



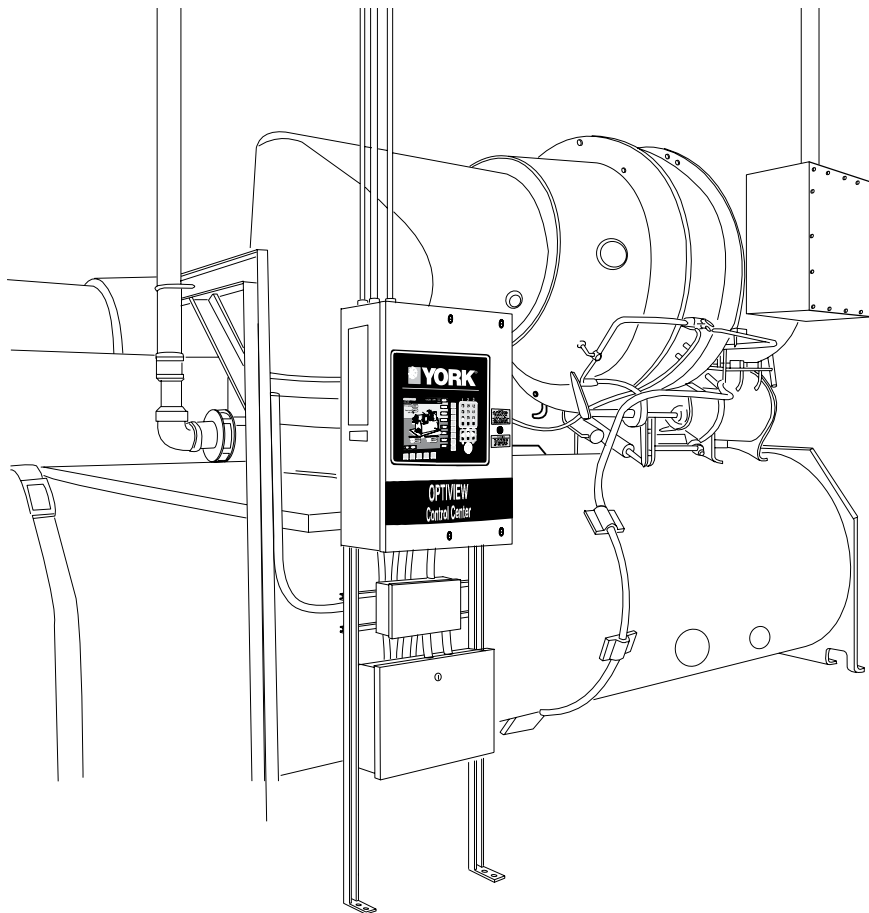
# OPTIVIEW™ CONTROL CENTER NON-YORK CENTRIFUGAL LIQUID CHILLERS

SERVICE MANUAL

NEW RELEASE

Form 160.10-M1 (310)

## OPTIVIEW™ CONTROL CENTER RETROFIT KIT FOR TRANE LOW PRESSURE CENTRIFUGAL CHILLERS



## GENERAL SAFETY GUIDELINES

# IMPORTANT!

## READ BEFORE PROCEEDING!

This equipment is a relatively complicated apparatus. During installation, operation, maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, oils, materials under pressure, rotating components, and both high and low voltage. Any of these has the potential to cause bodily injury or death if proper precautions are not taken. The operating/service personnel has the obligation and responsibility 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 the equipment is situated, as well as severe

personal injury or death to themselves and people at the equipment site.

This document is intended for use by owner-authorized operating/service personnel. The individual performing the tasks outlined in this manual must possess independent training that will enable them to perform the assigned tasks properly and safely. Before any work is performed on this equipment, the technician/operator must read and understand the content in this document and any referenced materials. This individual must also be familiar and comply with all applicable governmental standards and regulations pertaining to the task being performed.

### SAFETY SYMBOLS

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



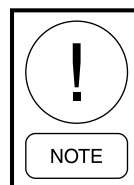
*Indicates a possible hazardous situation which will result in death or serious injury if not proper care is not taken.*



*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 and 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 micro panel. All wiring must be in accordance with Johnson Controls' published specifications and must be performed ONLY by a qualified electrician. Johnson Controls will NOT be responsible for damage/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this warning will void the manufacturer's warranty and cause serious damage to property or personal injury.*

## EMERGENCY SHUTDOWN

In the case of a malfunction or emergency that arises while the chiller is running, IMMEDIATELY switch the OptiView compressor switch to the OFF position.

## RESPONSIBILITY FOR SAFETY

Every effort has been made in the design and manufacture of this kit to ensure the safety of personnel working on the chiller. However, the individual operating/working on any equipment is ultimately responsible for:

- Personal safety, the safety of other personnel, and the machinery.
- Correct utilization of the machinery in accordance with the procedures detailed in the YORK and Trane manuals.
- Proper chiller maintenance.

## ABOUT THIS MANUAL

The contents of this manual include suggested best working practices and procedures related to the service and repair of this kit. These are issued for guidance only; they do not take precedence over the above stated individual responsibility and local safety regulations.

For information related directly to the chiller shells, compressor and other components, refer to the specific manual provided by the manufacturer of the chiller.

## PROPER EQUIPMENT HANDLING

### Proper Lock-Out / Tag-Out

To ensure safety, notify proper personnel of chiller shutdown and then proceed to switch off the chiller and lock-out / isolate all chiller power supply. Be sure to tag the chiller as “Out of Operation”. Keep the lock-out key on person to avoid accidental chiller restart.

### Suitability for Application

The OptiView Retrofit Kit is intended to control and operate competitive centrifugal chillers cooling water or brine solutions and is not suitable for purposes other than those specified in these instructions. Any use of the equipment other than what is intended or operation of the equipment contrary to the relevant procedures may result in injury to the operator, or damage to the equipment. YORK will NOT be responsible for damage due to misuse.

The chiller must not be operated outside the design parameters specified in any of the manuals included with the OptiView Retrofit Kit and the Trane unit.

## Structural Support

Proper structural support of the OptiView Panel must be provided as indicated in these instructions. Failure to provide proper support may result in injury to the operator or damage to the equipment and/or building.

## Mechanical Strength

The OptiView Panel is not designed to withstand loads or stresses from adjacent equipment, pipework or structures. No other components may be mounted on or to the OptiView Control Panel. Any extraneous loads may cause failure and may result in injury to the operator, or damage to the equipment.

## Pressure Systems

The chiller contains refrigerant vapor and liquid under pressure, which can be a hazardous and cause injury if released. Care must be taken during installation, operation and maintenance of this kit to avoid damage to the pressure system. No attempt should be made to gain access to the component parts of the pressure system other than by suitably trained and qualified personnel.

## Electrical

The control center must be grounded. No installation or maintenance work should be attempted on the electrical equipment without first switching the equipment OFF, then isolating and locking out the power supply. Work on live equipment must only be carried out by suitably trained and qualified personnel. Do not attempt to gain access to the inside of the control panel or electrical enclosures during normal operation of the unit.

## Refrigerants and Oils

Refrigerants and oils used in the unit are generally non-toxic, non-flammable and non-corrosive, and pose no special safety hazards. However, when an open flame is applied to refrigerant, toxic gases are created. Never subject refrigerant to an open flame. The possibility of refrigerant vapor build up does pose a risk of asphyxiation in confined or enclosed spaces and attention should be given to provide good ventilation.

Use of gloves and safety glasses are required when working with refrigerant and oil.

## General Access

There are a number of areas and features which may be a hazard and potentially cause injury when operating the Control Center and chiller unless suitable safety precautions are taken. Access to the Control Center and chiller should be restricted to suitably qualified persons who are familiar with the potential hazards and precautions necessary for safe operation and maintenance of equipment containing high temperatures, pressures and voltages.

## CHANGEABILITY OF THIS DOCUMENT

In complying with YORK's policy for continuous product improvement, the information contained in this document is subject to change without notice. While YORK makes no commitment to update or provide current information automatically to the manual owner, that information, if applicable, can be obtained by contacting the nearest YORK Applied Systems Service office.

Operating/service personnel maintains the responsibility of the applicability of these documents to the competitive equipment the kit is installed on. If there is any question regarding the applicability of these documents, the technician should verify whether the equipment has been modified and if current literature is available with the owner of the equipment prior to performing any work on the chiller.

## REFERENCE MANUALS LIST

Manual Description	Manual Number
OptiView Control Center Retrofit Kit - Trane Installation Manual	160.10-N1
OptiView Control Center Retrofit Kit - Trane Service Manual	160.10-M1
OptiView Control Center Retrofit Kit - Trane Operation Manual	160.10-O1
Wiring Diagram – Unit with Electromechanical Starter	160.10-PW1
ISN MicroGateway - Installation Manual	450.20-NOM1
CX MicroGateway - Installation Manual	450.24-N11
ModBus MicroGateway - Installation Manual	450.24-N1
N2 MicroGateway - Installation Manual	450.24-N2
ASCII MicroGateway - Installation Manual	450.24-N15
Renewal Parts – OptiView Control Center Retrofit Kit	160.10-RP1
Solid State Starter MOD "B" – Operation/Service Manual	160.00-O2
Variable Speed Drive – Operation Manual	160.00-O1
Variable Speed Drive – Service Manual	160.00-M1

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## SECTION 1 - SERVICE MANUAL INTRODUCTION

### ABOUT THIS SERVICE MANUAL

This document describes the operating principles for the major components of the OptiView Control Center Retrofit Kit for Trane chillers. Applicable chillers are the CVHA, CVHB, CVHE, and CVHF Trane models. The purpose of this manual is to allow service technicians to diagnose and repair problems directly related to the components of the Retrofit Kit. Refer to the chiller manufacturer's service manual for any chiller problems that are not related to the components of the Retrofit Kit.



***Electrical Shock Hazard! Lock-out/Tag-out the chiller using proper procedures before performing repairs to this equipment. If power is necessary for troubleshooting, use extreme caution while working on live equipment. Personal injury, death or damage to the chiller may occur if proper care is not taken.***

Specific procedures and details to calibrate, troubleshoot, and service the OptiView Retrofit Kit are provided within this manual. Most service related to the OptiView software requires the technician to be at the "Service" access level or higher on the control center. Some repair operations also require special system reset procedures or programming before the chiller can be restarted. Due to the complexity of this equipment and the associated service procedures, only qualified and properly trained personnel should service this equipment.

Before beginning troubleshooting of the OptiView Retrofit Kit, the service technician should retrieve all manuals and wiring diagrams included with this kit. Johnson Controls also strongly recommends that the service technician read *SECTION 2 - SYSTEM ARCHITECTURE*. Reading this section ensures the technician servicing the Retrofit Kit will have an understanding of how the circuitry and components work to control chiller operation. This understanding will also save time in isolating the source of any malfunction. *SECTION 2 - SYSTEM ARCHITECTURE* of this manual provides block diagrams.

When the chiller shuts down due to a safety or cycling issue, or a malfunction prevents the chiller from starting, a message is displayed on the OptiView Control Center screen. This message displays the reason for the

shutdown and the operating conditions at the time of shutdown are stored in the OptiView's battery-backed memory (BRAM). The message, as well as the history data, can be recalled to provide the service technician with a starting point for diagnosis and repair of the malfunction. A detailed description of each message and the procedure to recall chiller history is described in the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)*.

In addition to the shutdown messages and chiller history, certain diagnostic routines allow the following functions and related components to be analyzed on the OptiView display:

- Analog Inputs
- Digital Inputs
- Digital Outputs
- Serial Data Ports
- LCD display
- Keypad

Once the source or area of the malfunction has been identified, the service technician can use this service manual, along with the supporting manuals and drawings to isolate and repair the malfunction. The *Manual Reference Guide*, located in the beginning of this manual, can be used to reference other manuals which are applicable to the service of the OptiView Retrofit Kit.



***Electrical Shock Hazard! Lock-out/Tag-out the chiller using proper procedures before performing repairs to this equipment. If power is necessary for troubleshooting, use extreme caution while working on live equipment. Personal injury, death or damage to the chiller may occur if proper care is not taken.***

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## SECTION 2 - SYSTEM ARCHITECTURE

### OPTIVIEW FEATURES AND FUNCTIONS

The OptiView Control Center Retrofit Kit is a complete, microprocessor-based control system for Non-YORK competitive centrifugal chillers. The OptiView Control Center efficiently monitors, controls, and provides operation information for the chiller. In summary, the major OptiView Retrofit Kit features and functions are:

- Adjusts chiller capacity to cool liquid to the user-defined temperature setpoint.
- Controls chiller solenoid valves, relays, actuators, and motor contactors to the chiller operating program.
- Accepts user-defined setpoints and controls chiller operation accordingly.
- Monitors chiller operating conditions and automatically shuts down chiller operation when safety or cycling thresholds are exceeded.
- Provides visual display of chiller operating conditions, alarm and shutdown messages, and operating history data.
- Features a soft-touch keypad for local control of chiller operations.
- Allows manual control of chiller components such as the PRV actuator and oil pump motor.
- Provides both local (manual) and remote chiller start/stop commands.
- Allows chiller operating temperature and current to be remotely changed via 0-10 VDC, 2-10 VDC, 0-20 mA, 4-20 mA contact closures or via serial communications.
- Transmits chiller operating conditions to remote devices using serial communications and contact closures.
- Allows real-time data and history to be printed out using an optional printer.
- Controls compressor motor starter functions for electromechanical starters, solid state starters, and YORK variable speed drives.

These features and functions are controlled by the microprocessor located on the OptiView microboard. The microprocessor receives analog, digital, and serial data inputs and controls analog, digital and serial data outputs to peripheral components according to the chiller operating program/software.

### OPTIVIEW COMPONENTS

There are many components that work together in the OptiView Control Center in order to provide efficient control and operation of the chiller. The major components and the function of each are provided in the following paragraphs. Reference the figures at the end of this section for component connections, voltages, and communication flow for each type of starter.

#### Power Supply

The OptiView panel contains a power supply which converts 115 VAC to the necessary supply voltages to components located inside the panel. The supplied voltages are: +12 Volts DC, – 12 Volts DC, +5 Volts DC, and +24 Volts DC. The 115 VAC supply current is typically received from the transformer in the starter cabinet.

#### Microboard

All chiller operating functions are controlled at the microboard by the microprocessor and supporting components. The microboard holds the chiller operating software (program), stores chiller operating history and memory functions, receives analog and digital inputs, controls digital outputs to operate relays and triacs, and controls serial data transmissions.

The OptiView Control Center will be equipped with one of two different microboards, depending on the date of manufacture. The main difference between the microboards is the way each stores the chiller operating software. The two microboard part/model numbers are described as follows:

- **031-01730-000** – The “1730” microboard is the early model. This style of microboard stores the chiller operating software in a replaceable flash card, which in turn is installed in a socket soldered to the microboard. Whenever the operating software is upgraded, the flash card is replaced.

- **031-02430-000** – The “2430” microboard is the latest model. The 2430 board stores chiller operating software in non-removable flash memory. The operating software is downloaded to memory via a portable program card. Whenever the operating software is upgraded, the new program is downloaded into the onboard flash memory.

All OptiView Retrofit Kit components are compatible with either microboard. In this case, the newer 2430 board will replace a 1730 board if service replacement is ever necessary.

For identification purposes, the part/model number of the microboard is imprinted on board. The location of this imprint is different on each board. For imprint location, refer to *SECTION 3 - MICROBOARD 031-01730-000* or *SECTION 4 - MICROBOARD 031-02430-000*.

The microboard accepts analog inputs provided by the system sensors through direct connections. This applies for all sensors except for motor winding and bearing temperature sensors.

Serial data communication is also provided via direct connection to the microboard at the COM ports. The serial data is transmitted to and received from devices using RS-232, RS-485, or opto-couple communication formats. This communication can be used as a link between devices such as the compressor motor starter, a MicroGateway or remote device, a printer, etc. Refer to *SECTION 3 - MICROBOARD 031-01730-000* and *SECTION 4 - MICROBOARD 031-02430-000* for microboard information, including operating software information.

### Input/Output Board

The input/output (I/O) board is located in the OptiView cabinet, below the microboard. The I/O board conditions digital input and output signals for the microboard, allowing control of chiller operation through relays and triacs. The relays and triacs are mounted on the I/O board; these devices control components such as the vent line solenoid, PRV motor actuators, starter contacts, the oil pump and oil heater, etc.

The I/O board uses opto-couplers to convert 115 VAC digital inputs from relay and switch contacts to logic-level voltages which can be read by the microboard. The microboard receives the logic signals from the I/O board and uses this information to control the 12 VDC coils on the I/O board relays or switch the triacs on/off. Refer to *SECTION 5 - INPUT/OUTPUT BOARD* for additional I/O board information.

### Sensors

The OptiView Retrofit Kit utilizes pressure transducers and thermistors to monitor system pressures and temperatures. These sensors output an analog DC voltage in the range of 0.5 - 4.5 VDC, which are connected to the analog inputs at the microboard.

These sensors provide the microboard with information to monitor and control chiller operation. Refer to *SECTION 12 – OPTIVIEW PRESSURE TRANSDUCERS* and *SECTION 13 – OPTIVIEW TEMPERATURE THERMISTORS* for additional sensor information.

### Current Control Module Board (CM-2)

When the compressor motor utilizes an electromechanical type starter, a current control module board is included with the OptiView Retrofit Kit. This board is mounted to the right of the microboard, below the OptiView panel power supply. The purpose of the CM-2 board is to provide motor current overload and power interruption protection to the compressor motor. The CM-2 board reads compressor motor current supply using current transformers (CTs) installed on the motor leads. The CTs provide an AC signal that represents motor operating current. A diode bridge (rectifier) and slide resistor assembly aid the CM-2 board in reading this by converting AC current to DC current. Refer to *SECTION 8 – OPTIVIEW CURRENT MODULE (ELECTROMECHANICAL STARTERS)* for additional CM-2 board information.

### Adaptive Capacity Control Board (ACC)

If the chiller is equipped with a variable speed drive (VSD), an adaptive capacity control board is mounted in the OptiView cabinet. The ACC board serves as a gateway between the microboard and VSD boards to communicate, monitor, and control operating parameters and control the VSD efficiently. The ACC board is adaptive to the chiller demand and capacity required to operate compressor at the lowest possible speed without compressor surge. Refer to *SECTION 10 – ADAPTIVE CAPACITY CONTROL (ACC) BOARD* for additional ACC board information.

### External Analog Input/Output Board

The analog input/output board is a supplemental I/O board included with the OptiView Retrofit Kit. This board is located on the upper right side of the OptiView panel cabinet. The purpose of this board is to provide auxiliary analog input/outputs functions to the microboard. Currently, this board converts analog signals from the

Trane motor winding temperature and bearing temperature sensors to logic-level voltages for the microboard to interpret. Optionally, this board can also be used to control Hot Gas Bypass, if equipped. The analog I/O board communicates, via RS-485 serial data, to COM-3 (J12) of the microboard. Reference *SECTION 11 – EXTERNAL DIGITAL AND ANALOG INPUT/OUTPUT BOARDS* for additional information.

### External Digital Input/Output Board

The digital input/output board is a supplemental I/O board included with the OptiView Retrofit Kit. This board is located on the lower right side wall of the OptiView cabinet. The purpose of this board is to provide auxiliary digital input and output functions to the microboard. Currently, this board is used to provide alarm or excess purge inputs from the purge unit to the microboard. Additionally, this board may also control a chiller motor refrigerant pump, as equipped. The digital I/O board communicates, via RS-485 serial data, to COM-3 (J12) of the microboard. Reference *SECTION 12 – OPTIVIEW PRESSURE TRANSDUCERS* for additional information.

### Display Interface

The front panel of the OptiView Control Center is equipped with a liquid crystal display (LCD) which gives the operator the ability to locally monitor system operating conditions. A circuit board is utilized to interpret signals from the microboard, allowing the LCD to display chiller conditions. The display is backlit, permitting easy viewing in all light conditions. Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional information on the display and back-light.

### Keypad

A keypad is located on the front panel of the OptiView Control Center to allow local control of chiller operation. The keypad is equipped with 31 membrane keys which are connected directly to the microboard. By using the keypad, operator and service personnel may navigate the OptiView screens, change setpoints and control chiller operation. Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional information on the keypad.

### Microgateway

The MicroGateway is an optional device which, if installed, is located at the upper left wall inside the OptiView cabinet. The MicroGateway receives data

from the microboard and transmits the data to a remote network, such as the YORK Integrated Systems Network (ISN). The remote communication also allows for control of the chiller and operating setpoints. Refer to *SECTION 15 – MICROGATEWAY* for additional MicroGateway information.

### Chiller Operation Sequence

The OptiView Control Center controls operation of the chiller in stages, which are different depending on the type of starter employed by the chiller. The system prelude and system coastdown stages have operator-defined durations. The operation sequence of the chiller is outlined in the following paragraphs. Refer to *Figures 1 and 2* for examples of operating sequences.

#### System Prelude

When the compressor switch on the OptiView panel is placed in the “RUN” position, the chiller is placed in the “system prelude” stage. Adjustable from 10 to 60 seconds, the time remaining will be countdown on the panel display. In the prelude stage, the OptiView Control Center energizes the oil pump, supplying the compressor motor bearings with oil. The oil pressure is checked during the last five (5) seconds of this stage and the chiller will not start unless proper oil pressure is attained. If any faults are recognized by the OptiView software during prelude, the chiller will stop the sequence and indicate the fault present on the OptiView display.

If the chilled liquid pump is controlled by the OptiView Control Center, the pump will be started three seconds into system prelude.

#### System Run

Once the system prelude is complete, the OptiView Control Center will enable the starter to run the compressor motor. While the chiller is in a run state, the OptiView Control Center is constantly monitoring the operating conditions and comparing them with the programmed setpoints and parameters. The chiller will continue to be in a run sequence until stopped by a safety or cycling fault, a local stop occurs, or a remote stop occurs.

After the chiller has been running for 300 seconds (5 minutes), the vent line solenoid will be opened. The vent line solenoid will remain open until the chiller is stopped.

### System Coastdown

When the chiller is stopped for any reason, the OptiView Control Center will begin the "System Coastdown". Adjustable from 150 to 600 seconds, the time remaining will countdown on the panel display. During system coastdown, the oil pump remains energized, supplying oil to the compressor motor bearings. This ensures the motor bearings do not overheat and seize as the motor stops and cools down.

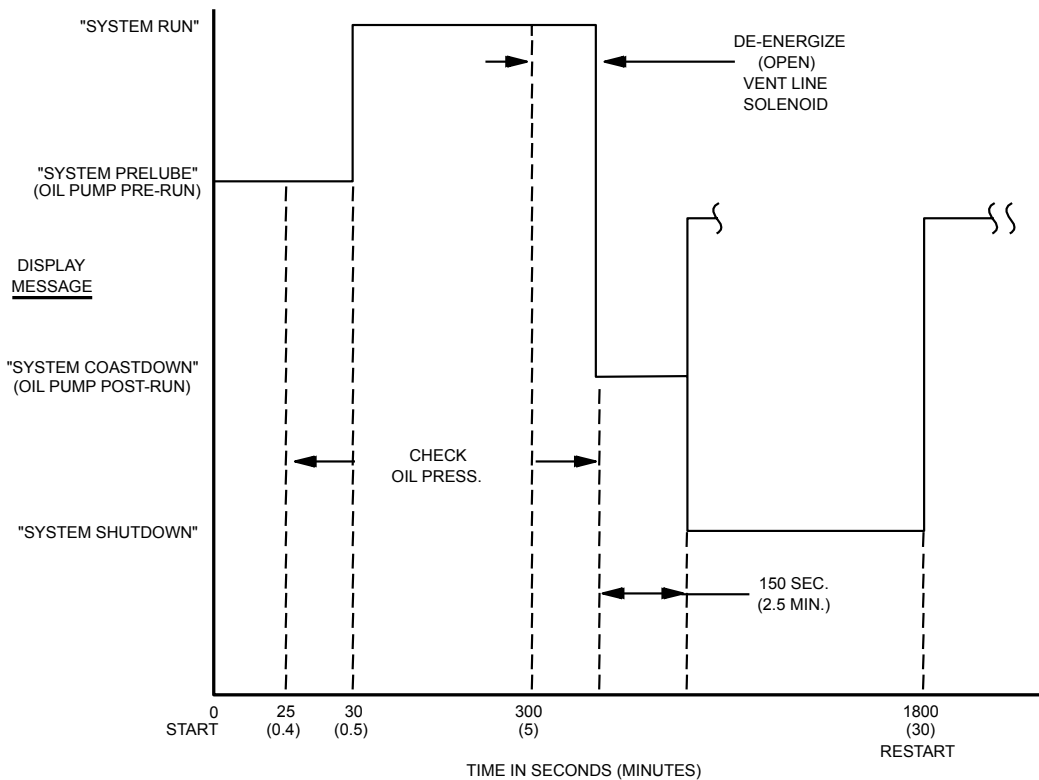
The chilled liquid pump will be stopped unless the cycling fault "Leaving Chilled Liquid Temperature" or the "enhanced" chilled liquid pump mode is selected. Anytime the compressor switch is placed in the "OFF" position, the chilled liquid pump will be stopped.

### System Stopped

Once the system coastdown is complete, the chiller will be stopped. The type and reason for chiller shutdown will be shown on the panel display.

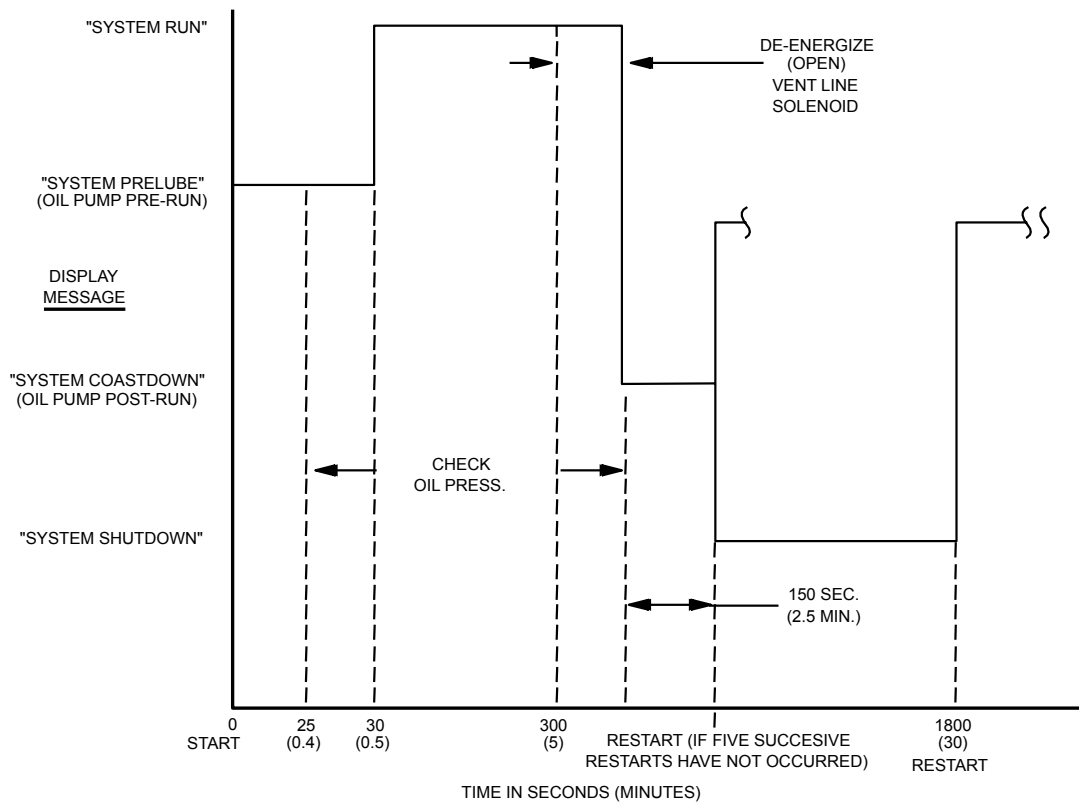
The OptiView Control Center has an Anti-Recycle feature that starts a thirty (30) minute timer when the chiller has shutdown. This feature will not allow the chiller to be restarted until that time has expired. For chillers equipped with a VSD, the chiller can be immediately restarted up to five (5) times upon completion of the system coastdown. If this occurs more than five times, the OptiView Control Center will initiate a ten (10) minute timer. The chiller will not restart until the ten minutes has elapsed.

If the anti-recycle function is disabled, the chiller can be restarted at anytime upon completion of system coastdown. This function should never be disabled unless under the advisement of YORK/Johnson Controls Aftermarket Service.



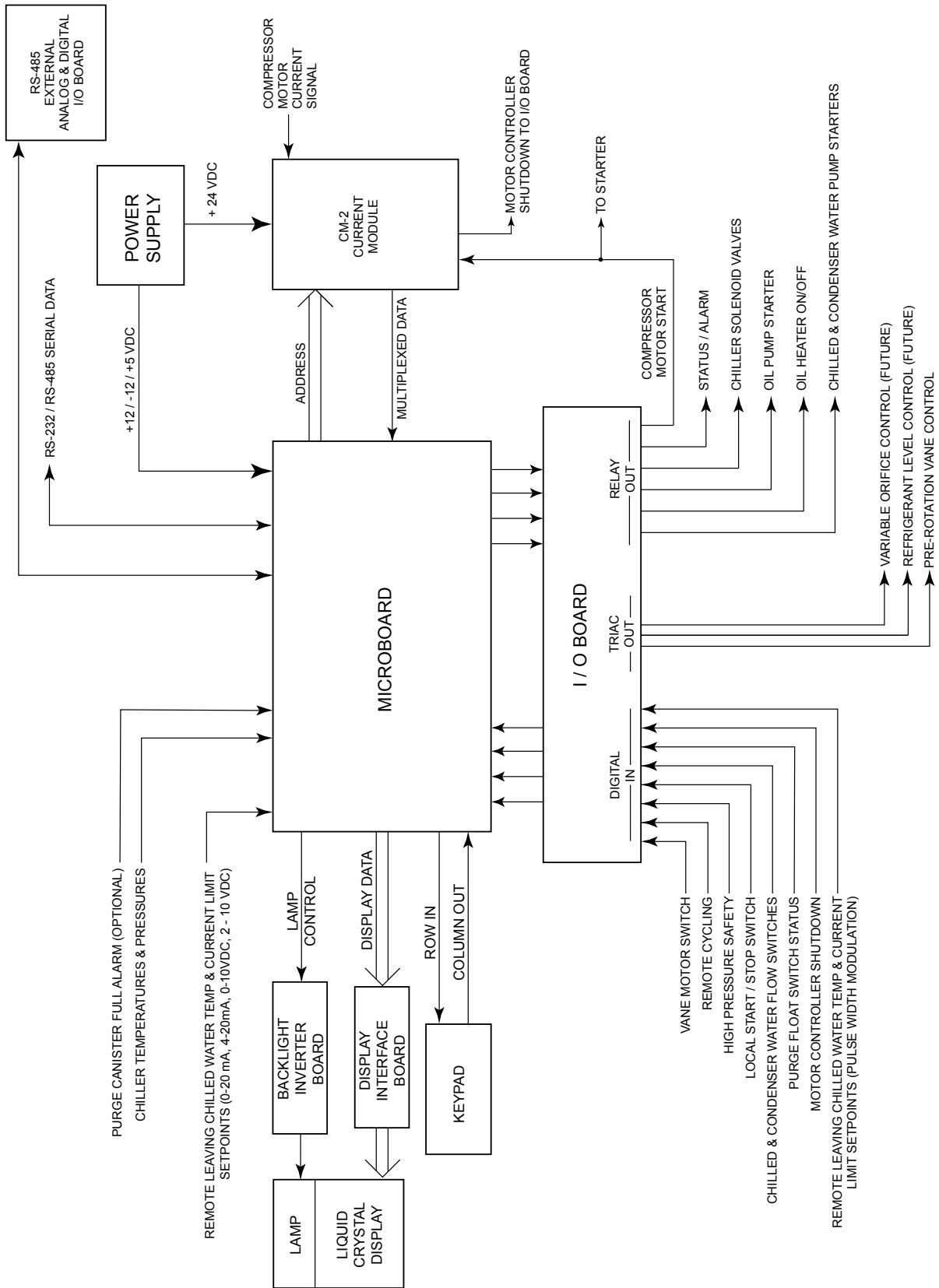
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**FIGURE 1 - OPERATION SEQUENCE TIMING DIAGRAM (ELECTROMECHANICAL AND SOLID STATE STARTER APPLICATIONS)**



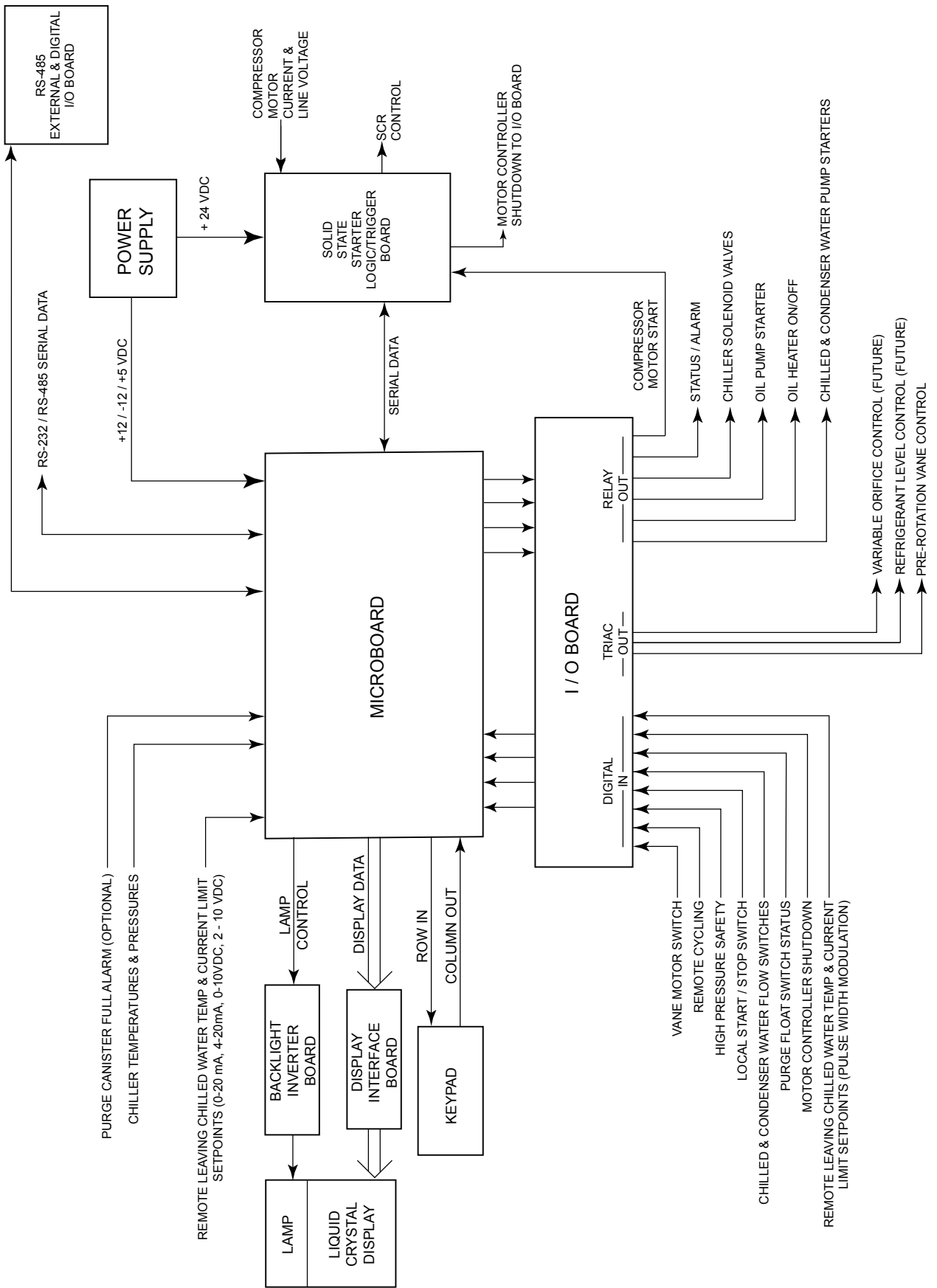
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**FIGURE 2 - OPERATION SEQUENCE TIMING DIAGRAM (COMPRESSOR MOTOR WITH VARIABLE SPEED DRIVE)**



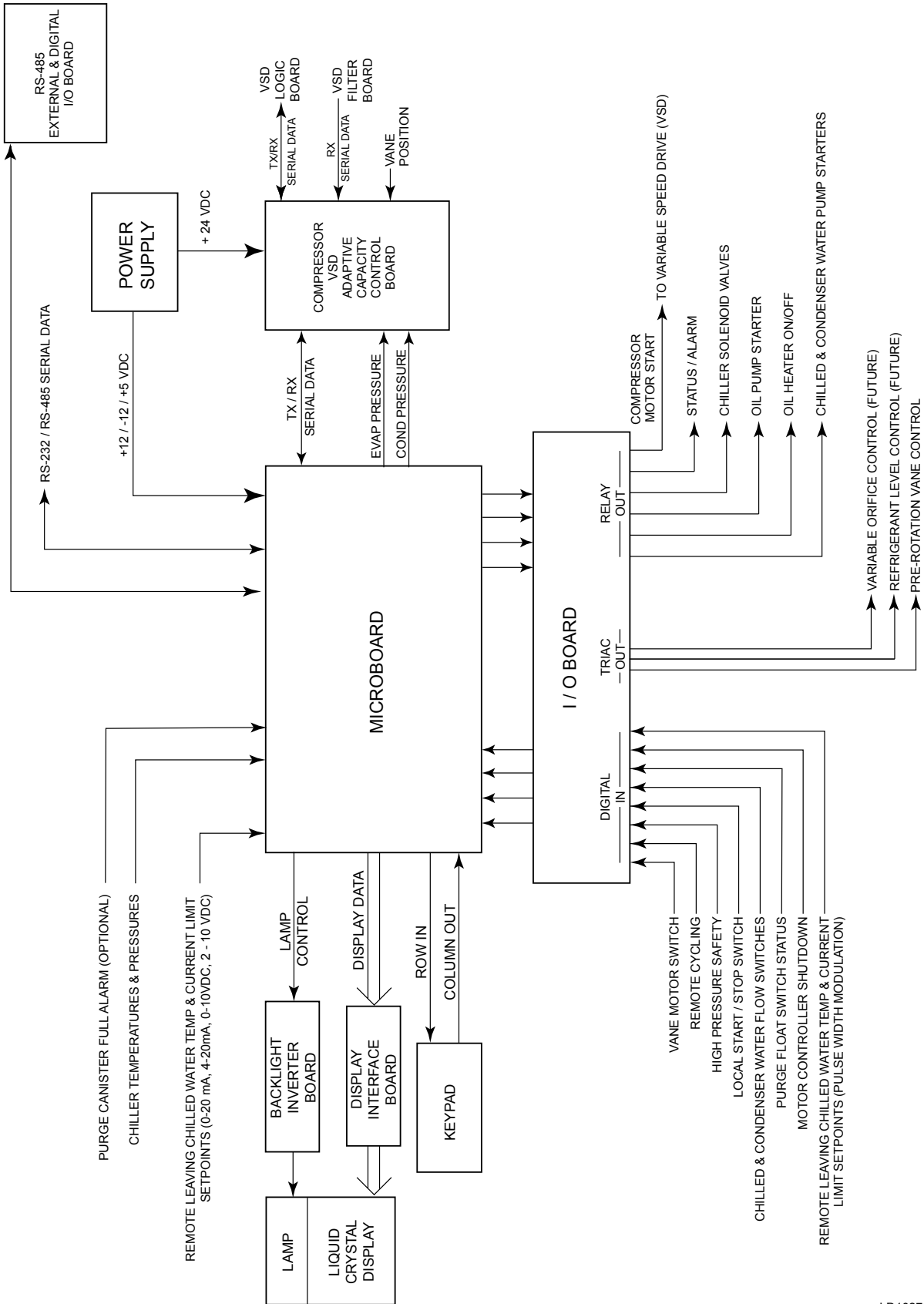
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**FIGURE 3 - OPTIVIEW CONTROL CENTER - ELECTROMECHANICAL STARTER APPLICATIONS**



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**FIGURE 4 - OPTIVIEW CONTROL CENTER - MOD "B" SOLID STATE STARTER APPLICATIONS**



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FIGURE 5 - OPTIVIEW CONTROL CENTER - COMPRESSOR MOTOR VARIABLE SPEED DRIVE

## SECTION 3 - MICROBOARD 031-01730-000

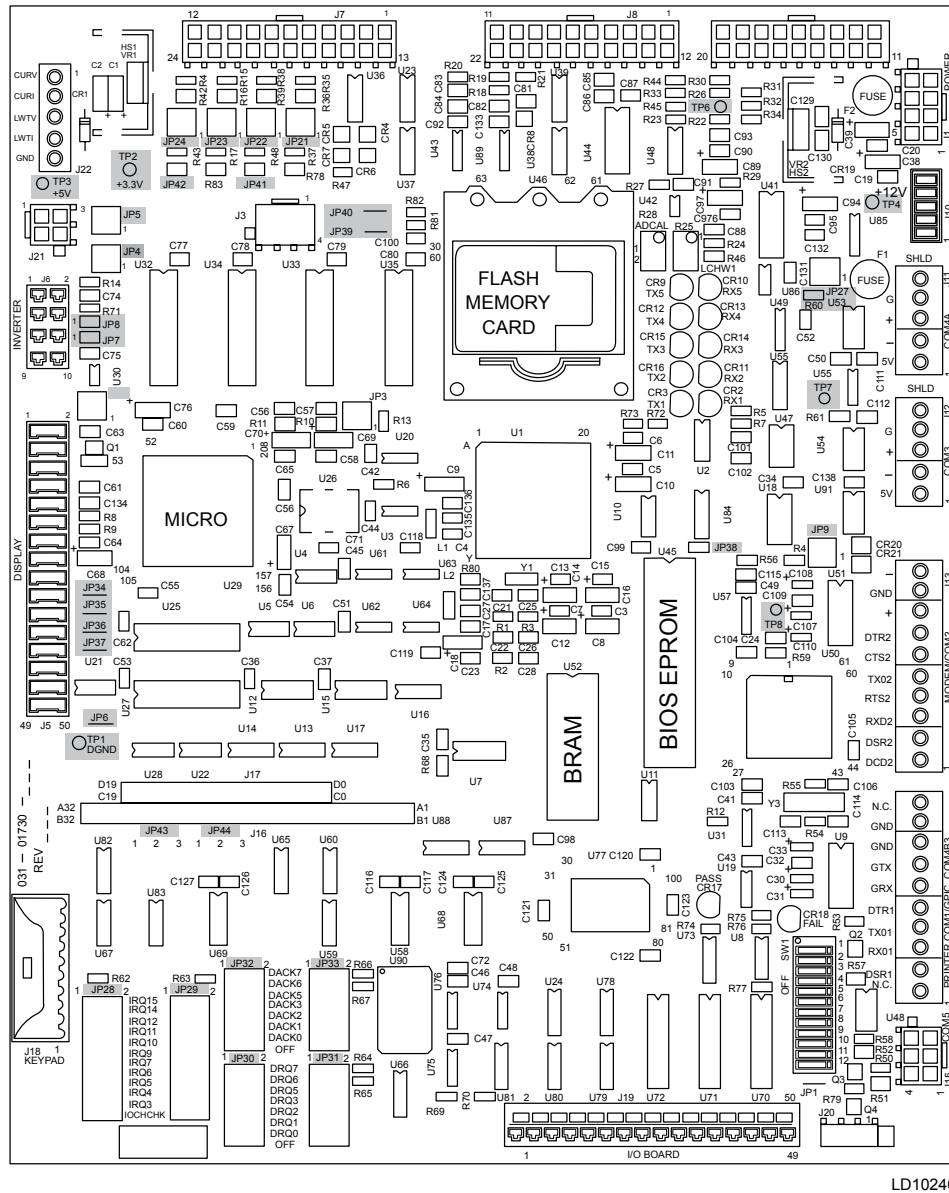


FIGURE 6 - OPTIVIEW 1730 MICROBOARD

### MICROBOARD DESCRIPTION

The microboard contains the microprocessor (micro), the operating software, the BIOS EPROM, the system memory, and all of the interfaces that allow the microprocessor to control chiller operation to software and user-determined parameters.

This section describes the 031-01730-000 “1730” microboard. The 1730 microboard can be identified by the flash-card type interface for the operating software. The part number for the 1730 board is printed

on the left side of the board, vertically, below the J5 display connection. The major components of the microboard are outlined and described in the following paragraphs.

### MICROBOARD COMPONENTS

#### Microprocessor

The microprocessor controls chiller operation by reading and executing the operating software (program) instructions. These instructions are performed in a set

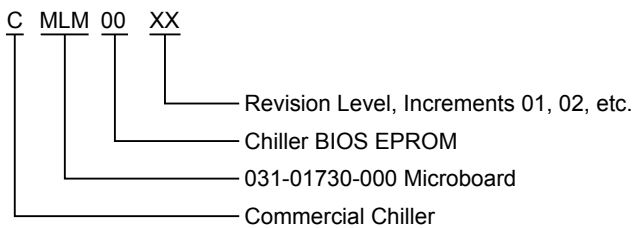
sequence determined by the operating software. The microprocessor interprets analog, digital, and serial data inputs to determine chiller operating conditions as per the operating software. Digital inputs include those received from the operator pressing the keypad. The microprocessor compares the data from inputs to operating thresholds, parameters contained in the operating software, and those programmed by the operating personnel. Under program control, the microprocessor controls chiller operation using digital outputs.

While the chiller is operating, a status/details message will be shown on the OptiView display. If the chiller is operating outside of set parameters, a fault message will be displayed. Depending on the severity of the fault, the microprocessor may stop chiller operation. The status/details messages are color coded according to the program software to indicate severity. Refer to the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)* for information regarding these messages.

**BIOS EPROM**

The BIOS EPROM (Basic Input/Output System Erasable Programmable Read Only Memory) is a memory device which contains the OptiView boot-up program. On 1730 microboards, the EPROM is located at socket U45. For identification purposes, the version of the BIOS EPROM is printed on a label adhered to the chip. The BIOS EPROM is also shown on the OptiView display during system boot-up.

The EPROM is removable and can be replaced in the event of failure. If the EPROM needs replaced, the replacement must be compatible with the program card installed, otherwise the boot-up process will not complete and the chiller will not be operational. Refer to the *Renewal Parts - OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for replacement information. Use the following the legend to determine the version of EPROM installed on the microboard.



Whenever power is applied to the OptiView Control Center, the microprocessor executes a startup/boot-up process using instructions located in the BIOS. These instructions initialize, configure, and start the opera-

tion of certain microboard components prior to executing the main program stored in the flash card.

There are five steps to the boot-up process. The descriptions for each of the five steps are as follows.

1. **First Initiate Table Complete** - Registers in the microprocessor are configured and allowed to perform basic read/write functions.
2. **FPGA Configuration** - The Field Programmable Gate Array (FPGA) is configured to process digital inputs and outputs.
3. **Flash Mini Card Signature Test** - This test verifies that the location in the Flash Card that contains the code identifying the manufacturer is the same as the location that contains the manufacturer's name. These values must be the same to pass.
4. **Flash Mini Card Checksum Test** - The flash card checksum is verified by calculating the checksum and comparing the value to the last checksum value stored in the last address of the flashcard. These values must be the same to pass.
5. **BRAM Quick Test** - Test data is written to and then read from several memory locations to verify the battery-backed random access memory (BRAM) is functioning properly. The data read must be the same as the data written to pass.

Each step gives a visual indicator the step has been performed and has passed or failed. During boot-up, the green CR17 (pass) and the red CR18 (fail) LEDs will illuminate to show results for each step. These LEDs are located in the lower right quadrant of the microboard. Both of these LEDs will illuminate for one second once power is supplied to the OptiView control panel. The results of boot-up steps 3 through 5 are displayed on the OptiView screen. Refer to *Table 1* for the LED activity associated with each step.

**TABLE 1 - BOOT-UP LED INDICATORS**

STEP	PASS	FAIL
1	Green on, red off	Watchdog System Reboot
2	One green flash	One repeating red flash Boot-up halts
3	One green flash	Two red flashes, repeating Boot-up halts
4	One green flash	Three red flashes, repeating Boot-up halts
5	One green flash	Four red flashes, repeating Boot-up halts

Once the BIOS EPROM boot-up process is complete, the CR17 and CR18 LEDs will either extinguish or remain illuminated to indicate the positions of microboard program DIP switches 7 and 8. Refer to *Program Switch* in this section for additional information.

### Program Flash Miniature Card

The program flash mini card is a portable, non-volatile memory device which stores the OptiView Control Center operating software. This device is primarily read-only; the only time the card is written to is during the boot-up process described previously. For successful boot-up to occur, the write-protect switch on the card must be in the “enabled” position. The flash mini card is located in socket U46 on the microboard.

Whenever the OptiView Control Center is updated, a new flash card is issued and replaces the current flash card installed on the microboard. The version of the operating software is printed on a label adhered to the flash card.

The software versions (C.MLM.yy.zz) are alpha-numeric codes that represent the microboard, software application, and revision levels as shown below. Each time the software is revised, the respective revision level increments.

