulating the heat rejection through the standard lower tube bundle (sourced by cooling tower or other water circuit). This is done by controlling the temperature of the Return Condenser Water Temperature (by tower bypass circuit to elevate the temperature of the return condenser water) or varying the condenser water flow. This control can be performed by the OptiView™ Control Center or an external controller. If the OptiView™ Control Center is used to perform this control, The Heat Recovery Control Valve is modulated to control the Leaving Heating Condenser Water Temperature to the Hot Water setpoint. The control output to the valve is Direct Acting (when the Leaving Heating Condenser Water Temperature rises above the Hot Water setpoint, the valve is driven more open to provide greater cooling to the standard lower tube bundle).

The heat recovery bundle is provided with a Leaving Heating Condenser Water Thermistor, Return Heating Condenser Water Thermistor and a Heating Condenser Water Flow Switch. The heat recovery circuit control is only active when the flow sensor indicates flow.

If the chiller is equipped for Heat Recovery, the feature must be ENABLED on the SETUP Screen. Otherwise, it must be DISABLED. Once enabled, the HEAT RECOVERY Screen is available from the CONDENSER Screen. All of the Heat Recovery parameters are displayed on this screen. If Head Pressure Control is also enabled, the Head Pressure parameters appear on the HEAT RECOVERY Screen (there is no separate HEAD PRESSURE CONTROL screen in this configuration).



The heat recovery feature cannot be used with the Heat Pump feature. If HEAT PUMP Duty is enabled, heat recovery will be disabled and locked.

INPUTS/OUTPUTS

The I/O used for the heat recovery feature is:

- Leaving Heating Condenser Water Temperature Thermistor input
- Entering Heating Condenser Water Temperature Thermistor input
- Heating Condenser Water Flow Switch input (paddle or thermal type)
- Heat Recovery Control Valve output (0 to 10VDC or 4 to 20mA)

The above are interfaced to the LTC I/O Board 031-02895-000 as shown in *Figure 56 on Page 156* (the thermal flow switch connects directly to the microboard). The operation of this I/O Board is explained in *SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001*. The microboard communicates with this board using RS-485 Modbus serial communications. The microboard reads the Heating Condenser Water Temperature Thermistors and the Flow Switch status via this interface. The microboard directly drives the Heat Recovery Control Valve via a 0 to 10VDC or 4 to 20mA output.

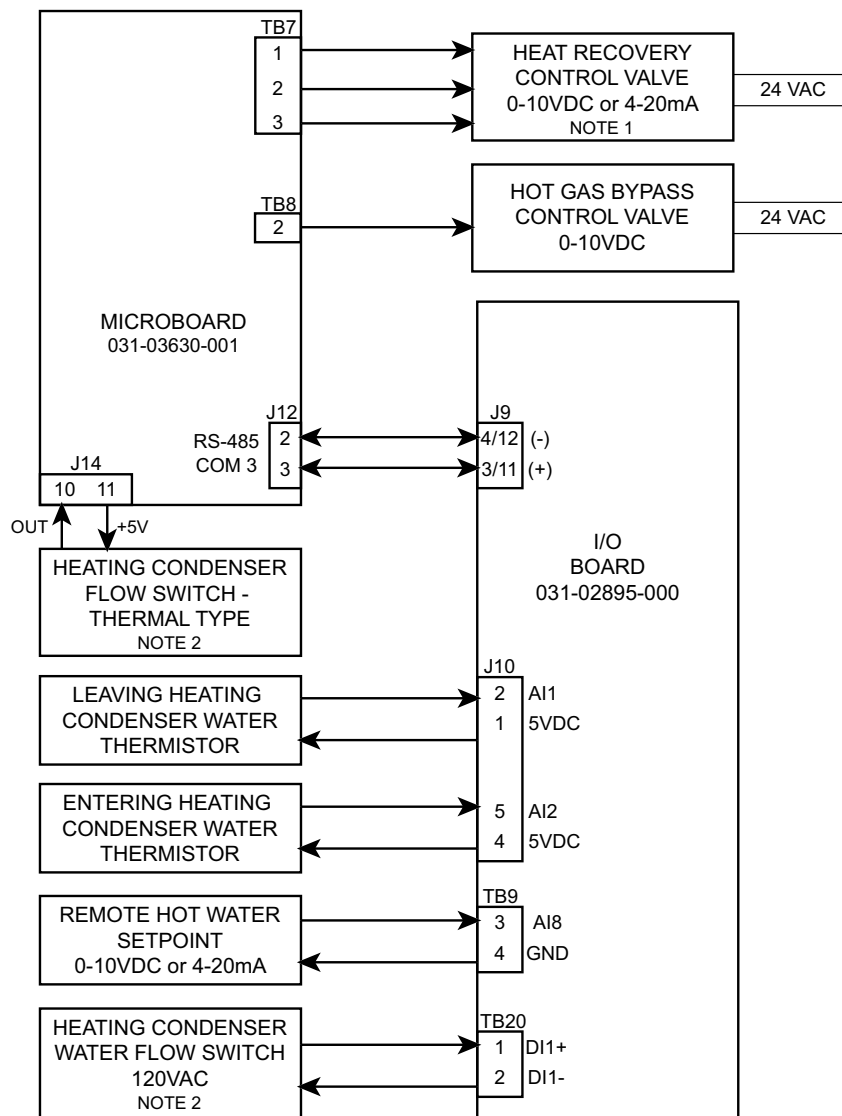
To convert the heating condenser thermistors voltage output to a (°F) temperature value.

CONTROL

If the OptiView™ Control Center is used to control the heat recovery valve, then the hot water control setpoint on the HEAT RECOVERY screen must be enabled. If disabled, only the heat recovery inputs are displayed. When enabled, all of the control parameters are displayed on this screen as described below.

Setpoints

- Hot Water Control setpoint – (Extended temp range equals 65.0°F to 125.0°F; default 95.0) (Standard temp range equals 65.0°F to 112°F; default 95.0) Sets the temperature that the Leaving Heating Condenser Water Temperature will be controlled to Displayed as Active Hot Water setpoint.



NOTES:

- If Head Pressure Control is ENABLED and Hot Water Control is DISABLED or if Hot Water Control is ENABLED but there is NO water flow in the heating condenser, valve control will automatically switch over to the Head Pressure Control.
- The chiller could be equipped with either paddle/differential pressure (120VAC) type or Thermal Type (+5VDC) flow switches. Each Type must be connected as shown.

LD19807

FIGURE 56 - HEAT RECOVERY BLOCK DIAGRAM

- Control Valve Output Settings:
 - a. TYPE – Makes the control signal to the Heat Recovery Control Valve either 0 to 10VDC or 4-20mA (default 0 to 10VDC).
 - b. PID OUTPUT – Makes the control signal to the Heat Recovery Control Valve either Direct or Reverse acting (default Direct). Set to Direct for this application.
 - c. SET – Is used to manually set the Heat Recovery Control Valve to any position between 0.0% and 100%.
 - d. AUTO – Returns the Heat Recovery Control Valve to Automatic Control Mode (default Auto).
- Hot Water Control – Sets the proportional gain of the control:

P – Sets the proportional gain of the control over the range of 0.00 to 5.00 (default 2.00)

I – Sets the integral gain of the control over the range of 0.0 to 5.00 (default 2.00)

D – Sets the derivative gain of the control over the range of 0.0 to 5.00 (default 0.00)

- Remote Input Type – Configures the LTC I/O Board input (TB9-3/4) to accept either a 0-10Vdc or 4 to 20mA input signal type for the Remote Hot Water setpoint input.

When Hot Water Control is active, the Control Valve Output is modulated by a direct acting PID control. The inputs to the PID control are the Leaving Heating Condenser Water Temperature and the Hot Water setpoint (the Active Hot Water setpoint displays the setpoint in use). The PID control error is defined as (Hot Water setpoint – Leaving Heating Condenser Water Temperature). The PID control's proportional, integral and derivative gains are programmable using the CHANGE SETPOINTS key. The Control Valve position is displayed as 0.0% to 100% in the box labeled CONTROL VALVE OUTPUT. The control output to the valve is Direct Acting (when the Leaving Heating Condenser Water Temperature rises above the Hot Water Setpoint, the valve is driven more open to provide greater cooling to the standard lower tube bundle). The following diagram shows the PID controller.

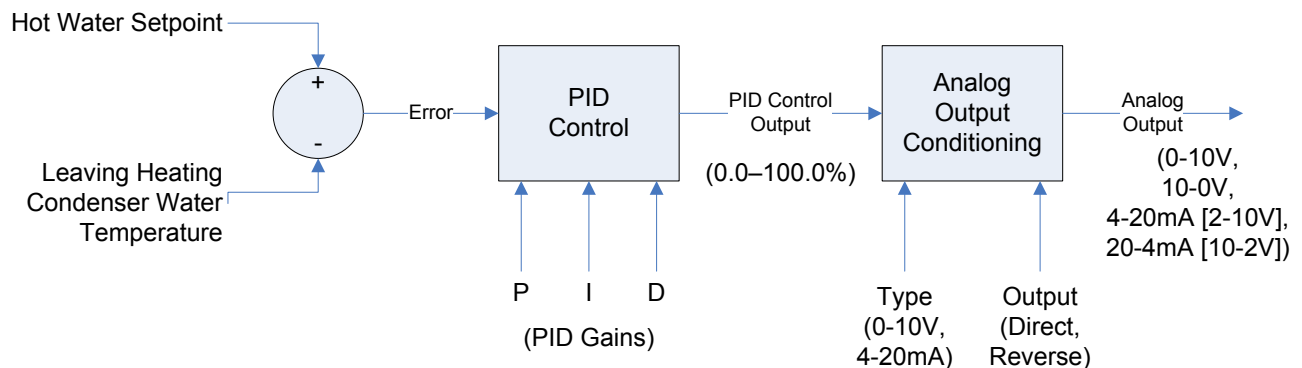


FIGURE 57 - PID CONTROLLER DIAGRAM

The Control Valve Output Settings keys are used to configure the output signal to the Heat recovery Control Valve. The Type setpoint is used to make the control signal either 0 to 10VDC or 4 to 20mA. The Auto setpoint is used to place the control in Automatic Mode. The Set setpoint places the valve control in manual. It is used to manually position the control valve at any position between 0.0% and 100%. The Control Valve Control Mode shall be reset to Auto upon logging out of Service Level Access. The Control Valve Control Mode data box displays the Operating Mode as MANUAL or AUTO as appropriate.

The PID Output setpoint is used to configure the signal to the Control Valve to be DIRECT or REVERSE acting (default DIRECT). In this application, it should be set to DIRECT. The output for each setting is per the following table:

CONTROL VALVE OUTPUT TYPE	PID OUTPUT	PID CONTROL 0% OUTPUT	PID CONTROL 100% OUTPUT
0-10V	Direct	0V	10V
0-10V	Reverse	10V	0V
4 to 20mA	Direct	4mA (2V)	20mA (10V)
4 to 20mA	Reverse	20mA (10V)	4mA (2V)

If the chiller is equipped with both Heat Recovery and Head Pressure Control (See *SECTION 25 - HEAD PRESSURE CONTROL*) and both are enabled, there is not a Control Valve for each feature. Rather, there is one common valve that is either performing Hot Water Control for Heat Recovery or it is performing Head Pressure Control. It will not be performing control for both features at the same time. Normally, it will be performing Hot Water Control until certain operating conditions cause it to switch over to Head Pressure Control. The PID Control Mode displays which feature is controlling the valve at any given time. When performing Hot Water Control, HOT WATER is displayed. When performing Head Pressure Control, HEAD PRESSURE is displayed. There are also conditions under which it not controlling either feature, in which case INACTIVE is displayed and the valve is set to 0% position. Which feature is controlling the valve at any instant and when it is inactive is determined by operating conditions as shown in the following flow chart.

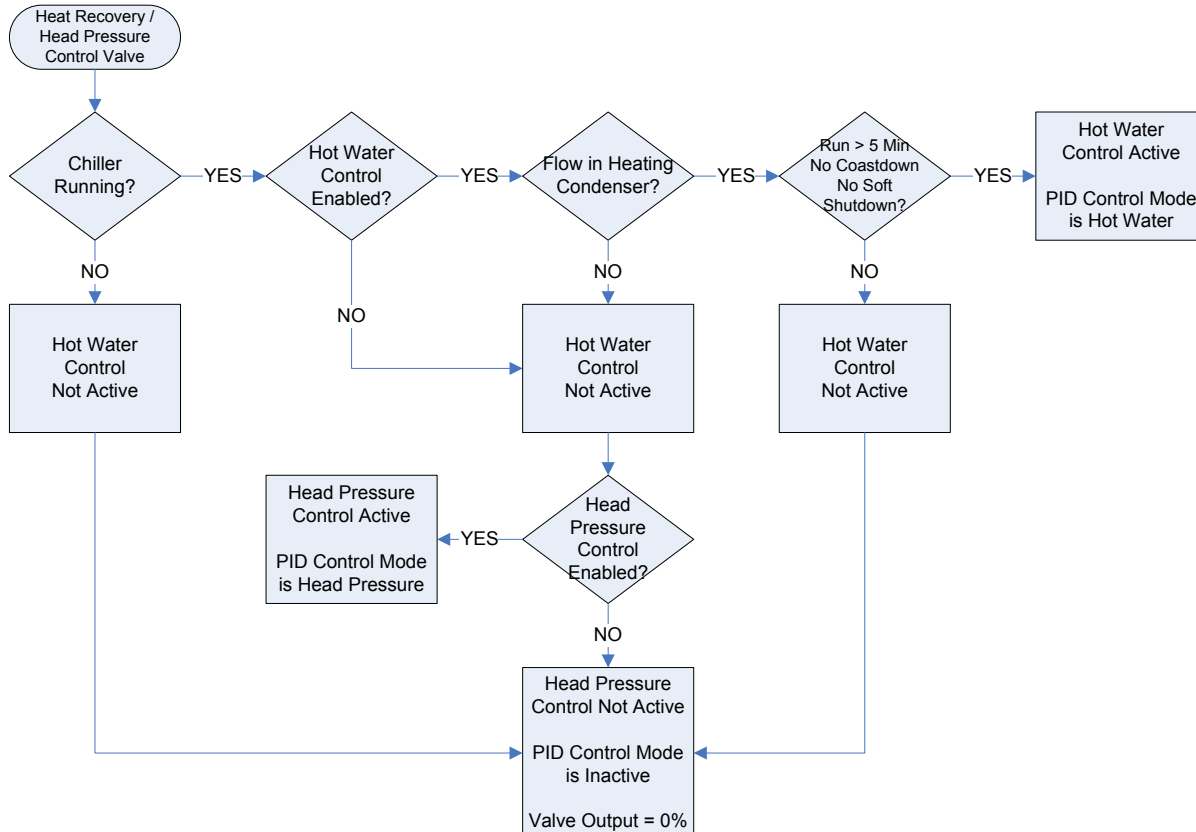


FIGURE 58 - HEAT RECOVERY FLOW DIAGRAM

REMOTE HOT WATER SETPOINT

The Hot Water setpoint can be remotely changed based on the chiller's Control Source setting. The Active Hot Water setpoint will contain the actual setpoint being used for Hot Water Control. The following table shows what setpoint is used based on the Control Source.

The allowable range for the Active Hot Water setpoint is the same as the Local Hot Water setpoint. If a remote value is received that is greater than the maximum, the active setpoint shall be set to the maximum. If a remote value is received that is less than the minimum, the active setpoint shall be set to the minimum. The Remote Hot Water setpoint Input Type selects the type of input signal to be used (0-10V or 4 to 20mA) when the Control Source is set to Analog.

The Remote Input Type setpoint is used to configure the LTC I/O Board input TB9-3/4 to accept either a 0 to 10VDC or 4 to 20mA input for the Remote setpoint input. This setpoint must be set to the same value for the actual input applied. Otherwise, the remote setpoint will not be interpreted correctly. The Active Hot Water setpoint data box displays the remote setpoint that is in effect.

CONDENSER FLOW SWITCH OPEN FAULT

The CONDENSER-FLOW SWITCH OPEN Cycling Shutdown is changed when Heat Recovery is enabled. It shall shut the unit down only if both the Condenser Flow Switch and the Heating Condenser Flow Switch are open using the same timing as in the current logic. If either flow switch is closed, the chiller will not shut down.

TABLE 15 - CONTROL SOURCE SETPOINTS

ACTIVE HOT WATER SETPOINT	CONTROL SOURCE	INPUT	DESCRIPTION
Hot Water Setpoint	Local and Digital	Heat Recovery Screen	Locally programmed value
Remote Hot Water Setpoint	BAS	YORK Talk III Comms	Remote value via communications (GPIC List)
Remote Hot Water Setpoint Offset	Analog	Analog Input	Offset added to local Hot Water Setpoint 0V = -0°F offset, 10V = -20°F offset 4mA = -0°F offset, 20mA = -20°F offset

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SECTION 25 - HEAD PRESSURE CONTROL

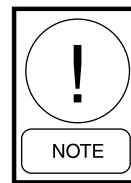
(SOFTWARE VERSION C.OPT.01.21.307 AND LATER)

YK chillers are capable of operation within a wide range of condenser water temperatures. However, a minimum condenser water temperature, as specified in the Engineering Guide, is required to maintain sufficient pressure differential (head) between the condenser and evaporator for proper oil and refrigerant management in the chiller.

Should colder condenser water temperatures be anticipated at the cooling source, a field mounted facility control means may be provided to ensure adequate head pressure exists. The preferred means would be a cooling tower bypass circuit that maintains a constant flow rate through the condenser, since this would maintain adequate tube velocity in the condenser, while regulating the return cooling water to the condenser. However, a two-way condenser water throttling valve, a variable speed cooling tower pump, or tower fan control circuit might also be employed.

The head pressure control function provides an analog output control signal from the OptiView™ Control Center that responds to the programmed Head Pressure (Condenser Pressure minus Evaporator Pressure) setpoint. The output is direct acting (as the Head Pressure increases above the setpoint, the valve is driven more open to provide less tower bypass or more flow through the condenser).

If the chiller is equipped for Head Pressure Control, the feature must be ENABLED on the SETUP Screen using the Head Pressure Control setpoint. Otherwise it must be DISABLED. Once enabled, the HEAD PRESSURE CONTROL Screen is available from the CONDENSER Screen. All of the Head Pressure Control parameters are displayed on this screen. If Heat Recovery is also enabled, the Head Pressure parameters appear on the HEAT RECOVERY Screen (there is no separate HEAD PRESSURE CONTROL Screen in this configuration).



The Head Pressure feature cannot be used with the Heat Pump feature. If HEAT PUMP Duty is enabled, Head Pressure will be disabled and locked.

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INPUTS/OUTPUTS

The I/O used for Head Pressure Control feature is:

- Evaporator Transducer
- Condenser Transducer
- Head Pressure Control Valve output (0 to 10VDC or 4 to 20mA)

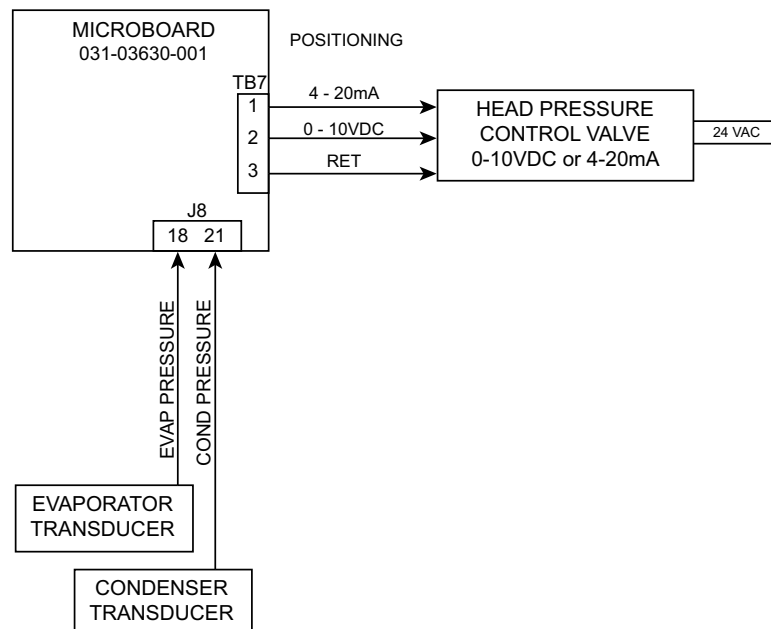


FIGURE 59 - HEAD PRESSURE CONTROL BLOCK DIAGRAM

The evaporator and condenser transducers are connected to the microboard as shown in *Figure 59 on Page 161*. This provides the head pressure (condenser minus evaporator) to the microboard. The Head Pressure Control Valve is driven by the Analog Output on the 03630 microboard.

CONTROL

When Head Pressure Control is enabled, all the following programmable settings and applicable parameters are available on the HEAD PRESSURE CONTROL Screen (or HEAT RECOVERY Screen, if Heat Recovery is enabled).

Setpoints

- Head Pressure setpoint (15.0 PSID to 60.0 PSID; default 23 PSID) - Sets the Head Pressure that the control will control to. Value entered is displayed as Head Pressure setpoint.
- Control Valve Output Settings:
 - TYPE – Makes the control signal to the Head Pressure Control Valve either 0 to 10VDC or 4-10mA (default 0 to 10VDC).
 - PID OUTPUT – Makes the control signal to the Head Pressure Control Valve either Direct or Reverse acting (default Direct). Set to Direct for this application.
 - SET – Is used to manually set the Head Pressure Control Valve to any position between 0.0% and 100%.
 - AUTO – Returns the Head Pressure Control Valve to Automatic Control Mode (default Auto).

- Head Pressure Control – Sets the proportional gain of the control:

P- Sets the proportional gain of the control over the range of 0.00 to 5.00(default 2.00).

I – Sets the integral gain of the control over the range of 0.0 to 5.00 (default 2.00).

D – Sets the derivative gain of the control over the range of 0.0 to 5.00 (default 0.00).

When Head Pressure Control is enabled, the Control Valve Output is modulated by a direct acting PID control. The inputs to the PID control are the chiller Head Pressure (Condenser Pressure – Evaporator Pressure) and the Head Pressure setpoint. The PID control error is defined as Head Pressure setpoint – Head Pressure. The PID control's proportional, integral and derivative gains are programmable using the CHANGE SETPOINTS key. The Control Valve position is displayed as 0.0% to 100% in the box labeled CONTROL VALVE OUTPUT. The control output to the valve is direct acting (as the Head Pressure increases above the setpoint, the valve is driven more open to provide less tower bypass or more flow through the condenser). The following diagram shows the PID controller.

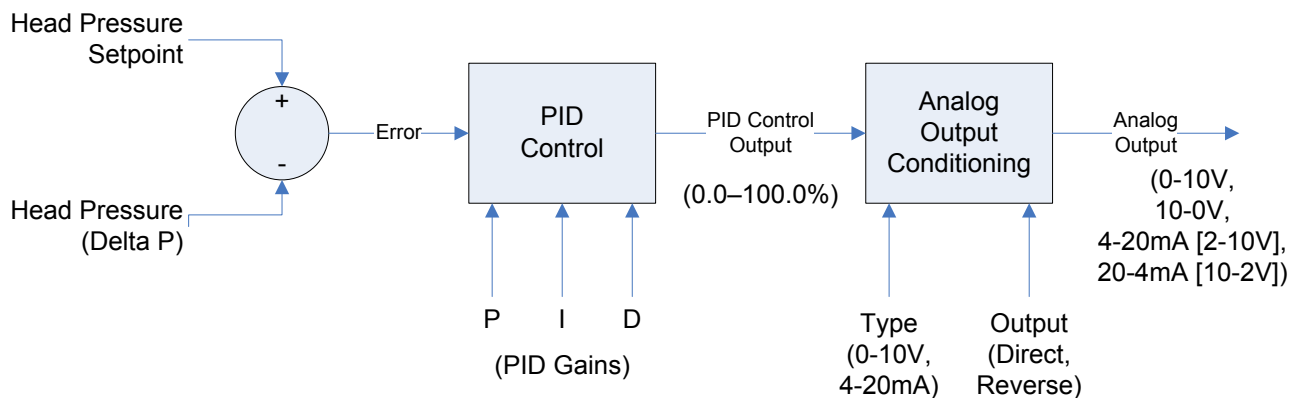


FIGURE 60 - HEAD PRESSURE CONTROL FLOW DIAGRAM

The Control Valve Output Settings keys are used to configure the output signal to the Heat Recovery Control Valve. The Type setpoint is used to make the control signal either 0 to 10VDC or 4 to 20mA.

The Auto setpoint is used to place the control in Automatic Mode. The Set setpoint places the valve control in manual. It is used to manually position the control valve at any position between 0.0% and 100%. The Control Valve Control Mode shall be reset to Auto upon logging out of Service Level Access. The Control Valve Control Mode data box displays the operating Mode as MANUAL or AUTO as appropriate.

The PID Output setpoint is used to configure the signal to the Control Valve to be DIRECT or REVERSE acting (default DIRECT). In this application, it should be set to DIRECT. The output for each setting is per the following table.

