



MILLENNIUM®
ROTARY SCREW LIQUID CHILLERS

SERVICE INSTRUCTIONS

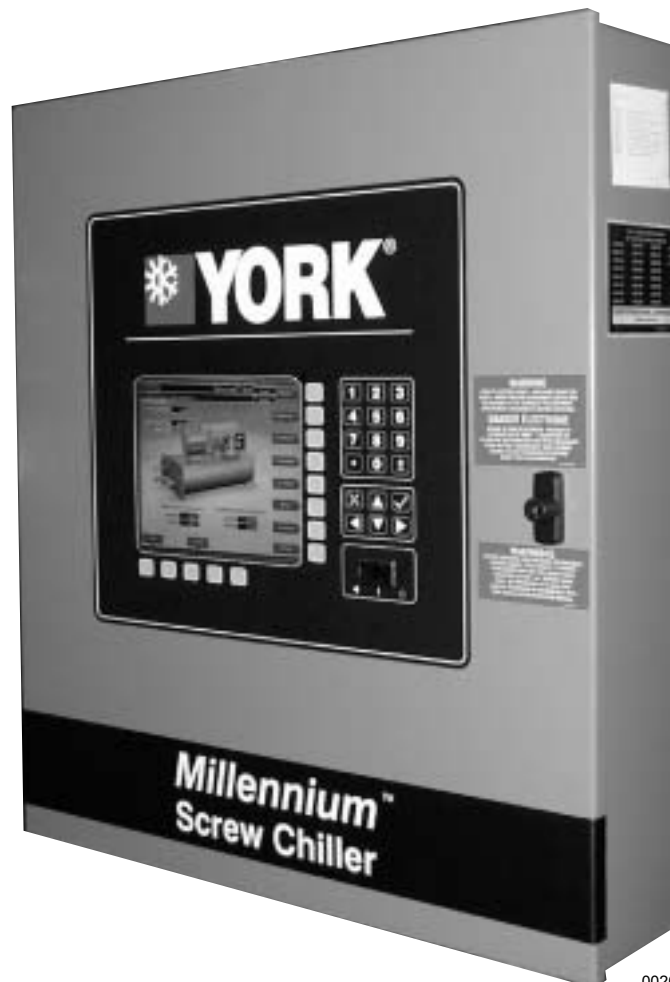
Supersedes: 160.80-M1 (402)

Form 160.80-M1 (604)

OPTIVIEW™ CONTROL CENTER

371-02459-101	(ELECTRO-MECHANICAL STARTER - NEMA 1)
371-02579-101	(ELECTRO-MECHANICAL STARTER - CE)
371-02578-101	(ELECTRO-MECHANICAL STARTER - NEMA 4/12)
371-02459-102	(SOLID STATE STARTER - NEMA 1)
371-02578-102	(SOLID STATE STARTER - CE)
371-02448-102	(SOLID STATE STARTER - NEMA 4/12)

MODEL YS (STYLE E)



00200VIP



Metric Conversions

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

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

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

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

SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to areas of potential hazard:



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



CAUTION identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



NOTE is used to highlight additional information which may be helpful to you.



External wiring, unless specified as an optional connection in the manufacturer's product line, is NOT to be connected inside the micro panel cabinet. Devices such as relays, switches, transducers and controls may NOT be installed inside the micro panel. NO external wiring is allowed to be run through the micro panel. All wiring must be in accordance with YORK's published specifications and must be performed ONLY by qualified YORK personnel. YORK will not be responsible for damages/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this will void the manufacturer's warranty and cause serious damage to property or injury to persons.

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.

It is the responsibility of operating/service personnel as to the applicability of these documents to the equipment in question. If there is any question in the mind of operating/service personnel as to the applicability of these documents, then, prior to working on the equipment, they should verify with the owner whether the equipment has been modified and if current literature is available.

REFERENCE INSTRUCTIONS

DESCRIPTION	FORM NO.
SOLID STATE STARTER (MOD "A") – OPERATION & MAINTENANCE	160.46-OM3.1
SOLID STATE STARTER (MOD "B") – OPERATION & MAINTENANCE	160.00-O2
INSTALLATION	160.80-N1
OPERATION	160.80-O1
WIRING DIAGRAM – UNIT WITH ELECTRO-MECHANICAL STARTER	160.80-PW1
WIRING DIAGRAM – UNIT WITH MOD "B" SOLID STATE STARTER	160.80-PW2
RENEWAL PARTS – UNIT	160.80-RP1
RENEWAL PARTS – OPTIVIEW CONTROL CENTER	160.80-RP3

NOMENCLATURE

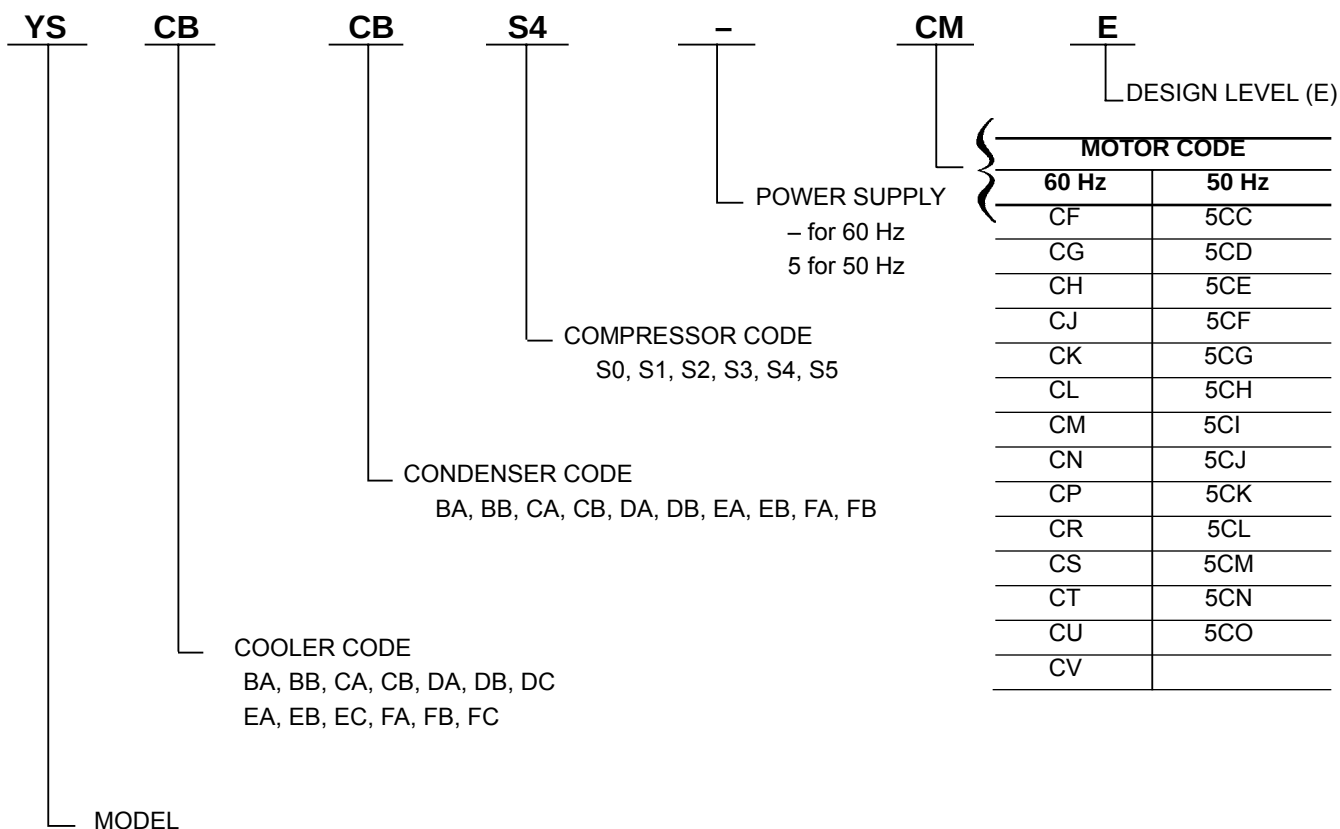


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SECTION 1 INTRODUCTION

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

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

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

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

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

In addition to this document, several levels of supporting documentation are required while servicing the system. Field Control Modifications Diagram 160.80-PW5 provides details of the interface to remote devices. Operations Manual 160.80-O1 explains the operation of the Control Center Keypad, how to enter Setpoints and explains all the messages displayed on the Control Center display. The following wiring diagrams provide

the connections between the printed circuit boards and components within the Control Center:

- YORK Form 160.80-PW1 – Chillers equipped with Electro-Mechanical starter
- YORK Form 160.80-PW2 – Chillers equipped with Mod “B” YORK Solid State Starter

When the chiller shuts down on a **SAFETY** or **CYCLING** shutdown or is being prevented from starting, a message is displayed providing the reason for the shutdown. This message, along with all the chiller operating conditions at the instant of the event are stored in the Microboard battery-backed memory. This history data can be displayed or printed using an optional printer. The Operations Manual 160.80-O1 provides a detailed description of this message, including the conditions required to produce the message and conditions required to restart the chiller.

Diagnostic Routines allow service analysis of the following functions:

- Display
- Analog inputs
- Digital inputs
- Digital outputs
- Serial Data ports

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

SECTION 2

SYSTEM ARCHITECTURE

The Control Center performs the following functions:

- Controls chiller capacity to chill liquid to the chilled liquid temperature setpoint.
- Controls chiller solenoid valves, relays, actuators and motor contactors per the operating program.
- Displays chiller operating conditions, alarms, shutdown messages and history data.
- Accepts operator-programmed setpoints and controls the chiller accordingly.
- Allows manual control of chiller motor contactors and actuators.
- Monitors chiller operating conditions and shuts down chiller when Safety or Cycling thresholds are exceeded.
- Allows local manual start/stop and accepts start/stop commands from remote devices, via contact closures or serial communications.
- Allows setpoints to be changed from a remote location via 0-10VDC, 2-10VDC, 0-20mA, 4-20mA, contact closures or serial communications.
- Provides chiller operating data and status to remote devices via serial communications and contact closures.
- Allows real-time data and history data to be printed on an optional printer.
- Controls the compressor motor starter and contains a printed circuit board logic that supports Electro-Mechanical Starters, and Solid State Starters.

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

System pressures are sensed by pressure **transducers**. The output of each transducer is a DC voltage that is analogous to the pressure input. System temperatures are sensed by **thermistors**. The output of each thermistor is a DC voltage that is analogous to the temperature it is sensing. Typical output voltage range of both is 0.5 to 4.5VDC. These are **analog** inputs to the Control Center.

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

Digital Outputs are on/off outputs from the Control Center in the form of relay contacts and triacs. The relay contacts and triacs typically switch 115VAC. Relay outputs include status/alarm, chiller solenoid valves, oil heater, and chilled and condenser water pump starters, etc. Triac outputs include slide valve control.

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

The Control Center supports three types of starters; Electro-Mechanical Starter, Mod "A" Solid State Starter and Mod "B" Solid State Starter. However, all Control Centers contain the following standard components, regardless of the starter type applied:

- Microboard
- I/O (input/output) Board
- Keypad
- Display
- Power Supply

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

- Electro-Mechanical Starter - CM-2 Current Module
- Solid State Starter (Mod "A" only) - Logic Board

Figures 1 through 3 are Control Center block diagrams of the three starter types. On each block diagram, the standard components are shown, along with the printed circuit board that supports the applied starter type. Figure 4 is an Operation Sequence timing diagram.

The microprocessor and all supporting logic circuits, along with the memory devices containing the operating program, reside on the **Microboard**. All chiller operating decisions are made here. It receives analog and digital inputs from the chiller and remote devices. The analog inputs are connected directly to the Microboard. The digital inputs are received via the I/O Board (see description below). Under Program control, the Microboard operates the relays and triacs that are located on the I/O Board.

The control center could be equipped with either of the following Microboards:

- 031-01730-000 – Shipped in new production

chillers until March 2004. The program resides in a replaceable Flash Memory Card. The software version is C.MLM.03.xx.yzz. It is printed on a label adhered to the card. The Program can be upgraded by replacing the card.

- 031-02430-000 – Shipped in new production chillers after March 2004. The program resides in non-removable onboard memory. The software version is C.OPT.03.xx.yzz, and is viewable on the DIAGNOSTICS Screen in SERVICE access level. The Program can be upgraded by downloading a new program from a Program Card. Program Cards are shirt-pocket-size portable memory storage devices available from YORK.

Since the newer version Microboard is backward compatible to earlier vintage Optiview Control Centers, earlier vintage chillers could be equipped with a later version Microboard due to service replacement.

The software versions (C.MLM.03.xx.yzz or C.OPT.03.xx.yzz) are alphanumeric codes that are interpreted as follows. Each time the controls section or language section is revised, the respective revision level increments.

- C – Commercial chiller
- MLM – Used on Microboard 031-01730-000
- OPT - Used on Microboard 031-02430-000
- 03 – YS chiller
- xx - controls revision level (00, 01, etc)
- y – language package (0=English only, 1=NEMA, 2=CE, 3=NEMA/CE)
- zz – language package revision level (00, 01, etc)

Throughout this book, reference is made to functions and features that are only available in certain Flash Memory Card revision levels (C.MLM.03.xx.xxx). To cross reference C.MLM software to C.OPT software, refer to the controls revision level. Software version C.OPT.03.03A.xxx is of the same controls revision level as C.MLM.03.03.xxx. From this starting point, both receive the same updates at each revision. Software upgrades should only be performed by a Service Technician.

The **I/O Board** acts as an input/output device for the Microboard. It conditions the digital input signals for the Microboard and contains relays and triacs that are controlled by the Microboard to control solenoids, motor contactors and actuators. The 115VAC digital inputs from switch and relay contacts are converted to

logic level voltages by Opto-Couplers. The relays have +12VDC coils that are energized and de-energized by the Microboard. The contacts of these relays control the 115VAC system solenoids, relays and motor contactors. The triacs are turned on and off by the Microboard.

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

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

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

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

When the compressor motor is driven by the YORK Solid State Starter, there could be either of two different Solid State Starters applied. New production chillers are equipped with the Mod “B” Solid State Starter. This starter contains a combination Logic/Trigger Board that interfaces the Microboard via a serial communications link. Earlier vintage chillers, such as those encountered in Control Center retrofit applications, are equipped with the Mod “A” Solid State Starter. This starter contains a Trigger Board that interfaces to a Logic Board that is installed inside the Control Center. The Logic Board interfaces the Microboard via a multiplexed data interface.

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

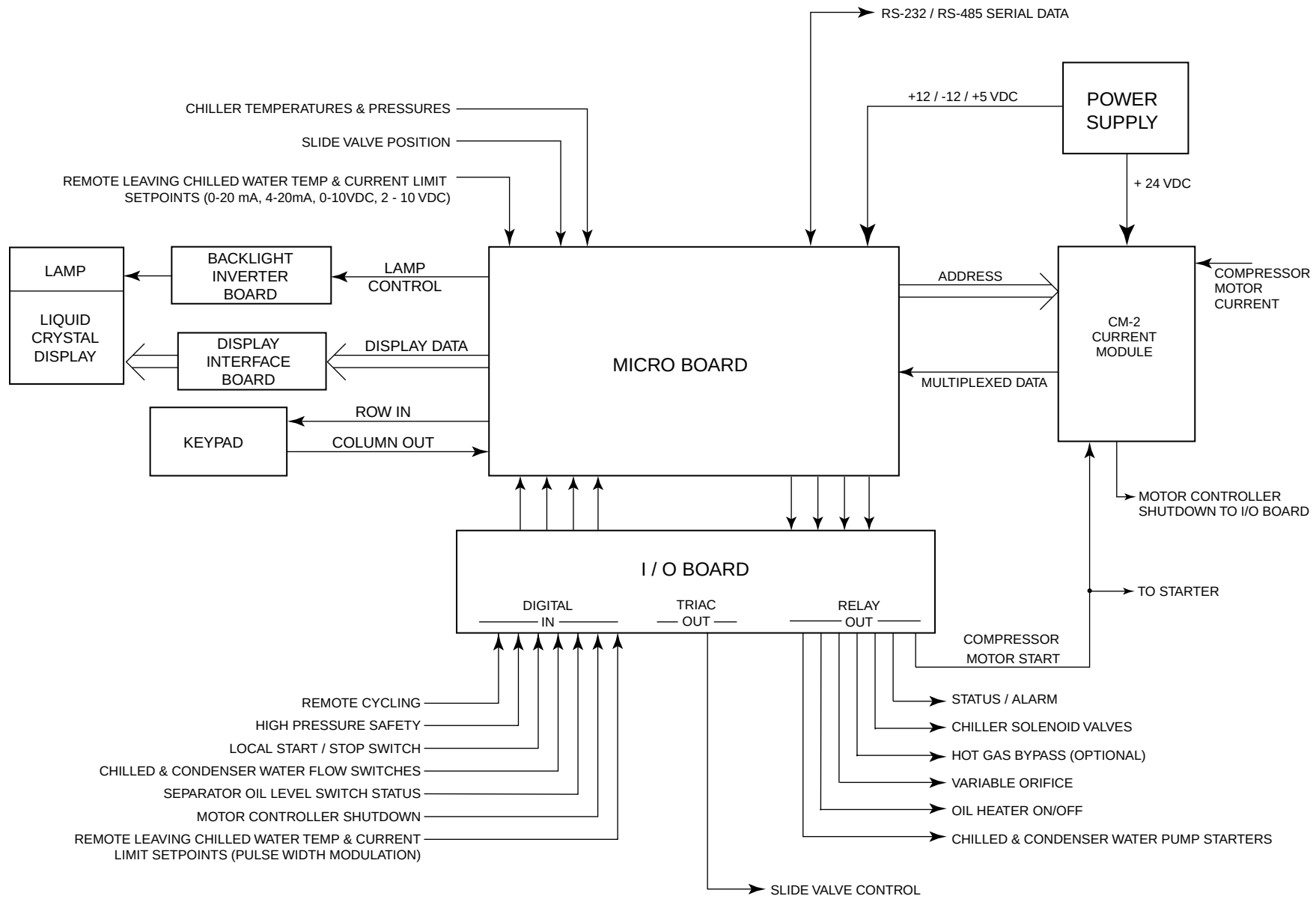


FIG. 1 – CONTROL CENTER - ELECTRO-MECHANICAL STARTER APPLICATIONS

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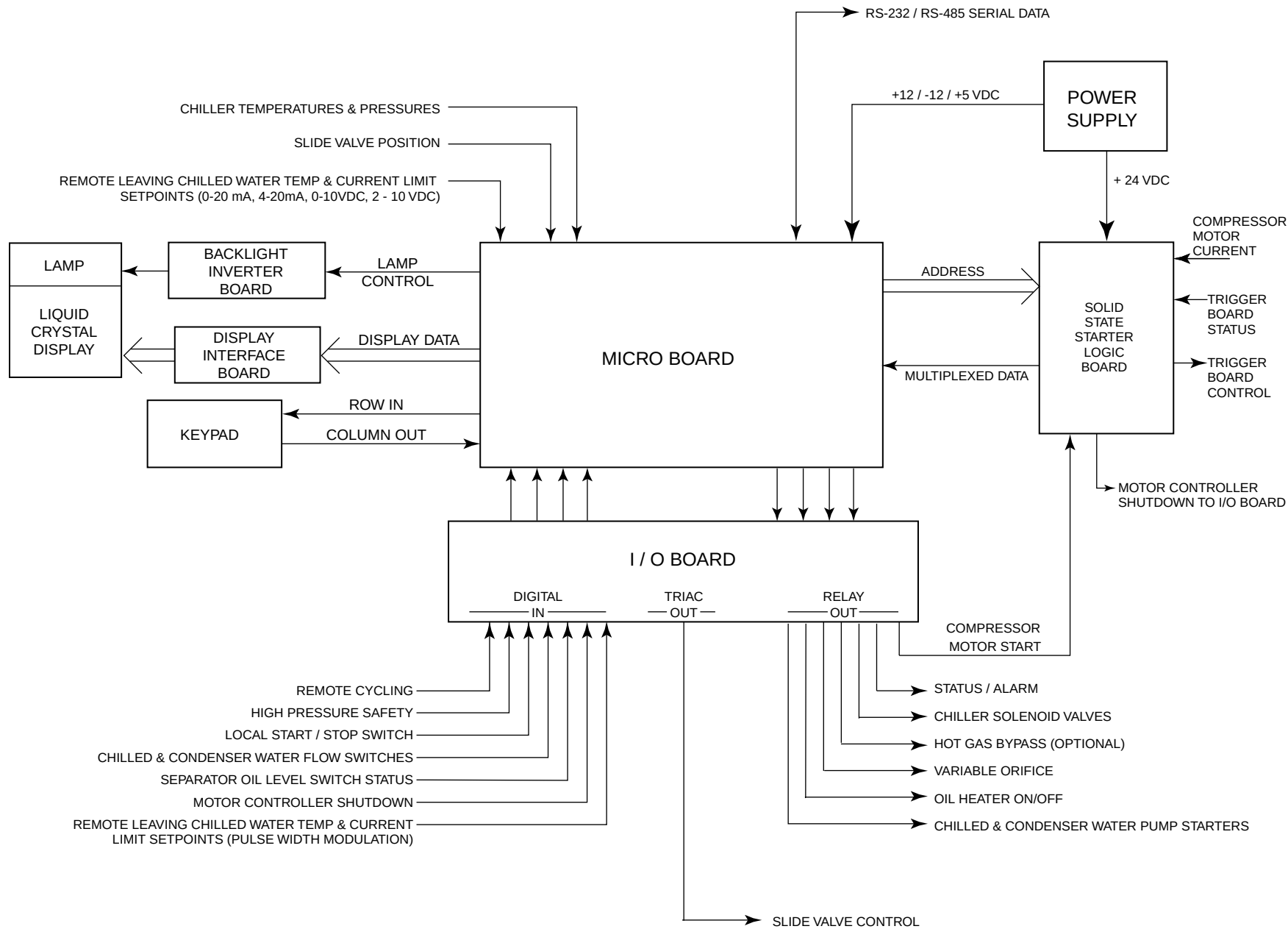


FIG. 2 – CONTROL CENTER - MOD "A" SOLID STATE STARTER APPLICATIONS

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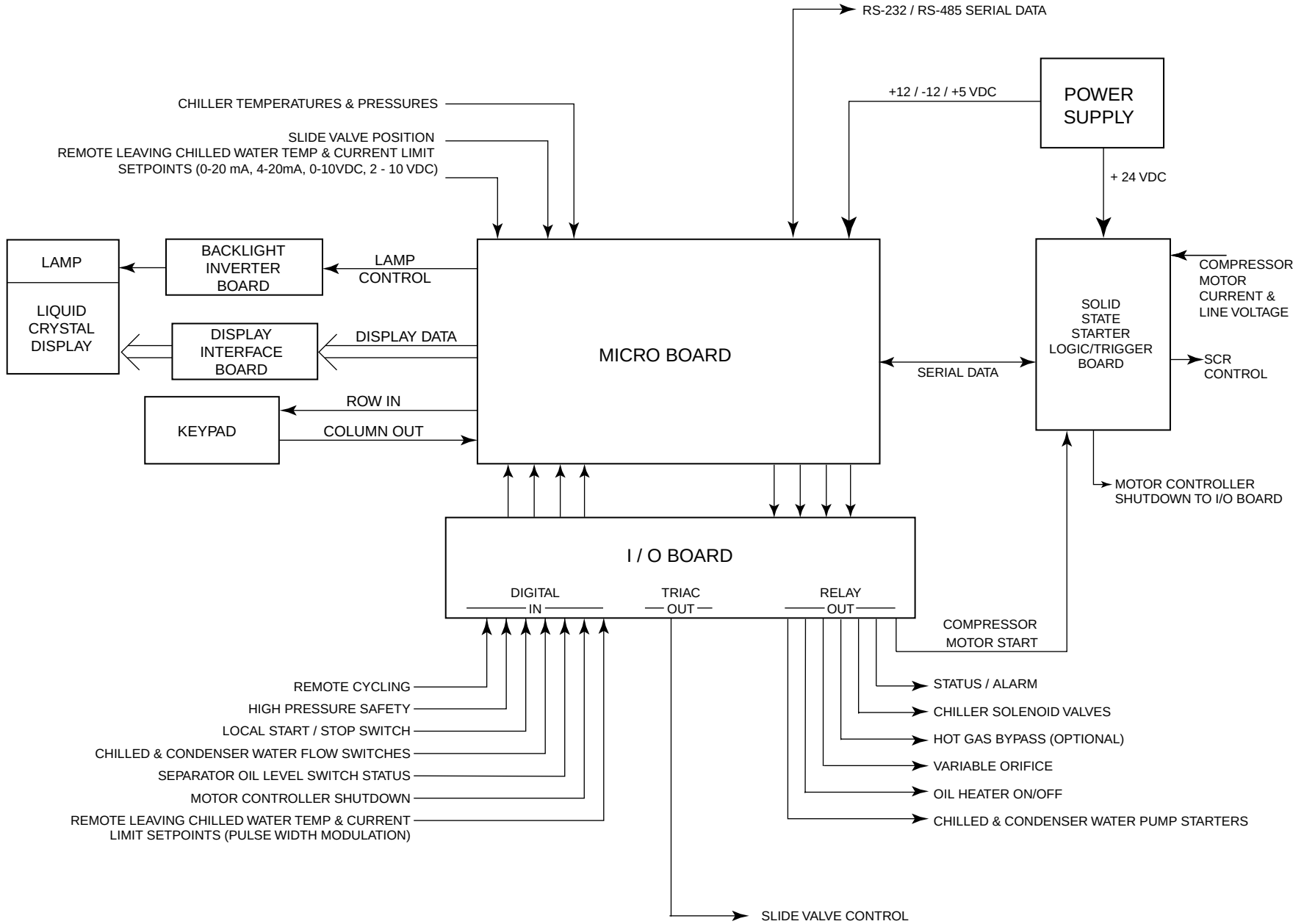


FIG. 3 – CONTROL CENTER - MOD "B" SOLID STATE STARTER APPLICATIONS

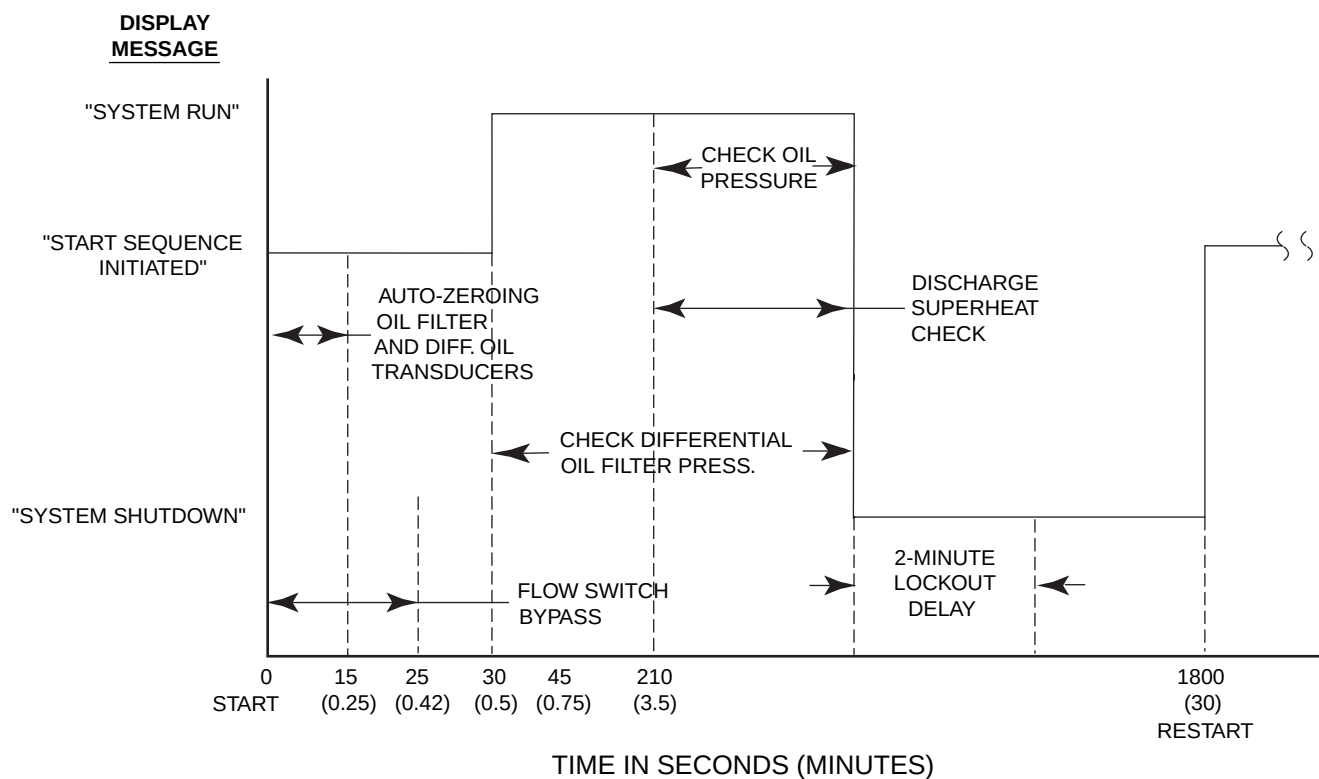


FIG. 4 – OPERATION SEQUENCE TIMING DIAGRAM
(ELECTRO-MECHANICAL & SOLID STATE STARTER APPLICATIONS)

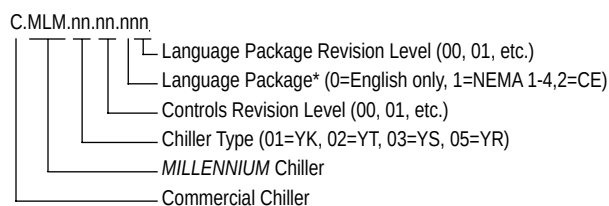
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SECTION 3 MICROBOARD

031-01730-000
(REFER TO FIG. 5 - 10)

The **Microboard** contains the operating software (Program), microprocessor (Micro), and supporting circuits for the Micro.

The **Program** is a set of instructions to control the chiller, the display and peripheral devices. It also contains the Safety and Cycling shutdown thresholds (non changeable) and Display messages and screens. It is stored in a memory device called a **flash memory card**. This is a type of nonvolatile memory that can be read from or written to, but requires the locations to be erased before they are written to. With the exception of a write/read sequence that occurs during the Boot-up process explained below, this device is used primarily as read-only in this application. A write protect switch is located on the left edge of the card as shown in Fig. 6. It must be placed in the "Write Enabled" position in order to allow successful Boot-up. The card is located in socket location U46 (ref. Fig. 5). It connects to the Board via an Elastomeric connector that is a silicon rubber strip embedded with silver conductors. The Card can be removed from its socket by using the thumb to press down on the socket's plastic tension spring. The card is installed by inserting it into the socket/holder and pressing on the surface of the Card until it snaps into place. The Memory card is a replaceable component. Refer to YORK Renewal Parts List Form 160.80-RP3. The version of the Memory card is an alphanumeric code that represents the application and revision level. The version is printed on a label adhered to the memory card's surface. The version code is as follows:



* Refer to YORK Renewal Parts List 160.80-RP3 for available languages.

- 1 = Supplied in new NEMA 1-4 OptiView Control Centers but can be retrofit to any OptiView Control Center.
- 2 = Supplied in new CE (European Community) OptiView Control Centers but can be retrofit to any OptiView Control Center.

There are two Flash Memory Cards available. The difference between them is the different languages that can be displayed on the Display Screens. Language selection

is performed on the USER Screen following instructions in Operations Manual 160.80-O1. Not all languages are available. Refer to Renewal Parts List 160.80-RP3 for list of available Flash Memory Cards and display languages. **IMPORTANT!** – Not all versions of Flash Memory Cards are compatible with revision "E" (and later) Microboards or all BIOS Eproms. If an incompatible version is used, the initialization (boot-up) process will not complete and the chiller will not run! Refer to Renewal Parts List 160.80-RP3 and "Service Replacement" paragraph in this section.

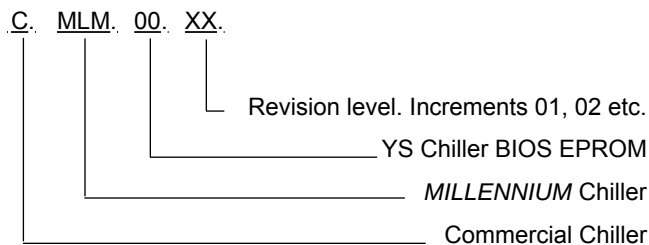
The **Micro** controls the chiller by reading and executing the Program instructions in a sequence determined by the Program. Under Program control, the Micro reads the Analog and Digital Inputs to determine the operating conditions and controls Digital Outputs based upon these inputs. These inputs are compared to stored thresholds to determine if a Safety or Cycling shutdown is required. If a threshold has been exceeded, a shutdown is performed and the appropriate message is retrieved from the Program and displayed on the Liquid Crystal Display. As operating conditions require, status messages are retrieved and displayed. The Keypad is read as Digital Inputs. When an operator presses a key to request a display, the Micro interprets the request, retrieves the display from the Program and displays it. The Program assembles data in the correct format for transmission through the Serial Data Ports to peripheral devices. The Program also instructs the Micro to respond to requests from peripheral devices for serial data transmissions.

The **Watchdog** circuit monitors the +5VDC supply from the external Power Supply to determine when a power failure is occurring. Just prior to the supply decreasing to a level where the Micro and supporting circuits can no longer operate, it applies a reset signal to the Micro.

The Micro responds by de-energizing the run digital output, shutting down the chiller and retrieving the **Power Failure** message from the Program and sending it to the Display Controller for display. Similarly, when power is first applied after a power failure, it maintains the Micro in a reset state until the +5VDC has returned to a sufficient level. The Watchdog circuit also assures that all the Program instructions are being performed and that the Program has not latched-up, bypassing important safety

thresholds. If the Program has latched-up, The Micro initiates a Safety shutdown and displays **WATCHDOG – SOFTWARE REBOOT** message.

The **BIOS EPROM** (basic input/output system erasable programmable read only memory) is a memory device that contains the bootstrap or power-up program. It is located in socket location U45. This EPROM is replaceable. Refer to YORK Renewal Parts List Form 160.80-RP3. The EPROM version is an alphanumeric code that represents the application and revision level. The version is printed on a label adhered to the EPROM's surface. The version code is as follows:



There are two different BIOS Eproms. Eprom 031-01796-001 can only be used in revision "A" through "D" Microboards. Eprom 031-01796-002, although it can be used in revision "A" through "D" Microboards, is required in revision "E" and later Microboards to support the use of either 65548 or 65550 Display Controllers (U29). **IMPORTANT!** Eprom 031-01796-002 is **NOT** compatible with all versions of Flash Memory Cards. If an incompatible Flash Memory Card version is used with this BIOS, the initialization (boot-up) process will not complete and the chiller will not run! (refer to Renewal Parts List 160.80-RP3 and "Service Replacement" paragraph in this section.

When power is applied to the Control Center following a power failure, the Micro executes the instructions in the BIOS EPROM program to initialize, configure and start operation of certain Microboard components before the main program (stored in the Flash Memory Card) is started. Depending upon the application, the Microboard could be equipped with an EPROM that has either 128K, 256K or 512K capacity. Microboard Program Jumper JP38 must be positioned according to the actual EPROM installed. Refer to Table 1 (Program Jumpers). There are 5 steps to the boot-up process. During the boot-up

process, there is a visual indication as each step is performed, followed by a Pass/Fail status of the step. On the Microboard, a green LED (CR17 - Pass) flashes to indicate the step was successful. If a step is unsuccessful, a red LED (CR18 - Fail) flashes and the Boot-up process terminates. The execution and Pass/Fail status of steps 3 through 5 are displayed on a white Keypad Display Screen as they are performed. This white display screen also lists the BIOS EPROM Version. The steps of the Boot-up process are as follows. Also, below is listed the LED activity associated with each step.

BOOT-UP STEP AND DESCRIPTION

1. First initiate table complete.

Registers in the Micro are configured to allow it to perform basic memory read/write functions.

2. FPGA configuration.

The Field Programmable Gate Array (FPGA) is configured to process Digital Inputs and Outputs.

3. Mini-card signature test.

A location in the Flash Memory Card that contains a code identifying the Manufacturer is compared to other locations that contain the manufacturer's name. If these values are the same, it is **pass**. If they are different, it is **fail**.

4. Mini-card checksum.

The **Flash** Memory Card checksum is calculated and compared to the checksum value that is stored in the Card at the time the Card was initially programmed at the YORK factory. If both values are the same, it is considered **pass**. If the calculated value is different than the stored value, it is considered **fail**.

5. BRAM quick test.

Test data is written to and then read from several memory locations to verify BRAM operation.

LED INDICATORS

When power is applied to the Control Center, both the red (CR18 - Fail) and green (CR17 - Pass) LEDs simultaneously illuminate for 1 second, then the Boot-up process begins in the following sequence.

STEP	PASS	FAIL
1	Green on, Red off	Watchdog will initiate a re-boot
2	Green flash once	Boot-up process halts. One red flash repeating
3	Green flash once	Boot-up process halts. Two red flashes repeating
4	Green flash once	Boot-up process halts. Three red flashes repeating
5	Green flash once	Boot-up process halts. Four red flashes repeating

When all steps have been completed, the LED's will then illuminate or extinguish, as long as power is applied, according to the settings of Microboard Programs Switches 7 and 8 as follows:

GREEN (CR17)

Program SW 7 set to ON - extinguishes
OFF - illuminates

RED (CR18)

Program SW 8 set to Standard - illuminates
Enhanced - extinguishes

The **BRAM** (battery backed random access memory) is a memory device that contains a battery that preserves the data during power failures. It is a replaceable part. Refer to YORK Renewal Parts List Form 160.80-RP3. It is located in socket location U52. The Micro stores the setpoints programmed by the Operator or Service Technician, History Data and other data that requires preservation, in this device. Also, the day of week, time of day and calendar date timekeeping are done here.

Program Jumpers/Program Switches

The Program Jumpers (Table 1) and Program Switches (Table 2) are used to alter the program operation or configure the Microboard hardware for specific operation. This allows the Program and Microboard to be universal for all standard applications. Refer to Table 3 and 4 for the function of each jumper and switch. The position of some jumpers can be determined by the Service Technician to meet the desired operation. Others must be positioned according to the requirements of the size, type or style of components and thus are determined by the YORK factory. Some jumpers are plastic sleeves with metal inserts that are inserted over 2-prong or 3-prong conductors. Others are wire bridges that are either cut or left in place. The Program Switches are miniature switches that are placed in either the ON or OFF position.

Keypad Interface

The Keypad is read via J18. The Keypad is a matrix of conductors arranged in rows and columns (ref fig 32 and 33). There are 4 rows and 8 columns. When a key is pressed, the conductors are pressed together at that point, creating continuity between the row conductor and the column conductor. The keypad is read by applying a logic low to a row while leaving +5vdc pullup on all other rows. The micro then reads the 8 columns. If any column has a logic low on it, the key corresponding to that coordinate (row, column) is being pressed. The micro reads the entire keypad by repeating this routine beginning with row 1 and ending with row 4. The entire keypad is continually read while the control center is powered. Refer to SECTION 8 of this manual for details of the Keypad.

CM-2 Board or Style A Solid State Starter Interface

The microboard retrieves certain operating parameters (via J10) from the compressor motor starter control board (CM-2 Current Board for Electromechanical starter or Style "A" Solid State Starter Logic Board). Refer to the appropriate section of this book for detailed explanation of each board. Both boards contain an 8 channel multiplexer. The micro sequentially and continually reads channels 0 through 7. It reads each channel by applying a 3-bit binary address to the multiplexer. A 0-5vdc analog value is returned from each channel. The function of each is in the table below. The micro determines which board, and therefore which starter is present, by the value returned from channel 0. Since channels 0 through 6 are grounded, the CM-2 board returns a 0vdc value. The Solid State Starter Logic Board returns a value >0.41vdc to +5vdc. If the value is <0.4vdc, it indicates the starter is an Electro-mechanical (EM) starter and the micro then reads channel 7 to retrieve the peak motor current value. A value >0.4vdc indicates the starter is an "A" style Solid State Starter and the micro reads channels 1 through 7. In the Solid State Starter, channel 0 indicates the starter size (model) and voltmeter range (300Vac or 600Vac). Channel 1 is a hardware generated 100% FLA (prevents pre-rotation vanes from further opening) or 104% FLA (closes pre-rotation vanes until motor current is <102%) current limit override command that overrides normal Pro-rotation Vanes control. Channels 2 through 4 are analog voltages that represent phase A, B and C motor current. The highest phase is Channels 5 through 7 are analog voltages that represent phase A, B and C Line Voltage. The data for each channel is shown below:

The addresses and associated data are shown below.

CM-2 Board		Mod "A"	
		Solid State Starter Logic Board	
Address	Data	Address	Data
0 thru 6	Gnd	0	starter model / voltmeter range
7	Peak Motor Current	1	current limit command
		2 - 4	phase C, B, A motor current
		5 - 7	phase A, B, C line voltage

Style B Solid State Starter Interface

If equipped with either of these drives, the drive is interfaced to the Microboard via the Opto-Coupled COM 5 serial data port (J15). The serial data is represented by +5vdc and 0vdc logic levels. J15-1 is TX data to the drive and J15-2 is RX data from the drive. Refer to SECTION 11 (Solid State Starter) for details of this interface.

Printer Interface

An optional Printer can be connected to COM1 RS-232 serial data port (J2). J2-4 is TX data to the printer. J2-2 is the DSR (Data Set Ready or busy) signal from the printer. Signal levels are standard RS-232. The microboard sends data to the printer at the selected baud rate until the printer buffer becomes full, whereupon the printer asserts its Busy signal. The microboard suspends data transmission until the printer can accept more data. Each printer must be setup/configured to operate properly with the microboard. The Baud, Data Bits, Parity and Stop Bits must be programmed on the Comms Screen. Other printer setup is performed on the PRINTER Screen. Refer to YORK manual 160.80-O1 for details of available printers and printer setup instructions.

MicroGateway Interface

An optional Microgateway printed circuit board can be connected to the COM 4B RS-232 serial data port (J2). J2-7 is TX data to the MicroGateway. J2-6 is RX data from the Microgateway. Signal levels are standard RS-232. The MicroGateway polls system pressures, temperatures and status from the microboard. It holds it for retrieval by third-party devices. Refer to SECTION 15 of this manual.

Digital Inputs

The I/O Board converts the 115Vac inputs to logic level inputs for the microboard at J19. A 115Vac input to the I/O board is converted to a logic low (<1Vdc). A 0Vac input to the I/O Board is converted to a logic high (>4Vdc). Refer to SECTION 4 of this manual for details of the I/O Board.

Digital Outputs

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

The microboard controls Actuator motors via Triacs on the I/O Board. Each actuator has an open winding and a close winding. Current flowing through a winding causes the actuator to rotate in the respective direction. Each winding is controlled by a Triac. The Triac is turned on to allow current to flow through a winding. The microboard turns on the Triac by applying a logic low (<1Vdc) to the Triac driver on the I/O Board. It turns it off by applying a logic high (>4vdc). Refer to SECTION 4 of this manual for details of the I/O Board.

Analog Inputs

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

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

Serial Data Ports

The Microboard is equipped with 5 serial data ports (ref fig 11). Each port is dedicated for a specific function as follows:

- COM1 (J2) – RS-232. Printer
- COM2 (J13) – RS-232. Not used
- COM3 (J12) – RS-485. Optional I/O.
- COM4 (4A-J11), (4B-J2) – This port is actually two ports. However, they cannot be used simultaneously. The position of program jumper JP27 determines which port can be used. (refer to table 3). COM4A–RS485 Not used. COM4B – RS-232 Microgateway.

e. COM5 (J15) – Opto-coupled transmit/receive. Style B Solid State Starter.

Each port is equipped with two LED's. A red TX LED illuminates as data is transmitted to or requested from another device. A green RX LED illuminates as data is received from another device. The RS-232 voltages are industry standard +5 to +25vdc and -5vdc to -25vdc logic levels. The RS-485 voltages are industry standard 0vdc and +1.5 to +5vdc logic levels. COM5 logic levels are 0vdc and +5vdc. A diagnostic test can be performed on each serial port to confirm proper operation. Refer to Diagnostics SECTION 23 of this manual.