- **C** – Commercial chiller
- **MLM** – Used on Microboard 031-01730-000
- **OPT** – Used on Microboard 031-02430-000
- **yy** – Chiller Manufacturer (08 Trane, 09 Carrier, 10 McQuay)
- **zz** - controls revision level (00, 01, etc)

To cross reference C.MLM software to C.OPT software, refer to the controls revision level. From this starting point, both microboards receive the same software updates at each revision. Software updates should only be performed by a qualified Service Technician. Refer to the *Service Replacement* portion of this section for flash card replacement and software update instructions.

### Battery-Backed Ram (BRAM)

The BRAM (Battery-backed Random Access Memory) is a replaceable memory device with a battery backup used to retain data during power failures. Any operator programmed setpoints, history data, time/date, schedules, sales order information, etc.that requires preservation is stored in this device. These setpoints and sales data will need to be reprogrammed if the BRAM fails;

refer to *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)*. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for BRAM replacement part numbers.

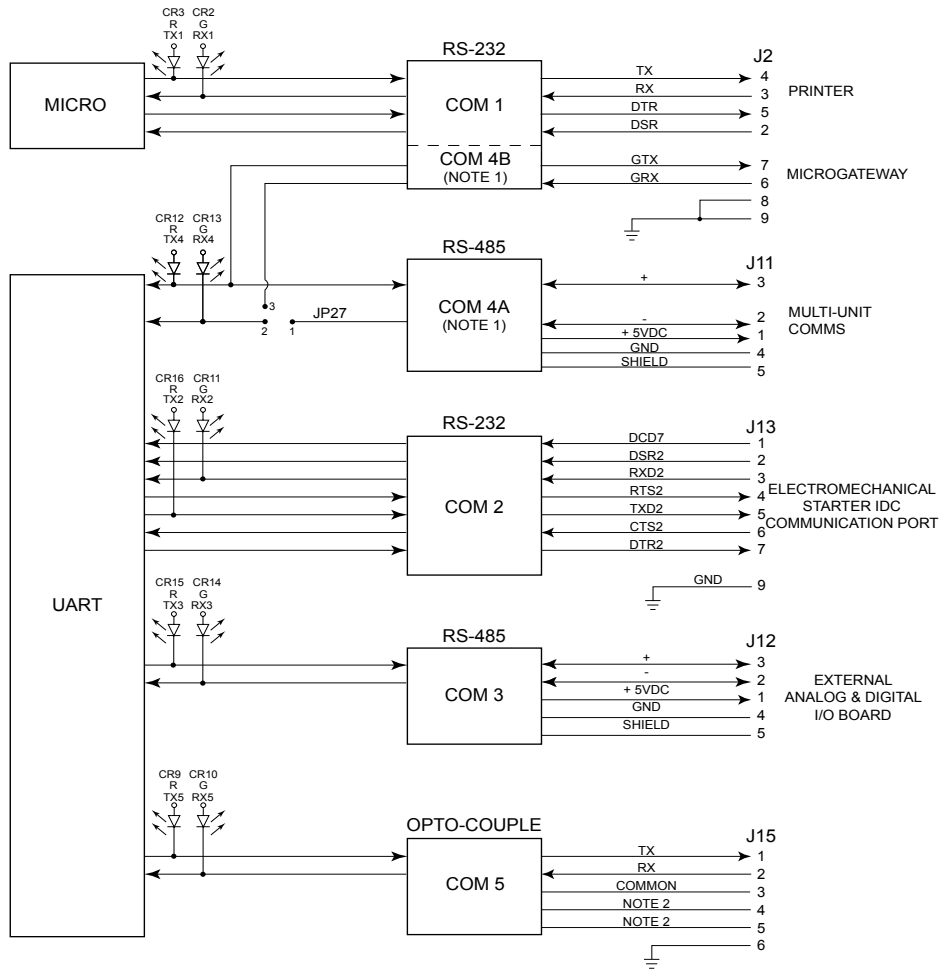
### Watchdog Circuit

The watchdog circuit is an integrated microboard circuit which monitors microboard power supply and program operation. The function of the watchdog circuit that monitors microboard power supply for power failure is referred to as the “hardware” watchdog circuit. The function of the watchdog circuit that monitors the operation of the software for program latch-up is referred to as the “software” watchdog circuit.

The “hardware” watchdog circuit monitors the power supply level of the microboard. When power drops to a level where the microprocessor and supporting circuits can no longer operate, the watchdog circuit sends a “reset” signal to the microprocessor. These voltage levels are +4.75 to +4.5 VDC for the onboard power supply and +3.04 to +2.8 VDC for the onboard regulator. The microprocessor responds by de-energizing the “run” digital output (if running), stopping chiller operation. When this “hardware” watchdog initiated shutdown occurs, the “CONTROL PANEL - POWER FAILURE” message is generated, which is stored in chiller history and displayed on the OptiView LCD after power is returned to operational levels.

When the power supply is returned to the control panel, microboard performs the boot-up process described previously. When boot-up is complete, “CONTROL PANEL - POWER FAILURE” is displayed on the OptiView LCD and stored in chiller history.

The “software” watchdog circuit detects if the operating program has latched-up or has been interrupted, bypassing the safety thresholds. This portion of the watchdog circuit is a timer that is signaled to reset by the microprocessor upon completion of running the system operating program. The microprocessor takes less than one second to execute the operating program, which is continually run. If the watchdog circuit does not receive a reset signal within 2.25 seconds after the microprocessor executes the operating program, the watchdog returns a “reset” signal to the microprocessor. The microprocessor responds by de-energizing the “run” digital output (if running), stopping chiller operation. This is a “software” watchdog initiated shutdown. The software is automatically rebooted and “WATCHDOG - SOFTWARE REBOOT” is displayed on the OptiView LCD and stored in chiller history.



NOTES:

1. Microboard Program Jumper JP27 determines whether COM 4A or 4B can be used. 1 & 2 - 4A, 2 & 3, 4B.
2. J15-4 Loop-Around Test IN. J15-5 Loop-Around Test OUT. Refer to Fig. 12 for details.

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**FIGURE 7 - MICROBOARD SERIAL DATA COMMUNICATION PORTS**

**Serial Data Ports**

The microboard is equipped with six serial data communication ports, located along the right side of the board. Each port performs a specific function, as described below.

**COM 1** - Printer communication port. Connection is at J2. RS-232 type communication.

**COM 2** - Optional electromechanical starter IDC communication port. Microboard connection is at J13. RS-232 type communication.

**COM 3** - External digital and analog board communication port. Microboard connection is at J12. RS-485 type communication.

**COM 4A** - This port is not utilized at this time. Microboard connection is at J11. Configured for RS-485 type communication. Cannot be used at the same time as COM 4B. Program jumper JP27 enables/disables this port.

**COM 4B** - MicroGateway communication port. Microboard connection is at J2. Configured for RS-232 type communication. Cannot be used at the same time as COM 4A. Program jumper JP27 enables/disables this port.

**COM 5** - VSD or Solid State Starter communication port. Microboard connection is at J15. Opto-coupler TX/RX type control.

As illustrated in *Figure 7*, each of the serial data ports are equipped with two LEDs. These LEDs will illuminate when the port is transmitting (TX) or receiving (RX) data. For LED designation, refer to *Figure 7*.

All serial port communication utilizes the industry standard DC voltages for each type of communication. RS-232 type communication is +5 to +25 VDC and -5 to -25 VDC, RS-485 type communication is 0 VDC and +1.5 to +5 VDC. The opto-couplers used on COM 5 are 0 VDC and +5 VDC.

Diagnostic tests can be performed on each serial data port to check for proper operation. Refer to *Serial Port Diagnostic Tests* in this section for the test procedure.

### Digital Inputs

The microboard receives logic-low (<1 VDC) and logic-high (>4 VDC) signals from the I/O board at connection J19. This connection is in bottom part of the microboard, located conveniently to the I/O board. The microboard is not able to convert 120 VAC signals to digital logic-level signals; the I/O board performs the conversion.

Refer to the *Section 5 - Input/Output Board* for additional information.

### Digital Outputs

The microboard controls 115 VAC power to relays, solenoids and actuator motors using the I/O board through connection J19. The I/O board contains +12 VDC relays and triacs which isolate the microboard from the 115 VAC the device relays, solenoids and the actuator motors use.

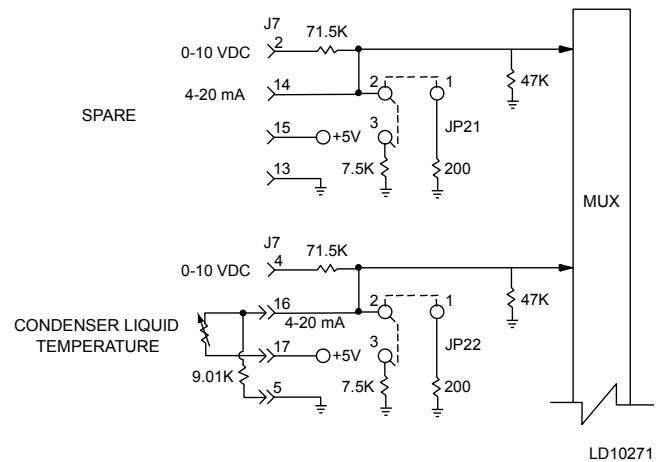
To control the relays, the microboard utilizes solid state switching devices to complete the negative ground to the +12 VDC relay coil. This energizes the relays, switching 115 VAC to the device relays and solenoids. The microboard de-energizes the relays by opening the ground to the relay coil.

The microboard controls the pre-rotation vane (PRV) actuator using triacs mounted on the I/O board. The PRV actuator has an open and close winding; the microboard uses a separate triac to send power to a solid state relay that controls each winding. When the microboard supplies a logic-low (<1 VDC) signal to the triac, the triac supplies the respective relay and winding (open or close) with 115 VAC. When the microboard applies a logic-high (>4 VDC) power is removed from the winding.

Refer to the *Section 5 - Input/Output Board* for additional information.

### Analog Inputs

The microboard analog inputs are located on the upper portion of the board. The connections for these inputs are J8, and J9. The analog inputs at J7 are configured for use by the operator/service personnel. Connection terminals J7-16, J7-17, and J7-5 are configured at Retrofit Kit installation to allow the optional condenser refrigerant temperature sensor input to be used. Refer to *Figure 8* for the J7 analog input circuit diagram.



**FIGURE 8 - J7 CONFIGURABLE ANALOG INPUTS**

The analog inputs are received by the system thermistors and pressure transducers. These sensors output an analog DC voltage in the range of 0.5 - 4.5 volts. The software provides look-up tables, formulas and graphs to convert these voltages to a temperature or pressure, as required.

Refer to *SECTION 12 - OPTIVIEW PRESSURE TRANSDUCERS* and *SECTION 13 - OPTIVIEW TEMPERATURE THERMISTORS* for additional information.

### Current Control Module Interface

If the chiller utilizes an electromechanical starter, the current control module (CM-2 board) is connected to the microboard at J10. The microboard constantly receives data from the CM-2 board using an eight channel multiplexer. The multiplexer transmits a 0 - 5.0 VDC signal to the microboard for each channel. Channels 0 - 6 are grounded (0 VDC), identifying the starter as

the electromechanical type. The signal from Channel 7 (0 - 5 VDC) is read as the peak motor current value for chiller motor, with 4.0 VDC as 100% full load amps (FLA).

Refer to *SECTION 8 – OPTIVIEW CURRENT MODULE (ELECTROMECHANICAL STARTERS)* for additional information.

### Electromechanical Starter Idc Interface

Chillers which utilize a wye-delta or autotransformer type electromechanical starter may be equipped with a YORK Starter Relay Kit to control starter operation. The IDC, which is programmed to operate the specific starter, communicates with the microboard at the COM 2 serial data port. The IDC is typically located in the starter cabinet. The microboard receives data through RXD2 at connector J13-3. Data is transmitted to the IDC from TXD2 at connector J13-5.

### MOD “B” Solid State Starter Or Variable Speed Drive Interface

If the chiller is equipped with a MOD “B” solid state starter (SSS) or a variable speed drive (VSD), the microboard uses the COM 5 serial data port to communicate with these devices. Opto-couplers at 0 VDC and +5 VDC logic levels are used to transmit and receive serial data. Connection J15-1 is for data transmission, while J15-2 is used to receive data. Refer to *SECTION 9 – MOD “B” SOLID STATE STARTER LOGIC/TRIGGER BOARD* and *SECTION 10 – ADAPTIVE CAPACITY CONTROL (ACC) BOARD* for additional information.

### Remote Setpoint Inputs

Remote leaving chiller liquid temperature and the current limit setpoints can be input directly from a remote device to the microboard at connection J22. These inputs are configured for 0-10 VDC, 2-10 VDC, 0-20 mA, or 4-20 mA by the microboard program jumpers JP23 and JP24, as illustrated in *Figure 9*. These inputs are used if a remote device is available but the MicroGateway is not installed. Refer to the *Program Jumpers and Switches* portion of this section and *SECTION 14 – OPTIVIEW REMOTE SETPOINTS* in this manual for additional information.

### Microgateway Interface

The optional MicroGateway control board is connected at the COM 4B serial data port. This device requests system operating conditions for retrieval by third-party devices as well as adjusting remote setpoints. Micro-

Gateway communication is the standard RS-232 type. Refer to *SECTION 15 – MICROGATEWAY* for additional information.

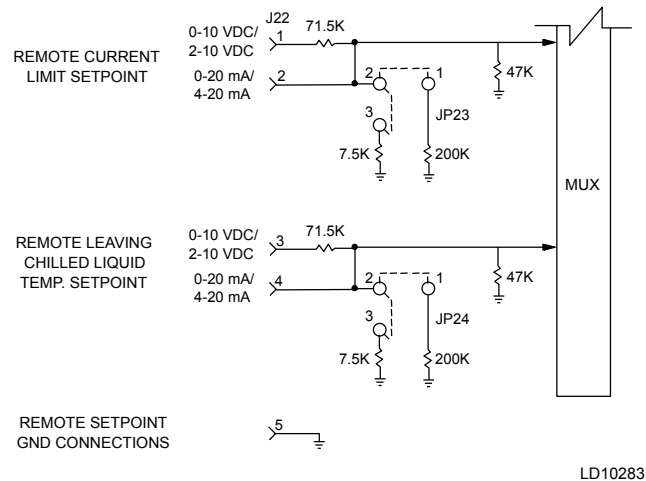


FIGURE 9 - J22 REMOTE SETPOINT INPUTS

### Printer Interface

As an option, a printer can be connected to the OptiView Control Center to provide a hardcopy of system conditions and setpoints. The printer is connected at the COM 1 serial data port (J2). Data is transferred and received using RS-232 type communication. Microboard connection terminal J2-4 is used for data transmission to the printer, while terminal J2-2 is used as the DSR (data set ready or busy) signal from the printer.

Data is transmitted to the printer at the proper baud rate until the printer buffer becomes full. When the printer buffer is full, the printer transmits the DSR busy signal to the board, stopping data transmission until the printer can receive more.

Each type of printer must be set up for proper communication with the microboard. Refer to the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-01)* for printing and setup information.

### Keypad Interface

The keypad is connected to the microboard at location J18, on the lower-left side of the microboard. The keypad is a matrix of conductors arranged in four rows and eight columns. When the operator presses a key, the conductors are pressed together at that point on the matrix, creating continuity between the row and column conductors.

To read the keypad, the microprocessor applies a logic-low (<1 VDC) signal to a row, while leaving a +5 VDC pull-up on all other rows. The microprocessor then reads the eight columns. If the microprocessor reads a logic-low signal on any of the columns, the microboard recognizes the key corresponding to that coordinate (row, column) on the keypad matrix is being pressed. While power is applied to the control panel, the microprocessor continually reads the keypad by cycling through the rows and columns.

Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional keypad information.

### Display Interface

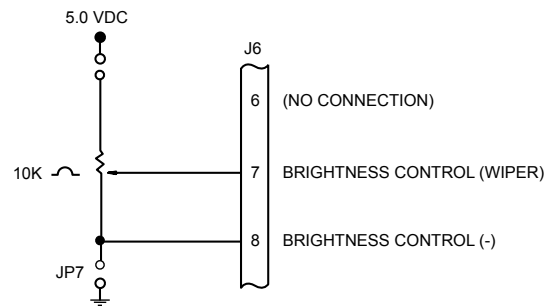
The graphic screens shown on the OptiView Control Center liquid crystal display (LCD) are created from the program in the software flash card. The LCD assembly (LCD and display interface board) is connected to the left side of the microboard at connection J5 by a ribbon cable.

As different display manufacturers require differing supply and control voltages, the microboard is designed to interface with a variety of manufacturer's displays. During the startup of the OptiView Control Center, the BIOS EPROM reads wire jumpers on the display interface board to determine the manufacturer of the board. The BIOS EPROM configures the microboard to operate with the display detected. The microboard program jumper, JP2, must also be configured to provide proper supply and control voltage levels (+5 VDC or +3.3 VDC) to the OptiView LCD. Refer to *Program Jumpers and Switches* portion of this section for proper jumper positioning.

Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional information.

### Display Backlight Inverter Interface

The OptiView display is equipped with a backlight assembly to provide the LCD with lighting to display screens. This assembly consists of a lamp and an inverter board to supply AC power to the lamp. The backlight assembly connects to the microboard with a ribbon cable at J6, located on the left side of the microboard.



LD10270

**FIGURE 10 - BACKLIGHT DIMMER CIRCUIT**

As with the supply and control voltages for the LCD, the backlight and inverters of different manufacturers must be configured for proper operation. Program jumpers JP3 – JP5, JP7, and JP8 determine how the microboard controls the backlight assembly. Refer to the *Program Jumpers and Switches* portion of this section for proper jumper positioning.

Under operating software control, the microboard controls the brightness of the backlight using a lamp dimmer circuit. The circuit incorporates the electrical equivalent of a 10k ohm potentiometer with 100 steps to control the brightness of the display. Jumpers must be configured for this circuit to control variable voltage (0 - 5.0 VDC) or variable resistance (0 - 10k ohms), as per the backlight manufacturer's requirements. The output of this circuit is at connection terminal J6-7.

If the microboard detects no keypad activity for ten minutes, the brightness of the display is reduced 50 percent. This extends the service life of the display backlight while still allowing the display graphics to be visible. Once a keystroke is detected by the microboard, the display brightness is returned to 100 percent.

Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional information on the backlight assembly.

### Microboard Power Supply

The microboard is supplied with three voltages (+12 VDC, -12 VDC, and +5 VDC) and ground from the OptiView power supply. The -12VDC and +12 VDC supplies are used directly by various microboard circuits. The +5 VDC and +12 VDC supplies are connected to voltage regulators to generate other regulated voltages. The +5 VDC voltage is regulated to +3.3 VDC. The +12 VDC is also regulated to +5 VDC, which is used to

power analog circuits and components. This includes the multiplexer (MUX), analog/digital converter, system pressure transducers and temperature sensors. Refer to *SECTION 7 – OPTIVIEW POWER SUPPLY* for additional information.

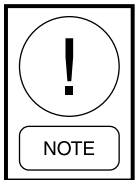
## MICROBOARD PROGRAM JUMPERS AND SWITCHES

The microboard is equipped with program jumpers and program switches to alter the operation of the program or to configure the microboard hardware for specific operation. The jumpers and switches allow the microboard to be universal to all standard hardware applications and conditions.

The 1730 model microboard contains forty-four jumpers and a single bank of twelve program DIP switches (SW1). Some of these jumpers and switches must be selected by the service technician during Retrofit Kit installation or if the microboard is replaced to ensure proper chiller operation. Not all jumpers and switches are used by the microboard.

The following paragraphs describe the positions and the functions of each program jumper and switch. Refer to *Figure 6* or the microboard for jumper and switch locations.

### Program Jumpers



*There are two types of program jumpers. One type is a wire bridge that is cut or left in place, as required. The other type is a two or three prong plastic sleeve with metal conductors that slide over pins on the microboard.*

**JP1** - Watchdog enable/disable. The position of this jumper, in conjunction with program switch SW 1, position 12, enables or disables the program Watchdog protection.



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

**IN** - Watchdog protection enabled. Protection status cannot be changed with program switch.

**OUT** - Permits program switch (SW1), position 12 to enable or disable Watchdog protection.

Program switch, position 12, sets Watchdog protection as follows:

**ON** - Watchdog protection enabled

**OFF** - Watchdog protection disabled

**JP2** - Liquid crystal display power and logic levels. Determines the power supply voltage applied to the display.

Pins 1-2: +5 VDC SHARP LQ10D367/368

Pins 2-3: +3.3 VDC

**JP3** - Liquid crystal display backlight enable signal level polarity. Jumper must be positioned according to the voltage level required to illuminate the display backlight.

**Pins 1-2:** 0 VDC

**Pins 2-3:** +12 or +5 VDC as determined by position of JP4. SHARP LQ10D367/368 displays use this position.

**JP4** - Liquid crystal display backlight enable signal logic levels. Determines the logic levels of the backlight enable signal as required by display manufacturer.

**Pins 1-2:** +12 VDC/0 VDC

**Pins 2-3:** +5 VDC/0 VDC SHARP LQ10D367/368 displays use this position.

**JP5** - Liquid crystal display backlight power. Determines the power supply voltage applied to the LCD backlight inverter board.

**Pins 1-2:** +12 VDC - SHARP LQ10D367/368

**Pins 2-3:** +5 VDC

**JP6** - Liquid crystal display memory type. Jumper must be positioned according to type of RAM used for display memory devices (U25 & U27).

**IN - EDO:** Extended data out type. Jumper should be IN.

**OUT - FPM:** Fast page mode type. Not used at this time.

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

**IN:** Variable voltage (0-5.0 VDC) SHARP LQ10D367/368

**OUT:** Variable resistance (0-10k Ohms)

**JP9 -** Configures COM2 serial port communication type. Used in Electromechanical starter IDC/ISN communication configuration.

**Pins 1-2:** Allows RS-232 communication for electromechanical starter IDC.

**Pins 2-3:** RS-485 Communication (not used) JP10 through JP20 - Not used at this time.

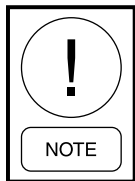
**JP21 -** Configures spare remote analog input at connection J7. Not supported at this time.

**OUT:** Allows a 0-10 VDC (J7-2) input or 2-10VDC (J7-14) input.

**Pins 1-2:** Allows a 0-20 mA (J7-2) input or 4-20mA (J7-14) input.

**Pins 2-3:** Not Used

**JP22 -** Configures spare remote analog input resistance at connection J7.



*The microboard connection this jumper (JP22) supports is used for the optional condenser refrigerant temperature sensor. The wiring harness for the sensor contains a resistor to supply proper resistance for this input. There should be no jumpers installed at this location.*

**OUT:** Jumper is out in order to allow proper signal for condenser refrigerant temperature sensor. Allows a 0-10 VDC (J7-4) input or 2-10 VDC (J7-16) input.

**Pins 1-2:** Allows a 0-20 mA (J7-4) input or 4-20mA (J7-16) input.

**Pins 2-3:** Not Used

**JP23 -** Configures proper input type for remote devices to adjust current limit setpoint remotely (J22). Configures analog input for 0-10 VDC, 2-10 VDC, 0-20 mA or 4-20 mA.

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

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

**Pins 2-3:** Not Used

**JP24 -** Configures proper input type for remote devices to adjust leaving chilled liquid tem-

perature setpoint remotely (J22). Configures analog input for 0-10 VDC, 2-10 VDC, 0-20 mA or 4-20 mA.

**OUT:** Allows a 0-10VDC OR 2-10VDC input on J22-3

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

**Pins 2-3:** Not Used JP25, JP26 - Not Used

**JP27 -** COM 4 serial communications data port. Configures COM 4 port to be either RS-485 for Multi-Unit Communications (COM 4A) or RS-232 for GPIC board (COM 4B).

**Pins 1-2:** Enables serial data port 4A. Allows an RS-485 connection to Microboard J11 for Multi-Unit Communications.

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

**JP28 through JP33 -** PC104 port. Not Used in OptiView Retrofit Kit applications.

**JP34 -** Chiller high/low pressure designation. Jumper must be positioned according to the chiller type.

**IN:** Low pressure chillers (Trane)

**OUT:** High pressure chillers

**JP35 -** Water/Brine chilled liquid application. Jumper must be positioned according to the type of chilled liquid.

**IN:** Water. Leaving chilled liquid temperature setpoint range 38°F (36°F if Smart Freeze is enabled) to 70°F.

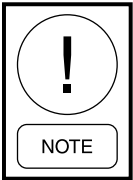
**OUT:** Brine. Leaving chilled liquid temperature setpoint range 10°F to 70°F.

**JP36 -** Determines the “System Coastdown” type. Must be “IN” for OptiView Retrofit Kit electrical compressor motor applications.

**IN:** Electric motor drive applications.

**OUT:** Not Used

**JP37 -** Selects compressor motor starter application utilized by the chiller.



***If the Variable Speed Drive application is selected (JP37 out), program jumper JP39 must also be “IN” for proper operation.***

**IN:** Electromechanical or Solid State Starter

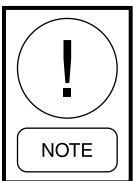
**OUT:** Variable Speed Drive

**JP38** - BIOS EPROM (socket U45) chip size. Jumper must be in or out, according to size of BIOS EPROM chip. Jumper is a 10 Ohm resistor soldered to microboard, not a shunt-type jumper.

**IN:** 256K

**OUT:** 64K or 128K. Must be “OUT” for OptiView Retrofit Kit applications.

**JP39** - This jumper selects the Mod “B” Solid State Starter or VSD application.



***If the Variable Speed Drive application is selected (JP37 out), program jumper JP39 must also be “IN” for proper operation.***

**IN:** VSD Applications

**OUT:** Mod “B” Solid State Starter

**JP40** - Not Used

**JP41** - Not Used

**JP42** - Not Used

**JP43, JP44** - Liquid crystal display controller type at Socket U29. The jumper must be positioned according to the LCD controller type installed on microboard. Configured at the time the OptiView Control Center is manufactured and should not require field configuration.

**Pins 1-2:** Type 65548

**Pins 2-3:** Type 65550

## PROGRAM SWITCHES (SW1)

**1** - Not Used

**2** - External oil heater - This switch enables/disables the external oil heater and must be in the “ON” position for proper oil heater operation.

**ON:** External oil heater enabled

**OFF:** External oil heater disabled

**3** - Oil pump type- Selects the type of oil pump the chiller is equipped with, auxiliary or constant run.

**ON:** Enables auxiliary oil pump control.

**OFF:** Constant run oil pump control. Typical Trane chiller configuration.

**4** - Diagnostics - Enables or disables advanced OptiView panel component diagnostics.

**ON:** Enables advanced diagnostics. Disables normal chiller operation

**OFF:** Disables advanced diagnostics. Enables normal chiller operation.

**5** - Auto-restart - Determines the course of action required to restart the chiller, if a power failure occurs while the chiller is running.

**ON:** Chiller will automatically restart when power is restored.

**OFF:** Requires a manual reset after power is restored. The chiller will not start until the operator moves the compressor motor switch to the “STOP/RESET” position. If in “Local” mode, the chiller can then be restarted by initiating a local start. If in “Remote” mode, the chiller will restart upon receipt of a remote start signal.

**6** - Anti-recycle - Enables or disables the anti-recycle timer.



***The anti-recycle timer must never be disabled unless absolutely necessary to do so during troubleshooting.***

**ON:** Enables anti-recycle timer. Solid State Starter and Electromechanical starter applications - Chiller cannot be started at intervals shorter than once every 30 minutes. VSD applications (JP37 Out) – Chiller can be started at the completion of “System Coastdown” up to five (5) times. On the fifth shutdown, a ten (10) minute timer is started and restart is inhibited until the timer has elapsed.

**OFF:** Disables anti-recycle timer. Chiller can be started at the completion of “System Coastdown”, regardless of how long the chiller had been running.

- 7 - Compressor motor Variable Speed Drive - motor/power line frequency type.

**ON:** 50Hz VSD Applications

**OFF:** 60Hz VSD Applications

- 8 - Chilled Water Pump Operation - Determines Chilled Water Pump control contacts (I/O Board TB2-44/45) operation when chiller stops on various cycling shutdowns.

**ON:** Enhanced operation. Contacts open at completion of system coastdown after all shutdowns except when shutting down on the following:

- “LEAVING CHILLED LIQUID - LOW TEMPERATURE”
- “MULTIUNIT CYCLING - CONTACTS OPEN”
- “SYSTEM CYCLING - CONTACTS OPEN”

**OFF:** Standard operation. Contacts open at completion of system coastdown after all shutdowns except when chiller shuts down on “LEAVING CHILLED LIQUID - LOW TEMPERATURE”. On low water tempera-

ture shutdowns, the contacts remain closed, causing the pump to continue to run while the chiller is shutdown.

- 9 - Not Used

- 10 - Not Used

- 11 - Not Used

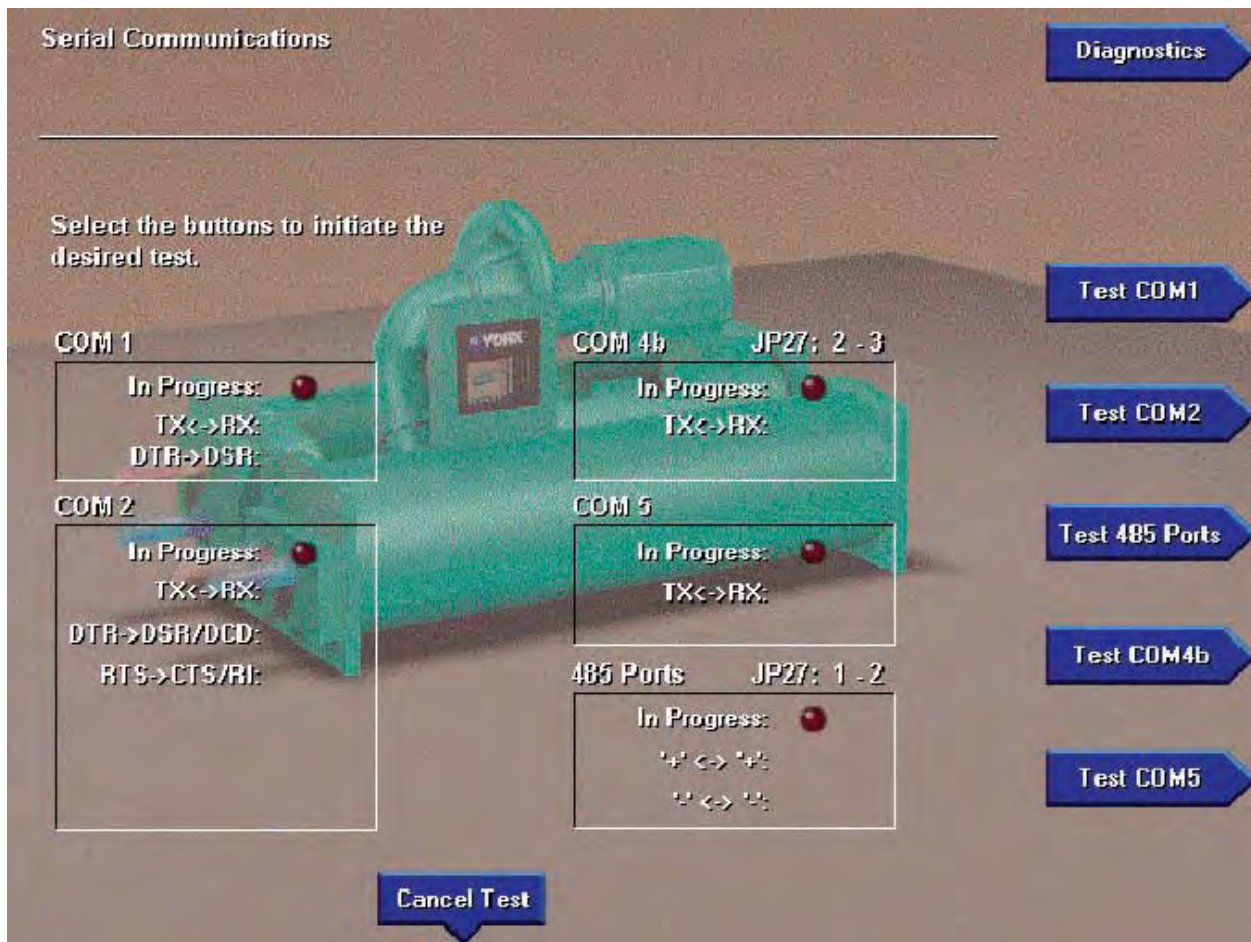
- 12 - Watchdog Protection -Used in conjunction with Program Jumper JP1 (described previously) to enable/disable the program watchdog protection. With JP1 “IN” this switch setting has no effect. With JP1 “OUT”, this switch setting determines whether the watchdog protection is enabled or disabled.



***NEVER disable the watchdog protection! Severe compressor or chiller damage could result. The ability to disable the watchdog protection is provided for YORK factory testing only.***

**ON:** Watchdog protection enabled.

**OFF:** Watchdog protection disabled.



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**FIGURE 11 - SERIAL DATA PORT DIAGNOSTIC TEST SCREEN**

### SERIAL DATA PORT DIAGNOSTIC TEST

This diagnostic test is used to verify correct operation of the serial data communications ports. There is a test for each of the five ports as follows:

- COM 1, 2, and 4B (RS-232) – Each of these ports are tested by transmitting serial test data from outputs to inputs of each port. The transmit and receive functions, as well as the control lines, are tested.
- COM 3 and 4A (RS-485) – These ports are tested by transmitting serial test data from one RS-485 port to another.
- COM 5 (opto-coupled) – This port 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 functioning properly. Otherwise, “FAIL” is displayed, indicating the serial port is defective and the microboard requires replacement.

## Procedure

1. Locate DIP switch #4 on the microboard. Place the switch in the “ON” position to enable diagnostics. The microboard will perform a watchdog reboot and the diagnostic screen will be displayed. Select the serial data communication port test.
2. For each serial port test, the service technician must create and install a wire loop-back connection for each port with connections described in Table 2. Use small gauge wire to fabricate the loop-back connections. Failure to install the loop-back connection or configure the microboard program jumper as noted will result in a FAIL outcome for the test.
3. After connecting the loop-back connections, press the appropriate key to initiate the desired test. An LED will illuminate, indicating the test is in progress. Test data is sent from an output to an input as described below.

**COM 1** – Two tests are performed.

- Test data is sent from TX (J2-4) to RX (J2-3) at 9600 Baud
- DTR (J2-5) is set to a Logic High level and read at DSR (J2-2).

If any test fails, the COM 1 tests are terminated.

**COM 2** – Three tests are performed.

- Test data is sent from TX (J13-5) to RX (J13-3) at 19200 Baud.
- DTR (J13-7) is set to a Logic High and read at DSR (J13-2) & DCD (J13-1).
- RTS (J13-4) is set to a Logic High and read at CTS (J13-6) & RI (J13-8).

If any test fails, all COM 2 tests are terminated.

**TABLE 2 - SERIAL DATA PORT DIAGNOSTIC TEST CONNECTIONS**

SERIAL PORT	FROM	TO	JUMPER
<b>COM1</b>	J2-4 (TX) J2-5 (DTR)	J2-3 (RX) J2-2 (DSR)	N/A
<b>COM2</b>	J13-5 (TX) J13-7 (DTR) J13-4 (RTS)	J13-3 (RX) J13-1 (DCD) & J13-2 (DSR) J13-6 (CTS) & J13-8 (RI)	N/A
<b>COM3 &amp; 4A</b>	J12-3 (+) J12-2 (-)	J11-3 (+) J11-2 (-)	JP27 Must be installed on pins 1&2.
<b>COM 4B</b>	J2-7 (GTX)	J2-6 (GRX)	JP27 Must be installed on pins 2&3.
<b>COM 5*</b>	J15-1 (TX) J15-2 (RX) J15-3 (COMMON)	J15-4 J15-5 J15-6	N/A

\* Make individual wire connections or use loop-around diagnostic connector, YORK part number 025-33778-000

**COM 3 & 4A** – Two tests are performed.

- Test data is sent from COM 3 RS-485 port to COM 4A RS-485 Port at 19200 Baud.
- Test data is then sent from COM 4A to COM 3 at 19200 Baud.

If either test fails, RS-485 tests are terminated.

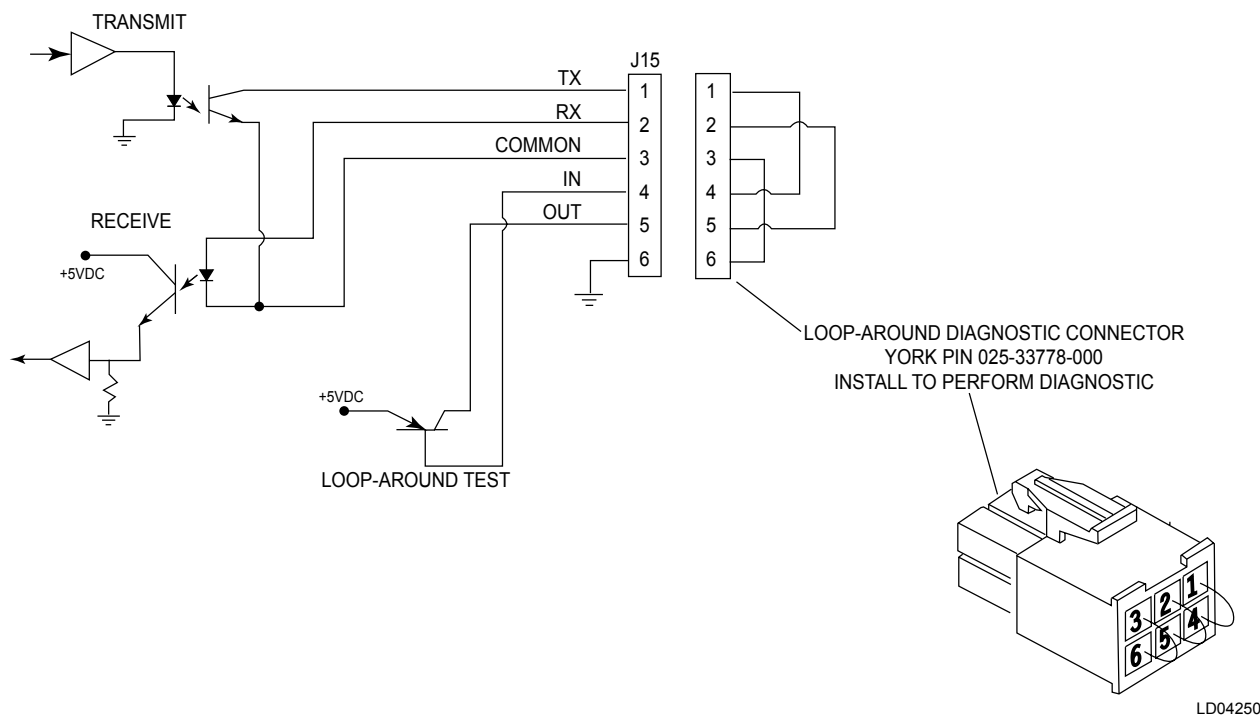
**COM 4B** – One test is performed.

- Test data is sent from GTX (J2-7) to GRX (J2-6) at 19200 Baud.

**COM 5** – One test is performed.

- 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/+5 VDC pulses from J15-5 to RX (J15-2) input.

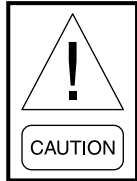
4. At the completion of each test, if the data received matches the data sent, the serial data port is operating properly and "PASS" is displayed. If the serial data is not received or does not match, "FAIL" is displayed, indicating the serial data port is not functioning properly.
5. Once testing is complete, open the OptiView cabinet door and place DIP switch 4 in the "OFF" position. The microboard will perform a watchdog reboot and return to the normal operation mode.



**FIGURE 12 - MICROBOARD COM-5 SERIAL DATA PORT**

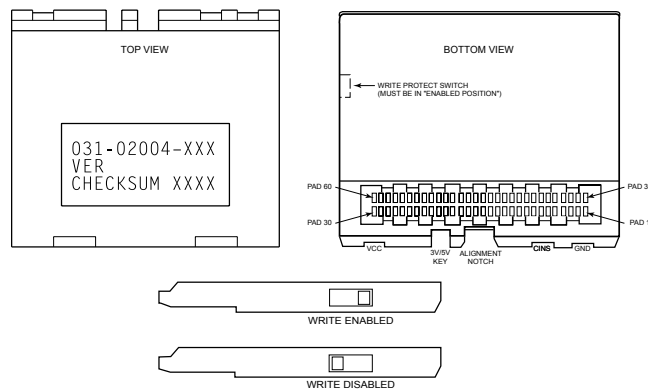
## MICROBOARD SERVICE

The OptiView Control Center microboard, program flash card, and several components are available for replacement. Refer to the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for a description of available components and part numbers.



**Follow all static electricity precautions when replacing the microboard and components. Component damage from static electricity may occur if these precautions are not followed.**

Prior to replacing the program flash card, BIOS EPROM, or BRAM, check the version currently installed in the OptiView panel. Compare the installed version with the replacement version for compatibility purposes. The installed versions of these items can be found on the component or on the OptiView diagnostic display screen via the Setup and Setpoints screens.



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**FIGURE 13 - PROGRAM MINIATURE FLASH CARD**

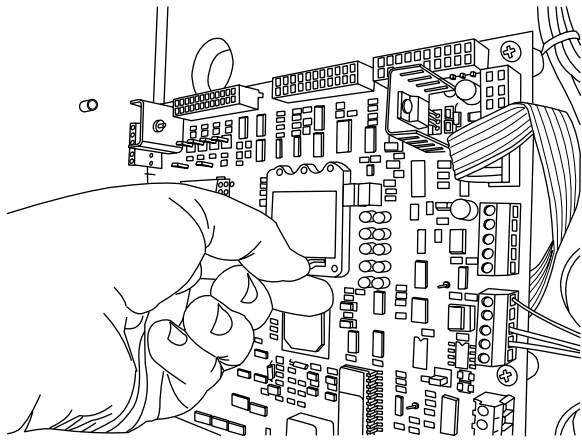
If components are replaced under the warranty, they must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.

### Program Mini Flash Card Replacement

The program miniature flash card is mounted in a socket at location U46 on the microboard. This socket has an elastomeric rubber connector imbedded with silver conductors that interfaces with the flash card for data transfer.

When replacing the program flash card, be sure the software version is the most current version available. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for the program flash card part number. Use the following procedure for flash card replacement.

1. Disconnect and lockout the OptiView Control Center power supply. Use proper lockout/tagout procedure.
2. Open the OptiView panel door and locate the program flash card socket at location U46.
3. Press down on the socket tension spring to release the flash card. Remove the flash card from the socket.
4. Before placing the replacement flash card in the socket, check to be sure the write/protect switch is in the “Write Enabled” position. The switch is located on the left edge of the card. The OptiView Control Center will not operate unless the switch is in this position.
5. Making sure the flash card connector is facing up and in towards the microboard, place the flash card in the socket. Insert the top of the card first, then push on the bottom to lock the card in place.
6. Close the OptiView panel cabinet door and connect power to OptiView panel. Check that the OptiView Control Center boot-up procedure is performed properly, then proceed with chiller operation.

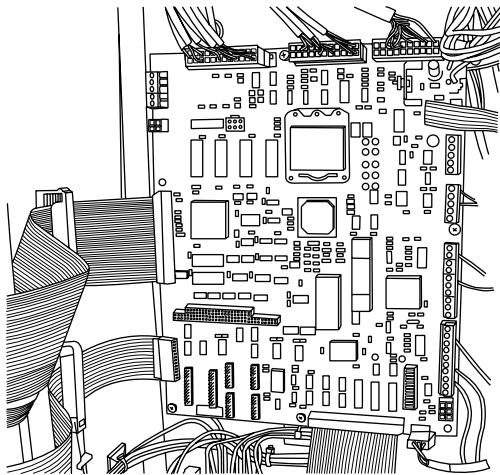


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**FIGURE 14 - FLASH CARD REMOVAL**

**Microboard Replacement**

Prior to replacing the microboard, use a voltmeter to test the DC voltages from the microboard power supply. This will ensure the problem is with the microboard and not the power supply. Refer to *SECTION 7 - OPTIVIEW POWER SUPPLY* for the power supply test procedure.

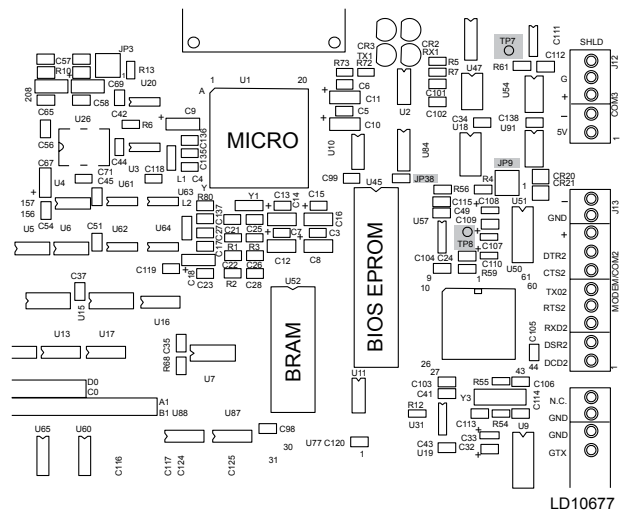


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**FIGURE 15 - OPTIVIEW MICROBOARD**

When replacing the microboard, the most current version of operating software is supplied with the board. The BRAM is not supplied and must be reused on the replacement board. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for the microboard part number. Use the following procedure for microboard replacement.

1. Disconnect and lockout the OptiView Control Center power supply. Use proper lockout/tagout procedure.
2. Open the OptiView panel cabinet door. Carefully disconnect all microboard connections from the microboard, labelling wires and connectors as necessary. Follow all static electricity precautions.
3. Carefully remove the BRAM from the microboard. Immediately install the BRAM on the replacement microboard. If the BRAM fails and replacement is necessary, all microboard-associated calibrations, setpoints and sales order data must be reprogrammed. All chiller setpoints and sales order data must be reprogrammed.
4. Remove the retaining screws securing the microboard to the rear wall plate mounts of the OptiView panel cabinet.
5. Align the replacement microboard with the mounting points on the rear wall plate in the OptiView panel cabinet. Install the retaining screws which secure the microboard to the OptiView cabinet. Do not overtighten the screws or damage to the microboard may occur.
6. Connect all wires and connectors to the replacement microboard. Close the OptiView panel cabinet door.
7. Connect power to the OptiView Control Center. Confirm that the OptiView Control Center boot-up procedure is performed properly, then proceed with chiller operation.



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**FIGURE 16 - MICROBOARD BRAM AND EPROM**

## SECTION 4 - MICROBOARD 031-02430-000

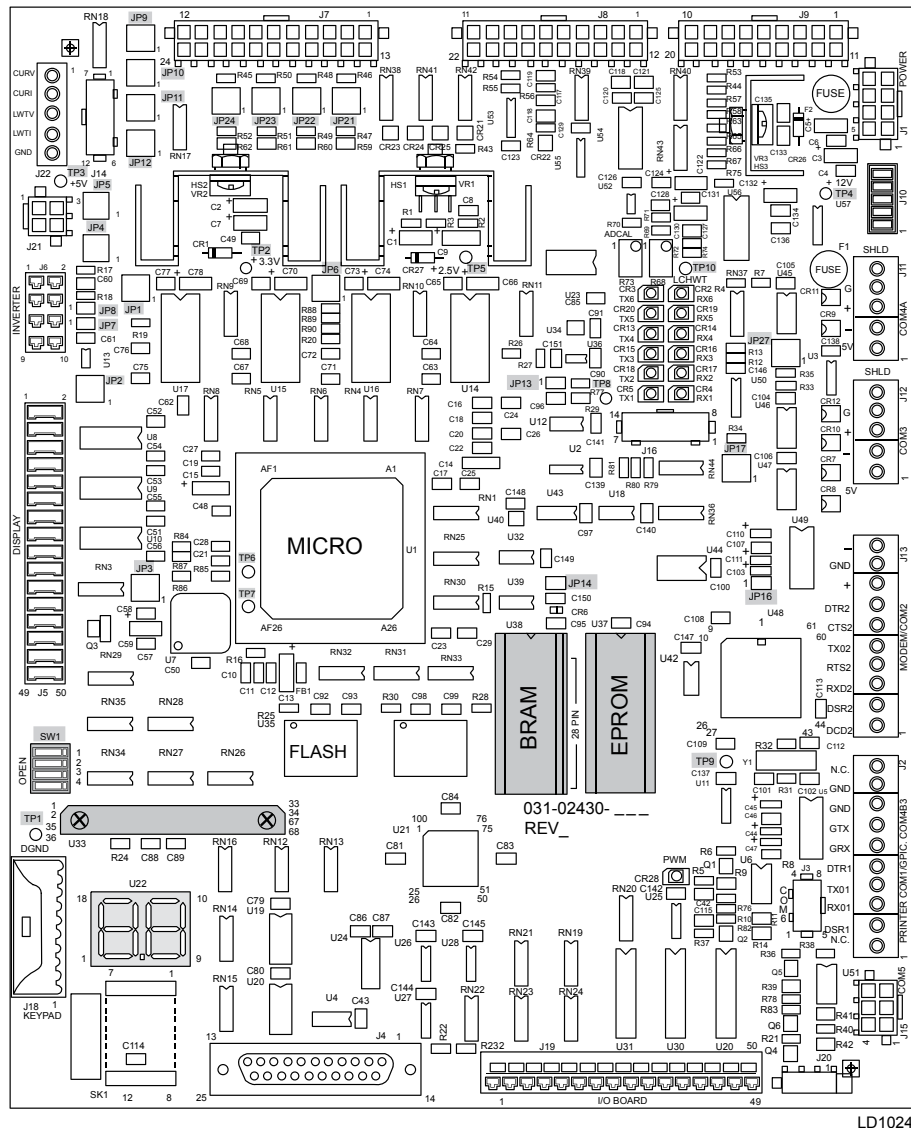


FIGURE 17 - OPTIVIEW 2430 MICROBOARD

### MICROBOARD DESCRIPTION

The microboard contains the microprocessor (micro), the operating software, the BIOS EPROM, the system memory, and all of the interfaces that allow the microprocessor to control chiller operation to software and user determined parameters.