CONTROL VALVE OUTPUT TYPE	PID OUTPUT	PID CONTROL 0% OUTPUT	PID CONTROL 100% OUTPUT
0-10V	Direct	0V	10V
0-10V	Reverse	10V	0V
4 to 20mA	Direct	4mA (2V)	20mA (10V)
4 to 20mA	Reverse	20mA (10V)	4mA (2V)

OPERATION WHEN EQUIPPED WITH BOTH HEAT RECOVERY AND HEAD PRESSURE CONTROL

If the chiller is equipped with both Heat Recovery and Head Pressure Control and both are enabled, there is no separate HEAD PRESSURE CONTROL Screen. All Head Pressure Control Parameters and setpoints are shown on the HEAT RECOVERY Screen. Also, there is not a Control Valve for each feature. Rather, there is one common valve that is either performing Hot Water Control for Heat Recovery or Head Pressure Control. It will not be performing control for both features at the same time. Normally, it would be performing Hot water Control until certain operating conditions cause it to switch over to Head Pressure Control. The PID Control Mode displays which feature is controlling the valve at any given time. When performing Hot Water Control, "Hot Water" is displayed. When performing Head Pressure Control, "Head Pressure" is displayed. There are also conditions under which it is not controlling either feature, in which case "Inactive" is displayed and the valve is set to 0% position. Which feature is controlling the valve at any given instant and when it is inactive is determined by operating conditions as shown in flow chart in *SECTION 24 - HEAT RECOVERY*.

Remote Head Pressure Setpoint

This setpoint cannot be set from a remote input.

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SECTION 26 - QUICK START

The Quick Start feature is useful in data center and process control applications where it is desirable to re-establish cooling as fast as possible after a shutdown or power failure. This feature, when enabled, allows quicker starts and restarts than normal control. It does this by reducing the time cycle for chiller restart and once running, loading the chiller as fast as possible. After the chiller is running and has met a specified setpoint or a specified period of time has elapsed, control returns to normal.

In order to use this feature, the chiller must be equipped with a Variable Speed Drive (VSD) or a medium Voltage VSD. The low inrush current of a VSD allows more starts per hour and allows the chiller to start with a more open vane position.

Although not required, the hot gas bypass option is recommended, as it will allow the chiller to startup more smoothly with less chance of surging.

QUICK START MODES

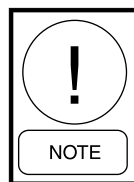
The quick start feature has two different start modes:

- **Quick Restart** – When a chiller shuts down, if certain conditions are met at the completion of coastdown (within 30 seconds thereafter), the VSD is started immediately with no pre-lube. The vanes are given a constant open pulse and after the VSD achieves its start frequency, the speed ramp rate is faster than with normal control.
- **Quick Normal Start** – If the conditions for a quick restart are not met, the next time the chiller is started, it has a pre-lube period just like a normal start, however the vanes will begin to open at the beginning of pre-lube, instead of waiting until system run. At the completion of pre-lube, the VSD is started and after the VSD achieves its Start Frequency, the speed ramp rate is faster than with normal control.

Although an Uninterruptible Power Supply (UPS) is not required for the quick start feature, powering the OptiView™ Control Center and VSD (except for the trigger board) with 115VAC from a UPS will reduce the time to restart after a power failure due to elimination of the OptiView™ reboot time which is about 20 seconds with the 03630 microboard. This provides the fastest possible ability to start or restart after generator or utility power is restored.

The quick start feature must be enabled per the procedure below to make it operational. There are certain requirements and limitations applied that determine if quick start can be enabled.

Once enabled, all setpoints and parameters related to this feature are displayed on the QUICK START screen, accessible from the SETPOINTS screen when logged in at SERVICE access level.



If it is desired to use the quick start feature while heat pump duty is enabled, quick start is only available when heat pump duty operational mode setpoint is set to cooling mode. When the heat pump duty operational setpoint is set to heating mode, quick start is automatically disabled.

SETPOINTS

The following setpoints are listed on the QUICK START Screen. Use the CHANGE SETPOINTS key and UP/DN Arrow keys to place a green box around the desired setpoint to be changed. Then press the ✓ key. A box will appear with the allowable values. Enter/Select the desired value and press the ✓ key.

Quick Start Mode

(Enabled, Disabled; default Disabled)

This setpoint is used to enable and disable the quick start feature. It can only be enabled when the motor drive type setpoint is set to VSD and the Motor Communications Protocol is set to Modbus. Or, the Motor Drive Type setpoint is set to MVVSD. If heat pump duty is enabled, the Quick Start feature can only be enabled when the Heat Pump Operational Mode setpoint is set to COOLING. The default is Disabled.

Quick Start can only be enabled using an ADMIN password. When logged in at ADMIN access level, a QUICK START key will appear on the SETPOINTS Screen. Pressing this key will navigate to the QUICK START Screen where this setpoint is used to enable/disable the feature.

Quick start can be disabled when logged in at SERVICE access level. However, once disabled, it requires an ADMIN password to enable it again, as explained above.

Quick Start Mode will be automatically disabled when any of the following occur:

- The Motor Drive Type is changed to something other than VSD or MVVSD.
- The Heat Pump Duty (if enabled) Operational setpoint is set to Heating Mode.

Quick Pulldown Setpoint Offset

(0°F to 10°F; default 5°F)

This setpoint sets the Leaving Chilled Liquid Temperature at which the control transitions from Quick Start Mode to normal operation. It is entered in the form of an offset above the active Leaving Chilled Liquid Temperature (LCHLT) setpoint. Once the leaving chilled liquid temperature falls below the Active LCHLT setpoint + Quick Pulldown Setpoint Offset, PRV (Quick Restart) and speed control (Quick Restart and Quick Normal Start) revert to normal automatic control. Lower values of this offset result in faster pulldown times but can result in overshoot of the LCHLT setpoint. Setting the value to its minimum of 0 results in the fastest pulldown time but nearly always results in setpoint overshoot. Depending upon how close the Low Chilled Liquid Temperature shutdown threshold is to the LCHLT setpoint, this could result in a Low Chilled Liquid Temperature cycling shutdown.

The leaving chilled liquid temperature and setpoint is shown on the QUICK START Screen for reference. This setpoint sets one of the two setpoints that determine when the control transitions from Quick Start Mode to normal operation. The other is the Pulldown Override Time below.

Pulldown Override Time

0 min to 15 min; default 10 min)

This setpoint is the length of time the PRV is held open (Quick restart) and the ACC speed (Quick Restart and Quick Normal Start) is increased on startup if the Quick Pulldown Setpoint Offset is not reached. This could be due to hitting current limit during the pulldown. If the Quick Pulldown Setpoint Offset is not reached in the Pulldown Override Time, PRV and ACC speed control will revert back to normal automatic control.

- **VSD Start Frequency** (60Hz units with quick start enabled equals 30Hz to 45Hz; default 45Hz) (50Hz equals 25Hz to 37.5Hz; default 37.5Hz) - This setpoint is the same as shown on the ACC DETAILS Screen. It can be programmed on either

the ACC Screen or the QUICK START Screen. It sets the VSD start frequency from which the speed will ramp from.

- **ACC Mapping Enable** (0.5°F to 4.0°F; default 1.0°F) - This is the same setpoint as shown on the ACC DETAILS Screen. It can be programmed on either the ACC Screen or the QUICK START Screen. It sets the Delta T needed to be met to enable surge mapping and speed reduction initially on startup.
- **Quick Ramp Current Threshold** (20% to 80% FLA; default 50%) - This setpoint sets the motor current threshold where the VSD speed command ramp rate changes. At or below this threshold the speed command ramp is 4X of standard control. Over this threshold, the ramp rate is 2X of standard control until it hits the standard current limiting over 80% FLA. Higher current thresholds can result in faster pulldown times. However, setting this value too high can result in slower pulldown times due to hitting the current limit sooner on pulldown.
- **Coastdown Time** – When Quick Start is enabled, the minimum programmable coastdown time for this setpoint is lowered as follows:
 - Q Compressors from 150 seconds to 60 seconds
 - J7 and K7 Compressors from 240 to 150 seconds
 - All other Compressors from 150 to 90 seconds
- The shorter the programmed Coastdown Time, the less time it takes from a shutdown or power failure until the compressor can be restarted. This value is programmable from the SETUP Screen. The actual mechanical Coastdown Time should be observed while performing several hard stops (with control panel rocker switch) on the chiller at various load/head conditions and visually checking when rotation stops. The time period programmed for the Coastdown Time needs to be longer than the longest physical time it takes the compressor rotation to stop.

OPERATION

When Quick Start Mode is enabled, there are several operational enhancements common to both Quick Restart and Quick Normal Start to decrease time between starts as follows:

- The Coastdown time can be shortened using the Coastdown Time setpoint. The shortest possible time for the Coastdown Time setpoint should be determined using the procedure above under Coastdown Time setpoint.
- The OIL - LOW TEMPERATURE DIFFERENTIAL threshold is decreased to 10°F (from 30 or 40, depending on conditions) for 15 minutes after the last shutdown (the timer begins when the run signal is removed).
- The Oil Heater is controlled to maintain a minimum oil temperature, ensuring it is warm enough to allow a restart as follows: While the oil pump is running, if oil temperature is less than 100°F, the Oil Heater is turned ON until it reaches greater than 105°F whereupon it is turned OFF. In order for this function to operate, a wiring change is required to the Oil Heater wiring as described below.
- The Hot gas bypass Valve is positioned to the Maximum Open setpoint value during Soft Shutdown, Coastdown and while not running. It returns to normal control (closed) when the Run signal is ENABLED.
- The PRV open/close status switch does not have to be closed in order to start.

Quick Restart

Whenever the chiller shuts down, for whatever reason, the following will occur in preparation for a Quick Restart: During the Coastdown period and for 30 seconds after the end of Coastdown, the PRV and Variable Orifice positions are held in place, a precharge command is sent to the VSD, the chilled Liquid Pump contacts TB2-44/45 are maintained closed and the Oil Pump continues to run (target oil pressure 45PSID).

When Coastdown has completed (and for 30 seconds thereafter), if the following conditions are met, a run command is sent to the VSD and the Quick Pulldown begins. No Pre-lube occurs.

- Oil Pressure more than 25PSID
- VSD has completed Precharge

- Chiller start signal (local or remote) is present
- No faults/inhibits present
- Chilled liquid flow switch is closed

Since there is no Pre-lube, the Auto-zeroing that normally occurs between the Oil Pressure Transducers during Pre-lube, does not occur. The offset calculation from the last Quick Normal Start is used. The level control preset (for the duration set by the Valve Preset Time setpoint) does not take place.

When the run command is sent to the VSD, the chiller enters System run and the Quick Pulldown begins. The QUICK PULLDOWN IN EFFECT LED on the QUICK START Screen illuminates while the Quick Pulldown is in effect. The Level Control begins ramping immediately, rather than waiting for 3 minutes after entering System run, as it does in normal operation. The Oil Pump continues to use the Target Oil Pressure of 45 PSID for the first 15 seconds into run, then reverts to the programmed setpoint value. The speed command programmed as the VSD Start Frequency setpoint is sent to the VSD. The speed will ramp up to maximum frequency from this point at 4X the standard control until it reaches the current set as the Quick Ramp Current Threshold setpoint (20-80% FLA), whereupon it ramps at 2X standard control until it reaches the standard current limiting over 80% FLA, whereupon it ramps at standard rate. A continuous open signal is applied to the PRV.

The continuous open signal to the PRV and the quick VSD speed ramping will continue until either the Leaving Chilled Liquid Temperature decreases to the temperature set by the Quick Pulldown Setpoint Offset (0 to 10°F) setpoint or the Pulldown Override Time (0 to 15 min) setpoint has elapsed, whereupon all VSD speed control and PRV control returns to standard.

In order for a Quick Restart to be performed after a power failure, the power failure duration must be no longer than about 60 seconds. Data centers can generally guarantee stable generator power to be available 15 seconds or less following a power failure. Longer power failures will result in a Quick Start (see below) rather than a Quick Restart.

If the criteria for a Quick Restart above is not met within 30 seconds after coastdown has completed, the following control returns to standard control:

- Chilled Liquid Pump control returns to standard
- PRV control returns to standard

- Variable Orifice control returns to standard and is opened
- Oil Pump control is returned to standard and turns off

If a Quick Restart did not occur within 30 seconds of the end of Coastdown as described above, the next start that occurs will be a QUICK NORMAL START as described below.

Quick Normal Start

If a Quick restart does not occur within 30 seconds after the end of Coastdown as described above, the next start that occurs will be a Quick Normal Start. This is a start that uses a Pre-lube but loading is faster than normal.

During the Pre-lube, a continuous open signal is given to the PRV as soon as the oil pump run signal is enabled. This open signal will be sent until the Pre-lube is complete, whereupon PRV control returns to normal automatic control. The level Control and Oil Pump are controlled during Pre-lube and System run as in normal operation. At the completion of Pre-lube, a run command is sent to the VSD, the chiller enters System run and the Quick Pulldown begins. The “Quick Pulldown

In Effect” LED on the QUICK START Screen illuminates while the Quick Pulldown is in effect. The speed command programmed as the VSD Start Frequency setpoint is sent to the VSD. The speed will ramp up to maximum frequency from this point at 4X the standard control until it reaches the current set as the Quick Ramp Current Threshold setpoint (20-80% FLA), whereupon it ramps at 2X standard control until it reaches the standard current limiting over 80% FLA, whereupon it ramps at standard rate to full speed. If at any time during this ramping to full speed, if the Leaving Chilled Liquid Temperature decreases to the temperature set by the Quick Pulldown Setpoint Offset (0 to 10°F) setpoint, the Pulldown Override Time (0 to 15 min) setpoint has elapsed (whichever occurs first) or the motor current is greater than 100% FLA, the Quick Pulldown terminates and all VSD speed control returns to normal control.

Summary

The following table compares a Normal Start, Quick Normal Start and a Quick Restart. The Normal Start is that which has been the standard starting sequence and that which occurs when the Quick Start feature is disabled. This is a high level comparison and does not include all details of Quick Start Mode.

TABLE 16 - COMPARE A NORMAL START, QUICK NORMAL START AND A QUICK RESTART.

NORMAL START (STANDARD LOGIC)	QUICK NORMAL START	QUICK RESTART
Minimum Coastdown Time 150 sec (Q Compressors) 240 sec(J7,K7 Compressors) 150 sec(all other Compressors)	Minimum Coastdown Time 60 sec (Q Compressors) 150 sec (J7, K7 Compressors) 90 sec (All other Compressors)	Minimum Coastdown Time 60 sec (Q Compressors) 150 sec (J7, K7 Compressors) 90 sec (All other Compressors)
Chiller Off PRV Closed Variable Orifice Opened Hot gas Closed	Chiller Off PRV Closed Variable Orifice Opened Hot gas Opened	Coastdown PRV Held (Open) Variable Orifice Held (Open) Hot gas Opened
Pre-lube PRV Closed Variable Orifice Preset/Held Hot gas Closed	Pre-lube PRV Opened Variable Orifice Preset/Held Hot gas Opened	No Pre-lube
VSD Run Signal Enabled	VSD Run Signal Enabled	VSD Run Signal Enabled
PRV Controlled by Capacity Control Variable Orifice Preset/Held/Ramp VSD to Start Frequency Hot gas Standard Control	PRV Controlled by Capacity Control Variable Orifice Preset/Held/Ramp VSD to Start Frequency Hot gas Closed (Std Control)	PRV Given Constant Open Signal Variable Orifice Ramp VSD to Start Frequency Hot gas Closed (Std Control)
Slow Ramp-up of Speed	Quick Ramp-up of Speed Speed Control Returns to Standard when LCHLT less than Active LCHLT Setpoint + Quick Pulldown Setpoint Offset OR when Run Time more than Pulldown Override Time	Quick Ramp-up of Speed PRV and Speed Control Return to Standard when LCHLT less than Ac- tive LCHLT Setpoint + Quick Pulldown Setpoint Offset OR when Run Time > Pulldown Override Time

The following topics detail how the individual functions are changed for Quick Restarts and Quick Normal Starts:

PRV Control

When Quick Start is enabled the PRV switch shall be ignored and does not have to be closed in order to start.

When Quick Start is ENABLED the PRV position will be held during coastdown and for 30 seconds after coastdown. If a quick restart is not initiated, the PRV control will return to standard during the not running state.

When Quick Start is ENABLED during normal start-ups, a continuous open signal will be sent to the PRV as soon as the oil pump run signal is enabled during pre-lube. This open signal will be sent to the PRV until pre-lube is complete and then PRV control will return to standard automatic.

When Quick Start is ENABLED during quick restarts, when the VSD is given a run signal, a continuous open signal will be sent to the PRV. The open signal will be sent to the vanes until LCHLT falls below the Quick Pulldown Setpoint Offset. Once this occurs, vane control shall revert to standard automatic control. Any kind of limiting (current, etc.) that would close the vanes will cause the vane control to revert back to standard automatic control and operate as it currently does. The PRV control will also be returned to normal if the Pulldown Override Time timer expires. This timer shall begin counting when the run signal is enabled.

VSD Control

When Quick Start is ENABLED, the VSD shall be sent a precharge command during coastdown and for 30 seconds after the end of coastdown.

Chilled Liquid Flow

Normal operation checks for chilled liquid flow beginning 5 seconds before the end of pre-lube. When Quick Start is ENABLED this check is done before restarting. If chilled liquid flow is not present by 30 seconds after the end of coastdown, the chiller will revert to standard quick normal start logic.

Chilled Liquid Pump Control

Normal operation turns the chilled liquid pump off at the end of coastdown. When Quick Start is ENABLED the chilled liquid pump is kept on for 30 seconds after

coastdown is completed. If a quick restart is not initiated within 30 seconds of the end of coastdown, the pump is returned to normal control.

Condenser Level Control

When Quick Start is ENABLED the variable orifice position will be held in its current position during coastdown and for 30 seconds after the completion of coastdown. If a quick restart does not occur within 30 seconds of the end of coastdown the variable orifice control will revert to standard logic and open.

When Quick Start is ENABLED, if a quick restart does not occur within 30 seconds of the end of coastdown, set a QUICK PRESET TIMER to the programmed level control preset time. Count this timer down to 0. When the next normal quick start occurs, subtract the quick preset timer's current value from the preset time so the VO does not close too far and would essentially return to the last position it had held.

For normal operation a condenser level setpoint ramping algorithm is employed if the preset timer is set to zero or the chiller is running or if the preset timer is not zero and the chiller has been running for longer than 180 seconds. When Quick Start is ENABLED, for quick restarts only, the preset timer is ignored (no preset takes place) and the ramping algorithm is engaged immediately upon achieving a run state. For quick normal starts, level control works as it does currently.

Oil Sump Control

When Quick Start is ENABLED the pressure offset calibration (and the associated fault) is disabled for quick restarts only. The offset calculation from the last normal start shall be used. For a normal quick start the calibration and fault shall be active during pre-lube per the standard logic.

Normal operation checks for low oil pressure (greater than 25psid) beginning 5 seconds before the end of pre-lube. When Quick Start is ENABLED this check shall begin before restarting. If the chiller does not restart, this check will still be done on the next normal quick start using standard logic. If oil pressure is not present by 30 seconds after the end of coastdown, the chiller will revert to standard quick normal start logic but will not fault on low oil pressure. This fault is currently only active during pre-lube and run. It shall not cause a shutdown during coastdown or while not running.

Normal operation turns the oil pump off at the end of coastdown. When Quick Start is ENABLED the oil pump shall be kept running through coastdown until 30 seconds after the end of coastdown and into the restart. If a quick restart does not occur within 30 seconds of the end of coastdown, the oil pump shall return to standard control and turn off.

When Quick Start is ENABLED oil pressure pulldown is in effect (45 psid target) throughout coastdown, 30 seconds after coastdown is complete and 15 seconds into run if a quick restart is initiated.

The OIL - LOW TEMPERATURE DIFFERENTIAL cycling shutdown threshold is 30 or 40°F depending on conditions. When Quick Start is ENABLED this threshold is reduced to 10°F for 15 minutes after the last shutdown. This 15 minute time shall begin when the run signal is DISABLED.

With the Quick Start feature, the Oil Heater is controlled to maintain a minimum oil temperature, ensuring it is warm enough to allow a restart as described below.

While the oil pump is running, if oil temperature is less than 100°F, turn the Oil Heater on and if oil temperature is greater than 105°F, turn the Oil Heater off. Otherwise, do not change existing logic. The Oil Heater wiring must be changed in order to make this function work properly. In standard configuration, the Oil heater does not have AC power available to it (from TB5-23) when the chiller run signal is enabled. Since the Oil Heater logic with Quick Start, as described above, requires the heater to be turned on while the Oil Pump is running (which is while the chiller run signal is enabled), the Oil Heater wiring must be changed to a terminal (TB5-22) that has AC power, while the run signal is enabled by relocating wire #23 on I/O Board TB5-23 to TB5-22.

Hot gas Control

When Quick Start is enabled the hot gas output shall be set to the programmed Maximum Open value during all of the following conditions:

- During soft shutdown
- During coastdown
- While not running

Hot gas shall return to normal control (closed) when the run signal is enabled.

ACC Control

When the VSD has reached the VSD Start Frequency, the ACC speed command shall be ramped towards the maximum VSD frequency at a rate defined by the following table.

INITIAL RAMP FREQUENCY INCREASE RATE	CONDITIONS REQUIRED
0.1Hz / 2 sec	Quick Start Disabled
0.1Hz / 1 sec	Quick Start Enabled and Motor Current more than Quick Ramp Disable
0.1Hz / 0.5 sec	Quick Start Enabled and Motor Current less than or equal to Quick Ramp Disable

These rates will be reduced by the present ACC logic that limits the rate of speed increases when motor current is greater than 80% FLA. This initial ramp will continue until one of the following Quick Ramp Disable conditions are present:

- Motor Current more than 100% FLA
- LCHLT less than Active LCHLT setpoint + Quick Pulldown Setpoint Offset
- Command Frequency equals Maximum VSD Frequency
- Run Time more than Pulldown Override Time

Once one of these conditions is met, ACC control shall return to standard.

SECTION 27 - MOTOR MONITORING

The optional Motor Monitoring feature allows monitoring of the compressor motor windings temperatures, bearing temperatures, bearing vibration and motor cooling coil leak detection. Any combination of winding, bearing and leak monitoring can be selected based on the requirements of the job. Therefore, not all sensors may be present in all applications. Setpoints on the MOTOR DETAILS Screen allow any combination of these items to be enabled or disabled based on the actual equipment applied.

The motor could be equipped with different types of sensors for this monitoring. Either RTD's or thermistors could be applied for winding and bearing temperature monitoring. Motor cooling coil leak detection could be performed with either an optical sensor or float sensor. Setpoints on the MOTOR DETAILS Screen allow for the selection of the actual sensor type applied.

The hardware involved in this feature consists of motor temperature sensors, vibration sensors, a cooling coil leak detection sensor and a Motor Monitoring Board (Refer to *Figure 61 on Page 171*).