The LED's and their functions are as follows:

- CR2 RX1 – COM1 serial port receive data.
- CR3 TX1 – COM1 serial port transmit data.
- CR12 TX4 – COM4 serial port transmit data.
- CR13 RX4 – COM4 serial port receive data.
- CR15 TX3 – COM3 serial port transmit data.
- CR14 RX3 – COM3 serial port receive data.
- CR11 RX2 – COM2 serial port receive data.
- CR16 TX2 – COM2 serial port transmit data.
- CR10 RX5 – COM5 serial port receive data.
- CR9 TX5 – COM5 serial port transmit data.

Display Interface

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

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

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

The microboard controls the Display Backlight via J6. The Display Backlight is the light source for the display. The Backlight Inverter Board provides a high voltage AC power source for the lamp. It converts low voltage DC via J6-1 (+12vdc or +5Vdc, depending on position of Program Jumper JP5) to high voltage AC (500 to 1500Vac). This high voltage AC is applied to the lamp to cause it to illuminate. The Backlight is turned on and off with the "Backlight Enable" signal (J6-5). The position of Program Jumper JP4 determines whether this is a +12Vdc or +5vdc signal. In some displays, the backlight turns on when this signal transitions from low to high; others turn on when it transitions from high to low. The position of Program Jumper JP3 determines the transition that will occur when the Microboard outputs the Backlight Enable signal. JP3 must be positioned according to the display manufacturer's requirement.

Under program control, the microboard controls the backlight brightness via the Lamp Dimmer circuit output at J6-7. In order to extend the life of the Backlight lamp, the brightness is driven to 50% after 10 minutes of Keypad inactivity. At this brightness level, the graphics are still visible. When Keypad activity is detected (a key is pressed), the lamp is driven back to full (100%) brightness. Some display manufacturers require a variable voltage to vary the brightness; others require a variable resistance. Program Jumpers JP7 and JP8 must be configured to enable the appropriate technique. The Lamp Dimmer is an integrated circuit that is the electrical equivalent of a 10K ohm potentiometer with 100 positions or steps (ref fig 10A). The Lamp

Dimmer controls the position of the potentiometer. The lamp Dimmer varies the brightness of the backlight by applying a variable voltage (0-5.0vdc) or a variable resistance (0-10K ohms) to the Backlight Inverter Board. If Program Jumpers JP7 and JP8 are installed, the lamp Dimmer output is a variable voltage; if both are removed, the output is a variable resistance. The Lamp Dimmer outputs "Brightness Control Wiper" (J6-7) to the Backlight Inverter Board. If configured for variable voltage output, the voltage between J6-7 and J6-8 can be varied from 0Vdc (100% brightness) to 5.0Vdc (0% brightness). If configured for variable resistance, the resistance between J6-6 and J6-7 varies from 0 ohms (0% brightness) to 10K ohms (100% brightness).

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

Revision "A" through "D" Microboards are equipped with Display Controller (U29) type 65548. Revision "E" and later boards could be equipped with either a 65548 or 65550 Display Controller. To accommodate the use of either device, BIOS Eprom part number 031-01796-002 is required on revision "E" and later Microboards. Also, Program Jumpers JP43 and JP44 (refer to Table 1) must be configured according to the actual Display Controller installed on the board. These jumpers are positioned appropriately at the time the board is manufactured and should not require field configuration.

Remote Setpoints

Remote Leaving Chilled Liquid temperature and Current Limit setpoints can be input via the RS-232 Microgateway interface at J2 or directly to the Microboard at J22 (ref fig 12). The inputs at J22 are configured with Program Jumpers JP23 and JP24 to accept these inputs in either 0-10vdc, 2-10vdc 0-20Ma or 4-20Ma form. Refer to Table 3 for Program Jumper configurations and SECTION 18 of this manual for details of the Remote Setpoints.

Power Supply

The Microboard receives 3 supply voltages (Microboard J1) from the **Power Supply**; +12VDC, -12VDC, +5VDC and Ground. The -12VDC and +12VDC are used directly by various circuits. The +12VDC and +5VDC are input to **Voltage Regulators** to derive other regulated voltages. The +5VDC (fused by 5 Amp fuse F1 on rev "E" and later boards) is input to a +3.3VDC regulator. The output is a 3.3VDC regulated voltage. The +12VDC (fused by 5 Amp F2 on rev "E" and later boards) is input

to a 5VDC regulator. The output of this regulator powers only the Analog circuits. This includes the MUX, A/D converter, CM-2 module, Solid State Starter (Mod "A") Logic Board, Transducers and Thermistors. As depicted on Fig. 5, these voltages can be monitored at Test Posts TP1 through TP6.

Service Replacement

Service replacement Microboards are ordered under part number 331-01730-603. This part number includes an 031-01730-000 Microboard equipped as described below and the latest version of Flash Memory Card 031-02005-001.

If the Microboard is replaced within the warranty period, return the defective board along with any unused Flash Memory Cards per the warranty return Procedure.

Some removable components will have to be transferred from the defective board to the replacement board. The revision level of the replacement board determines which components from the defective board can be transferred to the new board. When the replacement Microboard is received, observe the revision level of the replacement board. Revision "E" and later boards have different component requirements and are supplied differently than revision "A" through "D" boards as follows:

Replacement Boards that are Revision "A" through "D":

Supplied without the following:

- BIOS Eprom (U45)
- BRAM (U52)

Remove the above devices from the defective board and use in replacement board. Transfer Flash Memory Card 031-02005-002 (available after October 2000) from the defective board to the replacement board or use latest version of Card 031-02005-001 supplied with replacement board. Select the Flash Memory Card based upon the display language requirements (refer to Renewal Parts List 160.80-RP3).

Not all combinations of Flash Memory Cards and BIOS Eproms are compatible. If incompatible versions are used, the initialization (boot-up) process will not complete and the chiller will not run! Acceptable Flash Memory Card and BIOS Eprom combinations that can be used in revision "A" through "D" Microboards are as follows:

1. BIOS Eprom 031-01796-001 can be used with Flash Memory Card 031-02005-001 (any version) or 031-02005-002 (any version; available after October, 2000).
2. BIOS Eprom 031-031-01796-002 can only be used with Flash Memory Card 031-02005-001 (version C.MLM.03.01 and later; ie, .02, .03, etc.) or 031-02005-002 (any version).

Replacement Boards that are Revision “E” or Later:
Supplied with:

- BIOS Eprom (U45) part number 031-01796-002

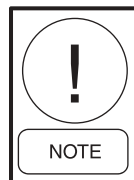
Supplied without:

- BRAM (U52)

Remove the BRAM from the defective board and use in the replacement board. Transfer Flash Memory card 031-02005-002 (available after October, 2000) from the defective board to replacement board or use latest version of Card 031-002005-001 supplied with replacement board. Select Flash Memory Card based upon display language requirements (refer to Renewal parts List 160.80-RP3).

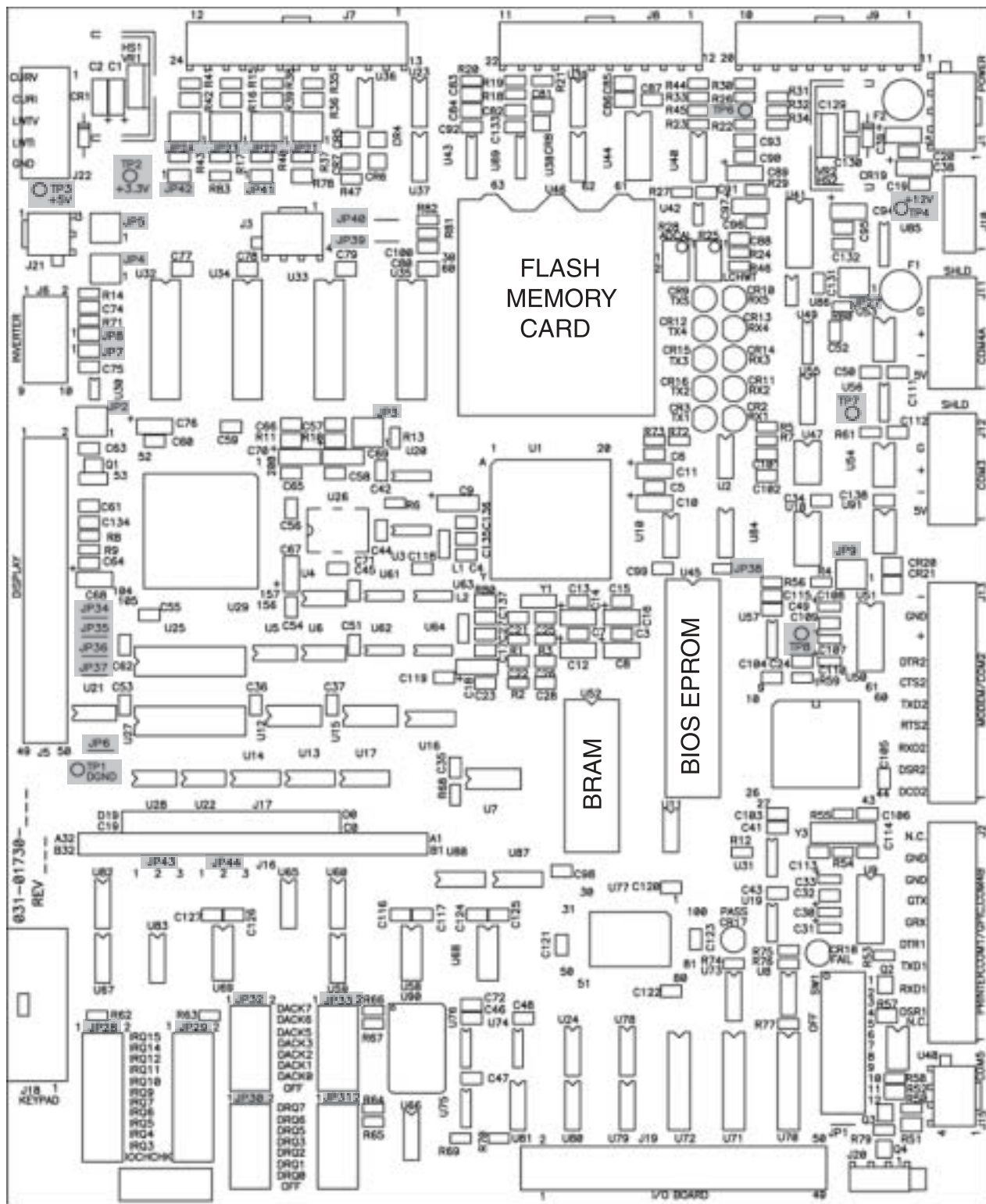
Not all combinations of Flash Memory Cards and BIOS Eproms can be used in revision “E” and later boards. If incompatible versions are used, the initialization (boot-up) process will not complete and the chiller will not run! The following is the requirements:

1. BIOS Eprom 031-01796-002 is required.
2. Flash Memory Card 031-02005-001 can be used. However, it **MUST** be version C.MLM.03.01 or later (ie; .02, .03, etc.). Earlier version C.MLM.03.00 is not compatible.
3. Flash Memory Card 031-02005-002 (any version; available after October, 2000) can be used.



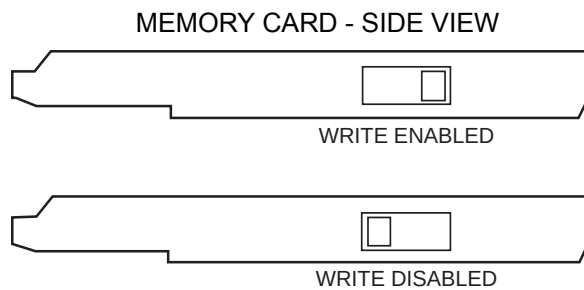
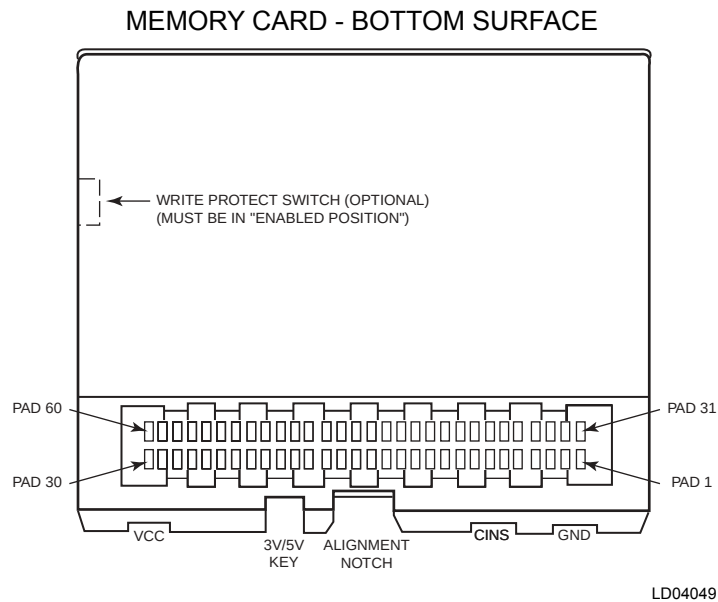
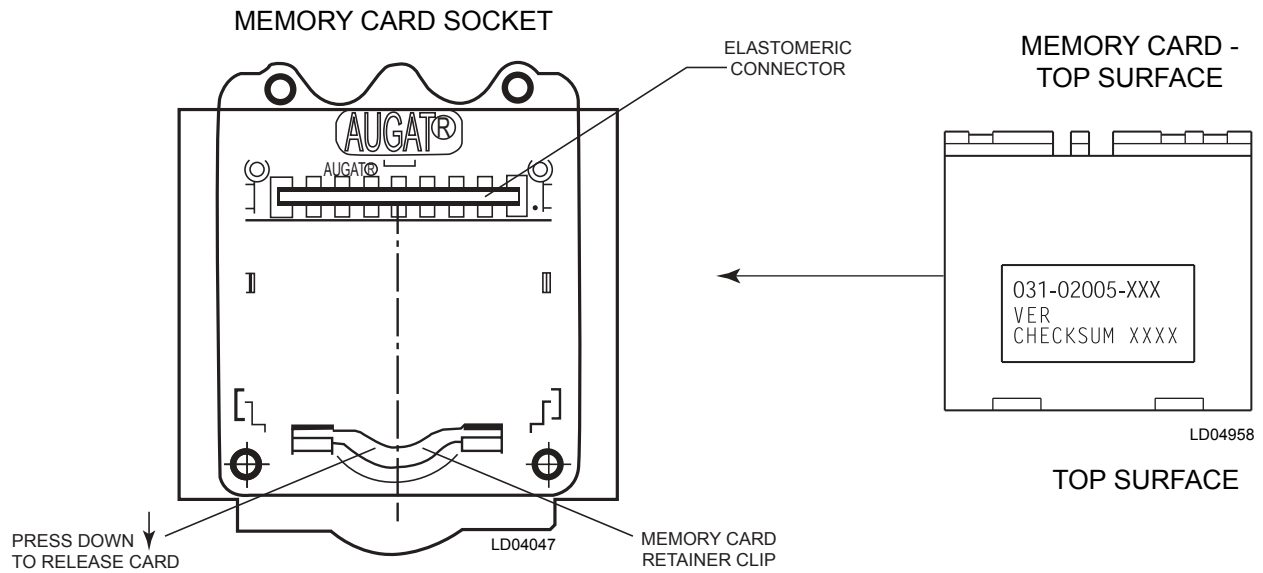
IMPORTANT! Since the BRAM memory device contains all of the programmed setpoints and Sales Order data, using the existing BRAM in the replacement Microboard eliminates the need to reprogram this extremely large amount of data. The process to manually program the Sales Order Data is extremely time-consuming. However, if the BRAM fails and field replacement is necessary, follow the procedure in the “Systems Calibration, Service Setpoints and Reset Procedures” section of this book.

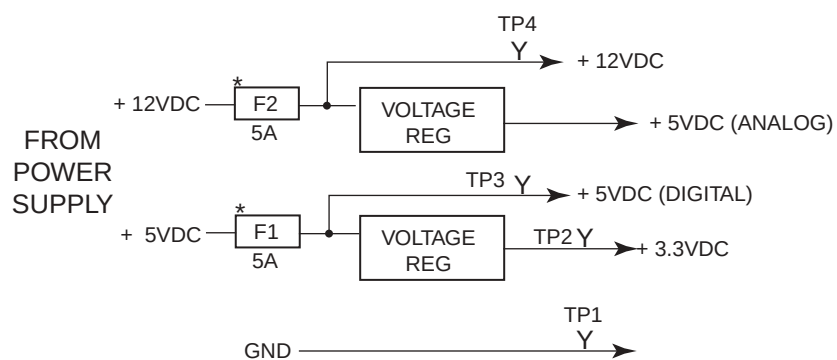
3



LD07786

FIG. 5 - MICROBOARD 031-01730-000

**FIG. 6 – FLASH MEMORY CARD**



* Rev "E" and later boards only

LD09475

FIG. 7 – MICROBOARD
(031-01730-000) POWER SUPPLY TEST POINTS

TABLE 1
MICROBOARD 031-01730-000 PROGRAM JUMPERS

MICROBOARD PROGRAM JUMPERS

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.

OUT - Permits Program switch SW1 position 12 to enable or disable the program

Watchdog protection as follows:

Position 12 **ON** - Watchdog protection enabled

OFF - Watchdog protection disabled

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

Pins 1-2: +5VDC SHARP LQ10D367 and LQ10D421 displays.

Pins 2-3: +3.3VDC NEC NL6448ACCC33-24 and LG Semicon LP104V2-W displays.

JP3 - Display backlight enable signal level polarity. Jumper must be positioned according to the voltage level required to turn on the Display Backlight.

Pins 1-2: 0VDC SHARP LQ10D421 Display.

Pins 2-3: +12VDC or +5VDC as determined by position of JP4. SHARP LQ10D367, NEC NL6448AC33-24 and LG Semicon LP104V2-W displays.

JP4 - Display backlight enable signal logic levels. Determines the logic levels of the Backlight enable signal.

Pins 1-2: +12VDC/0VDC SHARP LQ10D421 display.

Pins 2-3: +5VDC/0VDC SHARP LQ10D367, NEC NL6448AC33-24 and LG Semicon LP104V2-W displays.

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

Pins 1-2: +12VDC. SHARP LQ10D367 and LQ10D421, NEC NL6448AC33-24 and LG Semicon LP104V2-W displays.

Pins 2-3: +5VDC. Not Used

JP6 - 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 (0-5.0VDC). SHARP LQ10D367, LQ10D421 and LG Semicon LP104V2-W displays.

OUT: Variable resistance. NEC NL6448AC33-24 display.

JP9 - JP20 - Not Used

JP21 - Configurable Analog input (J7-2 & J7-14) type. Configures analog input for 0-10VDC, 4-20mA, thermistor (temperature) or transducer (pressure) input.

OUT: Allows a 0-10VDC input on J7-2 or a transducer input on J7-14.

Pins 1-2: Allows a 4-20mA input on J7-14.

Pins 2-3: Allows a thermistor input on J7-14.

JP22 - Configurable Analog input (J7-4 & J7-16) type. Configures analog input for 0-10VDC, 4-20mA, thermistor (temperature) or transducer (pressure) input.

OUT: Allows a 0-10VDC input on J7-4 or a transducer input on J7-16.

Pins 1-2: Allows a 4-20mA input on J7-16.

Pins 2-3: Allows a thermistor input on J7-16.

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

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 - Remote Leaving Chilled Liquid Temp Setpoint (J22) type. Configures analog input for 0-10VDC, 2-10VDC, 0-20mA or 4-20mA.

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 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 port 4A. Allows an RS-485 connection to Microboard J11 for Multi-Unit Communications.

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

JP28 - PC-104 Port interrupt assignment. Assigns selected PC-104 interrupt request to PIRQ7 on the microprocessor. Interrupt request selections are silk screened on the Microboard adjacent to the program jumper. Not used on YS chiller applications.

JP29 - PC-104 Port interrupt assignment. Assigns selected PC-104 interrupt request to PIRQ6 on the microprocessor. Interrupt request selections are silk screened on the Microboard adjacent to the program jumper. Future modem application.

JP30 - PC-104 Port DMA assignment. Assigns selected PC-104 DMA request to PIRQ0 on the microprocessor. DMA request selections are silk screened on the Microboard adjacent to the program jumper. Not used on YS Chiller applications.

JP31 - PC-104 Port DMA assignment. Assigns selected PC-104 DMA request to PIRQ1 on the microprocessor. DMA request selections are silk screened on the Microboard adjacent to the program jumper. Not used on YS Chiller applications.

JP32 - PC-104 Port DMA acknowledge assignment. Assigns selected PC-104 DMA acknowledge to PDACK0 on the microprocessor. DMA acknowledge selections are silk screened on the Microboard adjacent to the program jumper. Not used on YS Chiller applications.

JP33 - PC-104 Port DMA acknowledge assignment. Assigns selected PC-104 DMA acknowledge to PDACK1 on the microprocessor. DMA acknowledge selections are silk screened on the Microboard adjacent to the program jumper. Not used on YS Chiller applications.

JP34 - Refrigerant type. Jumper must be positioned according to the refrigerant type installed in the chiller.

IN: R22

OUT: R134a

JP35 - Water/Brine application. Jumper must be positioned according to whether the chiller is cooling water or a brine solution.

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 20°F to 70°F.

JP36, JP37 - Not Used

JP38 - BIOS EPROM U45 size. Jumper must be positioned according to size of U45. Jumper is a 10 Ohm resistor that is soldered to board. It is not a shunt jumper.

IN: 256K

OUT: 64K or 128K. Should be OUT for YS chiller applications.

JP39 - Solid State Starter style.

IN: Mod "A" Starter - Old style with Logic Board mounted in Control Center.

OUT: Mod "B" Starter - New style with integrated Logic/Trigger Board mounted Starter cabinet.

JP40, JP41, JP42 - Not Used

JP43, JP44 - Display Controller (U29) type (rev "E" and later boards only). Must be positioned according to the Display Controller type installed on Microboard. Configured at the time the board is manufactured and should not require field configuration.

Pins 1-2: Type 65548

Pins 2-3: Type 65550

TABLE 2
MICROBOARD 031-01730-000 PROGRAM SWITCHES

SW1

- 1 - Not Used
- 2 - Not Used
- 3 - Not Used
- 4 - Diagnostics - Enables or disables software diagnostics
ON: Enables software diagnostics. Disables normal chiller operation
OFF: Disables software 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 keypad **START-RUN-STOP/RESET** rocker 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 it is absolutely necessary to do so during troubleshooting.

ON: Enables anti-recycle timer. Solid State Starter and Electro-Mechanical starter applications - Chiller cannot be started at intervals shorter than once every 30 minutes.

OFF: Disables anti-recycle timer. Chiller can be started at the completion of **SYSTEM LOCK-OUT DELAY**, regardless of how long the chiller had been running.

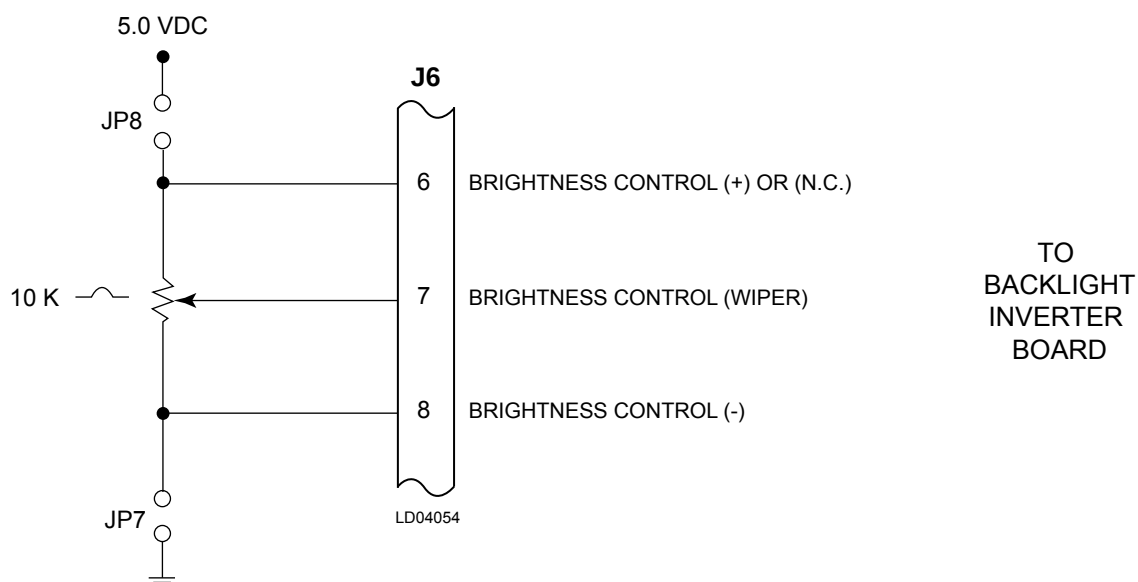
- 7 - Not Used
- 8 - Chilled Water Pump operation - Determines Chilled Water Pump control contacts (I/O Board TB2-44/45) operation when chiller shuts down on various **CYCLING** shutdowns.
ON: Enhanced operation. Contacts open at completion of **System Lockout Delay** after all shutdowns except when it shuts down on **“LEAVING CHILLED LIQUID - LOW TEMPERATURE”**, **“MULTI-UNIT CYCLING - CONTACTS OPEN”** AND **“SYSTEM CYCLING - CONTACTS OPEN”**.
OFF: Standard operation. Contacts open at completion of **System Lockout Delay** after all shutdowns except when chiller shuts down on **“LEAVING CHILLED LIQUID - LOW TEMPERATURE”**. On Low Water temp shutdowns, they 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 (see above) 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.

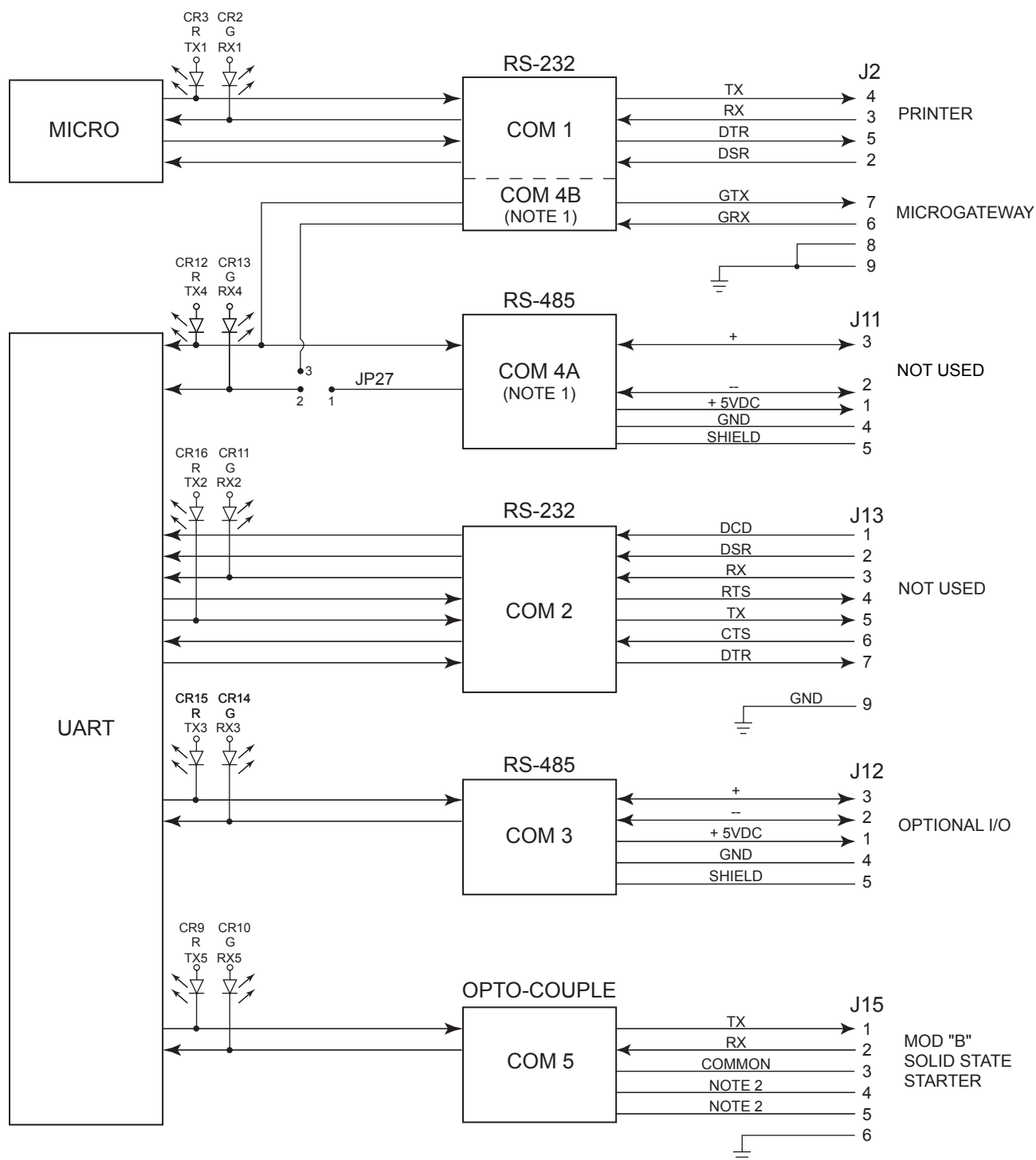
ON: Watchdog protection enabled.

OFF: Watchdog protection disabled.

**NOTES:**

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

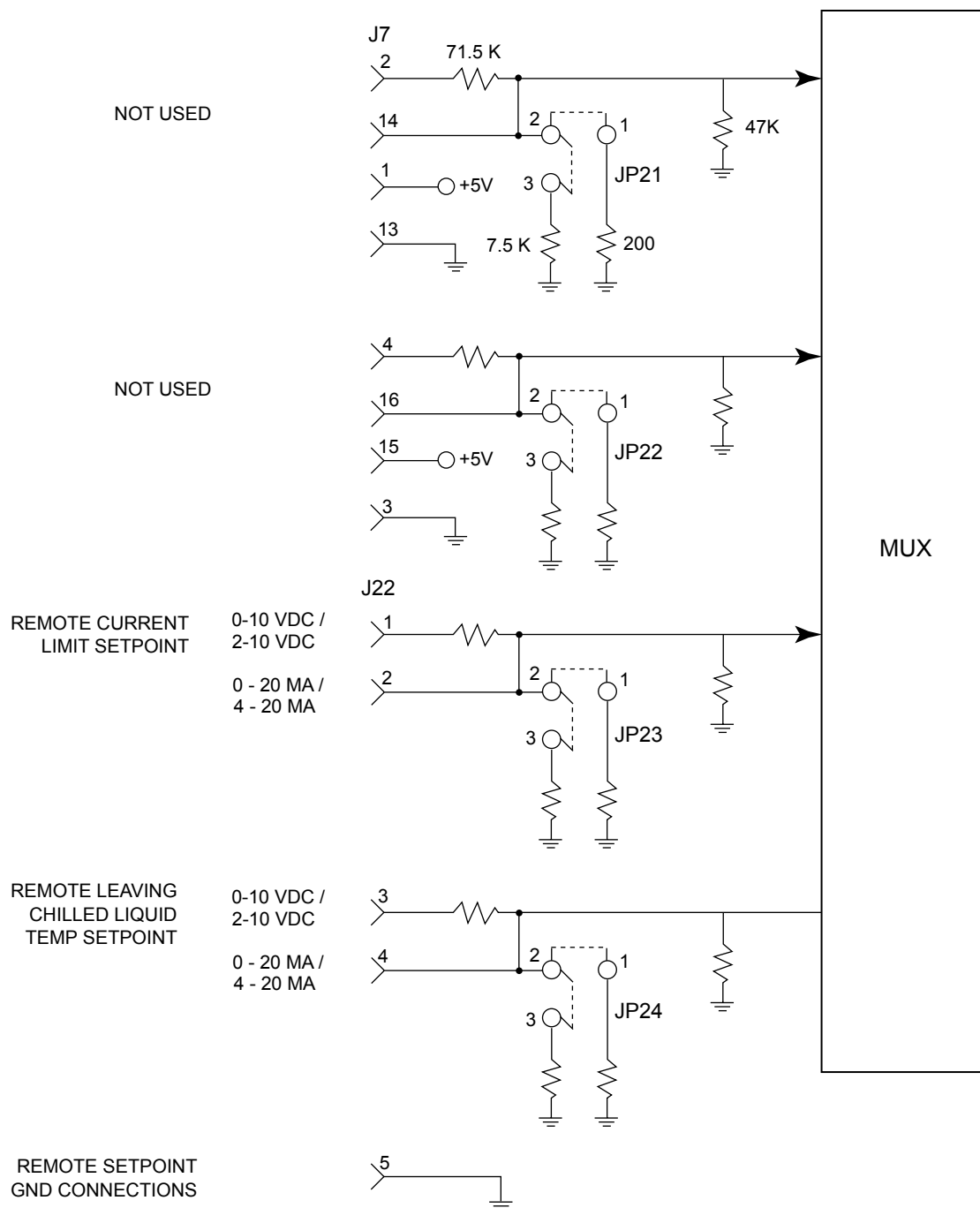
FIG. 8 – MICROBOARD LAMP DIMMER CIRCUIT

**NOTES:**

1. Microboard Program Jumper JP27 determines whether COM 4A or 4B can be used. 1 & 2 - 4A, 2 & 3, 4B. Refer to Table 1.
2. J15-4 Loop-Around Test IN. J15-5 Loop-Around Test OUT. Refer to Fig. 55 for details.

LD07788

FIG. 9 – MICROBOARD SERIAL DATA COMMUNICATIONS PORTS



LD04636

NOTE:

1. Program Jumpers JP21 – JP24 must be positioned on pins 1-2 or 3-4 according to input signal type. Refer to Table 1.

FIG. 10 – CONFIGURABLE ANALOG & REMOTE SETPOINT INPUTS

SECTION 3A MICROBOARD 031-02430-000 (REFER TO FIG 5A – 10A)

Beginning March 2004, new production YS chillers will be supplied with Microboard part number 031-02430-000 (ref fig 5A). Although this board uses a different microprocessor and supporting components, chiller control and operator interface are the same as the previous 031-01730-000 Microboard. It uses the same mounting hole pattern and has the same interface connectors as the previous board, making it backward compatible to all previous YS Optiview Control Centers equipped with the 031-01730-000 Microboard.

The board is supplied with +12vdc (J1-3), -12vdc (J1-4), +5vdc (J1-1) and ground (J1-2) from the Power Supply (ref fig 9A). The -12vdc is not used. The +5vdc (fused by F1) can be monitored at TP3. It is applied to a +3.3vdc regulator, +2.5vdc regulator and used directly by the microboard circuits as the Vcc voltage. The outputs of these regulators are applied to microboard circuits and can be monitored at TP2 and TP5 respectively. The +12vdc (fused by F2) can be monitored at TP4. It is applied to a +5vdc regulator and used directly by microboard circuits. The output of the regulator is the +5vdc (analog) supply that powers all analog circuits and is the source voltage for all transducers and thermistors. It can be monitored at TP10 as a 2.5vdc value created by 1K Ohm resistors voltage divider circuit as shown.

Test Points (Ref Fig 7A)

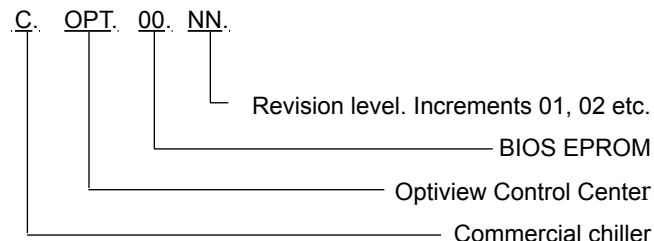
The power supply voltages can be measured at following test points:

TP1 Gnd
TP2 +3.3Vdc
TP3 +5Vdc
TP4 +12Vdc
TP5 +2.5Vdc
TP10 +2.5Vdc

Boot-up Program

The BIOS (Basic Input Output System) Eprom (U37) contains the boot-up program. It is a replaceable part. The YORK part number is 031-02429-001. It is available from the Baltimore Parts Distribution Center as a replacement part. The version is an alphanumeric code that identifies the application and the program revision level. The part number and version are printed on a label adhered to the surface of the Eprom. It is also displayed on the DIAGNOSTICS Screen in Service Access Level.

The version is as follows:



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

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

DIAGNOSTIC DISPLAY CODES

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

MISCELLANEOUS CODES

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

CRITICAL CODES

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

Chiller Operating Program

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

The chiller operating program is stored in a non-removable Flash Memory chip (U35) that is soldered to the Microboard. New chillers are supplied programmed with the latest program available at the time of manufacture. The program version that is currently residing in the Microboard Flash Memory chip is displayed on the DIAGNOSTICS Screen in Service Access Level.

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

Program Card

The on-board program can be upgraded by downloading the latest program version from a Program Card. This is a 2 1/8 x 3 3/8 x 1/8 inch plastic card weighing 1.1oz (ref fig 6A). It is a portable memory storage device that is programmed with the chiller operating program. The Program Card part number for YS chillers is 031-02488-001 and is available from the Baltimore Parts Distribution Center (PDC). There is a Program Card for each chiller type (YT, YK, YS, YR, YD, etc) and each has a unique part number. A label affixed to the Program Card contains the part number and version. The version is an alpha-numeric code that identifies the chiller model applicability, language package, language package revision level and chiller operating program revision level.

The Program Card is applicable to both NEMA and CE applications. The Program Card for YS chillers has English, Simplified and Traditional Chinese, French, Spanish, Portuguese, Italian, German and Hungarian languages.

The program version that is currently residing in the Microboard Flash memory chip is displayed on the DIAGNOSTICS Screen in Service Access Level.

The Program Card obtained from the PDC is programmed with the latest version of the chiller operating program. Program Cards can be reprogrammed.

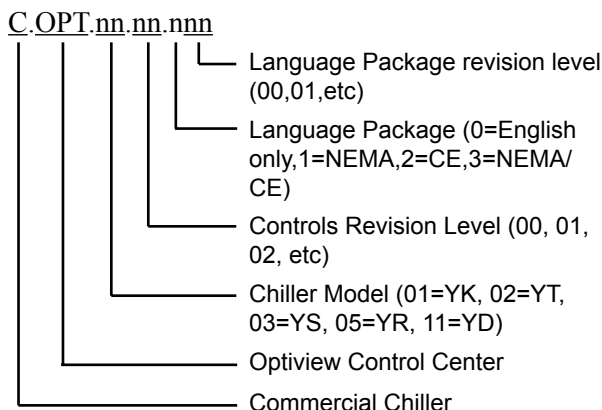
A Program Card for a particular chiller type can be used to re-program other chillers of the same type. For example, it is not necessary to have more than one YS Program Card. A single YS card can be carried to different locations to re-program other YS Optiview Control Centers.

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

Handling precautions for the Program Card include:

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

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



The Program card is inserted into connector U33 to download a program. Refer to instructions under Service Replacement below.

Program Download Connector U33

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

Parallel Port Connector

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

BRAM (U38)

The BRAM (battery backed random access memory) memory device contains a battery that preserves the stored data during power failures. All of the programmed Setpoints, Sales Order Data, History Data, time of day and calendar data is stored here. It is a replaceable part. The YORK Part number is 031-02431-000 and is printed on a label adhered to the surface of the BRAM. It is available from the Baltimore Parts Distribution Center as a replacement part.

Watchdog Circuit

The Watchdog circuit performs two functions as follows:

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

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

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

pulse to the Watchdog circuit every time the complete program has been executed. Since it takes less than 1 second to perform the entire program, the Watchdog circuit doesn't time-out under normal operation. However, if the entire program is not executed or something prevents the microprocessor from sending the reset pulse as described below, the Watchdog circuit times-out and sends a reset to the microprocessor, initiating a re-boot. If running, the chiller shuts down. The display momentarily blanks and white screen is displayed while the boot-up program executes as described above. When the graphic screen is displayed, either of two messages is displayed depending on the type of Watchdog shutdown as explained below.

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

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

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

Program Jumpers/Program Switches

The Program Jumpers (Table 3) and Program Switches (Table 4) are used to alter the program operation or configure the Microboard hardware for specific operation. This allows the Program and Microboard to be universal for all standard applications. Refer to Table 3 and 4 for the function of each jumper and switch. The position of some jumpers can be determined by the Service Technician to meet the desired operation. Others must be positioned according to the requirements of the size, type or style of components and thus are determined by the YORK factory. The jumpers are plastic sleeves with metal inserts that are inserted over 2-prong or 3-prong conductors. The Program Switches are miniature switches that are placed in either the ON or OFF position.

Keypad Interface

The Keypad is read via J18. The Keypad is a matrix of conductors arranged in rows and columns (ref fig 30 and 31). There are 4 rows and 8 columns. When a key is pressed, the conductors are pressed together at that point, creating continuity between the row conductor and the column conductor. The keypad is read by applying a logic low to a row while leaving +5vdc pullup on all other rows. The micro then reads the 8 columns. If any column has a logic low on it, the key corresponding to that coordinate (row, column) is being pressed. The micro reads the entire keypad by repeating this routine beginning with row 1 and ending with row 4. The entire keypad is continually read while the control center is powered. Refer to SECTION 8 of this manual for details of the Keypad.

CM-2 Board or Style A Solid State Starter Interface

The microboard retrieves certain operating parameters (via J10) from the compressor motor starter control board (CM-2 Current Board for Electromechanical starter or Style "A" Solid State Starter Logic Board). Refer to the appropriate section of this book for detailed explanation of each board. Both boards contain an 8 channel multiplexer. The micro sequentially and continually reads channels 0 through 7. It reads each channel by applying a 3-bit binary address to the multiplexer. A 0-5vdc analog value is returned from each channel. The function of each is in the table below. The micro determines which board, and therefore which starter is present, by the value returned from channel 0. Since channels 0 through 6 are grounded, the CM-2 board returns a 0vdc value. The Solid State Starter Logic Board returns a value >0.41vdc to +5vdc. If the value is <0.4vdc, it indicates the starter is an Electro-mechanical (EM) starter and the micro then reads channel 7 to retrieve the peak motor current value. A value >0.4vdc indicates the starter is an "A" style Solid State Starter and the micro reads channels 1 through 7. In the Solid State Starter, channel 0 indicates the starter size (model) and voltmeter range (300Vac or 600Vac). Channel 1 is a hardware generated 100% FLA (prevents pre-rotation vanes from further opening) or 104% FLA (closes pre-rotation vanes until motor current is <102%) current limit override command that overrides normal Pro-rotation Vanes control. Channels 2 through 4 are analog voltages that represent phase A, B and C motor current. The highest phase is Channels 5 through 7 are analog voltages that represent phase A, B and C Line Voltage. The data for each channel is shown on the following table:

MULTIPLEXER CHANNELS

	0	1	2	3	4	5	6	7
CM-2	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd	Peak Motor Current (%FLA)
STYLE A Solid State Starter	Starter model/voltmeter range	Current limit command	Phase C motor current	Phase B motor current	Phase A motor current	Phase A line voltage	Phase B line voltage	Phase C line voltage

3A

Style B Solid State Starter

If equipped with either of these drives, the drive is interfaced to the Microboard via the Opto-Coupled COM 5 serial data port (J15). The serial data is represented by +5vdc and 0vdc logic levels. J15-1 is TX data to the drive and J15-2 is RX data from the drive. Refer to SECTION 11 (Solid State Starter) for details of this interface.

Printer Interface

An optional Printer can be connected to COM1 RS-232 serial data port (J2). J2-4 is TX data to the printer. J2-2 is the DSR (Data Set Ready or busy) signal from the printer. Signal levels are standard RS-232. The microboard sends data to the printer at the selected baud rate until the printer buffer becomes full, whereupon the printer asserts its Busy signal. The microboard suspends data transmission until the printer can accept more data. Each printer must be setup/configured to operate properly with the microboard. The Baud, Data Bits, Parity and Stop Bits must be programmed on the Comms Screen. Other printer setup is performed on the PRINTER Screen. Refer to YORK manual 160.80-O1 for details of available printers and printer setup instructions.

MicroGateway Interface

An optional Microgateway printed circuit board can be connected to the COM 4B RS-232 serial data port (J2). J2-7 is TX data to the MicroGateway. J2-6 is RX data from the Microgateway. Signal levels are standard RS-232. The MicroGateway polls system pressures, temperatures and status from the microboard. It holds it for retrieval by third-party devices. Refer to SECTION 13 of this manual.