This section describes the 031-02430-000 “2430” microboard. The 2430 microboard can be identified by the program card interface for the operating software, which is stored in onboard memory. The part number for the 2430 board is printed in the center of the board, horizontally, below the BIOS EPROM chip. The 2430

board uses the same interfaces the 1730 board utilizes. This design allows the 2430 board to be a direct replacement for OptiView Control Centers originally equipped with the 1730 board. The major components and interfaces of the 2430 microboard are outlined and described in the following paragraphs.

### MICROBOARD COMPONENTS

#### Microprocessor

The microprocessor controls chiller operation by reading and executing the operating software (program) instructions. These instructions are performed in a set

sequence determined by the operating software. The microprocessor interprets analog, digital, and serial data inputs to determine chiller operating conditions as per the operating software. Digital inputs include those received from the operator pressing the keypad. The microprocessor compares the data from inputs to operating thresholds and parameters contained in the operating software and those programmed by the operating personnel. Under program control, the microprocessor controls chiller operation using digital outputs.

While the chiller is operating, a status/details message will be shown on the OptiView display. If the chiller is operating outside of set parameters, a fault message will be displayed. Depending on the severity of the fault, the microprocessor may stop chiller operation. The status/details messages are color coded according to the program software to indicate severity. Refer to the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)* for information regarding these messages.

### Program Card

The program card is a portable memory device which stores the OptiView Control Center operating software. This device is read-only, but can be re-programmed with a newer version of software.

The OptiView Control Center operating software is downloaded onto the 2430 board's onboard flash memory chip (located at U35) at interface connector U33. Once the program has been downloaded, the card is removed and both the interface connection and the program card are protected from damage with a cover/sleeve. The use of a removable program card and onboard flash memory allows one card to program multiple chillers of the same type.

Whenever the OptiView Control Center is updated, a new program card is issued and replaces the current software version loaded in the microboard. The version of the operating software is printed on a label adhered to the program card. The software versions (C.OPT.yy.zz) are alpha-numeric codes that represent the microboard, software application, and revision lev-

els as shown below. Each time the software is revised, the respective revision level increments.

- **C** – Commercial chiller
- **MLM** – Used on Microboard 031-01730-000
- **OPT** – Used on Microboard 031-02430-000
- **yy** – Chiller Manufacturer (08 Trane, 09 Carrier, 10 McQuay)
- **zz** - controls revision level (00, 01, etc)

To cross reference C.MLM software to C.OPT software, refer to the controls revision level. The version of software installed in the microboard can be viewed on the Diagnostics screen at the service access level. From this starting point, both microboards receive the same software updates at each revision. Software updates should only be performed by a qualified Service technician. Refer to the *Service Replacement* portion of this section for software update instructions.

### Battery-Backed Ram (BRAM)

The BRAM (Battery-backed Random Access Memory) is a replaceable memory device with a battery backup used to retain data during power failures. Any operator programmed setpoints, history data, time/date, schedules, sales order information and any other data which requires preservation is stored in this device. These setpoints and sales data will need to be reprogrammed if the BRAM fails; refer to *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)*. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for BRAM replacement part numbers.

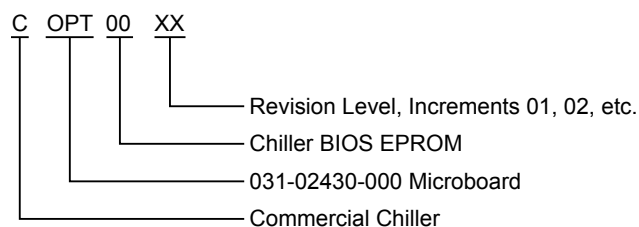
### BIOS EPROM

The BIOS EPROM (Basic Input/Output System Erasable Programmable Read Only Memory) is a memory device which contains the OptiView boot-up program. On 2430 microboards, the EPROM is located at socket U37. The version of the BIOS EPROM is printed on a label adhered to the chip. The BIOS EPROM is also shown on the OptiView display during system boot-up.

**TABLE 3 - 2430 BOARD BOOT-UP DIAGNOSTIC DISPLAY CODES**

TEST	PASS CODE	FAIL ACTION	DISPLAY ON LCD SCREEN
First Init Table Complete	00	watchdog will cause reboot	No
Sdram Regs. Configured	01	watchdog will cause reboot	No
Switch To Protected Mode	02	watchdog will cause reboot	No
Jump To 32-bit Code	03	watchdog will cause reboot	No
Low Memory Test Start	04	watchdog will cause reboot	No
Low Memory Test Complete	P1	"F1" on display and halt	No
Full Memory Test Complete	P2	"F2" on display and halt	No
FPGA Configuration	05	"P2" will remain on LED display	No
Display Cont. Configured	06	"05" will remain on LED display	No
Flash Checksum Test	P3	"F3" will remain on LED display	Yes
BRAM Test	P4	"F4" will remain on LED display	Yes
Flash Query Test	"passed"	"failed" and halt	Yes
Flash Checksum	"passed"	"failed", halt & display code = F3	Yes
BRAM Test	"passed"	"failed" and halt	Yes
MISCELLANEOUS CODES			
LED DISPLAY CODE	DESCRIPTION		
FF	FPGA Configuration failed, trying again		
CH	Flash Checksum Test in progress		
AP	Application setup in progress		
CRITICAL CODES			
LED DISPLAY CODE	DESCRIPTION		
Ni	NMI handler invoked (should never occur)		
[ ]	GPF has occurred (should never occur)		

The EPROM is removable and can be replaced in the event of failure. Use the following the legend to determine the version of EPROM installed on the microboard.



If the EPROM requires replacement, the new EPROM must be compatible with the program software installed, otherwise the boot-up process will not complete and the chiller will not be operational. Refer to the *Service Replacement* portion of this section and the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for replacement information.

Whenever power is applied to the OptiView Control Center, the microprocessor executes a startup/boot-up process using instructions located in the BIOS. These instructions initialize, test, configure, and start the operation of certain microboard components prior to executing the main program stored in the onboard flash.

The sequence of events in the boot-up process and the pass/fail status of each step is visually displayed on the microboard 7-segment LED Display, located at U22 on the microboard. Several steps of the startup/boot-up process are also displayed on the OptiView LCD's white startup screen. Due to the speed at which the boot-up occurs, not all steps will be visible during the process.

The Boot-up Diagnostic Display Code table, *Table 3* identifies the diagnostic tests and resulting displays that occur during boot-up.

## Watchdog Circuit

The watchdog circuit is an integrated microboard circuit which monitors microboard power supply and program operation. The function of the watchdog circuit that monitors microboard power supply for power failure is referred to as the “hardware” watchdog circuit. The function of the watchdog circuit that monitors the operation of the software for program latch-up is referred to as the “software” watchdog circuit.

The “hardware” watchdog circuit monitors the power supply level of the microboard. When power drops to a level where the microprocessor and supporting circuits can no longer operate, the watchdog circuit sends a “reset” signal to the microprocessor. These voltage levels are +4.75 to +4.5 VDC for the onboard power supply and +3.04 to +2.8 VDC for the onboard regulator. The microprocessor responds by de-energizing the “run” digital output (if running), stopping chiller operation. When this “hardware” watchdog initiated shutdown occurs, the “Control Panel - Power Failure” message is generated, which is stored in chiller history and displayed on the OptiView LCD after power is returned to operational levels.

The “software” watchdog circuit detects if the operating program has latched-up or has been interrupted, bypassing the safety thresholds. This portion of the watchdog circuit is a timer that is signaled to reset by the microprocessor upon completion of running the system operating program. The microprocessor takes less than one second to execute the operating program, which is continually run. If the watchdog circuit does not receive a reset signal within 2.25 seconds after the microprocessor executes the operating program, the watchdog returns a “reset” signal to the microprocessor. The microprocessor responds by de-energizing the “run” digital output (if running), stopping chiller operation. This is a “software” watchdog initiated shutdown. The software is automatically rebooted and “WATCHDOG - SOFTWARE REBOOT” is displayed on the OptiView LCD.

## Digital Inputs

The microboard receives logic-low (<1 VDC) and logic-high (>4 VDC) signals from the I/O board at connection J19. This connection is in bottom part of the microboard, located conveniently to the I/O board. The microboard is not able to convert 115 VAC signals to digital logic-level signals; the I/O board performs the conversion.

Refer to *SECTION 5 - INPUT/OUTPUT BOARD* for additional information.

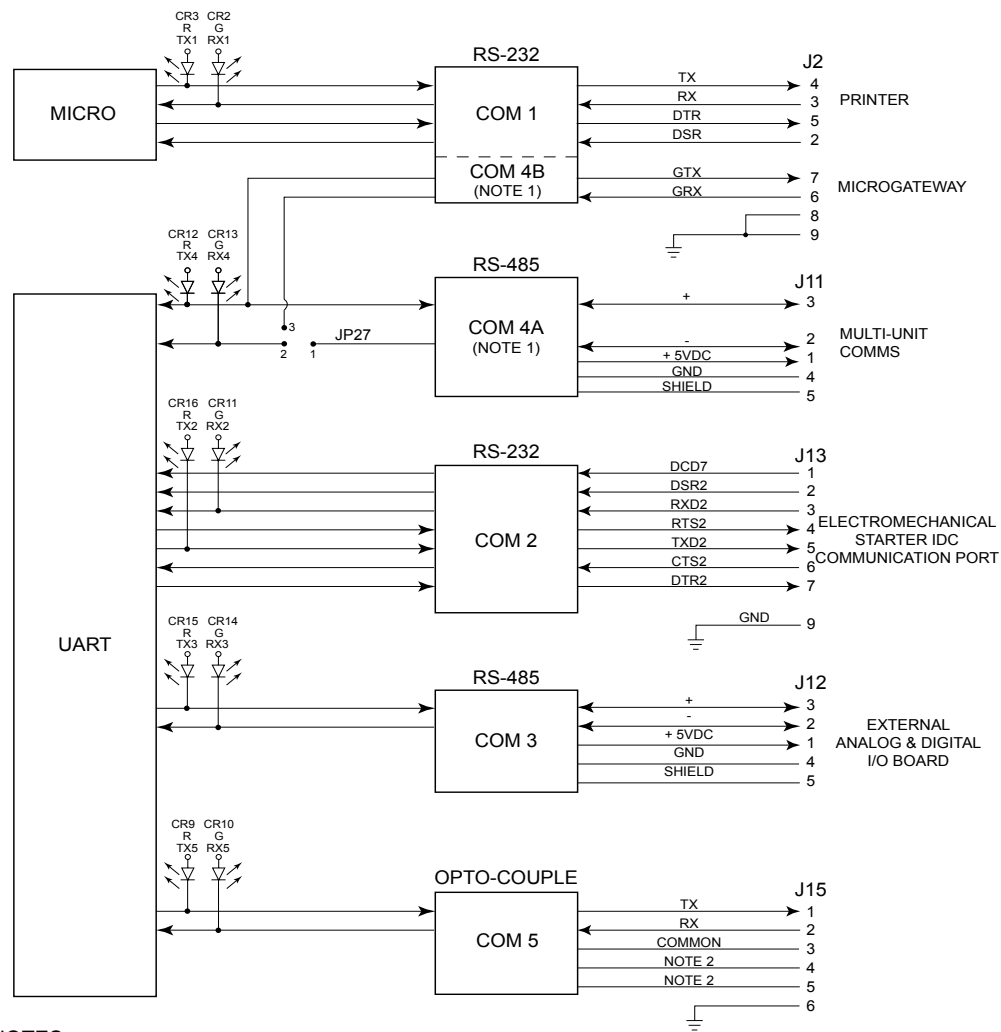
## Digital Outputs

The microboard controls 120 VAC power to relays, solenoids and actuator motors using the I/O board through connection J19. The I/O board contains +12 VDC relays and triacs which isolate the microboard from the 115 VAC the device relays, solenoids and the actuator motors use.

To control the relays, the microboard utilizes solid state switching devices to complete the negative ground to the +12 VDC relay coil. This energizes the relays, switching 115 VAC to the device relays and solenoids. The microboard de-energizes the relays by opening the ground to the relay coil.

The microboard controls the pre-rotation vane (PRV) actuator using triacs mounted on the I/O board. The PRV actuator has an open and close winding; the microboard uses a separate triac to send power to a solid state relay that controls each winding. When the microboard supplies a logic-low (<1 VDC) signal to the triac, the triac supplies the respective relay and winding (open or close) with 115 VAC. When the microboard applies a logic-high signal (>4 VDC) power is removed from the winding.

Refer to *SECTION 5 - INPUT/OUTPUT BOARD* for additional information.



**NOTES:**

1. Microboard Program Jumper JP27 determines whether COM 4A or 4B can be used. 1 & 2 - 4A, 2 & 3, 4B.
2. J15-4 Loop-Around Test IN. J15-5 Loop-Around Test OUT. Refer to Fig. 12 for details.

LD10277

**FIGURE 18 - MICROBOARD SERIAL DATA COMMUNICATION PORTS**

**Serial Data Ports**

The microboard is equipped with six serial data communication ports, located along the right side of the board. Each port performs a specific function, as described below.

**COM 1** - Printer communication port. Connection is at J2. RS-232 type communication.

**COM 2** - Electromechanical starter IDC communication port. Microboard connection is at J13. RS-232 type communication.

**COM 3** - External digital and analog board communication port. Microboard connection is at J12. RS-485 type communication.

**COM 4A** - This port is not utilized at this time. Microboard connection is at J11. Configured for RS-485 type communication. Cannot be used at the same time as COM 4B. Program jumper JP27 enables/disables this port.

**COM 4B** - MicroGateway communication port. Microboard connection is at J2. Configured for RS-232 type communication. Cannot be used at the same time as COM 4A. Program jumper JP27 enables/disables this port.

**COM 5** - VSD or Solid State Starter communication port. Microboard connection is at J15. Opto-coupler TX/RX type communication.

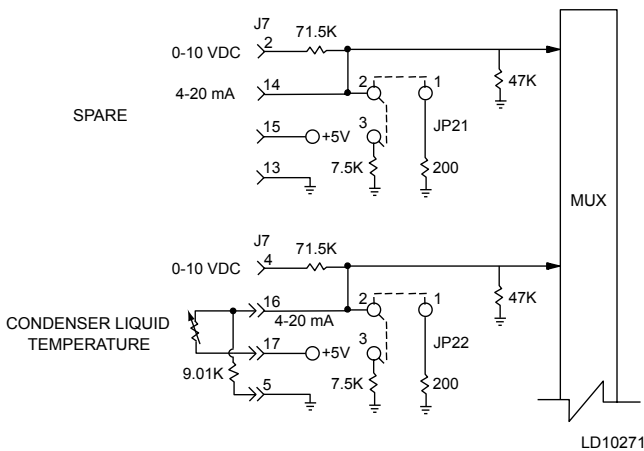
As illustrated in *Figure 18*, each of the serial data ports are equipped with two LEDs. These LEDs will illuminate when the port is transmitting (TX) or receiving (RX) data. Two microboard LEDs, CR2 and CR3 are not used; these are reserved for a future serial data port. For LED designation, refer to *Figure 18*.

All serial port communication utilizes the industry standard DC voltages for each type of communication. RS-232 type communication is +5 to +25 VDC and -5 to -25 VDC, RS-485 type communication is 0 VDC and +1.5 to +5 VDC. The opto-couplers used on COM 5 are 0 VDC and +5 VDC.

Diagnostic tests can be performed on each serial port to check for proper operation. Refer to *Serial Data Port Diagnostic Tests* in this section for the test procedure.

### Analog Inputs

The microboard analog inputs are located on the upper portion of the board. The connections for these inputs are J8, and J9. The analog inputs at J7 are configured for use by the operator/service personnel. Connection terminals J7-16, J7-17, and J7-5 are configured at Retrofit Kit installation to allow the optional condenser refrigerant temperature sensor input to be used. Reference *Figure 19* for the J7 analog input circuit diagram.



**FIGURE 19 - J7 CONFIGURABLE ANALOG INPUTS**

The analog inputs are received by the system thermistors and pressure transducers. These sensors output an analog DC voltage in the range of 0.5 - 4.5 volts. The software provides look-up tables, formulas and graphs

to convert these voltages to a temperature or pressure, as required.

Refer to *SECTION 12 – OPTIVIEW PRESSURE TRANSDUCERS* and *SECTION 13 – OPTIVIEW TEMPERATURE THERMISTORS* for additional information.

### Current Control Module Interface

If the chiller utilizes an electromechanical type starter, the current control module (CM-2 board) is connected to the microboard at J10. The microboard constantly receives data from the CM-2 board using an eight channel multiplexer. The multiplexer transmits a 0 - 5 VDC signal to the microboard for each channel. Channels 0-6 are grounded (0 VDC), identifying the starter as the electromechanical type. The signal from Channel 7 (0 - 5 VDC) is read as the peak motor current value for chiller motor, with 4.0 VDC as 100% full load amps (FLA).

Refer to *SECTION 8 – OPTIVIEW CURRENT MODULE (ELECTROMECHANICAL STARTERS)* for additional information.

### Electromechanical Starter IDC Interface

Chillers which utilize a wye-delta or autotransformer type electromechanical starter may be equipped with a YORK Starter Relay Kit to control starter operation. The IDC, which is programmed to operate the specific starter, communicates with the microboard at the COM 2 serial data port. The IDC is typically located in the starter cabinet. The microboard receives data through RXD2 at connector J13-3. Data is transmitted to the IDC from TXD2 at connector J13-5.

### MOD “B” Solid State Starter Or Variable Speed Drive Interface

If the chiller is equipped with a MOD “B” solid state starter (SSS) or a variable speed drive (VSD), the microboard uses the COM 5 serial data port to communicate with these devices. Opto-couplers at 0 VDC and +5 VDC logic levels are used to transmit and receive serial data. Connection terminal J15-1 is for data transmission, while J15-2 is used to receive data. Refer to *SECTION 9 – MOD “B” SOLID STATE STARTER LOGIC/TRIGGER BOARD* and *SECTION 10 – ADAPTIVE CAPACITY CONTROL (ACC) BOARD* for additional information.

### Remote Setpoint Inputs

Remote leaving chiller liquid temperature and the current limit setpoints can be input directly from a remote device to the microboard at connection J22. These inputs are configured for 0-10 VDC, 2-10 VDC, 0-20 mA, or 4-20 mA by the microboard program jumpers JP23 and JP24, as illustrated in Figure 20. These inputs are used if a remote device is available and the MicroGateway is not installed. Refer to the “Program Jumpers” portion of this section and SECTION 14 – OPTIVIEW REMOTE SETPOINTS in this manual for additional information.

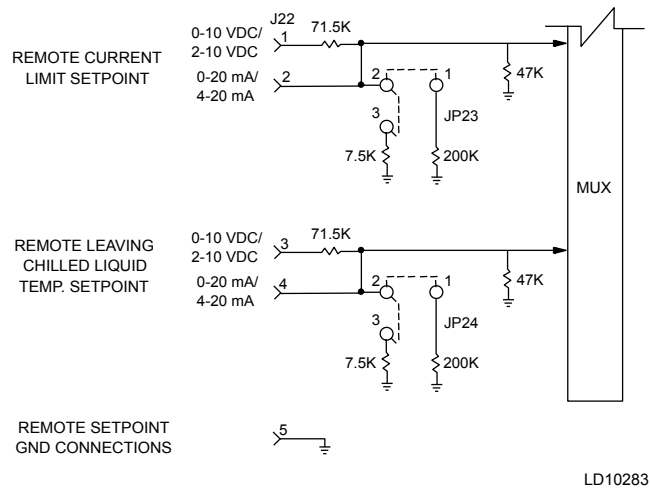


FIGURE 20 - J22 REMOTE SETPOINT INPUTS

### Microgateway Interface

The optional MicroGateway control board is connected at the COM 4B serial data port. This device requests system operating conditions for retrieval by third-party devices as well as adjusting remote setpoints. MicroGateway communication is the standard RS-232 type.

### Display Interface

The graphic screens shown on the OptiView Control Center liquid crystal display (LCD) are created from the program in the OptiView software. The LCD assembly (LCD and display interface board) is connected to the microboard at connection J5 by a ribbon cable.

As different display manufacturers require differing supply and control voltages, the microboard is designed to interface with a variety of manufacturer’s displays. During the startup of the OptiView Control Center, the BIOS EPROM reads wire jumpers on the display inter-

face board to determine the manufacturer of the board. The BIOS EPROM configures the microboard to operate with the display detected. The microboard program jumper, JP2, must also be configured to provide proper supply and control voltage levels (+5 VDC or +3.3 VDC) to the OptiView LCD. Refer to the “Program Jumpers” in this section for proper jumper positioning.

Refer to SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD for additional information.

### Display Backlight Inverter Interface

The OptiView Control Center display is equipped with a backlight assembly to provide the LCD with lighting to display screens. This assembly consists of a lamp and an inverter board to supply AC power to the lamp. The backlight assembly connects to the microboard using a ribbon cable at J6, located on the left side of the microboard.

As with the supply and control voltages for the LCD, the backlight and inverters of different manufacturers must be configured for proper operation. Program jumpers JP3 – JP5, JP7, and JP8 determine how the microboard controls the backlight assembly. Refer to the Program Jumpers and Switches portion of this section for proper jumper positioning.

Under operating software control, the microboard controls the brightness of the backlight using a lamp dimmer circuit. The circuit incorporates the electrical equivalent of a 10k ohm potentiometer with 100 steps to control the brightness of the display. Jumpers must be configured for this circuit to control variable voltage (0 - 5.0 VDC) or variable resistance (0 - 10k ohms), as per the backlight manufacturer’s requirements. The output of this circuit is at connection terminal J6-7.

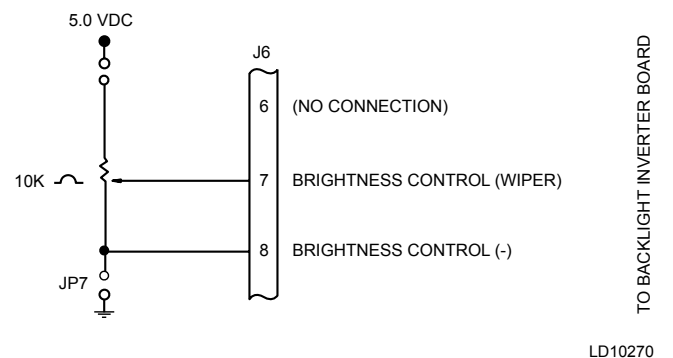


FIGURE 21 - BACKLIGHT DIMMER CIRCUIT

If the microboard detects no keypad activity for ten minutes, the brightness of the display is reduced 50 percent. This extends the service life of the display backlight while still allowing the display graphics to be visible. Once a keystroke is detected by the microboard, the display brightness is returned to 100 percent.

Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional information on the backlight assembly.

### Keypad Interface

The keypad is connected to the microboard at location J18, on the lower-left side of the microboard. The keypad is a matrix of conductors arranged in four rows and eight columns. When the operator presses a key, the conductors are pressed together at that point on the matrix, creating continuity between the row and column conductors.

To read the keypad, the microprocessor applies a logic-low (<1 VDC) signal to a row, while leaving a +5 VDC pull-up on all other rows. The microprocessor then reads the eight columns. If the microprocessor reads a logic-low signal on any of the columns, the microboard recognizes the key corresponding to that coordinate (row, column) on the keypad matrix is being pressed. While power is applied to the control panel, the microprocessor continually reads the keypad by cycling through the rows and columns.

Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional keypad information.

### Microboard Power Supply

The microboard is supplied with a ground and three voltages (+12 VDC, -12 VDC, and +5 VDC) from the OptiView power supply. The -12 VDC is not used. The +12 VDC supply is used directly by various microboard circuits. The +12 VDC is also regulated to +5 VDC, which is used to power analog circuits and components. This includes the multiplexer (MUX), analog/digital converter, system pressure transducers and temperature sensors. This voltage is monitored as +2.5 VDC at test point 10, as created by a 1K ohm resistor voltage divider circuit.

The +5 VDC supply is used directly by microboard circuits and is also connected to voltage regulators to generate other regulated voltages. The +5 VDC voltage is regulated to +3.3 VDC and +2.5 VDC by onboard regulators.

Refer to *SECTION 7 – OPTIVIEW POWER SUPPLY* for additional information and power supply testing.

### Printer Interface

As an option, a printer can be connected to the OptiView Control Center to provide a hardcopy of system conditions and setpoints. The printer is connected at the COM 1 serial data port (J2). Data is transferred and received using RS-232 type communication. Microboard connection terminal J2-4 is used for data transmission to the printer, while terminal J2-2 is used as the DSR (data set ready or busy) signal from the printer.

Data is transmitted to the printer at the proper baud rate until the printer buffer becomes full. When the printer buffer is full, the printer transmits the DSR busy signal to the board, stopping data transmission until the printer can receive more.

Each type of printer must be set up for proper communication with the microboard. Refer to the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-01)* for printing and setup information.

### MICROBOARD PROGRAM JUMPERS AND SWITCHES

The microboard is equipped with program jumpers and program switches to alter the operation of the program or to configure the microboard hardware for specific operation. The jumpers and switches allow the microboard to be universal to all standard hardware applications and conditions.

The 2430 model microboard contains twenty-seven (27) jumpers and a single bank of four (4) program DIP switches (SW1). Some of these jumpers and switches must be selected by the service technician during OptiView Retrofit Kit installation or if the microboard is replaced to ensure proper chiller operation. Not all microboard jumpers and switches are used.

Some program jumpers the original 1730 model microboard was equipped with are no longer present on the 2430 model board. The functions of these jumpers are now programmed in the “Setup Screen” using the keypad and display. The configurations for these functions are as follows:

### Chilled Liquid Pump Operation (Standard Or Enhanced)

Determines Chilled Water Pump control contacts (I/O Board TB2-44/45) operation when chiller stops on various cycling shutdowns.

“**Enhanced**” operation. Contacts open at completion of system coastdown after all shutdowns except when shutting down on the following:

- “LEAVING CHILLED LIQUID - LOW TEMPERATURE”
- “MULTIUNIT CYCLING - CONTACTS OPEN”
- “SYSTEM CYCLING - CONTACTS OPEN”

“**Standard**” operation. Contacts open at completion of system coastdown after all shutdowns except when chiller shuts down on “LEAVING CHILLED LIQUID - LOW TEMPERATURE”. On low water temperature shutdowns, the contacts remain closed, causing the pump to continue to run while the chiller is shutdown.

### Motor Type

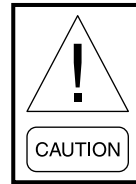
The proper compressor motor starter must be selected as the chiller is configured. The selections are:

- **EM** - Electromechanical Starter
- **SSS** - Mod “B” Solid State Starter
- **VSD 60Hz** - Variable Speed Drive, 60Hz
- **VSD 50Hz** - Variable Speed Drive, 50Hz

The chiller will not function unless the proper starter type is selected.

### Anti-Recycle (Enabled Or Disabled)

Enables or disables the anti-recycle timer.



*The anti-recycle timer must never be disabled unless absolutely necessary to do so during troubleshooting.*

- **ON:** Enables anti-recycle timer. Solid State Starter and Electromechanical starter applications - Chiller cannot be started at intervals shorter than once every thirty (30) minutes. VSD applications - Chiller can be started at the completion of “System Coastdown” up to five (5) times. On the fifth shutdown, a ten (10) minute timer is started and restart is inhibited until the timer has elapsed.
- **OFF:** Disables anti-recycle timer. Chiller can be started at the completion of “System Coastdown”, regardless of how long the chiller had been running.

### Power Failure Restart (Manual Or Automatic)

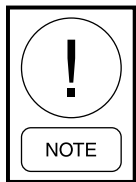
Determines the course of action required to restart the chiller if a power failure occurs while the chiller is running.

- **ON:** Chiller will automatically restart when power is restored.
- **OFF:** Requires a manual reset after power is restored. The chiller will not start until the operator moves the compressor motor switch to the “STOP/RESET” position. If in “Local” mode, the chiller can then be restarted by initiating a local start. If in “Remote” mode, the chiller will restart upon receipt of a remote start signal.

Refer to *Setup Screen* in the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-01)* for additional information on these functions for the 2430 board.

The following portion of this manual describes the positions and the functions of each program jumper and switch located on the 2430 microboard. Refer to *Figure 17* or the microboard for jumper and switch locations.

## PROGRAM JUMPERS



*There are two types of program jumpers. One type is a wire bridge that is cut or left in place, as required. The other type is a two or three prong plastic sleeve with metal conductors that slide over pins on the microboard.*

**JP1** - Not Used

**JP2** - Liquid crystal display power and logic levels. Determines the power supply voltage applied to the display.

**Pins 1-2:** +5 VDC SHARP LQ10D367/368

**Pins 2-3:** +3.3 VDC

**JP3** - Liquid crystal display backlight enable signal level polarity. Jumper must be positioned according to the voltage level required to illuminate the display backlight.

**Pins 1-2:** 0 VDC

**Pins 2-3:** +12 VDC or +5 VDC as determined by position of JP4. SHARP LQ10D367 and 368 displays use this position.

**JP4** - Liquid crystal display backlight enable signal logic levels. Determines the logic levels of the backlight enable signal as required by display manufacturer.

**Pins 1-2:** +12 VDC/0 VDC

**Pins 2-3:** +5 VDC/0 VDC SHARP LQ10D367 and 368 displays use this position.

**JP5** - Liquid crystal display backlight power. Determines the power supply voltage applied to the LCD backlight inverter board.

**Pins 1-2:** +12VDC - SHARP LQ10D367/368

**Pins 2-3:** +5VDC

**JP6** - Microboard boot-up source. Determines if boot-up occurs from the BIOS EPROM (U37) or the program card (program downloading)

**Pins 1-2:** Boot-up occurs from BIOS EPROM

**Pins 2-3:** Boot-up occurs from program card. Must be in this position to download operating program into onboard flash chip.

**JP7, JP8** - Display brightness control technique.

Determines whether the display brightness is controlled by a variable voltage or variable resistance.

**IN:** Variable voltage (0-5.0 VDC) SHARP LQ10D367/368

**OUT:** Variable resistance (0-10k Ohms)

**JP9** - Electromechanical starter IDC/ISN communication configuration

**Pins 1-2:** Allows communication between microboard and electromechanical starter IDC.

**Pins 2-3:** Not Used

**JP10 through JP12** - Not used at this time.

**JP13** - Watchdog Enable/Disable. This jumper is a soldered wire type.

**IN** - Watchdog protection enabled.

**OUT** - Watchdog protection disabled. Factory setting only.



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

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

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

**OUT** - 128K x 8

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

**IN** - Use external modem

**OUT** - Use on-board modem

**JP17** - COM 2 Serial Port configuration. Used in Electromechanical starter IDC/ISN communication configuration.

**Pins 1-2:** Allows RS-232 communication for electromechanical starter IDC.

**Pins 2-3:** RS-485 Communication (not used)

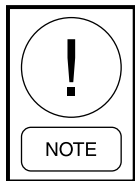
**JP21** - Configures spare remote analog input at connection J7. Not supported at this time.

**OUT:** Allows a 0-10 VDC (J7-2) input or 2-10VDC (J7-14) input.

**Pins 1-2:** Allows a 0-20 mA (J7-2) input or 4-20mA (J7-14) input.

**Pins 2-3:** Not Used

**JP22** - Configures spare remote analog input resistance at connection J7.



*The microboard connection this jumper (JP22) supports is used for the optional condenser refrigerant temperature sensor. The wiring harness for the sensor contains a resistor to supply proper resistance for this input. There should be no jumpers installed at this location.*

**OUT:** Jumper is out in order to allow proper signal for condenser refrigerant temperature sensor. Allows a 0-10 VDC (J7-4) input or 2-10 VDC (J7-16) input.

**Pins 1-2:** Allows a 0-20 mA (J7-4) input or 4-20mA (J7-16) input.

**Pins 2-3:** Not Used

**JP23** - Configures proper input type for remote devices to adjust current limit setpoint remotely (J22). Configures analog input for 0-10 VDC, 2-10 VDC, 0-20 mA or 4-20 mA.

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

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

**Pins 2-3:** Not Used

**JP24** - Configures proper input type for remote devices to adjust leaving chilled liquid temperature setpoint remotely (J22). Configures analog input for 0-10 VDC, 2-10 VDC, 0-20 mA or 4-20 mA.

**OUT:** Allows a 0-10VDC OR 2-10VDC input on J22-3

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

**Pins 2-3:** Not Used

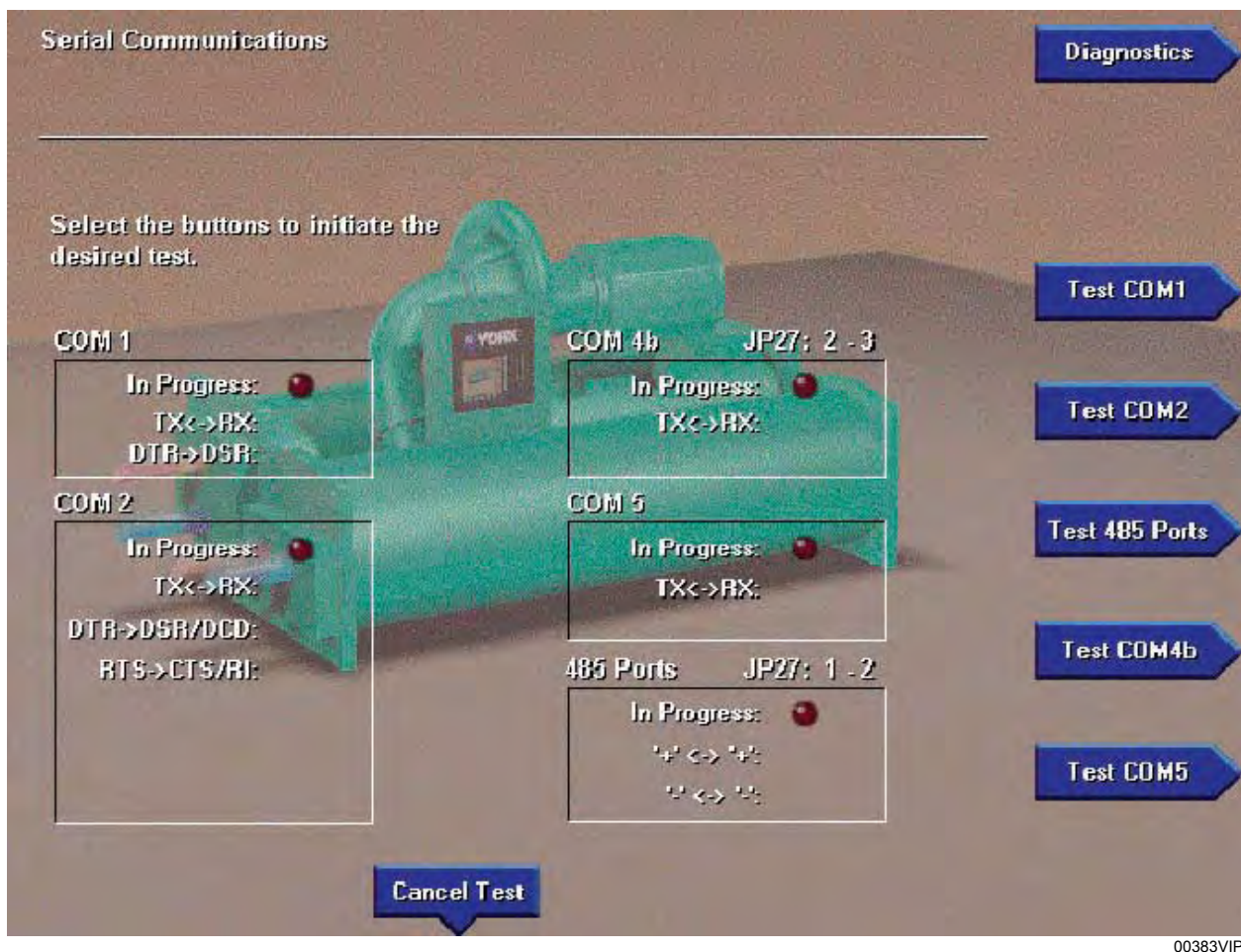
**JP27** - COM 4 serial communications data port. Configures COM 4 port to be either RS-485 for Multi-Unit Communications (COM 4A) or RS-232 for GPIC board (COM4B).

**Pins 1-2:** Enables serial data port 4A. Allows an RS-485 connection to Microboard J11 for Multi-Unit Communications.

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

## PROGRAM SWITCHES (SW1)

- 1 - Chiller Pressure Type – Selects high or low pressure chiller OptiView operation.  
**ON:** Low pressure operation  
**OFF:** High pressure operation
- 2 - Chilled Liquid Type – Must be set accordingly with the type of chilled liquid utilized by the chiller.  
**ON:** Brine - Leaving chilled liquid setpoint range is 10° - 70°F.  
**OFF:** Water - Leaving chilled liquid setpoint range is 38° - 70°F (36° - 70°F with Smart Freeze enabled).
- 3 - Diagnostics - Enables or disables advanced OptiView panel component diagnostics.  
**ON:** Enables advanced diagnostics. Disables normal chiller operation  
**OFF:** Disables advanced diagnostics. Enables normal chiller operation
- 4 - Not Used



**FIGURE 22 - SERIAL DATA PORT DIAGNOSTIC TEST SCREEN**

### SERIAL DATA PORT DIAGNOSTIC TEST

This diagnostic test is used to verify correct operation of the serial data communications ports. There is a test for each of the five ports as follows:

- COM 1, 2 and 4B (RS-232) – Each of these ports are tested by transmitting serial test data from outputs to inputs of each port. The transmit and receive functions as well as the control lines are tested.
- COM 3 and 4A (RS-485) – These ports are tested by transmitting serial test data from one RS-485 port to another.
- COM 5 (opto-coupled) – This port 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 func-

tioning properly. Otherwise, “FAIL” is displayed, indicating the serial port is defective and the microboard requires replacement.

### Procedure

1. Locate DIP switch #3 on the microboard. Place the switch in the “ON” position to enable diagnostics. The microboard will perform a watchdog reboot and the diagnostic screen will be displayed. Select the serial data communication port test.
2. For each serial port test, the service technician must create and install a wire loop-back connection for each port with connections described in Table 4. Use small gauge wire to fabricate the loop-back connections. Failure to install the loop-back connection or configure the microboard program jumper as noted will result in a FAIL outcome for the test.

3. After connecting the loop-back connections, press the appropriate key to initiate the desired test. An LED will illuminate, indicating the test is in progress. Test data is sent from an output to an input as described below.

**COM 1** – Two tests are performed.

- Test data is sent from TX (J2-4) to RX (J2-3) at 9600 Baud
- DTR (J2-5) is set to a Logic High level and read at DSR (J2-2).

If any test fails, COM 1 tests are terminated.

**COM 2** – Three tests are performed.

- Test data is sent from TX (J13-5) to RX (J13-3) at 19200 Baud.
- DTR (J13-7) is set to a Logic High and read at DSR (J13-2) & DCD (J13-1).
- RTS (J13-4) is set to a Logic High and read at CTS (J13-6) & R1 (J13-8).

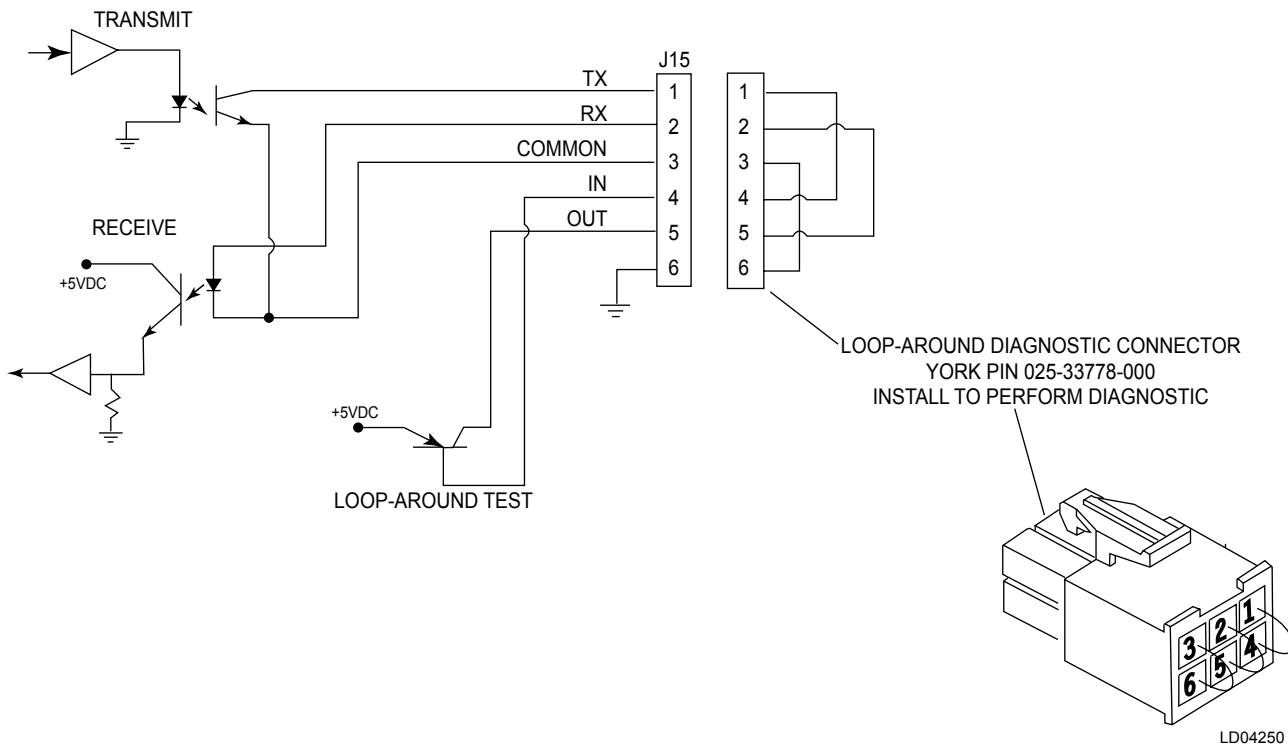
If any test fails, all COM 2 tests are terminated.

4

**TABLE 4 - SERIAL DATA PORT DIAGNOSTIC TEST CONNECTIONS**

SERIAL PORT	FROM	TO	JUMPER
COM1	J2-4 (TX) J2-5 (DTR)	J2-3 (RX) J2-2 (DSR)	N/A
COM2	J13-5 (TX) J13-7 (DTR) J13-4 (RTS)	J13-3 (RX) J13-1 (DCD) & J13-2 (DSR) J13-6 (CTS) & J13-8 (RI)	N/A
COM3 & 4A	J12-3 (+) J12-2 (-)	J11-3 (+) J11-2 (-)	JP27 Must be installed on pins 1&2.
COM 4B	J2-7 (GTX)	J2-6 (GRX)	JP27 Must be installed on pins 2&3.
COM 5*	J15-1 (TX) J15-2 (RX) J15-3 (COMMON)	J15-4 J15-5 J15-6	N/A

\*Make individual wire connections or use loop-around diagnostic connector, YORK part number 025-33778-000



**FIGURE 23 - MICROBOARD COM-5 SERIAL DATA PORT**

**COM 3 & 4A** – Two tests are performed.

- Test data is sent from COM 3 RS-485 port to COM 4A RS-485 Port at 19200 Baud.
- Test data is then sent from COM 4A to COM 3 at 19200 Baud.

If either test fails, RS-485 tests are terminated.

**COM 4B** – One test is performed.

- Test data is sent from GTX (J2-7) to GRX (J2-6) at 19200 Baud.

**COM 5** – One test is performed.

- 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/+5 VDC pulses from J15-5 to RX (J15-2) input.

4. At the completion of each test, if the data received matches the data sent, the serial data port is operating properly and "PASS" is displayed. If the serial data is not received or does not match, "FAIL" is displayed, indicating the serial data port is not functioning properly.

5. Once testing is complete, open the OptiView cabinet door and place DIP switch 3 in the "OFF" position. The microboard will perform a watchdog reboot and return to the normal operation mode.

**Microboard Service**



**Follow all static electricity precautions when replacing the microboard and components. Component damage from static electricity may occur if these precautions are not followed.**

The OptiView Control Center microboard, program card, and several components are available for replacement. Refer to the *Renewal Parts - OptiView Control Center Retrofit Kit Manual (Form 160.10-RP1)* for a description of available components and part numbers.

Prior to replacing the program flash card, BIOS EPROM, or BRAM, check the version currently installed in the OptiView panel. Compare the installed version with the replacement version for compatibility purposes. The installed versions of these items can be found on the component or on the OptiView diagnostic display screen via the Setup and Setpoints screens.

If components are replaced under the warranty, they must be returned following the warranty return procedure outlined in the *Renewal Parts - OptiView Control Center Retrofit Kit Manual (Form 160.10-RP1)*

### Operating Program Download

The chiller operating program is downloaded at microboard interface connector U33. This connector must be protected by a cover when a program is not being downloaded to keep dirt from entering the connector.

Before downloading the operating program, be sure the software version is the most current version available. The software version loaded into the microboard can be verified on the Diagnostics screen. Refer to *Renewal Parts - OptiView Control Center Retrofit Kit Manual (Form 160.10-RP1)* for the program card part number.

There are three steps involved in re-programming the operating software: erase, program, and verification. Once this automated procedure has begun, the process cannot be manually terminated. The program being downloaded must be verified as the correct version, otherwise the chiller will not function until the proper program is installed. The software version is adhered to the front of the program card for identification. Use the following procedure for downloading operating software.

1. Disconnect and lockout the OptiView Control Center power supply. Use proper lockout/tagout procedure.
2. Open the OptiView panel door and locate jumper JP6. Position the jumper to pins 2 and 3 (left side pins). This allows boot-up from the program card.
3. Locate and remove the protective cover from the connector at location U33.
4. Remove the program card from the protective sleeve. Place the card write-protect switch in the "WRITE PROTECT" position. Insert the program card into the connector. The label must face up when inserting the card.
5. Reconnect power to the OptiView panel. The LCD will display a white screen with the message "Flash Checksum Test" and the 7-segment LED (U22) on the microboard will display "CH". This indicates the microboard is performing a check-

sum test, which ensures the integrity of the program card before downloading the program. If the program card passes, the OptiView Flash Programmer Screen is displayed on the LCD.

6. Push the "START" key to begin the program download. A dialog box will appear to confirm the flash re-program.
7. Use the (▶) cursor key to scroll to YES.
8. Press (✓) key. The following steps will be performed:
  - A. Erasing. During this procedure, the program in the microboard flash memory will be erased. A green bar displays the progress of this procedure. The red LED next to this bar illuminates to indicate the procedure is in progress. The microboard LED readout displays "Er" during this process.
  - B. Programming. During this procedure, the program in the Program Card is downloaded into the Microboard Flash memory. A green bar displays the progress of this procedure. The red LED next to this bar illuminates to indicate the procedure is in progress. The microboard LED readout displays "Pr" during this process.
  - C. Verifying. During this procedure, a checksum test is performed on the new program in the microboard flash memory. A green bar displays the progress of this procedure. The red LED next to this bar illuminates to indicate the procedure is in progress. The microboard LED readout displays "CH" during this process.

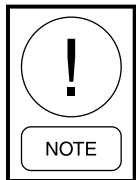
If re-programming is successful, "Flash Has Been Successfully Programmed" is displayed on the screen and "OPERATION SUCCESSFUL" is displayed in the Status box. A message in the status box will indicate if a step failed.

9. Disconnect power from OptiView Control Center.
10. Remove the program card from microboard connector U33 and replace the protective sleeve on the card and microboard connector.
11. Reposition microboard program jumper JP6 to pins 1 & 2 (right side pins).

12. Connect power to OptiView Control Center. Ensure the new operating program boots up properly.

### Microboard Replacement

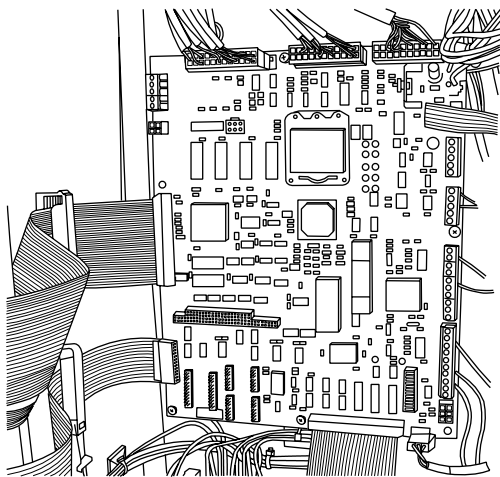
Prior to replacing the microboard, use a voltmeter to test the DC voltages from the microboard power supply. This will ensure the problem is with the microboard and not the power supply. Refer to *SECTION 7 – OPTIVIEW POWER SUPPLY* for the power supply test procedure.