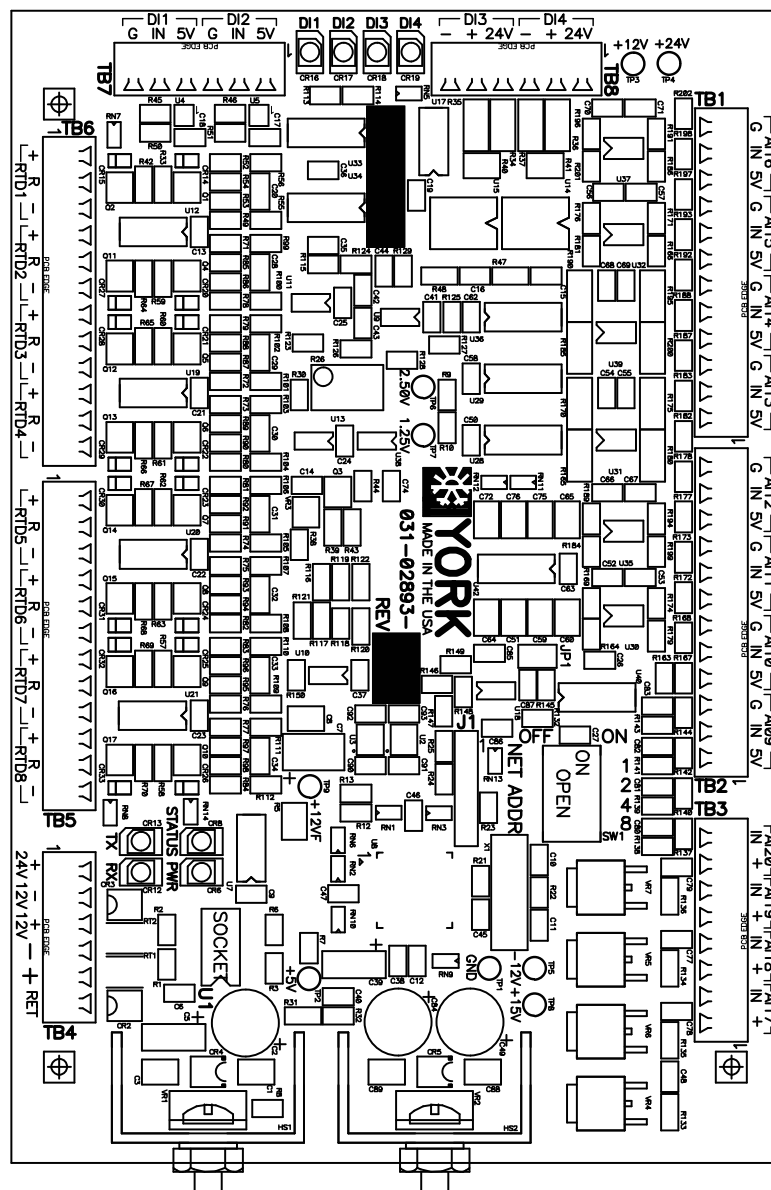
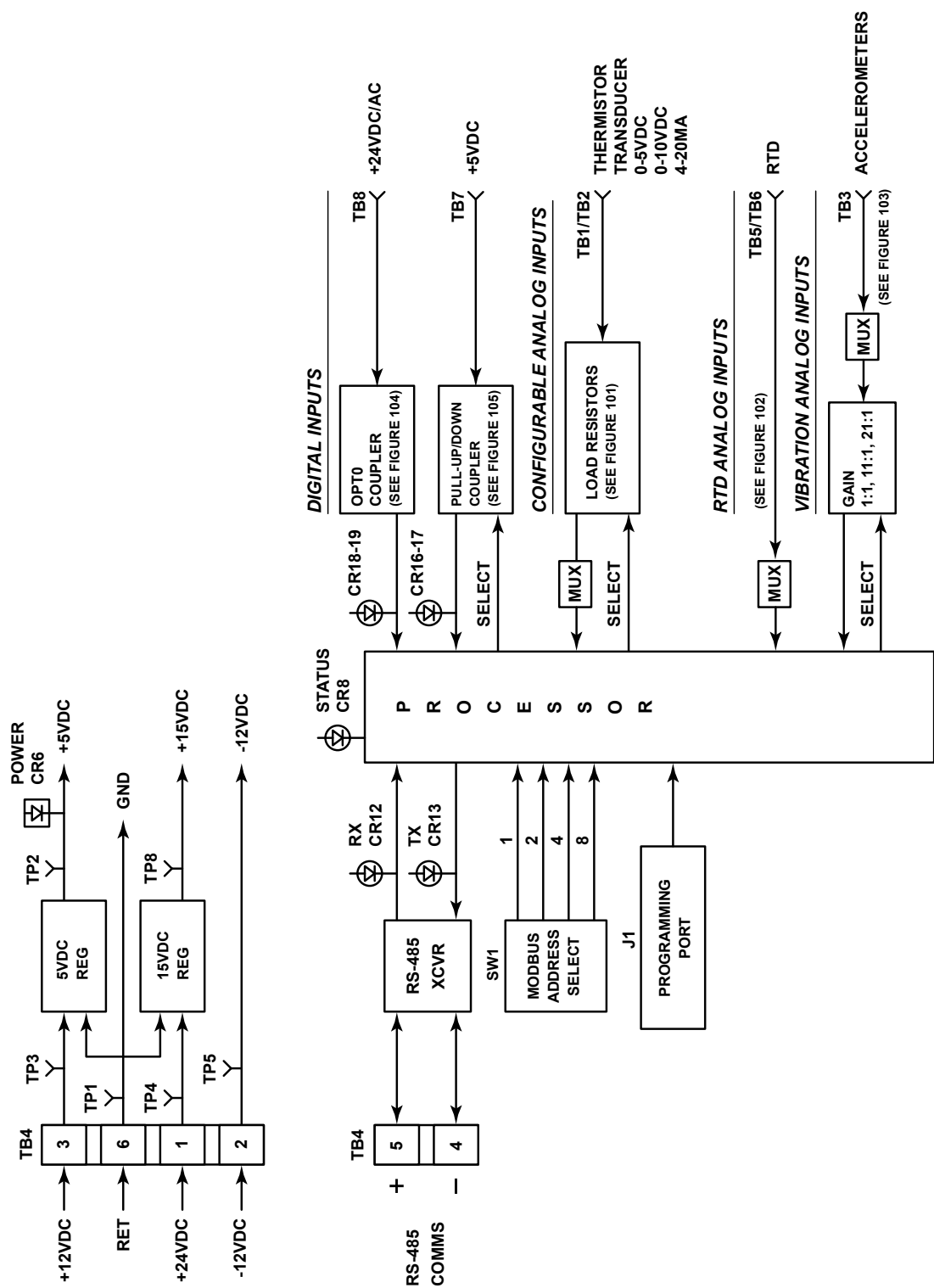


FIGURE 61 - MOTOR MONITORING BOARD (031-02893-000/001)

LD14241

MOTOR MONITORING Board BASIC BLOCK DIAGRAM



LD15001

FIGURE 62 - MOTOR MONITORING BOARD BASIC BLOCK DIAGRAM

This board resides in an enclosure that is mounted separately from the OptiView™ Control Center. The Motor Monitoring Board receives the outputs of the sensors and transmits the sensor values to the microboard COM3 port via RS-485 Modbus serial communications. The microboard sends the temperatures, vibration values and leak status to the display. It also compares these parameters to warning and safety shutdown thresholds. When the parameter exceeds the warning threshold, a warning message is displayed. When it exceeds the safety threshold, a safety shutdown is performed.

The motor monitoring feature must be enabled on the SETUP Screen. When enabled, the MOTOR DETAILS screen and MOTOR SETPOINTS screen are available, where all information pertinent to this feature is displayed as follows: The MOTOR DETAILS screen displays the temperature and vibration values, along with the leak status. It also allows a service technician to individually enable/disable the winding temperature, bearing temperature, vibration and cooling coil leak monitoring or enable the sensor type, based on the actual equipment applied. The MOTOR SETPOINTS screen allows a service technician to enter the WINDING and BEARING HIGH TEMPERATURE warning/safety shutdown thresholds, the high vibration warning/safety shutdown thresholds, set the vibration input gain and enable/disable individual winding temperatures. Procedures to enter these set-points are in *SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual.

MOTOR MONITORING BOARD

There are two versions of this board. The difference between the boards is the component population. The board part number is 031-02893-XXX (with XXX being -000 or -001). The different boards are identified by the 3-digit suffix (-000 or -001). The -001 board is fully populated and can be used in any application. On the -000 board, the RTD analog input and vibration analog input components are not populated. Therefore, it cannot be used in applications requiring those sensor types. The board is shown in *Figure 61 on Page 171*.

The board accepts both analog and Digital inputs from motor sensing devices (Refer to *Figure 62 on Page 172*). It transmits the data to the microboard using Modbus RS-485 serial communications. In some applications, certain sensors are connected to the VSD, instead of the Motor Monitoring Board, and the data is sent to the microboard via the VSD to Microboard RS-485 Modbus Serial Communications.

The board receives +24VDC, +12VDC and -12VDC power at TB4. The +12VDC is applied to a +5VDC regulator to create the +5VDC supply voltage. The POWER LED (CR6) illuminates when this +5VDC is present. The +24VDC is applied to a +15VDC regulator to create the +15VDC supply voltage. These voltages can be read at the following Test Points:

TP1	GND
TP2	+5VDC
TP3	+12VDC
TP4	+24VDC
TP5	-12VDC
TP6	+2.5VDC reference
TP7	+1.25VDC reference
TP8	+15VDC
TP9	+12VDC filtered

When the onboard program is running and operating normally, STATUS LED (CR8) blinks 2 times a second.

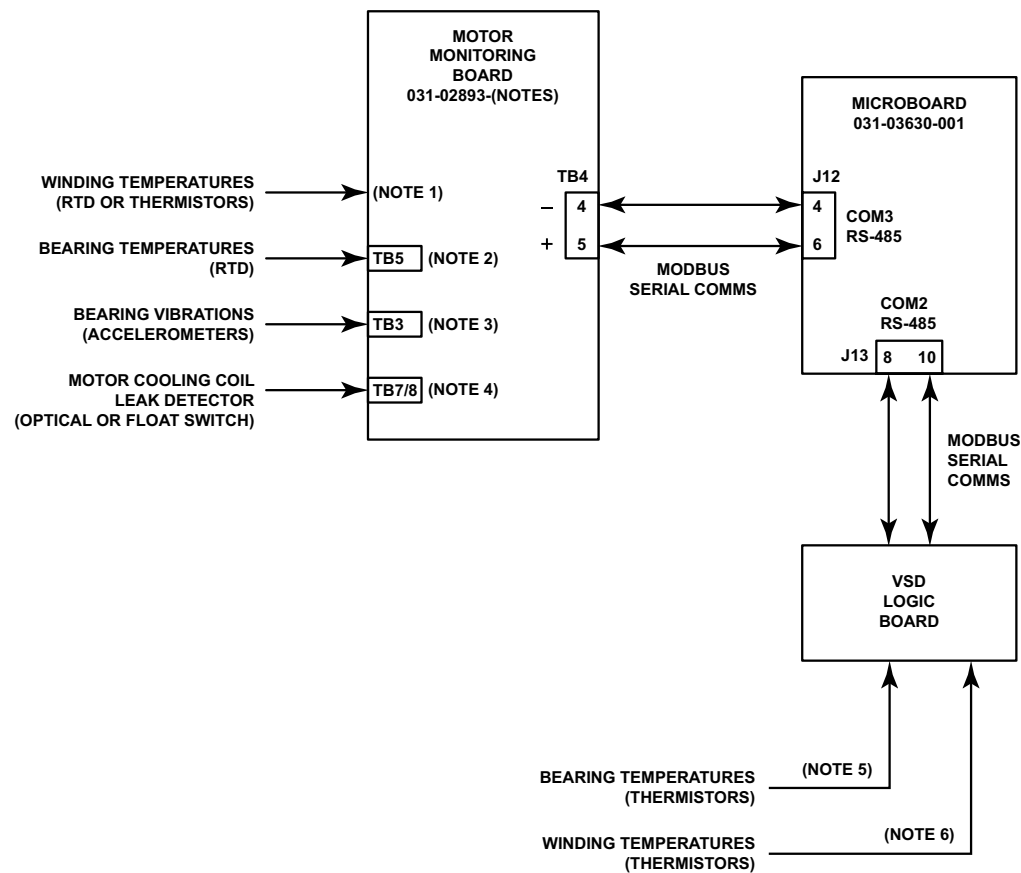
The Motor Monitoring Board communicates with the microboard using RS-485 Modbus serial communications. Every 2 seconds, the microboard reads data from and sends commands to the Motor Monitoring Board. The RX LED (CR12) illuminates as the data bits pass by the LED arriving on the Motor monitoring Board. The TX LED (CR13) illuminates as the data bits pass by the LED, leaving the board. The Network Address of this board is 2. This is set with the NETWORK ADDRESS switch SW1 as follows:

(Off = Switch open, On = Switch closed)

- 1=Off
- 2=On
- 4=Off
- 8=Off

The board does not contain a separate program storage device. The boards are programmed at the time of manufacture, and the program cannot be changed in the field.

MOTOR MONITORING BLOCK DIAGRAM



- NOTES**
- There are two Motor Monitoring Boards that can be used: 031-02893-(with suffix -000 or -001). The board required depends on the sensing devices used, as indicated above and notes below.
1. When Winding RTD's are used, they are connected to TB5/6 and the -001 board is required. When Winding Thermistors are used, they can be connected to TB1 (using the -000 or -001 board) or the VSD (see Note 6) and the temperature values transmitted via existing VSD to Microboard Serial Communications.
 2. When Bearing RTD's are used, they are connected to the Motor Monitoring Board TB5 and the -001 board is required. When Thermistors are used, they are connected to the VSD (see Note 5) and the temperatures are sent via existing VSD to Microboard Serial Communications.
 3. The -001 board is required.
 4. Either the -000 or -001 board can be used.
 5. Bearing temperatures can either be provided via direct RTD connection to the Motor Monitoring Board (see Note 2) or Thermistors connected to the VSD and provided via existing VSD to Microboard Serial Communications.
 6. When thermistors are used for Winding Temperatures, they can be connected to the Motor Monitoring Board TB1 (see Note 1) or the VSD and the temperature values transmitted via existing VSD to Microboard Serial Communications.

LD19809

FIGURE 63 - MOTOR MONITORING BLOCK DIAGRAM

The Motor Monitoring Board (Refer to *Figure 63 on Page 174*) has up to 4 different sections of inputs (depending on the board part number) as follows:

- Configurable Analog Inputs

There are 8 configurable Analog Inputs: AI9 - AI12 (TB2) and AI13 AI16 (TB1). Each input can be configured to accept one of the following types of inputs: 3K Thermistor, 10K Ohm Thermistor, 50K Ohm Thermistor, Pressure Transducer, 0 to 5VDC, 0 to 10VDC or 4 to 20mA. Each input is configured by a command sent from the microboard via the serial communications. Each input is configured by putting either 243 Ohm, 5K Ohm or 10K Ohm load resistor to ground on the input. See below for the configurations.

- Digital inputs

There are 2 low voltage DC inputs: DI1 and DI2 (TB7). Each input can be configured in either a pull-up or pull-down configuration. In the pull-up configuration, the input is high when the input switch is open; low when closed. In the Pull-down configuration, the input is low when the input switch is open; high when closed. Both of these inputs have an LED (DI1 and DI2) that illumi-

nates when the input is high. Each input is configured by a command from the microboard via serial communications. There are 2 Opto-coupler AC/DC inputs: DI3 and DI4 (TB8). These inputs can accept either 24VAC or 24VDC inputs. When the input signal is present, the input is considered active. Both of these inputs have an LED (DI3 and DI4) that illuminates when the input is active. There is no configuration on these inputs.

- RTD Analog Inputs

The -001 board can accept up to 8 RTD inputs: RTD1-RTD4 (TB6) and RTD5-RTD8 (TB5). There is no configuration on these inputs.

- Vibration Analog Inputs

The -001 board can accept up to 4 Vibration Analog Inputs - AI17 through AI20 (TB3). A command from the microboard, via the serial communications, sets the gain of each input to 1:1, 11:1 or 21:1(default). The gain value transmitted is programmed by a Service technician using the VIBRATION GAIN SETPOINT key on the MOTOR SETPOINTS Screen. Program Jumper JP1 must always be removed. It is only installed for manufacturing testing.

WINDING TEMPERATURES

The motor windings temperatures can be monitored with either RTD's or thermistors. When RTD's are used, there are 6 (2 per phase) RTD's and the -001 Motor Monitoring Board is required. When thermistors are used, there are 3 thermistors (1 per phase). The thermistors could be connected to the Motor Monitoring Board or the Variable Speed Drive. If connected to the Motor Monitoring Board, either the -000 or -001 board can be used. Refer to *Figure 64 on Page 176*.

The Winding Temperature Protection setpoint must be set to the sensor type that is used. Once set, the microboard via serial communications, commands the Motor Monitoring Board to read the appropriate sensor inputs and it also sends configuration commands as stated below. If set to any setting other than DISABLED, the respective temperatures are displayed on the MOTOR DETAILS Screen. The settings are:

- **DISABLED** Disables the Winding Temperature feature. No Winding sensor inputs are read, no winding temperatures are displayed and the heading, text and data boxes do not appear. The High Winding Temperature Fault and Warning will not occur. This setting is used when the motor is not equipped with winding temperature sensors or if is desired to disable the feature for service reasons. This is the default setting. The Motor Moni-

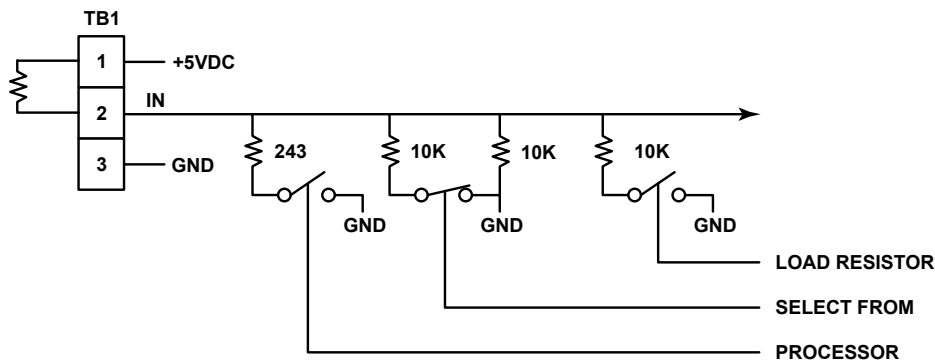
toring Board is commanded to not read any of its winding temperature sensor inputs. The winding displays can be individually disabled using the Temperature Disable setpoint (ADMIN access level) on the MOTOR SETPOINTS Screen.

- **RTD Enables** and displays the 6 (2 per phase) motor winding temperatures, as reported by the winding RTD's, via the Motor Monitoring Board serial communications. The microboard commands the Motor Monitoring Board to read the sensor inputs at the following points:

TB6-1,2,3	[Motor Winding Phase A1 Temperature
TB6-4,5,6	Phase A2 Temperature
TB6-7,8,9	Phase B1 Temperature
TB6-10,11,12	Phase B2 Temperature
TB5-1,2,3	Phase C1 Temperature
TB5-4,5,6	Phase C2 Temperature

- **THERMISTOR Enables** and displays the 3 motor winding temperatures, as reported by the thermistors via the Motor Monitoring Board serial communications. The microboard sends a command to have the Motor Monitoring Board read the sensor inputs at the following points and another command to configure these inputs to accept a 50K Ohm Thermistor.

CONFIGURABLE ANALOG INPUTS



NOTES
Phase A thermistor connection shown. Typical of all thermistor inputs.

LD15004

FIGURE 64 - WINDING TEMPERATURE – THERMISTORS

Motor Winding Phase

TB1-1,2	A Temperature
TB1-4,5	B Temperature
TB1-7,8	C Temperature

- VSD THERMISTOR Enables and displays the 3 motor winding temperatures, as reported by the thermistors via the VSD to Microboard serial communications. The Motor Monitoring Board is commanded to not read any of its winding sensor inputs.

The enabled winding temperatures for phase A, B and C, along with the Average Winding Temperature, are displayed on the MOTOR DETAILS Screen. They are displayed over the range of: RTD = 32.0 to 399.5°F; Thermistors = 31.2 to 412.5°F. If the Winding Temperature Protection setpoint (On the MOTOR DETAILS Screen) is set to DISABLED, no temperatures are displayed and the heading, text and data boxes do not appear. Individual winding temperatures can be disabled using the Temperature Disable setpoint (on the MOTOR SETPOINTS Screen). When an individual temperature is disabled, the temperature data boxes do not appear. Any RTD that registers as an open is considered invalid and displays as XXX.X.

The Average Winding Temperature is the average of all enabled and valid motor winding temperatures. Any winding temperature that registers as open, out of range or disabled is not used in the calculation. When RTD's are used for winding temperature measurement, there are a maximum of 6 temperatures used to calculate the average. When thermistors are used, there are a maximum of 3 temperatures used to calculate the average. The text description and data box do not appear when the Winding Temperature Protection setpoint is set to disabled.

On the microboard, the winding temperatures are compared to warning and safety shutdown thresholds. These thresholds are entered using the Winding Setup setpoint (on the MOTOR SETPOINTS Screen). The HIGH WINDING TEMPERATURE SHUTDOWN safety threshold is programmable over the range of 266 to 320°F (default 311). The WINDING HOTSPOT ALLOWANCE safety shutdown threshold is programmable over the range of 0 to 18°F (default 0). The values programmed for these safety thresholds are displayed in the respective data boxes on the MOTOR SETPOINTS Screen.

When any of the enabled winding temperatures exceeds [High Winding Temperature Shutdown threshold minus 18°F] for at least 3 continuous seconds, Warning Motor High Winding Temperature is displayed. This warning automatically clears when all winding temperatures decrease below the warning threshold. This warning will not occur when the Winding Temperature Protection setpoint is set to disabled on the MOTOR DETAILS Screen. Also, it will not act on any RTD input registering as an open RTD or any individual winding temperature sensor that has been disabled with the Temperature Disable setpoint on the MOTOR SETPOINTS Screen.

When either of the following conditions occur, a safety shutdown is performed and Motor-High Winding Temperature is displayed:

- Any of the enabled motor winding temperatures exceeded the programmed High Winding Temperature Shutdown Threshold plus the programmed Winding Hotspot Allowance threshold for 3 continuous seconds.

-OR-

- The Average Winding Temperature has exceeded the programmed High Winding Temperature Shutdown threshold for 3 continuous seconds.

The chiller can be restarted after all winding temperatures decrease to at least 18° F (10° C) below the shutdown threshold and the Clear Fault button is pressed. This safety shutdown will not occur when the Winding Temperature Protection setpoint is set to disabled on the MOTOR DETAILS Screen. Also, it will not act on any RTD input registering as an open RTD or any individual winding temperature sensor that has been disabled with the Temperature Disable setpoint on the MOTOR SETPOINTS Screen.

Refer to *Table 17 on Page 183* for RTD resistance/voltage table. Refer to *Table 18 on Page 183* for Thermistor resistance/voltage table.

BEARING TEMPERATURES

The motor bearing temperatures can be monitored with either RTD's or thermistors. Both the shaft end bearings and opposite shaft end bearings are monitored. Therefore, 2 RTD's or thermistors are used. When RTD's are used, they are connected to the Motor Monitoring Board and the -001 board is required. When thermistors are used, they are connected to the Variable Speed Drive.

The Bearing Temperature Protection setpoint must be set to the sensor type that is used. Once set, the microboard, via serial communications, commands the Motor Monitoring Board to read the appropriate sensor inputs. If set to any setting other than DISABLED, the respective temperatures are displayed on the MOTOR DETAILS Screen. The settings are:

- **DISABLED** Disables the Bearing Temperature feature. No bearing temperatures are displayed and the heading, text and data boxes do not appear. The High Bearing Temperature Fault and Warning will not occur. This setting is when if the motor is not equipped with bearing temperature sensors or if is desired to disable the feature for service reasons. This is the default setting. The Motor Monitoring Board is commanded to not read any of its bearing temperature sensor inputs.
- **RTD** Enables and displays the 2 motor bearing temperatures, as reported by the bearing RTD's, via the Motor Monitoring Board serial communications. The microboard commands the Motor Monitoring Board to read the sensor inputs at the following points:

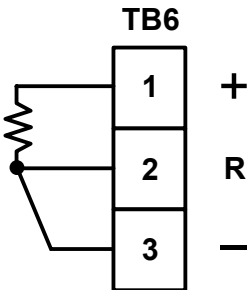
TB5-7,8,9	Motor Bearing Opposite Shaft End Temperature
TB5-10,11,12	Motor Bearing Shaft End Temperature

- **VSD THERMISTOR** Enables and displays the 2 motor bearing temperatures, as reported by the bearing thermistors via the VSD Logic Board serial communications. The Motor Monitoring Board is commanded to not read any of its bearing temperature inputs.

The enabled bearing temperatures for the shaft end and opposite shaft end bearings are displayed on the MOTOR DETAILS Screen. They are displayed over the range of 32.0 to 399.5°F. If the Bearing Temperature Protection setpoint (on the MOTOR DETAILS Screen) is set to DISABLED, no temperatures are displayed, and the heading, text and data boxes do not appear. Any RTD that registers as an open is considered invalid and displays as XXX.X.

On the microboard, the bearing temperatures are compared to warning and safety shutdown thresholds. These thresholds are entered using the Bearing Setup setpoint (on the MOTOR SETPOINTS Screen). The HIGH BEARING TEMPERATURE SHUTDOWN safety threshold is programmable over the range of 149 to 212°F (default 203). The HIGH BEARING TEMPERATURE WARNING threshold is programmable over the range of 140 to 194°F (default 194). The values programmed for these thresholds are displayed in the respective data boxes on the MOTOR SETPOINTS Screen.

RTD ANALOG INPUTS



NOTES
Phase A RTD connection shown. Typical of all RTD inputs.

LD15005

FIGURE 65 - WINDING AND BEARING TEMPERATURE – RTD

When either of the enabled motor bearing temperatures exceeds the programmed High Bearing Temperature Warning for 3 continuous seconds, Warning Motor High Bearing Temperature is displayed. This warning will automatically clear when both bearing temperatures decrease below the warning threshold. This warning will not occur when the Bearing Temperature Protection setpoint is set to disabled on the MOTOR DETAILS Screen. Also, it will not act on any RTD input registering as an open RTD.

When either of the enabled bearing temperatures exceed the programmed High Bearing Temperature Shutdown threshold for 3 continuous seconds, a safety shutdown is performed and Motor High Bearing Temperature is displayed. The chiller can be restarted after both bearing temperatures decrease to at least 9°F below the shutdown threshold and the Clear Fault soft key is pressed on the Home Screen. This safety shutdown will not occur when the Bearing Temperature Protection setpoint is set to disabled on the MOTOR DETAILS Screen. Also, it will not act on any RTD input registering as an open RTD.

Refer to *Table 17 on Page 183* for RTD resistance/voltage table. Refer to *Table 18 on Page 183* for Thermistor resistance/voltage table.

VIBRATION

The motor bearing vibration is monitored with accelerometers. Both the shaft end and opposite shaft end bearings are monitored. The -001 board is required.

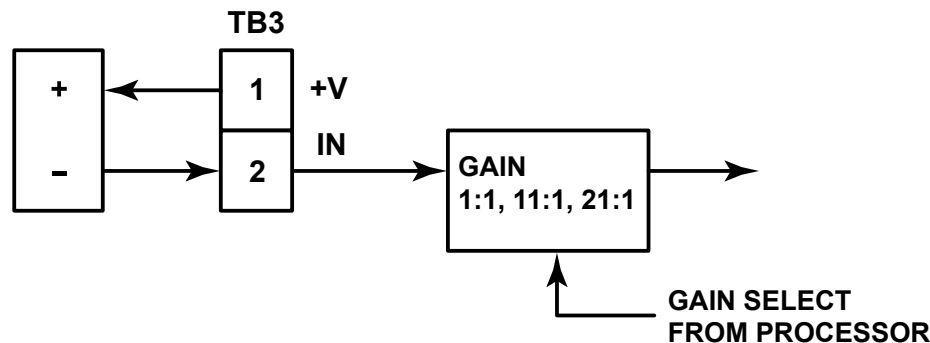
The Bearing Vibration Protection setpoint must be set to the sensor type that is used. Once set, the mi-

croboard via serial communications, commands the Motor Monitoring Board to read the appropriate sensor inputs and it also sends configuration commands as below. If set to any setting other than DISABLED, the respective vibration values are displayed on the MOTOR DETAILS Screen. The settings are:

- **DISABLED** - Disables the Bearing Vibration Protection feature. No bearing vibration values are displayed and the heading, text and data boxes do not appear. The High Bearing Vibration Fault, Warning and Baseline Not Set Warning will not occur. This setting is used when the motor is not equipped with bearing vibration sensors or if is desired to disable the feature for service reasons. This is the default setting. The Motor Monitoring Board is commanded to not read any of its vibration sensor inputs.
- **ROLLING ELEMENT** - Enables and displays the Bearing Vibration Protection feature. Displays the shaft end and opposite shaft end vibration values as reported by the vibration sensors via the Motor Monitoring Board serial communications. The Vibration Baseline values, created by either manual entry or by running the auto baseline routine are shown, along with the Auto Baseline and Auto Baseline setpoint keys. The microboard sends a command to have the Motor Monitoring Board read the sensor inputs at the following points and another command to set the gain of these inputs. The Gain value [1:1, 11:1, 21:1(default)] sent is the value set with the Vibration Gain setpoint (on the MOTOR SETPOINTS Screen).