Digital Inputs

The I/O Board converts the 115Vac inputs to logic level inputs for the microboard at J19. A 115Vac input to the I/O board is converted to a logic low (<1Vdc). A 0Vac input to the I/O Board is converted to a logic high (>4Vdc). Refer to SECTION 4 of this manual for details of the I/O Board.

Digital Outputs

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

The microboard controls Actuator motors via Triacs on the I/O Board. Each actuator has an open winding and a close winding. Current flowing through a winding causes the actuator to rotate in the respective direction. Each winding is controlled by a Triac. The Triac is turned on to allow current to flow through a winding. The microboard turns on the Triac by applying a logic low (<1Vdc) to the Triac driver on the I/O Board. It turns it off by applying a logic high (>4vdc). Refer to SECTION 4 of this manual for details of the I/O Board.

Analog Inputs

System pressures, in the form of analog DC voltages, are input from Pressure Transducers. Refer to SECTION 14 of this manual. Formulas and graphs are included to calculate the expected transducer output voltage for a given pressure input.

System temperatures, in the form of analog DC voltages, are input from Thermistors. Refer to SECTION 15 of this manual. Included are tables to convert the expected output voltage for any temperature applied to the thermistor.

Serial Data Ports

The Microboard is equipped with 5 serial data ports (ref fig 9A). Each port is dedicated for a specific function as follows:

- a. COM1 (J2) – RS-232. Printer
- b. COM2 (J13) – RS-232. Not used
- c. COM3 (J12) – RS-485. Optional I/O.
- d. COM4 (4A-J11), (4B-J2) – This port is actually two ports. However, they cannot be used simultaneously. The position of program jumper JP27 determines which port can be used. (refer to table 3). COM4A – RS485 Not used. COM4B – RS-232 Microgateway.
- e. COM5 (J15) – Opto-coupled transmit/receive. Style B Solid State Starter.

Each port is equipped with two LED's. A red TX LED illuminates as data is transmitted to or requested from another device. A green RX LED illuminates as data is received from another device. The RS-232 voltages are industry standard +5 to +25vdc and -5vdc to -25vdc logic levels. The RS-485 voltages are industry standard 0vdc and +1.5 to +5vdc logic levels. COM5 logic levels are 0vdc and +5vdc. A diagnostic test can be performed on each serial port to confirm proper operation. Refer to Diagnostics SECTION 22 of this manual.

The LED's and their functions are as follows:

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

Display Interface

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

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

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

The microboard controls the Display Backlight via J6. The Display Backlight is the light source for the display. The Backlight Inverter Board provides a high voltage AC power source for the lamp. It converts low voltage DC via J6-1 (+12vdc or +5Vdc, depending on position of Program Jumper JP5) to high voltage AC (500 to 1500Vac). This high voltage AC is applied to the lamp to cause it to illuminate. The Backlight is turned on and off with the “Backlight Enable” signal (J6-5). The position of Program Jumper JP4 determines whether this is a +12Vdc or +5vdc signal. In some displays, the backlight turns on when this signal transitions from low to high; others turn on when it transitions from high to low. The position of Program Jumper JP3 determines the transition that will occur when the Microboard outputs the Backlight Enable signal. JP3 must be positioned according to the display manufacturer’s requirement.

Under program control, the microboard controls the backlight brightness via the Lamp Dimmer circuit output at J6-7. In order to extend the life of the Backlight lamp, the brightness is driven to 50% after 10 minutes of Keypad inactivity. At this brightness level, the graphics are still visible. When Keypad activity is detected (a key is pressed), the lamp is driven back to full (100%) brightness. Some display manufacturers require a variable voltage to vary the brightness; others require a variable resistance. Program Jumpers JP7 and JP8 must be configured to enable the appropriate technique. The Lamp Dimmer is an integrated circuit that is the electrical equivalent of a 10K ohm potentiometer with 100 positions or steps (ref fig 8A). The Lamp Dimmer controls the position of the potentiometer. The lamp Dimmer varies the brightness of the backlight by applying a variable voltage (0-5.0vdc) or a variable resistance (0-10K ohms) to the Backlight Inverter Board. If Program Jumpers JP7 and JP8 are installed, the lamp Dimmer output is a variable voltage; if both are removed, the output is a variable resistance. The Lamp Dimmer outputs “Brightness Control Wiper” (J6-7) to

the Backlight Inverter Board. If configured for variable voltage output, the voltage between J6-7 and J6-8 can be varied from 0Vdc (100% brightness) to 5.0Vdc (0% brightness). If configured for variable resistance, the resistance between J6-6 and J6-7 varies from 0 ohms (0% brightness) to 10K ohms (100% brightness).

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

Remote Setpoints

Remote Leaving Chilled Liquid temperature and Current Limit setpoints can be input via the RS-232 Microgateway interface at J2 or directly to the Microboard at J22 (ref fig 10A). The inputs at J22 are configured with Program Jumpers JP23 and JP24 to accept these inputs in either 0-10vdc, 2-10vdc 0-20Ma or 4-20Ma form. Refer to Table 3 for Program Jumper configurations and SECTION 16 of this manual for details of the Remote Setpoints.

Configuration/Setup

The following functions are entered as setpoints on the SETUP Screen. Refer to entry instructions in SECTION 21 of this manual.

- Chilled Liquid Pump Operation – Determines Chilled Liquid Pump control contacts (I/O Board TB2-44/45) operation when chiller shuts down on cycling shutdowns. Selections are:
 1. Standard – Contacts open at completion of “System Lockout Delay” after all shutdowns except “Leaving Chilled Liquid – Low Temperature”. On this shutdown, they remain closed, causing the pump to continue to run while the chiller is shutdown.
 2. Enhanced – Contacts open at completion of “System Lockout Delay” after all shutdowns except “Leaving Chilled Liquid – Low Temperature, Multi-Unit Cycling- Contacts Open” and “System Cycling – Contacts Open”. On these shutdowns, they remain closed, causing the pumps to continue to run while the chiller is shutdown.
- Motor Drive Type – Configures the program for the applicable compressor motor drive type. Selections are:
 1. EM – Electromechanical Starter
 2. SSS-Mod A – Style A Solid State Starter
 3. SSS-Mod B – Style B Solid State Starter

- **Anti-recycle** – Enables or Disables the Anti-recycle timer. **CAUTION!** The Anti-recycle timer must never be disabled unless advised by YORK factory. Selections are:
 1. **Enabled** – Enables the anti-recycle timer. Solid state Starters and electromechanical starter applications cannot be started at intervals shorter than once every 30 minutes.
 2. **Disabled** – Disables the anti-recycle timer. Chiller can be started at the completion of “System Lockout Delay”, regardless of how long the chiller had been running.
- **Power Failure Restart** – Determines the course of action required to restart the chiller, if a power failure occurs while the chiller is running. Selections are:
 1. **Manual** – Requires a manual reset after power is restored. The chiller cannot be started until the operator moves the keypad Start-Run-Stop/Reset rocker switch to the stop/reset position.
 2. **Auto** – Chiller will automatically restart when power is restored.

Microboard Service Replacement

Microboard 031-02430-000 is available from the Baltimore Parts Distribution Center (PDC) as a replacement part. It is ordered under part number 331-02430-603. This includes the 031-02430-000 microboard, plus the 031-02488-001 Program Card (ref fig 6A) programmed with the latest YS chiller operating program and all applicable languages. Upon receipt of a replacement board, the program must be downloaded from the Program Card per the procedure above. The Program Card is explained above.

If the microboard is replaced within the warranty period, it is important it is returned per the Warranty return Procedure.

Although microboards 031-01730-000 and 031-02430-000 are interchangeable (a 2430 board can replace the 1730 and vice versa), order the same board for replacement as is already in the Control Center.

Replacement 031-02430-000 microboards are supplied with BRAM (U38) and BIOS Eprom (U37). If replacing a 2430 microboard with a 2430 microboard, the BRAM can be transferred from the defective board to the replacement board to avoid re-programming the Sales Order Data.



BIOS Eproms and BRAMS cannot be interchanged between the 031-01730-000 and 031-02430-000 microboards. The boards will not function with an incorrect component. Refer to the following table for applicability:

Microboard	BRAM	BIOS Eprom
031-02430-000	031-02431-000	031-02429-001
031-01730-000	031-02028-000	031-01796-002

Program Card Service Replacement

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

However, since chiller operating programs are occasionally revised, the Service Technician could have a Program Card that does not contain the latest program. Program Cards (031-02488-001) for YS chillers are available from the Baltimore Parts Distribution Center (PDC). The card received from the PDC is programmed with the latest version of the chiller operating program.

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

DOWNLOADING A PROGRAM FROM A PROGRAM CARD



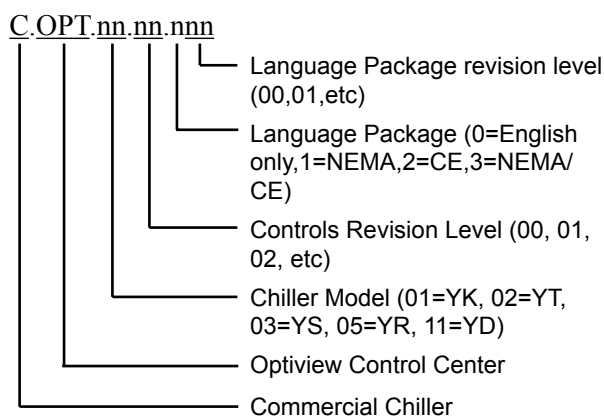
The Program Card Write Protect Switch must be in the “Write Protect” position!



There are 3 steps to the re-programming process: Erase, Program and Verification. Once the re-programming process is initiated, it automatically proceeds through these steps to completion. It cannot be manually terminated before completion. Therefore, once the process is initiated, the existing on-board program will be erased and replaced by the program in the

Program Card. Before proceeding, be absolutely certain the Program Card is applicable to your chiller model. For example, if your chiller is a YS chiller, the Program Card used MUST be for a YS chiller. If a YK chiller program is downloaded into a YS chiller, for example, the chiller will be rendered inoperable until this procedure is repeated using the correct Program Card!

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



Download the program as follows:

1. Remove power to Optiview Control Center.
2. Remove protective cover from Microboard connector U33.
3. Reposition Microboard Program Jumper JP6 to pins 2 & 3 (left-hand pins).
4. Insert Program Card into Microboard connector U33.
5. Restore power to Optiview Control Center. A white screen appears displaying "Flash Checksum Test:" and Microboard 7-segment LED (U22) displays "Ch". While this is displayed, the Microboard is performing a checksum test on the Program Card. This assures the integrity of the card before the download procedure can begin. If the checksum test fails, the card is defective or corrupted and the download procedure cannot be performed. If the checksum test passes, the

- "Optiview Flash Programmer" Screen is displayed.
6. Press START key to start the downloading process. A dialog box appears asking if you want to "Erase On-board Flash and Re-Program from PcCard?". **Do not proceed until you understand the above caution!**
7. Use the ► key to scroll to YES.
8. Press √ key. The following steps will be performed:
 - a. Erasing. During this procedure, the program in the Microboard Flash Memory will be erased. A green bar reflects the progress of this procedure. The red LED next to this bar illuminates while this procedure is in progress.
 - b. Programming. During this procedure, the program in the Program Card is downloaded into the Microboard Flash memory. A green bar reflects the progress of this procedure. The red LED next to this bar illuminates while this procedure is in progress.
 - c. Verifying. During this procedure, a checksum test is performed on the new program in the Microboard Flash Memory. A green bar reflects the progress of this procedure. The red LED next to this bar illuminates while this procedure is in progress.

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

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

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

TABLE 3
MICROBOARD 031-02430-000 PROGRAM JUMPERS

JP1 – Not Used.

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

JP3 – Display backlight enable signal level polarity. Jumper must be positioned according to the voltage level required to turn on the Display Backlight.

Pins 1-2: 0VDC SHARP LQ10D421 display.

Pins 2-3: +12VDC or +5VDC as determined by position of JP4. SHARP LQ10D367/368 (031-01774-000), NEC NL644AC33-24 and LG Semicon LP104V2-W (031-02046-000) displays.

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

Pins 1-2: +12VDC/0VDC SHARP LQ10D421 display.

Pins 2-3: +5VDC/0VDC SHARP LQ10D367/368 (031-01774-000), NEC NL6448AC33-24 and LG Semicon LP104V2-W (031-02046-000) displays.

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

Pins 1-2: +12VDC. SHARP LQ10D367/368 (031-01774-000) and LQ10D421, NEC NL6448AC33-24 and LG Semicon LP104V2-W (031-02046-000) displays.

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

JP6 – Boot-up source. Determines whether the boot-up is performed from the Program Card or Eprom U37.

Pins 1-2: Boots-up from Eprom U37. Must be in this position unless re-programming from the Program Card.

Pins 2-3: Boots-up from the Program Card. Must be in this position when re-programming from the Program Card.

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

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

OUT: Variable resistance. NEC NL6448AC33-24 display

JP9 – Not Used.

JP10 – Not used.

JP11 – Not used.

JP12 – Not used.

JP13 – Watchdog Enable/Disable. Soldered wire jumper.



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

In – Watchdog enabled

Out – Watchdog disabled

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

In - 32K x 8. Installed for present production.

Out – 128K x 8

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

In – Use external modem

Out – Use on-board modem

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

Pins 1-2 – RS-485

Pins 2-3 – RS-232 (modem)

JP21 – Not Used

JP22 – Not Used

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

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

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

Pins 3-4: Not used.

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

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

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

Pins 3-4: Not used.

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

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

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

3A

TABLE 4
MICROBOARD 031-02430-000 PROGRAM SWITCHES

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

ON – R134a

OFF – R22

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

ON – Brine. Leaving Chilled Setpoint range is 20°F to 70°F.

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

SW1-3 – Diagnostics. Enables or Disables the software diagnostics. Refer to SECTION 22 of this manual.

ON – Enables diagnostics. Disables normal chiller operation.

OFF – Disables diagnostics. Enables normal chiller operation.

SW1-4 – Not used.

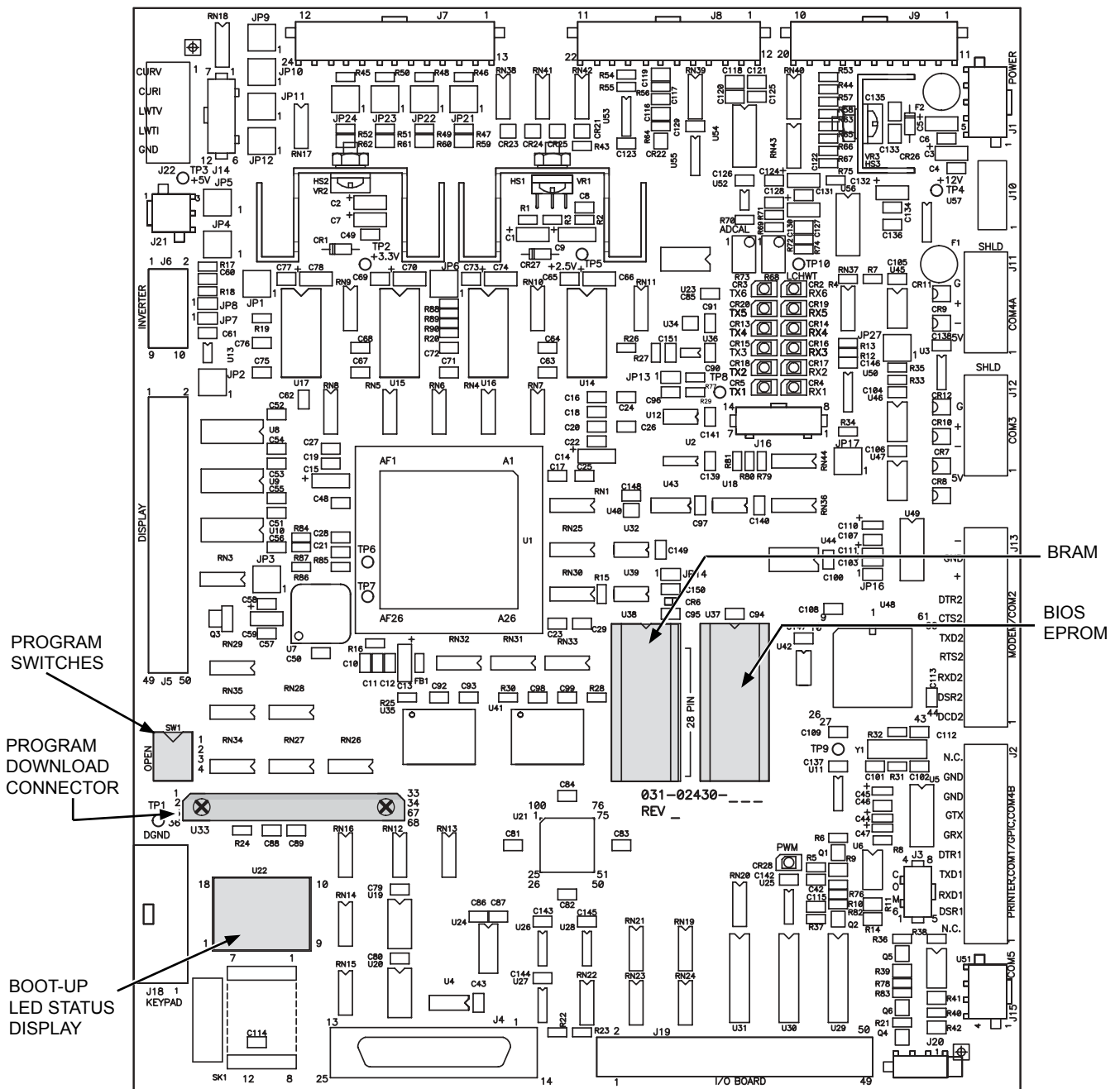


FIG. 5A – MICROBOARD 031-02430-000

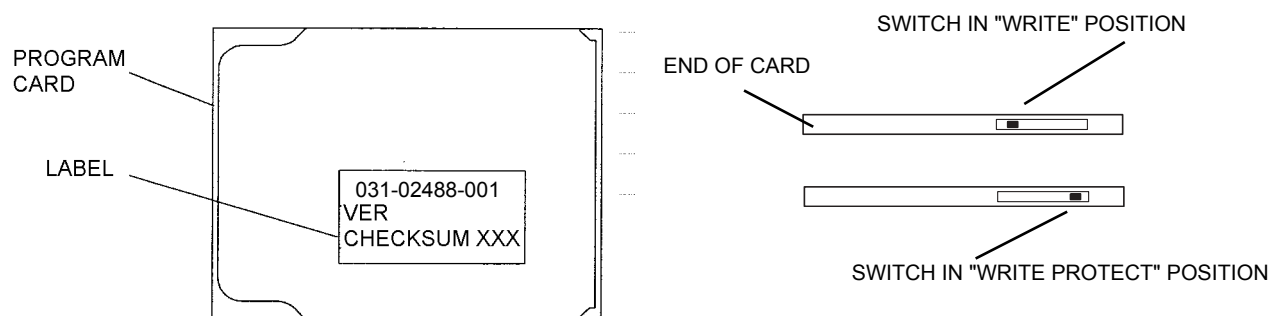
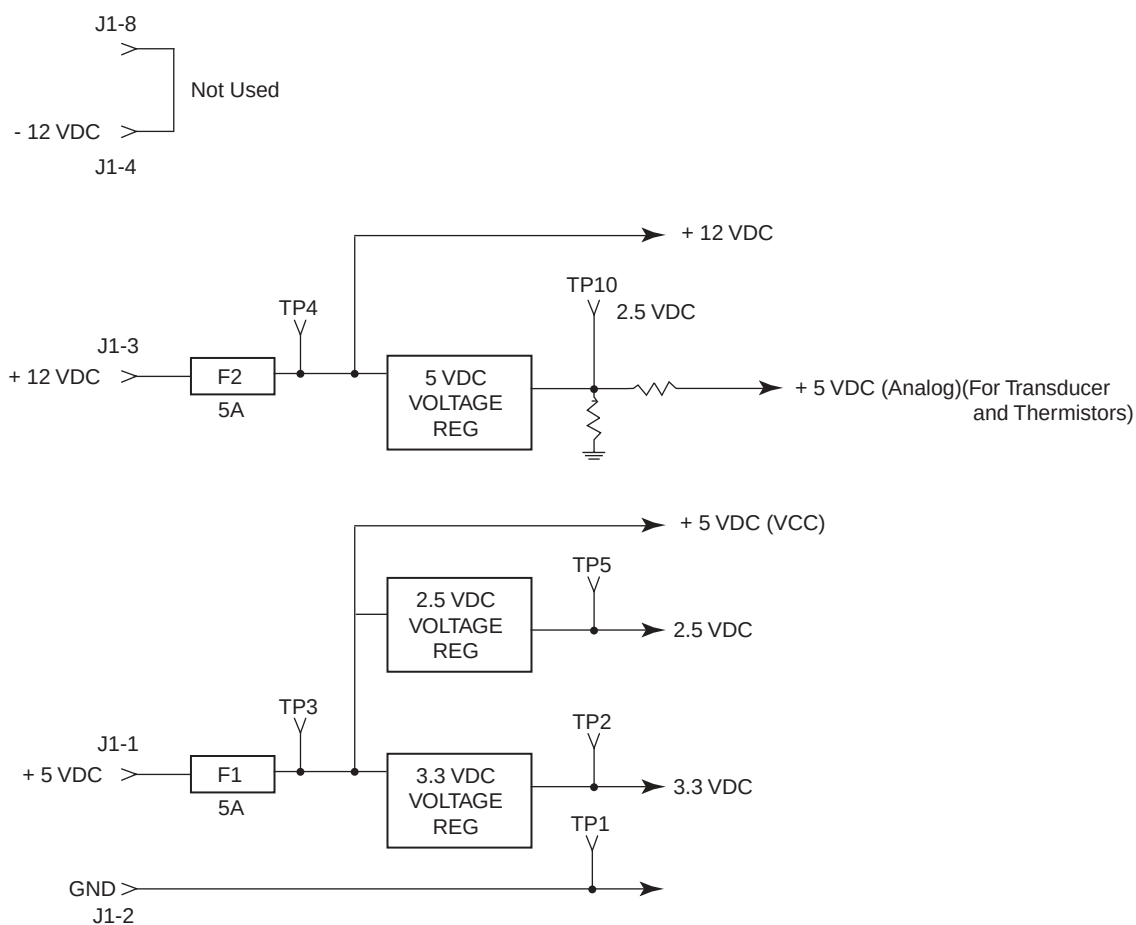
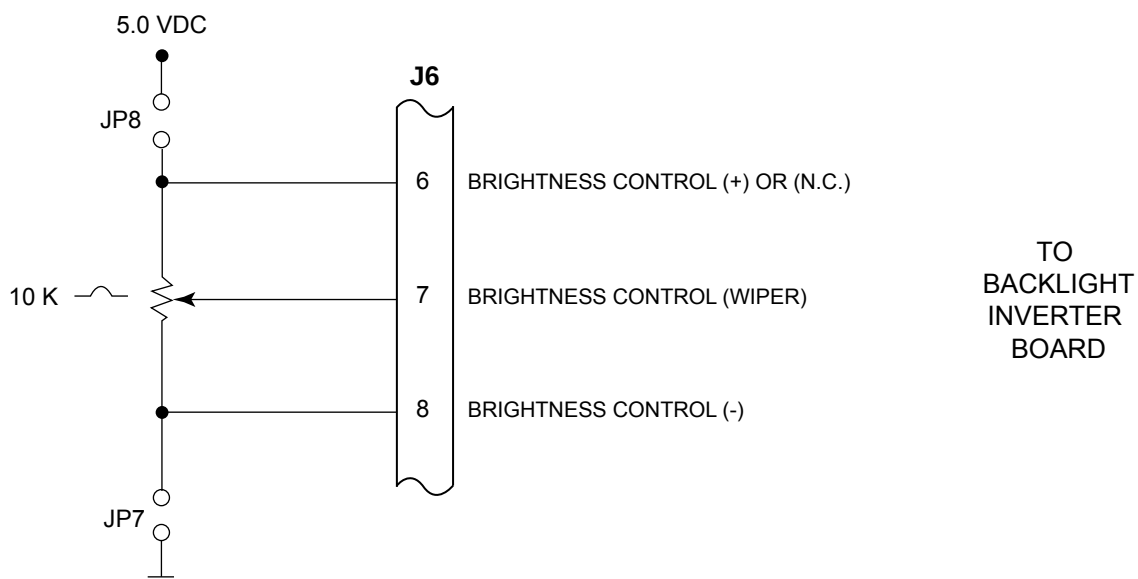


FIG. 6A – PROGRAM CARD 031-02488-001



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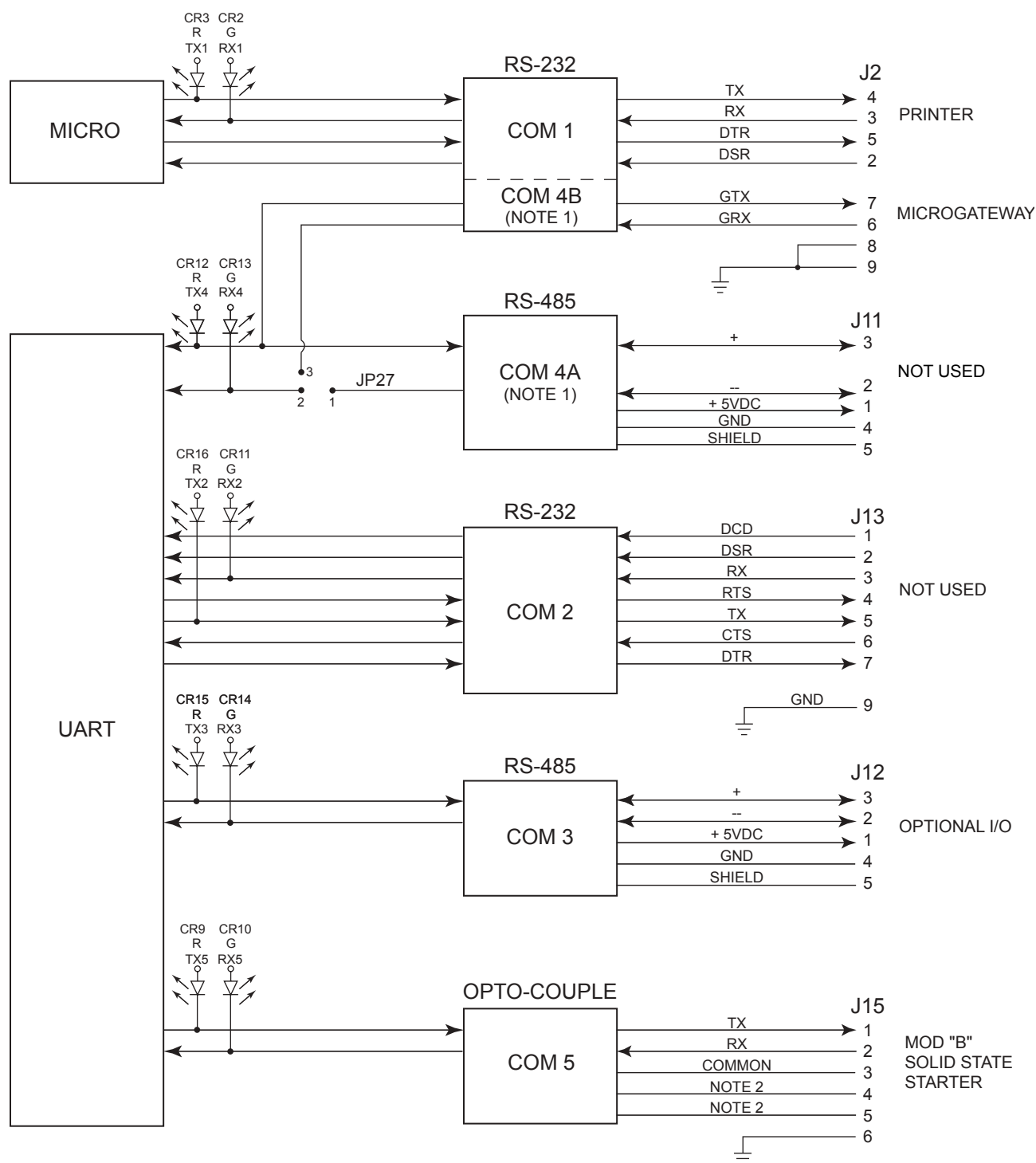
FIG. 7A – MICROBOARD (031-02430-000) DC POWER SUPPLY TEST POINTS

**NOTES:**

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

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FIG. 8A – MICROBOARD LAMP DIMMER CIRCUIT

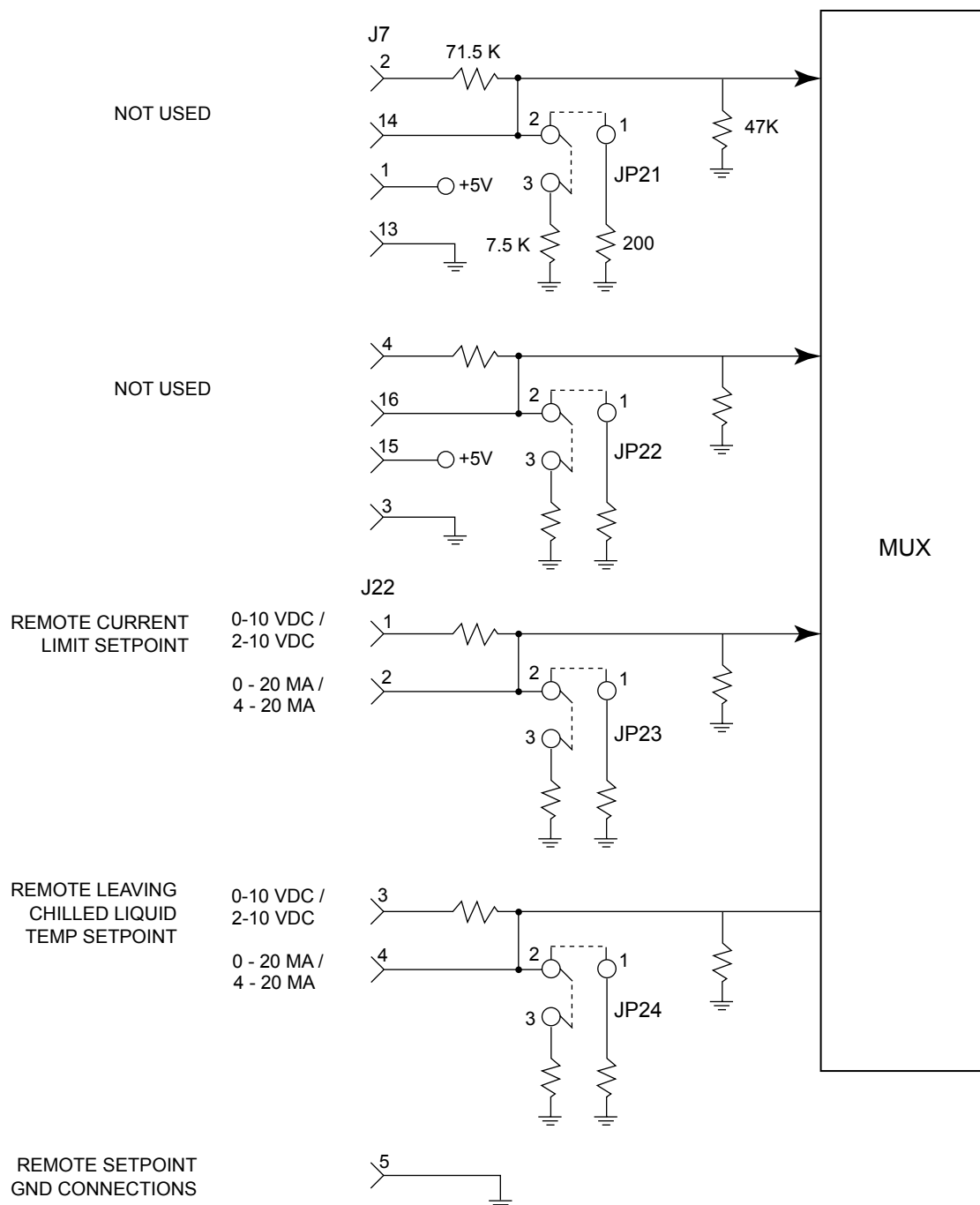


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NOTES:

1. Microboard Program Jumper JP27 determines whether COM 4A or 4B can be used. 1 & 2 - 4A, 2 & 3, 4B. Refer to Table 3.
2. J15-4 Loop-Around Test IN. J15-5 Loop-Around Test OUT. Refer to Fig. 55 for details.

FIG. 9A – MICROBOARD SERIAL DATA COMMUNICATIONS PORTS



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NOTE:

1. Program Jumpers JP21 – JP24 must be positioned on pins 1-2 or 3-4 according to input signal type. Refer to Table 3.

FIG. 10A – CONFIGURABLE ANALOG & REMOTE SETPOINT INPUTS

SECTION 4

I/O BOARD

(REFER TO FIG. 11 - 15)

The **I/O (input/output) Board** conditions the Digital Inputs for the Microboard and conditions the Microboard's Digital Outputs for application to other components and devices. The left side of the I/O Board performs the Digital Inputs function; the right side performs the Digital Outputs function. Refer to Fig. 11.

Digital Inputs are on/off inputs to the Microboard from relay and switch contacts, such as flow switches, start/stop switch, and remote cycling/safety devices (ref. Fig. 12). The Micro reads the state of these contacts and reacts per the Program instructions. The contact voltage is 115VAC when closed and 0VAC when open. These voltages are not suitable for direct input to the Microboard. Therefore, the I/O Board converts the 115VAC/0VAC contact voltages to 0VDC/+5VDC logic level inputs for the Microboard. Individual Opto-coupler circuits (ref. Fig. 13) perform the conversion for each Digital Input. When the input is 115VAC, the output will be 0VDC; when the input is 0VAC, the output will be +5VDC.

Field connected Digital Inputs, such as those from external devices that cycle the chiller, are connected to terminal strip TB4 (ref. Fig. 12). These inputs are in the form of dry contacts connected as shown in Fig. 14. The 115VAC power source that is switched by the remote contacts is supplied by the I/O Board TB4-1. There are multiple TB4-1 terminals located adjacent to the field input connections, as shown in Fig. 11 and 12.

Digital Outputs are on/off outputs from the Microboard that control solenoid valves, motor contactors, actuators, system relays and provide operating status to external devices (ref. Fig. 15). Per Program instructions, the Microboard energizes and de-energizes these devices. The coils of these devices operate on 115VAC and therefore cannot be directly connected to the Microboard. The Digital Outputs section of the I/O Board contains +12VDC coil relays that are driven by the Microboard's logic level outputs. The contacts of these +12VDC relays operate the external 115VAC coil devices. On the I/O Board, one side of each of the relay coils is permanently connected to +12VDC at J19-26/27. The other side of each relay coil is connected to the Microboard via I/O Board connector J19. The Microboard energizes each relay by driving the appropriate input at J19 to logic low voltage level (ground potential). The DC voltage at the appropriate input pin at J19 will be a logic high (>+10VDC) when the Microboard is commanding a

relay to de-energize; logic low (<+1VDC) when commanding a relay to energize.

Relay K18 is different from all other relays on the I/O Board; it has a 115VAC coil. It provides the start/stop signal to the Compressor Motor Starter and provides **Compressor Run** status to remote devices (ref. Fig. 15). Relay K18 is controlled by DC relays K13 (start) and K14 (stop). To start the compressor motor, the Microboard energizes K13 and K14 simultaneously. The 115VAC at TB1-6 is applied to the coil of K18 via K13 contacts, energizing K18. Approximately 0.2 seconds later, K13 is de-energized. K18 remains energized through K14 contacts and holding contacts of K18. To stop the compressor motor, the Microboard de-energizes K14. To prevent sags in Utility Power from chattering K18, the holding contact of K18, along with the contact of K13, creates an anti-chatter circuit for relay K18. Once energized, K18 cannot be reenergized until K13 is again energized; this will not occur until after a controlled shutdown has occurred and another start sequence has been initiated.

There are conditions external to the I/O Board required to energize relay K18. The 115VAC will be present at TB1-16 only if the motor controller contacts "CM" are closed and the circuit between external Terminal Strip TB6-1 and TB6-53 is closed. The "CM" are located on the CM-2 Board (relay K1), Electro-Mechanical starter applications, the Solid State Starter Logic Board (relay K1), Solid State Starter applications. The High Pressure safety switch "HP", must be closed and the **RUN** Switch "1SS" must be in the **RUN** position.

Triacs are used to control the Slide Valve 4-way solenoid valve. This Solenoid Valve is controlled by 115VAC power. It has a Load coil and an Unload coil that are energized by current flow through them. The Load triac is turned on to allow current flow through the Load coil. This diverts high pressure oil through the solenoid valve and into the load side of the Slide Valve cylinder, moving it in the Load direction. The Unload Triac is turned on to allow current flow through the Unload side of the Slide Valve cylinder, moving it in the Unload direction. Under Program control, the Microboard turns the Triacs on and off to control the Leaving Chilled Liquid Temperature to the Leaving Chilled Liquid Temperature Setpoint or limit compressor motor current. At appropriate intervals, a Triac is turned on for up to 3 seconds, as required,

to move the Slide Valve in the desired direction. The magnitude of Slide Valve movement for each Load or Unload pulse is determined by the oil pressure and the duration of time the Triac is turned on. The Microboard turns the Triacs on and off by applying control signals to the respective **Triac Driver**. The Triac Driver is an opto-coupler device that isolates the Microboard low voltage circuits from the higher actuator voltages. To turn on the Triac, the Microboard drives the Triac Driver input to logic low ($<+1\text{VDC}$) level. The Triac driver responds by shorting the Triac GATE to Triac terminal 2. To turn the Triac off, the Microboard opens its input to the Triac Driver and allows the input to pull up to $+12\text{VDC}$. The Triac Driver responds by opening the short from triac Gate to Triac terminal 2. A voltmeter can be used to determine if a Triac is turned on or off. Measure across the Triac; from Triac terminal 1 to Triac terminal 2. When the Triac is turned off, the voltage will be approximately 115VAC ; when turned on, it will be $<10\text{VAC}$.

RELAY TIMING

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

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

Dry closure contacts. When the chiller is started, the Contacts close 4 seconds after the start of "Start Sequence Initiated". Normally, they open coincident with the completion of **SYSTEM LOCKOUT DELAY** with the following exceptions:

- a. If a **LEAVING CHILLED LIQUID - LOW TEMPERATURE** cycling shutdown occurs, they do not open at the completion of **SYSTEM LOCKOUT DELAY**. They remain closed for the duration of the shutdown or until the Keypad **COMPRESSOR** switch is placed in the Stop-Reset (O) position, whereupon they open.
- b. If Microboard Program Switch SW1-8 is in the ON position, they do not open at the completion of **SYSTEM LOCKOUT DELAY** when the chiller shuts down on a **MULTI-UNIT CYCLING - CONTACTS OPEN** or **SYSTEM CYCLING - CONTACTS OPEN** cycling shutdown. They remain closed for the duration of the shutdown or until the Keypad **COMPRESSOR** switch is placed in the Stop-Reset (O) position, whereupon they open.

K1 - Anticipatory Alarm (TB2-55/56)

Dry closure contacts. Contacts close when one of the following Warning messages is Displayed. On most warnings, the contacts automatically open when the warning condition is no longer present. On those warnings marked with an asterisk, the contacts will open only after the warning condition is no longer present and the **WARNING RESET** key is pressed when logged in at **OPERATOR** access level or higher.

Freeze Threat From Operating Chiller, Low Discharge Superheat Detected*, Low Discharge superheat limit, Oil-Dirty Filter, Oil High Temperature, Real Time Clock failure, Setpoint Override*, Slide Valve Uncalibrated, External I/O – Serial Communications, Condenser – High Pressure Limit, Evaporator – Low Pressure Limit.

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

Dry closure status contacts that are closed to indicate to a Remote device that the chiller will start upon receipt of a remote start signal. The contacts open coincident with any Cycling or Safety shutdown or anytime the Keypad **COMPRESSOR** switch is placed in the Stop-Reset (O) position. On Cycling shutdowns, the contacts will close when the cycling condition clears. On safety shutdowns, the contacts will close only after the Safety condition clears, a manual reset is performed by placing the **COMPRESSOR** switch in the Stop-Reset (O) position and then back to the RUN (I) position.

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

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

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

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

K5 – Condenser Pump Starter (TB2-151)

Contacts close to start the condenser pump coincident with the beginning of "System Run". They remain closed as long as the chillers running. They open coincident with

the beginning of “System Lockout delay”. If equipped with Flash Memory Card version C.MLM.03.01 or later and Mod “B” Solid State Starter, the contacts remain closed at shutdown until all SCR Heatsink temperatures are $\leq 105^{\circ}\text{F}$ or a maximum of 45 minutes.

If the Freeze Warning feature has been enabled, the contacts will be controlled per the condenser saturation temperature while the chiller is shutdown as follows:

- a. At chiller shutdown, the contacts remain closed until the condenser saturation temperature increases to $>35.0^{\circ}\text{F}$, whereupon they open.
- b. During shutdown, if the condenser saturation temperature decreases to $<30.0^{\circ}\text{F}$, the contacts are closed until the temperature rises to $>35.0^{\circ}\text{F}$, whereupon they open.

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

K6-K9 – Not Used

K10 – Oil Heater (TB1-64)

Contacts close coincident with the beginning of “System Lockout Delay”. They remain closed as long as the chiller is shutdown unless the Separator Oil Level Switch is open, indicating insufficient oil level in the Separator. This allows the oil heater thermostat to control the oil heater while the chiller is shutdown. The contacts open coincident with the beginning of “System Run”. They remain open as long as the chiller is running. This prevents the oil heater from being turned on during compressor run.

K11 – Refrigerant Level Solenoid (TB1-29)

Contacts control the Refrigerant Level Solenoid valve for variable orifice control, per description in “Variable Orifice Control” section of this book.

K12 – Hot Gas Bypass Solenoid (TB1-61)

Contacts control the optional Hot Gas Bypass valve per description in the “Hot Gas Bypass” section of this book.

K13 – Compressor Motor Starter (start) -

(TB1-6/16) Contacts close coincident with the beginning of “System Run”. They remain closed for 0.2 seconds and then open.

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

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

K15 – Not Used

K16 – Oil Line Solenoid (TB1-62)

125 - 400 TR chillers only. Contacts close for the first 15 seconds and open for the last 15 seconds of “Start Sequence Initiated”. They then close coincident with the beginning of “System Run” and remain closed until the chiller is shutdown, whereupon they open coincident with the beginning of “System Lockout delay”. They remain open while the chiller is shutdown.

K17 – Not Used

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

Contacts operate the same as K14.