**The 1730 microboard is shown below for illustration purposes; 2430 microboard is similar.**

When replacing the microboard, the most current version of operating software is supplied with the board. The BRAM is not supplied and must be reused on the replacement board. Refer to *Renewal Parts - OptiView Control Center Retrofit Kit Manual (Form 160.10-RP1)* for the microboard part number. Use the following procedure for microboard replacement.

1. Disconnect and lockout the OptiView Control Center power supply. Use proper lockout/tagout procedures.
2. Open the OptiView panel cabinet door. Carefully disconnect all microboard connections from the microboard, labelling wires and connectors as necessary. Follow all static electricity precautions.

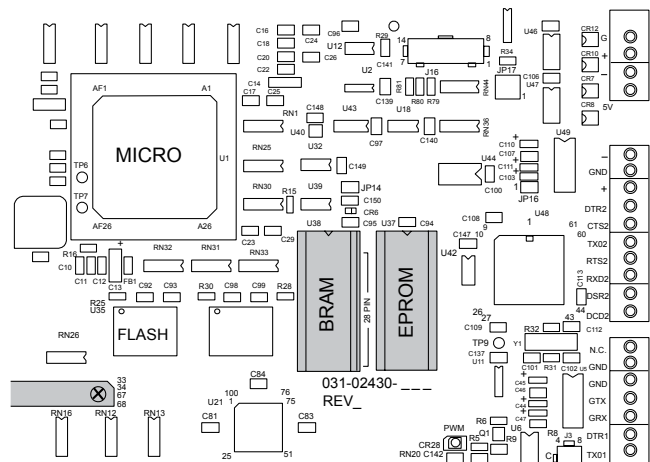


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**FIGURE 24 - OPTIVIEW MICROBOARD**

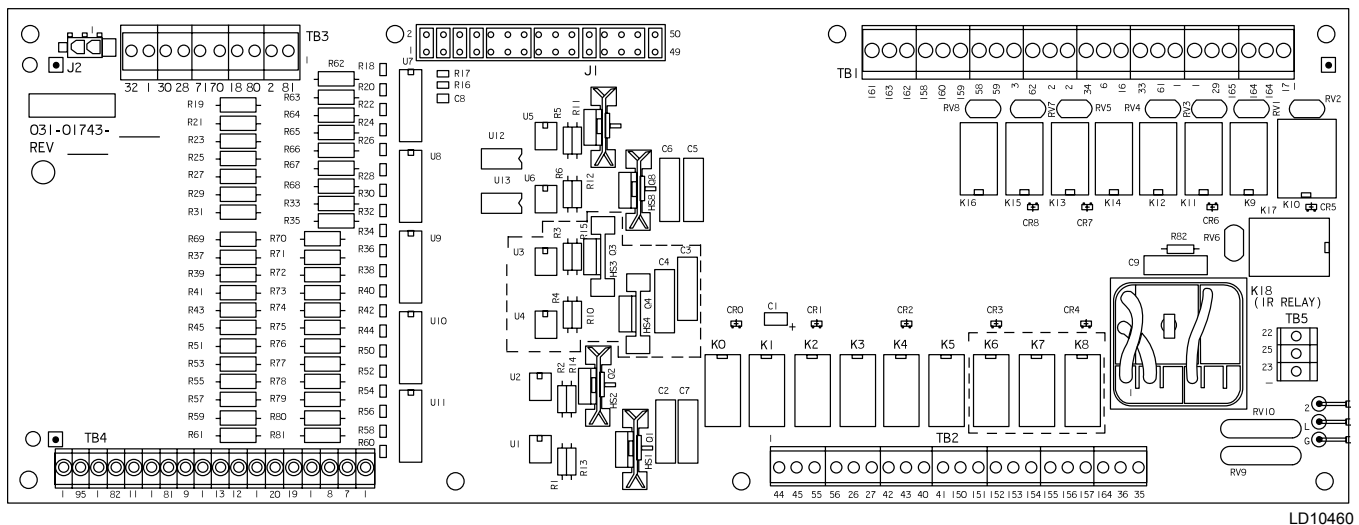
Carefully remove the BRAM from the microboard. Immediately install the BRAM on the replacement microboard. If the BRAM fails and replacement is necessary, all calibrations, setpoints and sales order data must be reprogrammed.

3. Remove the retaining screws securing the microboard to the rear wall plate mounting points in the OptiView panel cabinet.
4. Align the replacement microboard with the mounting points on the rear wall plate in the OptiView cabinet. Install the retaining screws which secure the microboard to the OptiView cabinet. Do not overtighten the screws or damage to the microboard may occur.
5. Connect all wires and connectors to the replacement microboard. Close the OptiView panel cabinet door.
6. Connect power to the OptiView Control Center. Check that the OptiView Control Center boot-up procedure is performed properly, then proceed with chiller operation.



**FIGURE 25 - MICROBOARD BRAM AND EPROM**

## SECTION 5 - INPUT/OUTPUT BOARD



**FIGURE 26 - I/O BOARD**

### INPUT/OUTPUT BOARD DESCRIPTION

The OptiView Input/Output (I/O) board is located directly below the microboard in the control center cabinet. The I/O board conditions the digital inputs to the microboard and digital outputs from the microboard for application to components and devices. The microboard uses several types of relays, opto-couplers, and triacs to condition input and output signals for the OptiView Control Center. The left side of the I/O Board conditions the digital inputs; the right side conditions the digital outputs.

The following paragraphs describe how the input and output signals are converted into signals for use by the microboard and other components.

### INPUT/OUTPUT BOARD OPERATION

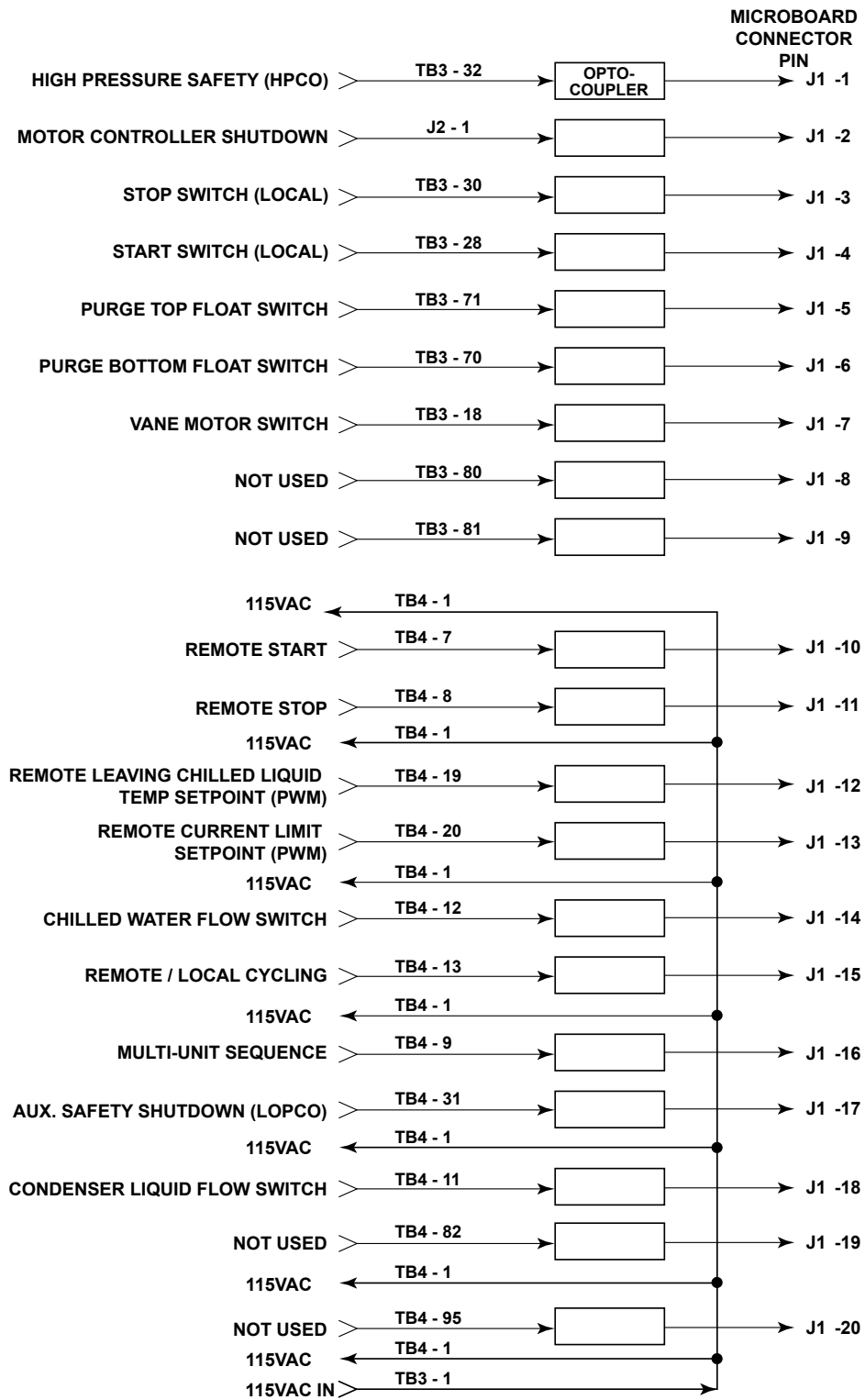
#### Digital Inputs

Digital inputs are “on/off” signals to the microboard from external relay and switch contacts, such as flow switches, the compressor motor switch, and cycling/safety devices. The microprocessor reads the state of these contacts and reacts according to the operating program instructions. The contact voltage to the I/O board is 115 VAC when closed and 0 VAC when open. The I/O Board converts the 115 VAC/0 VAC contact voltages to 0 VDC/+5 VDC logic level inputs for the microboard, as the microboard would be damaged by 115 VAC. Individual opto-coupler circuits perform the conversion for each of the twenty digital inputs, isolating the microboard from 115 VAC. When the input is 115 VAC, the output of the opto-coupler will be 0 VDC; when the input is 0 VAC, the output will be +5 VDC.

Digital inputs that require a 115 VAC supply are connected to terminal strip “TB4” on the I/O board. These inputs are in the form of dry contacts connected as shown in Fig.27. The 115 VAC 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 27*.

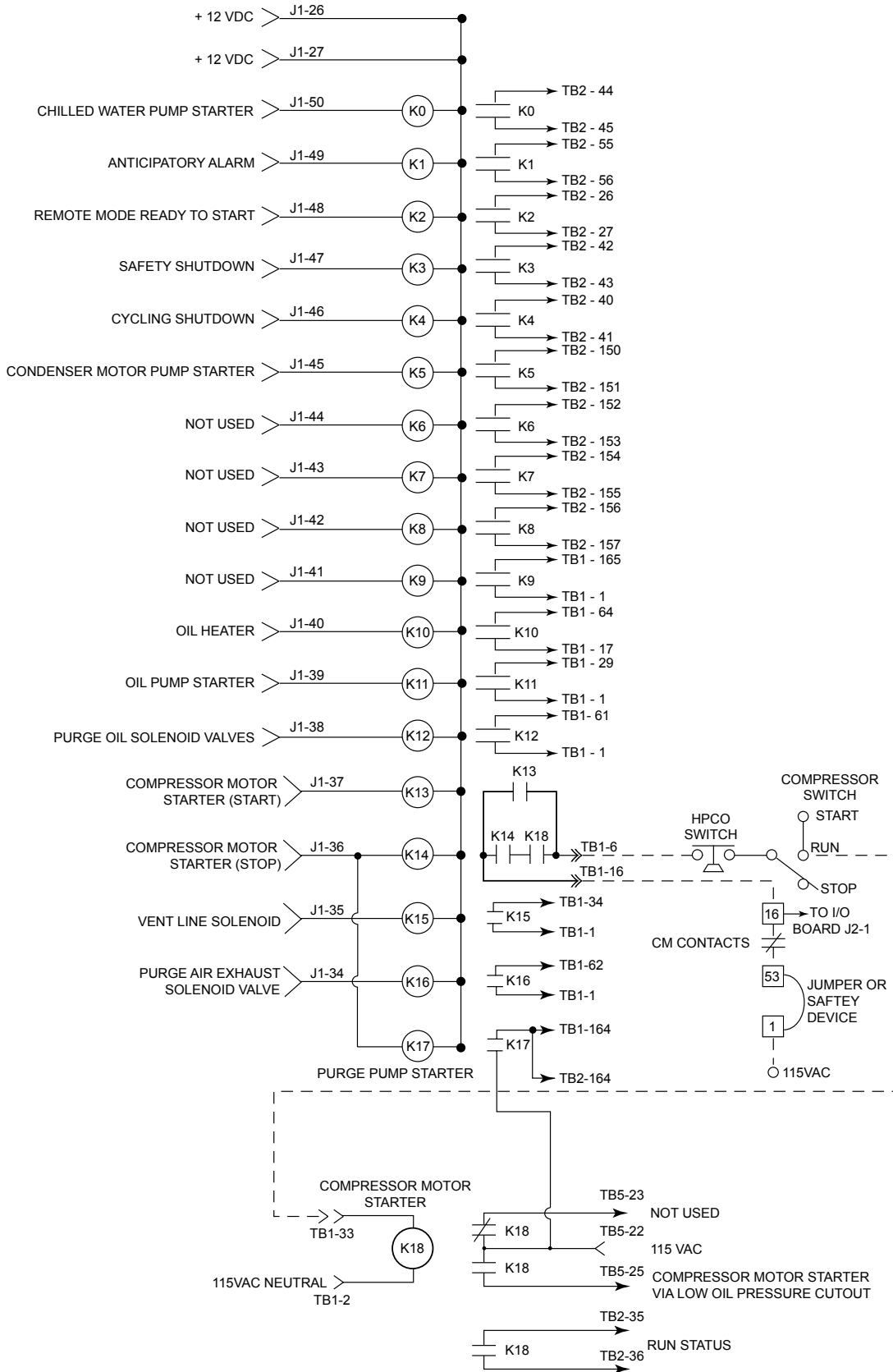
#### Digital Outputs

Digital outputs are “on/off” signals from the microboard that control the oil pump and heater, solenoid valves, system relays and provide the chiller operating status to external devices such as the purge unit. Following the operating program instructions, the microboard energizes and de-energizes these devices. Since the coils of these devices operate on 115 VAC, the devices cannot be directly connected to the microboard. The digital output portion of the I/O board contains +12 VDC coil relays which are driven by the microboard’s logic level outputs. The contacts of these +12 VDC relays control current to the external 115 VAC coil devices. On the I/O Board, one side of each relay coil is connected to +12 VDC 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 the logic-low voltage level (ground potential). The DC voltage at the appropriate input pin at J19 will be a logic-high (greater than +10 VDC) when the microboard is commanding a relay to de-energize; logic-low (less than +1 VDC) when commanding a relay to energize.



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FIGURE 27 - DIGITAL INPUTS



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FIGURE 28 - DIGITAL OUTPUTS

Relay K18 differs from all other I/O board relays as this relay contains a 115 VAC coil. K18 provides the start/stop signal to the compressor motor starter and provides the compressor “RUN” status to remote devices (fig. 28). Relay K18 is controlled by DC relays K13 (start) and K14 (stop).

To start the compressor motor, the microboard energizes K13 and K14 simultaneously. 115 VAC connected 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 the contacts of K14, and the “holding” contacts of K18. To stop the compressor motor, the microboard de-energizes K14. Once K18 is energized, K18 cannot be re-energized until K13 is energized. Relay K13 is prevented from re-energizing until a controlled shutdown has occurred and another chiller start sequence has been initiated.

The holding contact of K18, along with de-energizing relay K13, creates a circuit that prevents relay K18 from chattering due to sags in line power. K18 will de-energize if line power sags low enough.

Certain conditions outside of the I/O Board are required to energize relay K18. The 115 VAC will be supplied at TB1-16 only if conditions are as follows:

- The circuit between terminals 1 and 53, terminal block TB6 (located to the right of the I/O board), is closed.
- The high pressure cutout safety switch (HPCO), is closed.
- The motor controller contacts “CM” are closed. The “CM” contacts are located on the CM-2 board (relay K1) for electromechanical starter applications. The contacts are located on the solid state starter logic board (relay K1) for SSS applications or a relay mounted on the variable speed drive logic board on VSD applications.
- The compressor motor switch is in the “RUN” position.

### Digital Output Relay Operation

Under operating program control, the I/O board relays are energized and de-energized producing contact operation as described for each relay in the following paragraphs. The contact rating for each of these relays is 5 amps resistive or 2 amps inductive at 250 VAC.

### ***K0 - Chilled Water Pump Starter (TB2-44/45)***

Dry closure contacts-style relay. When the chiller is started, the contacts close thirteen (13) seconds after the start of “System Prelube”. Normally, the contacts open simultaneously with the completion of “System Coastdown” with the following exceptions:

- If a “LEAVING CHILLED LIQUID - LOW TEMPERATURE” cycling shutdown occurs, the contacts remain closed for the duration of the shutdown or until the compressor motor switch is placed in the “Stop/Reset” (O) position.
- If chilled liquid pump control is set to “Enhanced” operation, the contacts do not open at the completion off “System Coastdown” if the chiller is shutdown due to one of the cycling conditions associated with this configuration (see Section 3A or 3B for enhanced chilled liquid pump operation description) The contacts will remain closed for the duration of the shutdown or until the compressor motor switch is placed in the “Stop/Reset” (O) position.

### ***K1 - Anticipatory Alarm (TB2-55/56)***

Dry closure contacts style relay. Contacts close when one of the warning messages listed below is displayed. The contacts automatically open when the warning condition is no longer present.

- Real Time Clock Failure
- Condenser-High Pressure limit
- Evaporator-Low Pressure Limit
- Vanes Uncalibrated - Fixed Speed
- Vanes Uncalibrated
- External I/O - Serial Communications
- Harmonic Filter-Operation Inhibited
- Harmonic Filter-Data Loss
- Harmonic Filter-Input Frequency – Out Of Range
- Surge Detected – Excess Surge Limit

On the following warnings, 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” or higher access level.

- Oil – Low Differential Pressure
- Setpoint Override
- Excess Purge
- Purge – High Pressure
- Purge – Float Switch Error
- Excess Surge Detected
- Purge Canister #1 Full
- Condenser Transducer Error
- Evaporator Transducer Error

### **K2 - Remote Mode Ready to Start (TB2-26/27)**

This relay is only operational in Digital, Analog, or ISN Remote modes. Dry closure contacts close to signal a remote device that the chiller will start upon receiving a remote “START” signal. K2 relay contacts open simultaneously with any cycling or safety shutdown or anytime the compressor motor switch is placed in the “Stop/Reset” (O) position. On cycling shutdowns, the contacts will close when the cycling condition clears. On safety shutdowns, the contacts will be allowed to close after the safety condition clears and the compressor motor switch is placed in the “Stop/Reset” (O) position.

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

Dry closure status contacts-style relay. The contacts close simultaneously with a safety shutdown. The contacts remain closed until the safety condition clears and a manual reset is performed by placing the compressor motor switch in the “Stop/Reset” (O) position.

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

Dry closure status contacts-style relay. The contacts close simultaneously with a cycling shutdown. The contacts remain closed until the cycling condition clears.

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

Dry closure contacts-style relay. K5 contacts close simultaneously with beginning of “System Run”. The contacts open simultaneously with the beginning of “System Coastdown”, unless the chiller is equipped with the Mod “B” Solid State Starter. On Mod “B” Solid State Starter applications, the contacts remain closed at shutdown until all SCR heatsink temperatures are less than 105.0°F (45.6°C) or 45 minutes, whichever occurs first.

If 115 VAC is required to operate the condenser pump motor starter, a wire must be connected from TB5-22 to I/O board TB2-150. I/O board TB2-151 must then be field wired to the condenser pump motor starter.

K6-K9 - Not used for this application.

### **K10 - Oil Heater (TB1-64/17)**

Dry closure contacts-style relay. Contacts will close when sump oil temperature falls 2.0 °F (1.1 °C) below the oil temperature setpoint, as programmed in the OptiView software. The relay will open when the oil temperature rises 2.0 °F (1.1 °C) above the oil temperature setpoint.

### **K11 - Oil Pump Starter (TB1-29/1)**

In automatic oil pump operation, these relay contacts close, supplying current to the oil pump starter when the “System Prelube” is initiated. These contacts open at completion of “System Coastdown”. In manual oil pump operation, the contacts close for the duration of manual pump operation, which is ten (10) minutes.

As a safety precaution, anytime the chiller is stopped or in “System Coastdown” and a motor current value greater than 15% FLA is detected, the relay contacts close until current is no longer detected. A complete system coastdown will then be performed.

**K12 - Purge Oil Solenoid (TB1-61)**

K12 controls the purge oil solenoid valves for chillers equipped with a TurboGuard II purge unit. K12 is energized when both top and bottom purge float switches close (indicating the purge tank is empty), initiating a “fill” cycle. The contacts remain closed until both purge float switches open, indicating the purge tank is full. The contacts for K12 will then open to begin a “drain” cycle.

**K13 - Compressor Motor Start (TB1-6/16)**

Contacts close coincident with the beginning of “System Run”. The contacts remain closed for 0.2 seconds and then open.

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

Contacts close coincident with the beginning of “System Run”. The contacts remain closed as long as the system is running and will open when the chiller begins a “System Coastdown”.

**K15 - Vent Line Solenoid (TB1-34)**

The action relay K15 takes to open or close the vent line solenoid valve is controlled from the Compressor screen of the OptiView operating program (Vent Line Solenoid Off State). The contacts will close or open five (5) minutes after the compressor motor starts, energizing or de-energizing (opening, in either case) the vent line solenoid valve. The contacts open or close, as programmed, to close the valve, simultaneously with a “System Coastdown”.

The vent line off state for Trane chillers should be programmed as “energized”, as these valves are normally open.

**K16 - Purge Air Exhaust Solenoid (TB1-62)**

K16 is utilized when the chiller is equipped with a TurboGuard II purge unit. When the purge tank pressure increases above 90.0 PSIA (621 kPa), the relay contacts close, and the purge air exhaust solenoid valve is energized. The contacts open when the pressure decreases below 80.0 PSIA(552 kPa).

**K17 - Purge Oil Pump Starter (TB1-164)**

The contacts of this relay operate simultaneously with K14. This relay controls purge oil pump operation for chillers equipped with a TurboGuard II purge unit.

**K18 - Compressor Motor Starter (TB5-22/25) Run Status (TB2-35/36)**

The contacts for K18 operate the same as K14.

**Triacs**

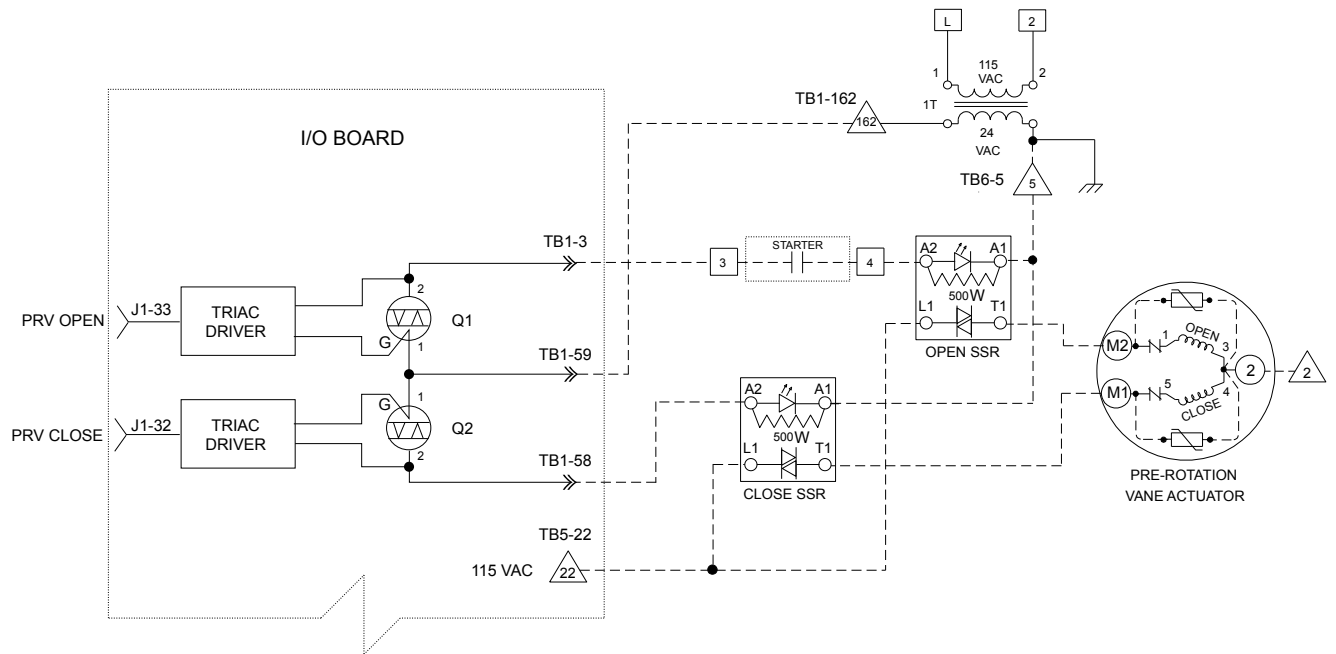
Under operating program control, the microboard switches I/O board triacs on and off by applying control signals to the respective triac driver. The triac driver is an opto-coupler device used to isolate the microboard low voltage circuits from the higher actuator voltages. To switch the triac on, the microboard drives the triac driver input to logic-low (less than +1 VDC) level. The triac driver responds by using the triac gate (close signal) to short terminal 1 to terminal 2. To switch the triac off, the microboard opens the input to the triac driver and allows the input to pull up to +12 VDC. The triac driver responds by opening the short from triac gate to triac terminal 2. Refer to Figure 29.

A voltmeter can be used to determine if a Triac is switched on or off by measuring voltage across triac terminal 1 to terminal 2. When the triac is switched “OFF”, the voltage will be approximately 24 VAC. When the triac is switched “ON”, voltage will be below 1.0 VAC.

The I/O board triacs are used to control the solid state relays (SSR) for the pre-rotation vanes actuator motor (ref. Fig. 29). The PRV actuator has an “open” winding and a “close” winding; each winding is controlled by a separate SSR. Current flowing through the open or close winding will cause the actuator shaft to rotate in the respective direction.

When a triac is switched on, 24 VAC is supplied to the SSR, closing the relay control circuit. This supplies 115 VAC to the appropriate PRV actuator winding (open or close). 500 ohm resistors are installed across the control terminals of the SSRs. These resistors are necessary to create enough current at the I/O board triac to allow the triac terminals to stay closed.

The 115VAC power source for the PRV actuator is TB1-17A, which is connected to TB5-22. The PRV actuator power supply is fused at 2FU (15A fuse), located on the right inside wall of the OptiView cabinet.



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FIGURE 29 - PRV ACTUATOR TRIACS



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**FIGURE 30 - DIGITAL I/O DIAGNOSTIC SCREEN**

## INPUT/OUTPUT BOARD SERVICE

The input/output board components are not serviceable. If a component on the input/output board fails, the board must be replaced. Refer to the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for the input/output board part number.

If the I/O board or other component is replaced under warranty, the board or component must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*

## Input/Output Board Diagnostics

There are several methods available to troubleshoot the digital inputs and outputs of the I/O board using the OptiView software. If troubleshooting using the OptiView software is unsuccessful, a voltmeter can be used to test the I/O board and connected components to locate the source of the malfunction.

While the chiller is running (or stopped), the internal digital I/O board diagnostic screens can be accessed from the Setpoints - Setup screen on the OptiView display. This method of diagnostics is useful by displaying the state of the digital input/output(s) while the chiller is running, helping the technician to determine if the malfunction is at the I/O board or other component. The state of the digital outputs cannot be manually controlled from this screen. Refer to *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)* for additional information on these screens.

The OptiView software also contains advanced diagnostics which allow the service technician to manually control the digital outputs while the chiller is stopped. This feature allows the technician to switch an output on or off to help determine whether the malfunction is at the I/O board or the component. The state of digital inputs are also monitored in advanced diagnostics.

**TABLE 5 - I/O BOARD DIGITAL INPUTS**

Digital Input	J1 Connector Terminal	Input Identification	Terminal Block Connection
High Pressure Cutout	J1-1	TB# 32	TB3-32
Motor Controller Contacts (CM)	J1-2	TB# J2-1	J2-1
Compressor Stop Switch (Local)	J1-3	TB# 30	TB3-30
Compressor Start Switch (Local)	J1-4	TB# 28	TB3-28
Purge Top Float Switch (TGII)	J1-5	TB# 71	TB3-71
Purge Bottom Float Switch (TGII)	J1-6	TB# 70	TB3-70
Vane Motor Switch	J1-7	TB# 18	TB3-18
Not Used	J1-8	TB# 80	TB3-80
Not Used	J1-9	TB# 81	TB3-81
Remote Start	J1-10	TB# 7	TB4-7
Remote Stop	J1-11	TB# 8	TB4-8
Remote Leaving Chilled Liquid Setpoint (PWM)	J1-12	TB# 19	TB4-19
Remote Current Limit Setpoint (PWM)	J1-13	TB# 20	TB4-20
Chilled Liquid Flow Switch	J1-14	TB# 12	TB4-12
Remote/Local Cycling Devices	J1-15	TB# 13	TB4-13
Multi-Unit Sequence	J1-16	TB# 9	TB4-9
Auxiliary Safety Shutdown (Low Oil Pressure Cutout)	J1-17	TB# 31	TB4-31
Condenser Water Flow Switch	J1-18	TB# 11	TB4-11
Not Used	J1-19	TB# 82	TB4-82
Not Used	J1-20	TB# 95	TB4-95

In order for the program software to allow the advanced diagnostics to function, the jumper or device installed between the motor control connection at TB6-1 and TB6-53 must be removed or disconnected. This fail-safe prevents possibility of the digital outputs being controlled while the chiller motor is operating.



***Shock Hazard! Exercise extreme care working while voltage is present. Take all necessary pre-cautions when working with voltage. Lock-out and tag-out the panel power source, as required.***

Use the following procedures to test the I/O board digital inputs, outputs, and triacs with the advanced diagnostics feature.

1. Disconnect the 115 VAC power source from the OptiView panel.
2. Remove the jumper between TB6-1 and TB6-53 or disconnect the wires at TB6-53.
3. Locate the diagnostic DIP switch (#3 or #4) on the microboard. Place the switch in the “ON” position to enable diagnostics.

4. Reconnect power to the OptiView panel. The panel will boot-up and display the Main Diagnostics screen. Press the “Digital I/O Test” key to advance to the I/O board test screen.

The I/O board test screen displays all microboard digital inputs and outputs and their operating states, as the I/O board interprets them. A red LED next to an input or output name indicates the input or output is enabled.

The position of microboard jumper and DIP switch inputs are displayed under the digital input column.

### Digital Input Testing

The digital inputs on the diagnostic screen are listed according to the terminal number on the I/O board, indicated by “TB#”. Use the OptiView wiring diagrams and refer to *Table 5* to reference the function or component that corresponds with each input.

**TABLE 6 - I/O BOARD RELAY DIGITAL OUTPUTS**

Relay Digital Output	J1 Connector Terminal	Relay Identification	Terminal Block Connection
+ 12 VDC Supply Voltage	J1-26, J1-27	N/A	N/A
Chilled Liquid Pump Starter	J1-50	K0	TB2-44, TB2-45
Anticipatory Alarm	J1-49	K1	TB2-55, TB2-56
Remote Mode Ready to Start	J1-48	K2	TB2-26, TB2-27
Safety Shutdown	J1-47	K3	TB2-42, TB2-43
Cycling Shutdown	J1-46	K4	TB2-40, TB2-41
Condenser Liquid Pump Starter	J1-45	K5	TB2-150, TB2-151
Not Used	J1-44	K6	TB2-152, TB2-153
Not Used	J1-43	K7	TB2-154, TB2-155
Not Used	J1-42	K8	TB2-156, TB2-157
Not Used	J1-41	K9	TB1-165, TB1-1
External Oil Heater	J1-40	K10	TB1-64, TB1-17
Oil Pump	J1-39	K11	TB1-1, TB1-29
Purge Oil Solenoid Valves (TGII only)	J1-38	K12	TB1-61, TB1-1
Compressor Motor Start	J1-37	K13	TB1-6, TB1-16
Compressor Motor Stop (TGII Purge Pump)	J1-36	K14 (K17)	TB1-6, TB1-16 (TB2-164)
Vent Line Solenoid (Not Applicable)	J1-35	K15	TB1-34, TB1-1
Purge Air Exhaust Solenoid Valve (TGII only)	J1-34	K16	TB1-62, TB1-1

- Using a voltmeter, check voltage at the I/O board terminals for the input in question. Compare the voltage indicated at the terminals with the following:
  - With 115 VAC applied to a particular I/O Board Digital Input, the applicable LED should be illuminated.
  - With 0 VAC applied to a particular I/O Board Digital Input, the applicable LED should be extinguished.

If the digital input tests fail to perform as described, proceed to the following steps. If a defective component is found during any of the following testing, replace the component as instructed. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for renewal parts. Retest the digital inputs to ensure the problem has been resolved.
- Verify the I/O board ribbon cable is properly connected. If the cable is connected securely, remove the cable and perform a continuity check between all terminals of the cable (I/O board J1 to microboard J19). If an open circuit is detected, replace the ribbon cable. Otherwise, reconnect the ribbon cable and proceed to next step.
- Measure the +5 VDC supply voltage to the I/O Board on I/O Board between J1-21 and J1-22. If the voltage is greater than 4.5 VDC, proceed to next step. If the voltage is less than 4.5 VDC, disconnect ribbon cable at I/O Board J1 and repeat the measurement at J1. If the reading is less than 4.5 VDC, replace the microboard. Reinstall the ribbon cable.
- Apply 115 VAC ( $\pm 10\%$ ) to the I/O board digital input that indicated improper operation and test the applicable I/O board voltage output at J1. The voltage should be at logic low level ( $<1.0$  VDC). If the voltage indicated is more than 1.0 VDC, replace the I/O board. If the voltage is at a logic low level, the applicable LED should be illuminated. Replace the microboard if the LED is not illuminated.
- Remove voltage (0 VAC) from the I/O board digital input that indicated improper operation and test the applicable I/O board voltage output at J1. The voltage should be at a logic high level ( $>4.0$  VDC). If the voltage indicated is less than 4.0 VDC, replace the I/O Board. If the output is at a logic high level, the applicable LED should be extinguished. Replace the microboard if the LED is illuminated.

**TABLE 7 - I/O BOARD TRIAC DIGITAL OUTPUTS**

Triac Digital Output	J1 Connector Terminal	Triac Identification	Terminal Block Connection
+ 12 VDC Supply Voltage	J1-26, J1-27	N/A	N/A
Vane Actuator - Open	J1-33	Q1	TB1-3, TB1-59
Vane Actuator - Close	J1-32	Q2	TB1-58, TB1-59
Hot Gas Bypass Valve - Open (Optional Equipment)	J1-31	Q3	TB1-158, TB1-159
Hot Gas Bypass Valve - Close (Optional Equipment)	J1-30	Q4	TB1-160, TB1-159
Refrigerant Level Control Valve - Open (Not Supported)	J1-29	Q5	TB1-161, TB1-162
Refrigerant Level Control Valve - Close (Not Supported)	J1-28	Q6	TB1-163, TB1-162

- If all desired tests have been performed, disconnect power to the OptiView panel. Locate and place the diagnostic DIP switch (#3 or #4) in the "OFF" position.
- Install Motor Controller connection from TB6-1 to TB6-53. Reconnect power to OptiView panel.

### Digital Output Testing

The digital output column on the diagnostic screen includes the I/O board digital outputs and triacs. Refer to the *Triac Testing* for triac test procedures. The digital outputs on this screen are displayed according to the I/O board identification number, indicated by "K". Use the OptiView wiring diagrams and refer to *Table 6* to reference the function or component that corresponds with each output.

- Press the "Select Output" key. A selection arrow will appear on-screen adjacent to relay "K0". Use the ▲ and ▼ cursor keys to place the arrow beside the relay to be manually controlled.
  - Press the "Enable Output" key to enable the selected output. The LED adjacent to the selected output will illuminate and the relay will energize, closing the internal contacts.
  - Press the "Disable Output" key to disable the selected output. The LED adjacent to the selected output will extinguish and the relay will de-energize, opening the internal contacts.

If the LED does not illuminate or extinguish when the relay digital output is enabled or disabled, perform a keypad diagnostic test before proceeding. Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for test procedures.

- If the digital output(s) fails to perform as described, proceed to the following steps. If a defective component is found during any of the following tests, replace the component as instructed. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*. Retest the digital outputs to ensure the problem has been resolved.
- Verify the I/O board ribbon cable is connected securely. If the cable is connected properly, remove the cable and perform a continuity check between all terminals of the cable (I/O board J1 to microboard J19). If an open circuit is detected, replace ribbon cable. Otherwise, reconnect the ribbon cable and proceed to next step.
- Measure the +12 VDC supply voltage to the I/O Board on I/O Board between J1-26 (+12 VDC) and J1-25 (Ground). If voltage is above 11.0 VDC, proceed to next step. If voltage is below 11.0 VDC, disconnect ribbon cable at I/O Board J1 and repeat measurement at J1. If the indicated voltage remains below 11.0 VDC, replace the microboard.
- Using the advanced diagnostics screen, re-select the digital output in question of failure.
- Press the "Enable Output" key. The LED adjacent to the selected output will illuminate. Using a voltmeter, test the output voltage as follows:
  - The appropriate microboard output pin at J19 for the selected output should be below 1.0 VDC (logic low) and the relays contacts should be closed. If voltage is above 1.0 VDC, replace the microboard.

7. Press “Disable Output” key. The LED adjacent to the selected output will extinguish. Using a voltmeter, test the output voltage as follows:
  - The appropriate microboard output pin at J19 for the selected output will be above 11.0 VDC (logic high). With the output at logic high, the relay contacts will be open. If the contacts are closed, replace the I/O board.
  - If voltage is less than 11.0 VDC, 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 more than 100 ohms, replace the I/O board. If the resistance is less than 100 ohms, replace the microboard.
8. Once all tests have been performed, disconnect power to the OptiView panel. Place microboard DIP switch #4 in the “OFF” position.
9. Install Motor Controller connection from TB6-1 to TB6-53. Reconnect power to OptiView panel.

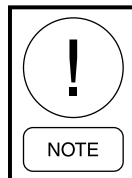
### Triac Testing

The operating state of triacs are listed under the digital output column on the advanced diagnostics screen. Triacs displayed on the OptiView diagnostic screen are identified with the letter “Q” and the triac I/O board number. Use the OptiView wiring diagrams and refer to *Table 7* to reference the function or component that corresponds with each triac output.

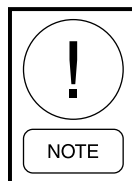
1. Press the “Select Output” key. A selection arrow will appear on-screen adjacent to relay “K0”. Use the ▲ and ▼ cursor keys to place the arrow beside to the triac (Q) to be manually controlled.
  - Press the “Enable Output” key to enable the selected output. The LED adjacent to the selected output will illuminate and the triac will energize.
  - Press the “Disable Output” key to disable the selected output. The LED adjacent to the selected output will extinguish and the triac will de-energize.

If the LED does not illuminate or extinguish when the triac output is enabled or disabled, perform a keypad diagnostic test before proceeding. Refer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for test procedures.

2. If the triac digital output(s) fails to perform as described, proceed to the following steps. If a defective component is found during any of the following tests, replace the component as instructed. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for renewal parts. Retest the digital outputs to ensure the problem has been resolved.
3. Verify the I/O board ribbon cable is connected securely. If the cable is connected properly, remove the cable and perform a continuity check between all terminals of the cable (I/O board J1 to microboard J19). If an open circuit is detected, replace ribbon cable. Otherwise, reconnect the ribbon cable and proceed to next step.
4. Measure the +12 VDC supply voltage to the I/O Board at the I/O Board between J1-26 (+12 VDC) and J1-25 (Gnd). If voltage is above 11.0 VDC, proceed to next step. If voltage is below 11.0 VDC, disconnect ribbon cable at I/O Board J1 and repeat measurement at J1. If the indicated voltage remains below 11.0 VDC, verify the power supply is providing the proper voltage to the microboard. Replace the microboard if the power supply is operating properly.
5. Using the advanced diagnostics screen, re-select the triac digital output in question of failure.



***The actuator/component that the triac controls must be installed and connected to the I/O board when testing triac operation. Testing will be inaccurate if the actuator is not connected.***



***Terminals TB6-3 and TB6-4 must be jumped if the Q1 (Vane Open) triac is being tested.***

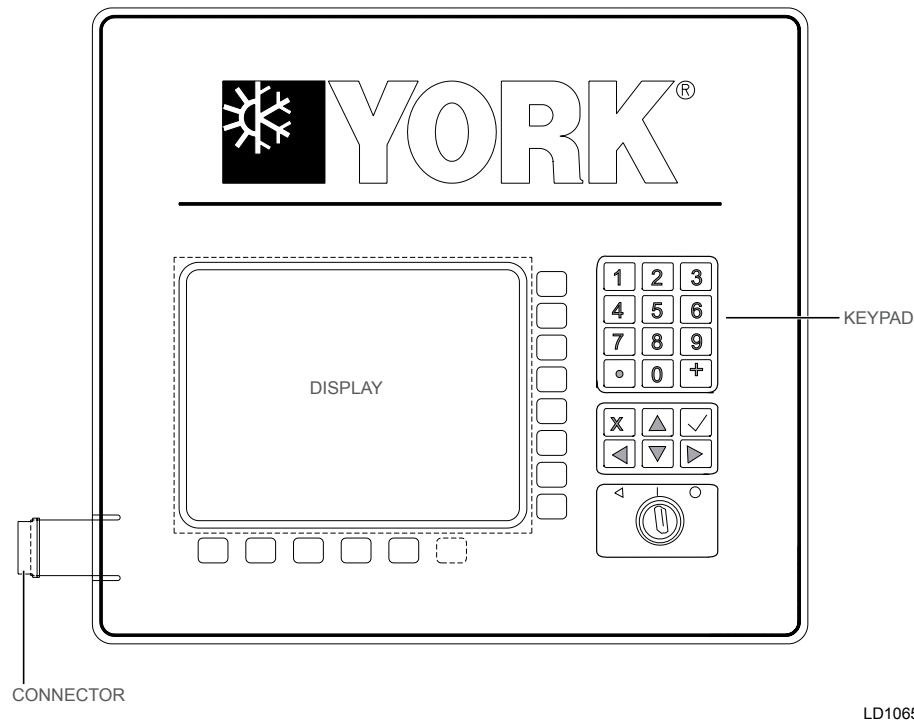
6. Press the “Enable Output” key. The LED adjacent to the selected output will illuminate. Using a voltmeter, test the output voltage as follows:
  - The appropriate microboard output pin at J19 for the selected output should be below 1.0 VDC (logic low) level. If voltage is more than 1.0 VDC, replace the microboard. With the output at a logic low level, the triac should be providing current at the device terminal block connections.
7. If voltage readings indicate the triac is de-energized, check the following components for proper operation:
  - Actuator controlled by triac.
  - Solid state relays (PRV actuator) - Terminals L1 and T1 will be closed when 24 VAC is applied across A1 and A2 and SSR LED will be illuminated.
  - 500 ohm resistors attached to PRV solid state relays (measure the resistance of each).

If the above components are functioning properly, replace the I/O board.

8. Press “Disable Output” key. The LED adjacent to the selected triac output will extinguish. Using a voltmeter, test the output voltage as follows:
  - The appropriate microboard output pin at J19 for the selected output will be above 11.0 VDC (logic high). With the output at logic high, the triac will be de-energized. If the triac remains energized, replace the I/O board.
  - If the voltage indicated is less than 11.0 VDC, 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 triac. If the resistance is more than 100 ohms, replace the I/O board. If the resistance is less than 100 ohms, replace the microboard.
9. Once all tests have been performed, disconnect power to the OptiView panel. Place microboard diagnostic DIP switch (#3 or #4) in the “OFF” position.
10. Install the jumper or safety device between TB6-1 and TB6-53. Reconnect power to OptiView panel.

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## SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD



**FIGURE 31 - OPTIVIEW KEYPAD**

### OPTIVIEW DISPLAY DESCRIPTION

The OptiView display is comprised of a 10.4 inch color Liquid Crystal Display, a Display Interface Board, and a Backlight Inverter Board.

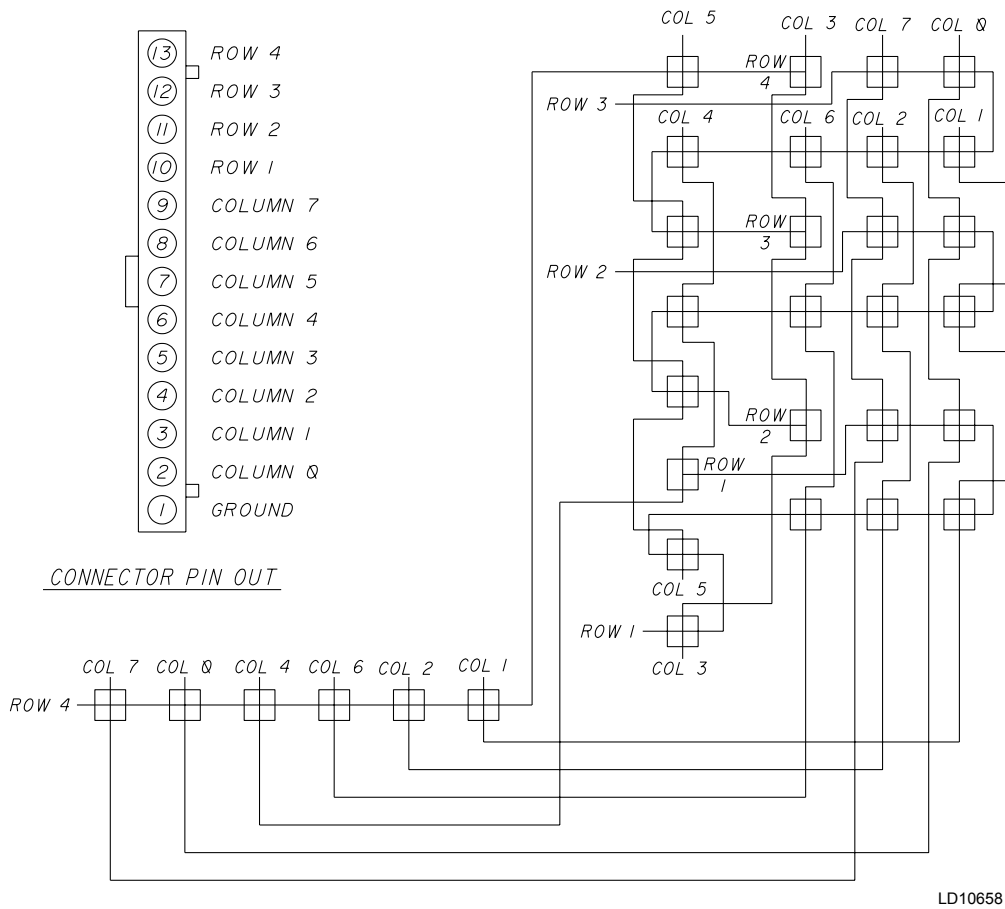
Detailed descriptions and service instructions are provided in the *OptiView Control Center Service Instructions Manual - Form 160.54-M1(1109)* in the following sections:

Form 160.54-M1(1109)	
Section 5	LCD Description LCD Diagnostics LCD Service
Section 6	Display Interface Board
Section 7	Display Backlight Inverter Board

### OPTIVIEW KEYPAD DESCRIPTION

The keypad is a touch-sensitive input device which allows the chiller 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 keypad is mounted to the front cabinet door of the OptiView panel with adhesive backing.

The top layer of the keypad contains embossed areas identifying the keys. Under each embossed key area is the intersection of two adjacent (stacked) conductors, arranged in a matrix of rows and columns and connected to the keypad connector (refer to *Figure 31*). Pressing the key creates contact and electrical continuity between the two conductors. The conductors are separated to avoid contact when the key area is not being pressed.



**FIGURE 32 - OPTIVIEW KEYPAD CONTACT LAYOUT**

The microboard operating program continuously scans the keypad to determine if a key is pressed. Beginning with row 1 and proceeding through all rows, the program sends a “logic low” (<1 VDC) signal to one row, a “logic high” (>4 VDC) signal to the other rows, and reads the keypad columns. A logic low signal in any column indicates a key in that column and row is pressed. For example, if column 3 is low at the same time row 4 is being driven low, then the microprocessor concludes the key at coordinate of row 4 and column 3 is pressed (continuity exists). This is the “1” key.