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VIBRATION ANALOG INPUTS



NOTES

Shaft end connection shown. Typical of opposite shaft end input.

LD15006

FIGURE 66 - BEARING VIBRATION SENSOR

TB3-1,2	Motor Bearing Shaft End Vibration
TB3-3,4	Motor Bearing Opposite Shaft End Vibration

The Vibration Gain setpoint is used to enter the appropriate gain [1;1, 11:1, 21:1(default)] for the vibration sensor input circuits of the Motor Monitoring Board. An ADMIN password is required. The Gain value entered is transmitted from the microboard to the Motor Monitoring Board via serial communications.

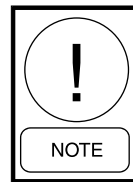
The enabled vibration values for the shaft end and opposite shaft end bearings are displayed on the MOTOR DETAILS Screen. The vibration values are not in any particular units of measure. They are relative values expressed over the range of 0.0 to 30.0. The larger the number, the greater the magnitude of vibration represented. If the Motor Vibration Protection setpoint is set to DISABLED, no vibration values are displayed and the heading, text and data boxes do not appear.

Vibration Baseline values must be established for the Shaft End and Opposite Shaft End bearings. They are established and displayed on the MOTOR DETAILS Screen. They are programmable over the range of 0.1 to 5.0 (default 2) and are expressed in the same units as the vibration values above. The Baseline values are established by either manual entry using the Manual Baseline setpoint or automatically by running the Auto Baseline Routine. Special password 0 3 6 8 is required. The Auto Baseline routine is initiated with the Auto Baseline setpoint. It can be run after the chiller has been running for greater than 2 minutes. The vibration level of each bearing is independently averaged for 1 hour at 1 minute intervals while the chiller is running. The time remaining in the routine is displayed as Auto Baseline Time Left on the MOTOR DETAILS Screen. At the completion of the routine, the derived values are displayed. WARNING MOTOR BEARING VIBRATION BASELINE NOT SET is displayed until both the Shaft end and Opposite Shaft End motor bearing vibration baseline values are entered. While this message is displayed, the vibration baseline values are set to X.X.

On the microboard, the Bearing Shaft End and Opposite Shaft End vibration values are compared to warning and safety shutdown thresholds. The actual thresholds used will be either the values derived from the Vibration Baseline setpoints (as explained below) or the values manually entered with the VIBRATION SETUP SETPOINT key. Normally, the Baseline derived values

are used but they can be overridden by manual entry. The actual thresholds that the software is using are displayed in the Motor Bearings High Vibration Warning and High Vibration Warning data boxes on the MOTOR SETPOINTS Screen. The HIGH VIBRATION WARNING threshold is programmable over the range of 1.0 to 15 (default Baseline X2). The High Vibration Shutdown threshold is programmable over the range of 2.0 to 30 (default Baseline X3). These thresholds are in the same units of measure as the vibration values as explained above. The vibration must exceed each threshold continuously for the number of seconds programmed with the Delay setpoints, before the Warning or Safety shutdown occurs. The warning Delay is programmable over the range of 0-120 seconds (default 30). The safety shutdown delay is programmable over the range of 0-30 seconds (default 15). The Delays are programmed with the Vibration Setup setpoint.

The Vibration Baseline values are used to create the vibration Warning and Thresholds as follows:



If the calculated value exceeds the minimum and maximum limits of the Shutdown (2.0 to 30.0) or Warning (1.0 to 15.0) threshold, the threshold is set to the respective upper or lower limit.

- Shaft End High Vibration Warning - Shaft End Vibration Baseline X2
- Shaft End High Vibration Warning Default - Shaft End Vibration Baseline X2
- Opposite Shaft End High Vibration Warning - Opposite End Vibration Baseline X2
- Opposite Shaft End High Vibration Warning Default - Opposite End Vibration Baseline X2
- Shaft End High Vibration Shutdown - Shaft End Vibration Baseline X3
- Shaft End High Vibration Shutdown Default - Shaft End Vibration Baseline X3
- Opposite Shaft End High Vibration Shutdown - Opposite Shaft End Vibration Baseline X3
- Opposite Shaft End High Vibration Shutdown Default - Opposite Shaft End Vibration Baseline X3

The values used by the software depend upon the sequence in which the setpoints are entered. If Vibration Baseline values are established after thresholds have been entered with the Vibration Setup setpoint, the baseline derived Shutdown and Warning thresh-

olds override the thresholds entered with the Vibration Setup setpoint. Thresholds entered with the Vibration Setup setpoint after baseline derived Shutdown and Warning thresholds are entered, override Baseline derived values.

When either the Shaft End or Opposite Shaft End motor bearing vibration has exceeded the value programmed for the High Vibration Warning setpoint for the programmed number of DELAY seconds, Warning Motor High bearing Vibration is displayed. This warning will automatically clear when both vibration values decrease below the warning threshold. This warning does not occur when the Motor Vibration Protection setpoint is set to disabled on the MOTOR DETAILS Screen or while the Warning Motor Bearing Vibration Baseline Not Set warning is displayed.

When either the Shaft End or Opposite Shaft End motor bearing vibration has exceeded the value programmed for the High Vibration Shutdown setpoint for the programmed number of DELAY seconds, a safety shutdown is performed and Motor High Bearing Vibration is displayed. The chiller can be restarted after both the vibration values decrease below the shutdown threshold and the Clear Fault soft key is pressed on the Home Screen. This safety shutdown does not occur when the Motor Vibration Protection setpoint is set to disabled on the MOTOR DETAILS Screen or while

the Warning Motor Bearing Vibration Baseline Not Set warning is displayed.

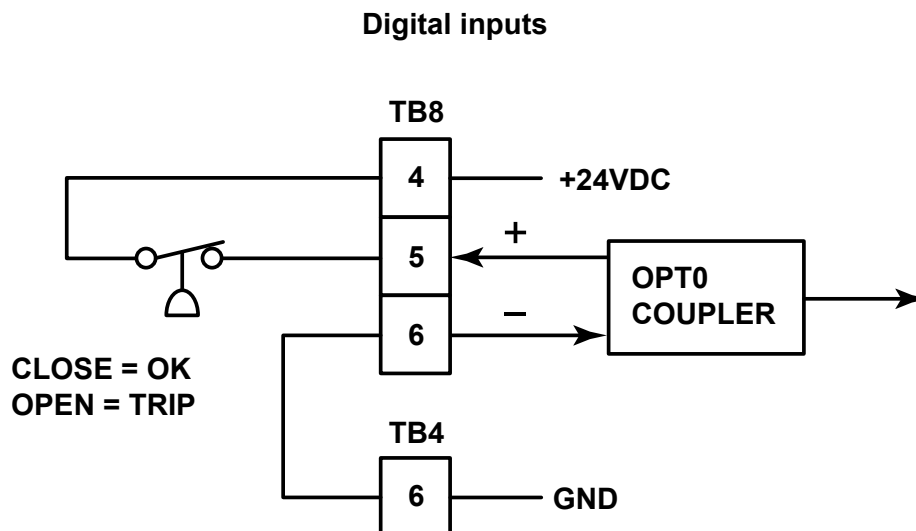
COOLING COIL LEAK DETECTION

The Motor Cooling Coil leak detection is performed with either a Float Switch or an Optical sensor. Either the -000 or -001 board can be used.

The Motor Cooling Coil Leak Protection Setpoint must be set to the sensor type that is used. Once set, the microboard, via serial communications, commands the Motor Monitoring Board to read the appropriate sensor input and it also sends a configuration command as described below. When set to any setting other than disabled, the LED status indicator is displayed and the MOTOR COOLING COIL safety fault will occur when the sensor indicates a leak. The settings are:

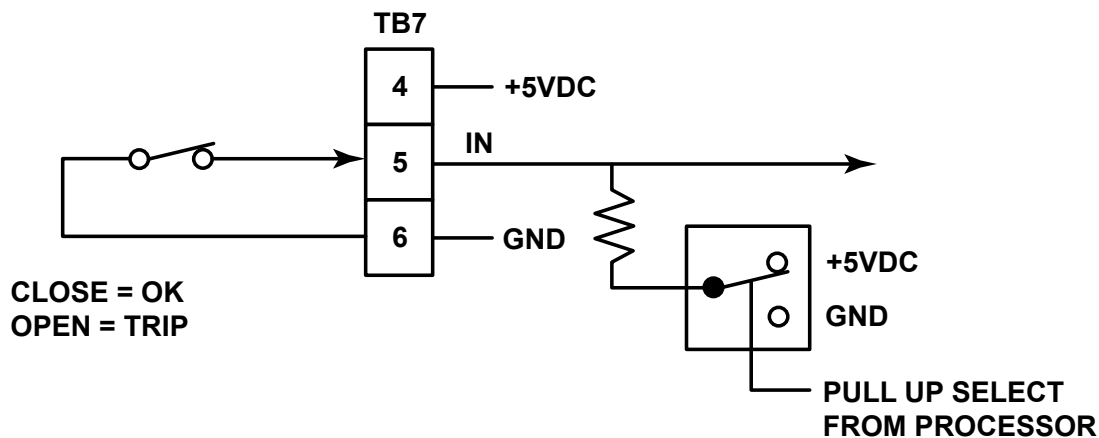
- **DISABLED** - Disables the Motor Cooling Coil Leak Protection feature. The status LED and text do not appear. The Motor Cooling Coil Leak fault will not occur. This setting is used when the motor is not equipped with a leak detector or if it is desired to disable this feature for service reasons. This is the default setting. The Motor Monitoring Board is commanded to not read any of its leak sensor inputs.

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LD15002

FIGURE 67 - MOTOR COOLING COIL LEAK DETECTOR – FLOAT SENSOR

Digital inputs (CONTINUED)

LD15003

FIGURE 68 - MOTOR COOLING COIL LEAK DETECTOR – OPTICAL SENSOR

- **OPTICAL** - Enables the optical sensor Digital Input and displays the leak status, as reported by the optical leak sensor, via the Motor Monitoring Board serial communications. The microboard commands the Motor Monitoring Board to read the sensor input at TB7-4,5,6. Another command is sent that configures the Digital Input for pull-up configuration. In the pull-up configuration, an open switch (leak detected) input produces a +5VDC input at TB7-5 (see below).
- **FLOAT** - Enables the float sensor Digital Input and displays the leak status, as reported by the float leak sensor, via the Motor Monitoring Board serial communications. The microboard commands the Motor Monitoring Board to read the sensor input at TB8-4,5,6.

The optical sensor contains a switch that is connected between TB7-5 (input) and TB7-6 (GND). With no leak being detected, the switch closes producing a less

than 1VDC input at TB7-5, as measured to TB7-6. When a leak is detected, the switch opens producing a +5VDC input at J7-5, as measured to TB7-6.

The Float Sensor contains a switch that is connected between TB8-5 (input) and TB8-4 (+24VDC). With no leak being detected, the switch closes producing +24VDC input at TB8-5, as measured to TB8-6. When a leak is detected, the switch opens producing a less than 1VDC input at TB8-5, as measured to TB8-6.

An LED status indicator, labeled Motor Cooling Coil Leak Detected appears on the MOTOR DETAILS Screen. It illuminates when a leak is detected.

If the Motor Cooling Coil Leak Detector has registered a fault condition for at least 3 continuous seconds, a safety shutdown is performed and Motor Cooling Coil Leak is displayed. The chiller can be started after the leak sensor no longer indicates a leak and the Clear Fault soft key is pressed on the Home Screen.

TABLE 17 - RTD RESISTANCE/TEMPERATURE CHART

RESISTANCE (OHMS)	°C	°F	RESISTANCE (OHMS)	°C	°F
100.0	0.00	32.00	141.7	108.43	227.18
105.9	15.13	59.23	147.6	124.07	255.32
111.9	30.59	87.06	153.6	140.04	284.08
117.8	45.86	114.54	159.5	155.83	312.49
123.8	61.45	142.62	165.5	171.96	341.53
129.8	77.13	170.83	171.5	188.18	370.72
135.7	92.61	198.70	177.4	204.20	399.56

TABLE 18 - THERMISTOR RESISTANCE/TEMPERATURE CHART

THERMISTOR RESISTANCE (OHMS)	°C	°F	THERMISTOR RESISTANCE (OHMS)	°C	°F
165667	-0.442	31.20	5039	86.080	186.94
106304	8.390	47.10	4734	88.076	190.54
77581	14.970	58.95	4446	90.097	194.17
60641	20.309	68.56	4176	92.146	197.86
49468	24.856	76.74	3920	94.228	201.61
41545	28.854	83.94	3678	96.349	205.43
35635	32.449	90.41	3449	98.514	209.33
31056	35.737	96.33	3232	100.729	213.31
27405	38.782	101.81	3025	103.001	217.40
24425	41.633	106.94	2829	105.336	221.60
21947	44.324	111.78	2642	107.744	225.94
19854	46.884	116.39	2464	110.233	230.42
18063	49.333	120.80	2293	112.814	235.07
16513	51.690	125.04	2131	115.500	239.90
15157	53.967	129.14	1975	118.305	244.95
13963	56.178	133.12	1827	121.245	250.24
12902	58.332	137.00	1684	124.340	255.81
11954	60.438	140.79	1547	127.614	261.71
11101	62.503	144.51	1416	131.096	267.97
10329	64.534	148.16	1290	134.821	274.68
9629	66.538	151.77	1169	138.835	281.90
8989	68.518	155.33	1052	143.193	289.75
8403	70.482	158.87	940	147.971	298.35
7864	72.433	162.38	831	153.267	307.88
7367	74.375	165.87	727	159.219	318.59
6907	76.313	169.36	626	166.021	330.84
6480	78.251	172.85	529	173.966	345.14
6082	80.192	176.35	435	183.518	362.33
5711	82.142	179.86	344	195.478	383.86
5364	84.103	183.39	257	211.400	412.52

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SECTION 28 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES

The chiller is supplied from the JCI YORK 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.

Most of the following procedures require the Service technician to be logged in at SERVICE access level (Access Code 1 3 8 0). However, others require the ADMIN (Administration) access level. The ADMIN Password changes daily and is valid for 1 calendar day only. This password is obtained by contacting the local Johnson Controls Service Office. When requesting this password, supply the “Controls” version of software (available on the DIAGNOSTIC Screen) and the calendar day on which you intend to use it.

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 YORK factory, they can be changed by a field Service technician. If the microboard is field replaced, all of the programmed setpoints will be lost. They will have to be re-entered into the new microboard. Each of these setpoints is described below. Programming procedures and OptiView™ Control Center Keypad operation required in the procedures below are detailed in *OptiView™ Control Panel – Operation (Form 160.76-O2)*. In general, the following procedure is used to enter setpoints in this section:

1. Log in with the appropriate access level.
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.

4. 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, and the ▶ key increases the value.

5. 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.

ELECTRO-MECHANICAL STARTER APPLICATIONS

If the Compressor Motor is driven by an Electro-Mechanical Starter, the OptiView™ Control Center is equipped with a CM-2 Current Module along with supporting components Diode Bridge (DB) and Calibration Resistors (RES), as described in a previous chapter of this manual. The following procedures can be used to verify the calibration and perform the calibration, if necessary. In addition to the calibration, Switch S1 and potentiometer R16 have to be set appropriately on the CM-2 Module. If the CM-2 and/or RES are field replaced, field calibration is necessary.

CM-2 Settings

1. Place Switch S1 in the appropriate position per the Starter type:

UP: Y-Delta or 57% Auto-transformer Starter

DOWN: All others
2. Calculate LRA/FLA ratio by dividing the Motor Lock Rotor Amps by the chiller Full Load Amps ($LRA/FLA = \text{ratio}$) and then adjust potentiometer R16 to the ratio value.

Calibration Verification

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select MOTOR Screen and set Current Limit and Pulldown Demand Limit setpoints to 100% FLA.
3. Run chiller. Read compressor motor current in Phase A, B, and C using a clamp-on Ammeter. Apply ammeter to highest Phase.
4. Select COMPRESSOR Screen.
5. Manually operate the Pre-rotation Vanes by pressing the OPEN and CLOSE Keys as required to achieve a motor current equivalent to 100% FLA as indicated by the clamp-on Ammeter. The motor current value on the Display should indicate 100% FLA.
6. Manually operate the Pre-rotation Vanes by pressing the OPEN and CLOSE keys as required to achieve a motor current equivalent to 105% FLA as indicated by the clamp-on Ammeter. The 105% LED on the CM-2 Module should illuminate.
6. Manually operate the Pre-rotation Vanes by pressing the OPEN, CLOSE and HOLD Keypad keys, as required, to achieve a motor current equivalent to 105% FLA as indicated by the clamp-on Ammeter. Loosen locking nut on potentiometer R8 on CM-2 and adjust until the CM-2 Module 105% LED illuminates. Counterclockwise increases signal level; Clockwise decreases signal level. Tighten locking nut.
7. Manually operate the Pre-rotation Vanes by pressing the OPEN and CLOSE Keypad keys, as required, to achieve a motor current equivalent to 100% FLA as indicated by the clamp-on Ammeter. Loose locking nut on potentiometer R34 on CM-2 and adjust until the motor current value on the Display indicates 100% FLA. Clockwise increases the signal level; Counterclockwise decreases the signal level. Tighten locking nut.

If the calibration verification does not perform as above, the following Calibration procedure will have to be performed.

Calibration

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select MOTOR Screen and set Current Limit and Pulldown Demand Limit setpoints to 100% FLA.
3. Select COMPRESSOR Screen.
4. Run chiller and read compressor motor current in Phase A, B and C using a clamp-on Ammeter. Apply Ammeter to highest Phase.
5. Manually operate the Pre-rotation Vanes by pressing the OPEN and CLOSE Keypad keys as required to achieve a motor current equivalent to 100% FLA as indicated by the clamp-on Ammeter. The voltage across Variable Resistors (RES) should be 0.90 to 1.05VDC. Measure this voltage by connecting a Voltmeter at CM-2 Board J1-2 (+) to J1-1(-). If necessary, adjust RES to achieve this value. *Figure 31 on Page 72* contains formulas to calculate the resistance of RES required to achieve this voltage. Adjust both resistors equally such that the combined resistance equals the calculated value.

SOLID STATE STARTER APPLICATIONS

When the compressor motor is driven by a YORK Solid State Starter, one of two different Starters could be applied. Chillers are equipped with either the Style B Liquid Cooled Solid State Starter (LCSSS) or the Medium Voltage Solid State Starter (MVSSS). Refer to *SECTION 10 - SOLID STATE STARTERS* for details of each of these starters. Use the following procedure to select the appropriate motor drive type, then select the appropriate procedure below for the starter type selected.

Motor Drive Type Selection:

- Microboard 031-03630-001:
 1. Chiller must be stopped.
 2. From Home Screen select SETPOINTS-SETUP
 3. Press CHANGE SETTINGS key.
 4. A green box will appear around the first changeable setpoint. Use ▲▼ keys to place the box around Motor Drive Type setpoint.
 5. Press ✓ key. A dialog box will appear with the range of settings. Use ◀▶ keys to select "SSS-Mod B" or "MV SSS", as appropriate.
 6. Press ENTER (✓) key.

Mod B Liquid Cooled Solid State Starter

1. At the keypad, log in at SERVICE access level using Password 1 3 8 0.
2. Select MOTOR Screen.

3. Enter the following setpoints using the procedures below:

Full Load Amps

This is the Full Load Amps (FLA) of the chiller as listed on the SALES ORDER Screen. The microboard uses the programmed value to perform Current Limit functions and display compressor motor current in terms of %FLA.

1. Press FULL LOAD AMPS key.
2. Use numeric keypad keys to enter correct value.
3. Press ENTER (✓) key.

Starting Current

The Logic/Trigger Board will limit compressor motor current to this value during starting. The correct value is (0.45 x Delta Locked Rotor amps), as listed on the SALES ORDER Screen.

1. Press STARTING CURRENT key.
2. Use numeric keypad keys to enter correct value.
3. Press ENTER (✓) key.

Voltage Range

This is the compressor motor AC power line application. Selections are 200-208, 220-240, 380, 400, 415, 440-480, 550-600 and disabled. The microboard uses the programmed value to determine the overvoltage and undervoltage shutdown thresholds for LCSSS – HIGH SUPPLY LINE VOLTAGE and LCSSS – LOW SUPPLY LINE VOLTAGE cycling shutdowns as described in *OptiView™ Control Panel – Operation (Form 160.54-O1)*. If DISABLED is selected, the shutdown thresholds will be ignored. This check should not be arbitrarily disabled.

1. Press VOLTAGE RANGE key.
2. Use ◀ and ▶ keys to scroll to desired value.
3. Press ENTER (✓) key.

Shorted SCR Enable/Disable

This allows the Shorted SCR safety check, performed by the Logic/Trigger Board, to be disabled. This must NEVER be disabled unless advised by the factory.

1. Press OPEN SCR key.
2. Use ◀ and ▶ keys to select Enable or Disable
3. Press ENTER (✓) key.

Open SCR Enable/Disable

This allows the Open SCR safety check, performed by the Logic/Trigger Board, to be disabled. This must NEVER be disabled unless advised by the YORK factory.

1. Press OPEN SCR key.
2. Use ◀ and ▶ keys to select Enable or Disable.
3. Press ENTER (✓) key.

Kilowatt Hours (KWH) Reset

This allows the KWH to be set to a desired starting value in the event the BRAM has to be field replaced. This must never be arbitrarily performed.

1. Press KWH RESET key.
2. Use numeric keypad keys to enter desired value.
3. Press ENTER (✓) key.

Motor Node ID

The Motor Node ID must be set to match the setting of the LCSSS Logic/Trigger Board Modbus Address Switch SW1. The address assigned to the Logic/trigger Board is “1”. This is done by setting Logic/Trigger Board 031-02505 Modbus Address Switch SW1 position 1 to ON; all other positions to OFF.

1. Chiller must be stopped.
2. Select SETPOINTS > Screen.
3. Press CHANGE SETTINGS key.
4. A green box will appear around the first changeable setpoint. Use ▲▼ keys to place box around the Motor Node ID setpoint.
5. Press ✓ key. A dialog box will appear with the range of settings. Use numeric keys to set this value to “1”.
6. Press ENTER (✓) key.

Voltage Range

This is the AC Power line voltage applied to the Compressor Motor. Selections are - 200-208, 220-240, 380, 400, 415, 440-480, 550-600 and Supply Voltage Range Disabled. The microboard uses the programmed selection to determine the overvoltage and undervoltage thresholds for Starter High Supply Line Voltage and Starter Low Supply Line Voltage. Cycling shutdowns as described in *OptiView™ Control Panel – Operation (Form 160.76-O2)*. If Supply Voltage Range Disabled is selected, the thresholds will be ignored and these

shutdowns will not occur. This check should not be arbitrarily disabled.

1. Press VOLTAGE RANGE key.
2. Use ◀ and ▶ keys to scroll to desired value.
3. Press ENTER (✓) key.

Medium Voltage Solid State Starter

1. At the keypad, log in at SERVICE access level using password 1 3 8 0.
2. Select MOTOR Screen.
3. Enter the following setpoints using procedures below:

Full Load Amps

This is the Full Load Amps (FLA) of the chiller as listed on the SALES ORDER Screen. The microboard uses the programmed value to perform Current Limit functions and display compressor motor current in terms of %FLA.

1. Press FULL LOAD AMPS key.
2. Use numeric keypad keys to enter the correct value.
3. Press ENTER (✓) key.

Start Current

The starter will limit compressor motor current to this value during starting. The correct value is (0.45 x Delta Locked Rotor Amps), as listed on the SALES ORDER Screen.

1. Press STARTING CURRENT key.
2. Use numeric keypad keys to enter correct value.
3. Press ENTER (✓) key.

COMPRESSOR MOTOR VARIABLE SPEED DRIVE APPLICATIONS

When the compressor motor is driven by a YORK Variable Speed Drive, there could be a Variable Speed Drive (VSD) or a Medium Voltage Variable Speed Drive (MV VSD) applied. The VSD Logic Board directly interfaces the microboard directly using RS-485 Modbus Protocol serial communications. The MV VSD is also interfaced to the microboard with RS-485 Modbus serial communications.

1. At the keypad, log in at SERVICE access level (unless otherwise noted) using password 1 3 8 0.
2. Enter the following setpoints using the procedures detailed below.

Motor Drive Type

The Variable Speed Drive type applied must be set as follows. Select the procedure based on the microboard that is present.

- Microboard 031-03630-001:
 1. Chiller must be in the stopped position.
 2. Select SETPOINTS > Screen.
 3. Press CHANGE SETTINGS key.
 4. A green box will appear around the first changeable setpoint. Use ▲▼ keys to place box around the MOTOR DRIVE TYPE setpoint.
 5. Press ✓ key. A dialog box will appear with the range of settings. Use ◀▶ keys to select “VSD-60Hz”, “VSD-50Hz” or “MV VSD”, as appropriate.
 6. Press ENTER (✓) key.

Full Load Amps (VSD)

This is the Full Load Amps (FLA) of the chiller as listed on the SALES ORDER Screen. The microboard uses the programmed value to perform Current Limit functions and display compressor motor current in terms of %FLA.