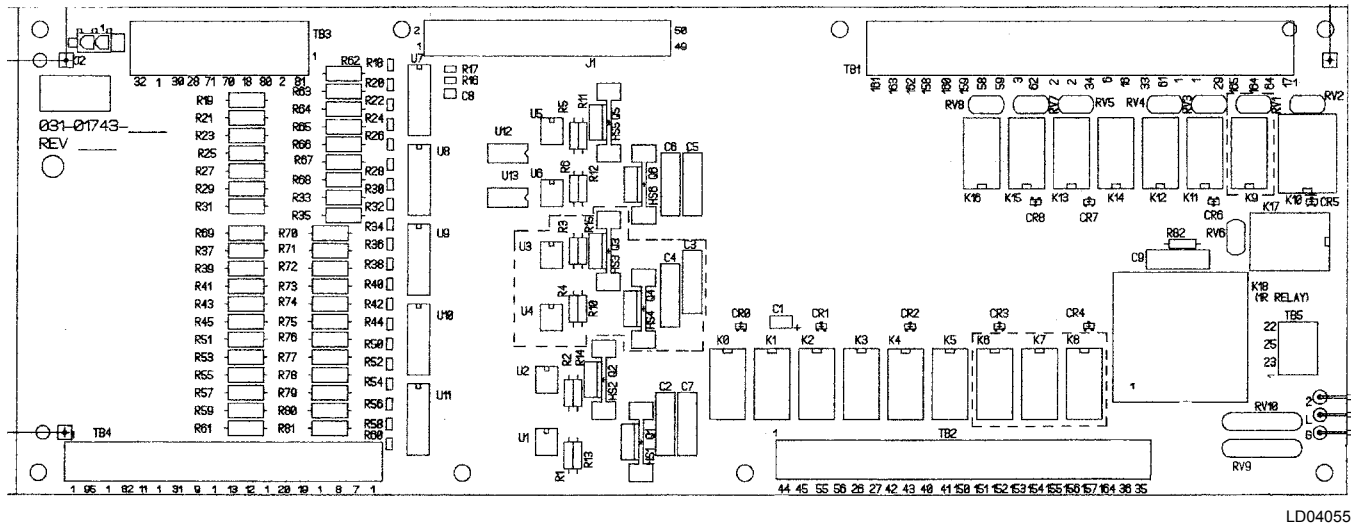
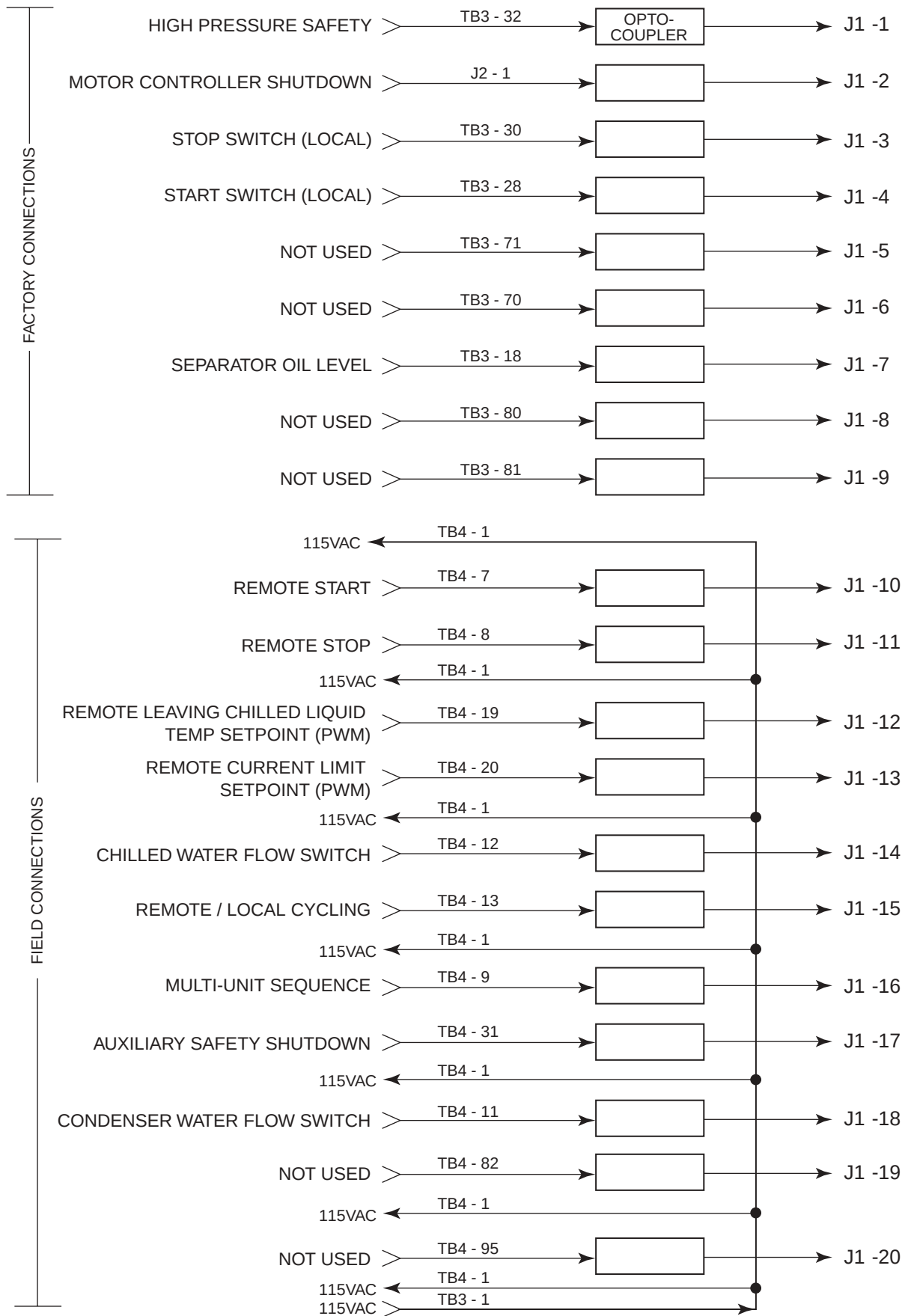
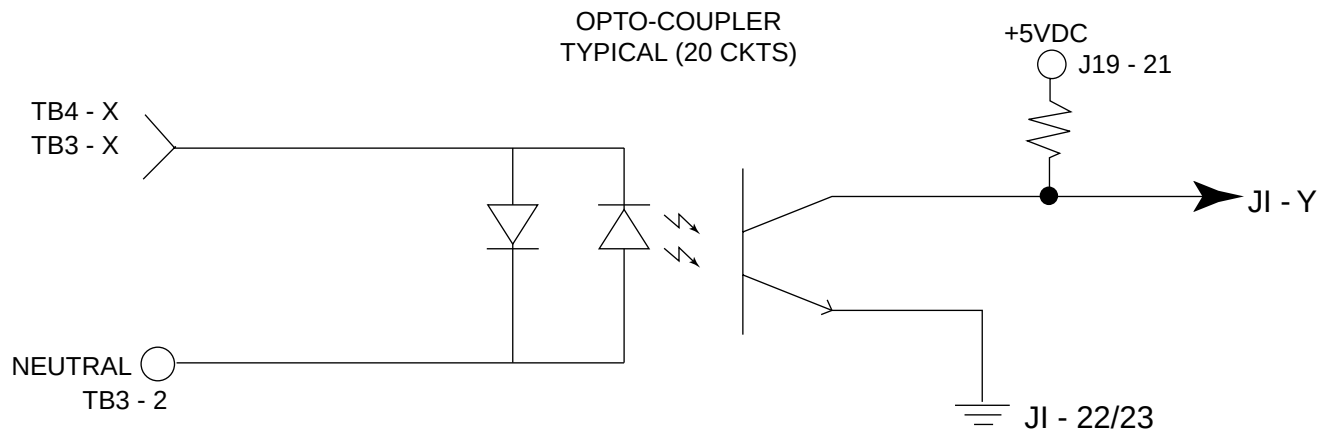


FIG. 11 – I/O BOARD



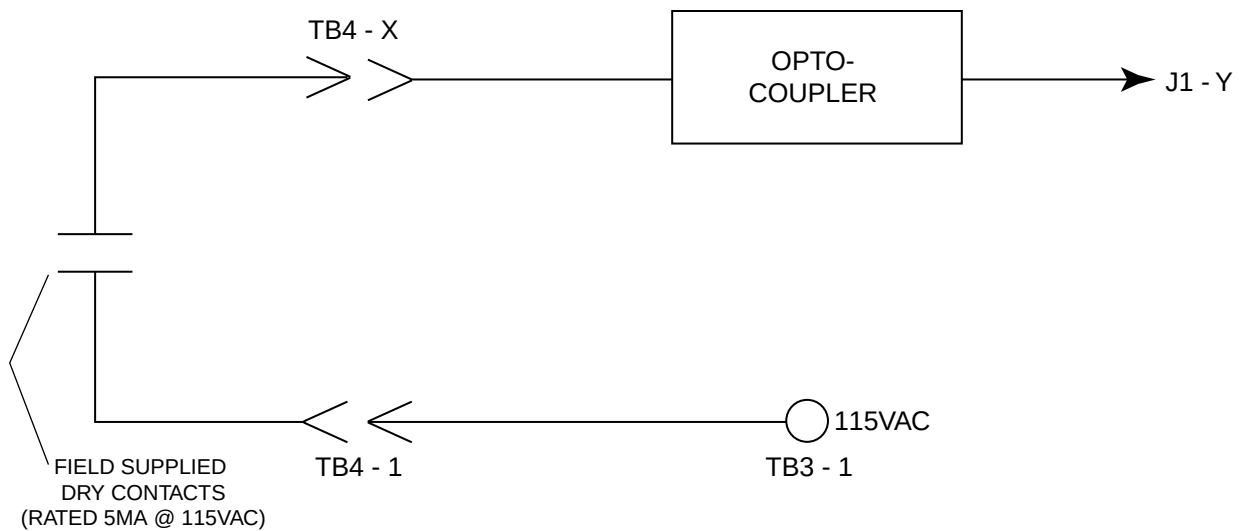
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FIG. 12 – I/O BOARD DIGITAL INPUTS



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FIG. 13 – I/O BOARD TYPICAL OPTO-COUPLER CIRCUIT

LD04058

FIG. 14 – I/O BOARD TYPICAL FIELD CONNECTIONS

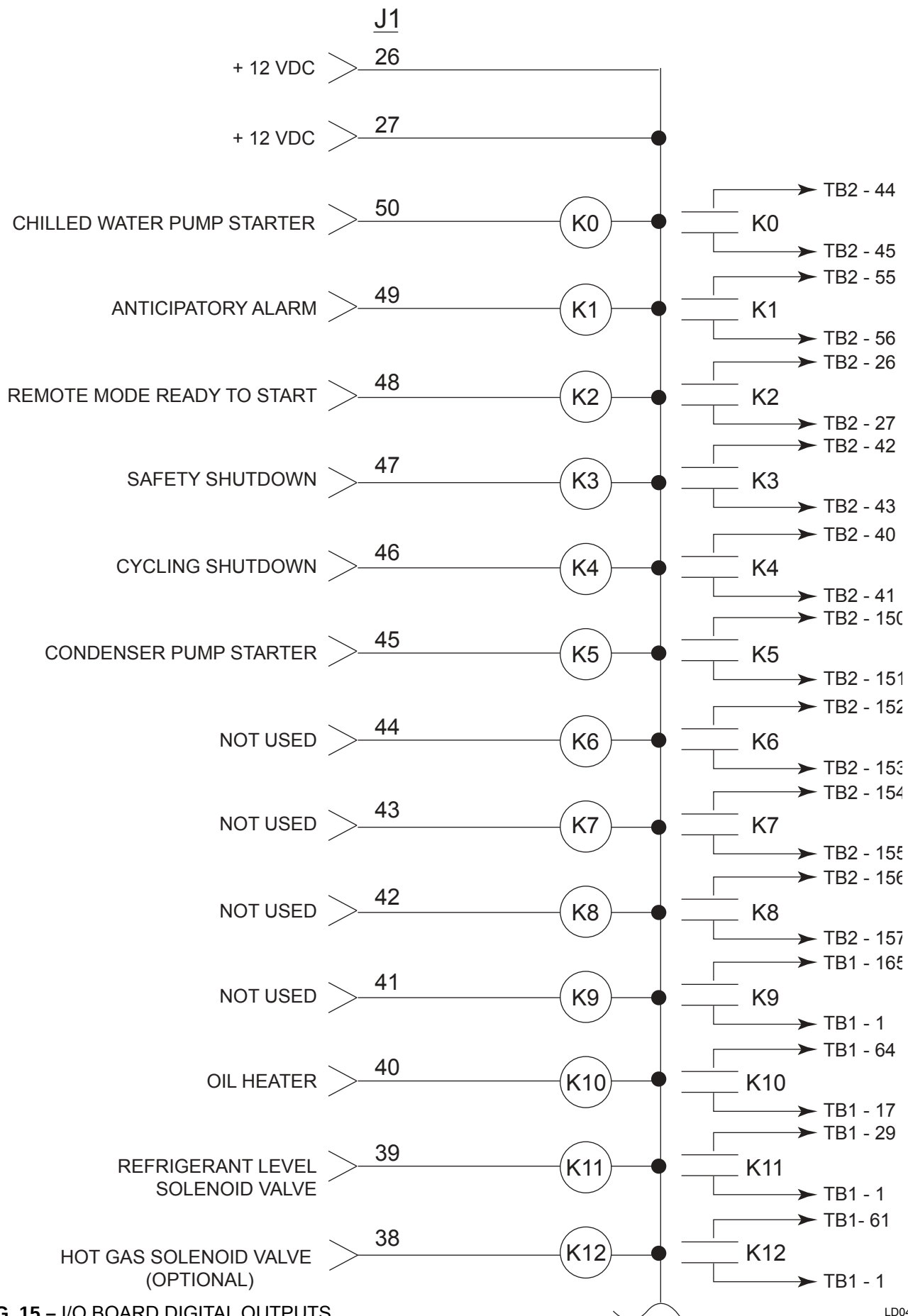
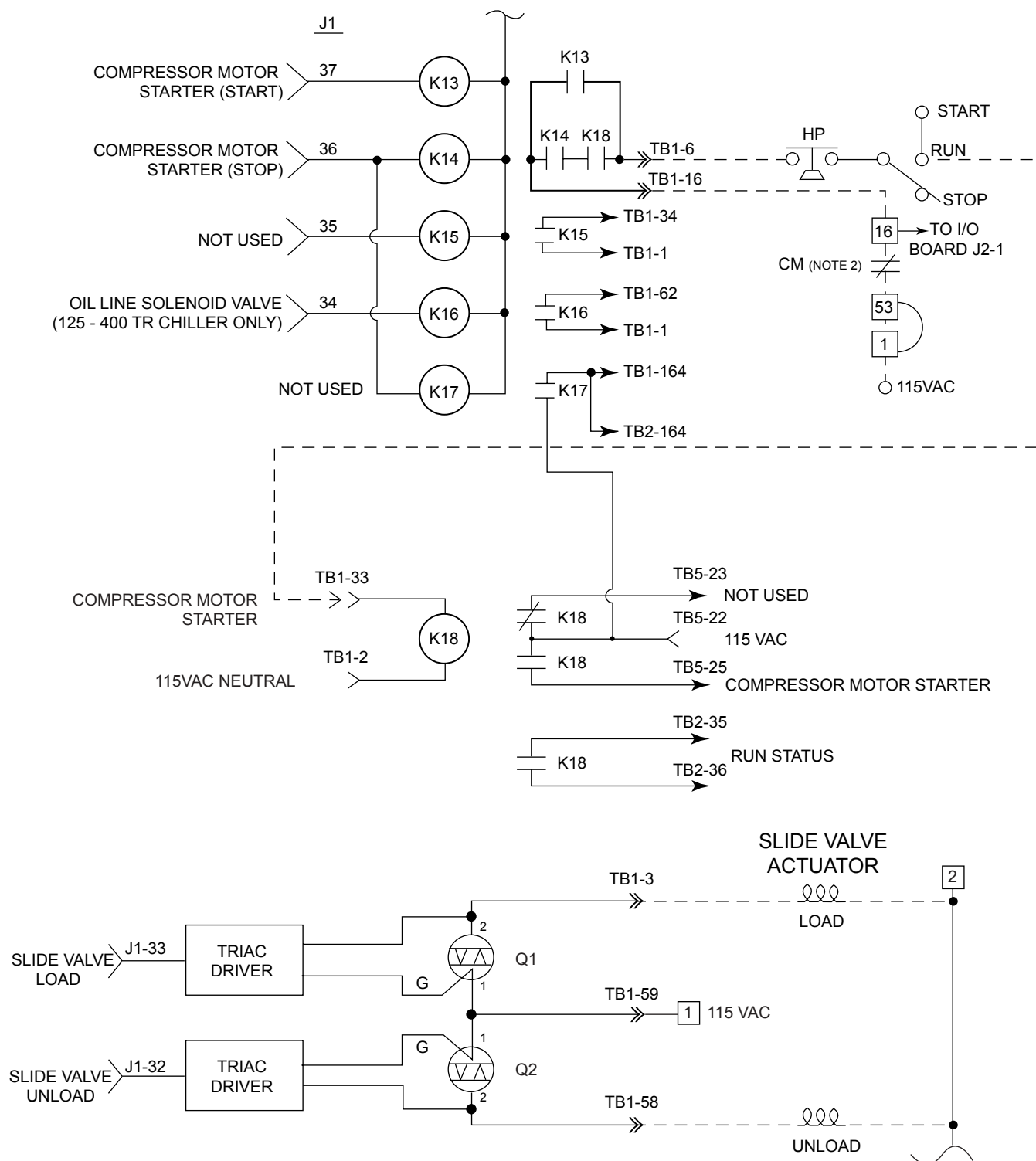


FIG. 15 – I/O BOARD DIGITAL OUTPUTS

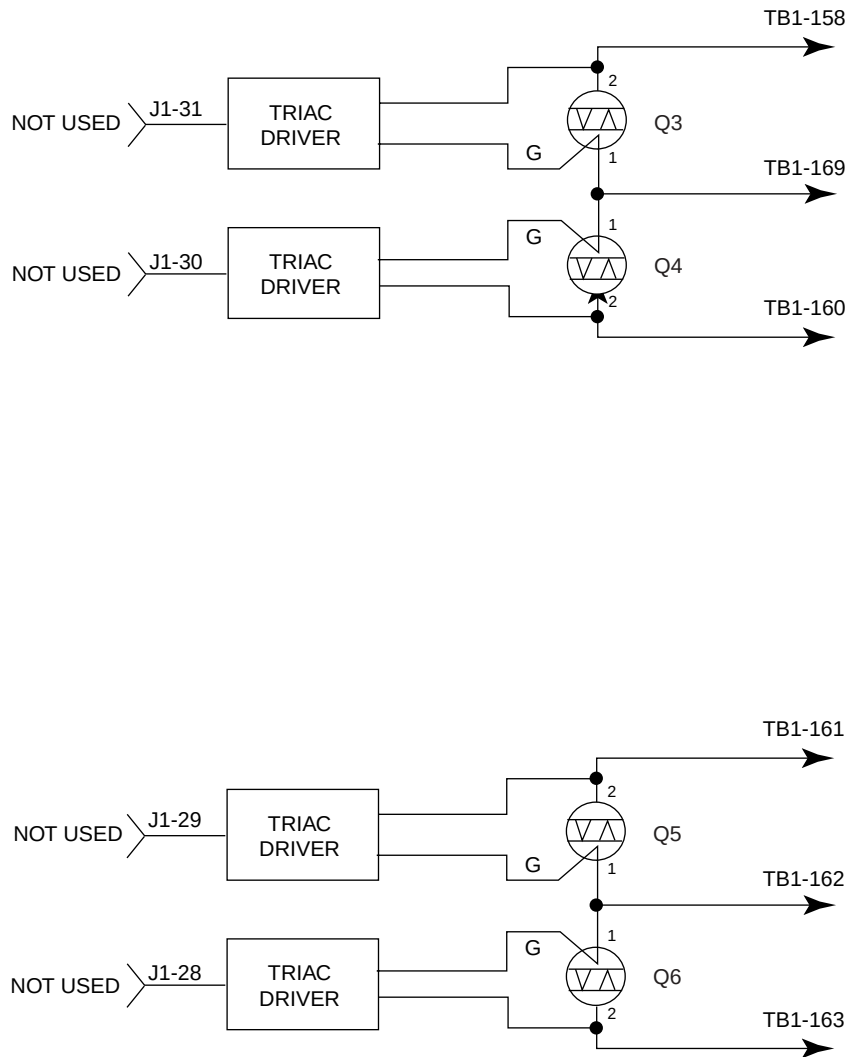
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**NOTES:**

1. - - - - - indicates wiring external to I/O Board.
2. "CM" – Contacts of Relay K1 on Current Module (EM Starter Applications) or Solid State Starter Logic Board (Solid State Starter Applications).

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FIG. 15 – (CONT'D) – I/O BOARD DIGITAL OUTPUTS



LD04964

FIG. 15 – (CONT'D) – I/O BOARD DIGITAL OUTPUTS

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SECTION 5

LIQUID CRYSTAL DISPLAY

(REFER TO FIG. 16 - 25)

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

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

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

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

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

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

Under Program control, the Display Controller on the Microboard sends a drive signal for each pixel to create the image on the display. Each pixel's drive signal is an 18 bit binary word; 6 bits for each of the 3 colors, red green and blue. The greater the binary value, the greater the amount of light permitted to pass. The columns of pixels are driven from left to right and the rows are driven top to bottom. To coordinate the drive signals and assure the columns are driven from left to right and the rows are driven from top to bottom, each drive signal contains a horizontal and vertical sync signal. The **Display Interface Board** receives these display drive signals from the Microboard J5 and applies them to the Display at connector CN1. Refer to Fig. 26.

Although there are variations in control signal timing between different display manufacturers, Fig. 21 depicts typical control signals. Since these control signals occur at rates greater than can be read with a Voltmeter, the following description is for information only. There are 480 horizontal rows of pixels. Each row contains 640 3-window pixels. Beginning with the top row, the drive signals are applied within each row, sequentially left to right, beginning with the left most pixel and ending with the right most pixel. The rows are driven from top to bottom. The Vertical Sync (VSYNC) pulse starts the scan in the upper left corner. The first Horizontal Sync (HSYNC) pulse initiates the sequential application of RGB drive signals to the 640 pixels in row 1. Upon receipt of the **ENABLE** signal, an RGB drive signal is applied to the first pixel. As long as the **ENABLE** signal is present, RGB drive signals are then applied to the remaining 639 pixels at the CLK rate of 25.18MHz, or one every 39.72 nanoseconds. Typically it takes 31 microseconds to address all 640 pixels. Similarly, the next HSYNC pulse applies drive signals to row 2. This continues until all 480 rows have been addressed. Total elapsed time to address all 480 rows is approximately 16 milliseconds. The next VSYNC pulse causes the above cycle to repeat. Displays can be operated in **FIXED** mode or **DISPLAY ENABLE** mode. In **FIXED** mode, the first pixel drive signal is applied a fixed number (48) of clock (CLK) cycles from the end of the HSYNC

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

- SHARP LQ10D367/368 (031-01774-000) & LDQ10D421 Displays - When **ENABLE** maintained “low”, display operates in fixed mode.
- NEC NL6448AC33-24 Displays - When **ENABLE** maintained “high” or “open”, display operates in fixed mode.
- LG SEMICON Display (031-02046-000) does not have the fixed mode feature.

As described above, in OptiView Control Center applications, the Display scan is left to right, beginning with the top row and continuing sequentially through the rows to the last row. However, in Display applications other than OptiView Control Centers, image reversal is sometimes required. In image reversal applications, the scan is reversed; the scan is right to left, beginning with the last row and proceeding to the top row. The SHARP or NEC Display is placed in the **NORMAL** or **REVERSE** scan mode by the voltage levels on the Display Interface Board J1-30 and J1-31 (display connector CN1-30/31). These voltage levels are determined by the configuration of Wire jumpers P30 and P31 on the Display Interface Board (ref. Fig. 26). The Display reads these voltage levels and automatically assumes **NORMAL** or **REVERSE** scan operation. Refer to **DISPLAY INTERFACE BOARD** section that follows for jumper configurations.

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

Display Interface Board required for each Display application and each has a unique jumper configuration that identifies the Display. A complete explanation of this process is included in the preceding “Microboard” section and the “Display Interface Board” section that follows.

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

The **Backlight Lamp** provides the illumination for the display. Average lamp life is 25000 hours (2.9 years). Some displays use one lamp. Others use two lamps. Lamps are replaceable, but not interchangeable between different displays. Each Display manufacturer specifies the required lamp for their display. Refer to replacement parts list for appropriate replacement lamp. Service replacement lamps are stocked in the YORK Service Parts Distribution Center. The lamp is illuminated by applying a high voltage AC (500 to 1500VAC) to it. This illumination voltage is created from a low level DC voltage (+12VDC or +5VDC as required by the Display manufacturer) by the **Backlight Inverter Board**. Lamp brightness is controlled by varying the high voltage AC. The greater the voltage the brighter the illumination. The lamp is controlled by on/off commands and brightness control signals applied to the **Backlight Inverter Board** from the Microboard. The Microboard Program determines when the lamp is turned on and off and the lamp brightness. Each Display manufacturer specifies the **Backlight Inverter Board** to be used. Therefore, it will vary according to the Display manufacturer. The ribbon cable that connects the Microboard to the Backlight Inverter Board also varies according to the Display manufacturer’s requirements. Refer to Fig. 22 to 25. Microboard Program Jumpers JP3, 4, 5, 7 and 8 determine the voltage levels of the control signals sent to the **Backlight Inverter Board** and must be configured per the Display manufacturer’s requirements as listed in Table 1. A detailed description of the operation of this board is in the “Backlight Inverter Board” section that follows. Also refer to the preceding “Microboard” section for a detailed description of the **Lamp Dimmer** circuit.

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

Display Replacement Kit 331-01771-000:

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

Display Handling:

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



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

BACKLIGHT LAMP REPLACEMENT:

SHARP LQ10D367/368 (031-01774-000) Display: (Refer to Fig. 22)

Removal:

The Lamp slides into the Display from left to right and is secured with a locking tab.

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

Installation:

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

SHARP LQ10D421 Display (refer to Fig. 23)

Removal:

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

1. Remove Control power from the OptiView Control Center.
2. Remove protective cover from rear of display.
3. Disconnect lamp AC power connector from defective lamp.
4. Using a thin flat blade screwdriver, press in on the small black locking tab.
5. Grasp Lamp AC power connector and gently pull until Lamp clears locking tab.
6. Grasp Lamp housing and pull until Lamp housing is completely removed from the display.

Installation:

Follow instructions above for SHARP 367 Display.

NEC NL6448AC33-24 Display (refer to Fig. 24)**Removal:**

Not available at this time.

Installation:

Not available at this time.

LG Semicon LP104V2-W (031-02046-000) Display (refer to Fig. 25)**Removal:**

The Lamp slides into the Display from left to right and is secured with a screw.

1. Remove Control Power from the OptiView Control Center.

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

Installation:

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

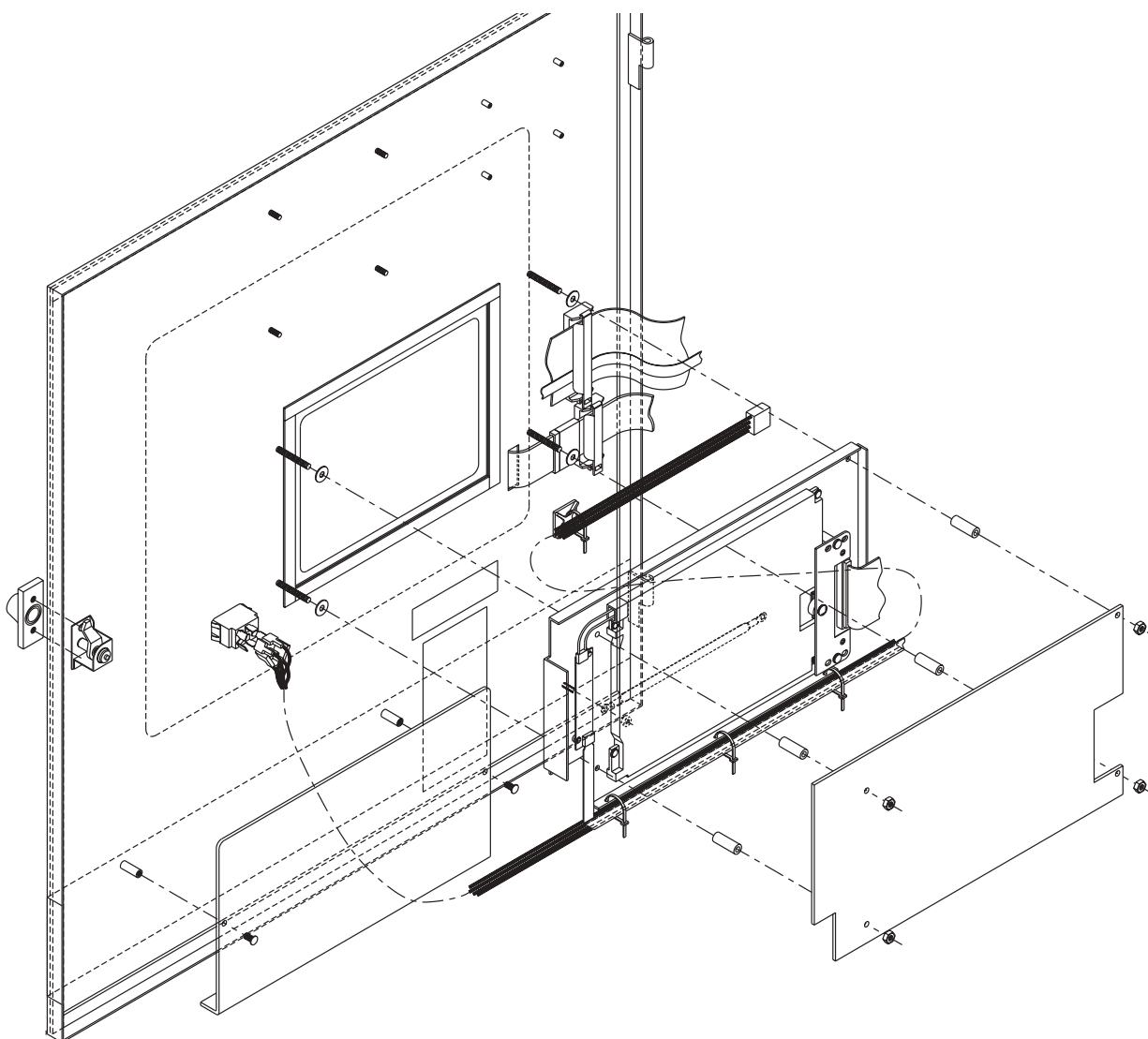
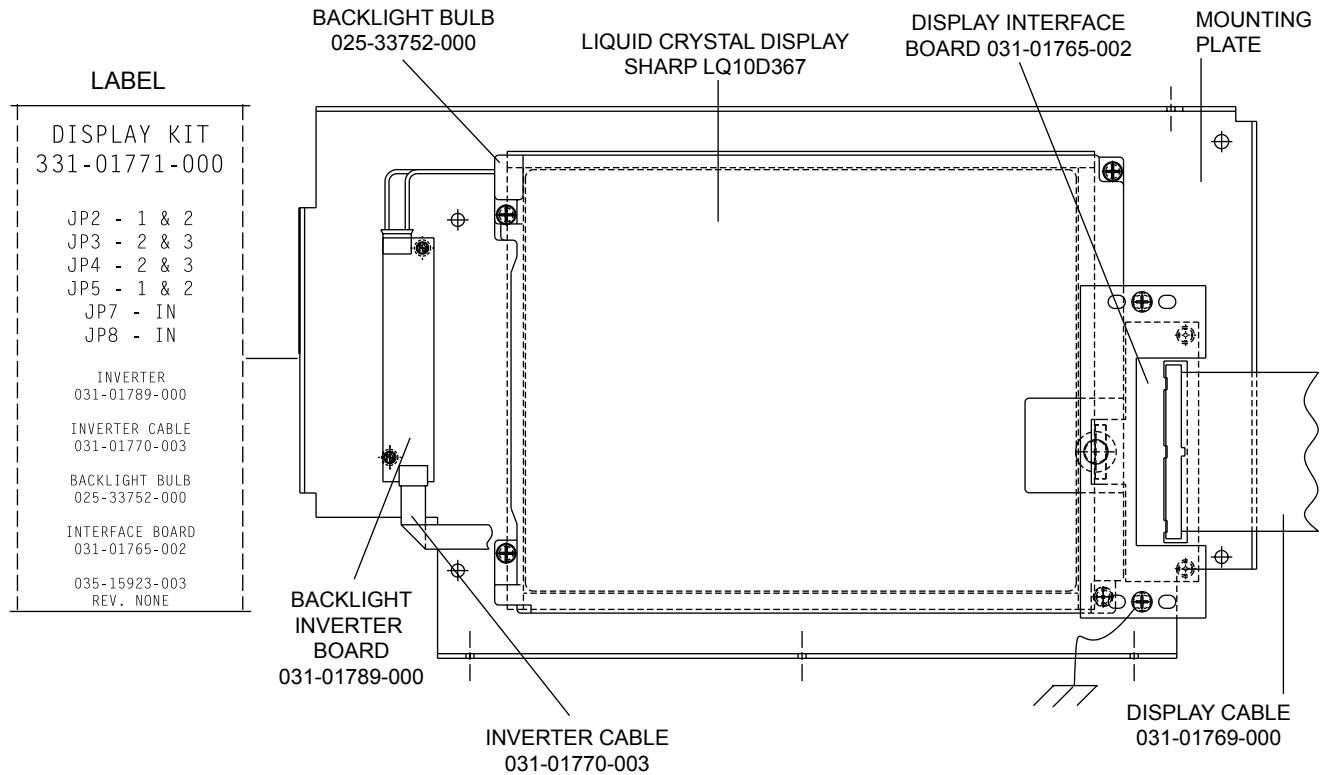


FIG. 16 – DISPLAY, MOUNTING

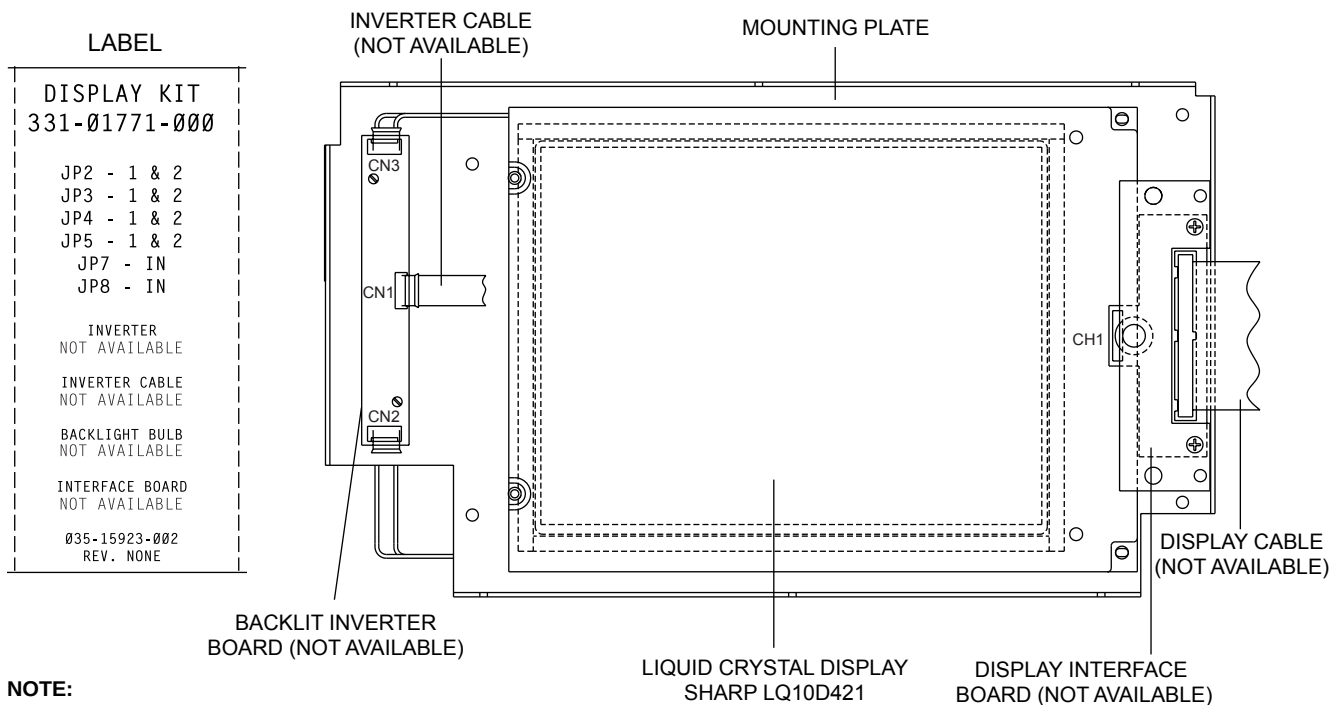


NOTE:

1. Configure Microboard Program Jumpers per label.

LD05563

FIG. 17 – LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ10D367/368 (031-01774-000) DISPLAY

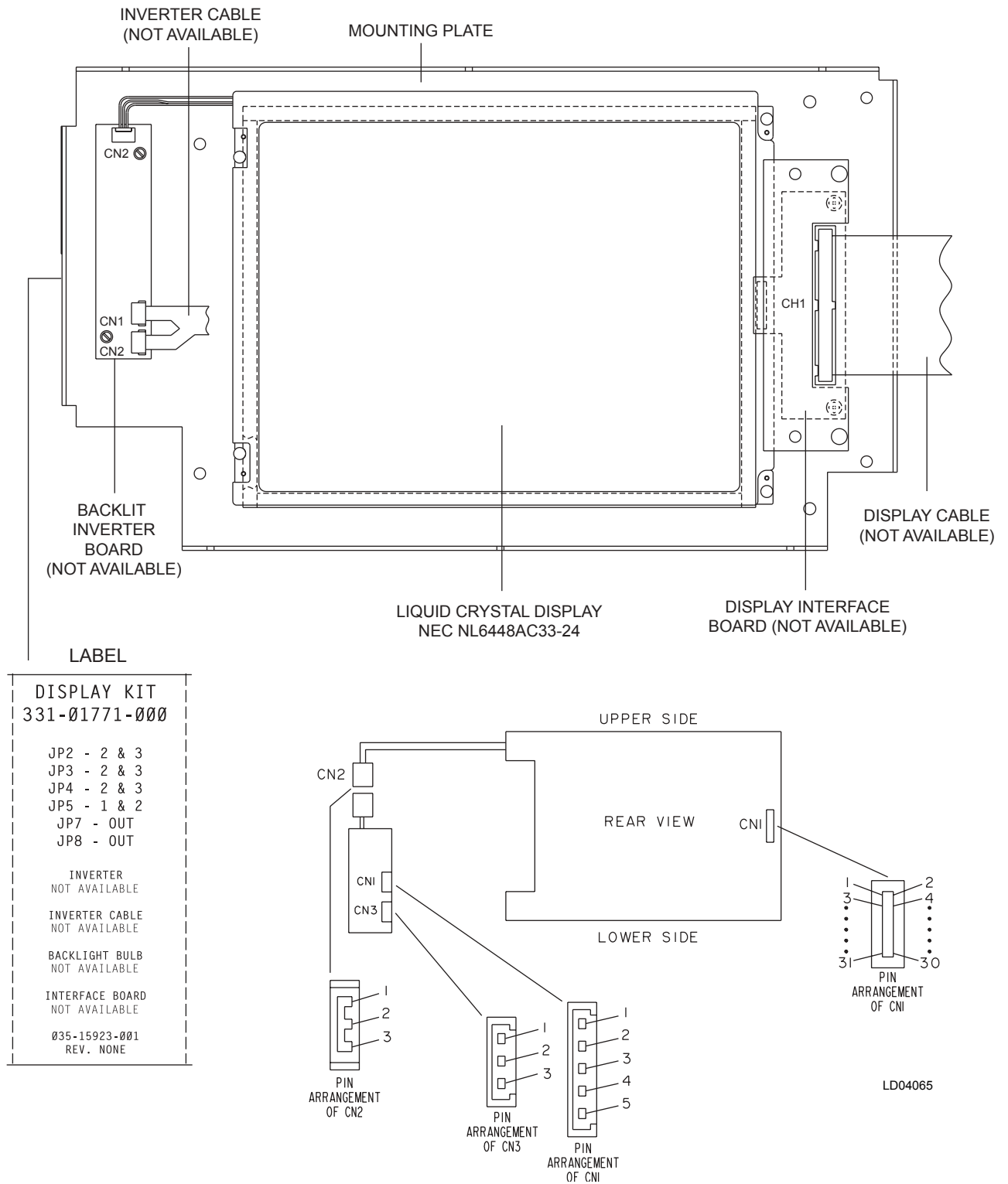


NOTE:

1. Configure Microboard Program Jumpers per label.

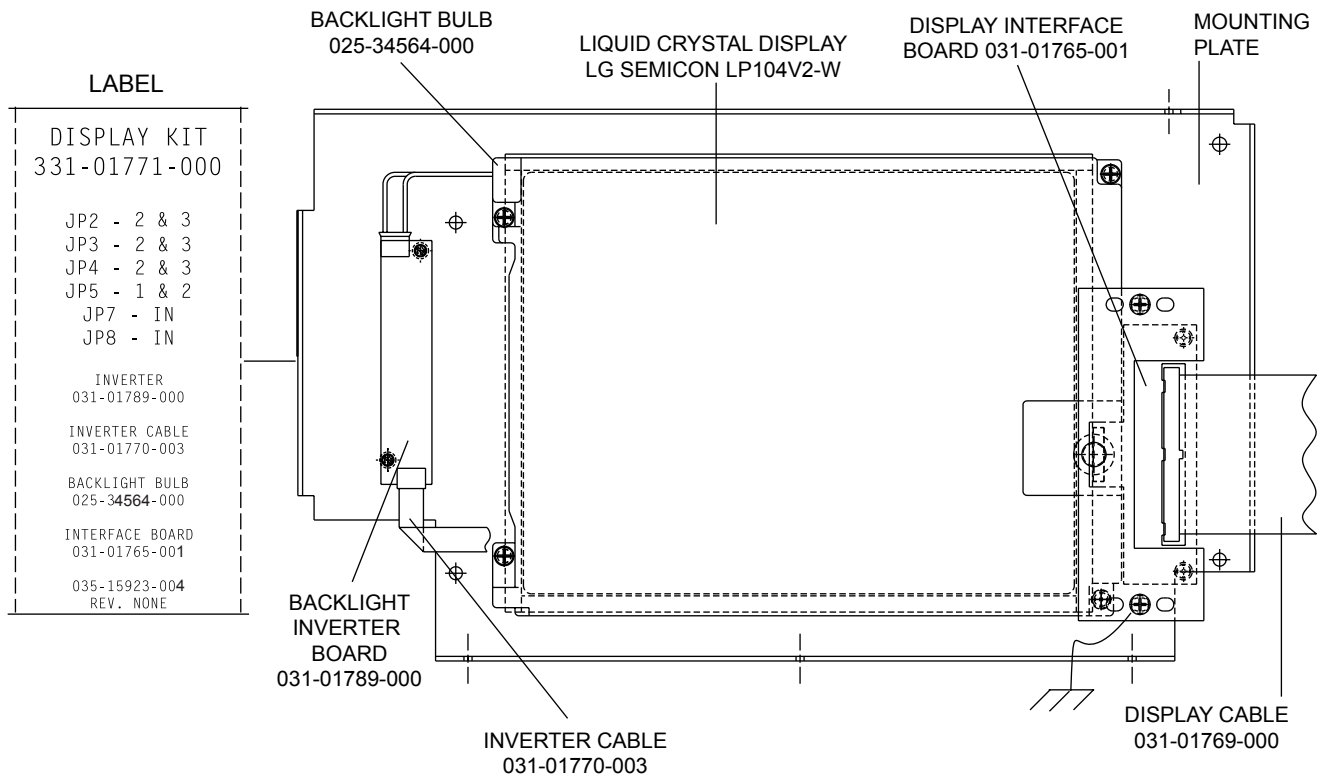
LD04064

FIG. 18 – LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ10D421 DISPLAY

**NOTE:**

1. Configure Microboard Program Jumpers per label.

FIG. 19 – LIQUID CRYSTAL DISPLAY ASSEMBLY – NEC NL6448AC33-24 DISPLAY

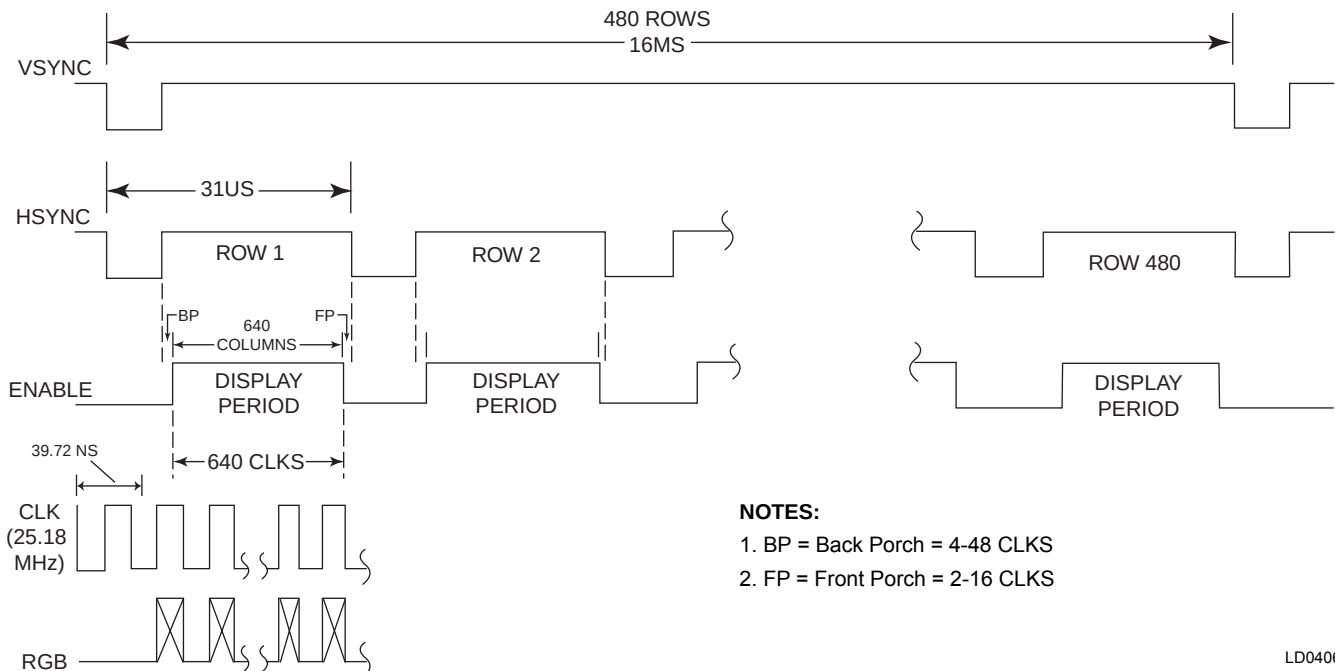


LD05525

NOTE:

1. Configure Microboard Program Jumpers per label.

FIG. 20 – LIQUID CRYSTAL DISPLAY ASSEMBLY - LG SEMICON LP104V2-W (031-02046-000)

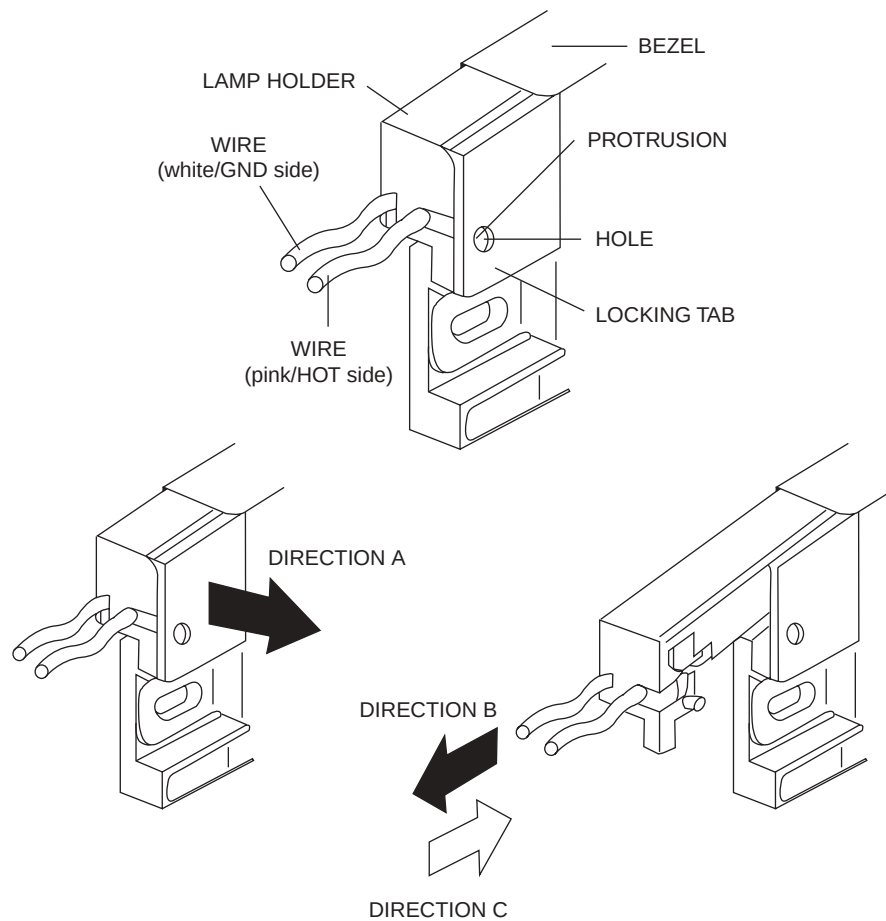


NOTES:

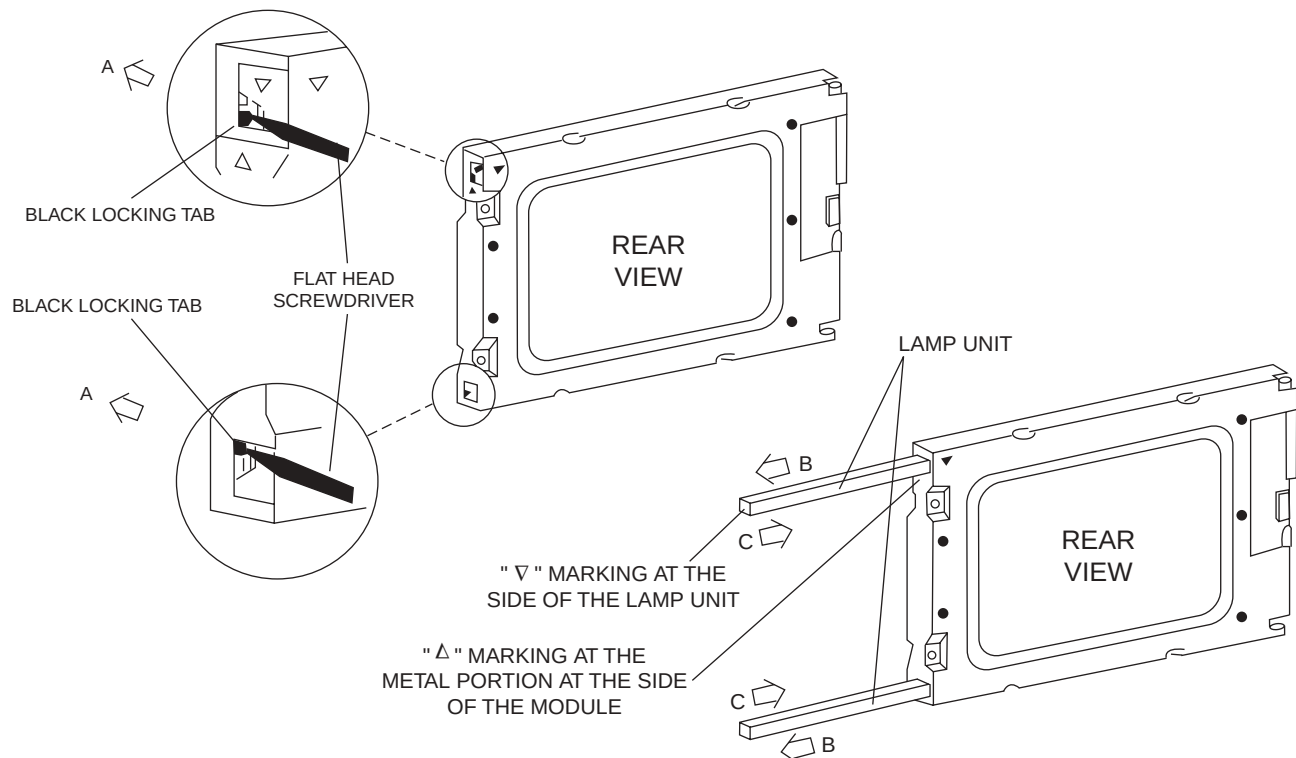
1. BP = Back Porch = 4-48 CLKS
2. FP = Front Porch = 2-16 CLKS

LD04066

FIG. 21– LIQUID CRYSTAL DISPLAY TYPICAL CONTROL SIGNAL TIMING



LD04067

FIG. 22 – DISPLAY (SHARP LQ10D367) LAMP REPLACEMENT

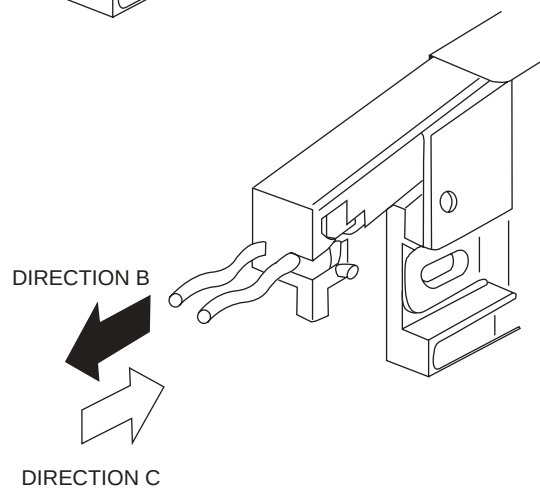
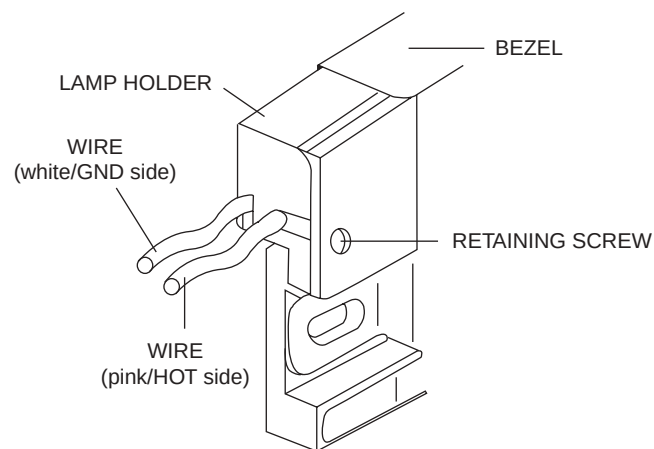
LD04068

FIG. 23 – DISPLAY (SHARP LQ10D367/368 [031-01774-000]) LAMP REPLACEMENT

NOT AVAILABLE AT THIS TIME

LD04069

FIG. 24 – DISPLAY (NEC NL6448AC33-24) LAMP REPLACEMENT



LD05565

FIG. 25 – DISPLAY (LG SEMICON LP104V2-W [031-02046-000]) LAMP REPLACEMENT

SECTION 6

DISPLAY INTERFACE BOARD

(REFER TO FIG. 26)

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

Since different Display manufacturers require different timing and control signals, the Display Controller on the Microboard must be configured to meet the requirements of the actual Display installed. When AC power is applied to the OptiView Control Center, as part of the power-up sequence, the Microboard reads the four Panel ID wire jumpers, P1D0 through P1D3, on the **Display Interface Board** to determine which Display is present. The configuration of these jumpers indicates the actual Display that is installed on the OptiView Control Center door. The Display Controller on the Microboard is then configured appropriately.

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

SHARP LQ10D367/368 (031-01774-000) & LQ10D421 Displays:

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

- P30 IN - Normal scan; left to right
- OUT - Reverse scan: right to left
- P31 IN - Normal scan; top to bottom
- OUT - Reverse scan; bottom to top

NEC NL6448AC33-24 Display:

- P30 Not used
- P31 IN or OUT - Normal scan; left to right, top to bottom

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

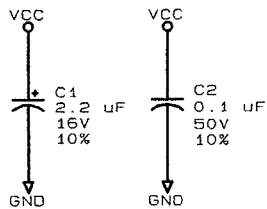
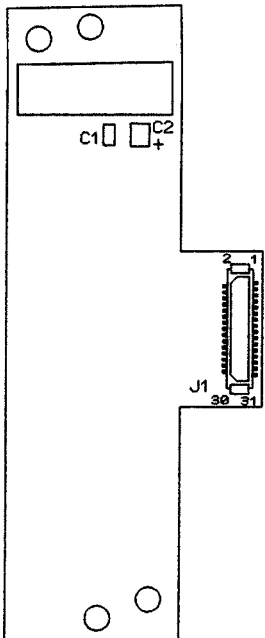
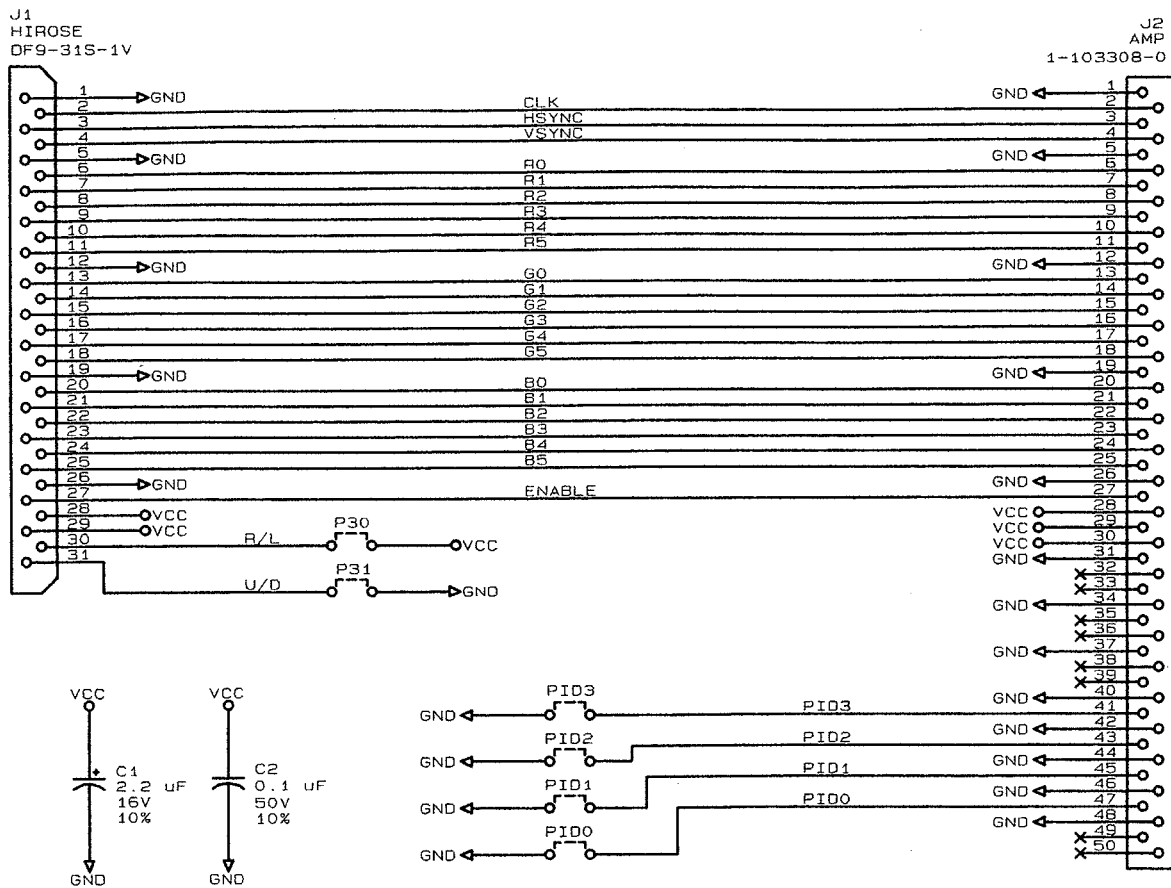
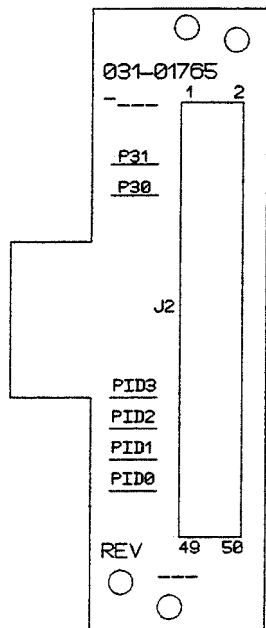
031-01765-001:

- Display applicability - LG Semicon LP104V2-W (031-02046-000) & NEC NL6448AC33-24
- Jumper configuration - PID0 - IN
PID1 - OUT
PID2 - OUT
PID3 - OUT
P30 - OUT
P31 - OUT

031-01765-002:

- Display applicability - SHARP LQ10D367/368 (031-01774-000) & LQ10D421
- Jumper configuration - PID0 - OUT
PID1 - IN
PID2 - OUT
PID3 - OUT
P30 - IN
P31 - IN

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



LG SEMICON LP104V2-W (031-02046-000)

NEC NL6448AC33-24 DISPLAY

031-01765-001	-	PID0	IN
		PID1-3	OUT
		P30, P31	OUT

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

031-01765-002	-	PID0	OUT
		PID1	IN
		PID2, 3	OUT
		P30, 31	IN

LD04070

FIG. 26 - DISPLAY INTERFACE BOARD

SECTION 7

DISPLAY BACKLIGHT INVERTER BOARD

(REFER TO FIG. 27- 29)

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

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



High voltage, up to 1500VAC, is present at the output of the backlight inverter board. Refer to Figures 27 to 29 and locate the output connectors. Use extreme caution when working in this area!!!

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

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

The lamp illumination high voltage AC is generated from either +12VDC or +5VDC as required by the manufacturer. Microboard Program Jumper JP5 must be positioned to provide the required voltage. The Microboard provides the **Backlight Enable** signal. This

signal turns the lamp on and off. Some manufacturers require this signal to be +12VDC, others require +5VDC. Program Jumper JP4 must be positioned to provide the required voltage. Further, some applications require this signal to be a +VDC (+12VDC or +5VDC) to turn on the lamp. Others require this signal to be 0VDC to turn on the lamp. Program Jumper JP3 must be positioned to provide the required polarity.

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

The OptiView Control Center could be supplied with any of several approved Displays. Each Display requires a specific Backlight Inverter Board as specified below and in Figures 27 to 29. These boards are individually available as service replacement parts (the required Backlight Inverter Board part number is listed on the label attached to the Display mounting plate). However, service replacement Displays are provided in a kit (YORK P/N 331-01771-000) that includes the appropriate Backlight Inverter Board (refer to "Liquid Crystal Display" Section).

SHARP model LQ10D367/368 (031-01774-000) AND LG Semicon LP104V2-W (031-02046-000) displays require a TDK CXA-LO612-VJL Backlight Inverter Board (YORK P/N 031-01789-000) (ref. Fig. 27). These boards generate a lamp illumination high voltage AC from +12VDC. When the Backlight Enable signal at connector CN1-3 is +5VDC, the high voltage signal is applied to the lamp. When CN1-3 is 0VDC, the high voltage signal is removed from the lamp, turning it off. The lamp brightness is controlled by a variable voltage signal, developed by the lamp dimmer circuit (ref. Fig. 8) on the Microboard and applied to connector CN1-4.

The lamp dimmer circuit varies the voltage at CN1-4 over the range of 0 to +3.0VDC. 0VDC produces maximum (100%) brightness; +3.0VDC produces minimum (0%) brightness. Voltages between these values produce a linear brightness 0 and 100%. Connector CN2 applies the high voltage lamp illumination signal to the lamp.

SHARP model LQ10D421 displays require a XENTEK LS520 Backlight Inverter Board (YORK P/N XXX-XXXXX-XXX) (refer to Fig. 28). These boards generate the lamp illumination high voltage AC from +12VDC. When the "Backlight Enable" signal at connector CN1-5 is 0VDC, the high voltage signal is applied to the lamp, turning it on. When CN1-5 is +12VDC, the high voltage signal is removed from the lamp, turning it off. The lamp brightness is controlled by a variable voltage signal, developed by the lamp dimmer circuit (ref. Fig. 8) on the Microboard and applied to connector CN1-6 and CN1-7. The Microboard places CN1-7 at ground (GND) potential. The lamp dimmer varies the voltage at CN1-6 over the range of 0 to +2.5VDC. 0VDC produces maximum (100%) lamp brightness; 2.5VDC produces minimum (0%) brightness. Voltages between these values produce a linear brightness between 0 and

100%. This display has a lamp at the top of the display and one at the bottom of the display. Connector CN2 applies the high voltage lamp illumination signal to the lower lamp; CN3 the upper lamp.

NEC model NL6448AC33-24 displays require an NEC 104PWBR1 Backlight Inverter Board (YORK P/N XXX-XXXXX-XXX) (refer to Fig. 29). These boards generate the lamp illumination high voltage AC from +12VDC. When the **Backlight Enable** signal at connector CN3-1 is +5VDC, the high voltage signal is applied to the lamp, turning it on. When CN3-1 is 0VDC, the high voltage signal is removed from the lamp, turning it off. The lamp brightness is controlled by a variable resistance, developed by the lamp dimmer circuit (ref. Fig. 8) on the Microboard and applied to connector CN3-2 and CN3-3. The lamp dimmer varies the resistance between CN3-2 and CN3-3 over the range of 0 to 10K Ohms. 0 Ohms produces minimum (0%) brightness; 10K Ohms produces maximum (100%) brightness. Resistances between these extremes produce linear brightness between 0% and 100%. Connector CN2 applies the high voltage lamp illumination signal.

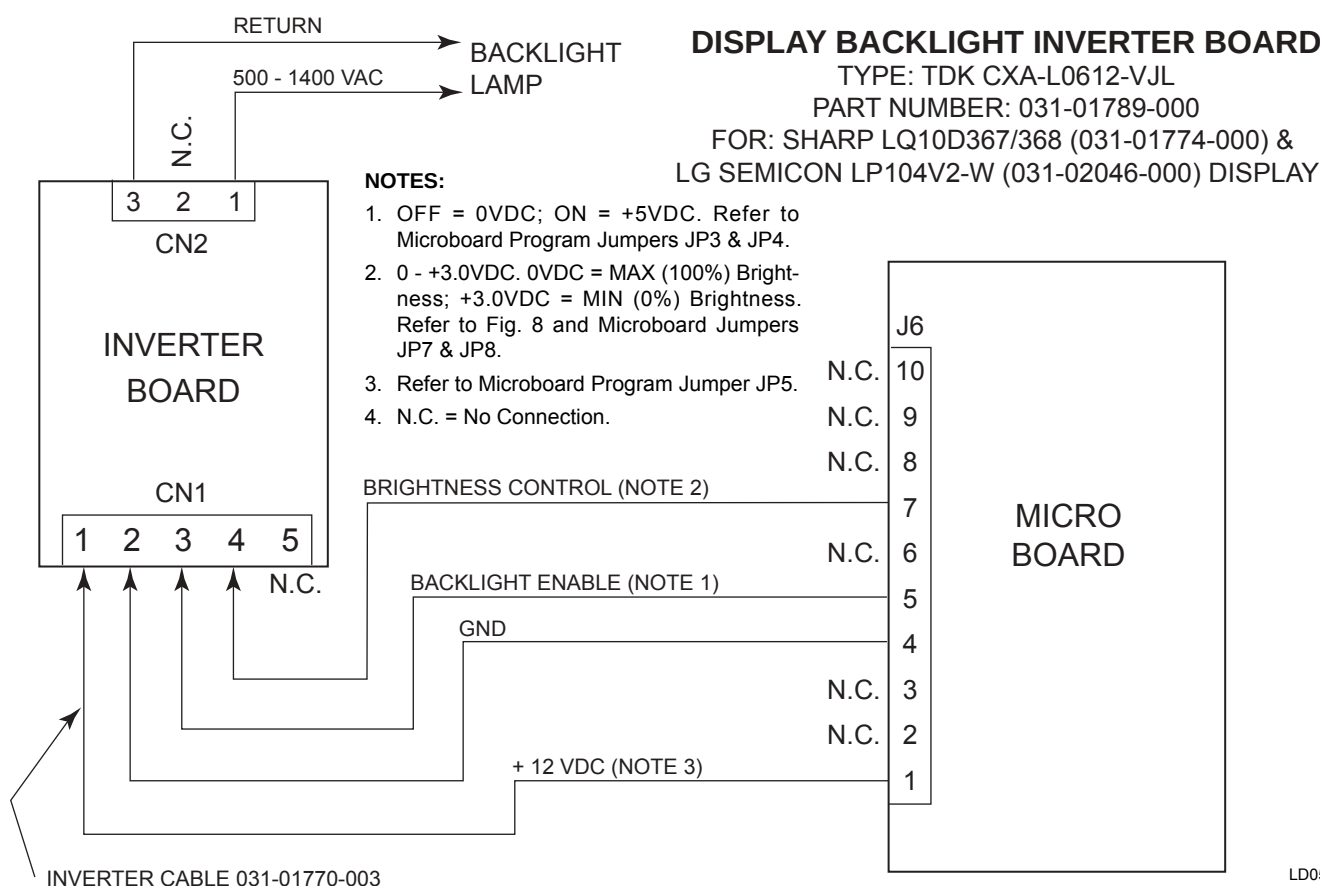
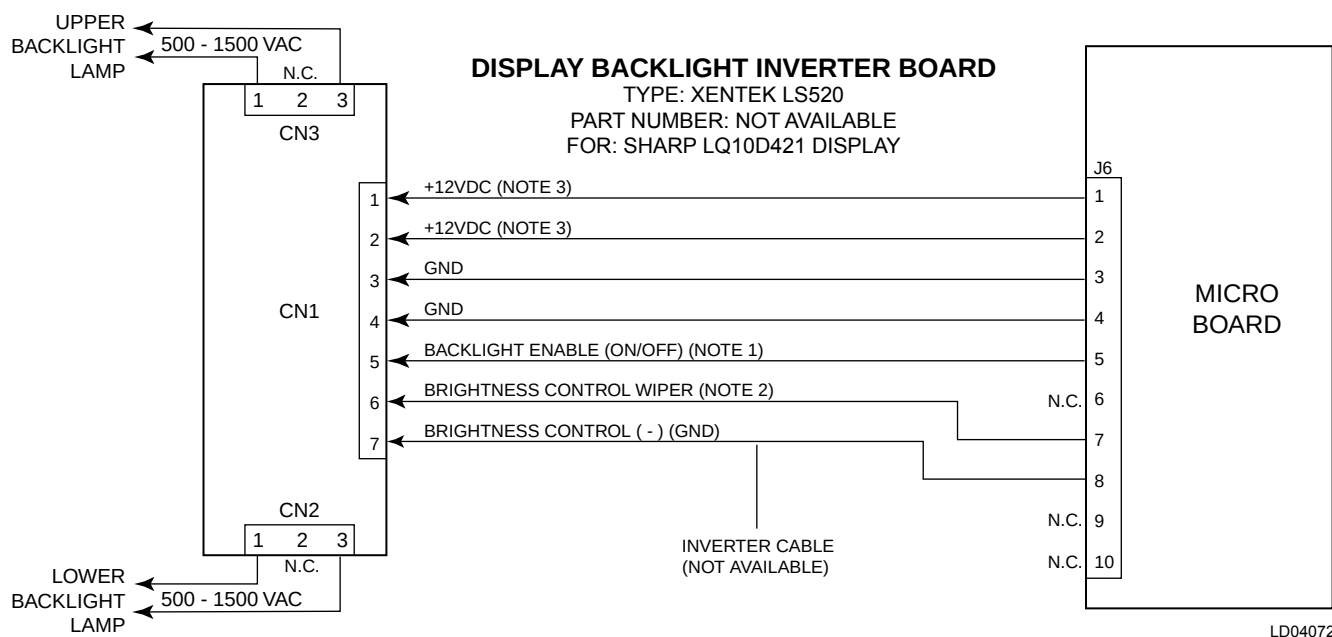
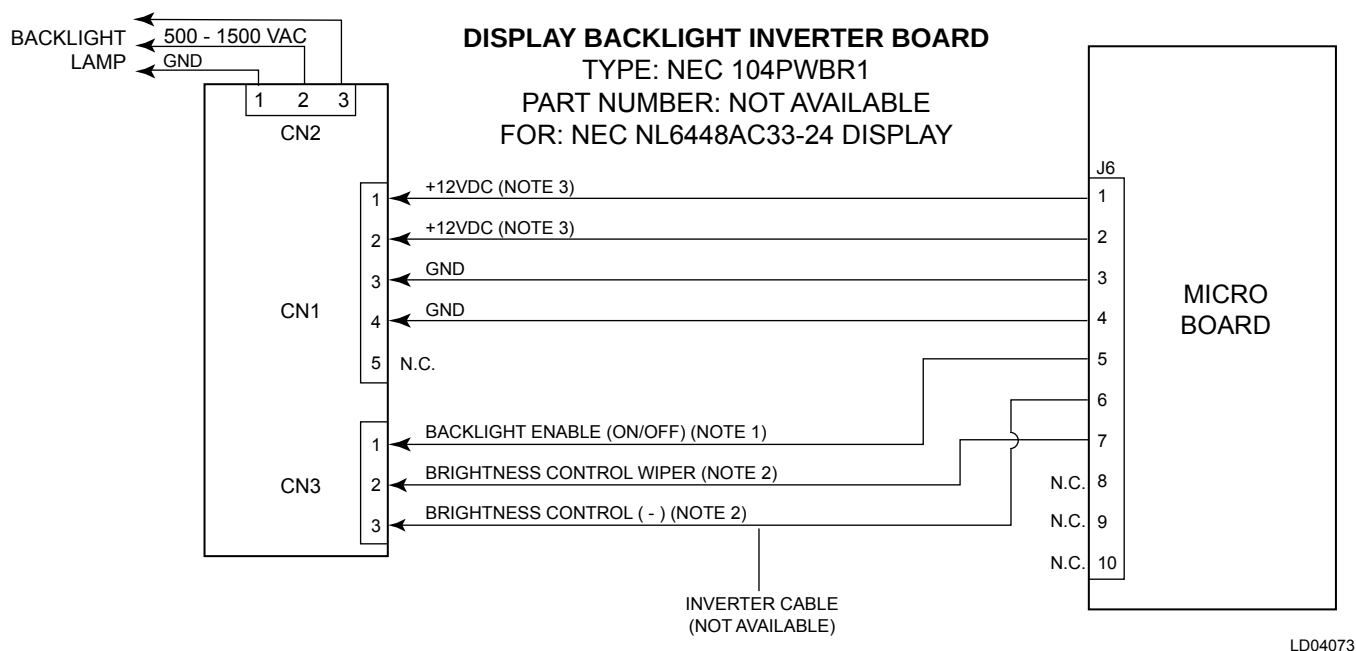


FIG. 27 – DISPLAY BACKLIGHT INVERTER BOARD (SHARP LQ10D367/368 (031-01774-000) & LG SEMICON LP104V2-W) (031-02046-000)

**NOTES:**

1. ON = 0VDC; OFF = +12VDC. Refer to Microboard Program Jumpers JP3 & JP4.
2. 0 - +2.5VDC. 0VDC = MAX (100%) Brightness; +2.5VDC = MIN (0%) Brightness. Refer to Fig. 8 and Microboard Program Jumpers JP7 & JP8.
3. Refer to Microboard Program Jumper JP5.
4. N.C. = No Connection.

FIG. 28 – DISPLAY BACKLIGHT INVERTER BOARD (SHARP LQ10D421)**NOTES:**

1. ON = +5VDC; OFF = 0VDC. Refer to Microboard Program Jumpers JP3 & JP4.
2. 0 - 10K Ohms. 0 Ohms = MIN (0%) Brightness; 10K Ohms = MAX (100%) Brightness. Refer to Fig. 8 and Microboard Program Jumpers JP7 & JP8.
3. Refer to Microboard Program Jumper JP5.
4. N.C. = No Connection.

FIG. 29 – DISPLAY BACKLIGHT INVERTER BOARD (NEC NL6448AC33-24)

SECTION 8

KEYPAD

(REFER TO FIGURES 30 & 31)

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

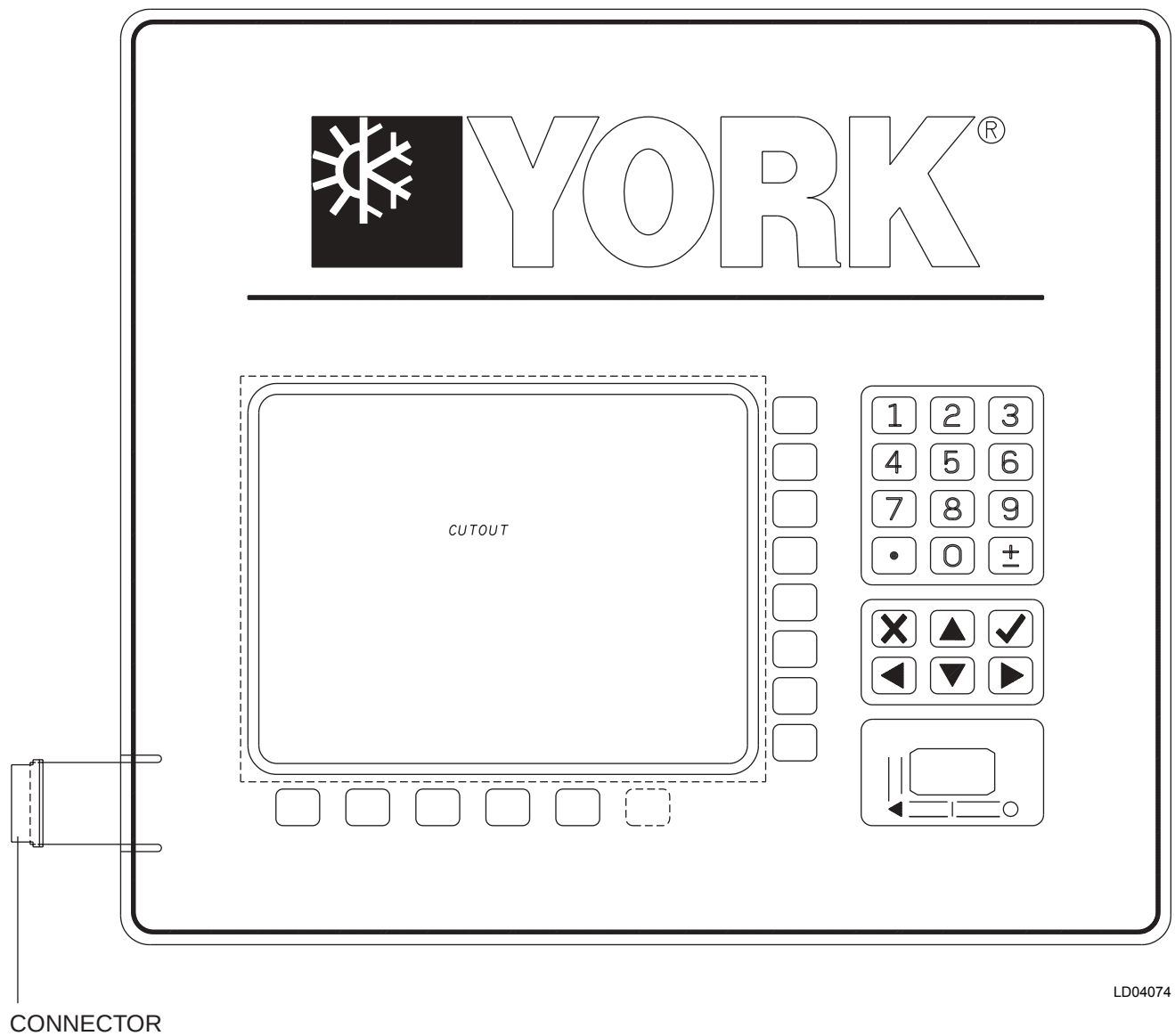
The top layer of the Keypad contains embossed areas identifying the keys. Under each embossed key area are two conductors, one on top of the other, separated by an air space. The conductors are arranged in a matrix of rows and columns and connected to the Keypad connector as shown in Fig. 31. The embossed area of each key is located directly over the intersection point of the conductors. Pressing the embossed key area causes contact and electrical continuity between the two conductors. For example, pressing the “1” key creates continuity between the Keypad connector pin 5 (column 3) and pin 13 (row 4). Since this connector is interfaced to the Microboard (J18), the Microboard senses this continuity as described below and concludes the “1” key is pressed.

The Microboard Program continuously scans the Keypad to determine if a key is pressed. Beginning with row 1 and proceeding through all rows, the Program places a “logic low” (<1VDC) on a row, a “logic high” (>4VDC) on the remaining rows and reads the columns. A logic low in any column indicates a key in that column and row is pressed. For example, if at the time row 4 is being driven low, if column 3 is low, then the Micro

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

In order for the Microboard to reliably detect closed and open keys, each key must meet a closed circuit and open circuit resistance requirement. When a key is pressed, the contact resistance must be ≤ 100 Ohms. When a key is not pressed, the contact resistance must be ≥ 1 Meg Ohm. If the Microboard is not responding to a pressed key, or if it’s detecting a closed key when none are pressed, it could be because the contact resistance requirements are not being met. The operation of each key can be checked with an Ohmmeter. To check the open and closed contact resistance of any key, refer to the “Diagnostics and Troubleshooting” Section 21 of this book.

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

**FIG. 30 – KEYPAD**

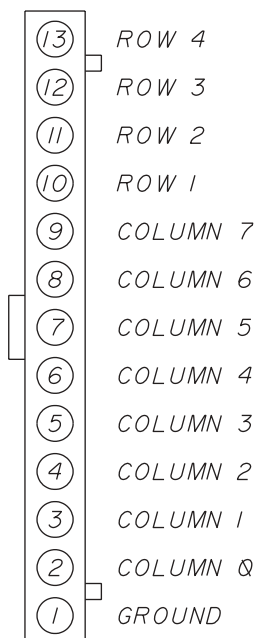
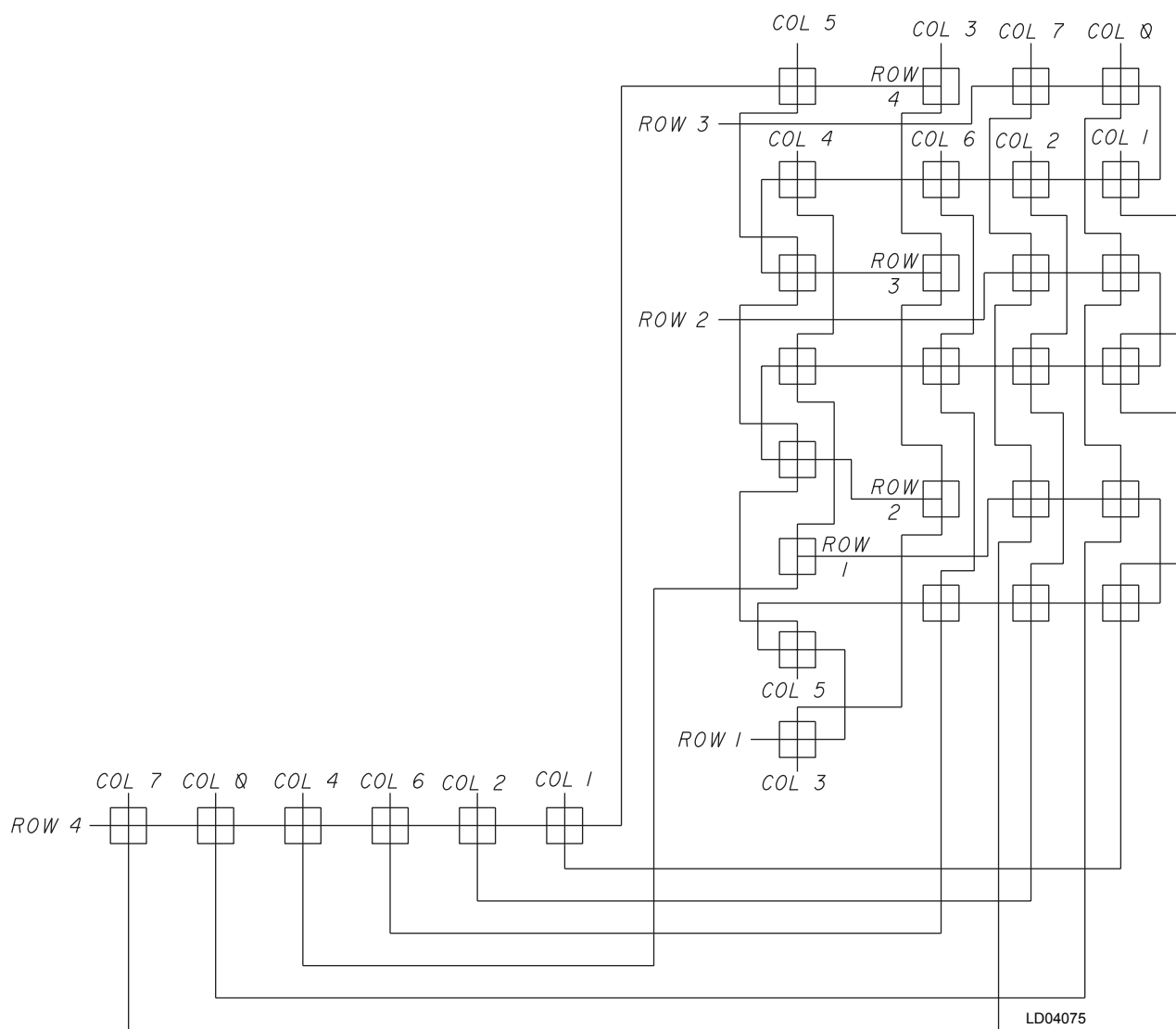


FIG. 31 – KEYPAD

CONNECTOR PIN OUT

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SECTION 9

POWER SUPPLY

(REFER TO FIG 32 & 33)

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

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

The +24VDC output provides power to the CM-2 Board (Electro-Mechanical starter applications), Solid State Starter Logic Board (Mod “A” SSS) or Solid State Starter Logic/Trigger Board (Mod “B” SSS).

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

The Condor Power supply allows adjustment of the +5Vdc output. To account for losses in wiring and connections and assure sufficient voltage level at the microboard input, the “VAdJ” (R51) potentiometer is adjusted to achieve +5.1Vdc at the input to the Microboard J1-1.

As shown in Fig 7 (031-01730-000 microboard) and Fig 7A (031-01730-000 microboard), the Microboard contains two voltage regulators that create separate +5VDC and +3.3VDC supplies. The +5VDC supply is dedicated to all the Microboard Analog circuits and is

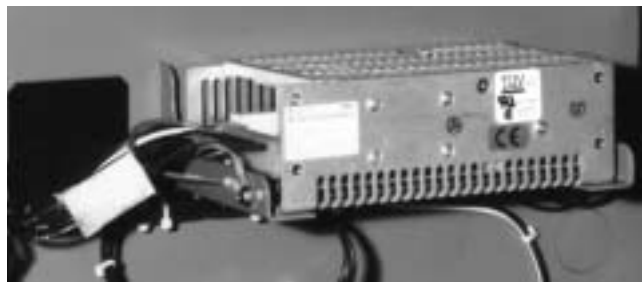


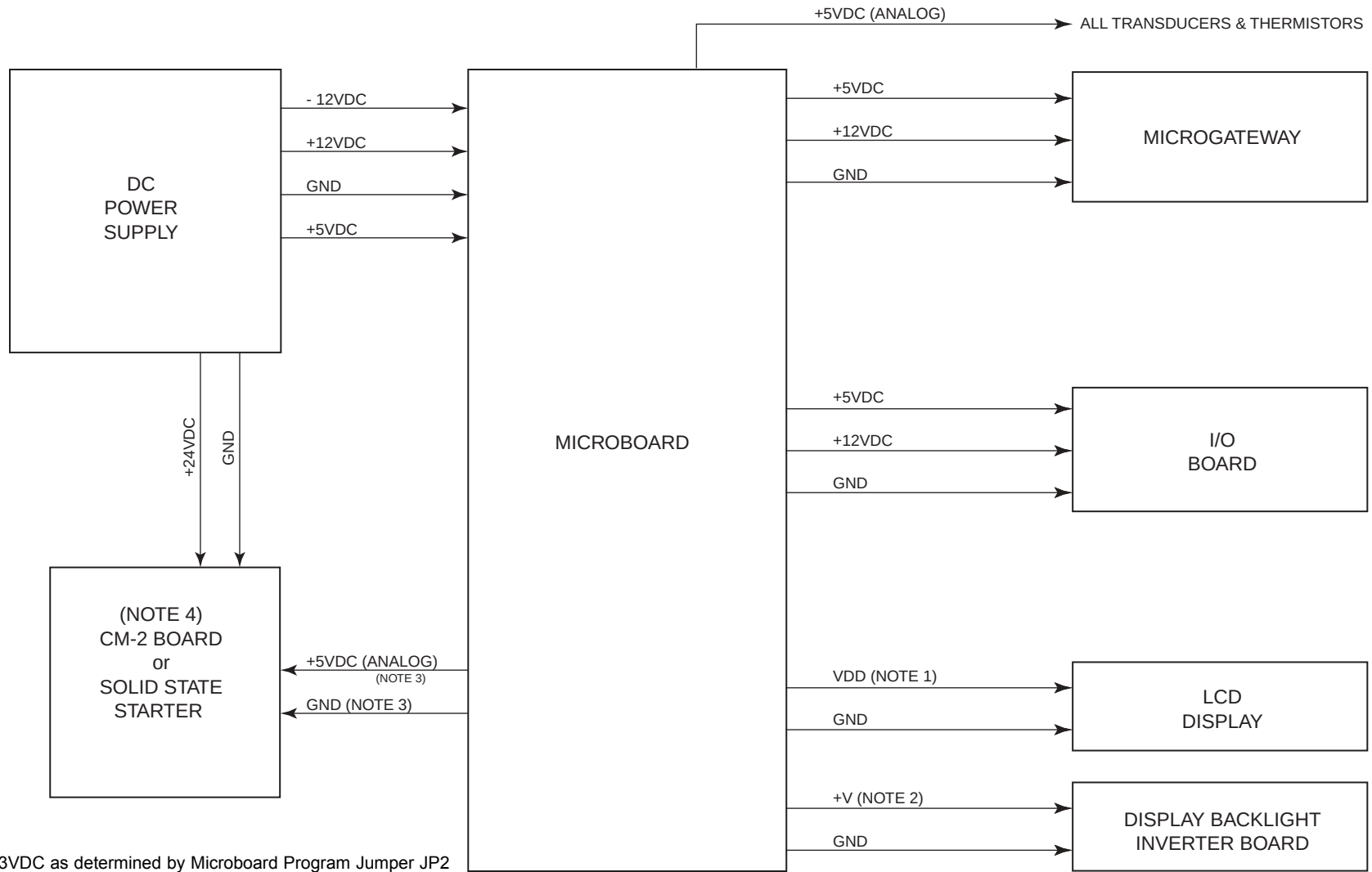
FIG. 32 – POWER SUPPLY

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labeled as the +5VDC (Analog) supply. It is also routed to all Pressure Transducers, Temperature Thermistors, and Motor controller Board (CM-2, Solid State Starter Logic Board [Mod “A” SSS]). This permits all Analog circuits to be powered by the same supply, eliminating any offsets caused by voltage regulator drift. Microboard 031-02430-000 has an additional voltage regulator that provides a 2.5Vdc power source. The +3.3VDC supply is utilized by the Microprocessor, Flash Memory Card and other digital circuits. It could also be applied to the Backlight Inverter Board, depending on the Display manufacturer’s requirements as explained below.