Since the coordinates of all keys are stored in the microboard’s operating program, the microboard can identify which key is at this coordinate and responds accordingly.

**OPTIVIEW KEYPAD SERVICE**

If the OptiView keypad malfunctions, the keypad must be replaced, as there are no serviceable parts in the

keypad. Refer to the *Renewal Parts - OptiView Control Center Retrofit Kit Manual (Form 160.10-RP1)* for the replacement keypad part number.

If components are replaced under the warranty, they must be returned following the warranty return procedure outlined in the *Renewal Parts - OptiView Control Center Retrofit Kit Manual (Form 160.10-RP1)*.

**OptiView Keypad Diagnostics**

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 or equal to 100 ohms. When a key is not being pressed, the contact resistance must be greater than one megohm. If the microboard is not responding to a pressed key, or if a closed key is detected when none are pressed, the contact resistance requirements are possibly not being met.

The OptiView operating software contains an advanced diagnostic feature for the keypad. The advanced diagnostics screen allows testing of the keypad contacts by indicating the contacts of the keys are open or closed. Use the following procedure to test the OptiView display with the advanced diagnostics feature.

1. Open the OptiView cabinet door and place the diagnostic DIP switch (#3 or #4) in the “ON” position to enable diagnostics. Close the OptiView cabinet door.
2. The OptiView software will perform a watchdog reset. Once the system re-boots, the advanced diagnostics screen will be displayed.
3. Press the “Keypad Test” key to advance to the keypad test screen.
4. Press each key on the OptiView panel keypad. Each time a key is pressed, an LED will illuminate, indicating the contacts for that particular key are functioning properly. The keypad, keypad ribbon cable, or microboard may be defective if the LED does not illuminate or is illuminated without a keypress.
5. Disconnect the keypad ribbon cable from the keypad. Locate the column pin and row pin for the malfunctioning key. Refer to *Figure 32*.
6. Insert the test leads for an ohmmeter into the column pin and row pin. The resistance while the key is not being pressed should be greater than one megohm.
7. Press and hold the keypad key. The resistance between the column pin and row pin should be less than 100 ohms. Replace the keypad if either of the tests fail. Refer to *Keypad Replacement* in this section.
8. If the keypad contact tests do not indicate a keypad malfunction, remove the keypad ribbon cable from the microboard. Using an ohmmeter, test for continuity between each of the cable pins (keypad to microboard). If an open circuit exists, replace the ribbon cable.
9. If the ribbon cable test does not indicate an open circuit, the microboard is the likely cause of the keypad malfunction.

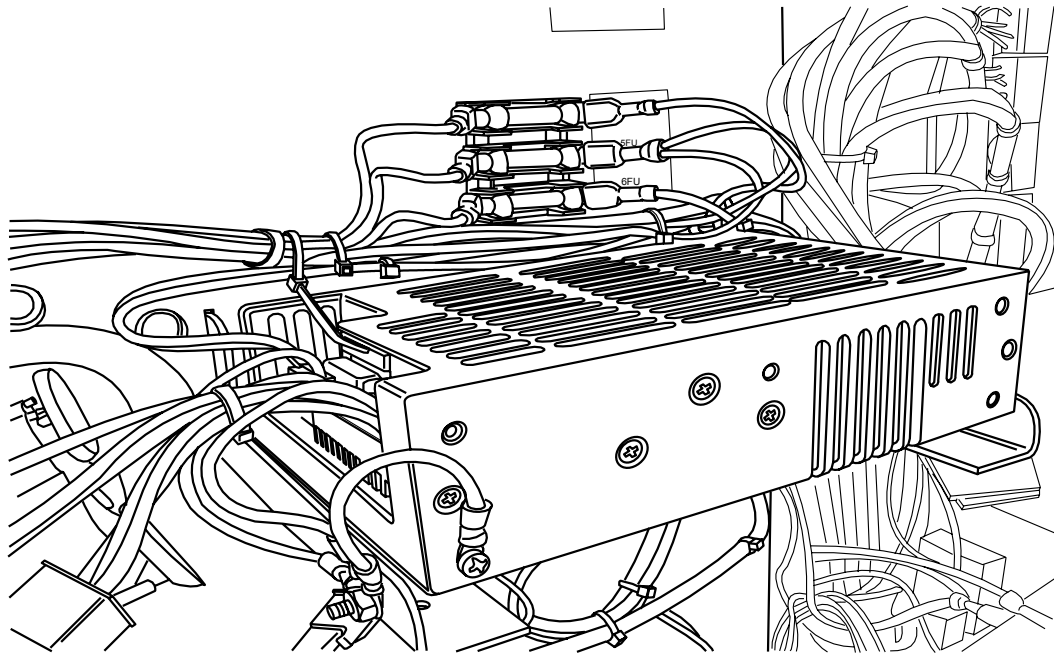
## OptiView Keypad Replacement

If keypad service replacement is required, use the following procedure.

1. Disconnect the keypad ribbon cable. Start at one corner and slowly peel the keypad from the door. Once the keypad is removed, clean any remaining adhesive residue from the Optiview panel door.
2. Remove the paper backing, from the replacement keypad. Align the keypad with the display and rocker switch openings and apply the keypad to the door.
3. Connect the ribbon cable to the new keypad.

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## SECTION 7 – OPTIVIEW POWER SUPPLY



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**FIGURE 33 - OPTIVIEW POWER SUPPLY**

### POWER SUPPLY DESCRIPTION

The power supply provides DC power for the OptiView Control Center circuit boards and display. The power supply is an inverter which receives 115 VAC (102 to 132 VAC) input from an external power source and converts the AC power to the following DC outputs:

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

The -12 VDC, +12 VDC, +5 VDC outputs and ground are applied to the microboard to circuits requiring the respective voltages. From the microboard, the -12VDC, +12 VDC and +5 VDC are distributed to other system components requiring these voltages. These include the microgateway, I/O boards, LCD display, and the display backlight inverter board.

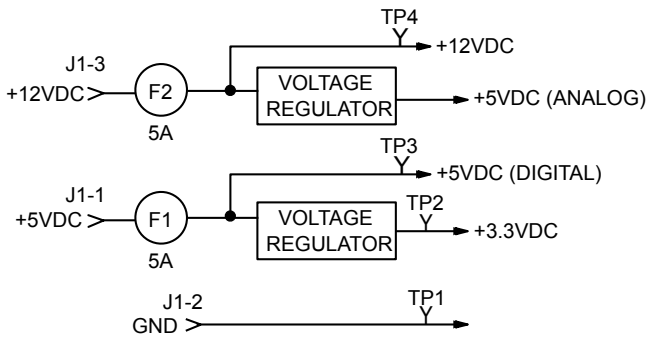
To account for losses in wiring and connections and assure sufficient voltage level at the microboard input, the power supply has a +5 VDC adjustment potentiometer.

The “V Adj” (R51) potentiometer is adjusted to achieve +5.1 VDC at the input to the microboard connection J1-1. The R51 pot does not require adjustment.

As shown in *Figure 33* (031-01730-000 microboard) and *Figure 34* (031-02430-000 microboard), the microboard uses additional voltage regulators that create separate +5 VDC, +3.3 VDC, and + 2.5 VDC (2430 microboard) power. The separate supplies are used as follows:

- The +5 VDC output is supplied to all microboard analog circuits and is labeled as the +5 VDC (Analog) supply. The +5 VDC power supply is also routed to the pressure transducers, temperature thermistors and motor control board (Electromechanical starter CM-2 board). This permits all analog circuits to be powered by the same supply, eliminating any offsets caused by voltage regulator drift.
- The +3.3 VDC supply is utilized by the microprocessor, flash memory card and other digital circuits. This voltage supply could also be applied to the backlight inverter board, depending on the display manufacturer’s requirements. Re-

fer to *SECTION 6 – OPTIVIEW DISPLAY AND KEYPAD* for additional information on display requirements.



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**FIGURE 34 - 1730 BOARD POWER SUPPLY TEST POINTS**

- Microboard 031-02430-000 has an additional voltage regulator that provides a 2.5 VDC power source to the microboard.

The power supply +24VDC output provides power to the CM-2 Board (electromechanical starter), Mod “B” Solid State Starter Logic/Trigger Board or Adaptive Capacity Control (ACC) Board for Variable Speed Drive applications. The +24 VDC power supply is fuse protected with a 5 amp buss-style fuse at 5FU, located above the power supply. Refer to the *Retrofit Kit Wiring Diagrams* for power distribution and wiring references.

### OPTIVIEW POWER SUPPLY SERVICE

The OptiView power supply is not serviceable and must be replaced if defective. Refer to the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for the replacement power supply part number.

If components are replaced under the warranty, they must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.

### OptiView Power Supply Diagnostics

If the OptiView power supply is suspected of malfunctioning, inspect the power supply circuits and check for an open (blown) fuse at 1FU main fuse panel.

The microboard +5 VDC and +12 VDC power supplies are also fuse protected, using 5 amp microfuses located on the microboard at F1 and F2, respectively.

The F1 and F2 fuses can be tested using the fuse tester on the external digital I/O board. The tester is located on the bottom of the board at D27. Refer to *Figure 35* in this manual.

The 1730 microboard is equipped with four test points (TP) to monitor or verify the power supply voltages. The test points are as follows:

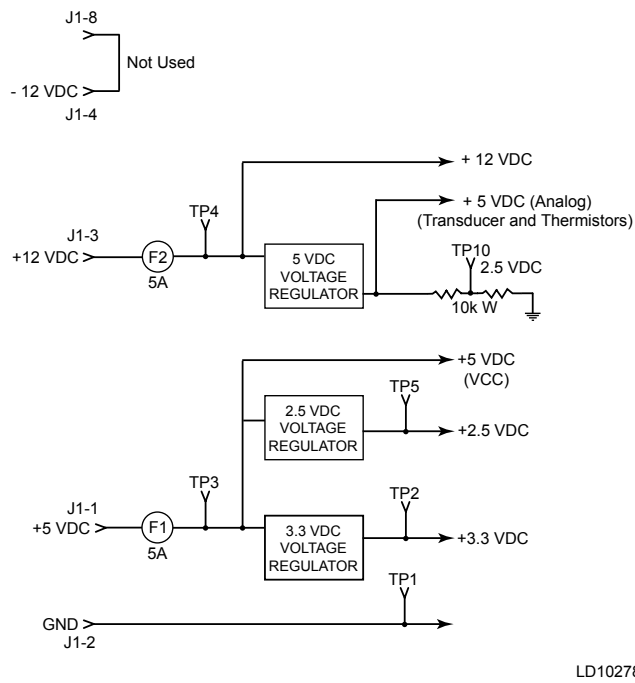
- TP 1 - Ground Source
- TP 2 - +3.3 VDC
- TP 3 - +5.0 VDC (Digital)
- TP 4 - +12.0 VDC

Refer to *Figure 33* for the 1730 microboard test point and fuse circuit diagram.

The 2430 microboard is equipped with five test points (TP) to monitor or verify the power supply voltages. The test points are as follows:

- TP 1 - Ground Source
- TP 2 - +3.3 VDC
- TP 3 - +5.0 VDC (Digital)
- TP 4 - +12.0 VDC
- TP 5 - +2.5 VDC

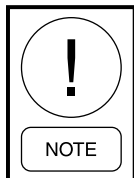
Refer to *Figure 34* for the 2430 microboard test point and fuse circuit diagram.



**FIGURE 35 - 2430 BOARD POWER SUPPLY TEST POINTS**

If the voltages at the microboard test points are not at the proper levels, disconnect the power supply wiring harness (P1) at microboard connection J1 and power supply connection J2. Perform the following tests.

- Using an ohmmeter on diode test mode, check for continuity between the microboard and the power supply ends of the wiring harness. An open circuit indicates a wire is broken. Repair or replace the wiring harness as necessary.



***When testing voltages at connectors, insert the test probes at the rear of the connector. Inserting the probes at the front of the connector may damage the pin terminals.***

- Reconnect the wiring harness to the power supply. With power applied to the power supply, test voltages to ground at the power supply connector to the microboard, P1. DC voltage from the power supply should be as follows:

- J1-1: +5 VDC
- J1-2: Continuity to Ground
- J1-3: +12 VDC
- J1-4: -12 VDC

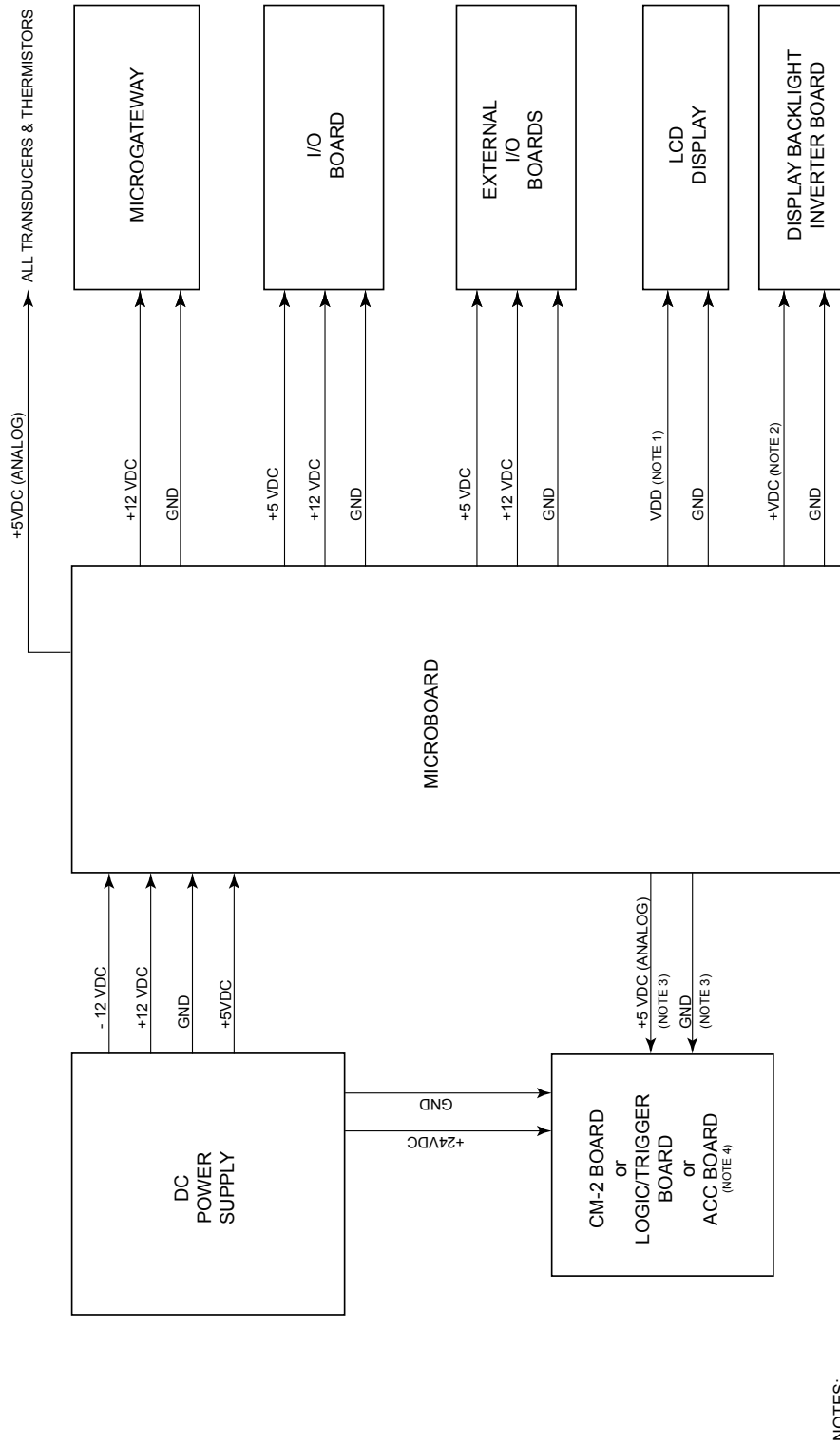
- Replace the power supply if the voltages are not as specified. If the voltages from the power supply are at the appropriate levels, replace the microboard.

- Test the + 24 VDC power supply to the motor controller board. Refer to *Table 9* for the power supply connections that correspond with the different motor controller boards. Verify fuse 5FU above the power supply is intact (not blown).

Replace the power supply if the +24 VDC power is not present at the motor controller board and fuse 5FU is intact.

**TABLE 8 - MOTOR CONTROLLER BOARD POWER SUPPLY CONNECTIONS**

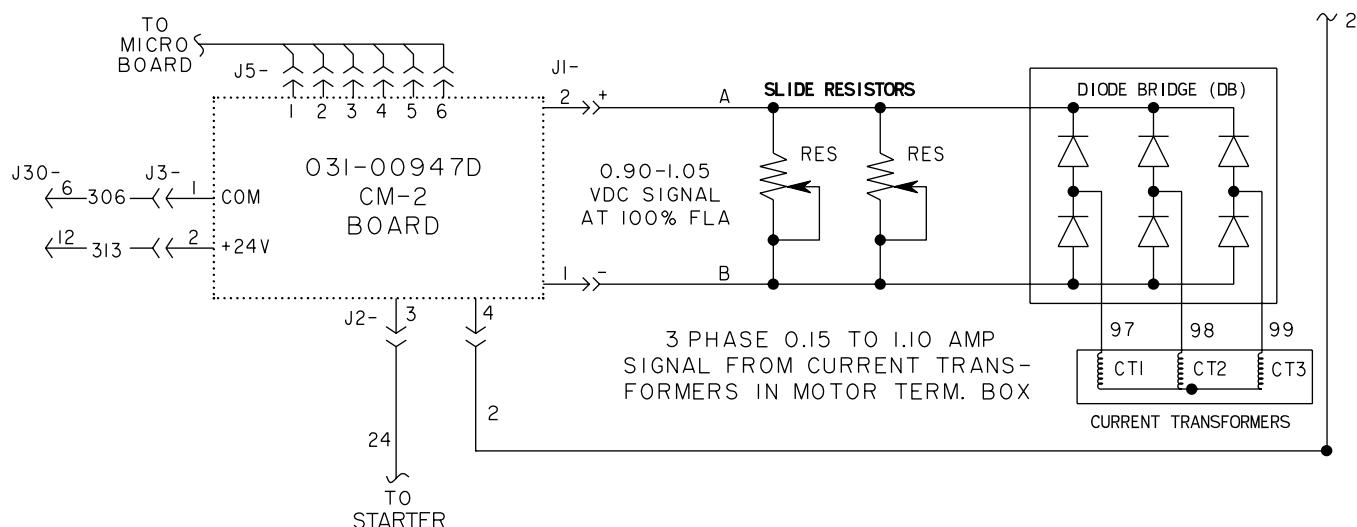
Motor Board	Positive Connection	Ground Connection
EM Starter CM-2 Board	J3-2	J3-1
LCSSS Logic/ Trigger Board	TB2-4	TB2-5
VSD ACC Board	J6-1	J6-2



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**FIGURE 36 - POWER SUPPLY – DC POWER DISTRIBUTION (REFER TO RETROFIT KIT WIRING DIAGRAMS FOR CONNECTIONS)**

## SECTION 8 – OPTIVIEW CURRENT MODULE (ELECTROMECHANICAL STARTERS)



LD10656

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**FIGURE 37 - CURRENT MODULE WIRING DIAGRAM**

### CURRENT MODULE DESCRIPTION

Chiller systems which utilize an electromechanical starter to control the compressor motor are equipped with a current module board and supporting components. The current module board, also known as the CM-2 Board, is located in the OptiView cabinet.

The purpose of the current module and supporting components is to provide the chiller with motor current control as well as current overload and fault protection.

The microboard must be setup to communicate with the CM-2 board. Refer to *SECTION 3 - MICROBOARD 031-01730-000* or *SECTION 4 - MICROBOARD 031-02430-000*.

### CURRENT MODULE COMPONENTS

The CM-2 board is the main component of the electromechanical starter current module. The printed circuit board contains circuitry to monitor and control motor current as well as detect overload conditions and power faults. The CM-2 board provides the microboard with an analog signal which represents the current chiller motor operating full load amps (FLA) value. The microboard uses this signal to adjust the position of the pre-rotation vanes (PRV) to control and limit the motor current to the system's 100% FLA value or below.

A ribbon cable connects the CM-2 board at J5 to the microboard at J10.

Three current transformers (CTs) are located in the motor terminal box or in the starter cabinet. The motor leads are passed through CTs, which are inductive to three phase power. The CTs generate a low AC current that is sent to the diode bridge.

The number of times the motor leads are required to pass through the CTs is determined by system FLA and motor voltage.

The diode bridge (DB) receives a 0.15 to 1.10 amp AC signal from each CT, rectifies each signal and then combines the three signals into one DC signal. This signal is applied to the parallel variable sliding resistors (RES). The resistors are field-adjusted to provide a nominal 1.0 VDC (0.90 to 1.05 VDC) signal (motor current signal) to the CM-2 board at J1-1 and J1-2 when the compressor motor current is at 100% FLA.

### CURRENT MODULE OPERATION

#### Motor Current Circuit

The motor current signal, input from slide resistors at J1-1 & J1-2, is applied to the current calibration potentiometer (R8) on the CM-2 board. This potentiometer is field-adjusted to illuminate the "105% CURR" LED (CR6) when the compressor motor current reaches 105% FLA.



nated until manually reset with the “Reset” switch (S2) on the CM-2 board. Relay K1 is de-energized for one (1) second, opening the CM contacts and then returned to the energized state. A “System Coastdown” is initiated and “Power Fault” is displayed on the OptiView display. The chiller will automatically restart upon completion of the system coastdown.

### CURRENT OVERLOAD CIRCUITS

If the motor current remains continuously at or above 105% FLA for 50 seconds (nominal), an overload shutdown is initiated and the “Overload” LED (CR4) is illuminated. Relay K1 is de-energized, opening the relay contacts (CM). Relay K1 remains de-energized until the S2 is pushed. A “System Coastdown” is initiated and “Motor Controller - Contacts Open” is displayed on the OptiView LCD. The “Overload” LED remains illuminated, the K1 relay remains de-energized, and the chiller cannot be started again until the “Reset” switch (S2) on the CM-2 board is manually pressed.

The CM-2 board is also equipped with three additional overload circuits. If the motor current remains at 245% FLA for 40 seconds, 290% FLA for 20 seconds or 360% FLA for 10 seconds, an overload shutdown is initiated. These values are possible at start-up as a result of motor current inrush.

Depending upon the position of the “starter selection” switch, S1, the 245% starter overload may not be used. If S1 is in the “Y-Delta/57%” position, there is no 245% FLA threshold. If the S1 switch is in the “All Others” position, all of the overload circuits operate. The S1 switch must be positioned according to the type of electromechanical starter present; “up” for wye-delta or autotransformer starters using 57% tap, “down” for across-the-line starters or autotransformer starters using 65% tap.

The LRA/FLA ratio potentiometer (R16) is field-adjusted to the ratio of Locked Rotor Amps to Full Load Amps. The correct setting is determined by dividing the LRA by the FLA. The R16 potentiometer calibrates the 245%, 290%, and 360% overloads to function properly according to the motor installed on the chiller.

### MULTIPLEXER

The multiplexer (MUX) is an electronic switch with 8 inputs and 1 output. The input applied to the output is determined by the multiplexer switch position (internal), which is controlled by the OptiView microboard. On the CM-2 board, the inputs to channel 0 through 6 are connected to ground (0 VDC). When channel “0” is connected to ground, the starter is identified as the electromechanical type. The input to channel 7 is a 0.0 to 5.0 VDC analog signal, representing motor current.

Under operating program control, the microboard commands the multiplexer to route the eight inputs to the multiplexer output by applying a 3-bit binary address to each of the multiplexer inputs at CM-2 board connection J5-1,2,3. The voltage level for logic “1” is +12 VDC and logic “0” is 0 VDC. The microboard reads the multiplexer output at J5-6.

The 0.0 - 5.0 VDC analog signal from channel 7 represents the percentage of FLA being utilized by the chiller motor. When the analog signal is at 4.0 VDC, the motor current is represented as 100% FLA. This FLA percentage is displayed on the OptiView LCD.

The analog signal is field-calibrated with the CM-2 board 100% FLA potentiometer (R34) to be 4.0 VDC when the compressor motor current is at 100% FLA. This signal can only be calibrated after the R8 potentiometer has been calibrated as the analog signal is provided from the motor current input signal.

The microboard also uses the analog signal for motor current control by adjusting pre-rotation vanes (PRV) to limit motor current. When motor current rises to 100% FLA, the microboard prevents any further current rise by inhibiting the PRV from opening until current 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.

In order to allow the current calibration potentiometer (R8) to be calibrated to 105%, the current limit thresholds of 100% and 104 % are increased for ten (10) minutes the first time the “PRV Open” key is pressed on the Compressor screen. The increased current limit thresholds are only in effect while logged in at the “Service” access level. The increased thresholds allow 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 ten minutes, the normal current limit thresholds of 100% FLA and 104% FLA are restored. Refer to *Table 9* for current limit thresholds.

**TABLE 9 - PRV/FLA CONTROL THRESHOLDS**

Vane Control	Motor Current (% FLA)	
	Normal Thresholds	Service Mode Thresholds
On rise, inhibit open	100	107
On fall, allow open	98	106
On rise, start close	104	110
On fall, stop close	102	109

### OPTIVIEW CURRENT MODULE SERVICE

The current module components are all available separately, should a component failure occur. The part numbers for the CM-2 board, diode bridge, slide resistors, current transformers, and CM-2 ribbon cable can be found in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.



***Shock Hazard! Due to the extremely high voltage conditions present in the chiller starting components and motor, extreme care should be exercised during service. Lock-out and tag-out equipment as necessary.***

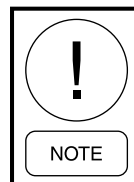
The current module components can be replaced by simply locking-out the power supply, disconnecting, and removing the component. Malfunctioning current transformers must be replaced with the proper range and wired the appropriately according to the motor voltage and full load amps. Perform calibration of the current module anytime a component is replaced.

Components that are replaced under the warranty must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.

### OptiView Current Module Diagnostics

If the current module is suspected of being faulty, use the following procedure to test the components.

1. Verify that all wiring harness connections to the microboard, I/O board, CM-2 board, and other components are secure. Refer to the *Retrofit Kit Wiring Diagrams* for wiring connections.
2. Verify the current module does not require a reset. Press the reset switch (S2) on the CM-2 board.
3. Remove the ribbon cable connecting the CM-2 board to the microboard. Using an ohmmeter on the diode test setting, test the continuity of each wire between each of the cable connectors. An open circuit indicates the ribbon cable requires replacement. Reconnect the cable when testing is complete.
4. If the chiller is operational, lock-out the starter power supply and place a clamp-on ammeter on a motor lead to measure operating amperage.
5. Reconnect power to the chiller and start chiller operation. Reduce the leaving chilled liquid temperature setpoint and open the PRV to increase chiller load to 105% FLA. The 105% Curr. LED should illuminate. Compare the amperage on the ammeter with the FLA percentage displayed on the OptiView screen. If the readings differ more than two percent ( $\pm 2\%$ ), calibrate the current module.



***Insert the test probes at the rear of the connector. Inserting the probes at the front of the connector may damage the pin terminals.***

6. With the chiller stopped, disconnect the slide resistor (motor current signal) wiring harness, P1, from the CM-2 board at J1. Using an ohmmeter on the diode test setting, test wire continuity be-

tween the connector and the wire end that attaches to the resistor. Repair or replace the wires as necessary.

7. With the slide resistor harness disconnected from the CM-2 board, measure resistance between the terminals of the P1 plug. The resistance should be as calculated using the formula in *Table 10*. If the resistance is not as calculated, adjust the slide resistors to achieve proper resistance between the P1 plug terminals. Replace the resistors and perform module calibration if proper resistance cannot be achieved.

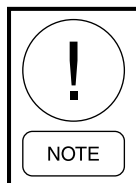
**TABLE 10 - SLIDE RESISTOR CALCULATION**

Motor Voltage	FLA	CT Ratio	"R" Resistor Setting
200/600	65-111	200:1	R=1.282 (CT Ratio)/ FLA
	112-224	350:1	
	225-829	700:1	
	830-1790	1400:1	
2300/4160	11-18	200:1	R=0.247 (CT Ratio)/ FLA
	19-37	200:1	R=0.370 (CT Ratio)/ FLA
	38-123	200:1	R=0.740 (CT Ratio)/ FLA
	124-264	350:1	

**Current Module (CM-2) Calibration**



***Shock Hazard! Extremely high voltage conditions are present at the chiller starting components and motor, extreme care should be exercised during calibration. While working within the starter or motor panels, LOCK-OUT and tag-out the starter power source.***

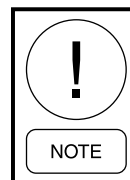


***Do not use the OptiView display to determine when the chiller is operating at full load. The OptiView full load amps display is not a source of calibration.***

1. Lockout and tag-out the OptiView and starter power supply. Place a clamp-on ammeter on a motor lead to read operating amps.
2. The S1 switch on the CM-2 board must be positioned according to the type of electromechanical starter present; “up” for wye-delta or autotrans-

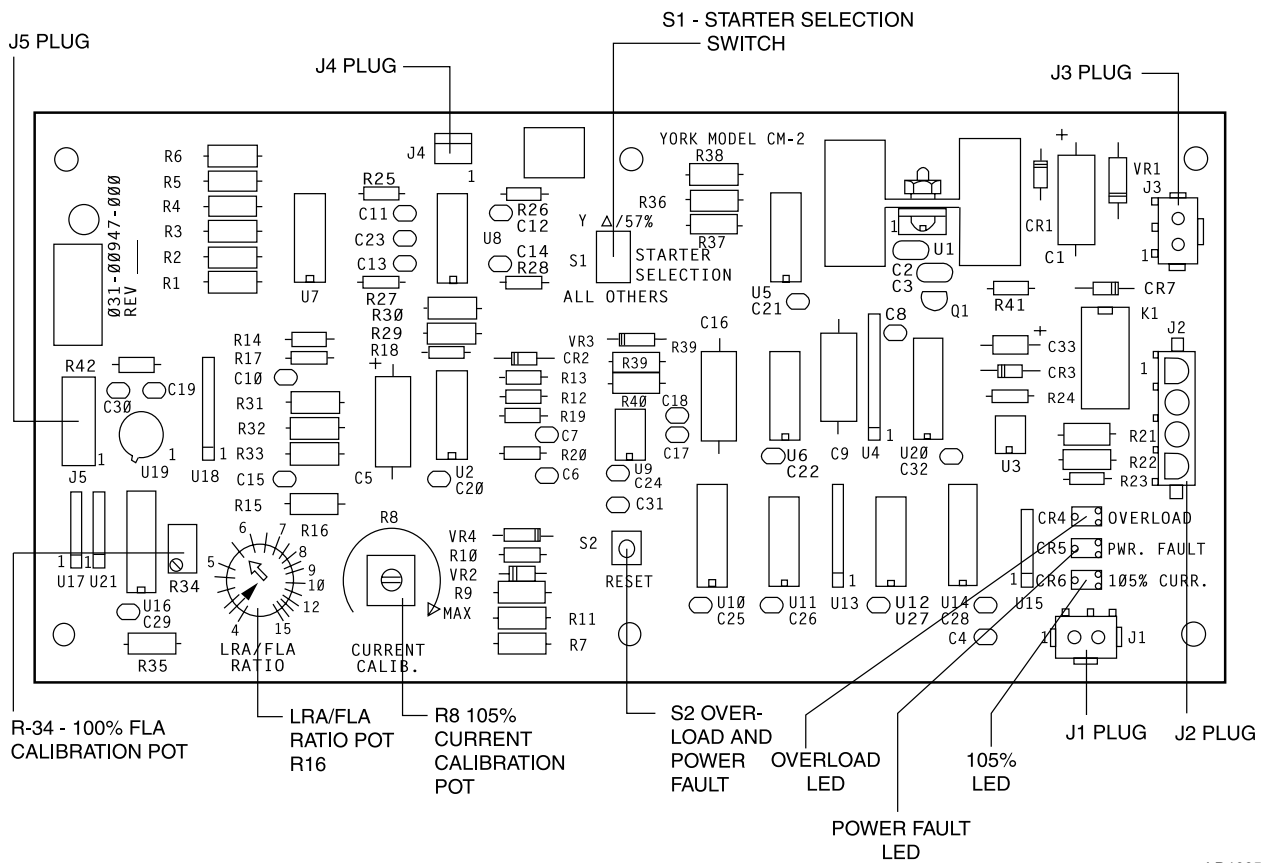
former starters using 57% tap, “down” for across-the-line starters or autotransformer starters using 65% tap.

3. Calculate the LRA/FLA ratio by dividing motor lock rotor amps by full load amps. Adjust the LRA/FLA ratio potentiometer (R16) on the CM-2 board accordingly.
4. With the slide resistor harness (P1) disconnected from the CM-2 board, measure resistance between the terminals of the P1 plug. Adjust the slide resistors to the resistance calculated from the appropriate formula in *Table 10*.
5. Reconnect power to the chiller and start chiller operation.
6. Login to the OptiView Control Center at the “Service” access level. Verify the current limit and pulldown current limits are set to 100% on the OptiView Motor screen. Run the chiller to full 100% load to allow CM-2 board calibration. Use the remote type clamp-on meter on a motor lead to measure load on starters not equipped with an ammeter. To load the chiller, the pre-rotation vanes can be manually operated, load rate can be increased, the chilled liquid temperature can be lowered and the condenser water temperature raised. The chiller must be running under full load before proceeding.



***Insert the test probes at the rear of the connector. Inserting the probes at the front of the connector may damage the pin terminals.***

7. Check the voltage reading across the J1-1 and J1-2 connector terminals of the CM-2 board (leave connected to CM-2 board). If the slide resistors are adjusted properly, the voltage between these terminals should be 0.90 - 1.05 VDC. If the voltage is not at the proper level, change the resistance of the slide resistors 5% until the proper voltage is achieved.
8. With the chiller motor running at full load amps (FLA), calculate 105% of FLA and increase chiller load to this value, as indicated by the ammeter. Adjust the current calibration screw (R8) until the 105% LED (CR6) illuminates. Reduce chiller operation to 100% full load amps.

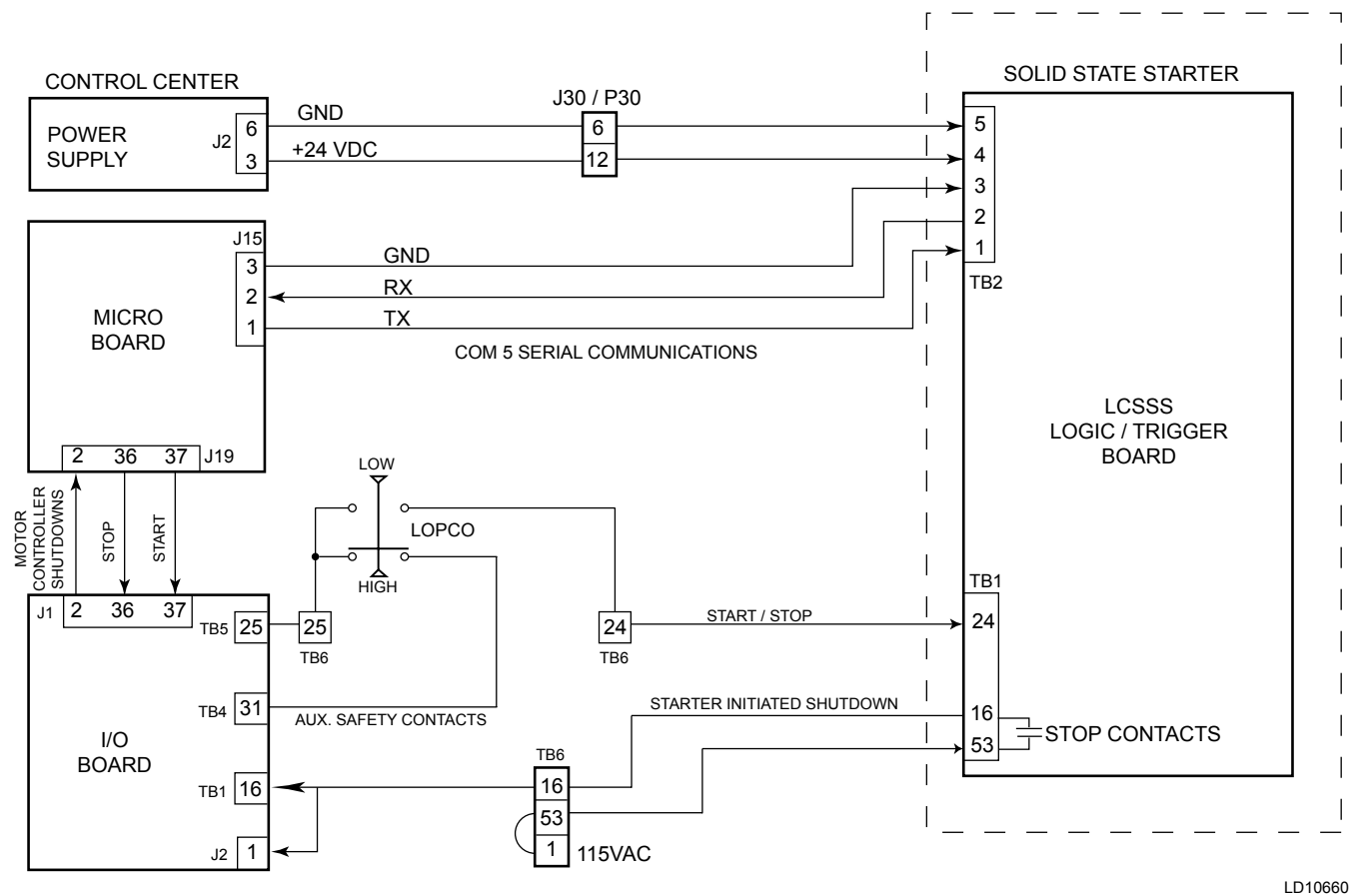


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**FIGURE 39 - CM-2 BOARD**

9. When the chiller is running at 100% of FLA (as indicated by the ammeter), adjust the potentiometer screw at R34 on the CM-2 board so the display on the OptiView panel reads 100% FLA. Clockwise increases the display reading; counter-clockwise decreases the display reading.
10. Return the pre-rotation vanes to automatic control and re-program or adjust any setpoints manipulated to acquire full load on the chiller.
11. Stop chiller operation and lock-out/tag-out the chiller power supply. Remove the clamp-on ammeter from the motor lead. Reconnect the chiller power supply.

## SECTION 9 – MOD “B” SOLID STATE STARTER LOGIC/TRIGGER BOARD



**FIGURE 40 - MOD “B” LIQUID COOLED SOLID STATE STARTER (LCSSS) - OPTIVIEW CONTROL CENTER INTERFACE**

### LOGIC/TRIGGER BOARD DESCRIPTION

The OptiView Control Center will accommodate the Mod “B” Liquid Cooled Solid State Starter (LCSSS). The Mod “B” LCSSS contains an integrated logic/trigger board which monitors and controls starter operation per OptiView Control Center commands. The logic/trigger board interfaces with the OptiView Control Center via the COM 5 serial data communications link and hardwired relay contacts. The microboard must be configured to allow appropriate program and microboard operation for the LCSSS. Refer to *SECTION 3 - MICROBOARD 031-01730-000* or *SECTION 4 - MICROBOARD 031-02430-000*.

As shown in *Figure 40*, the LCSSS contains a single Logic/Trigger printed circuit board. This board performs the following functions:

- Generates the Silicone Controlled Rectifier (SCR) trigger pulses.
- Receives start/stop commands from the microboard.
- Transmits operating status and fault data to the microboard.
- Generates all LCSSS associated safety and cycling shutdowns. The stop relay contacts on the logic/trigger board assure a positive shutdown on all LCSSS initiated shutdowns.

The logic/trigger board is powered by +24VDC from the control center power supply.

The following portions of this section describe microboard and logic/trigger board interaction. A complete description, theory of operation, and service

instructions for the LCSSS are contained in the *Solid State Starter, MOD “B” – Operation/Service Manual (Form 160.00-O2)*.

## LOGIC/TRIGGER BOARD OPERATION

### Communication

Communication 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.

The microboard communicates with the logic/trigger board via a 1200 baud 0/+5 VDC serial data communications link at microboard connection J15. If this communications link is suspected of not operating properly, correct serial port operation can be verified using the serial port diagnostic procedure in section 3A or 3B of this manual.

After power has been applied to the chiller system, the microboard will initialize and establish communications with the starter logic/trigger board. If unsuccessful within ten (10) attempts, the microboard signals a cycling shutdown and displays “LCSSS - INITIALIZATION FAILED” on the system details line of the control center display. The microboard will attempt to establish communications until successful.

At initialization, the logic/trigger board reads wire jumpers at connection J1 to determine the LCSSS model installed (refer to *Solid State Starter, MOD “B” – Operation/Service Manual (Form 160.00-O2)*). If an invalid jumper configuration is read, the logic/trigger board signals a cycling shutdown and “LCSSS - INVALID CURRENT SCALE SELECTION” is displayed on the system details line of the control center display.

After successful communication has been established, the microboard sends a data request every two (2) seconds. Under normal operation the logic/trigger board responds to each request. However, if the microboard does not receive a response within ten (10) consecutive requests, the microboard signals a cycling shutdown and displays “LCSSS - SERIAL COMMUNICATIONS” on the system details line of the control center display. In addition, the logic/trigger board will initiate the same cycling shutdown if a data request is not received from the microboard after ten (10) successive attempts to send data.

The logic/trigger board transmits the following parameters to the microboard over the serial communications link; they are interpreted by the microboard and displayed on the Motor screen:

**Starter Model** – There are four Mod “B:” LCSSS model designations: 7L, 14L, 26L and 33L. The starter model designation is transmitted to the microboard and displayed on the Motor screen. The microboard uses the model to determine the allowable range for the Full Load Amps (FLA) and start current setpoints on the Motor screen.

The FLA range setpoint allows the amount of motor amperage to be programmed in the control center in order to take full advantage of the chiller design capacity. Start current range is programmable and necessary to limit inrush motor current during startup. This setpoint should be programmed to 45% of motor Delta Locked Rotor Amps. The FLA and start current ranges allowed for each starter are shown in *Table 11*.

**TABLE 11 - LCSSS FLA AND START CURRENT SETPOINTS**

LCSSS Model	FLA Range	Start Current Range
7L	35 - 260 Amps	310 - 700 Amps
14L	65 - 510 Amps	620 - 1400 Amps
26L	125 - 825 Amps	1150 - 2600 Amps
33L	215 - 1050 Amps	1460 - 3300 Amps

**3-Phase Line-to-Line Motor Supply Voltage** – To ensure 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 starter voltage application has allowable upper and lower limits. If the supply voltage goes above or drops below these limits continuously for twenty (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. The acceptable ranges and restart levels are shown in *Tables 12 and 13*.

**Input Power (kW)** – This is the input power being utilized by the chiller motor, shown in kilowatts (P). To calculate input power, the current (I) being used by the

chiller motor is multiplied by the 3-phase line voltage (E) being input to the motor ( $P=I \cdot E$ ). The supply line with the highest voltage is used in the calculation.

**TABLE 12 - LOW SUPPLY LINE VOLTAGE THRESHOLDS**

Supply Voltage	LIMIT STARTING	LIMIT RUNNING
200 - 208 Volts	174 V	160 V
220 - 240 Volts	200 V	185 V
380 Volts	331 V	305 V
400 Volts	349 V	320 V
415 Volts	362 V	335 V
440 - 480 Volts	400 V	370 V
550 - 600 Volts	502 V	460 V

**TABLE 13 - HIGH SUPPLY LINE VOLTAGE THRESHOLDS**

Supply voltage	LIMIT STARTING	LIMIT RUNNING
200 - 208 Volts	226 V	227 V
220 - 240 Volts	261 V	262 V
380 Volts	414 V	415 V
400 Volts	435 V	436 V
415 Volts	453 V	454 V
440 - 480 Volts	523 V	524 V
550 - 600 Volts	654 V	655 V

**3-Phase SCR Module Temperature** – This is the temperature of the SCR modules in the starter panel. If the temperature of any of the SCR modules are at or above 110°F (43.3° C), the LCSSS cooling pump will run and the chiller will be inhibited from starting until the temperature has decreased below 109°F (42.8° C). 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.

**3-Phase Motor Current** – The logic/trigger board transmits the current draw for each phase of the motor power supply: A, B, and C. The microboard uses the supply line with the highest current reading to calculate the percentage of FLA being used by the motor. This is calculated by taking the current being used and dividing by the FLA setpoint.

The microboard also uses the motor current to control the Pre-rotation Vanes (PRV). The microboard will open, close, or hold the PRV to increase or limit the compressor motor current, as required by chiller demand, current limit setpoint or the pulldown demand limit, as programmed.

If the motor current reaches 100% of the current limit setpoint or pulldown demand limit, the pre-rotation vanes are inhibited from opening further until the motor current decreases below 98% of the current limit setpoint.

If the motor current increases to 104% of the current limit or pulldown demand limit setpoint, the pre-rotation vanes will be driven closed until motor current decreases to 102% of the current limit setpoint. The vanes will then be inhibited from opening until motor current decreases to less than 98% of the current limit setpoint.

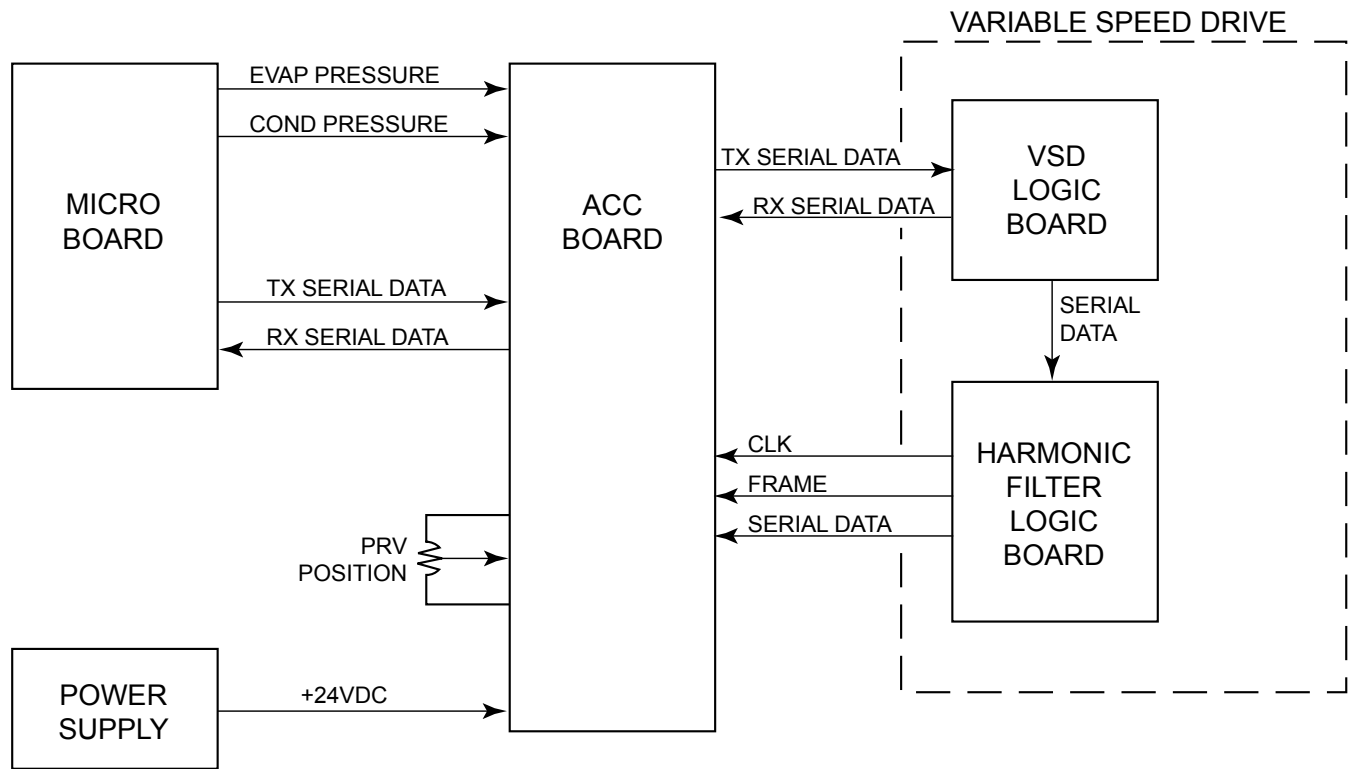
### Microboard Interface

When the chiller is started, the OptiView Control Center sends two start signals simultaneously to the logic/trigger board. One start signal is transmitted via the COM 5 serial communications link. The other applies a 115 VAC signal to logic/trigger board TB1-24 through the OptiView I/O board 1R (K18) “Run” contacts. If these two signals are not received within five (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.

Anytime the logic/trigger board initiates a cycling or safety shutdown, the logic/trigger board “Stop” contacts are opened. These contacts, which are between TB1-16 and TB1-53 on the logic/trigger board, are connected in series with the 1R (K18) “Run” relay coil on the OptiView I/O board. The contacts remain open as long as a condition exists. When the “Stop” contacts are opened, the circuit to 1R is opened, de-energizing the relay and removing the run signal to the LCSSS. Simultaneously with the de-energizing of the 1R coil, 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 and a snapshot of the LCSSS operating parameters at the instant of the fault at the next microboard data request. This is logged into the OptiView operating history. Any additional faults that occur within the two second transmission time are also sent and logged in the OptiView operating history. This information is viewable on the History screen. Refer to the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)* for description of all cycling and safety shutdown messages and viewing chiller operating history.