1. Place Compressor Start/Stop Switch in the Stop-Reset (O) position.
2. Select VSD DETAILS Screen from the MOTOR Screen.
3. Inside the VSD, locate the small trim pot on the VSD Logic Board; (R34) on Logic Board 031-02506.
4. While monitoring the VSD Full Load Amps 000.0 A message on the VSD DETAILS Screen, adjust this trim pot until the correct Full Load Amps value is displayed. Clockwise will increase the value.

Full Load Amps (MV VSD)

This is the Full Load Amps (FLA) of the chiller as listed on the SALES ORDER Screen. The microboard uses the programmed value to perform Current Limit functions and display compressor motor current in terms of %FLA.

1. Select MOTOR Screen.
2. Press FULL LOAD AMPS key.

3. Use NUMERIC Keypad keys to enter the correct value.
4. Press ENTER (✓) key.

Adaptive Capacity Control

1. Select ACC DETAILS Screen.
2. The following keys are available:
 - a. Surge Map Clear – Clears all previously established surge points that are stored in memory. When this key is pressed, a dialog box appears requesting the special ACC Map Clear Password. Enter 0 3 6 8 and press the ENTER (✓) key. A message is displayed advising the clearing is in progress. Another message is displayed when the clearing has completed. IMPORTANT! – This should not be performed unless advised by YORK factory Service.
 - b. Surge Map Print – Prints the entire array of stored surge points to a printer connected to COM1 serial port.
 - c. Auto Map Print – Prints new surge points, as they are established, to a printer connected to COM1 serial port.
 - d. Manual Surge Point – Captures the instantaneous operating conditions and stores them as a surge point in the surge map. When this key is pressed, a dialog box appears requesting the special password. Enter 0 3 6 8 and press the ENTER key. The chiller must be running to enter this point.
 - e. Surge Margin Adjust – Refer to *Opti Speed VSD Service Manual (Form 160.00-M4)*.
 - f. Surge Sensitivity – Sets the sensitivity of the ACC surge detection in the microboard. Programmable over the range of 1.5 to 2.0 (default 2.0). Smaller values increase the sensitivity.
 - g. VSD Start Frequency - Sets the starting frequency from which the ramp-up will begin. Programmable over the following range: 60Hz units – 30Hz to 60Hz (default 45Hz), 60Hz units with Quick Restart-30Hz to 45Hz (default 45Hz), 50Hz units – 25Hz to 50Hz (default 37.5Hz), 50Hz units with Quick Restart – 25Hz to 37.5Hz (default 37.5Hz).

- h. ACC Mapping Enable – Sets the Delta T (Leaving Chilled Liquid Temperature - setpoint) needed to be met to enable surge mapping and speed reduction initially on startup. Programmable over the range of 0.5°F to 20.0°F (default 1.0°F).

1. Select SURGE MAP Screen.
2. The following keys are available:
 - a. Manual Surge Point – see above
 - b. Remove Surge Point – Allows a mapped surge point to be manually removed. Position the green box (□) over the desired surge point marked as X on the SURGE MAP Screen using the keypad arrow keys (▲▼◀▶). Then press the REMOVE SURGE POINT key. A dialog box will appear requesting a special password. Enter 0 3 6 8 and press the ENTER key. The selected point will be removed.

Kilowatt Hours

1. At the keypad, log in at ADMIN access level.
2. Select MOTOR Screen.
3. Press KWH RESET key.
4. Use numeric keypad keys to enter desired value.
5. Press ENTER (✓) key.

Frequency Control

The VSD Frequency can be manually controlled as follows:

1. Select VSD TUNING Screen from the COMPRESSOR Screen.
2. On the VSD TUNING Screen, press the appropriate key as follows:
 - a. Set – Places Frequency Control in Manual Mode. Sets the VSD speed at a specific frequency between 1.0 and 60 (50)Hz.
 - b. Auto – Places the VSD in automatic frequency control. The frequency is determined by the ACC Board to achieve slowest speed possible while avoiding surge.
 - c. Fixed – Sets the VSD frequency at maximum: 60 (50)Hz.
 - d. Raise – Places Frequency Control in Manual Mode. Increases the VSD frequency by 0.1 to 10.0Hz, as programmed with the INCR AMT (increment amount) key.

Each press of this key increases the frequency by the programmed Amount (0.1 to 10.0Hz).

- e. Lower – Places frequency Control in Manual Mode. Decreases the VSD frequency by 0.1 to 10.0Hz, as programmed with the INCR AMT (increment amount) key.

Each press of this key decreases the frequency the programmed amount (0.1 to 10.0Hz).

- f. Incr Amt - Programmable setpoint (0.1 to 10.0Hz) that determines the amount of increase or decrease in VSD frequency that occurs with each press of the INC or DEC key in Manual Frequency Control Mode.

HIGH SPEED THRUST BEARING LIMIT SWITCH

The following is only applicable to chillers equipped with P compressors and style F and later chillers with “G, Q” or “H5-8” compressors: Anytime the chiller shuts down on a HIGH SPEED THRUST BEARING safety shutdown, displaying the message 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 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 CONTROL

A complete description of the Condenser refrigerant level control and the setpoints that affect this control are provided in *SECTION 13 - REFRIGERANT LEVEL CONTROL* 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 Variable Orifice using the procedure below.

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.

Digital/Analog

The type of Refrigerant Level Control, Level control operation must be set.

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. Select the Level Control Button
4. Use ◀ and ▶ keys to select Enable or Disable.
5. Press ENTER (✓) key.

Setpoints

The following are the setpoints and range of programmable values. The DEFAULT value is shown in parenthesis. 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. There are two different setpoint sets used depending upon the software vintage. Select the appropriate procedure per the installed software as follows:

- a. Level Setpoint - 20% to 80% (Default 50%).
- b. Startup Position - 50% to 100% (Default 50%)
- c. Statup Delay - 0s to 120s (Default 15%).
- d. Ramp Time 1m to 5m (Default 1minute).

Manual Control

The Variable Orifice can be manually controlled as follows:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.

2. Select REFRIGERANT LEVEL CONTROL Screen from the CONDENSER Screen.
3. On the REFRIGERANT LEVEL CONTROL Screen, press the LOWER, RAISE or HOLD key as required to control the Variable Orifice to achieve the desired refrigerant level. Pressing the AUTO key returns to automatic operation.

Level Sensor Calibration

Detailed instructions for calibrating Hansen, CS01, and CS02 Refrigerant Level Sensors is contained in the *Refrigerant Level Sensor Troubleshooting and Replacement Service Manual (Form 050-40-M1)*.

The **Innovation Solutions 4-button Refrigerant Level Sensor** outputs a voltage proportional to refrigerant level. Four values define the operation of the device. These values are:

1. Bottom of span output voltage
2. Top of span output voltage
3. Bottom of span refrigerant level
4. Top of span refrigerant level

When the refrigerant level is at the bottom of the span, the device will output the voltage set for the bottom of the span. When the refrigerant level is at the top of the span, the device will output the voltage set for the top of the span. Output is proportional to level change between top and bottom of span. All four of these parameters can be changed.

Before deciding the sensor needs any adjustments, check the following:

1. Determine issues with the level sensor separately from issues with the variable orifice valve control itself. If level is actually fluctuating because of control issues and the sensor is reporting that fluctuation, the problem is not with the sensor.
2. Ensure that the housing has a good ground path through the threaded connection to the probe by ensuring no sealant is present and the probe is tight.
3. Ensure all wiring is landed tightly and the voltage jumper on the board in the housing is set for 11-18V position not the 19-30V position.

4. Ensure that terminal 2 of the transmitter board is grounded to the housing. Probes sent from the factory since early 2007 have a ground wire from terminal 2 (parallel with cable wire) to the screw that holds the board in place. Sensors without this should have a wire added for this purpose. Be careful not to short to the circuitry when landing under the board mount screw. Ensure the jumper lug has good contact with the printed circuit ring around the board-mount screw. Also, make sure that any star washers have internal teeth. External teeth may miss the contact area.
5. If the sensor has demonstrated a definite calibration drift from a known good calibration, a problem may exist with that sensor's electronics. Obtain a replacement electronic head with updated oscillator according to the part number in the Replacement Parts sections of this letter. The replacement head is factory calibrated.
6. If Optiview reads <0% when the condenser is empty, verify the input voltage for the Refrigerant Level channel on the Diagnostics-Analog Inputs screen. A value at minimum coverage of 0.0 to 0.4 is not an operational concern. It represents a small deadband below the Optiview scaled range.

Generally with an adequate ground, the probe factory calibration is good and no calibration adjustments are required.

The device has four states of operation:

State 1- No pushbuttons depressed - Normal operation responding to refrigerant level

State 2- MIN pushbutton depressed and held - Sensor outputs the voltage preset for the bottom of the working span. In this mode the output of the device has nothing to do with existing refrigerant level. In this mode, the bottom span voltage value is seen and can be adjusted.

State 3- MAX pushbutton depressed and held - Sensor outputs the voltage preset for the top of the working span. In this mode the output of the device has nothing to do with existing refrigerant level. In this mode, this top span voltage value is seen and can be adjusted.

State 4- MIN and MAX pushbuttons depressed simultaneously - Probe level calibration mode. In this mode the device is reading existing refrigerant level awaiting the user to assign this level as top or bottom of span.

Verify or set the four span parameters as follows:

1. To verify the bottom of span output voltage, press and hold the MIN pushbutton. This output should be indicated between zero and 2% level on the Optiview, not < 0.

To adjust this output value, hold the MIN button and incrementally press either the F/UP or E/DOWN buttons several times as needed to achieve the desired Optiview value. F/up will increase the output voltage in increments. E/dn will decrease the output in increments.

2. To verify the top of span output voltage, press and hold the MAX pushbutton. This output should be indicated between 98% and 100% level on the Optiview, not >100.

To adjust this output value, hold the MAX button and incrementally press either the F/UP or E/DOWN buttons several times as needed to achieve the desired Optiview value. F/UP will increase the output voltage in increments. E/DOWN will decrease the output in increments.

If the Optiview does not change level indication during adjustment steps 1 or 2, verify whether the probe is the issue using a DC voltmeter to check output response between 0 to 5 VDC across sensor terminals 2 and 3. If the voltage does not change with button changes, and 11VDC is available across terminals 1 and 2, the sensor board may have failed. If the voltage changes but Optiview does not, check the wiring to the microboard.

3. To verify the bottom of span refrigerant level setpoint, that level must be achieved on the chiller. Normally this is preset correctly from the vendor. If adjustment is necessary, this is done by performing the following routine WHILE THE PROBE IS CURRENTLY SEEING THE MIN LEVEL OF REFRIGERANT. If this pushbutton procedure is done at any other refrigerant level, the transmitter will accept the bogus position as the end of span and performance will be unsatisfactory.

For YORK chillers, the full range of the probe must be effective, so this needs to be done while the probe is completely uncovered with refrigerant. With the chiller off and variable orifice open, the condenser level should be below the probe. If not, it may be necessary to flow warm condenser water to drive residual refrigerant to the evapora-

tor by pressure. In this condition, press and hold the MAX and MIN buttons together and while holding them, press the E/DOWN button and hold for about 5 seconds to register this position of level to the probe as the bottom of the range (E for Empty tank setpoint).

4. To verify the top of span refrigerant level setpoint, that level must be achieved on the chiller. Normally this is preset correctly from the vendor. The top of the probe is generally covered when the sightglass is fully covered. If the Optiview reads the value set in step 2 above when the condenser sightglass is completely full and begins to decrease as level decreases into the top ¼ inch of the glass, it is recommended that the existing adjustment is satisfactory and no reset needed. If adjustment is necessary, set the top of range by performing the following routine WHILE THE PROBE IS CURRENTLY SEEING THE MAX LEVEL OF REFRIGERANT. If this pushbutton procedure is done at any other refrigerant level, the transmitter will accept the bogus position as the end of span and performance will be unsatisfactory.

For YORK chillers, the full range of the probe must be effective, so this needs to be done while the probe is completely covered with refrigerant. With the chiller running, achieve a load where it is not likely to trip the unit on low evaporator pressure or cause surging and manually throttle the variable orifice to raise the condenser level above the top of the probe. In this condition, press and hold the MAX and MIN buttons together and while holding them, press the F/ UP button and hold for about 5 seconds to register this position of level to the probe as the top of the range. (F for Full tank setpoint). An alternate time to set this is with chiller off and all charge pumped in the condenser when condenser isolation valves exist.

The Optiview level indication should repeat at the level end positions and change smoothly between those levels

OIL PUMP VARIABLE SPEED DRIVE

A complete description of the Drive operation and the setpoints that affect this control are provided in *SECTION 14 - OIL PUMP VARIABLE SPEED DRIVE* 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.

Enable/Disable

The Oil Pump Variable Speed Drive Program operation must be enabled.

Entered as the Oil Pump setpoint on SETUP Screen.

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.

- Pressure Setpoint - 20 to 45 PSID (35)
- Control Period – 0.3 to 2.7 seconds in 0.3 second increments. (0.3)

Enter setpoints using procedure below:

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 0.5Hz increments using the RAISE and LOWER keys. Each time the key is pressed, the frequency is changed 0.5Hz.

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.

OIL RETURN MIN

To avoid an OIL – LOW TEMPERATURE DIFFERENTIAL cycling condition from preventing a chiller start after running at low load conditions for extended periods, the Oil Return Solenoid (1SOL) is cycled closed when the oil temperature gets too low on the P, Q and H9 compressor chillers, while the chiller is running. The OIL RETURN MIN SETPOINT key appears on the OIL SUMP Screen when the Chiller Style/Compressor Type setpoint (on the OPERATIONS Screen) is set to P, Q or H9 compressor in SERVICE access level. This setpoint is programmable over the range of 80.0°F to 110.0°F (default 95.0°F) and controls the oil return Solenoid as follows:

- When the compressor is running and the Oil Sump Temperature is less than Oil Return Min setpoint, close (de-energize) the Oil Return Solenoid by de-energizing K12 relay.
- When the compressor is running and Oil Sump Temperature is greater than Oil Return Min + 7°F, open (energize) the Oil Return Solenoid by energizing K12 relay.
- During coastdown, the solenoid operation is not changed from standard logic, it remains closed. During startup the operation is not changed from standard logic, it remains closed for 1 minute after System run.

In previous software versions, the Oil Return Solenoid (1SOL) is opened 1 minute into System run and remains open until System Coastdown.

STANDBY LUBRICATION

To maintain oil seal integrity while the chiller is shutdown, 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, STANDBY LUBE IN PROCESS, along with a countdown timer displaying the time remain-

ing 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.

If at least 15 PSID of oil pressure is not achieved within 30 seconds of turning on the Oil Pump, the cycle is terminated and WARNING - 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 less than or equal to 6.8 PSIG; LOP is less than or equal to 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 and the Pre-rotation Vanes are inhibited from further opening, is programmable over the range of 44.9 to 162.5 PSIG (R-134a). The Default value for R-134a is 162.5 PSIG. The threshold is automatically set to 193 PSIG when the Heat Pump Duty is set to enabled. The warning message will clear and the PRV inhibit is removed 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 PRES-SURE WARNING THRESHOLD key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

BRINE LOW EVAPORATOR PRESSURE CUTOUT

On Brine cooling applications, the LOW EVAPORATOR PRESSURE safety shutdown threshold is programmable over the range of 6.0 to 25.0 PSIG (Default 25.0 PSIG) for R-134a Refrigerant. The actual percentage of Brine solution determines this threshold. It is calculated at the YORK factory and programmed at the time of manufacture. If 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.

LEAVING CHILLED LIQUID TEMPERATURE CONTROL SENSITIVITY

This setpoint adjusts the Leaving Chilled Liquid Temperature control sensitivity. It determines the magnitude of Pre-rotation Vanes (PRV) response to correct the error between the Leaving Chilled Liquid Temperature setpoint and the actual liquid temperature leaving the chiller. There are three selections as follows:

- Normal - Provides standard control operation. PRV open and close pulses are standard durations for any given error. Longest allowed pulse is 18 seconds in duration. This selection will provide proper operation in most applications.
- 50% - Provides less sensitivity than the NORMAL selection. The longest allowed open or close pulse is limited to 50% of the maximum allowed with the NORMAL selection. This provides less overall PRV movement than the NORMAL selection. This selection will reduce PRV instability in short chilled liq-

uid loops, multi-pass chillers, parallel chiller configurations and other applications that cause PRV instability.

- 30% - Provides less sensitivity than the 50% selection. The longest allowed open or close pulse is limited to 30% of the maximum allowed with the NORMAL selection. This provides less overall PRV movement than the 50% selection. It's beneficial in the same applications as the 50% selection, but that require greater stability.

If the chiller is equipped with the YORK Compressor Motor Variable Speed Drive and the 50% or 30% Sensitivity is selected, the Pre-rotation Vane (PRV) movement is reduced further than described above when the chiller is operating at low load. When the PRV position is less than 25% and the Leaving Chilled Liquid Temperature is within plus or minus 2.5 °F of setpoint, the maximum allowed vane pulse is limited to 3.5 seconds at the 25% PRV position and 0.9 seconds at 0% position. PRV positions in between have linearly scaled maximums.

Proceed as follows to select this value:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select EVAPORATOR Screen.
3. Press SENSITIVITY key.
4. Use ◀ and ▶ keys to select 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 Enable or Disable.
5. Press ENTER (✓) key.

SMART FREEZE PROTECTION

This feature is described in *SECTION 20 - SMART FREEZE PROTECTION* 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 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 *SECTION 20 - SMART FREEZE PROTECTION* 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 optional Hot gas bypass Control and the setpoints that affect this control are provided in *SECTION 19 - HOT GAS BYPASS* of this manual. The setpoints are listed below. If the chiller is equipped with this feature, it must be ENABLED and the setpoints programmed using the procedure below. Otherwise, it must be DISABLED. The Hot gas valve can be manually controlled using the procedure below. The total lifetime Surge Count can be cleared. However, this should NOT be arbitrarily performed! Since the Pre-Rotation Vanes (PRV) position is used in the Hot gas control, the PRV position feedback potentiometer must be calibrated with the procedure below.

Enable/Disable

If the chiller is equipped with the optional Hot gas bypass Control, operation must be ENABLED. Otherwise, it must be DISABLED. Use the following procedure:

1. Shutdown chiller and place COMPRESSOR in the Stop 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. Use ◀ and ▶ keys to select Enable or Disable.
5. 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. There are two different setpoint sets used depending upon the software vintage. Select the appropriate procedure per the installed software as follows:

1. At the keypad, login at SERVICE access level using password 1 3 8 0.
2. Select Hot gas bypass Screen from the COMPRESSOR Screen.
3. On the Hot gas bypass 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 Hot gas valve can be manually controlled as follows:

1. At the keypad, log in at SERVICE access level using password 1 3 8 0.
2. Select Hot gas bypass Screen from the COMPRESSOR Screen.
3. On the Hot gas bypass Screen, press the OPEN or CLOSE keys as desired. Each time the key is pressed, the valve position will be increased or decreased 5%. Pressing the AUTO key invokes automatic operation.

Pre-rotation Vanes Position Potentiometer Calibration

Refer to the Pre-rotation Vanes Calibration procedure in this section.

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”.

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.

SURGE PROTECTION

A complete description of the Surge Protection feature and setpoints that affect this control are provided in *SECTION 21 - SURGE PROTECTION* of this manual. Although most setpoints are entered with OPERATOR access level, the Surge Sensitivity setpoint and Total Surge Count clearing require SERVICE access level or higher.

Surge Sensitivity

1. At the keypad, log in at SERVICE access level, using 1 3 8 0.
2. Select SURGE PROTECTION Screen from COMPRESSOR Screen.
3. Press SURGE SENSITIVITY key.
4. Using numeric and decimal point keypad keys, enter desired value. Programmable over range of 0.1 to 20. Default value is 2.5. Use leading zeroes where necessary and place decimal point between first and second digit (ie; 0.3, 1.2, etc.)
5. Press ENTER (✓) key.

Clear Surge Count



This should NOT be arbitrarily performed.

1. At the keypad, log in at ADMIN access level. Obtain ADMIN password from local service office. This password changes daily.
2. Select SURGE PROTECTION Screen from COMPRESSOR Screen.
3. Press CLEAR SURGE COUNT 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 microboard fails and requires field replacement, all of the data will be lost and will have to be manually programmed.

There are 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.

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 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.

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.

CHILLER STYLE/COMPRESSOR

The Chiller Style/Compressor combination must be entered. The various YK chiller style/compressor combinations are equipped differently and have different control requirements. Variables include the following:

- Flow Sensor – Paddle type or Factory Mounted Thermal Type. The paddle type applies 115VAC to the I/O Board Digital inputs TB4-12 (evaporator) and TB4-11 (condenser). The factory mounted thermal type (Standard with style H chillers), applies +5VDC to the microboard Analog Inputs at J7-14 (evaporator) and J7-16 (condenser). The software allows the use of either the Thermal type (Analog) or Paddle-type (Digital) flow sensors in the style F chillers. With these versions, the actual Flow Sensor type present must be entered using the Flow Switch setpoint.

Enter the appropriate chiller/compressor combination as follows:

1. At the keypad, login at SERVICE access level using password 1 3 8 0.
2. Select SETPOINTS/SETUP/OPERATIONS Screen.
3. Press the CHILLER STYLE/COMPRESSOR key.
4. Use ◀ or ▶ keys to select the appropriate chiller style/compressor combination. Default is “Style F/G,H5-8 Compr”.
5. Press ENTER (✓) key.

FLOW SWITCH

The chillers are supplied with factory mounted Thermal type flow sensors. The Paddle type sensors are connected to the I/O Board 115VAC Digital inputs TB4-12 (evaporator) and TB4-11 (condenser). The Thermal type sensors are connected to J14 on the microboard.

In order for the program to read the correct flow sensor input, the Flow Switch setpoint on the OPERATIONS Screen must be set appropriately in the procedure below. The correct setting is determined by the software version and the actual flow sensor connection point to the OptiView™ Control Center as follows:

Select J7 when the Thermal type flow sensors are connected to the microboard J7. Select J14 when the Thermal type sensors are connected to the microboard J14. Select TB4 when the Paddle type sensors are connected to the I/O Board TB4 (Refer to *Figure 16 on Page 50*) and the Heating Condenser Water Paddle type flow sensor is connected to the LTC I/O Board J20 (if equipped with the Heat Recovery option; Refer to *Figure 55 on Page 154*).

After the selection is made, the program will read the flow sensor input at the selected connection point and ignore the other connection points.

Enter the applicable flow sensor type as follows:

1. Select SETPOINTS/SETUP/OPERATIONS Screen.
2. Press FLOW SWITCH key.
3. Use ◀ or ▶ keys to make selection. Each time the key is pressed, the selections are alternately displayed.
4. Press ENTER (✓) key.

MICROBOARD 031-03630-001 SETUP/ CONFIGURATION

The following functions are programmed as setpoints on the Microboards Refer to the appropriate Microboard *SECTION 5 - 031-03630-001* for an explanation of each setpoint.

- Chilled Liquid Pump Operation.
- Motor Drive Type.
- Anti-recycle.
- Power Failure Restart.
- Coastdown.

- Pre-Run.
- Oil Pump Package.
- Motor Node ID (Only appears when SSS -Mod B is selected as Motor Drive Type).
- Coastdown Time
- Motor Monitoring - enable/disable
- Heat recovery-enable/disable
- Head Pressure Control-enable/disable
- Heat Pump Duty – enable/disable (only appears when logged in at ADMIN access level).

Program the above setpoints as follows:

1. At the keypad, login at SERVICE access level using access code 1 3 8 0 or required password as listed above. (“Motor Drive Type” requires chiller to be stopped with COMPRESSOR switch in the Stop position).
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 ◀▶ 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 22 - 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. If the chiller is equipped with the Compressor Motor Variable Speed Drive or the optional Hot gas bypass, the Pre-rotation Vanes (PRV) calibration is performed per procedures applicable to those features listed elsewhere in this section. Otherwise, the PRV must be calibrated per 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 COMPRESSOR start/Stop Switch in the Stop 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 ADMIN access level.
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.

- A. Surge Reaction Time - 1 to 30 seconds (5)
- B. PRV Offset – 0 to 5% (3)
- C. Probe Wait Time – 0.5 to 15 minutes (10)
- D. Open Pulse – 1 to 9 seconds (2)
- E. High Limit – 0.5 to 1.2VDC ()
- F. Low Limit – 0.4 to 0.8VDC ()
- G. Extreme Stall Duration – 10 to 20 minutes (10)
- H. PRV VGD Inhibit – 40% to 100% (100%;)

Use the following procedure:

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 with. Pressing the AUTO key invokes automatic operation.

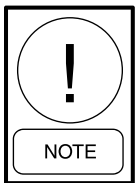
Pre-rotation Vanes Calibration

There is one procedure for all Pre-rotation Vanes (PRV) calibrations. The following procedure applies to the Compressor Motor Variable Speed Drive (VSD), Hot gas bypass, Variable Geometry Diffuser and any other PRV calibration.

1. Place the COMPRESSOR switch in the Stop position 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. The pot should be initially set so that the feedback at the fully closed PRV position is 0.3VDC to 0.7VDC. 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 + 0.025VDC 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 + 0.025VDC deviation) for 25 continuous seconds, the feedback voltage is logged as the 0% position. These endpoint voltages are stored in the FeRAM 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 uncalibrated.

HIGH CONDENSER PRESSURE FAULT WHILE SHUTDOWN – RESET PROCEDURE

High temperature condenser water 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 (R-134a), 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 (R-134a) and a special reset procedure is performed as follows:

1. Place the COMPRESSOR switch in the Stop position.
2. At the keypad, login at SERVICE access level using code 1 3 8 0.
3. Select Condenser screen.
4. Press the FAULT ACKNOWLEDGE key on the CONDENSER 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 Pre-lube, System run or Coastdown, the fault is handled in the normal way and does not require the special reset procedure.