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

**NOTES:**

1. +5 or +3.3VDC as determined by Microboard Program Jumper JP2 & display requirements.
2. +12 or +5VDC as determined by Microboard Program Jumper JP5 & display requirements.
3. Not Applicable to Mod "B" Solid State Starter Applications.
4. Applications - CM2 (Em Starter) Logic/Trigger Board (Mod "B" Solid State Starter).

LD06483

FIG. 33 – POWER SUPPLY – DC POWER DISTRIBUTION (REFER TO CONTROL CENTER WIRING DIAGRAM FOR WIRE CONNECTIONS)

SECTION 10

CURRENT MODULE (CM-2)

(REFER TO FIG 34 - 36)

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

The contacts of Current Module K1 relay (identified as "CM" contacts on the Control Center wiring diagram) are interfaced into the Motor Controller initiated shutdown circuit that is located between Control Center TB6-53 and I/O Board TB1-16 (ref. Fig 15 and 35). They are also connected as a digital input to I/O Board J2-1. Relay K1 is normally energized, maintaining its contacts in a closed position. Whenever the Current Module initiates a chiller shutdown, it de-energizes K1, opening its contacts. This interrupts the circuit to I/O Expansion Board RUN relay coil 1R (K18), de-energizing it and causing the Starter to shutdown. Simultaneously, the Microboard reads the opening of these contacts via I/O Board J2-1, initiates a **SYSTEM LOCKOUT DELAY** and displays the appropriate message as described below.

Three **Current Transformers** in the Compressor Motor Terminal Box (ref Fig. 36) provide 3 phase motor current signals to the **Diode Bridge** (DB). The required turns ratio of the Current Transformers is determined by the system 100% FLA. The Diode Bridge rectifies and combines the three signals into one DC signal that is applied to the parallel **Variable Resistors** (RES). These are Factory adjusted (field adjusted on service replacements) to provide a nominal 1.0VDC (0.15 to 1.10VDC) signal to the Current Module at J1-1 and J1-2 when the compressor motor current is at 100% FLA. Fig. 36 contains a formula to calculate the resistance of RES required to achieve 1.0VDC at 100%FLA. The 100% FLA value is located on a label adhered to the inside of the Control Center door.

The motor current signal input at J1-1 & J1-2 is applied to potentiometer R8. This is Factory adjusted (field adjusted on service replacements) to illuminate the 105% CURR indicator (CR6) when the compressor motor current reaches 105% FLA. This calibrated voltage is applied to the **Power Fault** detector, **Overload** detectors and Multiplexer (MUX).

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

If the motor current remains continuously at $\geq 105\%$ FLA for 50 seconds (Nominal), an **OVERLOAD** shutdown is initiated. The **Overload** indicator (CR4) is illuminated and remains illuminated until manually reset with **RESET** switch S2. Relay K1 is de-energized, opening K1 contacts (CM). Relay K1 remains de-energized until manually reset with **RESET** switch S2. A **SYSTEM LOCKOUT DELAY** is initiated and **MOTOR CONTROLLER-CONTACTS OPEN** is displayed. The chiller cannot be started until **RESET** switch S2 is manually pressed.

If the motor current remains continuously at 245% FLA for 40 seconds, 290% FLA for 20 seconds or 360% FLA for 10 seconds, an **OVERLOAD** shutdown is initiated. Relay K1 and **Overload** indicator CR4 operate as described immediately above. A **SYSTEM LOCKOUT DELAY** is initiated and **MOTOR CONTROLLER - CONTACTS OPEN** is displayed. The chiller cannot

be restarted until **RESET** switch is manually pressed. **LRA/FLA** Potentiometer R16 is factory adjusted (field adjusted on service replacements) to the ratio of Locked Rotor Amps to Full Load Amps. The correct setting is determined by dividing the LRA by the FLA. If Switch S1 is in the “Y-Delta/57%” position, there is no 245% FLA threshold. Switch S1 must be positioned according to the type of Electro-Mechanical starter present; **UP** for Y-delta or Autotransformer starters, **DOWN** for Across-the-Line starters.

The Multiplexer (MUX) is an electronic switch with 8 inputs and 1 output. The address applied to it determines the position of the switch (ie, which input is routed to the output). The inputs to channel 0 through 6 are grounded (0VDC). The input to channel 7 is a 0 to 4.0VDC analog signal, representing motor current over the range of 0 to 100% FLA. It is Factory calibrated by Potentiometer R34 to be 4.0VDC when the compressor motor current is at 100% FLA. Under Program control, the Microboard commands the **Mux** to route the inputs to the Mux output by applying 3-bit Binary addresses to the Mux address inputs at J5-1, 2, 3. The voltage level for a logic 1 is +12VDC and logic 0 is 0VDC. The Microboard reads the Mux outputs at J5-6. It first addresses channel 0 to determine the type of starter applied. The 0VDC at channel 0 indicates to the Microboard that this is an Electro-Mechanical Starter application (In all starter applications, the Micro reads channel 0 to determine the type starter applied; 0VDC = EM starter, >0VDC=Solid State Starter). It then addresses channel 7 (ignoring channels 1 through 6) to read the analog motor current voltage. The Microboard interprets this analog value in terms of %FLA and displays it upon operator keypad request. It also uses this value to invoke compressor motor **Current Limit** at 100% FLA and 104% FLA. When motor current rises to 100% FLA, the Microboard prevents any further current rise by inhibiting further Slide Valve loading until it decreases to 98% FLA. If

the motor current continues to rise to 104% FLA, the Microboard applies an unload signal to the Slide Valve until the motor current decreases to 102% FLA. While **Current Limit** is in effect, “**MOTOR - HIGH CURRENT LIMIT**” is displayed.

As detailed in the “System Calibration” section of this book, to field calibrate Potentiometer R8, the slide valve must be manually operated to achieve 105% FLA compressor motor current. Therefore, during this procedure, **Current Limit** is not invoked until 107% FLA and 110% FLA. The first time the **SLIDE VALVE LOAD** key is pressed on the **COMPRESSOR** Screen after logging in at **SERVICE** access level, a 10 minute window is opened, allowing the current to rise to 107% FLA before further slide valve loading 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 an unload signal is applied to the slide valve until the current decreases to 109% FLA. After 10 minutes, the normal current limit thresholds of 100% FLA and 104% FLA are applied.

The Mux address inputs along with respective outputs are as follows:

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

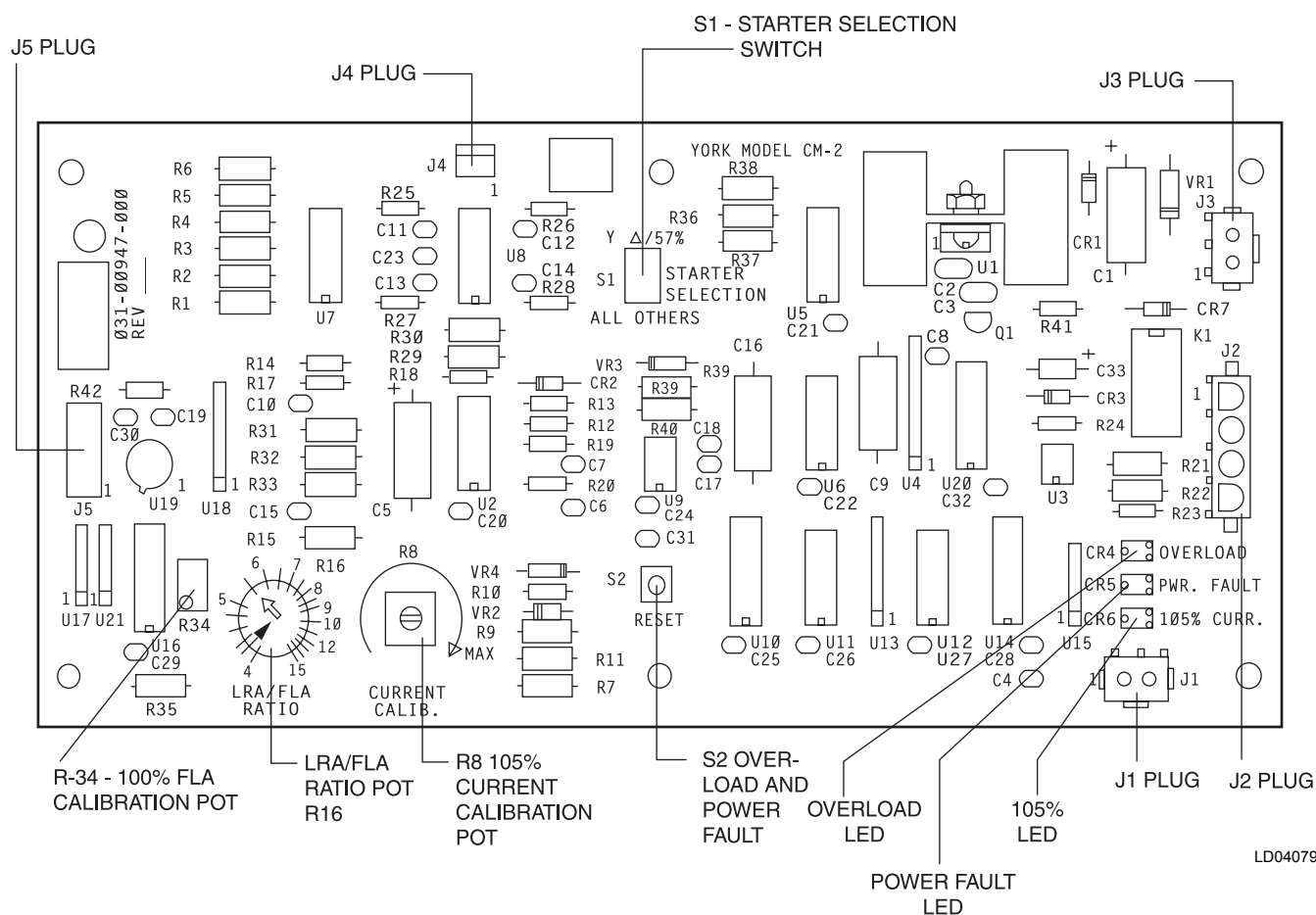


FIG. 34 – CM-2 CURRENT MODULE (ELECTRO-MECHANICAL STARTER APPLICATION)

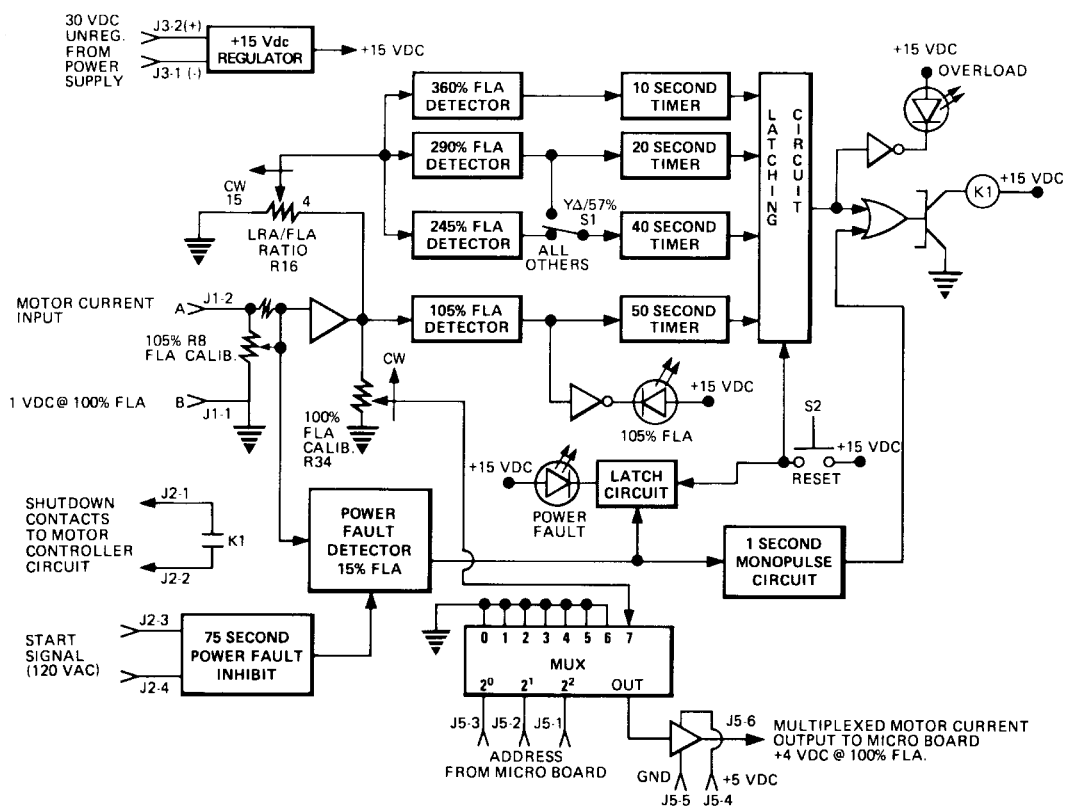
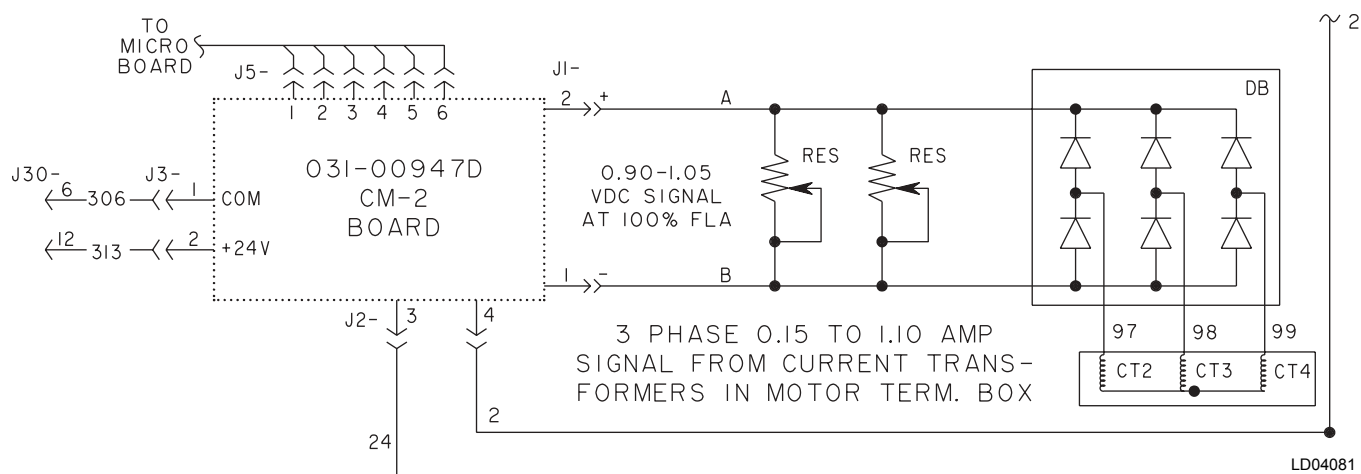


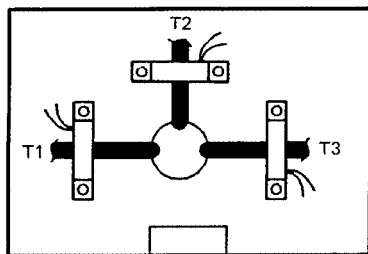
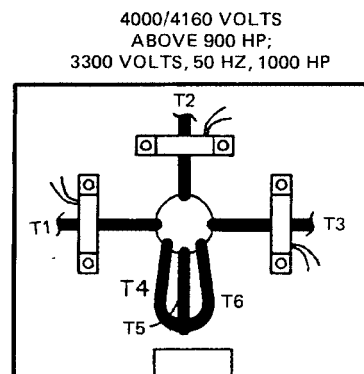
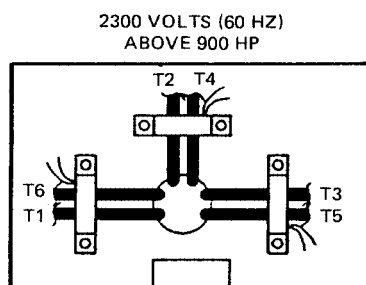
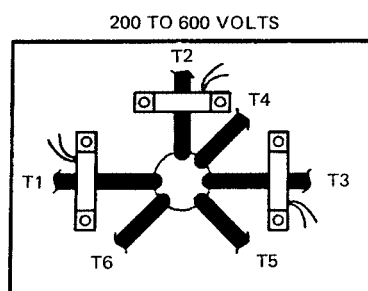
FIG. 35 – CM-2 CURRENT MODULE (ELECTRO-MECHANICAL STARTER APPLICATIONS)



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

NOTES:

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



2300 TO 4160 VOLTS THRU 900 HP;
2300 VOLTS, 50 HZ ABOVE 900 HP;
3000 TO 3300 VOLTS ABOVE 900 HP,
EXCEPT 3300 VOLTS, 50 HZ, 1000 HP

LD04082

FIG. 36 – CM-2 CURRENT MODULE – INTERFACE, CURRENT TRANSFORMERS & VARIABLE RESISTORS

SECTION 11

SOLID STATE STARTERS

(REFER TO FIGS. 37 - 40)

SOLID STATE STARTERS

The Control Center will accommodate either of two different YORK Liquid Cooled Solid State Starters (LCSSS). New production chillers after October 1999, are equipped with the Mod “B” LCSSS. This style LCSSS contains the Silicon Controlled Rectifier (SCR) assemblies, an integrated Logic/Trigger Board and interfaces the Control Center via a serial data communications link and hardwired relay contacts. The Control Center can be retrofit to earlier vintage chillers equipped with the previous version LCSSS that interfaces the Control Center via a multiplexed data interface and hardwired relay contacts. The earlier vintage LCSSS houses the SCR assemblies and Trigger board; a separate Logic Board is located inside the Control Center. Microboard Program Jumper JP39 must be positioned to invoke the appropriate Microboard/Program operation for the starter applied (refer to Table 1).

Mod “B” Serial Interface LCSSS (Refer to Fig. 37)

A complete description, theory of operation and troubleshooting instructions of this LCSSS are contained in YORK Service Manual 160.00-O2. The following describes the interface and interaction of the LCSSS with the Control Center.

As shown in Figure 37, the LCSSS contains a single Logic/Trigger printed circuit board. This board performs the following functions:

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

The Logic/Trigger Board is powered by +24VDC from the Control Center Power Supply. The Control Center Microboard (J15) communicates with this board via a 1200 baud 0/+5VDC serial data communications link. If this communications link does not operate properly, correct Microboard J15 serial port operation can be verified using the Serial Inputs and Outputs diagnostic

procedure in the “Diagnostics and Troubleshooting” section of this book. The **STOP** relay contacts on the Logic/Trigger Board assure a positive shutdown on all LCSSS initiated shutdowns.

After power has been applied to the system, the Microboard will attempt to establish communications with the Logic/Trigger Board. If unsuccessful within 10 attempts, the Microboard initiates a Cycling shutdown and displays “**LCSSS INITIALIZATION FAILED**” on the System Details line of the Control Center display. The Microboard will continue to establish communications until successful. Also, at power-up, the Logic/Trigger Board reads wire jumpers in its connector J1 to determine the LCSSS model applied (refer to 160.00-O2). If an invalid jumper configuration is read, the Logic/trigger Board initiates a Cycling shutdown and “**LCSSS - INVALID CURRENT SCALE SELECTION**” is displayed on the System Details line of the Control Center Display. The model designation is transmitted to the Microboard for display on the **MO-TOR** Screen. This designation determines the allowable range for the Full Load Amps (FLA) Setpoint and Start Current Setpoint. There are 4 LCSSS models: 7L, 14L, 26L and 33L. Each model has an allowable Full Load Amps (FLA) range and Start Current range as listed below.

Communications between the Microboard and Logic/Trigger Board are in the form of master/slave. The Microboard is the master and the Logic/Trigger Board is the slave. The Logic/Trigger Board sends two types of data to the Microboard: Status data and Fault data. After successful initialization, the Microboard sends a data request every 2 seconds. Normally, the Logic/Trigger Board responds to each request. However, if the Microboard does not receive a response to 10 consecutive requests, the Microboard initiates a Cycling shutdown and displays “**LCSSS - SERIAL COMMUNICATIONS**” on the System Details line of the Control Center display. In addition, the Logic/Trigger Board will initiate the same Cycling shutdown if it does not receive a data request from the Microboard after 10 successive attempts to send data.

Anytime the Logic/Trigger Board initiates a Cycling or Safety shutdown, it opens its **STOP** contacts that are

connected in series with the Control Center's 1R (K18) **RUN** relay coil. The contacts remain open as long as the condition exists. The open **STOP** contacts interrupt the circuit to 1R causing it to de-energize, removing the run signal to the LCSSS. Simultaneously, the Microboard reads the opening of the LCSSS STOP contacts via the I/O Board J2- 1. This signals the Microboard that the LCSSS has initiated a shutdown. The Logic/Trigger Board sends the cause of the shutdown in response to the next data request. This is logged on the **HISTORY** Screen as the "**LAST FAULT WHILE RUNNING**". A snapshot of the LCSSS operating parameters valid at the instant of the fault are also sent. Any additional faults that occur within the 2 second transmission time are also sent and logged on the **HISTORY** Screen under "**LAST TEN FAULTS**". Refer to Operation Manual 160.80-O1 for description of all Cycling and Safety shutdown messages. While this data is being sent, "**LCSSS - SHUTDOWN - REQUESTING FAULT DATA**" is displayed on the System Details line of the Control Center display. If fault data is not returned within 2 seconds, the Microboard will continue to send a request at 2 second intervals until the fault data is returned. If none is returned within 10 consecutive requests, it assumes it is not forthcoming and it displays "**LCSSS - STOP CONTACTS OPEN**" on the System Details line of the display.

The chiller can be started if there are no Safety and Cycling conditions. If the temperature of any of the SCR modules are $>110^{\circ}\text{F}$, the LCSSS cooling pump will run and the chiller will be inhibited from starting until the temperature has decreased below 109°F . While this start inhibit is in effect, "**LCSSS - HIGH TEMPERATURE PHASE X - STOPPED**" (where X is phase A, B, or C) is displayed on the System Details line of the display. When the chiller is started, the Control Center sends two start signals simultaneously to the Logic/Trigger Board. One is transmitted via the serial communications link. The other is the closure of 1R (K18) Start relay, applying 115VAC to Logic/Trigger Board TB1-24. If these two signals are not received within 5 seconds of one another, the Logic/Trigger Board initiates a cycling shutdown and "**LCSSS - RUN SIGNAL**" is displayed on the System Details line of the display.

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

- Three-phase motor current
- Three-phase line-to-line motor supply voltage
- Input Power (kW)

- Three-phase SCR module temperature
- Starter model designation

The following are the programmable setpoints associated with the LCSSS. They are programmed on the **MOTOR** Screen. Refer to programming instructions in the "System Calibration, Service Setpoints and Reset Procedures" section of this book.

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

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

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

LCSSS Model	Permissible Start Current Range
7L-46, 58 and 50	310 to 700 Amps
14L- 17, 28, 46, 58 and 50	620 to 1400 Amps
26L- 17, 28, 46, 58 and 50	1150 to 2600 Amps
33L-17, 28, 46 and 50	1460 to 3300 Amps

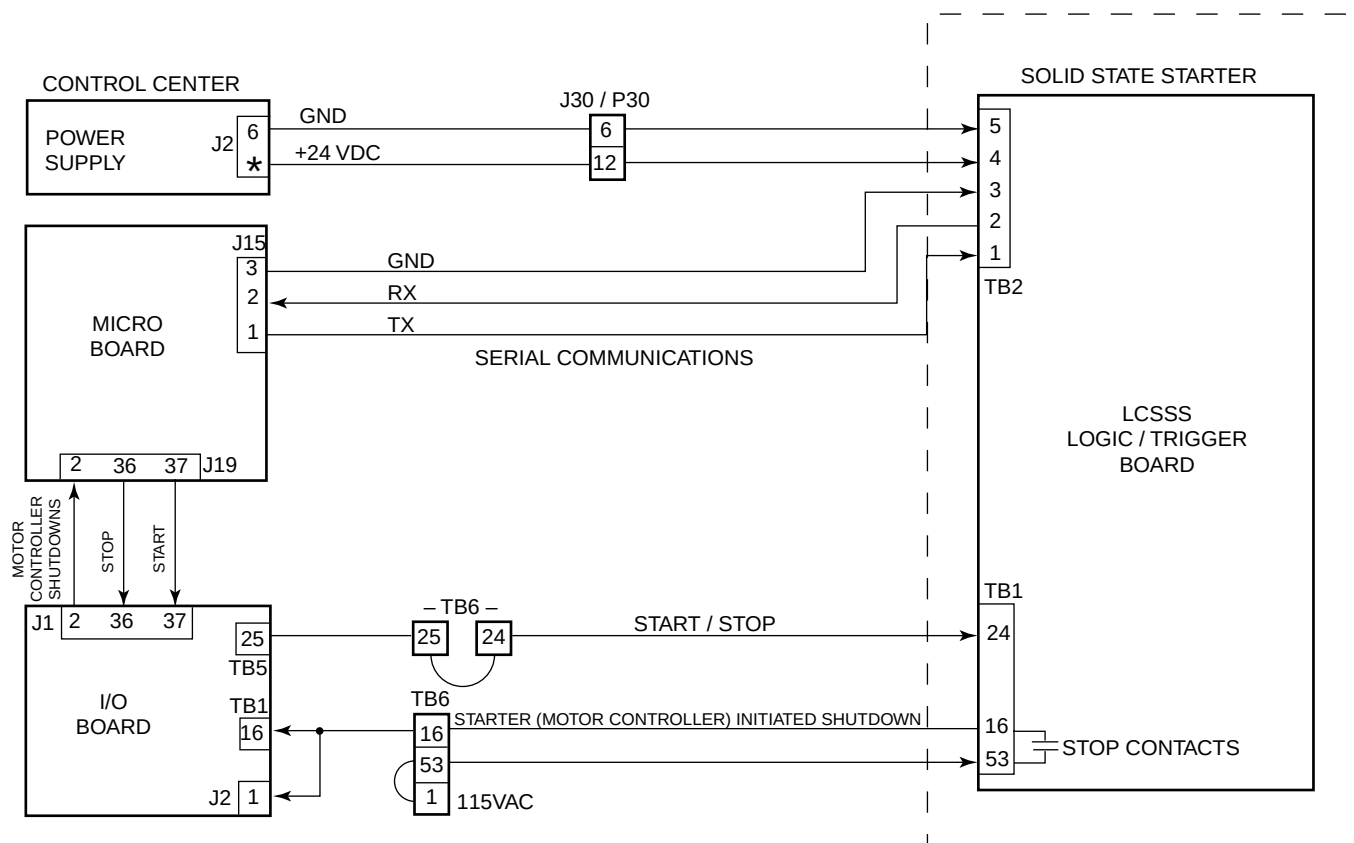
- **Supply Line Voltage Range** - This setpoint is the line voltage application and establishes the high and low line voltage shutdown thresholds. Shutdown and restart thresholds are contained in Operation manual 160.80-O1 under the messages "**LCSSS - LOW SUPPLY LINE VOLTAGE**" and "**LCSSS - HIGH SUPPLY LINE VOLTAGE**".
- **Open SCR Enable/Disable** - This enables or disables the Open SCR detection Safety protection performed by the Logic/Trigger Board. This protection must **never** be disabled unless advised by the YORK factory.

- **Kilowatt Hours (KWH) Reset** - This allows the accumulated KWH to be set to a desired starting value in the event the BRAM has to be field replaced. This must **never** be arbitrarily performed.

To assure the chiller is not permitted to run for extended periods with the supply line voltage outside of acceptable limits, the Logic/Trigger Board compares the actual 3-phase line voltage to the thresholds established with the Supply Line Voltage Range setpoint. Each supply voltage application has an allowable upper and lower limit. If the supply voltage goes above or below these limits continuously for 20 seconds, the logic trigger Board initiates a Cycling shutdown and displays “**LCSSS - HIGH SUPPLY LINE VOLTAGE**” or “**LCSSS - LOW SUPPLY LINE VOLTAGE**” as appropriate. The chiller will automatically restart when the line voltage is within the acceptable range.

While the chiller is running, the Microboard will unload or inhibit loading of the Slide Valve, as required, to limit the compressor motor current to the Current Limit or Pulldown Demand Limit setpoint (30% to 100% FLA) that is in effect. The Microboard calculates the “% Full Load Amps” (FLA) by dividing the highest phase of the 3-phase motor current, received from the Logic/Trigger Board, by the value programmed for the **FULL LOAD AMPS** setpoint. “% **FULL LOAD AMPS**” is displayed on the **MOTOR** Screen. If the motor current increases to the extent that the “% **FULL LOAD AMPS**” reaches 100% of the Current Limit Setpoint, the slide valve is inhibited from further loading until the motor current decreases to $\leq 98\%$ of the Current Limit setpoint. If the motor current increases to the extent that the “% **FULL LOAD AMPS**” is 104% of the Current Limit setpoint, the slide valve will be unloaded until the “% **FULL LOAD AMPS**” decreases to 102% of the Current Limit setpoint. The slide valve loading will then be inhibited until the “% **FULL LOAD AMPS**” decreases to $\leq 98\%$ of the Current Limit setpoint.

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**NOTE:**

9 – “CONDOR” Power Supply; 13 – “POWER ONE” Power Supply

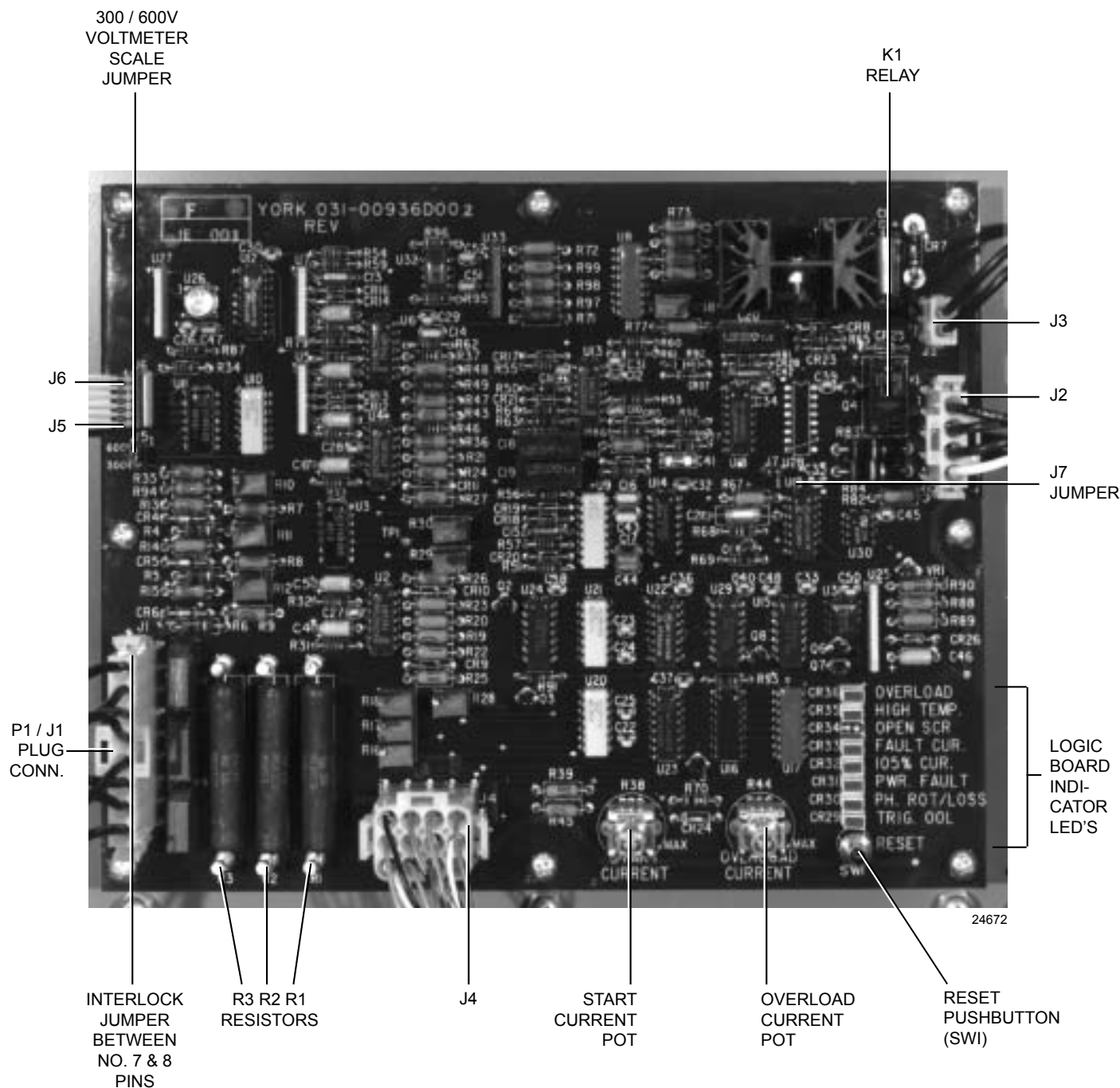
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FIG. 37 – MOD “B” SOLID STATE STARTER (LCSSS) - INTERFACE

Mod "A" Multiplexed Data Interface LCSSS**(Refer to Figs. 38 - 40)**

A complete description, theory of operation and troubleshooting instructions of this LCSSS are contained YORK Service Manual 160.46-OM3. 1.

As shown in Fig. 38, the Logic Board of this model starter is mounted inside the Control Center.

**FIG. 38 – SOLID STATE STARTER LOGIC BOARD**

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

The contacts of Logic Board relay K1 (identified as “CM” contacts on the Control Center wiring diagram) are interfaced into the Motor Controller initiated shutdown circuit that is located between Control Center TB6-53 and I/O Board TB1-16 (ref. Fig. 15 and 36). They are also connected as a digital input to I/O Board J2-1. Relay K1 is normally energized, maintaining its contacts in a closed position. Whenever the Logic Board initiates a chiller shutdown, it de-energizes K1, opening its contacts. This interrupts the circuit to I/O Board RUN relay coil 1R (K18), de-energizing it and causing the Starter to de-energize. Simultaneously, the Microboard reads the opening of these contacts via I/O Board J2-1, initiates a **SYSTEM LOCKOUT DELAY** and displays the appropriate message as described below.

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

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

When a Power line Phase Rotation/Loss or Trigger Board Out of Lock (OOL) condition is detected, Relay K1 contacts open and remain open for as long as the condition exists. If the contacts remain open for more than 3 seconds, **MOTOR CONTROLLER – CONTACTS OPEN** is displayed; if less than 3 seconds,

POWER FAULT is displayed. The respective Ph. Rot/Loss or Trig. OOL LED illuminates and remains illuminated until manually reset with the S1 **RESET** switch. The chiller will automatically restart when the contacts close.

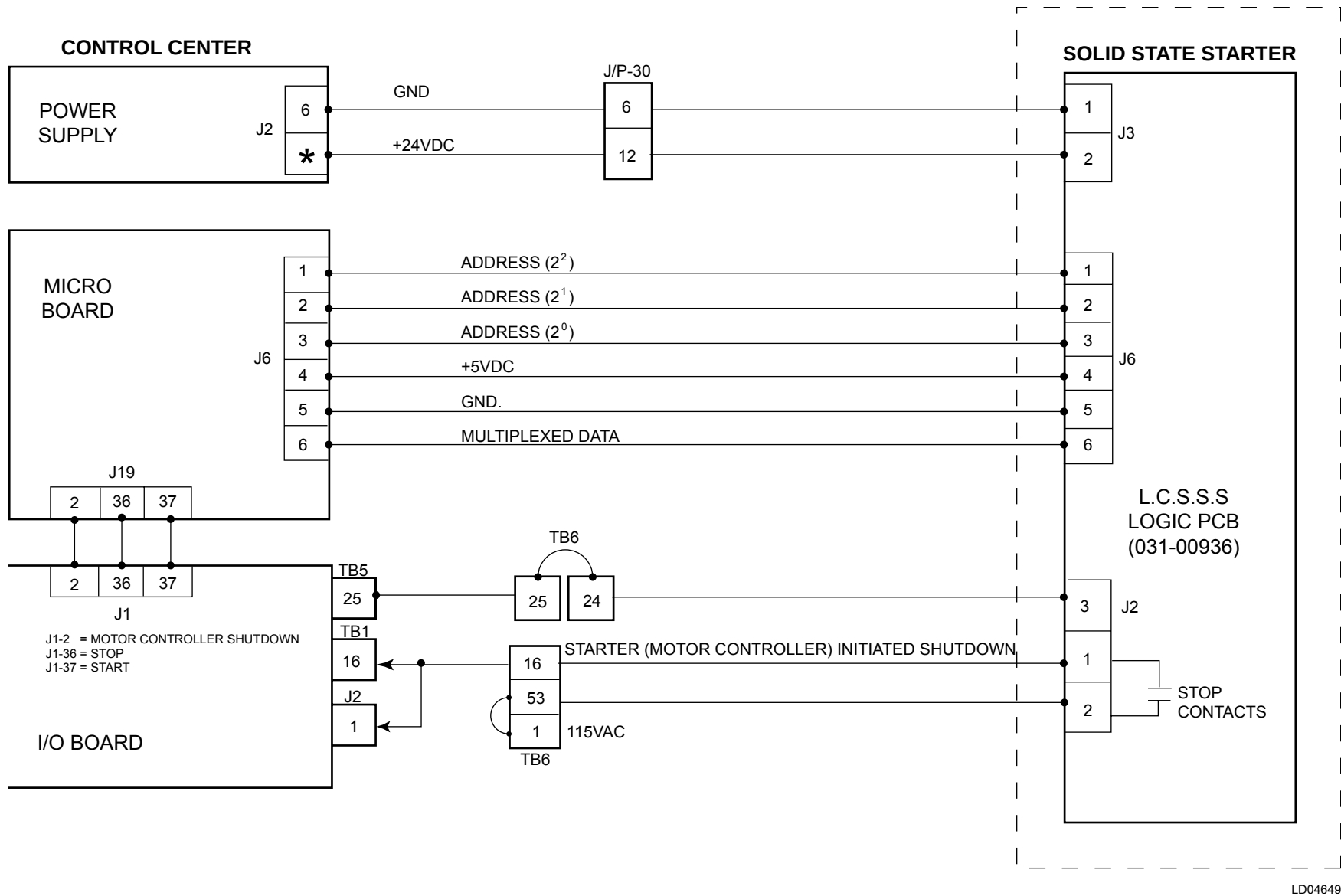
The Starter Trigger Board monitors the Starter’s Silicon Controlled Rectifier (SCR) heatsink temperature. Whenever the heatsink temperature increases to 212°F, the Trigger Board signals the Logic Board. **MOTOR CONTROLLER – CONTACTS OPEN** is displayed. The Logic Board illuminates the **High Temp LED**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

The Multiplexer (MUX) is an electronic switch with 8 inputs and 1 output. The address applied to it determines the position of the switch and therefore the output. Under Program control, the Microboard sequentially addresses MUX channels 0 through 7. The voltage output of each channel is listed in the table below. Channel 0 is an analog voltage that represents the Starter model and Power Line voltage Voltmeter scale. The Program uses this value to limit the Full Load Amps Setpoint range to the maximum allowed value for the Starter size. This value also determines the Line Voltage display range and Motor current display range. Channel 1 is a current limit command that forces the Micro to perform slide valve inhibit and unload at the 100% and 104% FLA. This command is in addition to the Micro’s software current limit feature that’s based on a calculation comparing the highest current phase to the programmed Full Load Amp Setpoint to arrive at an FLA Percentage. Channels 2 through 4 are analog voltages representing Phase C, B

and A Power Line Voltages. Channels 5 through 7 are analog voltages representing Phase A, B and C Compressor Motor Current. The addresses are +12VDC for logic high (1). <1VDC for logic low (0).