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## SECTION 10 – ADAPTIVE CAPACITY CONTROL (ACC) BOARD



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**FIGURE 41 - VARIABLE SPEED DRIVE ADAPTIVE CAPACITY CONTROL BOARD - OPTIVIEW CONTROL CENTER INTERFACE**

### ACC BOARD DESCRIPTION

Chillers which utilize a YORK Variable Speed Drive (VSD), are equipped with an Adaptive Capacity Control (ACC) Board. The ACC board, which is mounted in the OptiView Control Center cabinet, interfaces with the microboard via the COM 5 serial data communications link and hardwired relay contacts. The microboard must be configured to allow appropriate program control and operation for the VSD. The ACC board performs the following functions:

- Acts as a bidirectional serial communications gateway between the OptiView microboard and the VSD/harmonic filter logic boards (as equipped).
- Tells the VSD logic board the speed (frequency) to operate the compressor motor. The speed will be the lowest speed between 30 to 50 or 60 Hz (as equipped) the chiller can operate without compressor surging.

- Detects chiller compressor surge conditions and creates a surge map in the battery backed memory by storing the Pre-rotation Vanes (PRV) position, motor speed (frequency) and evaporator/condenser pressure differential (delta P/P) that exists when each surge occurs.

The VSD consists of the power electronics component, VSD logic board and an optional harmonic filter with a filter logic board, all located in the VSD cabinet that is either mounted to the floor. The VSD logic board serves the following functions:

- Controls the VSD power electronics to drive the compressor motor at the speed designated by the ACC board.
- Monitors the power electronics parameters and initiates chiller shutdowns when safety thresholds are exceeded.

- 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 serves the following functions:

- Controls the harmonic filter.
- Monitors filter parameters and initiates chiller shutdowns when safety thresholds have been exceeded.
- Transmits these parameters to the ACC board for communication to the microboard for display.

The following portions of this section describe microboard and ACC board interaction. Complete operation and service details of the VSD and components are contained in the *Variable Speed Drive – Service Manual (Form 160.00-M1)*.

## ACC BOARD OPERATION

### Communication

The microboard communicates with the ACC board, VSD logic board and optional harmonic filter logic board via a 1200 baud 0/+5VDC serial data communications link at microboard connection J15 (COM 5). When the ACC board is transmitting and receiving data to and from the microboard, the YM XMT (CR7) and YM RCV (CR6) LED's illuminate. If this communications link is suspected of not operating properly, correct serial port operation can be verified using the serial inputs and outputs diagnostic procedure in *SECTION 3 - MICROBOARD 031-01730-000* or *SECTION 4 - MICROBOARD 031-02430-000*.

Communication between the microboard and VSD circuit boards are in master/slave form. The VSD logic board and harmonic filter logic boards act as slaves to the ACC and the ACC acts as a slave to the microboard. When the ACC board and VSD logic boards are communicating (via serial data), the VS XMT (CR5) and VS RCV (CR4) LEDs illuminate. Serial data communication with the harmonic filter logic board takes place through the ACC microprocessor via the digital signal processor. This data is accompanied by a framing pulse and a CLK signal.

The microboard initiates all communications by sending a command to the ACC board. The ACC board passes the command to the VSD logic board. The VSD logic board responds to the command by returning the

requested data to the ACC board and passes the command to the harmonic filter logic board. The harmonic filter logic board returns the requested data to the ACC board. The ACC board returns both the VSD and harmonic filter logic boards' response to the microboard.

There are three different commands issued from the microboard: test and initialize, fault data request and status data request. When power is first applied to the control center, the microboard establishes serial communications with the ACC, VSD logic and harmonic filter logic boards. The following paragraphs describe each type of command issued from the microboard.

**Test and Initialize** - To establish communications, the microboard sends a test and initialize command to the ACC board, which transmits the command to the VSD logic board. The VSD logic board relays the command to the harmonic filter logic board, if equipped. If the VSD logic and harmonic filter boards respond appropriately to the ACC board, the ACC board responds to the microboard and communications are established.

If any of these boards fail to respond to the first command, the microboard sends the command again four (4) seconds later. The microboard will continue to send this command at four second intervals until a response is received. If, after ten (10) attempts, no response is received, a cycling shutdown is performed and "VSD - INITIALIZATION FAILED" is displayed. The microboard will attempt to establish communications until successful. Anytime communications have been established and then lost, the microboard will repeat this process to re-establish communications.

**Fault Data Request** - After communications have been established, the microboard sends a fault data request command. Any faults detected by the VSD logic or harmonic filter boards since communications were lost, are returned to the microboard at this time. If there is no response within two (2) seconds, this command is sent at two second intervals until a response is received. If no response is received after ten attempts, a cycling shutdown is performed and "VSD – SERIAL COMMUNICATIONS" is displayed.

**Status Data Request** - Once communications have been established and the fault data request has been transmitted, the microboard then begins normal communications with the ACC, VSD and harmonic filter logic boards. Operating command and data are exchanged during normal communications. The com-

mands and data are exchanged every two (2) seconds on the serial communications link. The microboard sends a status data request to the ACC board, which is passed along to the VSD logic board and harmonic filter logic boards. If there is no response within two (2) seconds, this command is sent at two second intervals until a response is received. If no response is received after ten attempts, a cycling shutdown is performed and “VSD – SERIAL COMMUNICATIONS” is displayed.

The microboard will not perform a shutdown when communication with harmonic filter is lost, as long as communication still exists with the VSD logic board. If communications are lost with the harmonic filter, “WARNING – HARMONIC FILTER – DATA LOSS” is displayed.

When the VSD logic and harmonic filter boards send data to the ACC board, the ACC board adds surge data and returns all the data to the microboard in one response. Data transmission continues until the VSD logic or harmonic filter boards detect a fault condition.

The following VSD status data is transmitted from the VSD logic board to the ACC board for transfer to the microboard for interpretation and display:

- Output frequency
- Output voltage
- Output current - three phase
- Input power kW
- kWh
- Motor 100% FLA rating
- DC link voltage
- DC link current
- Internal ambient temperature
- Inverter heatsink temperature – phase A, B, C
- Converter heatsink temperature
- Pre-charge relay energized/de-energized
- SCR gate drivers enabled/disabled
- Water (cooling) pump on/off status
- VSD running/stopped

- VSD software version
- Motor HP (horsepower)

The following harmonic filter status data is transmitted from the harmonic filter logic board to the ACC board for transfer to the microboard for interpretation and display:

- Input kVA
- Total power factor
- Filter DC link voltage
- Input voltage- phase A, B & C
- Input voltage THD – phase A, B & C
- Input peak voltage – phase A, B & C
- Input current – phase A, B & C
- Input current TDD – phase A, B & C
- Filter current – phase A, B & C
- Filter heatsink 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 – installed/not installed

The following ACC status data is transmitted from the ACC board to the microboard for interpretation and display:

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

### ACC BOARD VSD SPEED DETERMINATION

The speed of the VSD can be controlled manually or automatically. When the VSD speed is in the manual control mode, the VSD speed can be increased or decreased over a range of 1.0 to 50.0 Hz (or 60 Hz, as equipped) in 0.1 to 10 Hz increments. This adjustment is made using the OptiView keypad from the Motor screen. In manual operation mode, the ACC does not map compressor surges and the “Valid Point” LED (CR8) will illuminate on the ACC board to indicate as such.

When the VSD is in automatic control mode, the ACC board reduces/controls the speed of the VSD in order to conserve energy. Using the data described in the following paragraphs, the ACC board adaptively determines the optimum motor speed and commands the VSD logic board to drive the motor at that speed, a range of 30 to 50 Hz (or 60 Hz, as equipped). The optimum motor speed is the lowest speed the motor can drive the compressor at to avoid compressor surge conditions, but still meet capacity requirements.

**Delta P/P** – Delta P/P is a parameter that represents system pressure differential or “Head”. This is calculated by subtracting evaporator pressure from condenser pressure and then dividing by the evaporator pressure.

Delta P/P ranges from 0.00 to 3.60. The ACC board calculates this value from evaporator and condenser pressure values received from the microboard via serial communications link. The ACC board returns the calculated Delta P/P value to the microboard.

**Pre-rotation Vanes (PRV) position** – A potentiometer provides PRV position (0 to 100%) to the ACC board. The position is 0% when fully closed, 100% when fully open. This value is sent to the microboard for display. The potentiometer must be calibrated by a qualified service technician using the procedure detailed in the calibration portion of this section. VSD speed reduction is not permitted until this calibration has been performed.

**Motor Speed** – Motor speed is the actual drive frequency of 30 to 50 Hz (or 60 Hz, as equipped).

**Surge Map** – The surge map 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 array for each surge. The surge map is stored in the ACC board’s BRAM memory.

Before a reduction in VSD speed is permitted, the following conditions must be met:

- 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, the “Valid Point” LED (CR8) is illuminated.

- The leaving chilled liquid temperature must be within +0.3 °F (0.2 °C) and –0.6 °F (–0.3 °C) of the leaving chilled liquid setpoint.
- The chiller must have been running for longer than two (2) minutes.
- The leaving chilled liquid temperature must be stable. Lowering the speed while the temperature is unstable could possibly 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. This value is then compared to the programmed “Stability Limit” setpoint. If the rate of change exceeds the stability limit setpoint value, the microboard sends a flag to the ACC board. In response, the ACC board starts a 60 second timer. “Valid Point” LED (CR8) will be illuminated and speed decreases are prohibited until the timer has elapsed. Also, when making the transition from manual speed control mode to auto mode, the stability timer is started, preventing speed reduction for 60 seconds.
- The stability limit setpoint is programmed over the range of 1000 to 7000. This is a relative value representing a magnitude of stability. Higher values correspond to decreasing sensitivity. Refer to “Stability Limit Setpoint” in this section.

When the chiller is started, the speed is brought to 50Hz (or 60 Hz, as equipped). After two minutes of operation, the ACC board evaluates operating parameters so the motor speed can be reduced. If there are no conditions that would inhibit speed reduction, the ACC board compares the real-time delta P/P, PRV position and motor speed to the three dimensional arrays stored in the surge map.

If the real-time array does not match any previous surge condition, the speed will be decreased 0.1 Hz every six (6) seconds until motor speed is within 1 Hz of previously plotted surge condition array in the surge map. Motor speed will then be decreased 0.1 Hz every nine (9) seconds until speed is at the lowest value allowed by the surge map. If no plotted points are encountered, the motor speed is lowered until a surge is encountered or a minimum of 30 Hz is reached.

When Delta P/P increases above 3.60, motor speed will be slowly increased to the maximum speed (50 or 60

Hz). If this were to occur, Delta P/P would have to decrease below 3.55 before a speed decrease is once again permitted.

### Surge Detection

While the chiller is operating, the ACC board is collecting data related to compressor surge events and controlling motor speed according to that data. The ACC board employs two different methods of surge detection; “Delta P” method and “DC Link” method.

The ACC board detects a surge using the Delta P method by monitoring the outputs of the evaporator and condenser pressure transducers. When the difference between these pressures (Delta P) drops transiently toward 0.0 PSIG (0.0 kPa), a surge is indicated. A surge detected by the Delta P method must have all of the following conditions occur within five (5) seconds to be considered a valid surge:

- Delta P must make a negative transition and exceed 3.4 PSIG (23.4 kPa) for 100 Milliseconds.
- Delta P must also exceed 3.5 PSIG (24.1 kPa) for at least 340 milliseconds.
- Delta P must make at least 2 positive transitions.

When this criteria is met, the “Surge” LED (CR9) illuminates for two seconds, indicating a valid surge has been detected.

The ACC board detects a surge using the DC link method by monitoring the VSD’s DC link current. When the current drops transiently toward zero, a surge is indicated. A surge detected by this method must meet the following requirements to be considered a valid surge:

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

When both these criteria have been met, “Surge” LED (CR9) illuminates for two seconds, indicating a valid surge has been detected.

Each time a surge is detected, the ACC board increases the motor speed (up to a maximum of 50/60 HZ) to take the compressor out of surge. The amount of motor speed increase is either 0.8 Hz (normal) or 1.0 Hz (current limit), depending on operating conditions. Motor speed is increased 0.8 or 1.0 Hz in the following increments:

- 0.1 Hz every 2 seconds if motor current is less than 80% FLA.
- 0.1 Hz every [2 seconds + (%FLA-80)] if motor current is more than 80% FLA, but less than 98% FLA.
- 0.1 Hz every 20 seconds if motor current is above 98% FLA.

When a surge is detected in normal operation, the speed is increased 0.8 Hz 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. This offsets the motor speed above the surge points accordingly with the programmed surge margin frequency. The surge margin adjust setpoint can be programmed over the range of 0.0 to 25.0 Hz. The default value of 0.0 Hz will provide proper operation in most applications.

If current limit is in effect or the stability timer is running when a surge occurs, the speed is increased 1.0 Hz but the surge is not plotted on the surge map since these conditions would produce an erroneous value. “Valid Point” LED (CR8) is illuminated as a visual indication that one or both of these conditions are in effect.

When the speed has been increased either 1.0 Hz or 0.8 Hz as described above, the speed is maintained for the next fifteen (15) seconds. During this period, new surges are ignored. When the time has elapsed, a five (5) minute time period is entered where the speed is inhibited from decreasing, but increases are allowed. Surges detected during this five minute period are not plotted on the surge map, but the motor speed is increased as described previously. This process is repeated as long as the compressor continues to surge. Five minutes must elapse before a speed decrease is permitted or another surge can be plotted on the Surge map.

The ACC board counts the surges as they occur and sends a total count to the microboard for display on the ACC Details screen. The total surge count is not incremented if a different surge type occurs within ten (10) seconds of the previous surge. A surge that occurs within ten seconds of the previous surge is only counted if the surge is the same type.

For example: If a Delta P surge is detected and a DC Link surge is detected within ten seconds, the DC Link surge is not counted. The DC Link surge would be counted if the surge occurred more than ten seconds after the Delta P surge.

The total surge count displayed on the Surge Protection screen and the Hot Gas Bypass screen is accumulated by the surge protection feature, a different function of the control center.

A surge point can be manually inserted into the surge map using the “Manual Surge Point” key on the ACC Details screen and switch SW1 on the ACC board as described in the “System Calibration, Service Setpoints, and Reset Procedures” section of this book. Manual surge points are only to be used when the automatic surge detection does not respond to surge events. This is usually not required and is to be used only by qualified service technicians. At the instant the condition is identified as a surge event, the “Surge” LED (CR9) illuminates for two seconds.

The motor speed, Delta P/P and PRV position at the instant the surge point is plotted is unconditionally plotted as a 3-dimensional array in the surge map as a surge condition. This occurs regardless of whether or not the “Valid Point” LED (CR8) is illuminated. Once a manual surge point is plotted, the ACC board will respond to this point in exactly the same way the board responds to automatically plotted surge points, as described previously.

### Pre-Rotation Vanes

The microboard controls the pre-rotation vane position according to load, motor operating speed, and data received from the ACC board. A potentiometer mounted on the vane actuator supplies the ACC board with the position of the PRV, which is also required for speed control and surge prevention.

When the pre-rotation vanes approach the 100% open position during operation, there is very little PRV movement remaining to compensate for an increasing load condition. In automatic 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 temperature difference (delta T) between the leaving chilled liquid temperature and the leaving chilled liquid temperature setpoint. The speed is increased as follows:

- 0.1 Hz every 10 seconds when delta T is above 0.2 (0.1) and below 0.5°F (0.3°C).
- 0.1 Hz every 8 seconds when delta T is above 0.5 (0.3) and below 0.9°F (0.5°C).
- 0.1 Hz every 6 seconds when delta T is above 0.9°F (0.5°C).

The PRV potentiometer must be properly calibrated in order for variable speed control to be operative. The potentiometer calibration provides a voltage feedback to the ACC board when the PRV actuator is in the fully open and the fully closed positions. The voltage feedback between full open and full close is linear, so once calibration is completed, the ACC board can interpolate the exact position of the PRV actuator by the potentiometer feedback voltage. Refer to *PRV Calibration* in this section.

### ACC Board Components

The main components of the ACC board are as follows:

- **Microprocessor** – The microprocessor can be considered the center point of communication between the VSD components and the OptiView control center. The microprocessor is also the main surge detection component.
- **EPROM** – (Erasable Programmable Read Only Memory) The EPROM contains the operating program for the ACC board.
- **RAM** – The RAM serves as the “scratch pad” memory for the ACC board operation.
- **BRAM** – The BRAM is a battery backed memory device where the surge map is stored.
- **Watchdog** – 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 operating program is executed and that no program latch-ups occur.

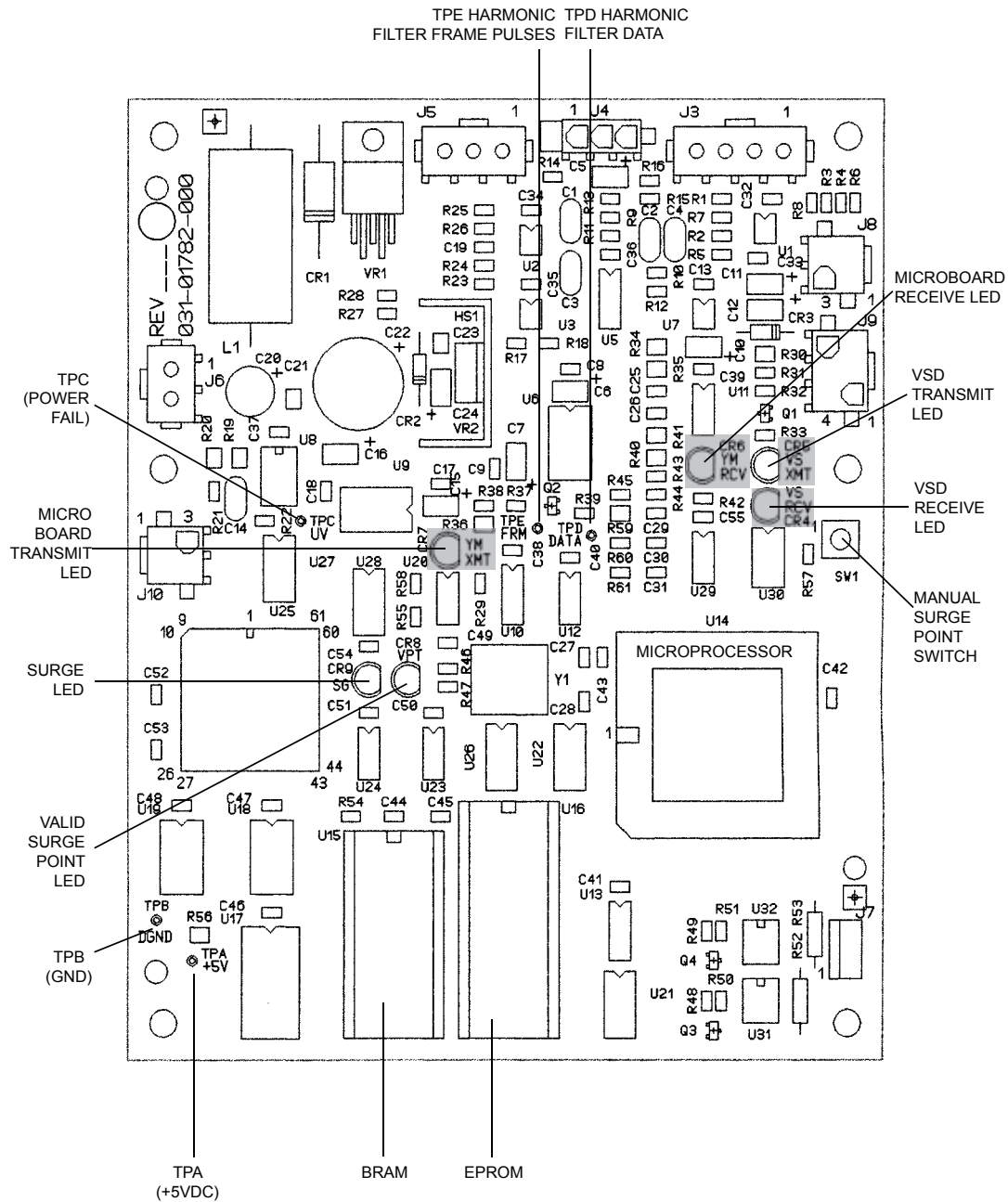


FIGURE 42 - VARIABLE SPEED DRIVE ADAPTIVE CAPACITY CONTROL BOARD

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To allow testing of the ACC board power supply and communication, test points are provided on the ACC board. These test points can be tested to assure the ACC board is receiving a power supply and is communicating properly. The test points are provided as follows:

- **TPA:** +5VDC supply voltage.
- **TPB:** Supply voltage ground.
- **TPC:** Watchdog power failure detection testpoint. Normally higher than +4.5 VDC. Transitions to logic low (<3.5 VDC) during low voltage conditions.
- **TPD:** Harmonic filter logic board 0/+5VDC 1200 baud serial data.
- **TPE:** Harmonic filter logic board frame pulse.

Use test point TPB as the source of ground for the other test points. Use an ohmmeter on the diode test setting to test the ACC board ground supply.

VSD service information is contained in the *Variable Speed Drive – Service Manual (Form 160.00-M1)*.

### ACC Board / Microboard Interface

Anytime the VSD logic board initiates a cycling or safety shutdown, the logic board “Stop” contacts are opened. These contacts are connected in series with the 1R (K18) “Run” relay coil on the OptiView I/O board. The contacts remain open as long as a condition exists. When the “Stop” contacts are opened, the circuit to 1R is opened, de-energizing the relay and removing the run signal to the VSD.

Simultaneously with the de-energizing of the 1R coil, the microboard reads the opening of the VSD “Stop” contacts via the I/O Board J2-1. This signals the microboard that a VSD shutdown has occurred. The microboard then 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” on the OptiView LCD. When the cause of the shutdown is received, the microboard displays a message describing the shutdown (refer to *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)* for complete listing of messages) and begins sending normal status data request commands. If the fault data is not returned to the microboard within two seconds, the microboard sends the command every two seconds

until fault data is returned. If the fault data is not returned within ten requests, the microboard assumes the data is not forthcoming and displays “VSD-STOP CONTACTS OPEN” on the OptiView LCD.

## CALIBRATION AND SETPOINT PROCEDURES

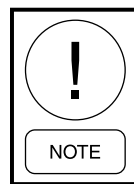
### VSD Full Load Amps Calibration

The full load amps calibration is required in order for the operating program to control VSD operation and initiate current threshold limits at 100% and 104% FLA.

1. Place the compressor switch in the Stop-Reset (O) position and wait until the “System Coastdown” is complete.
2. Login to Service access level and advance to the Motor screen.
3. Select the VSD details screen at the Motor screen.
4. In the VSD cabinet, locate the 100% FLA potentiometer located in the upper-central area of the VSD logic board.
5. While monitoring the VSD Full Load Amps (000.0) window on the VSD Details screen, adjust this potentiometer until the correct Full Load Amps value is displayed in the window. Clockwise will increase the value, counterclockwise will decrease the value.

### PRE-ROTATION VANE CALIBRATION

There is one procedure for all Pre-rotation Vane (PRV) calibrations.



***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, the previous calibration values will be used. If the PRV were not previously calibrated successfully, they will remain uncalibrated.***

The following procedure applies to the compressor motor Variable Speed Drive (VSD), and Hot Gas Bypass PRV calibration.

1. Place the compressor switch in the Stop-Reset (O) position and wait until the “System Coastdown” is complete.
2. Login to Service access level and advance to the Compressor screen.
3. Select the Pre-rotation Vanes Calibration screen at the Compressor screen.
4. Press the “Start Calibration” key to initiate the calibration. The “Calibration In Progress” and the “Pre-rotation Vanes Opening” LEDs will illuminate as an “open” signal is applied to the PRV actuator. After a 60 second delay, the program begins evaluating the feedback voltage from the PRV potentiometer. When the feedback voltage stops increasing and remains stabilized (so that there is no more than  $\pm 0.025$  VDC deviation) for 25 continuous seconds, the feedback voltage is logged as the 100% (open) position. A “close” signal is then applied to the PRV actuator and the “Pre-rotation Vanes Closing” LED illuminates. After a 10 second delay, the program begins evaluating the feedback voltage from the PRV potentiometer. When the feedback voltage stops decreasing and remains stabilized (so that there is no more than  $\pm 0.025$  VDC deviation) for 25 continuous seconds, the feedback voltage is logged as the 0% (closed) position. These endpoint voltages are stored in the ACC BRAM as the full open and full closed positions.
5. If the difference between the endpoint voltages is greater than 0.5 VDC, “PRV Calibration Successful” is displayed. Otherwise, “PRV Calibration Unsuccessful” will be displayed. “PRV Calibration Unsuccessful” is also displayed if the endpoints are not established within ten minutes.

### Stability Limit Setpoint

The Stability Limit setpoint factors whether a surge event is stored in the compressor map. This setpoint relates to the stability of the leaving chilled liquid temperature. When the leaving chilled liquid temperature is within  $+0.3$  and  $-0.8^{\circ}\text{F}$  ( $+0.2$  and  $-0.5^{\circ}\text{C}$ ) of the setpoint and the rate of change of this liquid temperature exceeds the programmed stability limit index, the system is considered unstable and a surge event that occurs under these conditions is not stored. The index is programmable over the range of 1000 to 7000, with the default being 4500. Higher values decrease sensitivity.

### Surge Margin Adjust

The Surge Margin setpoint allows the entire surge map to be adjusted up by a fixed offset value. The motor speed will be increased by the programmed frequency above each surge point in the surge map. This setpoint is programmable over the range of 0 to 25.0 Hz. The default setting is 0 Hz and is sufficient in most cases.

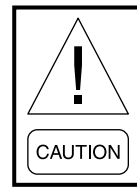
### Manual Surge Point

This key manually plots a surge point on the surge map. This key should only be used when the ACC board fails to detect a surge condition.

Navigate to the OptiView ACC Details screen. Press the “Manual Surge Point” key when necessary. Within 15 seconds of pressing this key, press SW1 on the ACC board for at least 1 second. The ACC board will confirm the point was plotted by illuminating red “Surge” LED (CR9) for 2 seconds. The operating conditions at the instant the key was pushed are captured and stored as a surge point.

### Surge Map Clear

This key clears all of the previously established surge points that are stored in the ACC board’s BRAM memory.



***Clearing the surge map should ONLY be done under the advisement of YORK/Johnson Controls Aftermarket Service.***

When this key is pressed, a dialog box appears requesting the ACC Map Clear password. Enter 0, 3, 6, 8 and press the “Enter” key. Press switch SW1 (for at least 1 second) on ACC Board within 15 seconds of pressing the “Enter” key. A message is displayed advising the clearing is in progress. Another message will be displayed advising the surge map clear was successful or failed. The Surge map clear can be canceled by pressing the appropriate key.

### Manual VSD Speed Control

The VSD Frequency can be manually controlled as follows:

1. Navigate to the “VSD Tuning” screen from the Compressor screen.

2. For desired operation, press the appropriate key as follows:

- **Set** – Places Frequency Control in Manual Mode. Sets the VSD speed at a specific frequency between 1.0 and 60 (50) Hz.
- **Auto** – Returns the VSD to automatic frequency control. The frequency is determined by the ACC Board to achieve slowest speed possible while avoiding surge.
- **Fixed** – Sets the VSD frequency at maximum: 50 or 60 Hz, as equipped.
- **Raise** – Places VSD frequency control in manual mode. Increases the VSD frequency by 0.1 to 10.0 Hz, as programmed with the INCR AMT (increment amount) key.

Each press of this key increases the frequency by the programmed increment amount (0.1 to 10.0 Hz)

- **Lower** – Places VSD frequency control in manual mode. Decreases the VSD frequency by 0.1 to 10.0 Hz, as programmed with the INCR AMT (increment amount) key.

Each press of this key decreases the frequency the programmed amount (0.1 to 10.0 Hz).

- **Incr Amt** - This setpoint determines the amount of increase or decrease (0.1 to 10.0 Hz) in VSD frequency that occurs with each press of the “Raise” or “Lower” key in manual control mode.

When making the transition from manual to automatic mode, if the VSD speed is below 30 Hz, the frequency setpoint will automatically be set to 30 Hz and adjusted to this point. If the motor is not in current limit, the setpoint is full speed (50 or 60 Hz) and the VSD speed will be increased as follows:

- 0.2 Hz every second if leaving chilled liquid temperature more than 0.2°F (0.1°C) below the setpoint and motor current is below 80% FLA.
- 0.2 Hz every [1 second + (%FLA-80)] seconds if leaving chilled liquid temperature is more than 0.2°F (0.1°C) below the setpoint and the motor current is above 80% but less than 98% FLA.

- 0.2 Hz every 19 seconds if neither of the above conditions are present.

When the leaving chilled liquid temperature is within 0.2°F of the setpoint, a close signal is applied to the PRV for the following durations at intervals of 4.5 seconds as speed increases:

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

## SECTION 11 – EXTERNAL DIGITAL AND ANALOG INPUT/OUTPUT BOARDS

### EXTERNAL I/O BOARD DESCRIPTION

The OptiView Retrofit Kit is equipped with an additional analog I/O board and an additional digital I/O board. These additional I/O boards are referenced as external boards as they are considered an external device to the OptiView Control Center, although the boards are mounted to a plate on the right inside wall of the OptiView cabinet.

The additional I/O boards are necessary to handle the additional inputs and outputs required by the OptiView Retrofit Kit. These additional input/output requirements include the purge alarm, motor and bearing winding temperature sensors, motor coolant pump and thermostat, hot gas bypass, and refrigerant level control (future).

The OptiView microboard communicates with the external I/O boards through the COM 3 serial data communication port. The COM 3 serial data port connection is located at J12 on the right side of the microboard. This port utilizes RS-485 type communication.

### EXTERNAL ANALOG I/O BOARD

The external analog I/O board is the upper printed circuit board mounted to the right inside wall of the OptiView cabinet. This board is used as an input device for signals from the Trane motor winding temperature sensors and the Trane bearing temperature sensors. The analog board conditions the temperature sensor inputs and provides an output to the microboard to interpret as a temperature.

The microboard also uses the analog I/O board as an output device to control the optional hot gas bypass and refrigerant level control. The hot gas bypass and refrigerant level control features are engineered specifically for each application and are not covered within this manual.

### I/O Board Power Supply

The external analog I/O board receives +12 VDC, - 12 VDC, and + 5VDC power and ground from the OptiView power supply. The +12 VDC and - 12VDC supplies are fed through the microboard at connection J1 and connected to the analog I/O board at P9. The +5 VDC and ground supplies are connected directly from OptiView power supply to the external I/O boards at P9.

The + 5 VDC and - 12 VDC power supplies are 5 amp, buss-style, fuse protected at 4FU and 6FU, respectively. These fuses are located and labeled at the fuse holder located above the OptiView power supply.

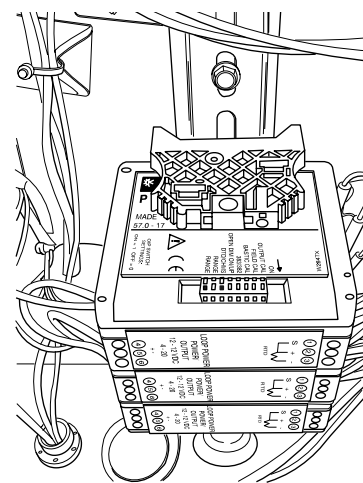
### Analog Inputs

#### Motor Winding Temperature Sensors

Trane chiller motors utilize non-replaceable RTD type sensors to measure the temperature of each chiller motor phase winding (phase A, B, C). The OptiView Control Center cannot read the RTD-type sensors directly, so the OptiView Retrofit Kit employs signal conditioner modules to convert the RTD signals into a 4-20 mA output. This output is connected from the signal conditioners to the analog I/O board inputs. The analog I/O board converts the 4-20 mA signal into an A/D counts signal that is interpreted as a temperature by the microboard. The signal is transmitted to the microboard COM 3 serial data communication port from analog board connection P9.

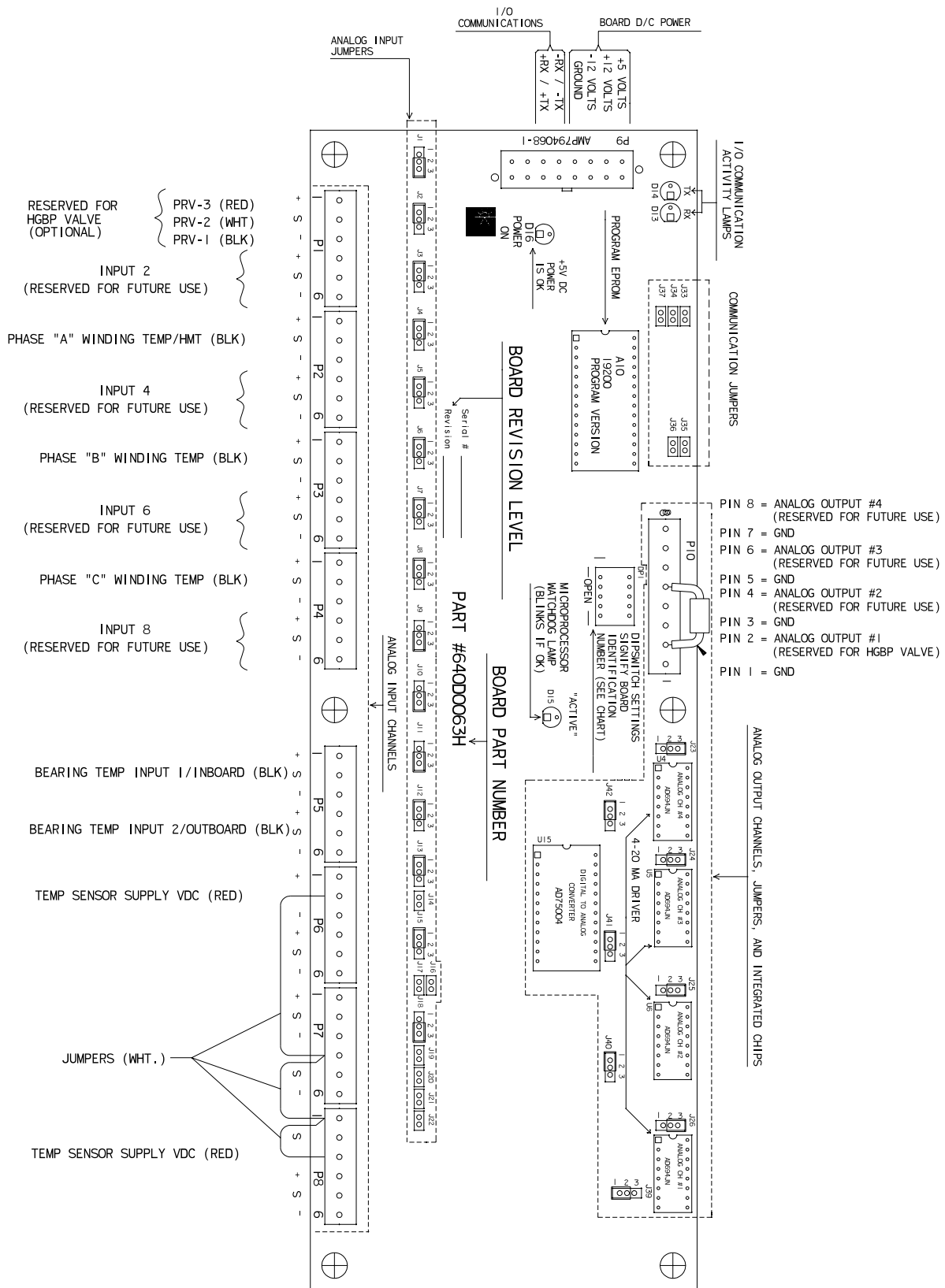
In order for the analog I/O board to read the 4-20 mA input, jumpers on the board must be configured properly for each channel. In addition to 4-20 mA inputs, the board can also read 0 to +5 VDC, 1 to +5 VDC and ICTD inputs.

Each motor phase winding sensor common wire and signal wire is connected to a corresponding signal conditioner (*Figure 43*). The signal conditioners, located in the auxiliary junction box, should be marked or labeled for the phase winding sensor the conditioner converts into a 4-20 mA signal. Each of the signal conditioners is configured (by DIP switch settings) to read the proper RTD range and provide a 4-20 mA signal to the analog I/O board.



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**FIGURE 43 - MOTOR RTD SIGNAL CONDITIONERS**



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FIGURE 44 - EXTERNAL ANALOG I/O BOARD

The signal conditioners require a 24 VDC power source in order to convert the Trane RTD signals into a 4-20 mA signal. The 24 VDC power source is supplied by the OptiView Control Center power supply. Terminal block 7 (TB7), located in the OptiView cabinet, is used to distribute the 24 VDC supply to each signal conditioner.

The +24 VDC supply is fused at 5FU with a 5 amp, buss-style fuse. This fuse also protects the +24 VDC source to the motor controller board.

The motor winding sensor 4-20mA input wires are connected to three of the analog I/O board's sixteen inputs. These inputs are made on channel 1 of the following I/O board connections:

- Phase A winding sensor - Connection P2-2 (S)
- Phase B winding sensor - Connection P3-2 (S)
- Phase C winding sensor - Connection P4-2 (S)  
("S" = I/O board signal input)

The analog I/O board reads the 4-20 mA signal at each of these connections and provides the data to the microboard for display and chiller control.

The OptiView microprocessor monitors each motor winding phase temperature per the operating software. The software allows the cutout temperature setpoint of the motor windings to be programmed. If any of the motor winding sensors reaches the cutout setpoint, the OptiView Control Center will perform a safety shutdown of the chiller.

The OptiView operating software also allows any of the three winding sensor inputs to be disabled, should the sensor malfunction. While all three winding sensors can be disabled in the OptiView software, at least one sensor must be operational as a safety precaution. If all three sensors were to malfunction, there would be no temperature protection should the motor windings overheat. The motor must be repaired or replaced when all three sensors no longer function.

### **Bearing Temperature Sensors**

Bearing temperature sensors are included with the OptiView Retrofit Kit that are optionally installed as an additional level of chiller operating safety. These 50K ohm sensors measure the temperature of the oil at the inboard and outboard compressor bearings.

Since the bearing temperature sensors are supplied with the York OptiView Retrofit Kit, the sensors are the thermistor-type. Thermistors can be read by the analog I/O board without additional signal conditioners, as required for the motor winding sensors.

The bearing temperature sensors are connected directly to the analog I/O board at connections P5, P6, and P8. A +5 VDC signal is applied to each sensor, which is passed through the sensor. As temperature rises, resistance in the thermistor decreases, allowing more voltage to pass through. The analog I/O board reads this voltage and converts voltage to an A/D counts signal for the microboard to interpret as temperature.

Factory installed jumpers on the analog I/O board between the P6, P7, and P8 terminal blocks create a voltage compensation circuit. This circuit supplies the sensors with +5 VDC and prevents voltage drop when the bearing temperature sensors are connected to the board. The voltage compensation circuit jumpers (white jumper wires) must be installed in the proper locations in order for the sensors to be read properly by the I/O board.

The bearing temperature sensors are the same type of sensor used to measure compressor discharge and sump oil temperatures. Refer to *SECTION 13 - TEMPERATURE SENSORS* for additional information.

### **EXTERNAL DIGITAL I/O BOARD**

The external digital I/O board is the lower printed circuit board mounted to the right inside wall of the OptiView cabinet. This board is used as an input device for signals from the chiller purge unit and the chiller motor refrigerant pump thermostat, as equipped. The digital I/O board reads the digital input and provides a signal to the microboard that gives the state of the digital input. The microboard communicates with the digital board through digital board connector P7. This connector is daisy-chained from the analog I/O board.

The digital I/O board also serves as an output device for the microboard. The digital output controls the operation of the motor refrigerant cooling pump, as the chiller is equipped.

All of the digital board input/output connections are optional and may or may not be installed, depending on how the chiller is equipped.

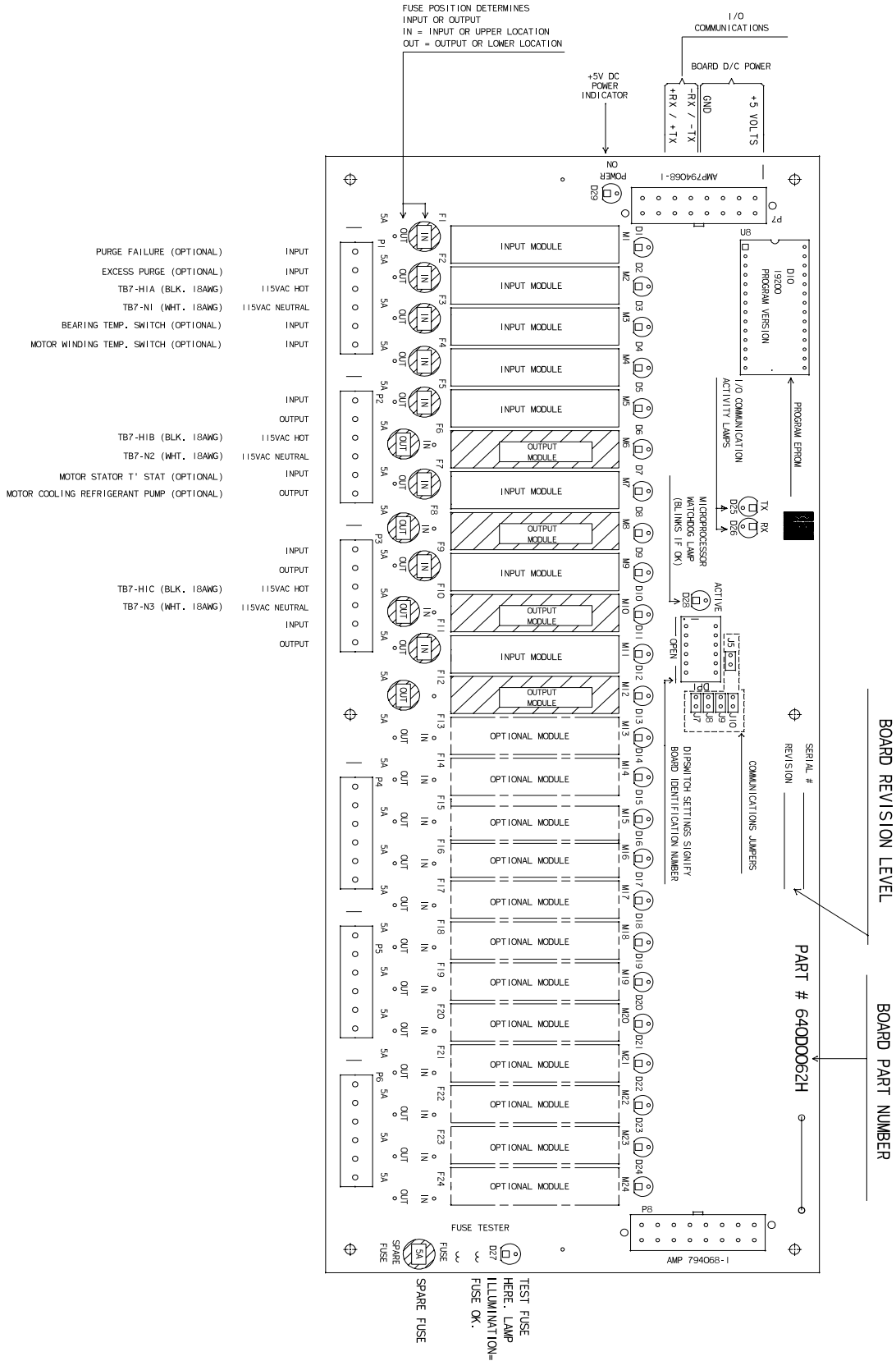


FIGURE 45 - EXTERNAL DIGITAL I/O BOARD

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## I/O Board Power Supply

The external digital I/O board power supply is daisy-chained to the analog I/O board. The digital I/O board receives +5 VDC power and ground at connector P7 from the analog I/O board. The +5 VDC is used for the digital I/O board logic circuits. The digital board does not require +12 and -12 VDC power.

Since the +5 VDC power supply for the digital I/O board is the same source used for the analog I/O board, the supply is fused at 4FU. This 5 amp, buss-style fuse is located above the microboard power supply. Each of the inputs/outputs for the digital board has additional 5 amp microfuse protection. The digital I/O board has two positions on the board for each microfuse, “in” or “out”. The position of the fuse determines whether corresponding connection is an input or output.

## Digital Inputs

Digital inputs are “on/off” signals from the contacts of external devices such as relays, solenoids and switches. When the contacts close, 115 VAC voltage is present at the I/O board inputs. This is the “on” state for the input. An LED next to the I/O board input will illuminate when the input is in the “on” state. When the voltage is not present, the input is in the “off” state.

In order for the I/O board to be able to read the input, an “input module” must be installed in the digital I/O board. The input modules detect the presence of voltage and send logic signals to the microboard. The microboard interprets the logic signal and indicates the device is “on” or “off”.

Input modules can be rated for 120 or 240 VAC controls. Both modules are yellow in color, but can be identified by reading the voltage range printed on the side of the module. The OptiView Retrofit Kit currently utilizes 120 VAC inputs only.

The 115 VAC power supply for the input signal is connected to the digital I/O board at each input that is used (P1-3, P2-3). This power source is supplied from the OptiView power supply and is routed from the power supply to the I/O board through terminal block 7 (TB7-H1A, TB7-H1B). This power supply is protected at 7FU by a 15 amp buss-style fuse. The 7FU fuse is located in TB7.

The microfuse adjacent to the location of the input module on the I/O board must be in the “in” position for the input module to function.

## Chiller Purge Unit Remote Fault/Alarm Input

The purge unit remote fault/alarm is an optional alarm which can be connected when the chiller is equipped with a Trane purge unit or a York SkyGuard purge unit. When the contacts of the remote fault (Trane) or alarm relay (SkyGuard) close, 115 VAC is present at the digital I/O board input at P1-1. The digital I/O board detects the presence of voltage and sends a signal to the OptiView microboard. “WARNING – PURGE FAULT” is displayed in the system status line when this condition occurs.

## Chiller Excess Purge Input

Purge units equipped with excess purge digital output can be connected to the digital I/O board. When the excess purge contacts close, 115 VAC is present at the digital I/O board input at P1-2. The digital I/O board detects the presence of voltage and sends a signal to the OptiView microboard. “WARNING – EXCESS PURGE” is displayed in the system status line when this condition occurs.

## Motor Winding and Bearing Thermal Switch Inputs

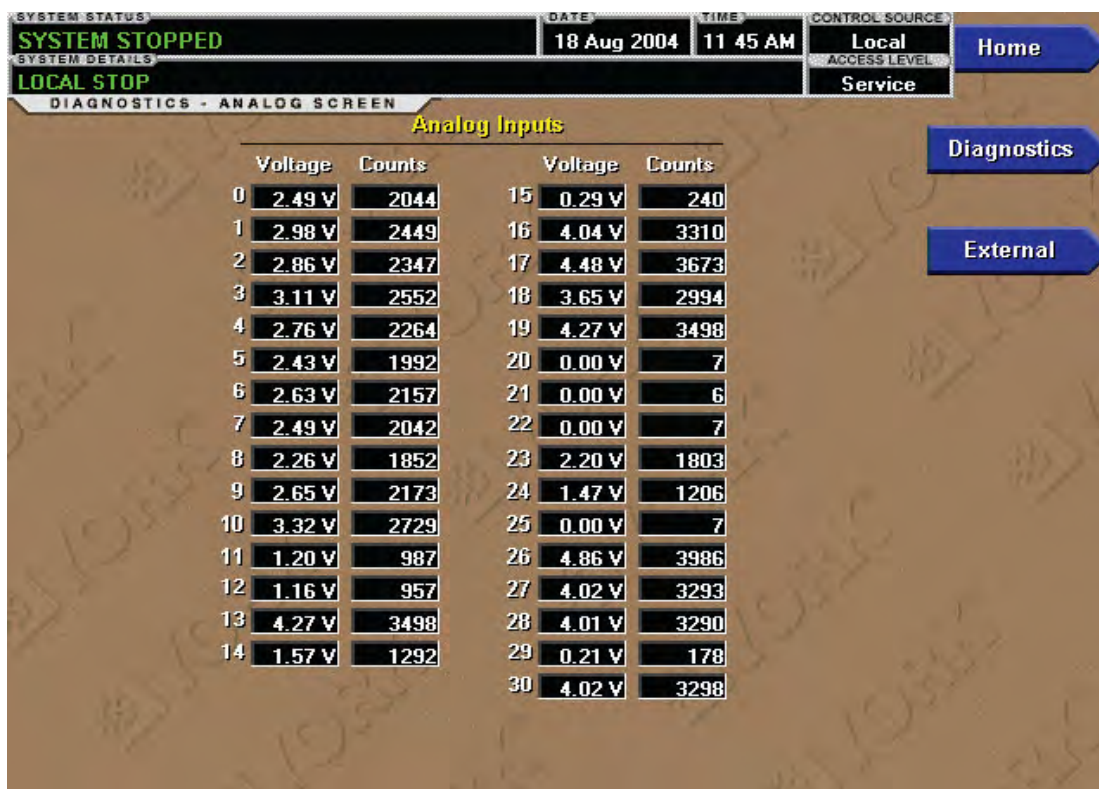
The external digital I/O board can accept an input from a motor winding and/or bearing thermal switch, as the chiller is equipped. The connections for the bearing and motor winding thermal switches are made at P1-5 and P1-6, respectively.