MOTOR LUBRICATION NOTIFICATION

This feature provides an indication when the compressor motor lubrication is required. The lubrication requirement and notification is based on the OPERATING HOURS SINCE LAST MOTOR LUBRICATION.

There are up to three levels of notification, each indicating an increasing level of urgency. WARNING – MOTOR BEARING LUBE SUGGESTED is displayed when the hours exceed 1000 hours (Ball Bearings or 4000 hours (Sleeve Bearings). If there is no response, WARNING – MOTOR BEARING LUBE REQUIRED is displayed when the hours exceed 1200 hours (Ball Bearings) or 5000 hours (Sleeve Bearings). If there is still no response, a safety shutdown is performed when the hours exceed 1400 hours (Ball Bearings) or 6000 hours (Sleeve Bearings) and MOTOR – LACK OF BEARING LUBRICATION is displayed.

To provide a record of when a motor lubrication is performed, the operator enters his/her initials, name or User ID using the MOTOR LUBE ACKNOWLEDGE key on the MOTOR LUBRICATION Screen. The date and time of this entry is automatically logged as the Date of Last Lubrication and Time of Last Lubrication. This also clears any motor lubrication warning or safety that is in effect and resets the Operating Hours Since Last Lubrication to zero.

The MOTOR LUBRICATION Screen, accessible from the MOTOR Screen in any access level, displays information applicable to this feature.

When both motor bearings have been lubricated, the operator must acknowledge the lubrication has been performed. This is done by entering his/her initials, name or User ID as a 3 to 8 character string. The entry is displayed as the operator initials at Last Lubrication. The date and time of this entry is automatically logged as the Date of Last Motor Lubrication and Time of Last Motor Lubrication. This entry also resets the Operating Hours Since Last Lubrication to zero.

This entry also resets the motor lubrication warning messages: WARNING – MOTOR BEARING LUBE SUGGESTED, WARNING – MOTOR BEARING LUBE REQUIRED and safety shutdown MOTOR – LACK OF BEARING LUBRICATION.

Enter your initials, name or User ID using the following procedure. The entry must be a minimum of 3 characters and a maximum of 8 characters.

1. At the keypad, log in at using Password 9 6 7 5. If resetting the safety shutdown “Motor – Lack of Lubrication”, place COMPRESSOR switch in Stop position.
2. Press the MOTOR LUBE ACKNOWLEDGE key. A dialog box appears. A red box highlights the first changeable location.
3. Use the ▲▼ keys to scroll sequentially through the alphabet to enter letters or numbers. Each time the ▲ is pressed, the next higher sequential alphabet letter or number is displayed. Each time the ▼ is pressed, the next lower alphabet letter or number is displayed. When the desired letter or number is displayed, use the ► key to forward space the red box for the next entry. Use the ◀ key to backspace, if necessary.
4. To write over an existing entry or to place a blank space, scroll to the beginning of the alphabet. The selection prior to the letter A is a blank space. Use the • key to enter a period/decimal point. During the entry process, if it is desired to exit the dialog box and retain the previous entry, press the CANCEL (X) key.
5. When all of the desired characters have been entered, press the ENTER (✓) key.

Motor Lube Date

Normally, the Date of Last Lubrication is automatically recorded when the operator enters his/her initials, name or User ID with the MOTOR LUBE ACKNOWLEDGE key in the above procedure. However, if it is necessary

to modify the motor lubrication date after that procedure was performed, proceed as follows:

1. At the keypad, login at ADMIN access level.
2. Press the Motor Lube Date key.
3. Using the number keys, enter the desired date.
4. Press the ENTER (✓) key.

Motor Auto Lube

The Motor Lube setpoint accommodates those chillers that are equipped with Automatic Motor Lubrication hardware that automatically lubricates the motor. Since chillers that are equipped with Automatic Motor Lubrication hardware don't require manual lubrication, the motor lubrication warnings (reminders) and safety shutdown are unnecessary. Therefore, when the automatic lubrication hardware is present, the Auto Lube setpoint in the SETUP Screen must be set to the appropriate seeing (Default = NONE, QLA401, P203, SLEEVE). With this setting, no lubrication warnings or shutdown will occur.

If the Auto Lube setpoint is NONE, as it should be when not equipped with the Automatic Motor Lubrication hardware, the motor lubrication warnings and shutdown will occur at the associated elapsed run times. With this setting, the safety shutdown can be enabled or disabled per the customer's preference. If enabled, the safety shutdown will occur at the normal interval. If disabled, a warning will be displayed but the safety shutdown will not occur.

Use the following procedure:

1. At the keypad, login at SERVICE access level using access level 1 3 8 0.
2. From the MOTOR Screen, select the MOTOR LUBE Screen.
3. Press the AUTO LUBE key.
4. Use the ◀ and ► keys to select Enable or Disable as desired per above.
5. Press ENTER key.
6. If Disable is selected in step 4, press the SHUTDOWN key.
7. Use the ◀ and ► keys to select Enable or Disable as desired per above.
8. Press ENTER (✓) key.

QUICK START

The Quick Start feature is useful in data center and process control applications where it is desirable to re-establish cooling as fast as possible after a shutdown or power failure. This feature, when enabled, allows quicker starts and restarts than normal by reducing the cycle time and once running, loading the chiller as fast as possible. By default, this feature is disabled. It must be enabled to use it. A complete explanation of this feature and the following setpoints is contained in *SECTION 26 - QUICK START* of this manual.

- Quick Start Enable
- Quick Pulldown Setpoint Offset
- Pulldown Override Time
- VSD Start Frequency
- Mapping Enable
- Quick ramp Current Threshold

This feature can only be enabled if the Motor Drive Type setpoint is set to MV VSD or VSD (and the Motor Communications Protocol setpoint is set to Modbus). It requires an ADMIN password to change. When logged in at ADMIN level, a QUICK START key appears on the SETPOINTS Screen. Pressing this key will navigate to the QUICK START Screen where the Quick Start Mode setpoint is used to enable/disable this feature as follows:

1. At the keypad, log in at ADMIN access level using an ADMIN password.
2. Select QUICK START screen from the SETPOINTS screen.
3. Press CHANGE SETPOINTS key.
4. A green box will appear around the Quick Start Mode setpoint.
5. Press the ✓ key. A dialog box will appear allowing enable/disable of the feature.
6. Use the ◀ and ▶ keys to select Enable.
7. Press the ✓ key.

Once enabled, the Quick Start setpoints can be changed using the following procedure.

1. At the keypad, login at SERVICE access level using access code 1380.
2. Select QUICK START from the SETPOINTS Screen.

3. Press CHANGE SETPOINTS key.
4. A green box will appear around the first changeable setpoint. Use the UP/DN arrow keys to place the box around the setpoint to be changed.
5. Press the ✓ key.
6. Use the ◀ and ▶ keys to select the desired setting.
7. Press the ✓ key.

HEAT PUMP DUTY

(Software Version C.OPT.01.23.307 and later)

The Heat Pump Duty feature is an available option on certain model YK chillers after January 2011. The feature is enabled and disabled on the SETUP Screen. Once enabled, Heat Pump Duty can be switched between Cooling Mode and Heating Mode on the HEAT PUMP Screen. In Cooling Mode, the chiller controls the Leaving Chilled Liquid Temperature to its setpoint. In Heating Mode, the chiller controls the Leaving Condenser Liquid Temperature to its setpoint.

Enable/Disable

Use the following procedure:

1. At the keypad, log in at ADMIN access level using an ADMIN password.
2. Select SETUP Screen from the SETPOINTS Screen.
3. Press CHANGE SETPOINTS key.
4. A green box will appear around the first changeable setpoint. Use Up/Down arrows to place the box around the Heat Pump Duty setpoint (The Refrigerant Selection setpoint must be set to R-134a in order for this setpoint to appear).
5. Press ✓ key. A dialog box appears with the range of settings.
6. Use left/right arrow keys to select the desired setting.
7. Press ✓ key.

Setpoints

Refer to the HEAT PUMP Screen section in Operation Manual 160.54-O1 and enter the following setpoints:

- Heating Sensitivity
- Operational Mode
- Leaving Condenser Liquid Temperature—Setpoint

- Leaving Condenser Liquid Temperature – Range
- Leaving Condenser Liquid Temperature Cycling Offset – Shutdown
- Leaving Chilled Liquid Temperature Cycling Offset – Restart
- Heating LCHLT (Leaving Chilled Liquid Temperature) Shutdown

MOTOR MONITORING SOFTWARE (VERSION C.OPT.01.22.307 AND LATER)

The optional Motor Monitoring feature monitors the winding temperatures, bearing temperatures and vibration and provides motor cooling coil leak detection. To use this feature, it must be enabled on the SETUP Screen. By default, this feature is disabled. When enabled, there are two display screens for this feature:

- The Motor DETAILS Screen is available from the MOTOR Screen.
- The MOTOR SETPOINTS Screen is available from the Motor DETAILS Screen.

A complete explanation of this feature and the following setpoints is contained in *SECTION 27 - MOTOR MONITORING* of this manual.

MOTOR DETAILS SCREEN

This screen allows any combination of winding temperature, bearing temperature and bearing vibration sensing to be enabled or disabled based on the actual equipment applied. The motor could be equipped with different types of sensors for motor monitoring. Either RTD's or thermistors could be applied for winding and bearing temperature monitoring. Motor cooling coil leak detection could be done with either an optical or float sensor. Setpoints on this screen allow for the enabling of the actual sensor type applied. Also on this screen, vibration baseline data can be entered manually or by running an auto baseline routine that plots a baseline over a 1 hour period while the chiller is running. To access the MOTOR DETAILS screen:

1. At the keypad, login at SERVICE access level using password 1 3 8 0.
2. From the MOTOR Screen, select the MOTOR DETAILS Screen and enter the following setpoints using the procedures below.

Winding Temperature Protection

Enables the type of temperature sensing device used to sense motor winding temperatures. Set to RTD when the winding sensors are RTD's. Set to Thermistor when the winding sensors are thermistors. Set to Disabled when the motor is not equipped with winding temperature sensors or it is desired to disable the feature for service reasons. The default setting is Disabled. To set the appropriate type of temperature sensing device:

1. Press WINDING TEMPERATURE PROTECTION key.
2. A dialog box appears with the selections.
3. Use ◀ and ▶ keys to select Disabled, RTD or Thermistor, as appropriate.
4. Press ENTER (✓) key.

Bearing Temperature Protection

Enables the type of temperature sensing device used to sense motor bearing temperatures. Set to RTD when the bearing sensors are RTD's. Set to VSD Thermistor when the bearing sensors are thermistors. Set to Disabled when the motor is not equipped with bearing temperature sensors or it is desired to disable the feature for service reasons. The default setting is Disabled. Select the appropriate sensing device as follows:

1. Press BEARING TEMPERATURE PROTECTION key.
2. A dialog box appears with the selections.
3. Use ◀ and ▶ keys to select Disabled, RTD or VSD Thermistor, as appropriate.
4. Press ENTER (✓) key.

Motor Vibration Protection

Enables and Disables the Motor Bearing Vibration Protection feature. Set to Rolling Element when the motor is equipped with bearing vibration sensors. Set to Disabled when the motor is not equipped with bearing vibration sensors or when it is desired to disable the feature for service reasons. The default setting is Disabled. To Enable or Disable the Motor Bearing Vibration Protection feature:

1. Press MOTOR VIBRATION PROTECTION key.
2. A dialog box appears with the selections.
3. Use ◀ and ▶ keys to select Disabled or Rolling Element, as appropriate.
4. Press ENTER (✓) key.

Cooling Coil Leak Detection

Enables the type of leak detection device used to detect a leak of the motor cooling coil. Set to Optical when the sensor is the optical type. Set to Float when the sensor is the float type. Set to Disabled when the motor is not equipped with leak sensors or for service reasons. The default setting is Disabled. To enable the type of leak detection:

1. Press MOTOR COOLING COIL LEAK PROTECTION key.
2. A dialog box appears with the selections.
3. Use ◀ and ▶ keys to select Disabled, Optical or Float, as appropriate.
4. Press ENTER (✓) key.

Manual Baseline

This setpoint is used to manually enter vibration baseline values (0.1 to 5.0; Default 2) for the Shaft End and Opposite Shaft End bearings. These values are not in any particular units of measure. They are relative values. The larger the number, the greater the magnitude of vibration represented. A special password is required. To enter the desired vibration baseline values:

1. Press MANUAL BASELINE key. A dialog box appears requesting a special password.
2. Using numeric keypad keys, enter 0 3 6 8 and press the ENTER (✓) key. A green box appears around the Shaft End vibration baseline value.
3. Press ENTER (✓) key. A dialog box appears giving the range of values.
4. Using numeric keypad keys, enter the desired value.
5. Press ENTER (✓) key.
6. Using the ▶ key, move the green box around the Opposite Shaft End vibration baseline value.
7. Press ENTER (✓) key. A dialog box appears giving the range of values.
8. Using numeric keypad keys, enter desired value.
9. Press ENTER (✓) key.

Auto Baseline

This key is used to run the auto baseline routine to automatically establish a vibration baseline for the shaft end and opposite shaft end bearings. The vibration level of each bearing is independently averaged for 1 hour

at 1 minute intervals, while the chiller is running (for at least 2 minutes). While the routine is running, the time remaining in the 1 hour routine is displayed on this screen as "Auto Baseline Time Left XX Min". At the completion of the routine, the derived values appear on the Screen as the VIBRATION BASELINE values (0.1 to 5.0) for the shaft end and opposite shaft end bearings. These values are not in any particular units of measure. They are relative values. The larger the number, the greater the magnitude of vibration. A special password is required. This key only appears while the chiller is running and after 2 minutes of compressor operation. To initiate the Auto Baseline routine:

1. The chiller must be running (for at least 2 minutes).
2. Press the AUTO BASELINE key. A dialog box appears requesting a special password.
3. Using numeric keypad keys, enter 0 3 6 8 and press the ENTER (✓) key.
4. The Auto Baseline routine begins running.
5. At the completion of 1 hour, the routine terminates and the derived values appear as the Vibration Baselines for the Shaft End and Opposite Shaft End bearings.
6. If it is desired to terminate the routine prior to the 1 hour completion, repeat steps 2 and 3.

MOTOR SETPOINTS SCREEN

This screen allows programming of the WINDING and BEARING HIGH TEMPERATURE warning/safety shutdown thresholds and the high vibration warning/safety shutdown thresholds, along with the vibration input gain. Also, individual winding temperature sensors can be disabled on this screen.

Temperature Disable

This setpoint allows the individual winding temperature sensors to be enabled or disabled. A sensor can be disabled if it is defective or for service reasons. Otherwise, it should be enabled. The respective temperature data box on this screen reflects enabled or disabled status. When a sensor is disabled, the respective temperature data box does not appear on the MOTOR DETAILS Screen. This key is only shown when logged at ADMIN access level and Winding Temperature Protection setpoint on the MOTOR DETAILS Screen is not set to disabled. Enable or Disable the individual winding temperature sensors as follows:

1. Login at ADMIN access level.
2. Press TEMPERATURE DISABLE key. A green box appears around the Motor Windings Phase A Temperature.
3. Use ◀ and ▶ keys to place the green box around the sensor to be enabled or disabled.
4. When the desired sensor is selected, press the ENTER (✓) key. A dialog box appears allowing selection of enable or disable.
5. Use left/right arrow keys, select enable or disable, as desired.
6. Press ENTER (✓) key.
7. Repeat steps 3 through 6 until all sensors have been enabled or disabled as desired.
8. Press CANCEL (X) key to exit.

Winding Setup

This setpoint is used to enter the High Winding Temperature (266 to 320°F; default 311) and High Hotspot Allowance (0 to 18°F; default 0) safety shutdown thresholds. This key is not shown when the Winding Temperature Protection setpoint on the MOTOR DETAILS Screen is set to disabled. To enter desired values:

1. Press WINDING SETUP key. A green box appears around the High Winding Temperature Shutdown setpoint.
2. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
3. Using numeric keypad keys, enter the desired value.
4. Press ENTER (✓) key.
5. Use Up/Down arrow keys to place the green box around the Winding Hotspot Allowance setpoint.
6. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
7. Using numeric keypad keys, enter the desired value.
8. Press ENTER (✓) key.
9. Press CANCEL (X) key to exit.

Vibration Setup

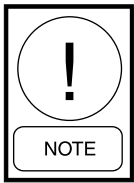
This setpoint is used to enter the Motor Bearings High Vibration Shutdown safety threshold (2.0 to 30; default baseline X3) and High Vibration Warning threshold (1.0 to 15; default baseline X2) for the shaft end and opposite shaft end bearings, along with the desired delays for each:

- Shutdown equals 0 to 30 seconds, default 15
- Warning equals 0 to 120 seconds; default 30

The vibration values are not in any particular units of measure. They are relative values. The larger the number, the greater the magnitude of vibration represented. This key is not shown when the Motor Vibration Protection setpoint on the MOTOR DETAILS Screen is set to disabled. To enter desired values:

1. Press VIBRATION SETUP key. A green box appears around the High Vibration Shutdown Shaft End setpoint.
2. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
3. Using numeric keypad keys, enter desired value
4. Press ENTER (✓) key.
5. Use Up/Down and Left/Right arrow keys to place the green box around the next desired value to be changed.
6. Repeat steps 2 through 5 until all desired values have been entered.
7. Press CANCEL (X) key to exit.

The actual values used for the VIBRATION safety shutdown and warning thresholds will be either the values entered manually with this setpoint or the values derived from the Vibration Baseline setpoints (provided they don't exceed the minimum and maximum limits of the shutdown and warning thresholds. See below and Manual Baseline and Auto Baseline setpoints on MOTOR DETAILS screen). The values used depend on the sequence in which they are entered. Whichever values are entered last, are the ones that are used. The active threshold values are displayed in the Motor Bearings High Vibration shutdown and High Vibration Warning data boxes on this MOTOR SETPOINTS Screen. The Vibration Baseline values from which the Vibration Shutdown and Warning thresholds are derived, are displayed on the MOTOR DETAILS Screen. The thresholds are derived from these values as follows:



If the calculated value exceeds the minimum and maximum limits of the Shutdown (2.0 to 30.0) or Warning (1.0 to 15.0) threshold, the calculated value is not used and the threshold is set to the respective upper or lower limit.

- Shaft End High Vibration Warning - Shaft End Vibration Baseline X2
- Shaft End High Vibration Warning Default - Shaft End Vibration Baseline X2
- Opposite Shaft End High Vibration Warning - Opposite End Vibration Baseline X2
- Opposite Shaft End High Vibration Warning Default - Opposite End Vibration Baseline X2
- Shaft End High Vibration Shutdown - Shaft End Vibration Baseline X3
- Shaft End High Vibration Shutdown Default - Shaft End Vibration Baseline X3
- Opposite Shaft End High Vibration Shutdown - Opposite Shaft End Vibration Baseline X3
- Opposite Shaft End High Vibration Shutdown Default - Opposite Shaft End Vibration Baseline X3

Vibration Gain

This setpoint is used to enter values for the vibration input gain [1:1, 11:1, 21:1 (default)]. This key is only shown when logged at ADMIN access level and Motor Vibration Protection setpoint on the MOTOR DETAILS Screen is not set to disabled. To enter desired values:

1. Login at ADMIN access level.
2. Press VIBRATION GAIN key. A green box appears around the Vibration Input Gain setpoint.
3. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
4. Use ◀ and ▶ keys to select the desired value.
5. Press ENTER (✓) key.
6. Press CANCEL (X) key to exit.

Bearing Setup

This setpoint is used to enter the High Bearing Temperature Shutdown safety threshold (149 to 212°F; default 203) and High Bearing Temperature Warning threshold (140 to 194°F; default 194). This key is not shown when the bearing temperature protection setpoint on the MOTOR DETAILS Screen is set to disabled. To enter desired values:

1. Press BEARING SETUP key. A green box appears around the High Bearing Temperature Shutdown setpoint.
2. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
3. Using numeric keypad keys, enter desired value.
4. Press ENTER (✓) key.
5. Use Up/Down arrow keys to place the green box around the High Bearing Temperature Warning setpoint.
6. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
7. Using numeric keypad keys, enter the desired value.
8. Press ENTER (✓) key.
9. Press CANCEL (X) key to exit.

SECTION 29 - DIAGNOSTICS AND TROUBLESHOOTING

The problems that could be encountered in the OptiView™ Control Center are in the following categories:

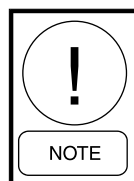
- Keypad
- Display
- Serial Input/Output (I/O)
- Digital Input/Output (I/O)
- Analog Inputs

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 listed in the Associated Literature table at the front of this manual.

There are two versions of the Diagnostics screens available as follows:

1. Shown in *Figure 61 on Page 171 through Figure 70 on Page 212*. 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 Compressor Stop switch in the Stop position.
 - c. Ensure the Compressor motor current is 0% FLA.
 - 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.



If the Program Switch is moved to the ON position before logging in at a Service Level, 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 two screens available that allow the Analog Input voltage levels and Digital I/O states to be monitored. These screens are preceded by a general screen that provides the installed software versions.

DIAGNOSTICS SCREEN

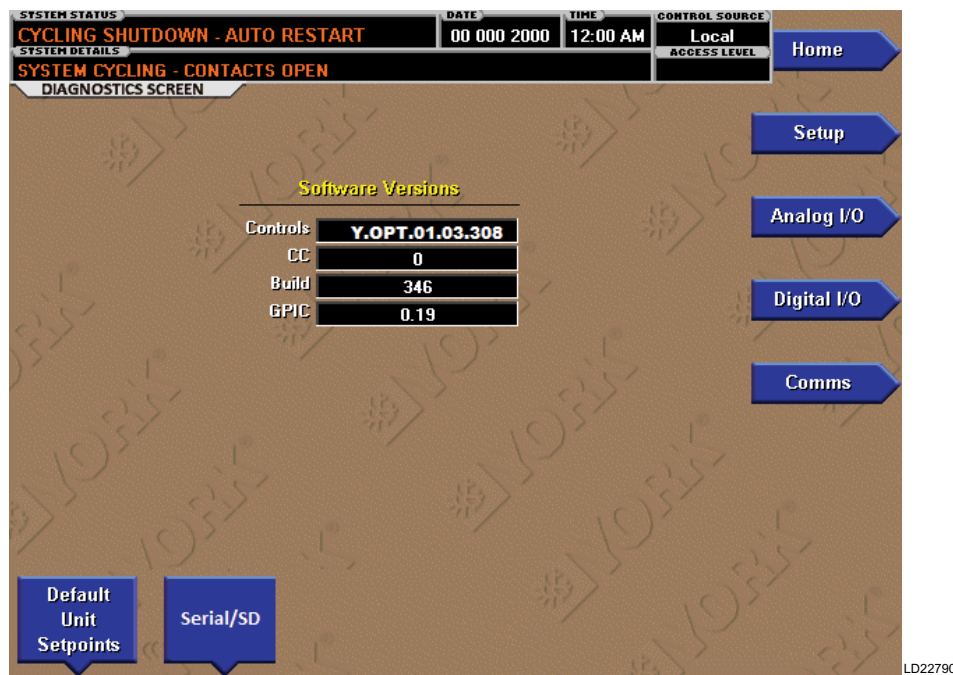


FIGURE 69 - DIAGNOSTICS SCREEN

This screen shows all of the software that is loaded onto the microboard and the motor starter connected to the microboard via serial communications.

Controls – Software that controls the chiller.

CC - Version of control routines.

GUI – Graphical User Interface version.

SIO – software that is part of flash memory.

GPIC – Version of the data map for the SC-EQ Gateway.

Ext I/O – Software in I/O Board 031-02895-000.

SSS, VSD, MVSSS or MVVSD – software that is in the respective device.

VSD Rectifier – Version of the rectifier software.

VSD Inverter – Version of the inverter software.

VSD Modbus – Version of the Modbus communications protocol used to communicate with the VSD.

Motor Monitoring – Version of the Motor Monitoring board software.

BUTTONS

Default Unit Setpoints

Many of the control parameters are automatically configured by pressing this button after the Sales Order screen is entered. Failure to press this button can result in unstable control. Note that some versions of software also have a Default Setpoints button on the Capacity Control screen. That button does not need to be pressed because the Default Unit Setpoints button on the Diagnostic screen will set all of the parameters.

NAVIGATION

Serial/SD – Navigates to the Serial/SD screen where data logging and Save and Restore Parameters is accomplished.

Erase All NOVRAM (Displayed at Admin Level) – Pressing this button erases all of the sales order setpoints, configurations and history in the microboard.