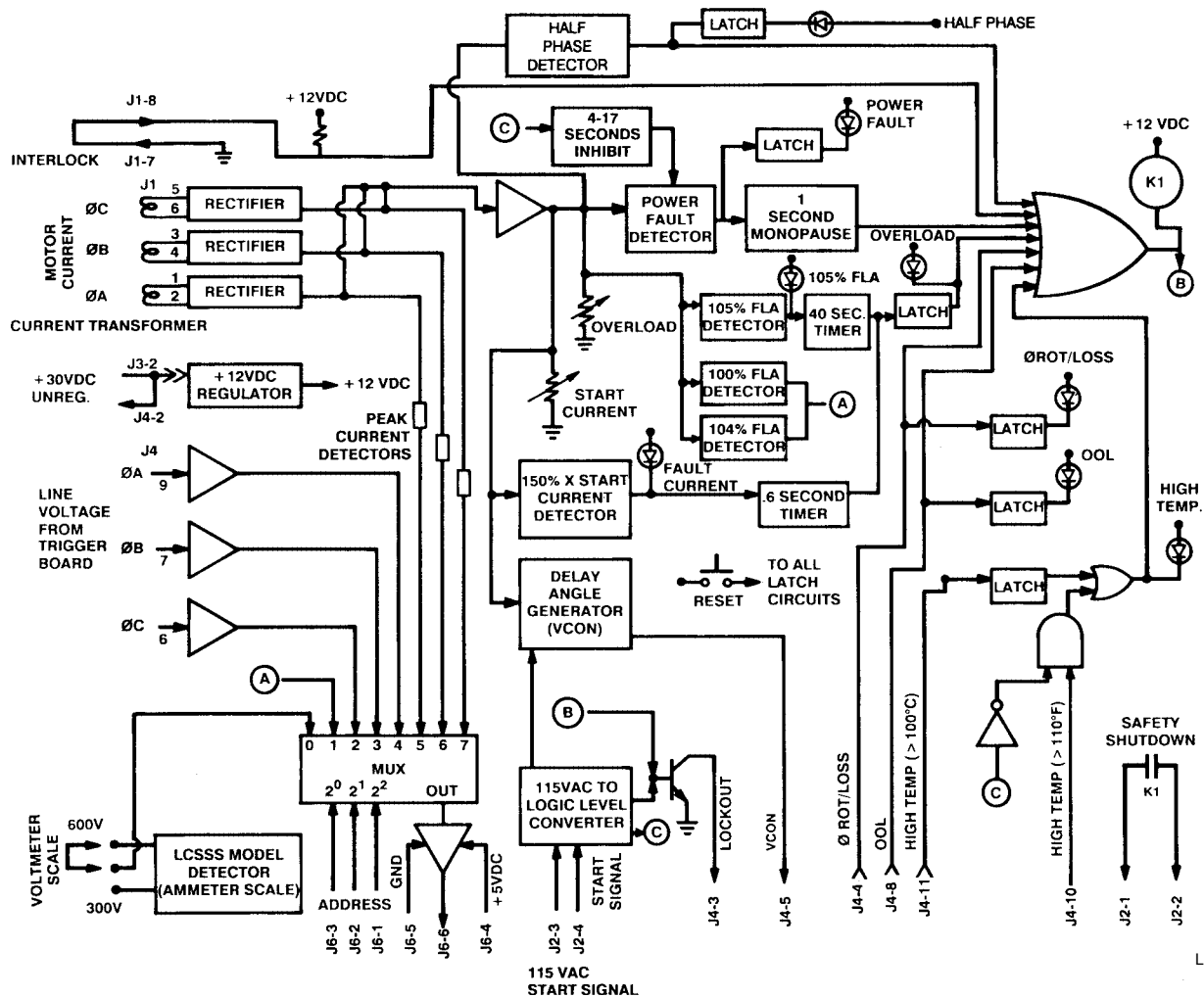
The Logic Board MUX address inputs, along with the respective outputs are as follows:

BINARY			DECIMAL	OUTPUT
J6-1	J6-2	J6-3		
0	0	0	0	Starter Model/Voltmeter/Ammeter full scale, max FLA: 0.41 to 0.77VDC – 7L, 600VAC, max FLA 281, full scale 787A 0.78 to 1.22VDC – 14L, 300VAC, max FLA 551, full scale 1574A 1.23 to 1.76VDC – 14L, 600VAC, max FLA 551, full scale 1574A 1.77 to 2.39VDC – 26L, 300VAC, max FLA 916, full scale 2938A 2.40 to 3.08VDC – 26L, 600VAC, max FLA 916, full scale 2938A 3.09 to 3.87VDC – 33L, 300VAC, max FLA 1134, full scale 3672A 3.88 to 5.00VDC – 33L, 600VAC, max FLA 1134, full scale 3672A
0	0	1	1	Current Limit commands 3.46 to 5.00VDC – <98% FLA 1.21 to 3.45VDC – ≥100% FLA 0.0 to 1.20VDC – ≥104% FLA
0	1	0	2	Phase "C" AC Power Line voltage as follows: 300VAC scale = $VDC(out) = \frac{VAC}{67.9}$ 600VAC scale = $VDC(out) = \frac{VAC}{135.8}$
0	1	1	3	Phase "B" AC Power Line voltage. Same as Phase "C" above.
1	0	0	4	Phase "A" AC Power Line voltage Same as Phase "C" above.
1	0	1	5	Phase "A" Compressor Motor Current. 0 to +5VDC spanning range in address 0 above.
1	1	0	6	Phase "B" Compressor Motor Current. 0 to +5VDC spanning range in address 0 above.
1	1	1	7	Phase "C" Compressor Motor Current. 0 to +5VDC spanning range in address 0 above.

**NOTES:**

- * 9 on "CONDOR" Power Supply
- 13 on "POWER ONE" Power Supply

87 **FIG. 39 – MOD "A" LIQUID COOLED SOLID STATE STARTER (LCSSS) - INTERFACE**



LD04083

FIG. 40 – MOD "A" SOLID STATE STARTER LOGIC BOARD

SECTION 12

VARIABLE ORIFICE CONTROL

A solenoid valve (2SOL), located in a line parallel with the refrigerant orifice, is opened and closed to create a variable orifice. Opening the parallel line allows a greater refrigerant flow to the evaporator. The solenoid valve is driven from the I/O Board TB1-29. Under Program control, it is energized to open the parallel line and de-energized to close the parallel line.

When the chiller is not running, the solenoid valve is opened during the 2-minute “SYSTEM LOCKOUT DELAY”, closed thereafter. During run, the Solenoid Valve is primarily controlled by DELTA P control. However, Low Evaporator Pressure and Discharge Superheat conditions can override DELTA P control as explained below.

During run, the solenoid valve is opened and closed per the **DELTA P** Setpoint that has been programmed by a qualified Service Technician. The setpoint is programmed over the range of 25 to 150 PSIG (R22) or 15 to 110 PSIG (R134a). The system Delta P is the differential between the condenser and evaporator pressure, calculated as $\Delta P = \text{condenser pressure} - \text{evaporator pressure}$. If the system Delta P decreases to $\leq$ the DELTA P setpoint, the solenoid valve is opened. It will remain open until the system Delta P increases to (DELTA P Setpoint + 10), whereupon it will close.

If the evaporator pressure decreases to the Low Evaporator Pressure Warning threshold of 56.2 PSIG (R22) or

27.0 PSIG (R134a), DELTA P control is overridden and the solenoid valve is opened. While this condition is in effect, “WARNING - EVAPORATOR – LOW PRESSURE LIMIT” is displayed and the **Low Evaporator Pressure Override** LED is illuminated on the Variable Orifice Control Screen. The solenoid will remain open until the Low Pressure limit condition is no longer in effect (≥ 57.5 PSIG R22; ≥ 28.0 PSIG R134a, whereupon the Low Pressure override is released.

If the Discharge Superheat (Discharge temp – Condenser Saturation temp) is $< 15.0^\circ\text{F}$ (R22) or $< 10.0^\circ\text{F}$ (R134a), DELTA P control or any Low Evaporator Pressure override (as explained above) that is in effect is overridden and the solenoid valve is closed. While this condition is in effect, the **Superheat Override** LED is illuminated. The solenoid valve will remain closed until the Discharge Superheat increases to $\geq 20.0^\circ\text{F}$ (R22) or $\geq 15.0^\circ\text{F}$ (R134a), whereupon the Discharge Superheat override is released.

The Variable Orifice Control Screen, accessed from the CONDENSER Screen in SERVICE access level, displays all of the applicable Variable Orifice control parameters and allows a Service technician to program the DELTA P Setpoint. The Low Evaporator Pressure and Superheat Override LEDs are located on this screen.

SECTION 13

MICROGATEWAY

(REFER TO FIG. 41)

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

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

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

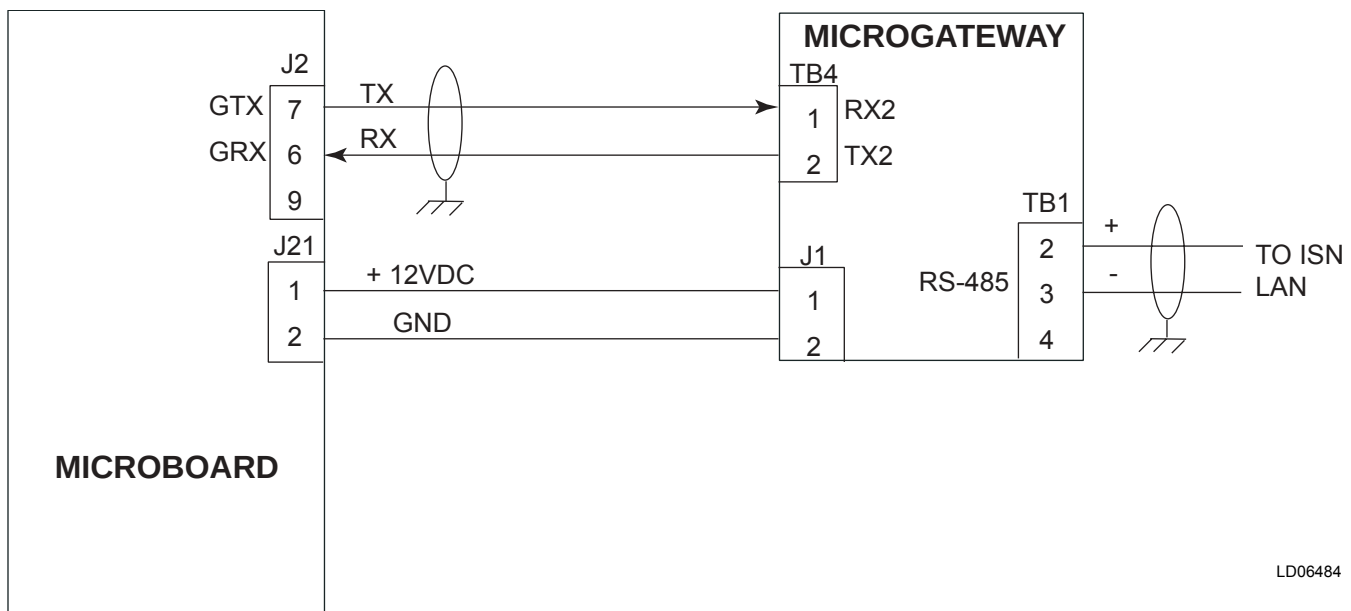
The MicroGateway communicates with the Microboard COM 4B communications port via an RS-232 interface (ref. Fig. 41). As shown in Figure 9, Microboard Program Jumper JP 27 must be placed on pins 2 and 3 to allow data to be received from the MicroGateway.

If the remote device that is connected to the MicroGateway is going to provide remote Start-Stop signals, remote Leaving Chilled Liquid Temperature and/or remote Current Limit Setpoint resets, the Control Source must

be set to ISN on the OPERATIONS Screen. Otherwise, communications will take place in any Control Source mode.

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

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



LD06484

FIG. 41 – MICROGATEWAY INTERFACE BLOCK DIAGRAM

SECTION 14

PRESSURE TRANSDUCERS

(REFER TO FIG. 42)

System pressures are sensed by Pressure Transducers. There are different transducers used to sense the various system pressures. The actual transducer used is determined by the required pressure range and refrigerant application. The operation of the various transducers is identical. The difference between them is simply the pressure range over which they operate. Each of the different transducers has a different YORK part number. Figure 44 lists the transducers and the application of each one. The Transducers are as follows:

Pressure Transducer	Location	Pressure Sensed
Evaporator	Evaporator	Evaporator
Condenser	Condenser	Condenser
Filter Oil	Separator	Oil Filter Input
Oil	Compressor SB-2	Compressor oil input / Oil Filter output
Seal Oil	Compressor SB-3	Seal oil

The output of each transducer is displayed on the appropriate screen as a discrete pressure value in terms of PSIG (pounds per square inch gauge) in English mode or KpaG (Kilo Pascals) in Metric mode. In addition, some pressure values are subtracted from other pressure values to create “differential” pressures displayed as PSID (pounds per square inch differential, in either PSIG or KpaG). These differential pressures are as follows:

“Differential Oil Pressure” =
Oil Pressure – Evaporator Pressure

“Differential Filter pressure” =
Filter Oil Pressure – Oil Pressure

“Differential Seal Pressure” =
Seal Oil Pressure – Evaporator Pressure

To compensate for transducer differences and assure differential pressure accuracy, the transducers that are involved in the creation of a differential value are compared in a process called **Auto-Zeroing**. During the first 15 seconds of the “Start Sequence Initiated” period, the output of both transducers that are creating the dif-

ferential value are compared to determine the offset between them. Since system pressures should be equalized during this period, both transducers will be sensing the same pressure and their outputs should indicate the same pressure. However, due to accuracy tolerances in transducer design, differences can exist. Therefore, to compensate for differences between transducers and assure differential pressure accuracy, this offset is added or subtracted from the actual differential pressure, at completion of the Auto-zeroing period, to produce the displayed PSID value. The displayed differential value is the actual differential value plus or minus the offset that existed during the Auto-zeroing period. For example, if the Oil Pressure Transducer indicates 1.0 PSIG greater than the Evaporator Transducer during the Auto-zeroing period, then 1.0 PSIG will be subtracted from the displayed PSID value during “System Run”. Similarly, if the Oil Pressure Transducer indicates 1.0 PSIG less than the Evaporator Transducer during this period, then 1.0 PSIG is added to the displayed value during “System Run”.

The Auto Zeroing feature can be Enabled or Disabled following a procedure in the “System calibration, Service Setpoints and Reset Procedures” section of this book. Normally, the Auto Zeroing feature should be Enabled. However, certain local conditions could require the Auto-Zeroing feature be disabled. For example, standby chillers, configured in series or parallel piping arrangements, can experience large evaporator/condenser pressure differentials while not running. This differential is created by the cold evaporator chilled liquid and/or warm condenser water from the running chiller flowing through the standby chiller. The existence of this differential during the Auto Zeroing period produce large artificial offsets that are not a result of transducer tolerances. Therefore, in these installations, the Auto Zeroing should be Disabled.

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

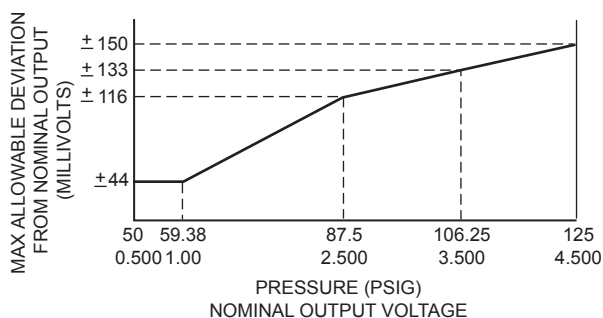
The transducers output a 0.5 to 4.5VDC voltage that is analogous to the pressure applied to the device. These outputs are applied to the Microboard, where this voltage is interpreted as a pressure value. The Program converts the transducer output voltage to a pressure value with the appropriate formula in Figure 42. The pressures are displayed and used for Chiller control and Safety shutdowns.

The transducers operate from a +5VDC power source. This supply voltage is provided from the Power supply via the Microboard. Each transducer is connected to the Microboard with three wires. Two wires provide the +5VDC supply voltage and Ground (Gnd) and the remaining wire connects the transducer output to the Microboard. The voltage output of each transducer can be measured with a Voltmeter at the Microboard. Measurement should be made from the transducer output to Ground (Gnd). For example, the output of the Condenser transducer would be read from Microboard

J8-21 (signal) to J8-22 (Gnd). To convert this output to a pressure, refer to the appropriate formula in Figure 42. If the pressure is known, the transducer output can be predicted with the appropriate formula in Figure 42.

New production chillers are equipped with the Seal Oil Pressure Transducer. Previous vintage chillers, such as those encountered in retrofit applications are not equipped with this transducer. Therefore, Seal Oil Pressure Transducer operation must be Enabled or Disabled as required for the application. This procedure is in the “System Calibration, Service Setpoints and Reset Procedures” section of this book.

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



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

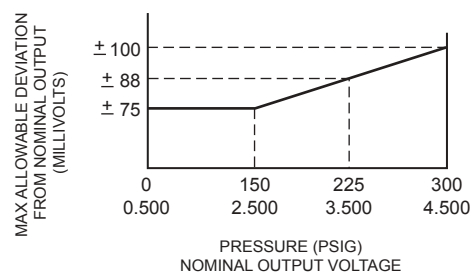
$$V = \frac{(P \times 4) - 162.5}{75}$$

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

V = VOLTS DC

P = PRESSURE (PSIG)

LD04994



PRESSURE TRANSDUCER
YORK PART NO. 025-28678-006

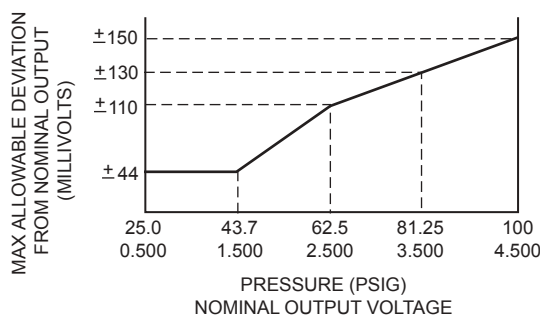
$$V = \frac{P + 37.5}{75}$$

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

V = VOLTS DC

P = PRESSURE (PSIG)

LD04995



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

$$V = \frac{P - 15.6}{18.75}$$

$$P = 18.75 \times V + 15.6$$

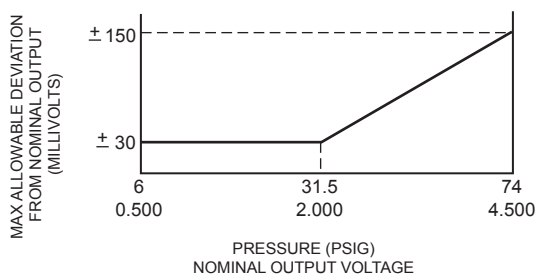
V = VOLTS DC

P = PRESSURE (PSIG)

LD04996

PRESSURE TRANSDUCER APPLICATIONS CHART

TRANSDUCER PART NUMBER	FUNCTION	R22 APPLICATION	
		WATER	BRINE
025-28678-006	CONDENSER, OIL, FILTER, SEAL	X	X
025-28678-113	EVAPORATOR	X	
025-28678-114	EVAPORATOR		X
R134a			
025-28678-006	CONDENSER, OIL FILTER, SEAL	X	X
025-28678-112	EVAPORATOR	X	X



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

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

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

V = VOLTS DC

P = PRESSURE (PSIG)

LD04102



**All transducers have
straight threads with neo-
prene O-rings.**

FIG. 42 – PRESSURE TRANSDUCERS

SECTION 15

TEMPERATURE THERMISTORS

(REFER TO FIG. 43 - 47)

System temperatures are sensed by **Thermistors**. There are two different thermistor types used to sense the various system temperatures. Each type has its own YORK part number. Part numbers are listed in YORK Renewal Parts List 160.80-RP3. The Return and Leaving Chilled Water, Return and Leaving Condenser Water, Condenser Liquid, and Evaporator Refrigerant Temperatures are sensed by 3K Ohm thermistors. The Oil and Compressor Discharge temperatures are sensed by 50K Ohm thermistors.

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

The thermistors are connected to the Microboard. A +5VDC supply voltage is applied to one side of the thermistor. The other side of the thermistor is connected to Ground through a series resistor on the Microboard, thus forming a voltage divider network. The temperature applied to the thermistor determines the resistance value. The resistance value determines the amount of current

that will flow through the thermistor and thus the voltage drop across it. The Program reads this voltage at the input to the Microboard and converts it to a temperature value.

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

- Leaving Chilled Liquid Temperature – Fig. 43
- Return Chilled Liquid Temperature – Fig. 44
- Leaving and Return Condenser Liquid Temperature – Fig. 45
- Oil and Discharge Temperature – Fig. 46
- Evaporator Refrigerant Temperature – Fig. 47

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

FIG. 43 – LEAVING CHILLED LIQUID TEMPERATURE

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

FIG. 43 – LEAVING CHILLED LIQUID TEMPERATURE (CONT'D)

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

FIG. 43 – LEAVING CHILLED LIQUID TEMPERATURE (CONT'D)

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

FIG. 43 – LEAVING CHILLED LIQUID TEMPERATURE (CONT'D)

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

FIG. 43 – LEAVING CHILLED LIQUID TEMPERATURE (CONT'D)

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

FIG. 44 – RETURN CHILLED LIQUID TEMPERATURE

Temp (°F)	Temp (°C)	Vin	Temp (°F)	Temp (°C)	Vin	Temp (°F)	Temp (°C)	Vin
15.01	-9.44	1.5918	23.03	-4.98	1.8604	30.78	-0.68	2.1289
15.16	-9.36	1.5967	23.17	-4.91	1.8652	30.92	-0.60	2.1338
15.31	-9.27	1.6016	23.31	-4.83	1.8701	31.06	-0.52	2.1387
15.46	-9.19	1.6064	23.45	-4.75	1.8750	31.20	-0.44	2.1436
15.61	-9.11	1.6113	23.60	-4.67	1.8799	31.34	-0.37	2.1484
15.76	-9.02	1.6162	23.74	-4.59	1.8848	31.48	-0.29	2.1533
15.91	-8.94	1.6211	23.88	-4.51	1.8896	31.62	-0.21	2.1582
16.05	-8.86	1.6260	24.02	-4.43	1.8945	31.76	-0.13	2.1631
16.20	-8.78	1.6309	24.16	-4.36	1.8994	31.90	-0.06	2.1680
16.35	-8.70	1.6357	24.31	-4.27	1.9043	32.04	0.02	2.1729
16.50	-8.61	1.6406	24.45	-4.19	1.9092	32.18	0.10	2.1777
16.64	-8.53	1.6455	24.59	-4.12	1.9141	32.32	0.18	2.1826
16.79	-8.45	1.6504	24.73	-4.04	1.9189	32.46	0.26	2.1875
16.94	-8.37	1.6553	24.87	-3.96	1.9238	32.60	0.33	2.1924
17.09	-8.28	1.6602	25.01	-3.88	1.9287	32.74	0.41	2.1973
17.23	-8.21	1.6650	25.16	-3.80	1.9336	32.88	0.49	2.2021
17.38	-8.12	1.6699	25.30	-3.72	1.9385	33.02	0.57	2.2070
17.53	-8.04	1.6748	25.44	-3.64	1.9434	33.16	0.64	2.2119
17.68	-7.96	1.6797	25.58	-3.57	1.9482	33.30	0.72	2.2168
17.82	-7.88	1.6846	25.72	-3.49	1.9531	33.44	0.80	2.2217
17.97	-7.80	1.6895	25.86	-3.41	1.9580	33.59	0.88	2.2266
18.11	-7.72	1.6943	26.00	-3.33	1.9629	33.73	0.96	2.2314
18.26	-7.63	1.6992	26.14	-3.26	1.9678	33.87	1.04	2.2363
18.41	-7.55	1.7041	26.28	-3.18	1.9727	34.01	1.12	2.2412
18.55	-7.47	1.7090	26.42	-3.10	1.9775	34.15	1.19	2.2461
18.70	-7.39	1.7139	26.56	-3.02	1.9824	34.29	1.27	2.2510
18.84	-7.31	1.7188	26.71	-2.94	1.9873	34.43	1.35	2.2559
18.99	-7.23	1.7236	26.85	-2.86	1.9922	34.57	1.43	2.2607
19.13	-7.15	1.7285	26.99	-2.78	1.9971	34.71	1.51	2.2656
19.28	-7.07	1.7334	27.13	-2.71	2.0020	34.85	1.58	2.2705
19.43	-6.98	1.7383	27.27	-2.63	2.0068	34.99	1.66	2.2754
19.57	-6.91	1.7432	27.41	-2.55	2.0117	35.13	1.74	2.2803
19.71	-6.83	1.7480	27.55	-2.47	2.0166	35.27	1.82	2.2852
19.86	-6.74	1.7529	27.70	-2.39	2.0215	35.41	1.89	2.2900
20.00	-6.67	1.7578	27.84	-2.31	2.0264	35.55	1.97	2.2949
20.15	-6.58	1.7627	27.98	-2.23	2.0313	35.69	2.05	2.2998
20.29	-6.51	1.7676	28.12	-2.16	2.0361	35.83	2.13	2.3047
20.44	-6.42	1.7725	28.26	-2.08	2.0410	35.97	2.21	2.3096
20.58	-6.34	1.7773	28.40	-2.00	2.0459	36.11	2.28	2.3145
20.73	-6.26	1.7822	28.54	-1.92	2.5058	36.25	2.36	2.3193
20.87	-6.18	1.7871	28.68	-1.84	2.0557	36.39	2.44	2.3242
21.01	-6.11	1.7920	28.82	-1.77	2.0605	36.53	2.52	2.3291
21.16	-6.02	1.7969	28.96	-1.69	2.0654	36.67	2.59	2.3340
21.30	-5.94	1.8018	29.10	-1.61	2.0703	36.81	2.67	2.3389
21.45	-5.86	1.8066	29.24	-1.53	2.0752	36.95	2.75	2.3438
21.59	-5.78	1.8115	29.38	-1.46	2.0801	37.09	2.83	2.3486
21.73	-5.71	1.8164	29.52	-1.38	2.0850	37.23	2.91	2.3535
21.88	-5.62	1.8213	29.66	-1.30	2.0898	37.37	2.98	2.3584
22.02	-5.54	1.8262	29.80	-1.22	2.0947	37.51	3.06	2.3633
22.17	-5.46	1.8311	29.94	-1.14	2.0996	37.66	3.14	2.3682
22.31	-5.38	1.8359	30.08	-1.07	2.1045	37.80	3.22	2.3730
22.45	-5.31	1.8408	30.22	-0.99	2.1094	37.94	3.30	2.3779
22.60	-5.22	1.8457	30.36	-0.91	2.1143	38.08	3.38	2.3828
22.74	-5.14	1.8506	30.50	-0.83	2.1191	38.22	3.46	2.3877
22.88	-5.07	1.8555	30.64	-0.76	2.1240	38.36	3.53	2.3926

FIG. 44 – RETURN CHILLED LIQUID TEMPERATURE (CONT'D)

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

FIG. 44 – RETURN CHILLED LIQUID TEMPERATURE (CONT'D)

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

FIG. 45 – RETURN AND LEAVING CONDENSING WATER

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

FIG. 45 – RETURN AND LEAVING CONDENSING WATER (CONT'D)

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

FIG. 45 – RETURN AND LEAVING CONDENSING WATER (CONT'D)

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

FIG. 46 – OIL AND DISCHARGE TEMPERATURE

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

FIG. 46 – OIL AND DISCHARGE TEMPERATURE (CONT'D)

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

FIG. 46 – OIL AND DISCHARGE TEMPERATURE (CONT'D)

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

FIG. 46 – OIL AND DISCHARGE TEMPERATURE (CONT'D)

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

FIG. 46 – OIL AND DISCHARGE TEMPERATURE (CONT'D)

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

FIG. 47 – EVAPORATOR REFRIGERANT SENSOR

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

SECTION 16

REMOTE SETPOINTS

(SEE FIGS. 10, 11 & 12)

There are three different **Remote** operating Modes that can be selected at the Keypad: **Analog** Remote mode, **Digital** Remote Mode or **ISN** Remote Mode.

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

Analog Remote Mode

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

Digital Remote Mode

- Pulse Width Modulation (PWM) Input

ISN Remote Mode

- RS-232 Serial Port via MicroGateway

The Analog inputs are connected to the Microboard J22 as shown in Fig. 10 and described below. Microboard Program Jumpers JP23 and JP24 must be positioned appropriately to receive either a 0-10VDC, 2-10VDC, 0-20mA or a 4-20mA signal. Refer to Table 1 “Microboard Program Jumpers” and for required configurations.

The PWM inputs are in the form of a 1 to 11 second Relay contact closure that applies 115VAC to the I/O Board TB4-19 (Leaving Chilled Liquid Temp) and TB4-20 (Remote Current Limit) for 1 to 11 seconds. Refer to Fig. 14. The source of 115VAC is I/O Board TB4-1. The PWM input must be received at a frequency of at least once every 30 minutes. If not received within this time interval, the Program assumes the remote device is defective and defaults the Current Limit Setpoint to 100% and the Leaving Chilled Liquid Temperature Setpoint to the locally programmed Local **BASE** value.

The Microboard COM 4B RS-232 Serial Port (J2) receives the Setpoints in serial data form from the MicroGateway located inside the Control Center enclosure. The MicroGateway receives Setpoints from remote external devices and transfers them to the Microboard.

CURRENT LIMIT

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

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



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

0-10VDC

As shown in Fig. 10, connect input to Microboard J22-1 (signal) and J22-5 (Gnd). The setpoint varies linearly from 100% to 30% FLA as the input varies from 0 to 10VDC. This input will only be accepted when **ANALOG** Remote Mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10

Volts and Microboard Program Jumper JP23 has been removed. Calculate the Setpoint for various inputs as follows:

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

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

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

2-10VDC

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

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

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

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

0-20mA

As shown in Fig. 11, connect input to Microboard J22-2 (signal) and J22-5 (Gnd). The Setpoint varies linearly from 100% to 30% FLA as the input varies from 0mA to 20mA. This input will only be accepted when **ANALOG** remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10 Volts” and Microboard Program Jumper JP23 has been placed on pins 1 and 2. Calculate the Setpoint for various inputs as follows:

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

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

$$\begin{aligned}\text{Setpoint (\%)} &= 100 - (8 \times 3.5) \\ &= 100 - 28 \\ &= 72\% \\ &= 74\%\end{aligned}$$

4-20mA

As shown in Fig. 11, connect input to Microboard J22-2 (signal) and J22-5 (Gnd). The Setpoint varies linearly from 100% to 30% FLA as the input varies from 4mA to 20mA. This input will only be accepted when **ANALOG** remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “2-10 Volts” and Microboard Program Jumper JP23 has been placed on pins 1 and 2. Calculate the Setpoint for various inputs as follows:

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

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

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

PWM

The Pulse Width Modulation input is in the form of a 1 to 11 second relay contact closure that applies 115VAC to the I/O Board TB4-20 for 1 to 11 seconds. As shown in Fig. 14, connect dry closure relay contacts between I/O Board TB4-20 (signal) and TB4-1 (115VAC). The setpoint varies linearly from 100% to 30% as the relay contact closure time changes from 1 to 11 seconds. The relay contacts should close for 1 to 11 seconds at least once every 30 minutes to maintain the setpoint to the desired value. If a 1 to 11 second closure is not received within 30 minutes of the last closure, the setpoint is defaulted to 100%. A closure is only accepted at rates not to exceed once every 70 seconds. This input will only be accepted in **DIGITAL** remote mode. Calculate the Setpoint for various inputs as follows:

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

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

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

RS-232

As shown in Fig. 9, a setpoint can be received in serial data form at Microboard J2 from the GPIC.

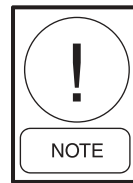
LEAVING CHILLED LIQUID TEMPERATURE**REMOTE LEAVING CHILLED LIQUID TEMPERATURE SETPOINT with 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or Pulse Width Modulation Signal**

Remote Leaving Chilled Liquid Temperature setpoint reset can be accomplished by supplying (by others) a 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or 1 to 11 second Pulse Width Modulated (PWM) signal to the Control Center. The **LEAVING CHILLED LIQUID TEMPERATURE** setpoint is programmable over the range of 38°F to 70°F (water applications); 36°F to 70°F (water applications with Smart Freeze protection enabled); or 20°F to 70°F (brine applications). The Remote input signal changes the setpoint by creating an offset above the locally programmed Leaving Chilled Liquid Temperature Base setpoint value. The setpoint can be remotely changed over the range of 10, 20, 30 or 40°F (as per the locally programmed **REMOTE RESET TEMPERATURE RANGE** setpoint) above the Local Leaving Chilled Liquid Temperature Setpoint. For example, if the Local setpoint is 40°F and the **REMOTE RESET TEMPERATURE RANGE** setpoint is programmed for 10°F, the Leaving Chilled Liquid Temperature setpoint can be remotely reset over the range of 40°F to 50°F. The setpoint received through the COM 4B RS-232 serial port is not an offset that is applied to the locally programmed **BASE** value as described above. Rather, it is an actual Setpoint value. The locally programmed value is not used as a **BASE** in this application.

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

- The appropriate Remote Mode must be selected: **ANALOG** Remote Mode must be selected when using a voltage or current signal input. **DIGITAL** Remote Mode must be selected when using a PWM input.
- If **ANALOG** Remote Mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint must be set to "0-10VDC" or "2-10VDC" as detailed below, regardless of whether the signal is a voltage or current signal type.
- Microboard Program Jumper JP24 must be positioned appropriately per the input signal type

as detailed below. It is recommended a qualified Service Technician position this jumper.



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

0-10VDC - As shown in Fig. 10, connect input to Microboard J22-3 (signal) and J22-5 (Gnd). A 0VDC signal produces a 0°F offset. A 10VDC signal produces the maximum offset (10, 20, 30 or 40°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies linearly over the range of 0VDC to 10VDC. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for "0-10VDC" and Microboard Program Jumper JP24 has been removed. Calculate the Setpoint for various inputs as follows:

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

$$\text{Setpoint (°F)} = \text{Locally programmed BASE value} + \text{Offset}$$

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

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

2-10VDC

As shown in Fig. 12, connect input to Microboard J22-3 (signal) and J2-5 (Gnd). A 2VDC signal produces a 0°F offset. A 10VDC signal produces the maximum allowed

offset (10, 20, 30 or 40°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies over the range of 2VDC to 10VDC. This input will only be accepted when **ANALOG** remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “2-10VDC” and the Microboard Program Jumper JP24 has been removed. Calculate the setpoint for various inputs as follows:

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

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

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

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

0-20mA

As shown in Fig. 12, connect input to Microboard J22-4 (signal) and J22-5 (Gnd). A 0mA signal produces a 0°F offset. A 20mA signal produces the maximum allowed offset (10, 20, 30 or 40°F above the Local setpoint value). The setpoint is changed linearly between these extremes as the input varies over the range of 0-20mA. This input will only be accepted when **ANALOG** remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10VDC” and Microboard Program Jumper J24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

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

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

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

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

$$\begin{aligned} \text{Setpoint (°F)} &= 40 + 4 \\ &= 44^\circ\text{F} \end{aligned}$$

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

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

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

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

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

$$\begin{aligned} \text{Setpoint (°F)} &= 40 + 2.5 \\ &= 42.5 \end{aligned}$$

PWM

The Pulse Width Modulation input is in the form of a 1 to 11 second relay contact closure that applies 115VAC to the I/O Board TB4-19 for 1 to 11 seconds. As shown in Fig. 14, connect dry closure relay contacts between I/O Board TB4-19 (input) and TB4-1 (115VAC). A contact closure time (pulse width) of 1 second produces a 0°F offset. An 11 second closure produces the maximum allowed offset (10 , 20, 30 or 40°F above the Local Setpoint value). The relay contacts should close for 1 to 11 seconds at least once every 30 minutes to maintain the setpoint to the desired value. If a 1 to 11 second closure is not received within 30 minutes of the last closure, the setpoint is defaulted to the Local setpoint value. A closure is only accepted at rates not to exceed once every 70 seconds. This input will only be accepted in **DIGITAL** Remote mode. Calculate the setpoint for various pulse widths as follows:

$$\text{Offset (°F)} =$$

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

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

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

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

$$\begin{aligned} \text{Setpoint (°F)} &= 40 + 4 \\ &= 44^\circ\text{F} \end{aligned}$$

RS-232 - As shown in Fig. 9, a Setpoint can be received in serial data form at the Microboard COM 4B serial port (J2) from the MicroGateway.

SECTION 17

HOT GAS BYPASS

The optional Hot Gas Bypass diverts hot gas directly from the Oil Separator to the Evaporator, bypassing the Condenser. Solenoid Valve 3 SOL, located in the bypass line, is driven by the I/O Board TB1-61 to control the bypass. Under Program control, it is turned on (energized) to open the bypass line and turned off (de-energized) to close the bypass line.

When the chiller is shutdown, the Hot Gas Bypass is turned off coincident with removing the start signal from the motor starter. It remains off while the chiller is shut down.

Each time the chiller is started, the solenoid valve is turned off for the first 3 minutes of operation. After that, the solenoid valve is controlled per the differential between the Return Chilled Liquid Temperature and the Leaving Chilled Liquid Temperature Setpoint, as compared to the Hot Gas Bypass **ON Setpoint** and **OFF Setpoint** as follows: It is turned on when the Return Chilled Liquid Temperature decreases to $\leq x^{\circ}\text{F}$ (programmed as the ON Setpoint) above the Leaving Chilled Liquid Temperature Setpoint. Once turned on,

it is turned off when the Return Chilled Liquid Temperature increases to $\geq x^{\circ}\text{F}$ (programmed as the OFF Setpoint) above the Leaving Chilled Liquid Temperature Setpoint.

The ON Setpoint is programmed over the range of 1.0 to 10.0°F (default 1.0). The OFF setpoint is programmed over the range of 2.0 to 15.0°F (default 2.0). These Setpoints are programmed by a Service Technician using instructions in the “System Calibration, Service Setpoints and Reset Procedures” section of this book. If the chiller is equipped with the Hot Gas Bypass option, operation must be enabled on the OPERATIONS Screen.

The HOT GAS BYPASS Screen, accessed from the COMPRESSOR Screen, displays a pictorial of the bypass line and solenoid valve location on the chiller. The Hot Gas ON and OFF Setpoints are programmed on this screen and system parameters pertinent to Hot Gas Bypass operation are displayed. An LED illuminates when the Hot Gas Solenoid is ON.

SECTION 18

SMART FREEZE PROTECTION

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

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

Smart Freeze protection uses the Evaporator Refrigerant Temperature as one of the variables to determine when freezing is imminent. If the chiller is equipped with the Evaporator Refrigerant Temperature Sensor (RT7), and the sensor is enabled using the “System Calibration, Service Setpoints and Reset Procedures” section of this book, this value is used as the refrigerant temperature. Otherwise, the Evaporator Saturation Temperature (as derived from the output of the Evaporator Pressure Transducer. The pressure is converted to a temperature via the appropriate refrigerant “pressure/temperature lookup table”) is used as the refrigerant temperature.

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

Unless **Smart Freeze** protection is **activated**, the fixed Low Evaporator Pressure Safety thresholds (R22 – 54.3 PSIG, 29.6°F) (R134a – 25.0 PSIG, 28.7°F) are used.

SMART FREEZE protection is **activated** only when the feature is enabled **AND** the Leaving Chilled Liquid Temperature Setpoint is < 38°F. Once activated, the total number of seconds that the evaporator refrigerant temperature is below the freeze threshold is counted. The freeze threshold is 32.8°F (refrigerant temp. sensor RT7) or 34.0°F (evaporator saturation temp.). The count is incremented once for every second the evaporator refrigerant temperature is below the freeze threshold and decremented once for every second it is above the freeze threshold (but it is never decremented below zero). Thus if the evaporator refrigerant temperature goes below the freeze threshold for 30 seconds, then goes above it for 10 seconds, then goes below the threshold for 5 seconds, the total number of seconds the evaporator refrigerant temperature was below the freeze threshold was 25 seconds. If Smart Freeze is no longer activated due to the Leaving Chilled Liquid Temperature Setpoint being raised to ≥ 38°F, the total number of seconds being tracked is set to zero.

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

Number of seconds to freezing =

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

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

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

Even though **Smart Freeze** protection is enabled and activated, the Slide Valve Load inhibit still occurs at the same thresholds as with normal operation; inhibit at 56.2 PSIG (R22) and 27.0 (R134a). As in normal operation, loading will be allowed when the pressure increases to 57.5 PSIG (R22) and 28.0 PSIG (R134a).

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

SMART FREEZE DISABLED:

- Minimum Leaving Chilled Liquid Setpoint: 38.0°F
- Low Chilled Liquid Temp cycling shutdown threshold: 1° to 34.0°F below the Leaving Chilled Liquid temp Setpoint, as programmed, or a minimum of 36.0°F.
- Low Evaporator Pressure safety shutdown threshold: R22 - 54.3 PSIG (29.6°F); R134a – 25.0 PSIG (28.7°F)
- PRV Load Inhibit: R22 – 56.2 PSIG; R134a – 27.0 PSIG
Load Inhibit disable: R22 – 57.5 PSIG; R134a – 28.0 PSIG

SMART FREEZE ENABLED:

- Minimum Leaving Chilled Liquid Setpoint: 36.0°F
- *If the Leaving Chilled Liquid Temperature Setpoint is $\geq 38.0^\circ\text{F}$:*
 1. The Low Leaving Chilled Liquid Temperature Cycling shutdown threshold: 1 to 34.0°F be-

low the Leaving Chilled Liquid Temperature Setpoint, as programmed, or a minimum of 36.0°F.

2. The Low Evaporator Pressure Safety shutdown threshold is the same as **Smart Freeze Disabled** above.
- If the Leaving Chilled Liquid Temperature Setpoint is $< 38.0^\circ\text{F}$:
 1. The Low Leaving Chilled Liquid Temperature Cycling shutdown threshold: 1 to 3.0°F below the Leaving Chilled Liquid Temperature Setpoint, as programmed, or a minimum of 34.0°F.
 2. Low Evaporator Pressure shutdown threshold: Determined by how far the evaporator refrigerant temperature is below the freeze threshold of 32.8°F (refrigerant sensor RT7) or 34.0°F (Evaporator Saturation temp.), and the total number of seconds it remains there. Refer to previous explanation.
 - Slide Valve Load Inhibit: same as **Smart Freeze Disabled** above.
 - Load Inhibit Disable: same as **Smart Freeze Disabled** above.

SECTION 19

STANDBY CHILLER FREEZE PROTECTION

In multiple chiller applications, it may be possible for the chilled liquid from an operating chiller (water or brine) to flow through the evaporator of a standby chiller. This presents a possible freeze threat to the condenser of the standby chiller. To minimize this freeze potential, the Control Center of the standby chiller cycles the condenser pump (via I/O Board TB2-151) based upon the Condenser Saturation Temperature of the standby chiller, while the chiller is shutdown. If the temperature continues to decrease after the pump has been turned on, a Warning message is displayed and the Warning/Anticipatory alarm contacts (I/O Board TB2-55/56) are closed to annunciate the condition. If Standby Chiller Freeze Protection feature is desired, it must be Enabled. Otherwise, it must be Disabled. A Service Technician must Enable or Disable this feature using the “System Calibration, Service Setpoints and Reset Procedures” section of this book.

The Warning and Alarm will occur only after the bypass time programmed as the **Freeze Warning Time Delay** Setpoint (30 to 60 minutes; default 30 minutes) has elapsed. This Setpoint is programmed by a Service Technician using instructions in the “System Calibration,

Service Setpoints and Reset Procedures” section of this book. The condenser pump operation is independent of this time delay.

At chiller shutdown, the condenser pump continues to run until the Condenser Saturation Temperature increases to $> 35.0^{\circ}\text{F}$. During shutdown, anytime this temperature decreases to $< 30.0^{\circ}\text{F}$, the pump is turned on until the temperature increases to $> 35.0^{\circ}\text{F}$. After the chiller has been shutdown for at least the amount of time programmed as the Freeze Warning Time Delay, if the temperature continues to decrease to $< 28.0^{\circ}\text{F}$, “Warning – Freeze Threat From Operating Chiller” is displayed on the System Details line of the Display and the Warning/Alarm contacts close. The Warning message and Warning/Alarm contacts automatically clear when the temperature increases to $> 28.0^{\circ}\text{F}$.

The condenser water flow switch (I/O Board TB4-11) is bypassed for 60 seconds after the condenser pump is turned on. If the flow switch is not closed within 60 seconds after pump turn on or if it opens continuously for 2 seconds after the 60 second bypass, “Warning – Freeze Threat, Condenser Flow Switch open” is displayed on the System Details line of the Display.

SECTION 20

OIL RECOVERY FEATURE

20

An **Oil Recovery** feature is included in Flash Memory Card version C.MLM.03.03.xxx (and later). Extended operation at low load, entering condenser water temperatures that are below design, oil cooler supply problems or oil solenoid valve problems can allow oil to migrate from the oil separator to the evaporator refrigerant charge. This reduces the quantity of oil in the separator and can result in “Oil Separator – Low Level” safety shutdowns. Excess oil mixed with the refrigerant in the evaporator will cause severe foaming when the chiller is started. This foaming carries liquid refrigerant into the compressor, lowering the compressor discharge temperature. As the compressor discharge temperature approaches the condenser saturation temperature (low discharge superheat), the refrigerant gas has a greater affinity to absorb more oil. When the discharge superheat is reduced, oil cannot be separated from the refrigerant gas in the oil separator.

The Oil Recovery feature is used to automatically recover the oil that has accumulated in the evaporator refrigerant. It accomplishes this by applying load, unload or hold outputs to the slide valve in 5-second intervals according to the rate of change of the discharge superheat in each interval. This operation is detailed below. The feature can be Enabled or Disabled. The Default is Disabled. Pertinent information for this feature is displayed on the Oil Separator Screen. The change in superheat that occurs in each 5-second interval is displayed as “Change in Discharge Superheat = xx.x °F”. Increases are displayed as xx.x. Decreases are displayed as –xx.x. The Oil recovery feature is Enabled and Disabled on this screen. The access level is OPERATOR or higher. This allows an Operator at the chiller facility, under the direction of a qualified service technician from a remote location, to enable the feature and restart a chiller that has shutdown on an Oil Level safety shutdown. This feature should only be used as a tool to recover oil and should only be enabled following an oil loss safety shutdown. It should be disabled after the oil has been recovered. Since it inhibits Slide Valve loading, chiller capacity will be affected while this routine is in effect. Therefore, it should be disabled after the oil has been recovered.