## Motor Stator Thermostat Input

The external digital I/O board can accept an input from a motor stator thermostat, as equipped. This connection is made at P2-5 on the digital I/O board. When the motor temperature increases and the thermostat closes, 115 VAC is present at the digital board. The digital I/O board reads the voltage and sends a logic signal to the microboard that the thermostat is closed. The microboard responds by energizing the digital output for the motor refrigerant pump. A display window on the OptiView Motor Temperature screen indicates if the thermostat contacts are open or closed.

## Digital Outputs

Under the control of the microboard, the digital I/O board is capable of controlling outputs to external devices. The outputs are “on/off” signals to devices such as the refrigerant pump for the chiller motor. When the microboard sends a logic signal to the digital I/O board to place the device in the “on” state, voltage (115 VAC) is applied to the device. An LED next to the I/O board output will illuminate when the output is in the “on” state.



LD10022

**FIGURE 46 - EXTERNAL ANALOG I/O BOARD INPUT DIAGNOSTIC SCREEN**

In order for the digital I/O board to control the output, an “output module” must be installed in the digital I/O board. The output modules detect a logic signal from the microboard and apply voltage to the connected device. Output modules are black in color and capable of controlling up to 280 VAC. Currently, only 115 VAC is supplied through the output modules.

The 115 VAC power supply for the output signal is connected to the digital I/O board at each output connector that is used (P2-3). This power source is supplied from the OptiView power supply and is routed from the power supply to the I/O board through terminal block 7 (TB7-H1B). This power supply is protected at 7FU by a 15 amp buss-style fuse. The 7FU fuse is located in TB7.

The microfuse adjacent to the location of the output module on the I/O board must be in the “out” position for the output module to function.

### Motor Coolant Pump Output

On chillers equipped with a motor coolant pump, the pump is controlled by an external I/O board digital output. This output is enabled by the OptiView microboard. When the microboard receives a signal indicating the motor thermostat contacts are closed, the microboard responds by switching the digital output to the coolant

pump “on”. The output (P2-6) supplies 115 VAC, operating the pump until the thermostat contacts open.

The motor coolant pump output can also be controlled manually from the Motor Temperature screen. A Motor Coolant Pump LED on the Motor Temperature screen illuminates when the digital output is “on”.

### EXTERNAL I/O BOARD DIAGNOSTICS

The OptiView Control Center software allows the state of external analog I/O board inputs and outputs to be monitored. This is useful to help locate a problem with the analog I/O board.

The external I/O boards and several I/O board components such as input or output modules, fuses, etc. can be replaced if a malfunction occurs. The external I/O boards are available individually, but board jumper setup must be verified if a replacement board is installed. Refer to *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for the part numbers of the serviceable components.

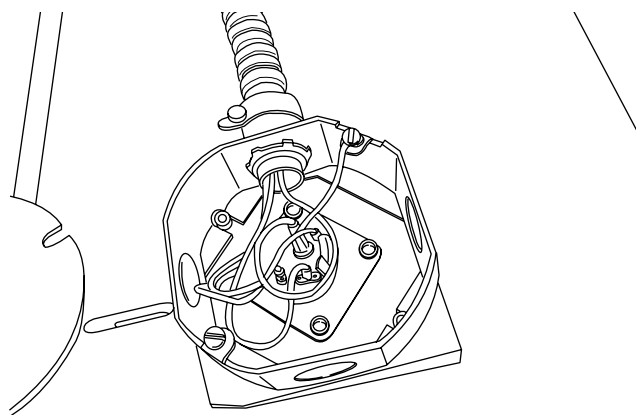
Components that are replaced under the warranty must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.

## Analog I/O Board And Component Testing

The external analog I/O board inputs can be monitored on the “external” view of the OptiView Analog Diagnostic screen. The voltage and the microboard count number of each analog input is displayed on this screen.

If the I/O board problem cannot be determined using the diagnostic screen, perform the following procedure to test the analog I/O board:

1. Open the OptiView cabinet door and inspect all wiring harness connections between the external I/O boards and the microboard and other connections. Verify all harness connectors are firmly connected. Inspect the following buss-style fuses (5 amp) for the external I/O board power supplies.
  - 4FU – I/O Board +5 VDC Supply
  - 5FU – Signal Conditioner + 24 VDC Supply
  - 6FU – I/O Board -12 VDC Supply
2. Verify the I/O board jumpers, including the wire jumpers, are in the proper positions. Refer to the *OptiView Retrofit Kit Wiring Diagrams* for the proper jumper positions.
3. Locate the logic voltage LED (D16) on the board. The LED will be illuminated when the analog I/O board is receiving +5 VDC logic supply voltage.
4. Measure the +5 VDC supply voltage between P9-18 to P9-15. Keep the connector attached to the I/O board while testing voltage, carefully inserting the test probes into the rear of the connector. The minimum acceptable board voltage is +4.98 VDC. If voltage is below this specification, check operation of the OptiView power supply and microboard.
5. Verify the voltage between connector terminals P9-17 and P9-15 is +12 VDC. Verify voltage between connector terminals P9-16 and P9-15 is -12 VDC.
6. Using an ohmmeter on diode test, check for continuity between P9-15 and ground. Inspect power supply wiring if there is insufficient grounding or an erratic reading.
7. When the microboard and the I/O boards are communicating through the COM 3 serial data port, the analog I/O board TX/RX LEDs will be flashing. If the TX/RX LEDs are not flashing on the I/O board, check operation of the microboard COM 3 serial port using the diagnostic procedure in Section 3A or 3B of this manual.



LD10261

**FIGURE 47 - WINDING TEMPERATURE RTD BOX**

8. Verify the bearing temperature sensors are operating properly. Refer to *SECTION 13 - TEMPERATURE SENSORS* in this manual. The bearing sensors operate the same as the oil sump temperature sensor.
9. The following steps detail testing of the Trane motor winding sensors and related components. Typically, if only one motor winding temperature is out of range, a malfunctioning winding RTD or signal conditioner is at fault.

With the chiller motor at ambient temperature, remove the cover of the motor winding RTD box on the chiller motor. Using an ohmmeter in diode test mode, test continuity to ground. Verify a wire from sensor common to the motor RTD junction box has been installed.



***YORK does NOT recommend operating the chiller while motor winding sensors are disconnected or inoperative. Extensive damage to the chiller as well as physical injury may result in the event the chiller motor malfunctions and overheats.***

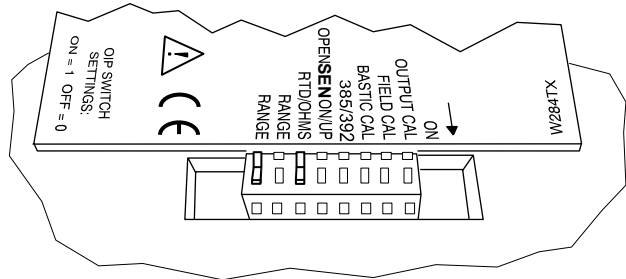
10. Test the resistance of each motor RTD between the sensor and common. Record the resistance of each of the three sensors. If an open sensor is found, the sensor can be disabled in the Motor Temperature screen.
11. Compare the recorded resistance of the motor RTDs with the data listed in Table 15 and the sensor temperature displayed on the motor temperature sensor screen. The motor windings should be close to ambient air temperature when performing this comparison. If the recorded sensor resistance and temperature are not comparable, test operation of the RTD signal conditioner module.

**TABLE 14 - MOTOR WINDING RTD DATA**

Sensor Temperature*		Sensor Voltage ( $\pm 0.05$ Volts)	Nominal Resistance (Ohms)	Acceptable Resistance Values (Ohms)	
°F	°C			Minimum	Maximum
50	10	0.321	70.1 $\pm$ 2.7	67.4	72.8
55	13	0.326	71.1 $\pm$ 2.7	68.4	73.8
60	16	0.330	72.1 $\pm$ 2.7	69.4	74.8
65	18	0.334	73.1 $\pm$ 2.7	70.4	75.8
70	21	0.338	74.0 $\pm$ 2.6	71.4	76.6
75	24	0.342	75.0 $\pm$ 2.6	72.4	77.6
80	27	0.347	76.0 $\pm$ 2.6	73.4	78.6
85	29	0.351	77.0 $\pm$ 2.6	74.4	79.6
90	32	0.355	78.0 $\pm$ 2.6	75.4	80.6
95	35	0.359	79.0 $\pm$ 2.6	76.4	81.6
100	38	0.364	80.0 $\pm$ 2.6	77.4	82.6
110	43	0.372	82.0 $\pm$ 2.5	79.5	84.5
120	49	0.381	84.0 $\pm$ 2.5	81.5	86.5
130	54	0.390	86.0 $\pm$ 2.5	83.5	88.5
140	60	0.397	88.0 $\pm$ 2.5	85.5	90.5
150	66	0.407	90.2 $\pm$ 2.4	87.8	92.6
160	71	0.415	92.2 $\pm$ 2.4	89.8	94.6
170	77	0.424	94.3 $\pm$ 2.3	92.0	96.6
180	82	0.433	96.5 $\pm$ 2.3	94.2	98.8
190	88	0.441	98.5 $\pm$ 2.3	96.2	100.8
200	93	0.450	100.8 $\pm$ 2.3	98.5	103.1
210	99	0.459	103.0 $\pm$ 2.2	100.8	105.2
220	104	0.468	105.1 $\pm$ 2.2	102.9	107.3
230	110	0.476	107.2 $\pm$ 2.1	105.1	109.3
240	116	0.486	109.5 $\pm$ 2.0	107.5	111.5
250	121	0.494	111.6 $\pm$ 2.0	109.6	113.6
260	127	0.504	114.0 $\pm$ 2.0	112.0	116.0
270	132	0.514	116.4 $\pm$ 2.1	114.3	118.5
280	138	0.523	118.7 $\pm$ 2.2	116.5	120.9
290	143	0.532	121.1 $\pm$ 2.2	118.9	123.3
300	149	0.542	123.6 $\pm$ 2.3	121.3	125.9
310	154	0.552	126.1 $\pm$ 2.3	123.8	128.4

\*Overall accuracy of the motor winding temperature RTD's is  $\pm 15^{\circ}\text{F}$  ( $\pm 8^{\circ}\text{C}$ ).

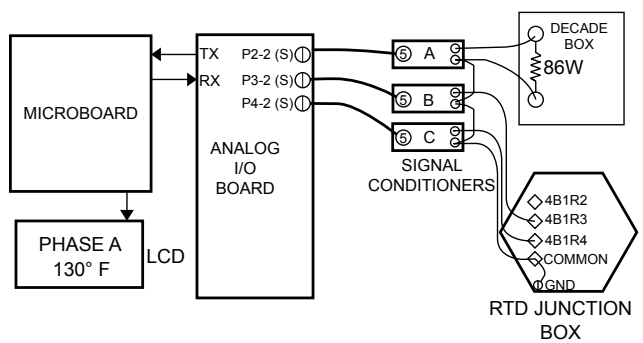
- Using a DC voltmeter, verify there is +24 VDC voltage at terminal 4 of each signal conditioner.
- Check the position of the DIP switches for each signal conditioner. All switches except 6 (RTD/Ohms) and 8 (Range) should be in the “OFF” position.



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**FIGURE 48 - SIGNAL CONDITIONER DIP SWITCHES**

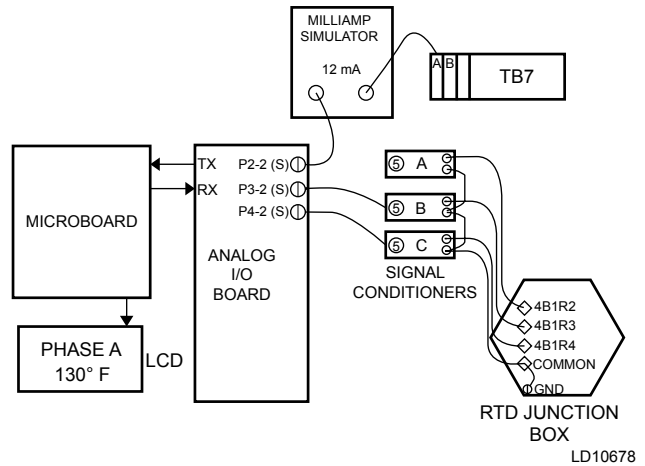
- If the proper voltage is present at each signal conditioner and the DIP switches are properly set, test the signal conditioner with a module that is known to be operating properly or connect a decade resistance box to the phase A signal conditioner as shown in Figure 55. The decade resistance box should be set at 86 ohms. The temperature reading on the motor temperature screen should be at 130°F (54° C). Perform this test for the remaining signal conditioners.



LD10673

**FIGURE 49 - SIGNAL CONDITIONER TEST**

- If the temperature for any of the motor winding sensors does not register as 130°F (54° C), connect a milliampere simulator to I/O board phase A winding sensor input at P2-2 and TB7-A (+24 VDC) as shown in Figure 56. Set the milliampere simulator to 12 mA. The reading on the OptiView panel display for the phase A winding sensor should be 130°F (54° C). Repeat the test for phase B and C (inputs P3-2 and P4-2).



LD10678

**FIGURE 50 - ANALOG I/O BOARD TEST**

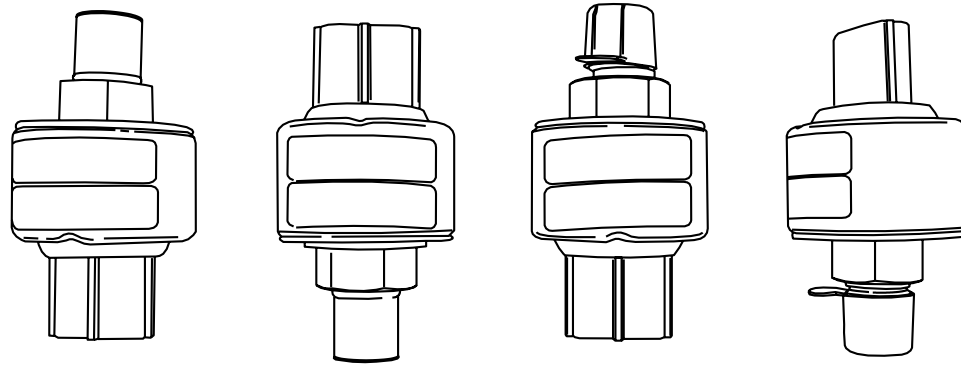
- The temperature displayed on the Motor Temperature screen for each phase should be approximately 130°F (54° C). If the displayed temperature is correct after the milliampere simulator is used, the RTD signal conditioner is at fault, replace the signal conditioner. If the temperature is not as specified after the milliamp simulator is used, the analog I/O board is at fault.

## Digital I/O Board And Component Testing

The state of the external digital I/O board inputs and outputs cannot be monitored on the OptiView Digital Diagnostic screen. The state of the digital input or output is indicated on the board with an LED.

1. Open the OptiView cabinet door and inspect all wiring harness connections between the external I/O boards and the microboard and other connections. Verify all harness connectors are firmly connected. Inspect the following buss-style fuses (5 amp) for the external I/O board power supplies.
  - 4FU – Board +5 VDC Supply
  - 6FU – Board -12 VDC Supply
  - 7FU – Output 115 VAC Supply
2. Verify the microfuse for the input or output is in the proper position, “in” for inputs, “out” for outputs. Remove the fuse for the input and place the fuse in the fuse tester at the bottom of the digital I/O board. If the fuse is intact, the fuse tester LED (D27) will illuminate. Replace the fuse if necessary, checking for problems with the input and input wiring that would be cause for the fuse to blow.
3. Verify the DIP switches on the I/O board are in the proper position according to the part number of the board. Refer to the OptiView Retrofit Kit drawings.
4. Locate the logic voltage LED (D29) on the board. The LED will be illuminated when the digital I/O board is receiving +5 VDC logic supply voltage.
5. Using a DC voltmeter, measure the +5 VDC supply voltage between P7-18 to P7-15. Keep the connector attached to the I/O board while testing voltage, carefully inserting the test probes into the rear of the connector. The minimum acceptable board voltage is +4.98 VDC. If voltage is below this specification, check operation of the OptiView power supply and microboard.
6. Using an ohmmeter on diode test mode, check for continuity between P7-15 and ground. Inspect power supply wiring if there is insufficient grounding or an erratic reading.
7. When the microboard and the I/O boards are communicating through the COM 3 serial data port, the digital I/O board TX/RX LEDs will be flashing. If the TX/RX LEDs are not flashing on the I/O board, check operation of the microboard COM 3 serial port using the diagnostic procedure in Section 3A or 3B of this manual.
8. If the chiller is equipped with a motor coolant pump, enter the Motor Temperature screen on the OptiView display. Check the condition of the motor stator thermostat. Compare the thermostat condition displayed with the thermostat digital input LED (D7) on the digital board. The LED will be illuminated when the thermostat is closed. If the LED and display do not match and COM 3 serial data communications are operating properly, replace the input module.
9. Place the motor coolant pump in manual operation mode. If the pump does not operate, verify the I/O board LED (D8) for the pump digital output is illuminated. If the LED does not illuminate, replace the output module.
10. If the digital output LED (D8) for the coolant pump illuminates, but the pump does not operate, check the pump wiring harness and verify that the pump is receiving 115 VAC from the digital I/O board (P2-6).
11. Verify the purge related digital inputs are operating properly by applying 115 VAC current to each input (P1-1, P1-2, as equipped). The LED (D1, D2) for each input should illuminate when 115 VAC is applied. If the LED does not illuminate, check the input module with one that is known to work properly. Verify the fuse for the input is intact.
12. If the input module is working properly and the fuse is intact, check the operation of the chiller purge unit. Refer to the service information provided with the purge unit.

## SECTION 12 – OPTIVIEW PRESSURE TRANSDUCERS



LD10250

**FIGURE 51 - PRESSURE TRANSDUCERS**

### PRESSURE TRANSDUCER DESCRIPTION

The chiller system pressures are sensed by pressure transducers. The evaporator, condenser, pump oil (HOP), sump oil (LOP) and purge (as equipped) pressures are measured. There are different transducers used to sense the various system pressures. The actual transducer used is determined by the required pressure range and the medium the transducer is measuring (oil, refrigerant, etc.).

The operation of the various transducers is identical, the difference between them is the pressure range over which each operates. Each of the transducers has a different application and YORK part number.

### PRESSURE TRANSDUCER OPERATION

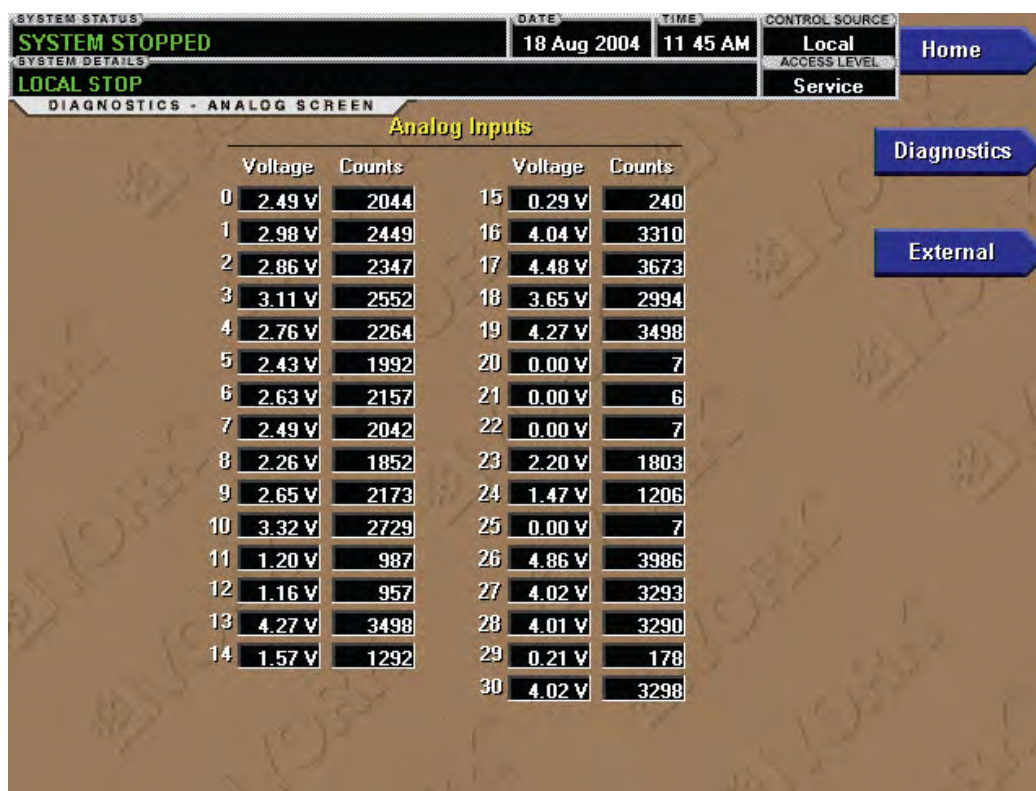
#### Description

The transducers operate from a +5VDC which is provided by the power supply through the microboard. Each transducer is connected to the microboard with three wires at connections J8 and J9. Two wires provide the +5 VDC supply voltage and ground (GND) and the remaining wire connects the transducer output to the microboard.

Each transducer outputs a 0.5 to 4.5 VDC voltage signal that is analogous to the pressure applied to the device. The OptiView microprocessor converts the transducer output voltage to a pressure value with the appropriate formula for each transducer according to the operating software. The pressures are measured as PSIA (pounds per square inch absolute) in English unit mode or kPA (kilopascals) in Metric unit mode. The pressures are displayed on the OptiView screen. In addition to being displayed, the pressures are used for chiller control and safety shutdowns.

#### Chiller Shell Transducers

The OptiView Control Center provides evaporator and condenser saturation temperatures using the pressure provided from the corresponding pressure transducer. The temperature is displayed per the appropriate refrigerant pressure/temperature conversion table contained in the operating software. The saturation temperatures are used for chiller control.



LD10022

FIGURE 52 - ANALOG INPUT DIAGNOSTIC SCREEN

## Oil Pressure Transducers

The outputs of the sump and pump oil pressure transducers are displayed individually as PSIA (pounds per square inch absolute) values. However, the system oil pressure is displayed as a differential value in terms of PSID (pounds per square inch differential). This PSID value is calculated by subtracting the sump oil pressure transducer value from the pump oil pressure transducer value.

## Purge Pressure Transducer

If the chiller is equipped with a TurboGuard II purge unit, the purge pressure can be monitored on the Purge screen (Refer to *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1)*). Purge pressure is measured and displayed as a PSIA value.

## PRESSURE TRANSDUCER SERVICE

If a pressure transducer fails, replace the transducer with one of the same part number. An improper pressure transducer installed in the chiller system may result in the chiller being inoperable. Refer to the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for pressure transducer part numbers.

Components replaced under the warranty must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.

## Transducer Troubleshooting

There are several methods available to troubleshoot suspected problems with the system pressure transducers. The OptiView operating software contains an analog I/O diagnostic screen which displays the DC voltage signal for each analog input. *Table 15* shows the assigned number for the analog input and the transducer related to that input.

**TABLE 15 - TRANSDUCER ANALOG INPUT DIAGNOSTIC CHANNELS**

Analog Input Number	Transducer
9	Condenser Pressure
10	Evaporator Pressure
11	Sump Oil Pressure (LOP)
12	Pump Oil Pressure (HOP)
14	Purge Pressure (as equipped)

**TABLE 16 - TRANSDUCER ANALOG INPUT VOLTAGES AT MICROBOARD**

Transducer	Input Terminal	Ground Terminal
Condenser Pressure	J8-21	J8-22
Evaporator Pressure	J8-18	J8-9
Sump Oil Pressure (LOP)	J9-1	J9-2
Pump Oil Pressure (HOP)	J8-6	J8-7
Purge Pressure	J8-15	J8-16

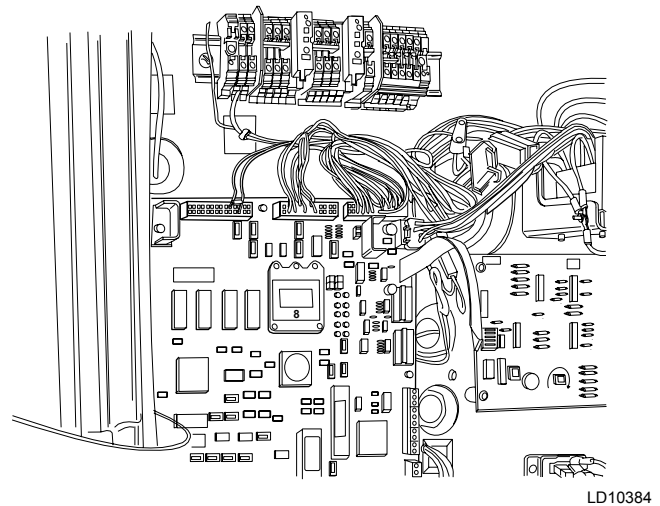
The voltage output of each transducer can also be measured with a voltmeter at the microboard. The measurement should be made from the transducer output (microboard input) to ground (GND). Refer to *Table 17* for the transducer connection terminals.

To convert the measured signal voltages to a pressure, refer to the formula in *Figure 54* that corresponds with the appropriate transducer. If the pressure is known, the approximate transducer voltage output can also be calculated using the formula in *Figure 54*.

If the voltage or calculated pressure is out of the specifications shown for the transducer in *Figure 54*, perform the following test procedure:

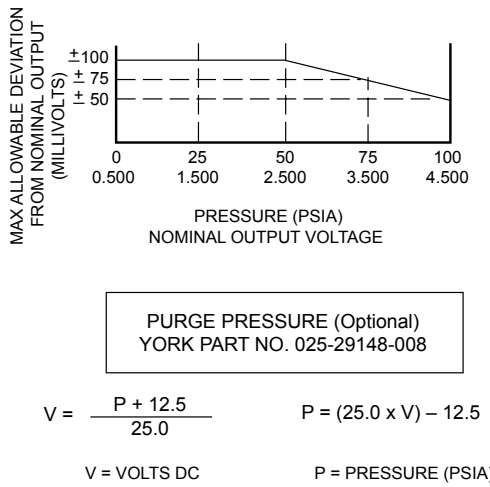
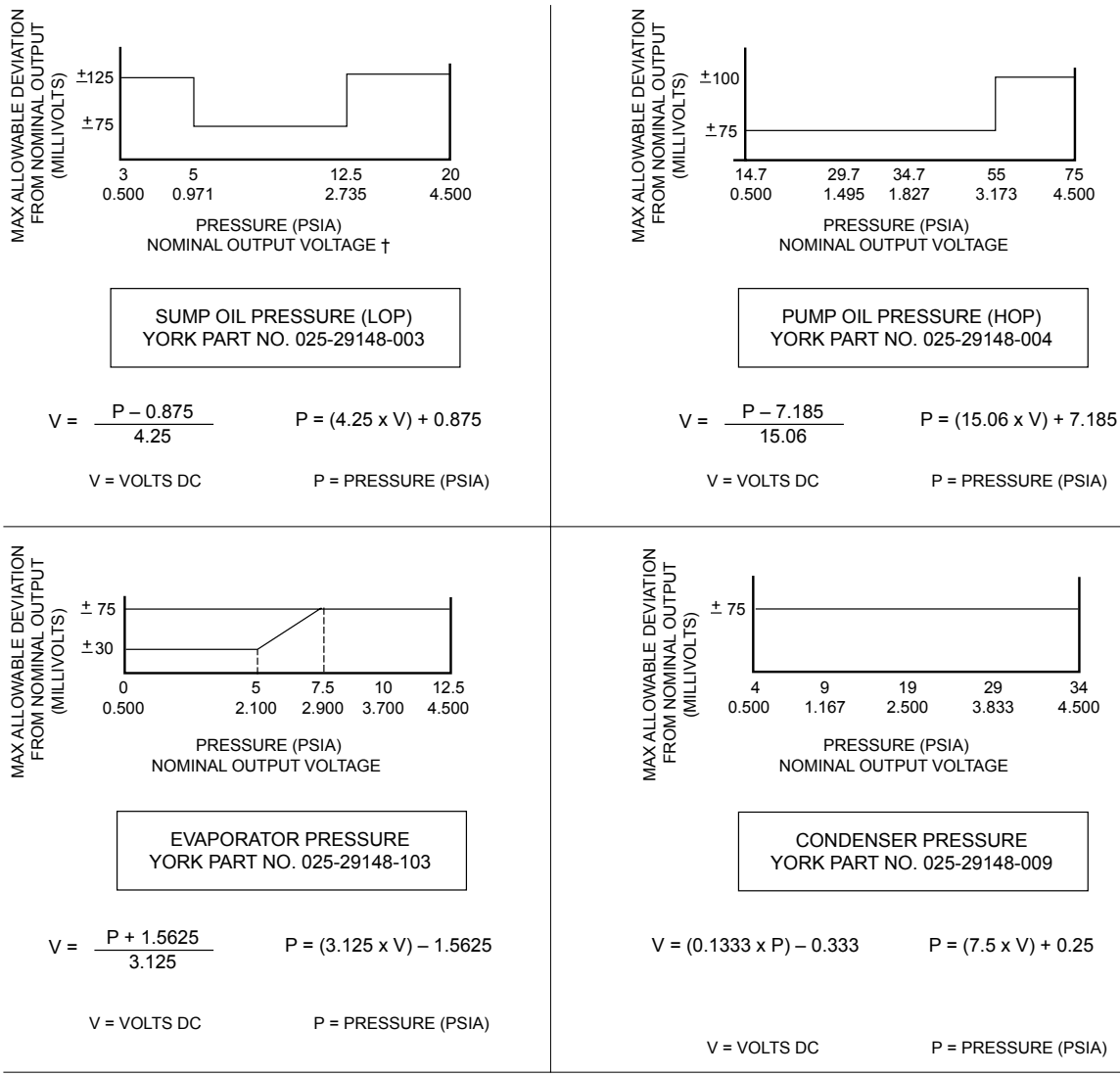
1. Disconnect both ends of the wiring harness for the analog input that is malfunctioning. Using an ohmmeter on the diode test setting, perform a continuity test between all conductors in the cable. An open circuit indicates the wire or wire terminal is defective.
2. Using a voltmeter, measure the +12 VDC supply voltage input at the microboard J1-3 to J1-2 (Gnd). If the voltage is below 11.5 VDC, check wiring to power supply. If the wiring is OK, the power supply is most likely defective, refer to “Section 7 - OptiView Power Supply”.

3. Using a voltmeter, measure the supply voltage (+5VDC) from the microboard to the sensor. If voltage is not within  $\pm 10\%$  ( $\pm 0.5$  VDC) of the specified voltage, disconnect J7, J8 and J9 from the microboard.
4. Removing J7, J8 and J9 disconnects all analog devices from the microboard. If the measured voltage at the microboard increases to the correct level, a thermistor or transducer is possibly shorted. Locate the shorted device and replace. If the supply voltage is still not within 10% of the specified value after removing the connectors, the voltage supply source (microboard or power supply) is most likely defective.
5. If all wiring and power sources are tested OK, the transducer is defective.



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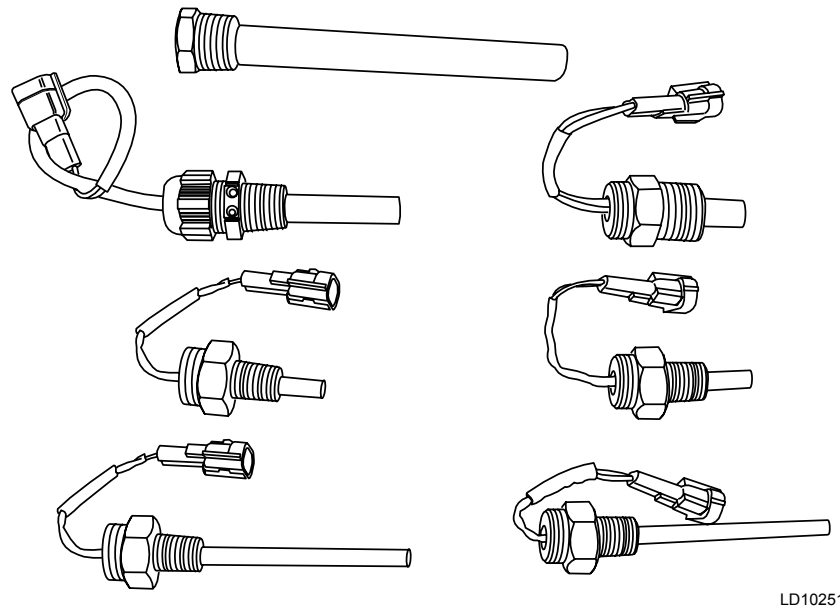
**FIGURE 53 - SENSOR MICROBOARD CONNECTIONS**



LD10663

**FIGURE 54 - PRESSURE TRANSDUCER SPECIFICATIONS**

## SECTION 13 – OPTIVIEW TEMPERATURE THERMISTORS



**FIGURE 55 - TEMPERATURE THERMISTORS**

### TEMPERATURE THERMISTOR DESCRIPTION

The OptiView Control Center measures chiller system temperatures with thermistors. The chiller operating temperatures are constantly monitored by the control center. The OptiView Control Center uses the operating temperatures to control chiller operation according to the operating program.

There are two different thermistor types used to sense the various system temperatures, 3k ohm and 50k ohm.

The following thermistors are 3k ohm:

- Leaving chilled liquid (RT1)
- Entering chilled liquid (RT9)
- Leaving condenser liquid (RT4)
- Entering condenser liquid (RT5)
- Drop leg refrigerant - optional (RT6)
- Evaporator refrigerant - optional (RT7)
- Condenser refrigerant - optional (RT17)

The 50K ohm thermistors include:

- Compressor discharge (RT2)
- Oil sump (RT3)
- Inboard compressor bearing - optional (RT15)
- Outboard compressor bearing - optional (RT16)

### THERMISTOR OPERATION

The 3K Ohm thermistors are defined by the characteristic of having 3000 Ohms of resistance at 77°F (25° C). Similarly, the 50K Ohm thermistors have 50,000 ohms of resistance at 77°F (25° C).

Thermistors vary resistance as the sensed temperature varies. As the temperature the thermistor is sensing increases, the resistance decreases. As the temperature decreases, the resistance increases.

The thermistors are connected to the microboard at J7, J8, and J9. A +5 VDC supply voltage is applied to one side of the thermistor. The other side of the thermis-

tor is connected to ground through a series of resistors on the microboard, forming a voltage divider network. The microboard reads the voltage passing through the sensor as an analog input and determines the temperature to display on the OptiView LCD according to the operating software.

Each thermistor is connected to the microboard with two wires. The red wire supplies the +5 VDC voltage to the thermistor and the black wire is the output of the thermistor (analog input to microboard).

### THERMISTOR SERVICE

If a thermistor fails, replace the thermistor with one of the same part number. An improper thermistor installed in the chiller system may result in the chiller being inoperable. Refer to the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)* for thermistor part numbers.

Components replaced under the warranty must be returned following the warranty return procedure outlined in the *Renewal Parts – OptiView Control Center Retrofit Kit (Form 160.10-RP1)*.

### Troubleshooting

There are several methods available to troubleshoot suspected problems with the chiller thermistors. The OptiView operating software contains the analog I/O diagnostic screen which displays the DC voltage signal for each thermistor analog input. *Table 17* shows the assigned number for the analog input and the thermistor related to that input. Note that the compressor bearing analog voltages must be monitored on the “external” view of the analog I/O diagnostic screen.

**TABLE 17 - THERMISTOR ANALOG INPUT DIAGNOSTIC CHANNELS**

Analog Input Number	Thermistor
1	Leaving Chilled Liquid
2	Return Chilled Liquid
3	Leaving Condenser Liquid
4	Return Condenser Liquid
5	Drop Leg Refrigerant (Optional)
6	Compressor Discharge
7	Oil Sump
8	Evaporator Refrigerant (Optional)
29	Condenser Refrigerant (Optional)
9 (External)	Inboard Compressor Bearing (Optional)
10 (External)	Outboard Compressor Bearing (Optional)

The thermistor output voltage can also be measured with a DC voltmeter. The measurement should be made from the thermistor output (microboard input) to the microboard ground test point 1 (TP1). Refer to *Table 18* for each thermistor connection terminal. Note that voltage measurements for the compressor bearing thermistors are taken at the external analog I/O board, not at the microboard.

**TABLE 18 - THERMISTOR ANALOG MICROBOARD INPUT TERMINALS**

Thermistor	Microboard Input Terminal
Leaving Chilled Liquid	J9-10
Return Chilled Liquid	J9-9
Leaving Condenser Liquid	J9-8
Return Condenser Liquid	J9-7
Drop Leg Refrigerant (Optional)	J9-6
Compressor Discharge	J9-5
Oil Sump	J9-4
Evaporator Refrigerant (Optional)	J9-3
Condenser Refrigerant (Optional)	J7-16
Inboard Compressor Bearing (Optional)	P5-2
Outboard Compressor Bearing (Optional)	P5-5

To convert this voltage to a temperature, refer to the appropriate volts/temp chart as follows:

- Leaving chilled liquid temperature – *Table 19*
- Return chilled liquid temperature – *Table 20*
- Leaving and return condenser liquid temperature – *Table 21*
- Oil, discharge, compressor bearing temperature – *Table 22*
- Drop leg and condenser refrigerant temperature – *Table 23*
- Evaporator refrigerant Temperature – *Table 24*

If the voltage or calculated temperature is out of the specifications for the thermistor, perform the following test procedure:

1. Disconnect both ends of the wiring harness for the analog input that is malfunctioning. Using an ohmmeter at the diode test setting, perform a continuity test between all conductors in the cable. An open circuit indicates the wire or wire terminal is defective.
2. Using a voltmeter, measure the +12 VDC supply voltage input at the microboard J1-3 to J1-2 (Gnd). If voltage is less than +11.5 VDC, check wiring to power supply. If the wiring is OK, the power supply is most likely defective, refer to *SECTION 7 - OPTIVIEW POWER SUPPLY*.
3. Using a voltmeter, measure the supply voltage (+5VDC) to each sensor (red wire). If voltage is not within  $\pm 10\%$  ( $\pm 0.5$  VDC) of the specified voltage, disconnect J7, J8 and J9 from the microboard.
4. Removing J7, J8 and J9 disconnects all analog devices from the microboard. If the measured voltage increases to the correct level, a thermistor or transducer is possibly shorted. Locate the shorted device and replace. If the supply voltage is still not within 10% of the specified value after removing the connectors, the voltage supply source (microboard or power supply) is most likely defective.
5. If all wiring and power sources are tested OK, the thermistor is defective.

**TABLE 19 - LEAVING CHILLED LIQUID TEMPERATURE SENSOR VOLTAGES**

Temp (°F)	Temp (°C)	Vin
9.5	-12.5	1.05
10.0	-12.2	1.08
10.5	-11.9	1.10
11.0	-11.7	1.13
11.5	-11.4	1.15
12.0	-11.1	1.18
12.5	-10.8	1.20
13.0	-10.6	1.23
13.5	-10.3	1.25
14.0	-10.0	1.28
14.5	-9.7	1.31
15.0	-9.4	1.33
15.5	-9.2	1.36
16.0	-8.9	1.38
16.5	-8.6	1.41
17.0	-8.3	1.44
17.5	-8.1	1.47
18.0	-7.8	1.50
18.5	-7.5	1.52
19.0	-7.2	1.55
19.5	-6.9	1.58
20.0	-6.7	1.60
20.5	-6.4	1.63
21.0	-6.1	1.66
21.5	-5.8	1.68
22.0	-5.6	1.71
22.5	-5.3	1.74
23.0	-5.0	1.77
23.5	-4.7	1.80
24.0	-4.4	1.82
24.5	-4.2	1.85
25.0	-3.9	1.88
25.5	-3.6	1.91
26.0	-3.3	1.94
26.5	-3.1	1.96
27.0	-2.8	1.99
27.5	-2.5	2.02
28.0	-2.2	2.05
28.5	-1.9	2.08
29.0	-1.7	2.10
29.5	-1.4	2.13
30.0	-1.1	2.16
30.5	-0.8	2.19
31.0	-0.6	2.21
31.5	-0.3	2.25
32.0	0.0	2.27
32.5	0.3	2.30
33.0	0.6	2.33
33.5	0.8	2.36
34.0	1.1	2.39
34.5	1.4	2.42
35.0	1.7	2.44
35.5	1.9	2.47
36.0	2.2	2.50
36.5	2.5	2.53

Temp (°F)	Temp (°C)	Vin
37.0	2.8	2.56
37.5	3.1	2.58
38.0	3.3	2.61
38.5	3.6	2.64
39.0	3.9	2.67
39.5	4.2	2.70
40.0	4.4	2.72
40.5	4.7	2.75
41.0	5.0	2.78
41.5	5.3	2.80
42.0	5.6	2.83
42.5	5.8	2.86
43.0	6.1	2.89
43.5	6.4	2.92
44.0	6.7	2.94
44.5	6.9	2.97
45.0	7.2	3.00
45.5	7.5	3.03
46.0	7.8	3.06
46.5	8.1	3.08
47.0	8.3	3.11
47.5	8.6	3.13
48.0	8.9	3.16
48.5	9.2	3.19
49.0	9.4	3.21
49.5	9.7	3.24
50.0	10.0	3.27
50.5	10.3	3.30
51.0	10.6	3.32
51.5	10.8	3.35
52.0	11.1	3.37
52.5	11.4	3.40
53.0	11.7	3.43
53.5	11.9	3.45
54.0	12.2	3.48
54.5	12.5	3.50
55.0	12.8	3.53
55.5	13.1	3.55
56.0	13.3	3.58
56.5	13.6	3.61
57.0	13.9	3.63
57.5	14.2	3.66
58.0	14.4	3.68
58.5	14.7	3.71
59.0	15.0	3.73
59.5	15.3	3.76
60.0	15.6	3.78
60.5	15.8	3.81
61.0	16.1	3.83
61.5	16.4	3.86
62.0	16.7	3.88
62.5	16.9	3.90
63.0	17.2	3.93
63.5	17.5	3.95
64.0	17.8	3.97

Temp (°F)	Temp (°C)	Vin
64.5	18.1	4.00
65.0	18.3	4.02
65.5	18.6	4.05
66.0	18.9	4.07
66.5	19.2	4.09
67.0	19.4	4.11
67.5	19.7	4.13
68.0	20.0	4.16
68.5	20.3	4.18
69.0	20.6	4.20
69.5	20.8	4.22
70.0	21.1	4.25
70.5	21.4	4.27
71.0	21.7	4.29
71.5	21.9	4.31
72.0	22.2	4.33
72.5	22.5	4.35
73.0	22.8	4.38
73.5	23.1	4.40
74.0	23.3	4.42
74.5	23.6	4.44
75.0	23.9	4.46
75.5	24.2	4.48
76.0	24.4	4.50
76.5	24.7	4.52
77.0	25.0	4.54
77.5	25.3	4.56
78.0	25.6	4.58
78.5	25.8	4.60
79.0	26.1	4.62
79.5	26.4	4.64
80.0	26.7	4.66
80.5	26.9	4.68
81.0	27.2	4.70
81.5	27.5	4.72
82.0	27.8	4.74

**TABLE 20 - RETURN CHILLED LIQUID TEMPERATURE SENSOR VOLTAGES**

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 20 - RETURN CHILLED LIQUID TEMPERATURE SENSOR VOLTAGES (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 20 - RETURN CHILLED LIQUID TEMPERATURE SENSOR VOLTAGES (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
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

Temp (°F)	Temp (°C)	Vin
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
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 21 - LEAVING AND RETURN CONDENSER LIQUID TEMPERATURE SENSOR VOLTAGES**

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
64.67	18.16	2.6367
64.83	18.24	2.6416

**TABLE 21 - LEAVING AND RETURN CONDENSER LIQUID TEMPERATURE SENSOR VOLTAGES (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 21 - LEAVING AND RETURN CONDENSER LIQUID TEMPERATURE SENSOR VOLTAGES (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
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

Temp (°F)	Temp (°C)	Vin
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
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

**TABLE 22 - OIL SUMP AND COMPRESSOR DISCHARGE TEMPERATURE SENSOR VOLTAGES**

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

Temp (°F)	Temp (°C)	Vin
58.43	14.68	0.5322
58.81	14.90	0.5371
59.18	15.10	0.5420
59.54	15.30	0.5469
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

Temp (°F)	Temp (°C)	Vin
75.98	24.44	0.8008
76.25	24.59	0.8057
76.53	24.74	0.8105
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 22 - OIL SUMP AND COMPRESSOR DISCHARGE TEMPERATURE SENSOR VOLTAGES (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 22 - OIL SUMP AND COMPRESSOR DISCHARGE TEMPERATURE SENSOR VOLTAGES (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 22 - OIL SUMP AND COMPRESSOR DISCHARGE TEMPERATURE SENSOR VOLTAGES (CONT'D)**

Temp (°F)	Temp (°C)	Vin
153.60	67.56	2.6807
153.79	67.67	2.6855
153.98	67.77	2.6904
154.17	67.88	2.6953
154.36	67.98	2.7002
154.55	68.09	2.7051
154.74	68.19	2.7100
154.94	68.31	2.7148
155.13	68.41	2.7197
155.32	68.52	2.7246
155.51	68.62	2.7295
155.70	68.73	2.7344
155.90	68.84	2.7393
156.09	68.94	2.7441
156.28	69.05	2.7490
156.47	69.16	2.7539
156.67	69.27	2.7588
156.86	69.37	2.7637
157.05	69.48	2.7686
157.25	69.59	2.7734
157.44	69.69	2.7783
157.64	69.81	2.7832
157.83	69.91	2.7881
158.02	70.02	2.7930
158.22	70.13	2.7979
158.41	70.23	2.8027
158.61	70.34	2.8076
158.80	70.45	2.8125
159.00	70.56	2.8174
159.19	70.67	2.8223
159.39	70.78	2.8271
159.59	70.89	2.8320
159.78	70.99	2.8369
159.98	71.11	2.8418
160.18	71.22	2.8467
160.37	71.32	2.8516
160.57	71.43	2.8564
160.77	71.54	2.8613
160.97	71.66	2.8662
161.16	71.76	2.8711
161.36	71.87	2.8760
161.56	71.98	2.8809
161.76	72.09	2.8857
161.96	72.21	2.8906
162.15	72.31	2.8955
162.35	72.42	2.9004
162.55	72.53	2.9053
162.75	72.64	2.9102
162.95	72.76	2.9150
163.15	72.87	2.9199
163.35	72.98	2.9248
163.55	73.09	2.9297
163.75	73.20	2.9346
163.96	73.32	2.9395
164.16	73.43	2.9443

Temp (°F)	Temp (°C)	Vin
164.36	73.54	2.9492
164.56	73.65	2.9541
164.76	73.76	2.9590
164.96	73.87	2.9639
165.17	73.99	2.9688
165.37	74.10	2.9736
165.57	74.21	2.9785
165.78	74.33	2.9834
165.98	74.44	2.9883
166.19	74.56	2.9932
166.39	74.67	2.9980
166.60	74.78	3.0029
166.80	74.89	3.0078
167.00	75.01	3.0127
167.21	75.12	3.0176
167.42	75.24	3.0225
167.62	75.35	3.0273
167.83	75.47	3.0322
168.04	75.58	3.0371
168.24	75.69	3.0420
168.45	75.81	3.0469
168.66	75.93	3.0518
168.87	76.04	3.0566
169.07	76.16	3.0615
169.28	76.27	3.0664
169.49	76.39	3.0713
169.70	76.51	3.0762
169.91	76.62	3.0811
170.12	76.74	3.0859
170.33	76.86	3.0908
170.54	76.97	3.0957
170.75	77.09	3.1006
170.96	77.21	3.1055
171.18	77.33	3.1104
171.39	77.45	3.1152
171.60	77.56	3.1201
171.81	77.68	3.1250
172.02	77.80	3.1299
172.24	77.92	3.1348
172.45	78.03	3.1396
172.66	78.15	3.1445
172.88	78.27	3.1494
173.10	78.40	3.1543
173.31	78.51	3.1592
173.53	78.63	3.1641
173.74	78.75	3.1689
173.96	78.87	3.1738
174.17	78.99	3.1787
174.39	79.11	3.1836
174.61	79.23	3.1885
174.83	79.36	3.1934
175.04	79.47	3.1982
175.26	79.60	3.2031
175.48	79.72	3.2080
175.70	79.84	3.2129

Temp (°F)	Temp (°C)	Vin
175.92	79.96	3.2178
176.14	80.08	3.2227
176.36	80.21	3.2275
176.58	80.33	3.2324
176.80	80.45	3.2373
177.02	80.57	3.2422
177.25	80.70	3.2471
177.47	80.82	3.2520
177.69	80.95	3.2568
177.91	81.07	3.2617
178.14	81.20	3.2666
178.36	81.32	3.2715
178.59	81.45	3.2764
178.81	81.57	3.2813
179.04	81.70	3.2861
179.26	81.82	3.2910
179.49	81.95	3.2959
179.72	82.07	3.3008
179.94	82.20	3.3057
180.17	82.32	3.3105
180.40	82.45	3.3154
180.63	82.58	3.3203
180.86	82.71	3.3252
181.09	82.83	3.3301
181.32	82.96	3.3350
181.55	83.09	3.3398
181.78	83.22	3.3447
182.01	83.35	3.3496
182.24	83.47	3.3545
182.48	83.61	3.3594
182.71	83.73	3.3643
182.94	83.86	3.3691
183.17	83.99	3.3740
183.41	84.12	3.3789
183.65	84.26	3.3838
183.88	84.38	3.3887
184.12	84.52	3.3936
184.36	84.65	3.3984
184.59	84.78	3.4033
184.83	84.91	3.4082
185.07	85.05	3.4131
185.31	85.18	3.4180
185.55	85.31	3.4229
185.79	85.45	3.4277
186.03	85.58	3.4326
186.27	85.71	3.4375
186.51	85.85	3.4424
186.75	85.98	3.4473
186.99	86.11	3.4521
187.24	86.25	3.4570
187.48	86.38	3.4619
187.73	86.52	3.4668
187.97	86.66	3.4717
188.22	86.80	3.4766
188.46	86.93	3.4814

**TABLE 22 - OIL SUMP AND COMPRESSOR DISCHARGE TEMPERATURE SENSOR VOLTAGES (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
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

Temp (°F)	Temp (°C)	Vin
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
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 23 - DROP LEG AND CONDENSER REFRIGERANT TEMPERATURE SENSOR VOLTAGES**

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 24 - EVAPORATOR REFRIGERANT TEMPERATURE SENSOR VOLTAGES**

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	7.22	2.620
47.31	8.51	2.698
49.67	9.82	2.777
52.06	11.15	2.855
54.49	12.50	2.933
56.96	13.87	3.011
59.50	15.28	3.089
62.10	16.72	3.167
64.77	18.21	3.245
67.51	19.73	3.324
70.35	21.31	3.402
73.29	22.94	3.480
76.36	24.65	3.558
79.55	26.42	3.636
82.89	28.27	3.714
86.41	30.23	3.792
90.12	32.29	3.871
94.07	34.49	3.949
98.31	36.84	4.027
102.87	39.38	4.105
107.81	42.12	4.183
113.26	45.15	4.261
119.30	48.50	4.339
126.10	52.28	4.418

## SECTION 14 – OPTIVIEW REMOTE SETPOINTS

### REMOTE SETPOINT DESCRIPTION

Several OptiView Control Center setpoints can be controlled remotely using one of three different remote operating modes. The three different modes are: analog remote mode, digital remote mode, and ISN remote mode. The remote operating modes are selected under “Control Source” at the OptiView panel Operation screen. Refer to *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-01)* for additional information on the remote setpoints.