Home – Returns to the Home screen

Setup – Navigates to the Setup screen

Analog I/O – Navigates to the Analog I/O screen

Digital I/O – Navigates to the Digital I/O screen

Comms – Navigates to Comms screen

SERIAL/SD SCREEN

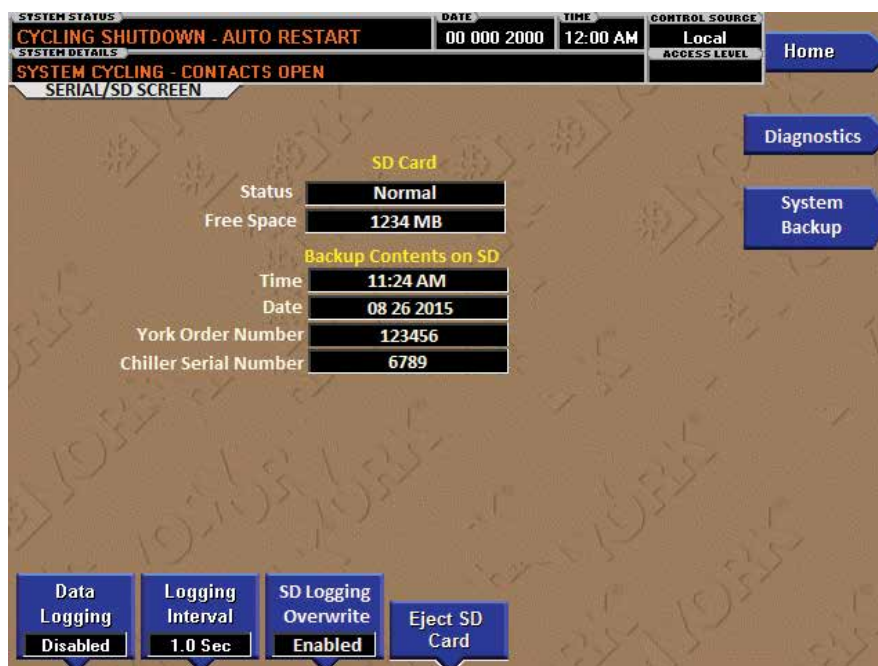


FIGURE 70 - SERIAL/SD SCREEN

This screen shows the SD card status and enables System Backup & Restore along with Data logging.

BUTTONS

Data Logging – Four modes are available:

- **Disabled**
- **Serial** – data logs to the printer port
- **SD** – data logs to an SD card (Any size is supported)
- **Serial/SD** – data logs to both the printer port and the SD

Logging Interval – Adjustable from 0.1 to 60 seconds

SD Logging Overwrite – Two modes are available:

- **Disabled** – Will stop logging to the SD card when it is full.
- **Enabled** – Will Overwrite the oldest day file with the present day log information. The SD Data log creates a file for each day. This file is in .csv format and can be read by Microsoft Excel where the chiller operating parameters can be analyzed and plotted.

Refer to *Table 19 on Page 230* for a list of the chiller parameters that are data logged.

Eject SD Card – Pressing this button before removing the SD card prevents it from being corrupted which could happen if the card is removed during a write event and this button was not pressed.

NOTE: System Backup and Restore buttons are only visible when Data logging is Disabled. System Backup allows all of the chiller parameters to be saved to an SD card and then Restored to a replacement microboard. This is equivalent to swapping the BRAM chip in the 02430 microboard.

System Backup – When pressed, saves the current chiller parameters to the SD card. A portion of a blank SD card is reserved for this data and the rest of the card can be used for Data logging. When Data logging is turned on, the chiller parameters are automatically saved to the SD card at midnight each day.

System Restore – When pressed, writes the parameters that were saved on the SD card back to the microboard NOVRAM memory.

NAVIGATION

Home – Returns to the Home screen

Diagnostics – Navigates to the Diagnostic screen

MAIN DIAGNOSTICS SCREEN



LD14328a

FIGURE 71 - MAIN DIAGNOSTICS

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

- Monitor Monitoring Board
- I/O Board
- Keypad test

- Display test
 - Bit patterns test
 - All red
 - All green
 - All blue
 - All white
 - All black
- Serial I/O test
- Digital I/O test
- Analog Inputs

The ADVANCED SECURITY key is used during the manufacturing process and has no field service use.

MOTOR MONITORING BOARD DIAGNOSTIC SCREEN



LD14330

FIGURE 72 - MOTOR MONITORING BOARD DIAGNOSTIC SCREEN

This diagnostic screen is used to analyze the analog and Digital inputs of the Motor Monitoring Board. The inputs are identified by terminal strip and terminal number. Also, serial communications error statistics are displayed here. Refer to description of this board in *SECTION 27 - MOTOR MONITORING* of this manual.

ANALOG INPUTS

The voltage level of each Analog Input (as measured to ground) at the indicated input terminals is displayed as X.XX VDC.

- TB1-2** Motor Winding Phase A Temperature (50K Ohm thermistor)
- TB1-5** Motor Winding Phase B Temperature (50K Ohm thermistor)
- TB1-8** Motor Winding Phase C Temperature (50K Ohm thermistor)
- TB2-11** Not used
- TB2-8** Not used
- TB2-5** Not used
- TB2-2** Not used
- TB1-11** Not used

VIBRATION INPUTS

Gain - Displays the value programmed for the Vibration Input Gain setpoint for the accelerometer inputs. The gain can be changed from this screen using the CHANGE GAIN key. See below.

Vibration - The accelerometer vibration level input (as measured to ground) at the indicated terminals is displayed as XX.X. The vibration values are not in any particular units of measure. They are relative values. The larger the number, the greater the magnitude of vibration.

- TB3-2** Motor Bearing Shaft End Vibration (accelerometer)
- TB3-4** Motor Bearing Opposite Shaft End Vibration (accelerometer)
- TB3-6** Not used
- TB3-8** Not used

RTD INPUTS

The voltage level of each RTD at the indicated input terminals is displayed as X.XX VDC. An LED illuminates to indicate an open RTD. All inputs are 100 Ohm RTD's.

TB6-1,3	Motor Winding Phase A1 Temperature
TB6-4,6	Motor Winding Phase A2 Temperature
TB6-7,9	Motor Winding Phase B1 Temperature
TB6-10,12	Motor Winding Phase B2 Temperature
TB5-1,3	Motor Winding Phase C1 Temperature
TB5-4,6	Motor Winding Phase C2 Temperature
TB5-7,9	Motor Bearing Opposite Shaft End Temperature
TB5-10,12	Motor Bearing Shaft End Temperature

Digital inputs

The state of each Digital Input is depicted by an LED. TB7 accepts +5VDC inputs. TB8 accepts 24VAC or DC inputs. When the input is high (24VAC/DC or +5VDC), the LED is illuminated. Otherwise, it is extinguished.

TB7-5	Motor Cooling Coil Leak Detector (low voltage optical)
TB7-2	Not used
TB8-5,6	Motor Cooling Coil Leak Detector (float switch)
TB8-2,3	Not used

MODBUS COMMUNICATION COUNTERS

The following error counts are displayed. Pressing the RESET COUNTERS key resets them to zero.

- ID Faults
- Checksum Errors
- Error Packets
- Timeout Faults

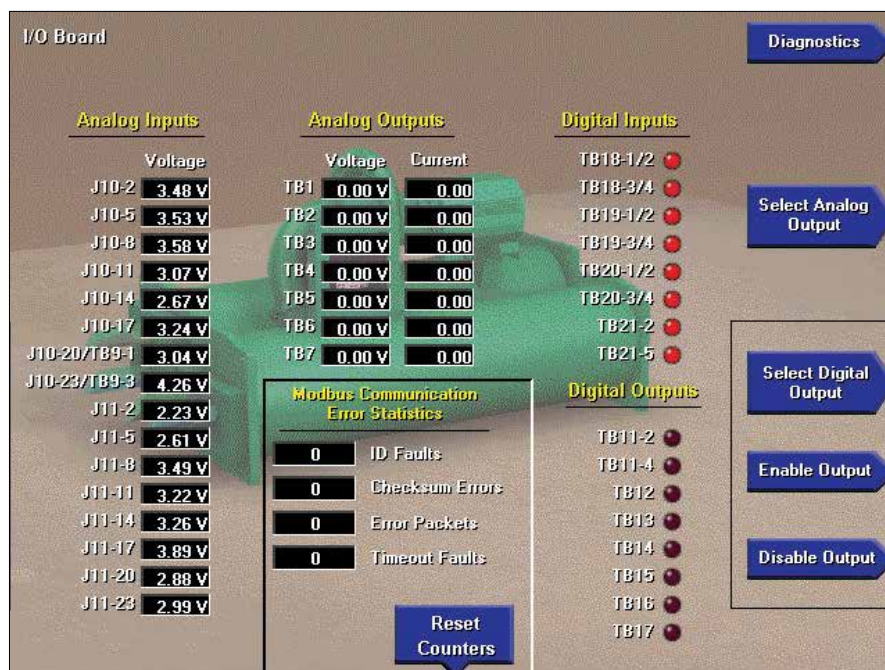
PROGRAMMABLE**Change Gain**

Access Level Required: ADMIN

This key can be used to change the input gain of the accelerometer vibration inputs. This key is only shown when Microboard switch SW1-3 is set to ON. Programmable as 1:1, 11:1 or 21:1. Gain of individual inputs cannot be changed. When any one is changed, they are all changed to the same value.

1. Begin with Microboard switch SW1-3 in the OFF position.
2. Login at VIEW access level.
3. Place Microboard switch SW1-3 in the ON position.
4. After reboot, on DIAGNOSTICS LOGIN Screen, login at ADMIN access level.
5. Press CHANGE VIBRATION key. A green box appears around the first Vibration Input Gain setpoint.
6. Press ENTER (✓) key. A dialog box appears with the range of allowed values.
7. Use ◀ and ▶ keys to select desired value.
8. Press ENTER (✓) key.
9. Press CANCEL (X) key to exit.

I/O BOARD (031-02895-000) DIAGNOSTIC SCREEN



LD14329

FIGURE 73 - I/O BOARD DIAGNOSTIC SCREEN

This diagnostic screen is used to analyze the analog and Digital inputs and outputs of I/O Board 031-02895-000. The outputs can be manually set to a desired level from here. Also, serial communications error statistics are displayed here. Refer to description of this board in *SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD* 031-02895-000/001 of this manual.

ANALOG INPUTS

The voltage level of each Analog Input at the indicated input terminals is displayed as x.xxVDC.

ANALOG OUTPUTS

The analog outputs are in the form of 0 to 10VDC or 0 to 20mA at each of the listed connectors. The values displayed are the values the I/O Board is intending to provide at the output connector. The voltage output is at terminal 2 of each output connector and is displayed as x.xxVDC. The current output is at terminal 1 of each output connector and is displayed as xx.xxmA.

The voltage value and the current value are directly scaled over their respective ranges of 0 to 10VDC and 0 to 20mA. For example, when the voltage output (terminal 2) is at 0VDC, the current output (terminal 1) is at 0mA. A 10VDC output produces a 20mA output. A 5VDC output produces a 10mA output, etc.

To test an output, each output can be manually set to any desired value within its range limits. The desired value is set in terms of a voltage value. For example, if the voltage is set to 5VDC, the current value will automatically be set to 10mA. When Diagnostic Mode is exited (DIP Switch 3 is set back to OFF position), outputs revert to Program control.

To manually set the output:

1. Press the SELECT ANALOG OUTPUT key, A green box will be placed around the first changeable output.
2. Use the keypad UP and DOWN arrow keys to place the green box around the desired output.

3. Press the ENTER (✓) key. A box will appear showing the range of allowed voltage values.
4. Using the keypad keys, enter the desired voltage value.
5. Press the ENTER (✓) key. The entered voltage value and corresponding current value will be shown in the selected output box. The voltage value is at terminal 2 of the selected output. The current value is at terminal 1 of the selected output.

Digital inputs

The state of each Digital Input is directly depicted by an LED. When the input is high (120VAC or +5VDC), the LED is illuminated). Otherwise, it is extinguished.

DIGITAL OUTPUTS

The state of each output is depicted by an LED. When the output is ON, it is illuminated. Otherwise, it is extinguished.

To test an output, each output can be manually set to ON or OFF. The motor controller circuit must be opened before manual control is allowed. Removing J2 from the I/O Board opens this circuit. When Diagnostic Mode is exited (DIP Switch 3 is set back to the OFF position), outputs revert to Program control.

To manually set the output:

1. Press SELECT DIGITAL OUTPUT key. A yellow arrowhead will appear to the right of the first digital output.
2. Use the UP and DOWN arrow keys to place the arrowhead at the desired output.
3. Press ENABLE OUTPUT key to turn the output on. Press the DISABLE OUTPUT key to turn the output off.

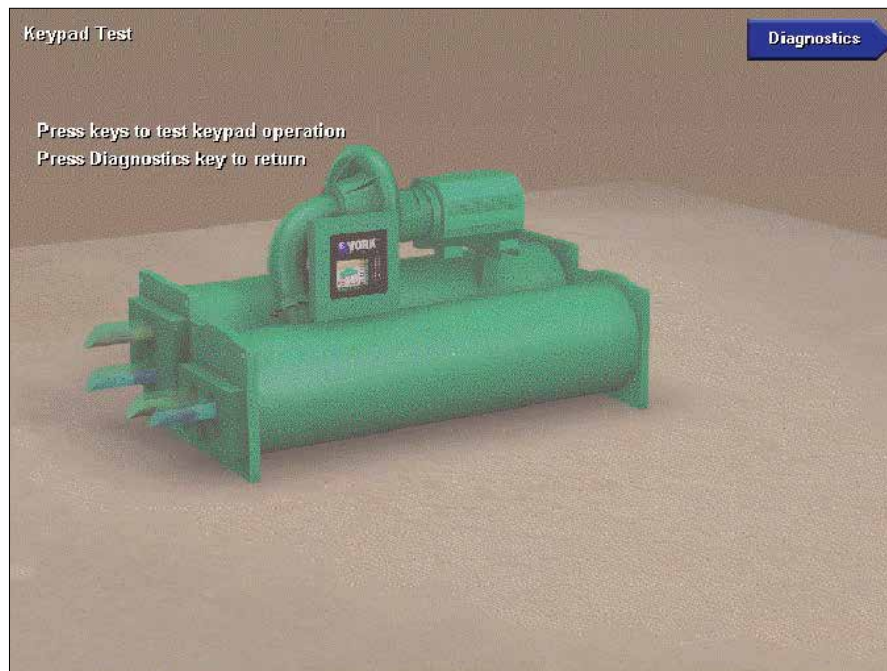
MODBUS COMMUNICATION ERROR COUNTERS

The following error counts are displayed:

- ID Faults
- Checksum Errors
- Error Packets
- Timeout Faults

Press the RESET ERROR COUNTERS key to reset these counters to zero.

KEYPAD TEST



00336VIP

FIGURE 74 - KEYPAD TEST SCREEN

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 7 - 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 26 on Page 65*.

- 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 greater than 100 Ohms, the keypad is defective.
- f. Release the key. If the contact resistance is greater than 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 MAIN SCREEN



00337VIP

FIGURE 75 - DISPLAY TEST MAIN SCREEN

Each display diagnostic 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* and *SECTION 6 - DISPLAY INTERFACE BOARD* of this manual.

PROCEDURE

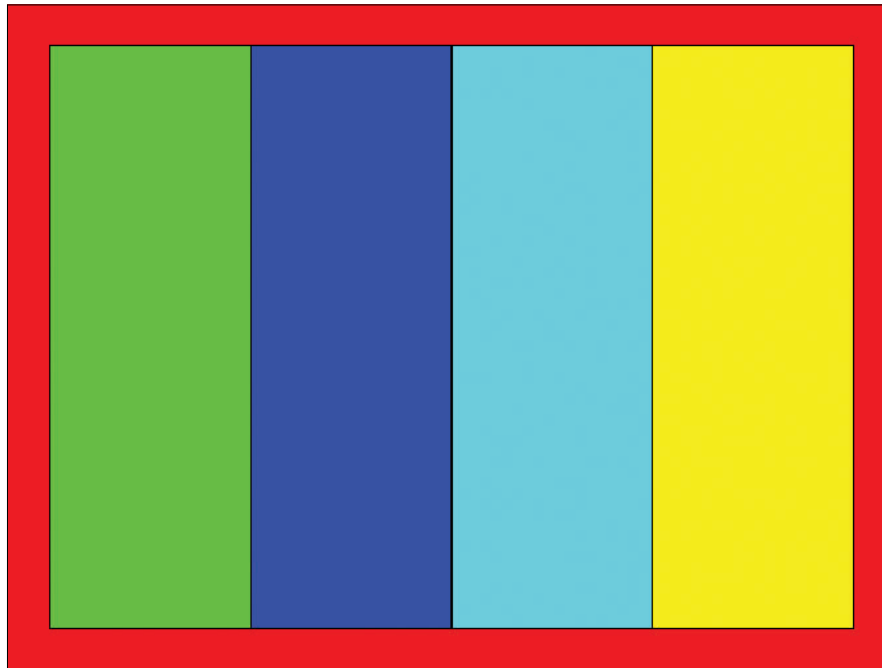
1. Press the appropriate keypad key to perform the desired test from the list below.
 2. Press the CANCEL (X) or ENTER (✓) key to terminate test and return to DISPLAY TEST MAIN Screen, from which another test can be selected.
 3. When all the desired tests have been performed, press the DIAGNOSTICS key 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 Pro-

gram Jumpers are not configured correctly for the installed display or the microboard Display Controller is defective. Refer to *Figure 55 on Page 154*.

- **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.

BIT PATTERNS TEST SCREEN



00338VIP

FIGURE 76 - BIT PATTERNS TEST SCREEN

TROUBLESHOOTING

If any of the tests from the previous screen do not perform correctly as described, 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 the 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 through 5), as measured to GND, should be greater than 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 through 5), as measured to GND, should be greater than 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 GND, should be greater than 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 greater than 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 greater than 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 TEST SCREEN



LD19811

FIGURE 77 - SERIAL INPUTS / OUTPUTS TEST SCREEN

This diagnostic is used to verify correct operation of the Serial Data Ports. There is a test for each of the six serial data ports. Each RS-232 port (COM 1, 4 and 5a) 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, 5b, and 2) are tested by transmitting serial test data from one RS-485 port to another. The TX/RX opto-coupled port (COM 5a) 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.

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.

RS-232	From	To
COM 1	J2-4 (TX) J2-5 (DTR)	J2-3 (RX) J2-2 (DSR)
RS-485	From	To
COM 2/3	J13-3 (+) J13-2 (-)	J12-5 (+) J12-4(-)
RS-485	From	To
COM 3/5b	J12-5 (+) J12-4 (-)	TB4-3 (+) TB4-2 (-)
RS-232	From	To
COM 4	J2-7 (GTX)	J2-6 (GRX)
RS-232	From	To
COM 5a	J15-1 (TX) J15-2 (RX) J15-3 (Common)	J15-4 J15-5 J15-6

COM 5b/6 does not apply to the -001 microboard used in the YK Chiller.

For COM 5a make individual wire connections or use YORK loop-around diagnostic connector 025-33778-000 as depicted in Figure 77 on Page 223 This connector is available from the Baltimore Parts 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.

RS-485 (COM 2 and 3) – Test data is sent from COM 2 RS-485 port to COM 3 RS-485 port at 19200 Baud. Test data is then sent from COM 3 to COM 2 at the same rate. If either test fails, the test is terminated.

RS-485 (COM 3 and 5b) – Test data is sent from COM 3 RS-485 port to COM 5b RS-485 Port at 19200 Baud. Test data is then sent from COM 5b to COM 3 at the same rate. If either test fails, the test is terminated.

COM 4 – Test data is sent from GTX (J2-7) to GRX (J2-6) at 19200 Baud.

COM 5a – 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 to +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.

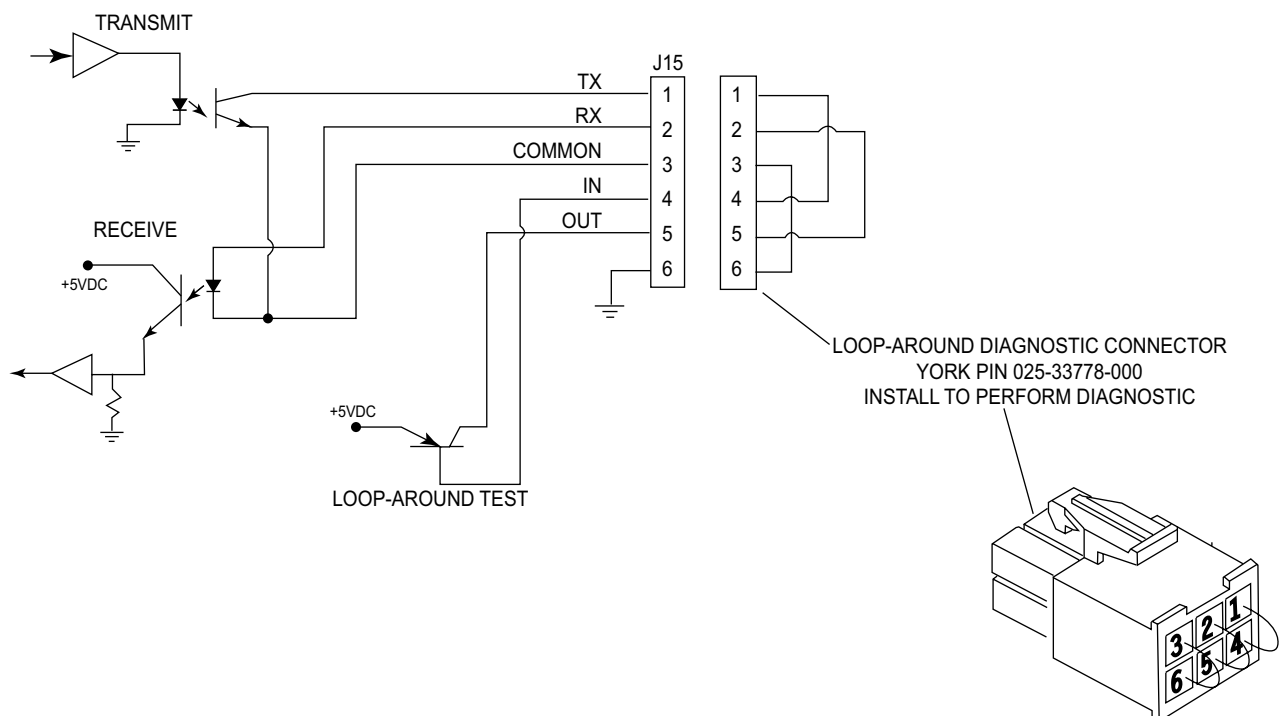


FIGURE 78 - MICROBOARD - COM 5 SERIAL DATA PORT

LD04250

DIGITAL INPUTS / OUTPUTS TEST SCREEN



LD19812

FIGURE 79 - DIGITAL INPUTS / OUTPUTS TEST SCREEN

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 (less than 1.0VDC) level, the LED is illuminated. If interpreted as being at a Logic High (greater than 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 (less than 1.0VDC), the LED is illuminated. If the intended output is a Logic High level (greater than 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.
- b. Microboard Program Jumpers and Program DIP Switches.

Figure 16 on Page 50 shows the devices connected to these terminals.

2. With 115VAC 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 appropriate troubleshooting procedure below.
4. If a Program Jumper is present, the applicable LED should be extinguished. If the LED is not extinguished, the microboard is defective.
5. If a Program Jumper is not present, the applicable LED should be illuminated. If the LED is not illuminated, the microboard is defective.
6. If a Program Switch (DIP) is in the ON position, the applicable LED should be illuminated. If the LED is not illuminated, the microboard is defective.

7. If the Program Switch (DIP) is in the OFF position, the applicable LED should be extinguished. If the LED is not extinguished, the microboard is defective.
8. 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 Motor Controller connection between TB6-15 and TB6-53 has been removed. This connection could be a jumper or it could be a connection from external devices in the starter. The Program will prevent manual control of Digital Output devices until this connection is removed.
2. The Digital Outputs are listed on this screen according to Relay and Triac number (KI, Q3, etc). *Figure 19 on Page 52* shows the external devices that are connected to these Relays and Triacs and the functions of each one.
3. Press SELECT key. An arrow will appear adjacent to relay KO. When Japanese, Korean or Chinese language is selected, the arrow is replaced with a green box.
4. Select a relay or triac for manual control by using the ◀ and ▶ keys to place the arrow adjacent to the desired device.
5. 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 Diagnostic 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.
6. 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.

7. When all desired tests have been performed, press DIAGNOSTICS key to return to the MAIN DIAGNOSTICS Screen.
8. Install Motor Controller connection from TB6-1 to TB6-15 removed in step 1.

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 16 on Page 50* and applicable wiring diagram referenced at the beginning of *SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001*. 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 the I/O Board between J1-21 and J1-22. If greater than 4.5VDC, proceed to next step. If less than 4.5VDC, disconnect the ribbon cable at I/O Board J1 and repeat the measurement at J1. If less than 4.5VDC, replace the microboard and re-install the ribbon cable.
3. With 115VAC (plus or minus 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 (less than 1.0VDC). If it is greater than 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 (greater than 4.0VDC). If it is less than 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

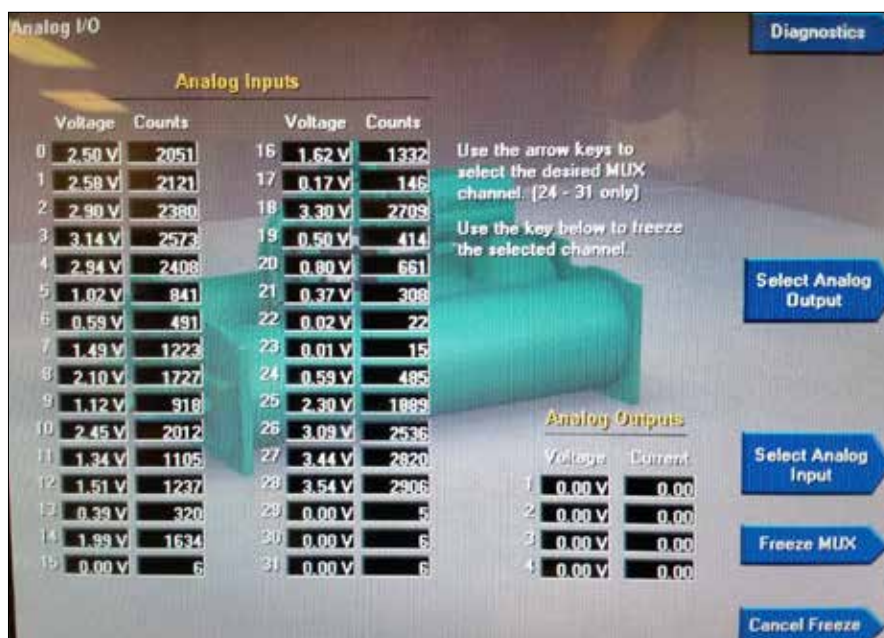
If any of the Digital Outputs tests fail to perform as described above, perform the following steps in sequence. Refer to *Figure 19 on Page 52* and applicable wiring diagram referenced at the beginning of *SECTION 23 - LARGE TONNAGE CHILLER (LTC) I/O BOARD 031-02895-000/001*. If a defective component 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 greater than 11.0VDC, proceed to next step. If less than 11.0VDC, disconnect ribbon cable at I/O Board J1 and repeat measurement at J1. If less than 11.0VDC, replace the microboard. Re-install the ribbon cable.
3. Using the Digital Outputs 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 (less than 1.0VDC). If it is greater than 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 (greater than 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 less than 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 greater than 100 Ohms, replace the I/O Board. If the resistance is less than 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 (greater than 10.0VDC) level. If it is less than 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

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 less than 10VAC. If the Triac is turned off, the voltage will be greater than 20VAC (PRV or Refrigerant Level Control Actuator).