### Analog Remote Mode

#### Connection

The OptiView Control Center is able to receive remote current limit and remote leaving chilled liquid temperature setpoints from an analog device at microboard connection J22.

In order for the analog remote device to control the current limit and leaving chilled liquid temperature, the microboard and operating software must be configured properly for the type of analog signal provided. The OptiView Control Center can accept the following types of analog remote signal inputs:

- 0-10 VDC analog input
- 2-10 VDC analog input
- 0-20 mA analog input
- 4-20 mA analog input

The position the analog inputs are connected at microboard connection J22 depend upon the type of analog signal being used for remote control. Connections to J22 are as follows:

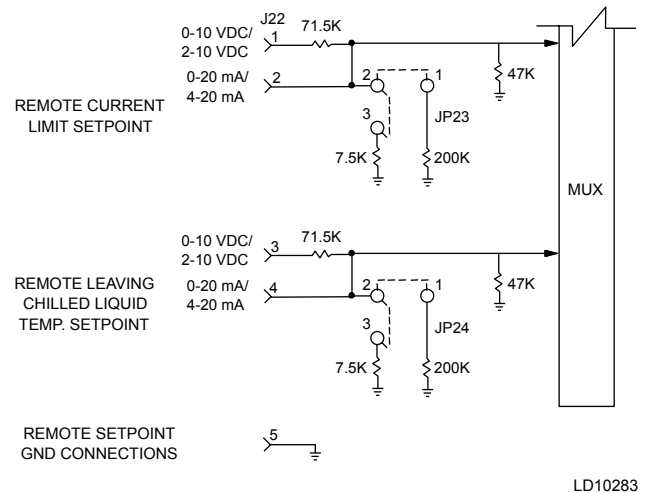
- J22-1 and J22-3 – DC volt signals
- J22-2 and J22-4 – Milliampere signals.
- J22-5 – Ground connection.

Microboard program jumpers JP23 (current limit) and JP24 (leaving chilled liquid) must be positioned appropriately to receive either a DC voltage signal or a milliamp signal. The jumpers JP23 and JP24 are configured as follows:

- OUT – DC voltage input signal
- PINS 1 and 2 – Milliamp input signal
- PINS 2 and 3 – Not Used

Both jumpers must be positioned identically for the remote setpoint feature to function properly.

Once the input connections are made and the proper jumper position is selected, the software must be set up at the Setpoints screen to interpret a 0-10 VDC or 2-10 VDC if the input is DC voltage, or 0-20 mA or 4-20 mA if the input is milliamperes.



**FIGURE 56 - J22 ANALOG REMOTE SETPOINT INPUTS**

### Current Limit Remote Setpoint

The remote current limit setpoint can be set over the range of 100% to 30% Full Load Amps (FLA). The current limit setpoint is remotely programmed by applying a voltage or current signal to the microboard. As the amount of voltage or current varies the setpoint is changed. The setpoint corresponding with the different input types is calculated as follows:

#### 0-10 VDC

This type of input varies the setpoint linearly as the input voltage varies from 0 VDC to 10 VDC. The setpoint for this type of input can be calculated using the following equation:

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

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

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

**2-10 VDC**

This type of input varies the setpoint linearly as the input voltage varies from 2 VDC to 10 VDC. The setpoint for this type of input can be calculated using the following equation:

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

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

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

**0-20 mA**

This type of input varies the setpoint linearly from 100% to 30% FLA as the input varies from 0 mA to 20 mA. The setpoint for this type of input can be calculated using the following equation:

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

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

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

**4-20 mA**

This type of input varies the setpoint linearly from 100% to 30% FLA as the input varies from 4 mA to 20 mA. The setpoint for this type of input can be calculated using the following equation:

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

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

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

**Leaving Chilled Liquid Temperature Setpoint**

The leaving chilled liquid temperature setpoint is programmable over the range of 38°F to 70°F (36°F to 70°F with Smart Freeze protection enabled) for applications that use water as chilled liquid or 10°F to 70°F for applications using brine as chilled liquid.

The remote input signal changes the setpoint by establishing an “offset” above the locally programmed leaving chilled liquid temperature “base” setpoint value. The chilled liquid setpoint can be remotely changed over a range of 10°F or 20 °F (as per the locally programmed “Local Leaving Chilled Liquid Temperature - Range”) above the local leaving chilled liquid temperature setpoint.

For example: If the local setpoint is 40°F and the “Local Leaving Chilled Liquid Temperature - Range” setpoint is programmed for 10°F, the leaving chilled liquid temperature setpoint can be remotely set over the range of 40°F to 50°F.

The leaving chilled liquid temperature setpoint is remotely programmed by applying a voltage or current signal to the microboard. As the amount of voltage or current varies the setpoint is changed. The following paragraphs describe how the setpoint corresponding with the different input types is derived.

**0-10 VDC**

For this type of input, a 0 VDC signal produces a 0°F offset. A 10 VDC signal produces the maximum offset (10 or 20°F above the local setpoint value). As the input value varies from 0 VDC to 10 VDC, the setpoint is adjusted linearly over the programmed range value. Calculate the setpoint for various inputs as follows:

$$\text{Offset (}^\circ\text{F)} = \frac{(VDC)(\text{Offset Range})}{10}$$

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

For example, if the input is +5 VDC, the range setpoint is programmed as 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:

$$\begin{aligned} \text{offset (}^\circ\text{F)} &= \frac{(5VDC)(10)}{10} \\ &= \frac{50}{10} \\ &= 5^\circ\text{F} \end{aligned}$$

$$\begin{aligned} \text{Setpoint (}^\circ\text{F)} &= 40^\circ\text{F} + 5^\circ\text{F} \\ &= 45^\circ\text{F} \end{aligned}$$

**2-10 VDC**

For this type of input, a 2 VDC signal produces a 0°F offset. A 10 VDC signal produces the maximum offset (10 or 20°F above the local setpoint value). As the input value varies from 2 VDC to 10 VDC, the setpoint

is adjusted linearly over the programmed range value. Calculate the setpoint for various inputs as follows:

$$\text{Offset } (^{\circ}\text{F}) = \frac{(\text{VDC}-2)(\text{Offset Range})}{8}$$

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

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

$$\begin{aligned} \text{offset } (^{\circ}\text{F}) &= \frac{(5\text{VDC}-2)(10)}{8} \\ &= \frac{(3)(10)}{8} \\ &= \frac{30}{8} \\ &= 3.8^{\circ}\text{F} \end{aligned}$$

$$\begin{aligned} \text{Setpoint } (^{\circ}\text{F}) &= 40^{\circ}\text{F} + 3.8^{\circ}\text{F} \\ &= 43.8^{\circ}\text{F} \end{aligned}$$

### 0-20 mA

For this type of input, 0 mA signal produces a 0°F offset and a 20 mA signal produces the maximum offset (10 or 20°F above the local setpoint value). As the input value varies from 0 mA to 20 mA, the setpoint is adjusted linearly over the programmed range value. Calculate the setpoint for various inputs as follows:

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

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

For example: If the input is 8 mA, the range setpoint is programmed for 10°F, and the local leaving chilled liquid temperature setpoint is programmed for 40°F, the setpoint would be set to 44°F as follows:

$$\begin{aligned} \text{offset } (^{\circ}\text{F}) &= \frac{(8\text{mA})(10)}{20} \\ &= \frac{80}{20} \\ &= 4^{\circ}\text{F} \end{aligned}$$

$$\begin{aligned} \text{Setpoint } (^{\circ}\text{F}) &= 40^{\circ}\text{F} + 4^{\circ}\text{F} \\ &= 44^{\circ}\text{F} \end{aligned}$$

### 4-20mA

For this type of input, 4 mA signal produces a 0°F offset and a 20 mA signal produces the maximum offset (10 or 20°F above the local setpoint value). As the

input value varies from 0 mA to 20 mA, the setpoint is adjusted linearly over the programmed range value. Calculate the setpoint for various inputs as follows:

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

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

For example: If the input is 8 mA, the 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:

$$\begin{aligned} \text{offset } (^{\circ}\text{F}) &= \frac{(8\text{mA}-4)(10)}{16} \\ &= \frac{(4)(10)}{16} \\ &= \frac{40}{16} \\ &= 2.5^{\circ}\text{F} \end{aligned}$$

$$\begin{aligned} \text{Setpoint } (^{\circ}\text{F}) &= 40^{\circ}\text{F} + 2.5^{\circ}\text{F} \\ &= 42.5^{\circ}\text{F} \end{aligned}$$

## Digital Remote Mode

### Connection

The OptiView Control Center is able to receive remote current limit and remote leaving chilled liquid temperature setpoints from a digital device at the input/output board terminal block 4, terminals 19 and 20 (TB4-19, TB4-20). The digital input is in Pulse Width Modulation (PWM) form as a 1 to 11 second relay contact closure that applies 115 VAC to the I/O Board connections. The 115 VAC supply for the signal is at TB4-1.

In order for the digital remote device to control the current limit and leaving chilled liquid temperature, the OptiView operating software must be set up for digital input signals. On the OptiView panel, Operation screen “Digital” must be selected under “Control Source”.

### Current Limit Remote Setpoint

The current limit setpoint varies linearly from 100% to 30% as the relay contact closure pulse width (time) varies from 1 to 11 seconds. The PWM signal for the current limit setpoint is received from the remote device at TB4-20 on the I/O board. The corresponding setpoint for a 1 second pulse is 100% and the setpoint for an 11 second pulse is 30%.

The relay contacts must close for 1 to 11 seconds at least once every 30 minutes to maintain the setpoint

at the desired value. If a PWM signal is not received by the microboard within 30 minutes of the previous signal, the current limit setpoint is defaulted to 100 % FLA. The PWM signal can only be read by the microboard once every 70 seconds. Calculate the current limit setpoint for various lengths of PWM signals as follows:

$$\text{Setpoint (\% FLA)} = 100 - [(PWM \text{ Time} - 1) \times 7]$$

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

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

### Leaving Chilled Liquid Temperature Setpoint

The leaving chilled liquid temperature setpoint is programmable over the range of 38°F to 70°F (36°F to 70°F with Smart Freeze protection enabled) for applications that use water as chilled liquid or 10°F to 70°F for applications using brine as chilled liquid.

The remote input signal changes the setpoint by establishing an “offset” above the locally programmed leaving chilled liquid temperature “base” setpoint value. The chilled liquid setpoint can be remotely changed over a range of 10°F or 20 °F (as per the locally programmed “Local Leaving Chilled Liquid Temperature - Range”) above the local leaving chilled liquid temperature setpoint.

For example: If the local setpoint is 40°F and the “Local Leaving Chilled Liquid Temperature - Range” setpoint is programmed for 10°F, the leaving chilled liquid temperature setpoint can be remotely set over the range of 40°F to 50°F.

The leaving chilled liquid temperature setpoint is remotely programmed by applying a PWM signal to TB4-19 on the I/O board. The corresponding setpoint for a 1 second pulse is 0°F offset and the setpoint for an 11 second pulse is the maximum offset (10°F or 20°F, as programmed by the offset range).

The microboard requires a PWM signal every 30 minutes to maintain the setpoint at the desired value. If a PWM signal is not received by the microboard within 30 minutes of the previous signal, the leaving chilled liquid temperature setpoint is defaulted to the value set locally (base value). The PWM signal can only be read by the microboard once every 70 seconds. Calculate the leaving chilled liquid temperature for various lengths of PWM signals as follows:

$$\text{Offset (°F)} = \frac{(PWM \text{ Time} - 1)(\text{Offset Range})}{10}$$

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

For example, if the relay contacts close for 5 seconds, the offset 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:

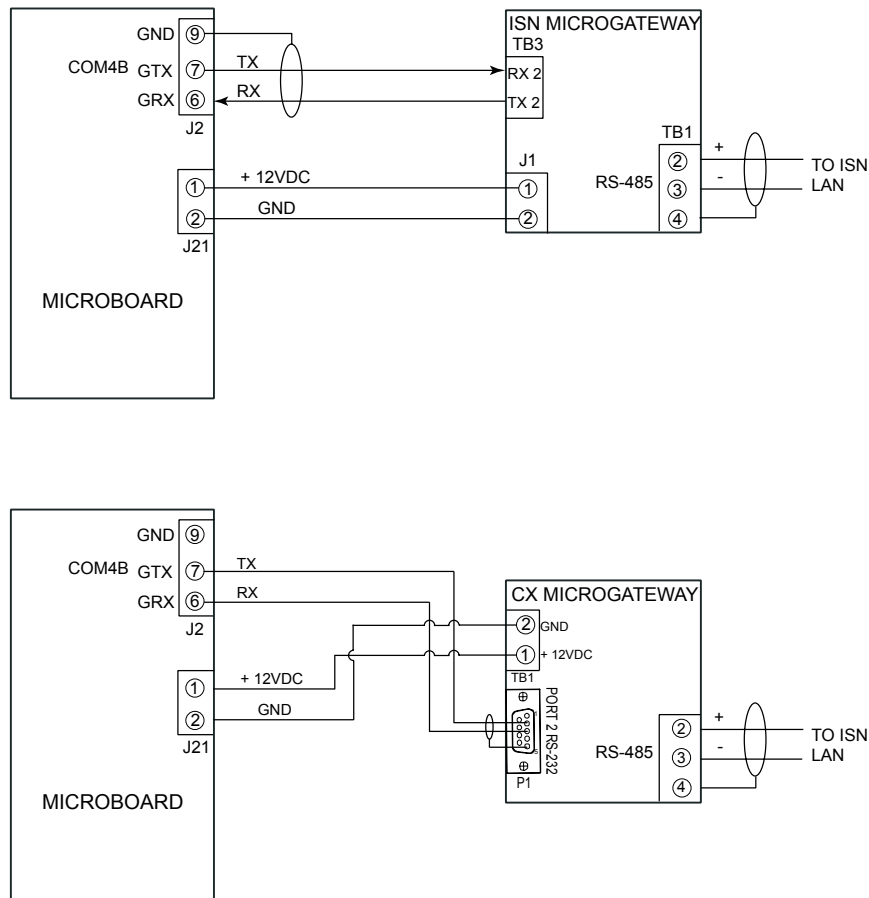
$$\begin{aligned} \text{Offset (°F)} &= \frac{(5s-1)(10)}{10} \\ &= \frac{(4)(10)}{10} \\ &= \frac{40}{10} \\ &= 4^\circ\text{F} \\ \text{Setpoint (°F)} &= 40^\circ\text{F} + 4^\circ\text{F} \\ &= 44^\circ\text{F} \end{aligned}$$

### ISN Remote Mode

When the “Control Source” is set to “ISN Remote” mode, the microboard receives setpoints from the optional MicroGateway via serial data communication port 4B. The MicroGateway receives the setpoints from remote external devices for transfer to the microboard.

For information on the MicroGateway operation, refer to *SECTION 15 – MICROGATEWAY* in this manual.

## SECTION 15 – MICROGATEWAY



LD10674

**FIGURE 57 - MICROGATEWAY INTERFACE BLOCK DIAGRAMS**

### MICROGATEWAY DESCRIPTION

The MicroGateway is an optional printed circuit board that provides an interface between the OptiView Control Center and YORK ISN (Integrated Systems Network) or other select networks. The MicroGateway allows chiller operating information and such as chiller pressures, temperatures and status to be transmitted from the microboard to the network. Chiller “Start/Stop” commands can also be transmitted to the microboard through the MicroGateway.

The MicroGateway is mounted on the upper corner of the OptiView cabinet left inside wall.

Refer to the appropriate MicroGateway manual for a complete description of MicroGateway operation, service, and connections to the microboard.

### MICROGATEWAY OPERATION

The MicroGateway utilizes +12 VDC power supply which is obtained from the microboard at connection J21. The power supply is connected to the microboard at connection J1.

Communication with the microboard is via a RS-232 serial data communication interface at COM 4B. In order for the microboard to be able to receive data from the MicroGateway, microboard jumper JP27 must be placed on pins 2 and 3.

If the remote device connected to the MicroGateway is going to provide remote “Start-Stop” signals and operation setpoints, “Control Source” on the OptiView Operation screen must be set to “ISN” mode. The microboard will not communicate with the MicroGateway if the control source is not properly programmed.

## **MICROGATEWAY SERVICE**

Microboard status LED's illuminate when the Microboard transmits and receives data on COM 4B. Green LED CR13 (RX4) illuminates when data is being received from the MicroGateway and Red LED CR12 (TX4) illuminates when data is being transmitted to the MicroGateway. Similar LEDs on the MicroGateway indicate data transfer to and from the microboard.

If a communication problem exists between the microboard and MicroGateway, the LEDs will not illuminate. The COM 4B Loop Back test can be used to verify operation of the microboard COM 4B serial data communications port. Refer to *SECTION 3 - MICROBOARD 031-01730-000* or *SECTION 4 - MICROBOARD 031-02430-000* for testing serial data communication ports.

## SECTION 16 – SURGE PROTECTION FEATURE

### SURGE PROTECTION DESCRIPTION

The surge protection feature detects surge events and provides a running count of the events that occur over the lifetime of the chiller (up to a maximum of 65535). If excess surging is detected by the OptiView Control Center, this feature can be configured to do one of the following:

- Stop chiller operation (Shutdown)
- Initiate a surge correction/avoidance mode (Extended Run)
- Display a warning message

The Surge Protection screen, accessible from the Compressor screen, displays all parameters relevant to this feature. All setpoints relating to this feature are also maintained using this screen. *Refer to OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-O1) for additional information.*

The detection and counting of surges in this feature is independent of the surge detection/counting performed by the compressor VSD Adaptive Capacity Control (ACC) Board *SECTION 10 – ADAPTIVE CAPACITY CONTROL (ACC) BOARD* as equipped). The ACC board detects surges to control the speed of the compressor motor. The surge counts accumulated by the ACC board are displayed on the ACC Details screen.

### SURGE PROTECTION FEATURE OPERATION

#### Surge Detection

Surge events are detected by monitoring the relationship between the condenser and evaporator pressures while the chiller is running. When the difference between these pressures decreases transiently and remains so for a period of time and then makes a positive transition within seven (7) seconds, the OptiView microboard (acting under operating software control) registers a surge event.

In order for the microboard/operating software to detect a surge, the evaporator pressure transducer output is subtracted from the condenser pressure transducer output to determine the differential. A negative pressure transition will occur if a possible surge event is occurring.

The OptiView microboard reads this condition and registers a surge event when either of the following negative transitions occur:

- If the pressure differential decreases more than 0.6 DC volts for 0.260 seconds or longer, followed by a 0.061 DC volts positive differential transition within seven seconds
- If the differential decreases more than X.X DC volts for 0.390 seconds or more.

X.X VDC is a result of the programmed surge sensitivity setpoint and is calculated as:

$$X.X \text{ VDC} = \frac{[(\text{Surge Sensitivity} \times 300) \times 1.22]}{1000}$$

For example, If the surge sensitivity is set to 0.5, the differential voltage would be calculated as follows:

$$\begin{aligned} X.X \text{ VDC} &= \frac{[(0.5 \times 3000) \times 1.22]}{10} \\ &= \frac{[150 \times 1.22]}{1000} \\ &= \frac{183}{1000} \\ &= 0.183 \end{aligned}$$

The surge detection sensitivity can be adjusted with the “Surge Sensitivity” setpoint. This setpoint is adjustable over the range of 0.3 to 1.3 in 0.1 increments, with default value as 0.3 (full sensitivity).

There are two surge counters that count surge events detected by this surge protection feature. These counts are displayed on the Surge screen. The “Surge Window Count” displays the number of surges that occur within the “Surge Window Time”. The “Total Surge Count” is the number of surges detected over the lifetime of the chiller. Each time a surge event is detected, the “Surge Detected” LED on the Surge Protection screen illuminates for five (5) seconds and a surge event is added to both counters.

The “Total Surge Count” can be cleared using the “Clear Surge Count” key on the Surge Protection screen. The ADMIN password must be used to clear surge count.

This password is only available from YORK Factory Service. Refer to the *OptiView Control Center Retrofit Kit - Trane Operation Manual (Form 160.10-01)* for additional information.

### Excess Surge Protection

An excess surge condition is detected by comparing the number of surge events that occur in a time period to a surge event threshold. Both the time period and surge event thresholds are programmable in the Surge Protection screen. When the number of surge events that occur in the programmed time period exceeds the surge event threshold, an excess surge condition is detected.

When an excess surge situation is detected, the action resulting from the situation depends upon how the shutdown and extended run setpoints are programmed:

- If both the shutdown and extended run setpoints are disabled, the chiller will continue to run, displaying the message “WARNING – EXCESS SURGE DETECTED”. This warning is displayed until “Warning Reset” key is depressed by the operator.
  - If the shutdown setpoint is enabled and the extended run setpoint is disabled, the chiller will perform a safety shutdown and display “SURGE PROTECTION – EXCESS SURGE”.
  - If the shutdown setpoint is disabled and the extended run setpoint is enabled, the pre-rotation vanes are driven closed for ten (10) minutes and “WARNING – SURGE PROTECTION – EXCESS SURGE LIMIT” is displayed. When the 10 minutes have elapsed, if the surge window count is less than or equal to the count limit, this message and load inhibit are automatically cleared. Alternating with this message is “WARNING – EXCESS SURGE DETECTED”, which continues after the 10 minute period has elapsed until manually cleared with the “Warning Reset” key.
- If both the shutdown and extended run setpoints are “Enabled”, the ten (10) minute extended run mode is invoked as described previously. However, if the surge window count exceeds the count limit at the completion of the ten (10) minute extended run period, a safety shutdown is performed and “SURGE PROTECTION – EXCESS SURGE” is displayed.

If the chiller is equipped with a VSD and/or hot gas bypass, there are several exceptions related to VSD and/or hot gas bypass equipped chillers for the surge correction/avoidance features to operate. These exceptions are as follows:

- If the hot gas bypass control is enabled, the valve position must be 100% before the shutdown or extended run feature is implemented.
- If the chiller is equipped with a VSD, output frequency must be at full speed (50 Hz/60 Hz) before the shutdown or extended run feature is implemented.
- If equipped with a VSD and hot gas bypass, the VSD output frequency must be at maximum and the hot gas valve must be at 100% before the shutdown or extended run feature is implemented.

## SECTION 17 – SMART FREEZE PROTECTION

### SMART FREEZE DESCRIPTION

The Smart Freeze feature prevents nuisance chiller shutdowns due to brief periods of chilled liquid (water) flow fluctuations or other brief operating conditions that would normally cause low evaporator pressure safety shutdowns. With Smart Freeze enabled and activated, the chiller is permitted to operate through these temporary conditions. This feature only functions on chiller systems that use water as chilled liquid.

As an additional benefit to the Smart Freeze Protection feature, the leaving chilled liquid temperature setpoint can be set as low as 36.0°F (2.2°C).

Smart Freeze is enabled or disabled in the Evaporator screen on the OptiView Control Center. Smart Freeze protection can be “Enabled” but will not be active until the leaving chilled liquid temperature setpoint is programmed below 38.0°F (3.3°C).

### SMART FREEZE OPERATION

The operating principle behind the Smart Freeze feature is that liquid contains latent heat that cannot be eliminated immediately. Therefore, the chilled liquid requires a certain amount of time at a temperature below freezing for the liquid to change to a solid. When the chiller is operating at conditions that would normally cause a low evaporator shutdown, parameters that determine when the liquid will freeze are evaluated. These parameters are as follows:

- **Evaporator Refrigerant Temperature** – 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 optional evaporator refrigerant temperature sensor (RT7), and the sensor is enabled, this value is used as the refrigerant temperature. Otherwise, the evaporator saturation temperature, as derived from the output of the evaporator pressure transducer, is used for refrigerant temperature. The evaporator pressure is converted to a temperature via the appropriate refrigerant “pressure/temperature lookup table” in the OptiView operating software.

- **Evaporator Refrigerant Freeze Threshold** – The evaporator refrigerant freeze threshold is depends upon the source of the refrigerant temperature:
  - 32.8°F (0.4°C) - refrigerant temp. sensor (RT7)
  - 34.0°F (1.1°C) - evaporator saturation temp.
- **Number of seconds refrigerant temperature is below the freeze threshold** - Once Smart Freeze is activated, the total number of seconds that the evaporator refrigerant temperature is below the freeze threshold is counted. The count is increased for every second the evaporator refrigerant temperature is below the freeze threshold and decreased once for every second the temperature is above the freeze threshold. The count never decreases below zero and is reset to zero if the leaving chilled liquid setpoint is raised to 38°F (3.3°C) or above.

Based on these parameters, the number of seconds before the chilled liquid will freeze is calculated by the OptiView Control Center using the following calculation:

$$\text{Number of seconds to freezing} = \frac{(4053.7)}{(\text{freeze threshold} - \text{evaporator refig temp})}$$

For example: If the evaporator saturation temperature is being used as the evaporator refrigerant temperature, and that temperature is 26.0°F, the chilled liquid would take 507 seconds (or 8 minutes and 27 seconds) to freeze, as follows:

$$\begin{aligned} \text{Number of seconds to freezing} &= \\ &= \frac{(4053.7)}{(34.0 - 26.0)} \\ &= \frac{(4053.7)}{(8.0)} \\ &= 506.7 \text{ Seconds} \end{aligned}$$

The control center suspends the fixed low evaporator pressure safety threshold [R11 = <5.4 PSIA (37.2 kPa), R123 = <4.4 PSIA (30.3 kPa)] and uses the number of seconds until freezing as the low evaporator pressure safety threshold.

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

When Smart Freeze is enabled, the leaving chilled liquid temperature setpoint can be set as low as 36.0°F (2.2°C). If the leaving chilled liquid temperature is programmed below 38.0°F (3.3°C), the leaving chilled liquid low temperature cycling shutdown threshold becomes a minimum of 34.0°F (1.1°C). This means that the leaving chilled liquid low temperature cycling offset - shutdown setpoint can be adjusted so that the cycling shutdown will occur at 34.0°F (1.1°C). Under normal operation (smart freeze disabled), the cycling offset - shutdown setpoint can be programmed to a minimum of 36.0°F (2.2°C).

The Pre-rotation Vanes (PRV) load inhibit will operate at the same thresholds as normal operation, even though Smart Freeze protection may be enabled and activated. The PRV will inhibit the chiller from loading when evaporator pressure falls to 5.5 PSIA (37.9 kPa) or below on R11 applications or 4.4 PSIA (30.3 kPa) on R123 applications. The PRV inhibit is removed when evaporator pressure returns to 5.6 PSIA (38.6 kPa) or above for R11 applications and 4.5 PSIA (31.0 kPa) or above for R123 applications.

## APPENDIX A – SYSTEM COMMISSIONING CHECKLIST

When system setpoints and/or calibrations have been lost due to replacement of a component (such as the BRAM, CM-2, microboard), the following list can be followed to assure all setpoints have been programmed and calibrations have been performed. Login at the “Service” access level for access to these setpoints. The setpoints are grouped under the OptiView display screen in which they appear. An explanation of each setpoint or calibration procedure below is contained in the reference document listed in parenthesis adjacent to each item.

1. **Program Jumpers/Program Switches** (Form 160.10-M1):
  - Verify the microboard program jumpers and program switches are configured appropriately according to the part number of the microboard installed in the OptiView panel. Refer to *SECTION 3 - MICROBOARD 031-01730-000* or *SECTION 4 - MICROBOARD 031-02430-000* in this manual for the correct jumper/switch positions.
2. **Evaporator Screen** (Form 160.10-O1):
3. Enter the following Setpoints:
  - Local leaving chilled liquid temperature (except ISN Remote mode)
  - Leaving chilled liquid temperature range (except in ISN Remote mode)
  - Leaving chilled liquid temperature cycling offset - shutdown
  - Leaving chilled liquid temperature cycling offset - restart
  - Sensitivity - Set to 10% for Trane chillers.
  - Brine Low Evaporator Pressure Cutout threshold.
  - Smart Freeze Protection - On/Off (Form 160.10-M1)
  - Refrigerant Temperature Sensor (RT7) - Enable/Disable (as equipped)
4. **Load Rate Screen** (Form 160.10-O1):
  - Adjust chiller load rate
5. **Condenser Screen** (Form 160.10-O1):
  - High pressure safety cutout setpoint - 25.0 PSIA (172.4 kPa)
  - Drop leg refrigerant temperature sensor (RT6) - Enable/Disable (as equipped)
  - Condenser refrigerant temperature sensor (RT17) - Enable/Disable (as equipped)
  - Select purge type
6. **Purge Screen (TurboGuard II only)** (Form 160.10-O1):
  - High efficiency purge (must be enabled)
  - Enter the maximum purges/hour setpoint
7. **Compressor Screen:** (Form 160.10-M1)
  - Select “auto” control for pre-rotation vanes.
8. **Surge Protection Screen:** (Form 160.10-M1)
  - Enable/Disable excess surge shutdown feature
  - Enable/Disable extended run feature
  - Count window
  - Count limit
  - Surge sensitivity
9. **Pre-rotation Vanes Calibration Screen** (Form 160.10-M1):
  - Perform pre-rotation vanes calibration (VSD applications only).
10. **VSD Tuning Screen** (Form 160.10-M1):
  - Select “auto” compressor motor frequency control (VSD applications only).

**11. Oil Sump Screen** (Form 160.10-O1):

- Oil low pressure limit setpoint
- Oil heater temperature setpoint
- Adjust prelube time (minimum 30 sec.)
- Adjust coastdown time (minimum 150 sec.)

**12. Motor Screen**

- Enter the desired current limit setpoint (Form 160.10-O1)
- Enter the desired pulldown demand limit and time setpoints (Form 160.10-O1)

**Current Module/Electromechanical Starter Applications** (Form 160.10-M1):

- Verify switch S1 (Ydelta/57% or all others) is in the proper position
- Verify potentiometer R16 (LRA/FLA ratio) setting
- Verify slide resistor assembly (RES) setting provides proper resistance/voltage at J1
- Verify 105% FLA calibration
- Verify 100% FLA display calibration

**Mod “B”Solid State Starter Motor Applications** (Form 160.10-M1 and 160.00-O2):

- Full Load Amps
- Start Current
- Supply Voltage Range
- Enable Open SCR Detection
- Enable Shorted SCR Detection
- kWh Reset

**Variable Speed Drive Applications** (Form 160.10-M1 and 160.00-M1):

- kWh Reset

**13. VSD Details Screen** (Form 160.10-M1):

- Set chiller Full Load Amps (FLA) value by adjusting the CRW20 potentiometer on VSD logic board.

**14. Adaptive Capacity Control (ACC) Details Screen** (Form 160.10-M1):

- Surge Map Auto Print Enable/Disable

The following Setpoints should not be changed unless under direction of YORK Aftermarket Service.

- Surge Margin Adjust
- Stability Limit

**15. Motor Temperature Screen** (Form 160.10-O1):

- Select active winding sensors
- Select winding sensor type (analog)
- Winding temperature cutout setpoint
- Select active bearing sensors
- Select bearing sensor type (analog)
- Bearing temperature cutout setpoint
- Motor cooling pump (enable or disable, as equipped)

**16. Setpoints Screen** (Form 160.10-O1):

Most values shown on the Setpoints screen reflect previously programmed values. However, the setpoints listed here can be changed on this screen, if desired. Proceed to the Setup screen.

- Select the remote analog input range (if equipped with analog remote device)

**17. Setup Screen** (Form 160.10-O1 and 160.10-M1.0):

- Enable Clock
- Enter Clock Time and Date
- Select 12 or 24 hour display mode

**Microboard 031-01730-000**

The state of Program Jumpers/Switches that affect chiller operation are displayed. Verify these settings are properly configured (configured in step 1).

**Microboard 031-02430-000**

The state of Program Switches SW1-1 (Refrigerant Selection) and SW1-2 (Liquid Type) is displayed. Verify these settings are properly configured (configured in step 1).

Enter the following Setpoints (Form 160.10-M1):

- Chilled Liquid Pump Operation (Standard or Enhanced)
- Motor Drive Type
- Anti-Recycle (must be enabled)
- Power Failure Restart (auto or manual)

**18. Schedule Screen** (Form 160.10-O1):

- Enable or Disable Daily start/stop schedule as desired.
- Enter chiller START/STOP schedule if schedule has been enabled.

**19. User Screen** (Form 160.10-O1):

- Select desired data display mode; English or Metric.
- Establish custom user ID's, access levels, and passwords, as desired.

**20. COMMS Screen:**

If a printer is connected to the microboard COM1 serial data port, enter the following parameters as required by the printer manufacturer under “Printer Setup” on the COMMS screen (Form 160.10-O1):

- Baud rate
- Number of data bits
- Parity
- Number of stop bits
- Chiller ID (identifies chiller on print-outs and remote devices)

If the chiller is equipped with an IDC for electromechanical starter control, set the following parameters under “COM2 Setup” on the COMMS screen (Form 160.10-O1):

- Baud rate (19200)
- Number of data bits (8)
- Parity (odd)
- Number of stop bits (1)

**21. Printer Screen:**

If a printer is connected to microboard, enter the following parameters:

- Automatic print logging (enable/disable)
- Automatic printer logging start time
- Automatic print logging interval
- Printer type (manufacturer)
- Report type: Status, Setpoints, Schedule or Sales Order

**22. Sales Order Screen:**

- Enter all applicable chiller data such as commissioning date, chiller capacity, etc. Use the TestOp access level (0 2 2 8) to enter all sales order data. Do not press the “Finish Panel Setup” key at the completion of sales order data entry.

**23. Operations Screen:**

- Select the refrigerant type utilized by the chiller.
- Select the chiller control source (operating mode); Local, ISN Remote, Digital Remote or Analog Remote.
- Select the chiller model.
- Hot gas bypass control - Enable/Disable (as equipped).
- Refrigerant level control operation Enable/Disable (future).
- Program the chiller operating hours and starts. Use the TestOp (0 2 2 8) or ADMIN access levels to enter these parameters.

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## APPENDIX B – PROGRAMMABLE SETPOINT VALUES

**TABLE 25 - PROGRAMMABLE SETPOINT VALUES**

<b>Evaporator Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Leaving Chilled Liquid Temperature - Setpoint	Operator	38.0 °F - Water 36.0 °F - Sm Frz 10.0 °F - Brine	70.0 °F	45.0 °F
Local Leaving Chilled Liquid Temperature - Range	Operator	10.0 °F	20.0 °F	10.0 °F
LChLT Cycling Offset - Shutdown	Operator	1.0°F	Varies with LChLT setpoint and chilled liquid type.	4.0 °F or highest allowed value, whichever is lower.
LChLT Cycling Offset - Restart	Operator	0.0 °F	Varies with LChLT setpoint and chilled liquid type.	0.0 °F
Brine Low Evaporator Cutout	Service	0.0 PSIA	12.5 PSIA	12.5 PSIA
Sensitivity	Service	10 %	200 %	100 %
Smart Freeze	Service	Off	On	Off
Refrigerant (Sensor)	Service	Disabled	Enabled	Disabled

<b>Load Rate Screen (Evaporator Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Load Rate	Service	0.38 °F / Min, 0.75°F / Min, 1.13 °F / Min, 1.50 °F / Min, 2.25 °F / Min, 3.00°F / Min, 5.25°F / Min, 10.50 °F / Min		0.38 °F / Min

<b>Condenser Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
High Pressure Warning Threshold	Service	14.0 PSIA	28.8 PSIA	28.8 PSIA
Drop Leg (Sensor)	Service	Disabled	Enabled	Disabled
Refrigerant (Sensor)	Service	Disabled	Enabled	Disabled
Purge Type	Service	TurboGuard, SkyGuard Local, SkyGuard Remote		SkyGuard Remote

<b>Purge Screen (Condenser Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
High Efficiency Purge System	Service	Disabled	Enabled	Disabled
Maximum Purges / Hour	Operator	10	30	20
Maximum Purges / Hour	Service	1	30	20

**TABLE 25 - PROGRAMMABLE SETPOINT VALUES (CONT'D)**

<b>Compressor Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Vent Line Off State	Service	De-Energized	Energized	De-Energized

<b>Hot Gas Bypass Screen (Compressor Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Close Percentage	Service	5 %	15 %	5 %
Hold Period	Service	30 Min	120 Min	30 Min
Surge Sensivity	Service	0.1	1.3	0.3
Minimum Load	Service	0 °F	4 °F	0°F

<b>VSD Calibration Screen (Compressor Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Increment Amount	Service	0.1 Hz	10.0 Hz	1 Hz

<b>Surge Protection Screen (Compressor Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Shutdown	Service	Disabled	Enabled	Enabled
Extended Run	Service	Disabled	Enabled	Disabled
Count Window	Service	1 Min	5 Min	3 Min
Count Limit	Service	4	20	15
Surge Sensivity	Service	0.3	1.3	0.3

<b>Oil Sump Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Manual Pump	Operator	Disabled	Enabled	Disabled
Low Pressure Limit	Service	10 PSID	40 PSID	25 PSID
Prelube Time	Service	15 Seconds	60 Seconds	30 Seconds
Coastdown Time	Service	150 Seconds	600 Seconds	150 Seconds
Heater Setpoint	Service	125 °F	155 °F	140 °F

<b>Electromechanical Starter Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min

**TABLE 25 - PROGRAMMABLE SETPOINT VALUES (CONT'D)**

<b>(MOD "B") Solid State Starter Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min
Full Load Amps	Service	35 Amps	1050 Amps	35 Amps
Voltage Range	Service	Disabled, 200-208, 220-240, 380, 400, 415, 440-480, 550 – 600		Disabled
Starting Current	Service	310 Amps	3300 Amps	310 Amps
Open SCR	Service	Disabled	Enabled	Disabled
Shorted SCR	Service	Disabled	Enabled	Enabled

<b>Variable Speed Drive Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min
Filter Inhibit	Service	Disabled	Enabled	Disabled

<b>Variable Speed Drive Details Screen (Variable Speed Drive Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min

<b>Adaptive Capacity Control Details Screen (Variable Speed Drive Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Service	30 %	100 %	100 %
Pulldown Demand Limit	Service	30 %	100 %	100 %
Pulldown Demand Time	Service	0 Min	255 Min	0 Min
Stability Limit	Service	1000	7000	4500
Surge Margin Adjust	Service	0.0 Hz	25.0 Hz	0.0 Hz
ACC Auto Map Print	Service	Disabled	Enabled	Disabled

<b>Harmonic Filter (Variable Speed Drive Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min

**TABLE 25 - PROGRAMMABLE SETPOINT VALUES (CONT'D)**

<b>Harmonic Filter Details Screen (Harmonic Filter Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min

<b>Motor Temperature Screen (Motor Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Winding Sensor Mode	Service	None, Analog, Digital, Analog & Digital		None
Winding Cutout	Service	150 °F	300 °F	265 °F
Bearing Sensor Mode	Service	None, Analog, Digital, Analog & Digital		None
Bearing Cutout	Service	100 °F	180 °F	180 °F
Motor Cooling Pump	Service	Disabled	Enabled	Disabled
Motor Cooling Pump Mode	Service	Automatic	Manual	Automatic
Phase A (Active Sensor)	Service	None, A1, A2, A1 & A2		None
Phase B (Active Sensor)	Service	None, B1, B2, B1 & B2		None
Phase C (Active Sensor)	Service	None, C1, C2, C1 & C2		None
Bearing (Active Sensor)	Service	None, Sensor 1, Sensor 2, Sensor 1 & 2		None

<b>Setpoints Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Local Leaving Chilled Liquid Temperature - Setpoint	Operator	38.0 °F - Water 36.0 °F - Sm Frz 10.0 °F - Brine	70.0 °F	45.0 °F
Local Leaving Chilled Liquid Temperature - Range	Operator	10.0 °F	20.0 °F	20.0 °F
LChLT Cycling Offset - Shutdown	Operator	1.0°F	64.0 °F	4.0 °F or highest allowed value, whichever is lower.
LChLT Cycling Offset - Restart	Operator	0.0 °F	70.0 °F	0.0 °F
Remote Analog Input Range	Operator	0 - 10 VDC	2 - 10 VDC	0 - 10 VDC
Motor Current Limit	Operator	30 %	100 %	100 %
Pulldown Demand Limit	Operator	30 %	100 %	100 %
Pulldown Demand Time	Operator	0 Min	255 Min	0 Min

**TABLE 25 - PROGRAMMABLE SETPOINT VALUES (CONT'D)**

<b>Setup Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Set Date	Operator	16/01/1963	01/01/4000	01/01/1999
Set Time	Operator	12:00 AM or 00:00	11:59 PM or 23:59	12:00 AM or 00:00
Clock	Operator	Disable	Enable	Enable
12/24 Hr (Clock Mode)	Operator	12 Hr Mode	24 Hr Mode	12 Hr Mode

<b>Schedule Screen (Setup Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Schedule	Operator	Disabled	Enabled	Disabled
Schedule Data: Sunday through Saturday, Start Time and Stop Time, Standard Week and six Exception Weeks	Operator	12:00 AM or 00:00	11:59 PM or 23:59	12:00 AM or 00:00
Repeat Sunday	Operator	No	Yes	No
Repeat Exceptions	Operator	No	Yes	No

<b>User Screen (Setup Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Data Display Mode	Operator	English or Metric		English
User ID (ID 1 through 4)	Service	1	9999	1
User Password (ID 1 through 4)	Service	0	9999	0
User Level (ID 1 through 4)	Service	0 - View, 1 - Operator, 2 - Service		0

<b>Comms Screen (Setup Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Chiller ID	Operator	0	255	0
Baud Rate (Printer Setup and COM 2)	Operator	1200, 2400, 4800, 9600, 19200, 38400, 57600		19200
Data Bits (Printer Setup and COM 2)	Operator	5 Bits, 6 Bits, 7 Bits, 8 Bits		8 Blts
Parity (Printer Setup)	Operator	None, Odd, Even		None
Parity (COM 2)	Operator	None, Odd, Even		Odd
Stop Bits (Printer Setup and COM 2)	Operator	1 Bit	2 Bits	1 Bit

**TABLE 25 - PROGRAMMABLE SETPOINT VALUES (CONT'D)**

<b>Printer Screen (Setup Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Log Start Time	Operator	12:00 AM or 00:00	11:59 PM or 23:59	12:00 AM or 00:00
Output Interval	Operator	1 Min	1440 Min	60 Min
Automatic Printer Logging	Operator	Disabled	Enabled	Disabled
ACC Auto Map Print	Operator	Disabled	Enabled	Disabled
Printer Type	Operator	Okidata, WeighTronix, Epson, Seiko		Okidata
Print Report	View	Status, Setpoint, Schedule, Sales Order, Slot List, Custom Screen Data		Status

<b>Operations Screen (Setup Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Control Source	Operator	Local, ISN, Analog, Digital, Modem		Local
Number Of Starts	Admin	0	99999	0
Operating Hours	Admin	0 Hours	876600 Hours	0 Hours
Hot Gas (Bypass)	Service	Disabled	Enabled	Disabled
(Refrigerant) Level Control	Service	Disabled	Enabled	Disabled
Chiller Model	Service	CVHA, CHVB, CVHE, CVHF		CVHA
Refrigerant	Service	R11	R123	R11

<b>History Screen</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Select Fault	View	Normal, Running, Fault #		Normal

<b>Custom View Setup Screen (Custom View Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Custom Slot (1 through 10)	Operator	0	65535	0

<b>Trend Setup Screen (Trend Subscreen)</b>				
<b>Setpoint</b>	<b>Access Level</b>	<b>Minimum Value</b>	<b>Maximum Value</b>	<b>Default</b>
Chart Type	Operator	Continuous	One Screen	Continuous
Collection Interval	Operator	1 Second	3600 Seconds	60 Seconds
Data Point Slot # (1 through 6)	Operator	0	65535	0
Data Point Min (1 through 6)	Operator	Varies with each slot number programmed		
Data Point Max (1 through 6)	Operator	Varies with each slot number programmed		

## APPENDIX C – ANALOG INPUT RANGES (LOW PRESSURE CHILLERS)

The following table indicates the valid display range for each of the analog sensor input parameters for low pressure chillers. In the event that the input sensor is reading a value outside of these ranges, the less than (<) or greater than (>) symbols will be displayed beside the minimum or maximum value, respectively.

**TABLE 26 - PROGRAMMABLE SETPOINT VALUES**

Analog Input	English Range			Metric Range		
	Low	High	Units	Low	High	Units
Leaving Chilled Liquid Temperature	0.0	82.0	°F	-17.7	27.7	°C
Return Chilled Liquid Temperature	0.0	94.1	°F	-17.7	34.5	°C
Leaving Condenser Liquid Temperature	8.0	133.5	°F	-13.3	56.3	°C
Return Condenser Liquid Temperature	8.0	133.5	°F	-13.3	56.3	°C
Evaporator Refrigerant Temperature	0.0	126.1	°F	-17.7	52.3	°C
Discharge Temperature	19.0	226.3	°F	-7.2	107.9	°C
Oil Temperature	19.0	226.3	°F	-7.2	107.9	°C
Condenser Pressure	2.5	35.3	PSIA	17.2	243.4	KPAA
Condenser Temperature (R11)*	-1.4	124.2	°F	-18.5	51.2	°C
Condenser Temperature (R123)*	7.2	130.1	°F	-13.7	54.5	°C
Evaporator Pressure	0.0	12.5	PSIA	6.9	86.2	KPAA
Evaporator Temperature (R11)*	-31.2	66.8	°F	-35.7	19.3	°C
Evaporator Temperature (R123)*	-22.4	74.2	°F	-30.2	23.4	°C
Oil Sump Pressure (LOP)	2.9	20.9	PSIA	20.0	144.1	KPAA
Oil Pump Pressure (HOP)	14.3	78.2	PSIA	98.6	539.2	KPAA
Purge Pressure	0.0	100.0	PSIA	6.9	689.5	KPAA
Drop Leg Refrigerant Temperature	0.0	121.8	°F	-17.7	49.8	°C
Refrigerant Level (Future)	0.0	100.0	%	0.0	100.0	%

\*Calculated values when represented as a saturation temperature. They will display XXX if the pressure used for the calculation is out of range.

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## SI METRIC CONVERSION

The following factors can be used to convert from English to the most common SI Metric values.

**TABLE 27 - ANALOG INPUT RANGES (LOW PRESSURE CHILLERS)**

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)	304.8	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.

$$\text{Ex: } (45.0^{\circ}\text{F} - 32^{\circ}) \cdot 0.5556 = 27.2^{\circ}\text{C}$$

To convert a temperature range (i.e., a range of 10°F) from Fahrenheit to Celsius, multiply by 5/9 or 0.5556.

$$\text{Ex: } 10.0^{\circ}\text{F range} \cdot 0.5556 = 5.6^{\circ}\text{C range}$$



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