ANALOG INPUTS/OUTPUTS TEST SCREEN

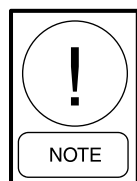


LD19813

FIGURE 80 - ANALOG INPUTS/OUTPUTS TEST SCREEN (SW1-3=ON)

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, or a 0 to 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 9 - CURRENT MODULE (CM-2), SECTION 10 - SOLID STATE STARTERS, SECTION 13 - REFRIGERANT LEVEL CONTROL, SECTION 16 - PRESSURE TRANSDUCERS, AND SECTION 17 - TEMPERATURE THERMISTORS.*

Channel

- 0 - +2.5VDC Analog supply voltage reference. Microboard TP18.

- 1 - Leaving Chilled Liquid Temperature
- 2 - Entering Chilled Liquid Temperature
- 3 - Leaving Condenser Liquid Temperature
- 4 - Entering Condenser Liquid Temperature
- 5 - Drop Leg Refrigerant Temperature
- 6 - Discharge Temperature
- 7 - Oil Temperature
- 8 - Evaporator Refrigerant Temperature
- 9 - Condenser Pressure
- 10 - Evaporator Pressure
- 11 - Sump Oil Pressure
- 12 - Pump Oil Pressure
- 13 - Proximity probe DC Voltage Reference
- 14 - Proximity probe Position
- 15 - Ground
- 16 - Refrigerant Level
- 17 - Stall Discharge Pressure
- 18 - Stall Detect for VGD
- 19 - PRV Potentiometer

- 20 - Remote Cooling Setpoint Offset (Cooling Mode)
Remote Heating Setpoint Offset (Heating Mode)
- 21 - Remote Current Limit Setpoint
- 22 - IFM Condenser Liquid Flow Sensor
- 23 - IFM Evaporator Liquid Flow Sensor
- 24 - CM-2 MUX output Channel 0
- 25 - CM-2 MUX output Channel 1
- 26 - CM-2 MUX output Channel 2
- 27 - CM-2 MUX output Channel 3
- 28 - CM-2 MUX output Channel 4
- 29 - CM-2 MUX output Channel 5
- 30 - CM-2 MUX output Channel 6
- 31 - CM-2 MUX output Channel 7

Procedure

- From the list above, select the Analog Input Channel that is malfunctioning. All inputs except channel 0, 15, 20, 21, 24-31, 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 24 through 31 are multiplexed outputs from the CM-2 Current Module (Electro-Mechanical Starter applications). Channels 20 and 21 are Remote setpoint inputs used in Analog Remote Mode.
- Refer to the appropriate Wiring Diagrams listed in front of this manual to identify the device that performs this function and the jack and pin connection to the microboard.

Channel 0

Using a Voltmeter, measure the voltage between Microboard TP18 (+2.5VDC) and TP11 (GND).

Compare this measured value to the displayed value. If the value is not between 2.44VDC and 2.55VDC, replace the microboard.

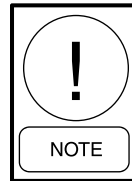
All channels except 0, 15, 20, 21, 24-31

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).

Channels 24-31

Select the desired channel by pressing the SELECT CHANNEL key and using the ◀ and ▶ keys to place the arrow head next to the desired channel. Then, freeze the address of that channel to the Solid State Starter or CM-2 MUX. Then measure MUX output at Microboard J10-6 (signal) to J10-5 (GND). When completed, press CANCEL FREEZE key.

Channels 20, 21



IMPORTANT! *This procedure only applies to 0-10VDC inputs. Using a Voltmeter, measure the Remote Current Limit setpoint input at J22-1 (signal) or Remote Leaving Chilled Liquid Temperature setpoint input at J22-3 (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 plus or minus 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 to the MAIN DIAGNOSTICS Screen.

Troubleshooting

All Channels except 0, 15, 20, 21, 24-31

- 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 J1-5 (+12VDC) to J1-3 (GND). If voltage is less than 11.58VDC, or greater than 12.5VDC check wiring to Power Supply. If wiring is OK, the Power Supply is most likely defective.
- Using a Voltmeter, measure the supply voltage (+5VDC, +1 2VDC or +24VDC) to the sensor. If voltage is not within plus or minus 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 it. 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 the sensor if necessary.

Channels 24-31

1. Disconnect both ends of the ribbon cable connected to Microboard J10. Using an Ohmmeter, perform a continuity test on all conductors in the cable. An open circuit would indicate the cable is defective.
2. Using a Voltmeter, measure the +12VDC supply voltage input at the microboard J1-5 (+12VDC) to J1-3 (GND). If the voltage is less than 11.58VDC, or greater than 12.5VDC check the wiring to Power Supply. If wiring is OK, the Power Supply is most likely defective.
3. Using a Voltmeter, measure the +5VDC supply voltage to the CM-2 Board. Make measurement at Microboard J10-4 (+5VDC) to J10-5 (GND). If voltage is less than 4.5VDC, replace the microboard.
4. Using a Voltmeter, verify the correct address is being sent from the microboard to the CM-2 Board. Freeze address as described above. If the address is correct, CM-2 Board or input devices to these boards are most likely the cause of the problem. If address is not correct, the microboard is most likely the cause of the problem.
5. Press **CANCEL FREEZE** key.

Channels 20, 21

1. Refer to *SECTION 3 - MICROBOARD 031-03630-001* "Microboard Program Jumpers" and verify Program Jumpers JP23 and JP24 are configured correctly for the type of input (0 to 10VDC or 4 to 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.

Data Logging Control

When Data Logging is enabled, data values are serially transmitted to the RS-232 port at an interval defined by the Data Logging Interval. The data will be comma separated with a carriage return and line feed transmitted at the end of each transmission interval. All data transmitted at each interval will be from the same snapshot in time.

Respective data shall be converted to Metric units when the Data Display Mode is set to Metric.

While Data Logging is enabled, the automatic fault data print is disabled.

Data Logging Configuration

Two buttons on the Diagnostic screen allow someone at Service Level to enable and set the time interval for logging data to a PC connected to the control panel serial port.

PROGRAM SETTING	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Data Logging	Service Access	Choices: Disabled Enabled		Disabled
Data Logging Interval	Service Access	0.1 sec	60.0 sec	sec

The following is a list of all data values that are included in Data Logging and the heading text that is included as the first line of data logging when it is enabled:



FIGURE 81 - DIAGNOSTIC SCREEN

LD17022a

Note that with a 03630 microboard and V03A or later software you can data log to an SD card. Refer to page 211 for details.

TABLE 19 - DATA LOGGING

NUMBER	DATA VALUE	HEADING TEXT
CHILLER DATA		
1	Date (DD/MM/YYYY format)	Date
2	Time (24 Hour format)	Time
3	Elapsed Time (seconds since data logging started)	Elapsed Time
4	Entering Chilled Liquid Temperature	ECHLT
5	Leaving Chilled Liquid Temperature	LCHLT
6	Active LCHLT Setpoint	LCHLT Setp
7	Remote LCHLT Setpoint	LCHLT Remote Setp
8	Entering Condenser Liquid Temperature	ECLT
9	Leaving Condenser Liquid Temperature	LCLT
10	Evaporator Press	Evap Press
11	Condenser Press	Cond Press
12	Delta Pressure	Delta P
13	Delta P / P	Delta P/P
14	Motor Current %FLA	Motor Curr
15	Active Motor Current Setpoint	Motor Curr Setp
16	PRV Position	PRV Pos
17	PRV Control Mode	PRV Mode
18	HGBP Command Position	HGBP Cmd
19	HGBP Control Mode	HGBP Mode
20	Condenser Refrigerant Liquid Level	Liquid Level
21	Active Refrigerant Level Setpoint	Act Level Setp
22	Level Control State	Level Control State
23	Evaporator Small Temperature Difference	Evap Small Temp Diff
24	Evaporator Saturation Temperature	Evap Sat Temp
25	Evaporator Refrigerant Temperature	Evap Refrig Temp
26	Evaporator Flow Switch	Evap Flow Switch
27	Condenser Small Temperature Difference	Cond Small Temp Diff
28	Condenser Saturation Temperature	Cond Sat Temp
29	Condenser Drop Leg Temperature	Cond Drop Leg Temp
30	Condenser Flow Switch	Cond Flow Switch
31	Subcooling	Subcooling
32	Discharge Temperature	Discharge Temp
33	Discharge Superheat	Discharge Sheat
34	Discharge Pressure	Discharge Press
35	Stall Detector Voltage	Stall Detector Voltage
36	Stall Detector High	Stall Detector High
37	VGD Control State	VGD State
38	VGD Control Mode	VGD Mode
39	Surge Detected	Surge Detected
40	Surge Count	Surge Count
41	Motor Run	Motor Run
42	Oil Pump Pressure	Oil Pump
43	Oil Sump Pressure	Oil Sump
44	Oil Differential Pressure	Oil Diff Pressure

TABLE 9 - DATA LOGGING (CONT'D)

NUMBER	DATA VALUE	HEADING TEXT
45	Oil Pump Command Frequency	Oil Pump Cmd Freq
46	Oil Pump Pressure Setpoint	Oil Pump Pres Setp
47	Proximity Differential	Prox Diff
48	Thrust Bearing Limit Switch	Thrust Limit Switch
49	Stall Detector Board Output Voltage	Stall Det Volt
50	HGBP Valve Opening	HGBP Valve Open
51	HGBP Valve Closing	HGBP Valve Close
VSD DATA		
#	Data Value	Heading Text
52	ACC Delta P / P	ACC Delta P/P
53	ACC Surge Detection	ACC Surge
54	ACC Surge Frequency	ACC Surge Freq
55	ACC Surge Map Count	ACC Map Count
56	VSD Command Frequency	VSD Cmd Freq
57	VSD Output Frequency	VSD Output Freq
58	VSD Control Mode (Auto/Manual)	VSD Mode
59	VSD DC Bus Voltage (Highest of the 6 for MVVSD)	VSD DC Bus
60	VSD Output Voltage	VSD Output Volt
61	VSD Phase A Current	VSD Phase A Cur
62	VSD Phase B Current	VSD Phase B Cur
63	VSD Phase C Current	VSD Phase C Cur
64	VSD Trigger SCR On	VSD SCR On
65	VSD Converter Heatsink Temperature	VSD Conv Temp
66	VSD Phase A Heatsink Temperature	VSD Phase A Temp
67	VSD Phase B Heatsink Temperature	VSD Phase B Temp
68	VSD Phase C Heatsink Temperature	VSD Phase C Temp
69	VSD Inverter Baseplate Temperature	VSD Inv Temp
IEEE 519 DATA		
#	Data Value	Heading Text
70	Filter Running	Filter Run
71	Filter Precharge Contactor	Filter Precharge
72	Filter Supply Contactor	Filter Contactor
73	Filter DC Bus	Filter DC Bus
74	Filter Baseplate Temperature	Filter Base Temp
75	Filter L1 – L2 RMS Voltage	Filter L1-L2 Volt
76	Filter L2 – L3 RMS Voltage	Filter L2-L3 Volt
77	Filter L3 – L1 RMS Voltage	Filter L3-L1 Volt
78	Filter L1 – N Peak Voltage	Filter L1-N Volt
79	Filter L2 – N Peak Voltage	Filter L2-N Volt
80	Filter L3 – N Peak Voltage	Filter L3-N Volt
81	Filter L1 RMS Filter Current	Filter L1 Filter Cur
82	Filter L2 RMS Filter Current	Filter L2 Filter Cur
83	Filter L3 RMS Filter Current	Filter L3 Filter Cur
84	Filter L1 RMS Supply Current	Filter L1 Supply Cur
85	Filter L2 RMS Supply Current	Filter L2 Supply Cur

TABLE 9 - DATA LOGGING (CONT'D)

NUMBER	DATA VALUE	HEADING TEXT
86	Filter L3 RMS Supply Current	Filter L3 Supply Cur
87	Filter Maximum Total Demand Distortion	Filter Max Demand
SSS DATA		
#	Data Value	Heading Text
52	SSS Phase A Current	SSS Phase A Cur
53	SSS Phase B Current	SSS Phase B Cur
54	SSS Phase C Current	SSS Phase C Cur
55	SSS Phase A Voltage	SSS Phase A Volt
56	SSS Phase B Voltage	SSS Phase B Volt
57	SSS Phase C Voltage	SSS Phase C Volt
LCSSS DATA		
#	Data Value	Heading Text
52	LCSSS Phase A Current	LCSSS Phase A Cur
53	LCSSS Phase B Current	LCSSS Phase B Cur
54	LCSSS Phase C Current	LCSSS Phase C Cur
55	LCSSS Phase A Voltage	LCSSS Phase A Volt
56	LCSSS Phase B Voltage	LCSSS Phase B Volt
57	LCSSS Phase C Voltage	LCSSS Phase C Volt
58	LCSSS Phase A Temperature	LCSSS Phase A Temp
59	LCSSS Phase B Temperature	LCSSS Phase B Temp
60	LCSSS Phase C Temperature	LCSSS Phase C Temp

SECTION 30 - SYSTEM COMMISSIONING CHECKLIST

Use the following checklist during commissioning to assure all setpoints have been programmed to the desired value and all calibrations have been performed. The programming of some of the setpoints require a SERVICE access level. To assure access to all setpoints, login at SERVICE access level before beginning. The setpoints are grouped under the display screen in which they appear. The indented screens are subscreens of the numbered screens and are accessed from the numbered screens. An explanation of each setpoint or calibration procedure below is contained in the reference document listed in parenthesis adjacent to each item. If any setpoint has to be changed, use the standard programming procedures in *OptiView™ Control Panel – Operation (Form 160.76-O2)*. Thresholds, values and calibrations of items marked with an asterisk (*) were determined and entered/set at the YORK factory at the time of manufacture.

1. PROGRAM JUMPERS/SWITCHES (160.76-M1)

____ Verify Microboard Program Jumpers and program switches are configured appropriately. Refer to *SECTION 3 - MICROBOARD 031-03630-001*.

2. EVAPORATOR Screen (160.54-O1)

Enter the following setpoints:

- ____ Leaving Chilled Liquid Temp (except ISN Remote Mode)
- ____ Remote Leaving Chilled Liquid Temp Setpoint Range (except ISN Remote Mode)
- ____ Low Chilled Liquid Temp Cycling Shutdown Temperature
- ____ Low Chilled Liquid Temp Cycling Shutdown Restart Temperature
- ____ Brine Low Evaporator Pressure Cutout Threshold* (160.76-M1)
- ____ Smart Freeze Protection ON/OFF (160.76-M1)
- ____ Refrigerant Temp Sensor Enable/Disable (160.76-M1)

3. CONDENSER Screen (160.76-O2)

- ____ Enter the High Pressure Limit/Warning Threshold Setpoint
- ____ Drop Leg Refrigerant Temp Sensor Enable/Disable

4. HEAT RECOVERY Screen

- ____ Hot Water Control Enable/Disable
- ____ Hot Water Setpoint
- ____ Head Pressure Setpoint
- ____ Remote Input Type
- ____ Control Valve Output Settings - Type
- ____ Control Valve Output Settings – PID Output
- ____ Control Valve Output Settings – Set
- ____ Control Valve Output Settings – Auto
- ____ Hot Water Control – P
- ____ Hot Water Control - I
- ____ Hot Water Control - D
- ____ Head Pressure Control – P
- ____ Head Pressure Control – I
- ____ Head Pressure Control - D

5. HEAD PRESSURE CONTROL Screen

- ____ Head Pressure Setpoint
- ____ Control Valve Output Settings – Type
- ____ Control Valve Output Settings – PID Output
- ____ Control Valve Output Settings – Set
- ____ Control Valve Output Settings – Auto
- ____ Head Pressure Control – P
- ____ Head Pressure Control – I
- ____ Head Pressure Control - D

**6. REFRIGERANT LEVEL CONTROL/
TUNING Screen (160.76-M1)**

Verify the following setpoints:

- ___ Level Setpoint*
- ___ Startup Position*
- ___ Startup Delay*
- ___ Manual or Auto control (as desired)
- ___ Verify Refrigerant Level Sensor calibration
- ___ Ramp Time

7. COMPRESSOR Screen (160.76-M1)

Proximity probe CALIBRATION Screen (except *P* compressors)

- ___ Verify that a proximity probe reference position* had been entered

PRE-ROTATION VANES CALIBRATE Screen

- ___ Perform pre-rotation vanes calibration (compressor motor VSD and hot gas bypass applications only)

VSD TUNING Screen

- ___ Select auto or manual compressor motor frequency control (compressor motor VSD applications only)

8. Hot gas bypass Screen (160.76-O2)

If chiller is equipped with optional hot gas bypass, enable operation on the OPERATIONS screen and enter the following setpoints:

- ___ Maximum Open
- ___ Hold Period
- ___ Close Percentage
- ___ Minimum Load

9. SURGE PROTECTION Screen (160.76-O2)

- ___ Enable/Disable Excess Surge Shutdown feature
- ___ Enable/Disable Extended Run feature
- ___ Count Window
- ___ Count Limit
- ___ Surge Sensitivity

**10. VARIABLE GEOMETRY DIFFUSER
SETPOINTS (160.76-O2)**

If compressor is equipped with the Variable Geometry Diffuser (VGD), enable operation on the OPERATIONS screen and enter the following setpoints:

- ___ Surge Reaction Time
- ___ Surge Wait Time
- ___ Stall Wait Time
- ___ PRV Offset
- ___ Open Pulse
- ___ High Limit
- ___ Low Limit
- ___ Extreme Stall Duration
- ___ PRV VGD inhibit
- ___ Manual or auto control, as desired

11. OIL SUMP Screen (160.76-O2)

- ___ Standby Lubrication Enable/Disable.
- ___ Oil Pressure Setpoint*
- ___ Control Period*
- ___ Manual or auto control (as desired)
- ___ Oil Return Minimum

12. SETPOINTS Screen (160.76-O2)

- ___ Enter the desired current limit setpoint
- ___ Enter the desired pulldown demand limit and time setpoint

Solid State Starter Applications (160.76-O2)
Mod B Solid State Starter

Verify the following setpoints were programmed:

- ___ Local Motor Current Limit*
- ___ Pulldown Demand Limit*
- ___ Pulldown Demand Time*
- ___ Full Load Amps*
- ___ Start Current*
- ___ Voltage Range*
- ___ Enable Open SCR Detection

___ Enable Shorted SCR Detection

___ KWH Reset

Medium Voltage Solid State Starter (160.76-O2)

Verify the following setpoints have been programmed:

___ Local Motor Current Limit*

___ Pulldown Demand Limit*

___ Pulldown Demand Time*

___ Full Load Amps*

___ Start Current*

Electro-Mechanical Starter (160.76-O2)

Current Module

___ Verify Switch S1 (Y delta/57% or all others) setting*

___ Verify Pot R16 (LRA/FLA ratio) setting*

___ Verify Slide Bar Resistor “RES” setting*

___ Verify 105% FLA calibration*

___ Verify 100% FLA display*

Variable Speed Drive Applications: (160.00-M4 (VSD), 160.00-M6 (MV VSD))

VSD DETAILS Screen (VSD)

___ Set chiller Full Load Amps (FLA) value by adjusting R34 potentiometer on VSD logic board.

MOTOR Screen (MV VSD)

___ Full Load Amps

ADAPTIVE CAPACITY CONTROL (ACC) DETAILS Screen (160.76-O2)

___ Auto Map Print

___ Surge Margin Adjust

___ ACC Surge Sensitivity

___ Mapping Enable

___ VSD Start Frequency

MOTOR LUBRICATION Screen

___ Enable/Disable Motor Auto Lubrication

___ Enable/Disable the Motor Lubrication

MOTOR DETAILS SCREEN (160.76-O2)

___ Winding Temperature Protection

___ Bearing Temperature Protection

___ Motor Vibration Protection

___ Motor Cooling Coil Leak Protection

___ Manual Baseline or Auto Baseline

MOTOR SETPOINTS SCREEN (160.76-O2)

___ Winding Setup

___ Bearing Setup

___ Vibration Setup

___ Leak Protection

13. SETPOINTS Screen (160.76-O2)

With the exception of the “Remote Analog Input Range”, the setpoints listed on the SETPOINTS Screen have already been programmed above on previous screens. The values shown reflect the previously programmed values. However, the setpoints listed here can be changed on this screen if desired. This screen is used primarily as a central location from which most setpoints can be programmed. If it is not desired to change any of the listed setpoints, proceed to the SETUP Screen below.

___ Remote Analog Input Range

SETUP Screen

___ Enable clock

___ Enter clock time and date

___ Select 12- or 24-hour Display Mode

Microboard 031-03630-001:

___ The state of program switches SW1-1 (refrigerant selection) and SW1-2 (liquid type) is displayed. These were configured in Step 1. Confirm they are correct.

Enter the following setpoints:

___ Chilled Liquid Pump Operation

___ Motor Drive Type

___ VGD Feedback

___ Anti-Recycle

___ Power Failure Restart

- ___ Coastdown
- ___ Pre-run
- ___ Oil Pump Package
- ___ Motor Node ID for LCSSS applications
- ___ Coastdown Time only appears if Coastdown setpoint above is set to STANDARD
- ___ Isolation Valves
- ___ Evaporator Transducer
- ___ Line Volatage
- ___ Line Frequency
- ___ Safety Stop
- ___ Motor Monitoring
- ___ Heat Recovery Enable/Disable
- ___ Head Pressure Control Enable/Disable
- ___ MotorAuto Lube Type

QUICK START Screen

- ___ Quick Start Mode Enable/Disable
- ___ Quick Start Pulldown Setpoint Offset
- ___ Pulldown Override Time
- ___ VSD Start Frequency
- ___ Mapping Enable
- ___ Quick Ramp Current Threshold

SCHEDULE Screen

- ___ Enable or disable daily start/stop schedule as required.
- ___ Enter Chiller Start/Stop schedule if required

USER Screen

- ___ Select desired Display Language
- ___ Select desired Display Units; English or Metric
- ___ If desired, establish custom User IDs and Passwords (160.54-M1)

COMMS Screen

If modem and or printer is connected to the microboard serial data ports, enter the following parameters as required for each device connected:

- ___ Baud rate
- ___ Number of data bits
- ___ Number of stop bits
- ___ Parity

Enter appropriate number for Modem, Printer or ISN Remote application:

- ___ Chiller ID (identification)

Printer Screen

If printer is connected to microboard serial ports, enter the following:

- ___ Automatic print logging enable/disable
- ___ Automatic printer logging start time
- ___ Automatic print logging interval
- ___ Printer type
- ___ Report type; Status, Setpoints, Schedule or Sales Order

SALES ORDER Screen

- ___ Enter system commissioning date

OPERATIONS Screen (160.76-O2)

- ___ Select desired Control Source (Operating Mode); Local, ISN Remote, Digital Remote or Analog Remote
- ___ Refrigerant Level Control operation Enable/Disable
- ___ Hot gas bypass Control (optional) Enable/Disable
- ___ Variable Geometry Diffuser (Enable/Disable)
- ___ Edit regional phone number if necessary
- ___ Enter local phone number
- ___ Enter Chiller Style/Compressor
- ___ Enter Flow Switch type

The following factors can be used to convert from English to the most common SI Metric values.

TABLE 20 - SI METRIC CONVERSION

MEASUREMENT	MULTIPLY ENGLISH UNIT	BY FACTOR	TO OBTAIN METRIC UNIT
Capacity	Tons Refrigerant Effect (ton)	3.516	Kilowatts (kW)
Power	Horsepower	0.7457	Kilowatts (kW)
Flow Rate	Gallons / Minute (gpm)	0.0631	Liters / Second (l/s)
Length	Feet (ft)	0.3048	Meters (m)
	Inches (in)	25.4	Millimeters (mm)
Weight	Pounds (lbs)	0.4538	Kilograms (kg)
Velocity	Feet / Second (fps)	0.3048	Meters / Second (m/s)
Pressure Drop	Feet of Water (ft)	2.989	Kilopascals (kPa)
	Pounds / Square Inch (psi)	6.895	Kilopascals (kPa)

TEMPERATURE

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), subtract 32° and multiply by 5/9 or 0.5556.

Example: $(45.0^{\circ}\text{F} - 32^{\circ}) \times 0.5556 = 7.22^{\circ}\text{C}$

To convert a temperature range (i.e., a range of 10°F) from Fahrenheit to Celsius, multiply by 5/9 or 0.5556.

Example: $10.0^{\circ}\text{F range} \times 0.5556 = 5.6^{\circ}\text{C range}$



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