After a 3-minute bypass at start, during which the Separator Oil Level Switch (SOLS) status is bypassed, the Oil Recovery operation is performed as follows:

1. If the discharge superheat is [$>15.0^{\circ}\text{F}$ (R22) (10.0°F for R134a) and $<25.0^{\circ}\text{F}$ (R22) (13.0°F for R134a)] or the Slide Valve position is $<40\%$, the superheat and superheat rate of change are evaluated every 5 seconds and the following action is taken at the end of each 5-second period. While this operation is in effect, “Warning – Oil Recovery limit” is displayed on the System Details line of the display. If the change in discharge superheat:
 - Remains the same or increases, apply 0.5 second load pulse
 - Decreases by 0.1 to 0.9°F , hold the slide valve
 - Decreases $>1^{\circ}\text{F}$, apply 0.5 second unload pulse.
2. If the discharge superheat is $<15.0^{\circ}\text{F}$ (R22) (10.0°F for R134a) but $>10^{\circ}\text{F}$ (R22) (5.0°F for R134a), hold the slide valve.
3. If the discharge superheat is $\leq 10.0^{\circ}\text{F}$ (R22) (5.0°F for R134a):
 - Inhibit loading
 - If condition exists for ≥ 10 seconds, invoke “Excess Charge Override” routine as follows: apply 0.5 second unload pulses every 3 seconds (during which “Warning – Low Discharge Superheat Limit” is displayed) until Superheat $\geq 15.0^{\circ}\text{F}$ (whereupon “Warning-Low Discharge Superheat Detected” replaces the message “Warning – Low Discharge Superheat Limit”).
4. When both the superheat increases to $\geq 25.0^{\circ}\text{F}$ (R22) (13.0°F for R134a) and the slide valve position is $\geq 40\%$, “Warning – Oil Recovery Limit” is cleared, Oil Recovery operation terminates and normal operation resumes.

If the Oil recovery feature is Enabled, the restart criteria following an “Oil Separator – Low Level” safety shutdown is different than if the feature is Disabled. With the feature Disabled, the Separator Oil Level Switch (SOLS) must be closed before a restart is allowed. This requirement is the same as in all previous software versions. However, to eliminate the need to manually bypass the SOLS in order to restart a chiller that has already suffered oil loss, the SOLS does not have to be closed to start the chiller when the feature is Enabled.

SECTION 21

SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES

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

Programmable Service Setpoints are used by the Program to control critical chiller operation. Also, some of these Setpoints can be used to enable or disable certain features. Although they have been entered at the YORK Factory, they can be changed by a field Service Technician that has logged in at SERVICE access level. If the BRAM battery backed memory device (U52) is field replaced, all of the programmed setpoints will be lost. They will have to be reentered into the new BRAM. Each of these Setpoints is described below. Programming procedures and Control Center Keypad operation required in the procedures below are detailed in YORK Operation Manual 160.80-O1. In general, the following procedure is used to enter Setpoints in this section:

1. Unless noted otherwise in procedures below, log in at SERVICE access level using Access Code 1 3 8 0 .
2. Select the appropriate Display Screen.
3. Press the desired Setpoint key.

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

4. If the dialog box begins with the word "Enter", use the numeric keys to enter the desired value. Leading zeroes are not necessary. Press the **•** key to place a decimal point at the appropriate place. Pressing the **▲** key displays the Default value. Pressing the **▼** key clears the entry. The **◀** key is a backspace key and causes the entry point to move back one space. If the dialog box begins with "Select" or "Enable", use the **◀** and **▶** keys to select the desired value. The **◀** key decreases the value. The **▶** key increases the value.
5. Press the ENTER (**✓**) key. If the value is within range, it is accepted and the dialog box disappears. The chiller will begin to operate based on the new value. If out of range, the value is not accepted and a message describing why it is not acceptable is displayed momentarily.

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

ELECTRO-MECHANICAL STARTER APPLICATIONS

If the Compressor Motor is driven by an Electro-Mechanical Starter, the Control Center is equipped with a CM-2 Current Module along with supporting components Diode Bridge (DB) and Calibration Resistors (RES), as described in a previous chapter of this book. The following procedures can be used to verify the calibration and perform the calibration if Necessary. In addition to the calibration, Switch S1 and Potentiometer R16 have to be set appropriately on the CM-2 Module. If the CM-2 and/or RES are field replaced, field calibration is necessary.

CM-2 Settings:

1. Place Switch S1 in the appropriate position per the Starter type:
 UP: Y-Delta or Autotransformer Starter
 Down: All others
2. Calculate LRA/FLA ratio by dividing the Motor Lock Rotor Amps by the chiller Full Load Amps ($LRA/FLA = \text{ratio}$) and then adjust Potentiometer R16 to the ratio value.

Calibration Verification:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select MOTOR Screen and set Current Limit and Pulldown Demand Limit Setpoints to 100% FLA.
3. Run chiller. Read compressor motor current in Phase A, B, and C using a clamp-on Ammeter. Apply ammeter to highest Phase.
4. Select COMPRESSOR Screen.
5. Manually operate the Pre-rotation Vanes by pressing the OPEN and CLOSE Keypad keys as required to achieve a motor current equivalent to 100% FLA as indicated by the clamp-on Ammeter. The motor current value on the Display should indicate 100% FLA.

6. Manually operate the Pre-rotation Vanes by pressing the OPEN and CLOSE keys as required to achieve a motor current equivalent to 105% FLA as indicated by the clamp-on Ammeter. The 105% LED on the CM-2 Module should illuminate.

If the calibration verification does not perform as above, the following Calibration procedure will have to be performed:

Calibration:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select MOTOR Screen and set Current Limit and Pulldown Demand Limit Setpoints to 100% FLA.
3. Select COMPRESSOR Screen.
4. Run chiller and read compressor motor current in Phase A, B and C using a clamp-on Ammeter. Apply Ammeter to highest Phase.
5. Manually operate the Slide Valve by pressing the LOAD and UNLOAD Keypad keys as required to achieve a motor current equivalent to 100% FLA as indicated by the clamp-on Ammeter. The voltage across Variable Resistors (RES) should be 0.90 to 1.05VDC. Measure this voltage by connecting a Voltmeter at CM-2 Board J1-2 (+) to J1-1(-). If necessary, adjust RES to achieve this value. Figure 36 contains formulas to calculate the resistance of RES required to achieve this voltage. Adjust both resistors equally such that the combined resistance equals the calculated value.
6. Manually operate the Slide Valve by pressing the LOAD, UNLOAD and HOLD Keypad keys, as required, to achieve a motor current equivalent to 105% FLA as indicated by the clamp-on Ammeter. Loosen locking nut on Potentiometer R8 on CM-2 and adjust until the CM-2 Module 105% LED illuminates. Counterclockwise increases signal level; Clockwise decreases signal level. Tighten locking nut.
7. Manually operate the Slide Valve by pressing the LOAD and UNLOAD Keypad keys, as required, to achieve a motor current equivalent to 100% FLA as indicated by the clamp-on Ammeter. Loosen locking nut on Potentiometer R34 on CM-2 and adjust until the motor current value on the Display indicates 100% FLA. Clockwise increases the signal level; Counterclockwise decreases the signal level. Tighten locking nut.

SOLID STATE STARTER APPLICATIONS

The chiller could be equipped with either of two different YORK Solid State Starters. New production chillers after October 1999 are equipped with the Mod "B" serial data interface Liquid Cooled Solid State Starter (LCSSS). Earlier vintage chillers, such as those encountered in retrofit applications are equipped with the Style "A" multiplexed data interface LCSSS. Microboard Program Jumper JP39 must be positioned to invoke the appropriate Microboard/Program operation for the starter applied (Refer to Table 1). A description of these starters is contained in the Solid State Starter section of this book. The procedures for both starters are listed below.

MOD "B" SERIAL DATA INTERFACE LIQUID COOLED SOLID STATE STARTER

Complete details of the operation of this starter are contained in YORK Service Manual 160.00-O2.

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select MOTOR Screen.
3. Enter the following Setpoints using procedures below:

Full Load Amps:

This is the Full Load Amps (FLA) of the chiller as listed on the Sales Order Screen. The Microboard uses the programmed value to perform Current Limit functions and display compressor motor current in terms of % FLA.

1. Press FULL LOAD AMPS key.
2. Use numeric keypad keys to enter correct value.
3. Press ENTER (✓) key.

Start Current:

The Logic/Trigger Board will limit compressor motor current to this value during starting. The correct value is $(0.45 \times \text{Delta Locked Rotor amps})$, as listed on the SALES ORDER Screen.

1. Press STARTING CURRENT key.
2. Use numeric keypad keys to enter correct value.
3. Press ENTER (✓) key.

Voltage Range:

This is the compressor motor AC Power line application. Selections are: 200-208, 220-240, 380, 400, 415, 440-480, 550-600 and Disabled. The Microboard uses the programmed value to determine the overvoltage and undervoltage shutdown thresholds for "LCSSS - HIGH SUPPLY LINE VOLTAGE" and "LCSSS - LOW SUPPLY LINE VOLTAGE" cycling shutdowns as described in Operator Manual 160.80-O1. If DISABLED is selected, the thresholds will be ignored and these shutdowns will not occur. This check should not be arbitrarily disabled.

1. Press VOLTAGE RANGE key.
2. Use the ◀ and ▶ keys to scroll to desired value.
3. Press ENTER (✓) key.

Open SCR Enable/Disable

This allows the Open SCR safety check, performed by the Logic/Trigger board, to be disabled. This must NEVER be disabled unless advised by the YORK factory.

1. Press OPEN SCR key.
2. Use the ◀ and ▶ keys to scroll to desired value.
3. Press ENTER (✓) key.

Shorted SCR Enable/Disable:**(Flash Memory Card version C.MLM.03.01 or later)**

This allows the shorted SCR safety check, performed by the Logic/Trigger Board, to be disabled. This must NEVER be disabled unless advised by the YORK factory!

1. Press SHORTED SCR key.
2. Use the ◀ and ▶ keys to select Enable or Disable.
3. Press ENTER (✓) key.

Kilowatt Hours (KWH)

This allows the KWH to be set to a desired starting value in the event the BRAM has to be field replaced. This must never be arbitrarily performed.

1. Press KWH RESET key.
2. Use the ◀ and ▶ keys to scroll to desired value.
3. Press ENTER (✓) key.

**MOD "A" MULTIPLEXED DATA INTERFACE
LIQUID COOLED SOLID STATE STARTER**

If the chiller is equipped with this model starter, the Starter Logic Board is located in the Control Center. Operation of this board and overall starter operation are detailed in YORK Form 160.46-OM3.1. The following procedures can be used to verify the calibration and

perform the calibration if necessary. If the Logic Board is field replaced, field calibration is necessary using the procedure below. Logic Board Program Jumper J5 (300V/600V) must be placed in the appropriate position per the Compressor Motor AC Power Supply.

Logic Board Program Jumper:

Place Jumper J5 (300V/600V) in appropriate position per the Compressor Motor AC Power Line application as follows:

600V - Place over pins 1 & 2 for 380/400/415, 440/460/480 or 550/575/600VAC applications.

300V - Place over pins 2 & 3 for 200/208 or 220/230/240VAC applications.

Setpoints:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select MOTOR Screen.
3. Enter the following Setpoints using procedures below:

Full Load Amps :

This is the Full Load Amps (FLA) of the chiller as listed on the Sales Order Screen. The Microboard uses the programmed value to perform Current Limit functions and display compressor motor current in terms of % FLA.

1. Press FULL LOAD AMPS key.
2. Use numeric keypad keys to enter correct value.
3. Press ENTER (✓) key.

Voltage Range:

This is the AC Power line voltage applied to the Compressor Motor. Selections are: 200-208, 220-240, 380, 400, 415, 440-480, 550-600 and Supply Voltage Range Disabled. The Microboard uses the programmed selection to determine the overvoltage and undervoltage thresholds for Starter High Supply Line Voltage and Starter Low Supply Line Voltage cycling shutdowns as described in Operator Manual 160.80-O1. If Supply Voltage Range Disabled is selected, the thresholds will be ignored and these shutdowns will not occur. This check should not be arbitrarily disabled.

1. Press VOLTAGE RANGE key.
2. Use the ◀ and ▶ keys to scroll to desired value.
3. Press ENTER (✓) key.

Current Unbalance Check Enable/Disable:

While the chiller is running, if the compressor Motor current in phase A, B and C becomes unbalanced, a Safety shutdown is performed. Refer to Operator Manual 160.80-O1 for complete description of this check. This Setpoint allows the check to be enabled or disabled. If enabled, the check is performed; if disabled, the check is not performed.

1. Press CURRENT UNBALANCE key.
2. Use the ◀ and ▶ keys to select Enable or Disable.
3. Press ENTER (✓) key.

Calibration Verification:

At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .

1. Compressor Motor current display accuracy -
 - a. Run chiller.
 - b. Select COMPRESSOR Screen.
 - c. Use the Slide Valve HOLD keypad key to stabilize the Compressor Motor current.
 - d. Measure phase A, B and C Compressor Motor current with a clamp-on ammeter. Compare the Ammeter values with displayed motor current values. If displayed values are not within $\pm 5\%$ of Ammeter values, refer to Solid State Starter Service Manual 160.46-OM3.1 to troubleshoot Starter.
2. Start Current - Proper starting current is (45% x Delta locked Rotor amps).
 - a. Select COMPRESSOR Screen.
 - b. Start chiller and monitor Compressor Motor starting current in phase A, B and C on the Compressor Screen.
Highest phase should be equivalent to (45% x Delta Locked rotor amps).
3. Overload -
 - a. Select COMPRESSOR Screen.
 - b. Run chiller and monitor Compressor Motor current on the COMPRESSOR Screen.
 - c. Manually operate the Slide Valve by pressing the LOAD, UNLOAD and HOLD keys, as required, until the highest phase indicates a current equivalent to 105% FLA.
The Display should indicate 105% and the 105% LED on the Solid State Starter Logic Board should illuminate when the 105% FLA value is reached.

If the calibration verification does not perform as above, one or both of the following Calibration procedures will have to be performed:

Calibration:

At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .

1. Start Current -
 - a. Select COMPRESSOR Screen.
 - b. Loosen locking nut on Solid State Starter Logic Board Potentiometer R38.
 - c. Start chiller and monitor Compressor Motor starting current in Phase A, B and C on the COMPRESSOR Screen.
 - d. While chiller is starting, adjust START CURRENT potentiometer (R38) on Solid State Starter Logic Board to achieve the proper starting current of (0.45 x Delta Locked rotor Amps) on the highest phase. Turning R38 Clockwise increases current; Counterclockwise decreases current. Multiple starts could be required to achieve the correct calibration. Tighten locking nut.
2. Overload -
 - a. Select COMPRESSOR Screen.
 - b. Run Chiller and monitor Compressor Motor current on the COMPRESSOR Screen.
 - c. Manually operate the Slide Valve by pressing the LOAD UNLOAD and HOLD keypad keys, as required, until the highest phase indicates a current equivalent to 105% FLA. Adjust OVERLOAD potentiometer (R44) on Solid State Starter Logic Board until the 105% FLA LED illuminates. Clockwise increases signal level; Counterclockwise decreases signal level. Tighten locking nut.

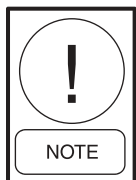
SLIDE VALVE POSITION**Potentiometer Calibration:**

To assure accuracy in the Slide Valve position display, a calibration procedure must be performed for the Slide Valve position potentiometer. The Slide Valve position will be displayed as "XXX" until this procedure is performed. The procedure can be performed whether the chiller is running or not. If performed while running, the Slide Valve is automatically driven to the full closed and full open positions as described below. However, if the procedure is performed while the chiller is not running, oil will have to be manually pumped into the

Slide Valve assembly, since there will be no oil pressure to move the Slide valve.

In the following, the Slide Valve potentiometer feedback voltage is measured at the Microboard J8-1 to Microboard TP1 (Gnd).

1. Remove Slide Valve potentiometer cover plate.
2. With chiller running, go to SLIDE VALVE CALIBRATION Screen from COMPRESSOR Screen.
3. Press Start Calibration key. Slide Valve will be driven to the fully closed position. Monitor Slide Valve potentiometer rotation. When potentiometer stops rotating, valve is fully closed.
4. When valve is fully closed, press Set 0% Position key. The potentiometer feedback voltage is stored in memory as the 0% position. If potentiometer feedback voltage is not within 0.04 to 0.12VDC range, "Slide Valve Calibration Failed" is displayed.
5. The Slide Valve will be driven to the fully open position. Monitor Slide Valve potentiometer rotation. When potentiometer stops rotating, valve is fully open.
6. When valve is fully open, press Set 100% Position key. If the feedback voltage at this position is 0.122VDC greater than the feedback voltage at the 0% position, "Slide Valve Calibration Successful" is displayed. Otherwise, "Slide Valve Calibration Unsuccessful" is displayed.
7. If calibration is successful, the calibration is complete. Otherwise, correct the problem and repeat the calibration procedure.
8. Install Slide Valve potentiometer cover plate.



The calibration procedure can be terminated at any time during the procedure by pressing the CANCEL CALIB key. If the Slide Valve was previously calibrated successfully, it will revert to using the previous calibration values. If they were not previously calibrated successfully, the message "WARNING SLIDE VALVE UNCALIBRATED" is issued.

HIGH CONDENSER PRESSURE WARNING THRESHOLD

The condenser pressure at which a High Pressure warning message is displayed and the Pre-rotation Vanes are inhibited from further opening, is programmable over the range of 44.9 to 251.3 PSIG. The Default value is 251.3 PSIG. The Warning message will clear and the PRV inhibit is removed when the pressure decreases to 5 PSIG below the programmed value. Proceed as follows to enter this value:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select CONDENSER Screen.
3. On the Condenser Screen, press HIGH PRESSURE WARNING THRESHOLD key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

BRINE LOW EVAPORATOR PRESSURE CUTOUT

On Brine cooling applications, the Low Evaporator Pressure safety shutdown threshold is programmable over the range of 25.0 to 54.3 PSIG (Default 54.3 PSIG) for R22 Refrigerant and 6.0 to 25.0 PSIG (Default 25.0 PSIG) for R134a Refrigerant. The actual percentage of Brine solution determines this threshold. It is calculated at the YORK Factory and programmed at the time of manufacture. If the BRAM memory device on the Microboard is replaced, the threshold will have to be programmed in the field. The threshold is logged on an adhesive label attached to the inside of the Control Center door. Proceed as follows to enter this value:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select EVAPORATOR Screen.
3. On the EVAPORATOR Screen, press the BRINE LOW EVAPORATOR CUTOUT key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

SMART FREEZE PROTECTION

This feature is described in the “Smart Freeze Protection” section of this book. When turned on, it allows the Leaving Chilled Liquid Temperature Setpoint to be as low as 36°F for water cooling applications. Along with this feature is a correspondingly lower Low Water Temperature Cycling Shutdown threshold and Low Evaporator Pressure Safety Shutdown threshold. The Smart Freeze Protection feature can be turned ON or OFF using the following procedure:

1. Shutdown the chiller and wait for completion of SHUTDOWN.
2. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
3. Select EVAPORATOR Screen.
4. Press SMART FREEZE key.
5. Use the ◀ and ▶ keys to select ON or OFF.
6. Press ENTER (✓) key.

EVAPORATOR REFRIGERANT TEMPERATURE

If the chiller is equipped with an Evaporator Refrigerant Temperature sensor, the feature must be Enabled with the procedure below. If not equipped with this sensor, it must be Disabled. If enabled, this temperature is displayed on the EVAPORATOR Screen, and is also used in the Smart Freeze protection Low Evaporator Pressure Safety Shutdown threshold calculation, as explained in the “Smart Freeze Protection” section of this book.

Use the following procedure to Enable or Disable this feature:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0 .
2. Select EVAPORATOR Screen.
3. Press REFRIGERANT key.
4. Use the ◀ and ▶ keys to select Enabled or Disabled.
5. Press ENTER (✓) key.

VARIABLE ORIFICE CONTROL

This feature and associated setpoint is described in the “Variable Orifice Control” section of this book. The variable orifice is controlled by the DELTA P setpoint. It is programmed over the range of 25 to 150 PSIG (R22);

15 to 110 PSIG (R134a) as follows. The default value is 25 PSIG for either refrigerant application.

1. At the Keypad, log in at SERVICE access level using Password 1 3 8 0 .
2. From the CONDENSER Screen, select VARIABLE ORIFICE Screen.
3. On the VARIABLE ORIFICE Screen, press DELTA P setpoint key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

HOT GAS BYPASS CONTROL

A complete description of the optional Hot Gas Bypass control and the Setpoints that affect the operation is in the “Hot Gas Bypass” section of this book. If the chiller is equipped with this option, Hot Gas operation must be enabled and the setpoints programmed using the procedure below. Otherwise, it must be disabled.

Enable/Disable:

If the chiller is equipped with the optional Hot Gas Bypass control, operation must be enabled. Otherwise, it must be disabled. Use the following procedure:

1. Shut down chiller and place COMPRESSOR Start/Stop Switch in the Stop-Reset (O) position.
2. At the keypad, log in at SERVICE access level using Password 1 3 8 0 .
3. Select SETPOINTS Screen. From SETPOINTS Screen, select SETUP Screen. From SETUP Screen, select OPERATIONS Screen.
4. Use the ◀ and ▶ keys to select Enable or Disable.
5. Press ENTER (✓) key.

Setpoints:

The following are the setpoints and range of programmable values. The Default value is shown in parenthesis. Enter the value that will provide the desired operation. Use procedure below.

- a. On Setpoint – 1.0 to 10.0°F (1.0)
- b. Off Setpoint – 2.0 to 15°F (2.0)

1. At the keypad, log in at SERVICE access level, using Password 1 3 8 0 .

2. From COMPRESSOR Screen, select HOT GAS BYPASS Screen.
3. On the HOT GAS BYPASS Screen, press the appropriate key to select the setpoint to be programmed. Using the numeric keypad keys, enter the desired value.
4. Press ENTER (✓) key.

TRANSDUCER AUTO ZERO ENABLE/DISABLE

A complete description of Pressure Transducer Auto Zeroing is in the “Pressure Transducers” section of this book. Normally, Auto Zeroing should be enabled. However, certain local conditions, as described in the Pressure Transducers section of this book, can require the Auto Zeroing be disabled. Use the following procedure.

1. At the Keypad, log in at SERVICE access level using password 1 3 8 0.
2. Select OIL SUMP Screen.
3. Press AUTO ZERO key.
4. Use the ◀ and ▶ keys to select ENABLE or DISABLE.
5. Press ENTER (✓) key.

SEAL OIL PRESSURE TRANSDUCER ENABLE/DISABLE

All new production chillers are equipped with Seal Oil Pressure Transducers. On these chillers, the Seal Oil Pressure Transducer operation must be Enabled. Earlier vintage chillers, such as those encountered in Control Center retrofits, are not equipped with this transducer. If the chiller is not equipped with this transducer, the Seal Oil Pressure Transducer operation must be disabled. Use the following procedure.

1. At the Keypad, log in at SERVICE access level using password 1 3 8 0.
2. Select OIL SUMP Screen.
3. Press SEAL PRESSURE key.
4. Use the ◀ and ▶ keys to select ENABLE or DISABLE.
5. Press ENTER (✓) key.

MAXIMUM LOAD LIMIT

After the chiller has been running for >3 minutes, this feature limits the compressor motor current to the programmed “Maximum Load FLA” setpoint value (60% to 100%, default 100%) whenever the Leaving Chilled Liquid temperature is $\geq$ the programmed “Maximum Load Temperature” setpoint value (50°F to 70°F, default 70). Whenever the slide valve loading is being inhibited by this feature, “Maximum Load – Load Limit” is displayed on the System Details Line of the Display. Normally, this feature is not required and should be disabled by setting both setpoints to the default values. However, when using certain compressor/chiller combinations under special operating conditions, separator overload could occur resulting in oil loss under high load conditions. Consult YORK factory for requirement. Program setpoints as follows:

1. At the Keypad, log in at SERVICE access level using password 1 3 8 0.
2. Select COMPRESSOR Screen.
3. Press MAXIMUM LOAD TEMPERATURE key. Using numeric keypad keys, enter desired value. Press ENTER (✓) key.
4. Press MAXIMUM LOAD FLA key. Using numeric keypad keys, enter desired value. Press ENTER (✓) key.

MINIMUM LOAD CONTROL SOURCE

The Minimum Load Control feature prevents the Slide Valve from unloading to a position that will not allow sufficient oil transfer to the Oil Separator while the chiller is running. If the Slide valve is permitted to unload too far, there will not be enough oil transfer to the Oil Separator and a “Oil Separator – Low Level” Safety shutdown will result. There are two selectable methods of setting the minimum allowed Slide Valve position:

1. Slide Valve – This method limits the minimum Slide Valve position to 15% (based on the position feedback potentiometer) after the chiller has been running for 3 minutes. When the Slide Valve unloads to 15%, no more unload pulses will be applied. If it decreases to < 15%, a 1 second load pulse is applied every 3 seconds until the Slide Valve position is $\geq$ 15%.
2. Motor FLA – This method limits the Slide Valve minimum position to one that will maintain the compressor motor current above the programmed Minimum Load FLA (15% to 70% FLA) Setpoint after the chiller has been running for 3 minutes.

When the Slide Valve unloads to the point where the motor current decreases to the Minimum Load FLA Setpoint, no more unload pulses will be applied. If it unloads to the point where the motor current is $<$ Minimum Load FLA Setpoint, a 1 second load pulse is applied every 3 seconds until the motor current is $\geq$ the Minimum Load FLA Setpoint.

Regardless of which method is selected, “Minimum Load – Load Limit” is displayed on the System Details line of the Display while the slide valve position is being limited.

Select the method that performs best in the application. The operating point at which low separator oil level will occur can be found by manually unloading the Slide Valve while observing system conditions.

1. At the Keypad, log in at SERVICE access level using password 1 3 8 0.
2. Select COMPRESSOR Screen.
3. Press MINIMUM LOAD CONTROL SOURCE key.
4. Use the ◀ and ▶ keys to select either Motor FLA or Slide Valve. If Slide Valve is selected, proceed to step 7.
5. Press MINIMUM LOAD FLA key.
6. Using numeric keypad keys, enter desired value.
7. Press ENTER (✓) key.

STANDBY CHILLER FREEZE PROTECTION

A complete description of this feature is contained in the “Standby Chiller Freeze Protection” section of this book. If this feature is desired, it must be Enabled using the procedure below. Otherwise, it must be Disabled. If the feature is Enabled, the Freeze Warning Delay Time Setpoint must be programmed per the procedure below.

Enable/Disable:

1. At the Keypad, log in at SERVICE access level using Password 1 3 8 0.
2. Select CONDENSER Screen.
3. Press FREEZE WARNING key.
4. Use the ◀ and ▶ keys to select Enable or Disable.
5. Press ENTER (✓) key.

Freeze Warning Time Delay:

If the standby chiller freeze protection is enabled using procedure above, a Freeze Warning Delay Time of 30 to 60 minutes (default 30) must be programmed as follows:

1. At the Keypad, log in at SERVICE access level using Password 1 3 8 0.
2. Select CONDENSER Screen.
3. Press FREEZE TIME key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

LEAVING CHILLED LIQUID TEMPERATURE CONTROL SENSITIVITY

This setpoint adjusts the Slide Valve unloading response to changes in Leaving Chilled Liquid Temperature. Normally, it is desired to have equal loading and unloading response. However, in applications where the load is quickly removed from the chiller, faster unloading might be required. There are two selections as follows:

NORMAL – Provides standard Slide Valve control. A Load or Unload pulse is applied, as required. This selection will provide proper operation in most applications.

2X – Provides fast unload Slide Valve operation. Operation is same as NORMAL, except all Unload pulses are twice as long as they would be in NORMAL operation. This provides for faster unloading.

1. At the Keypad, log in at SERVICE access level using Password 1 3 8 0.
2. Select EVAPORATOR Screen.
3. Press SENSITIVITY key.
4. Use the ◀ and ▶ keys to select NORMAL or 2X.
5. Press ENTER (✓) key.

ICE STORAGE MODE

A complete description of this feature is contained in the York Manual 160.80.O1. This feature can only be used in Brine mode (Microboard Program Jumper JP35 out). If this feature is desired, it must be turned ON. Otherwise it must be turned OFF. Use procedure following.

Turn On/Turn Off:

If the Ice Storage feature is desired, it must be turned ON. Otherwise, it must be turned OFF.

1. At the Keypad, log in at SERVICE access level using Password 1 3 8 0.
2. Select EVAPORATOR Screen.
3. Press ICE STORAGE key.
4. Use the ◀ and ▶ keys, select ON or OFF.
5. Press ENTER (✓) key.

MANUAL SLIDE VALVE CONTROL

The Slide Valve can be manually controlled from the Keypad as follows:

1. At the keypad, log in at SERVICE access level using Password 1 3 8 0.
2. Select COMPRESSOR Screen.
3. Pressing the following keys applies the following signals to the Slide Valve Actuator:

LOAD – Applies a continuous load signal.

UNLOAD – Applies a continuous unload signal.

HOLD – Applies neither a load nor unload signal.

AUTO – Places the Slide Valve under Program control (automatic operation).

SERVICE PHONE NUMBERS

(Flash Memory card version C.MLM.03.02.xxx and later)

Two service phone numbers (Regional and Local), with labels, can be displayed on the OPERATIONS Screen. The Default value for the Regional number is the “North American Toll Free Number” (1-800-861-1001). However, the label and number can be changed to any desired value. The Default value for the Local label and number is blank. The Service Technician enters the Local phone number and label.

The entry format consists of 4 fields (rows), vertically from the top. Up to 40 characters/numbers can be entered for each field.

Field 1 – Regional phone number label. Default value is “York Intl North American Toll Free Number”

Field 2 – Regional phone number. Default value is 1-800-861-1001.

Field 3 – Local service phone number label. Default value is blank.

Field 4 – Local service phone number. Default value is blank.

Use the following procedure to change any of the fields:

1. At the Keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select OPERATIONS Screen.
3. Press EDIT PHONE NUMBERS Key.
4. Use the ◀ and ▶ keys to move green selection box to the desired field to be changed.
5. Press the ENTER (✓) key.
6. In the Dialog box that appears, a red box appears over the first changeable value. Use the ◀ and ▶ keys to position the red box over the number/character to be changed or entered. Use the ◀ and ▶ keys to scroll sequentially through numbers, alphabet characters and punctuation marks to select the desired value. When the desired value displayed, use the ◀ and ▶ keys to move the red box to the next value to be changed. The numeric keypad keys can also be used to enter numbers. Continue this process until all desired values have been entered.
7. After all desired values have been entered in previous step, press ENTER (✓) key.

CHILLER STARTS AND OPERATING HOURS RESET

The Number of Starts and the Operating Hours can be reset to zero or preset to a desired number. However, this should never be arbitrarily performed. Use the following procedure:

1. At the keypad, log in at ADMIN access level. This password changes daily. Contact your local YORK Service Office.
2. Select OPERATIONS screen.
3. Press NUMBER of STARTS or OPERATING HOURS key as appropriate.
4. Using numeric keypad keys, enter desired number.
5. Press ENTER key (✓) key.

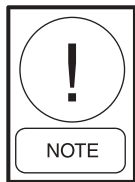
SALES ORDER DATA

All of the Sales Order Data, except the “Chiller Commissioning Date” is entered at the YORK Factory at the time of chiller manufacture. The Service Technician must enter the Chiller Commissioning Date and modify

the Job Name or Job Location if necessary at the completion of commissioning. Normally, the remainder of the Sales Order Data should never be modified. However, if there is a change to the chiller design, in the field, this data can be modified. If the BRAM battery-backed memory device (U52) fails and requires field replacement, all of the data will be lost and will have to be manually programmed.

There are three different Passwords used, depending on the circumstances, to change the Sales Order Data as follows:

- Chiller Commissioning - Service Technician must use password 1 3 8 0 to enter the Commissioning Date and modify Job Name and Job Location if necessary.
- Modifying Sales Order Data - Service Technician must use the ADMIN password. This password changes daily. Contact your local YORK Service Office.
- BRAM Replacement - If the BRAM (U52) is field replaced, the Service Technician must use password 0 2 2 8 to enter all Sales Order Data into a new blank BRAM. When logged in at this level, the ACCESS LEVEL shown will be TEST OP. This password only works with a blank BRAM.



When using this password to enter data into a new blank BRAM, the FINISH PANEL SETUP procedure (listed at the end of the entry procedure below) must be performed after all data has been entered. Failure to perform this procedure will result in unreliable Control Center operation! If this procedure is performed prior to entering all data, the ability to enter more data will be terminated.

Use the following procedure to enter data:

1. At the keypad, log in using the appropriate password as described above.
2. From the SETPOINTS Screen, select SETUP SCREEN. From the SETUP Screen, select SALES ORDER Screen.
3. If logged in at SERVICE Access level, press SET ORDER INFO key to enter Commissioning date, Job Name or Location and proceed to step 4. If logged in at ADMIN or TEST OP level, Press SELECT key to select the data category (ORDER, DESIGN, NAMEPLATE, SYSTEM) to be entered.

4. Press CHANGE key. The first changeable area in the selected category will be outlined in a green selection box. The procedure can be terminated anytime after this by pressing the CANCEL (X) key.
5. Use the ◀ and ▶ keys to move the green selection box to the desired value to be changed, within the category selected.
6. Press ENTER (✓) key.
7. Enter the appropriate data. Use the numeric keypad keys to enter numbers. Use the • key to enter a decimal point. Use the ◀ and ▶ keys to scroll sequentially up and down through the alphabet to enter letters or a comma (,), slash (/) or minus sign (-). Each time the ▶ key is pressed, the next higher sequential alphabet letter is displayed. Each time the ▼ key is pressed, the next lower alphabet letter is displayed. The comma, slash and minus sign can be selected after scrolling through the entire alphabet. During the entry process, the ◀ key can be used to backspace and the ▶ key can be used to forward space.
8. Press ENTER (✓) key.
9. Use the ◀ and ▶ keys to select another value to be changed within the same category or press CANCEL (X) key to exit and allow selection of another category.
10. EXTREMELY IMPORTANT! If the procedure above was performed using password 0 2 2 8 to enter data into a new blank BRAM, the following procedure must be performed after all the desired data is entered. If the following procedure is performed prior to entering all of the data, the ability to enter more data will be terminated. Failure to perform this procedure after all data has been entered will result in unreliable Control Center Operation!
 - a. On SALES ORDER screen, press FINISH PANEL SETUP key.
 - b. Use the ◀ and ▶ keys to select YES.
 - c. Press ENTER (✓) key.

CUSTOM USER ID AND PASSWORDS

When logging in, the user is requested to enter a User ID, followed by a Password. The universal and Default User ID is zero (0). The universal Password to log in at OPERATOR access level is 9 6 7 5 . The universal Password to log in at SERVICE access level is 1 3 8 0 . No log in is required for VIEW access level. However, if desired, the service technician can establish up to four custom User IDs and Passwords that can be used by

MICROBOARD 031-02430-000 SETUP/ CONFIGURATION

The following functions are programmed as Setpoints on the 031-02430-00 microboard. Refer to SECTION 3A for explanation of each setpoint.

- Chilled Liquid Pump Operation
- Motor Drive Type
- Anti-recycle
- Power Failure Restart

Program the above setpoints as follows:

1. At the Keypad, login at SERVICE access level using access code 1 3 8 0. (“Power Failure Restart” only requires OPERATOR access level 9 6 7 5). (“Motor Drive Type” requires chiller to be stopped with Compressor Switch in the Stop-Reset position).
2. Select SETUP Screen from SETPOINTS Screen.
3. Press CHANGE SETTINGS key.
4. A green box will appear around the first changeable setpoint. Use ▲ ▼ keys to place the box around the setpoint to be changed.
5. Press ✓ key. A dialog box will appear with the range of settings.
6. Use ◀ ▶ keys to scroll to desired setting.
7. Press ✓ key.

High Condenser Pressure Fault While Shutdown – reset procedure (Software version C.MLM.03.xx.xxx (and later) or C.OPT.03.xx.xxx (and later))

High temperature condenser water flowing through the condenser while the chiller is shutdown can cause a condenser high pressure condition in the condenser resulting in loss of refrigerant. This anticipatory safety fault annunciates condenser high pressure conditions when the chiller is not running as follows:

While the chiller is stopped, if the condenser pressure exceeds 245.0 PSIG, a safety fault occurs and “Condenser – High Pressure - Stopped” is displayed.

The chiller can be started after the condenser pressure decreases to less than 245.0, and a special reset procedure is performed as follows:

1. Place the COMPRESSOR switch in the Stop-reset position.
2. At the keypad, login at Service access level using code 1 3 8 0.
3. Select COMPRESSOR screen.
4. Press the FAULT ACKNOWLEDGE key on the COMPRESSOR Screen. A dialog box appears displaying “Enter Password to Clear Fault”.
5. Enter 1 3 9 7 and press the ENTER key (✓).

This anticipatory fault is only performed while the chiller is stopped. If a “Condenser – High Pressure” fault is detected while the chiller is in Pre-lube, System Run or Coastdown, the fault is handled in the normal way and does not require the special reset procedure.

SECTION 22

DIAGNOSTICS & TROUBLESHOOTING

The problems that could be encountered in the Control Center are in the following categories:

- Keypad
- Display
- Serial Input/Output (I/O)
- Digital Input/Output (I/O)
- Analog Inputs

There is a Diagnostic and associated Troubleshooting procedure for each category. They are described on the following pages. Each Diagnostic is accessed from the Diagnostics Main Screen, which is entered using the procedure below. If there is a Control Center problem, determine the category of the problem. Then perform the applicable Diagnostic. If the Diagnostic reveals a malfunction, perform the Troubleshooting procedure to locate the defective component.

There are several documents that must be referred to while performing the Diagnostics and Troubleshooting procedures. Each procedure references the Section and figures of this book that describe the operation of the component being tested. Also, the applicable Control Center wiring diagram must be used as follows: 160.80-PW1 (Electro-Mechanical Starter) or 160.80-PW2 (Mod "B" Solid State Starter).

There are two versions of the Diagnostics screens available as follows:

1. Shown in figures 50 through 57. These screens are used during the Diagnostics and Troubleshooting process. They allow output states to be changed. Access the Diagnostics Main Screen as follows:
 - a. The chiller must be stopped.
 - b. Place Compressor Start/Stop switch in the Stop-Reset position (O).
 - c. Ensure the Compressor motor current is 0% FLA.
 - d. Log in at SERVICE access level using access code 1 3 8 0.
 - e. Move Microboard Program Switch SW1-4 to the ON position. A Watchdog reset will occur and the Boot-up process will commence. At the completion of the Boot-up process, the Diagnostics Main Screen will appear. (Note: If SW1-4 is moved to the ON position before step 4 above is performed, the "LOG IN" key will be displayed and Logging in at SERVICE access level must be performed before the Main Screen is displayed.
2. Not shown. Available when logged in at SERVICE access level, whether the chiller is running or not. Accessed from the SETUP screen via the SETPOINTS screen. There are two screens available that allow the Analog Inputs voltage levels and Digital I/O states to be monitored. These screens are preceded by a general screen that provides the installed software versions.

SOFTWARE VERSION

Controls - FLASH Memory Card on Microboard

BIOS - BIOS EPROM on Microboard

Kernel - Software that is part of FLASH Memory Card

GUI - Software that is part of FLASH Memory Card

SIO - Software that is part of FLASH Memory Card

GPIC - EPROM in MicroGateway

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MAIN DIAGNOSTICS SCREEN



FIG. 49 – MAIN DIAGNOSTICS SCREEN

00211VIP

Each of the Diagnostics is accessed from this screen. Press the appropriate key to select the desired diagnostic. After each diagnostic is performed, return to this MAIN Screen, from which the next diagnostic can be selected.

Some of the diagnostics have sub-screens that are accessed from the selected diagnostic screen. The sub-screens are shown indented:

Main screen

- Keypad test
- Display test
 - Bit patterns test
 - All red
 - All green
 - All blue
 - All white
 - All black
- Serial I/O test
- Digital I/O test
- Analog Inputs

The ADVANCED SECURITY key is used during the manufacturing process and has no field service use.

KEYPAD TEST

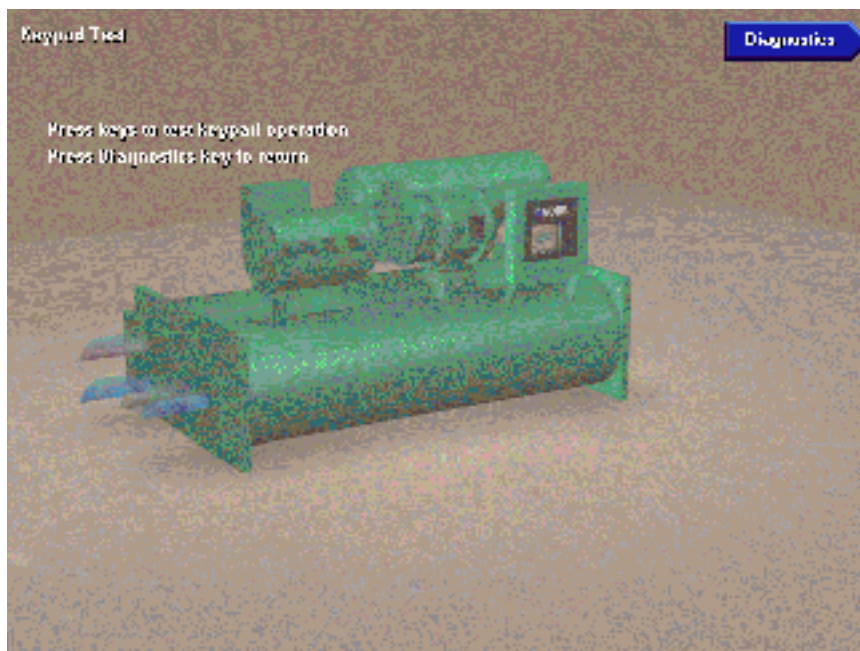


FIG. 50 – KEYPAD TEST SCREEN

00212VIP

This diagnostic is used to verify Keypad operation and the Microboard's ability to respond to a pressed key. Refer to description of Keypad operation in Section 8 of this book.

PROCEDURE

1. Press each keypad key. As the key is pressed, an illuminated LED is displayed corresponding to the key location on the keypad.
2. Press the DIAGNOSTICS key to return to the MAIN DIAGNOSTICS Screen.

TROUBLESHOOTING

If an LED is not displayed when a key is pressed, the Keypad, Keypad ribbon cable or Microboard could be defective. Use the following procedure to locate the defective component.

1. Keypad

- a. Disconnect the ribbon cable from the Keypad.

- b. Identify row/column coordinate of the key to be tested. Refer to Figure 31.
- c. In the Keypad connector, locate the pins of the row/column coordinate of the key of the key to be tested.
- d. Insert the leads of an Ohmmeter into the pins identified in step "c" above.
- e. Press the key to be tested. If the contact resistance is >100 Ohms, the Keypad is defective.
- f. Release the key. If the contact resistance is <1 Meg Ohm, the Keypad is defective.

2. Ribbon Cable

Using an Ohmmeter, perform a continuity test on all conductors in the ribbon cable. An open circuit would indicate the ribbon Cable is defective.

3. Microboard

There are no checks or measurements to be made on the Microboard. If the Keypad and Ribbon Cable check OK per the above procedures, the Microboard is most likely the cause of the problem.

DISPLAY TEST



FIG. 51 – DISPLAY TEST MAIN SCREEN

00213VIP

Each of the Display Diagnostics is accessed from this screen. After each diagnostic is performed, return to this screen, from which the next diagnostic can be selected. Refer to description of Display operation in Sections 5 through 7 of this book.

PROCEDURE

1. Press the appropriate keypad key to perform the desired test from the list below.
2. Press the CANCEL (X) or ENTER (✓) key to terminate test and return to DISPLAY TEST MAIN SCREEN, from which another test can be selected.
3. When all the desired tests have been performed, press the DIAGNOSTICS key to return to the MAIN DIAGNOSTICS SCREEN.
 - **Bit Patterns** - This test is used to detect jitter and alignment defects. It verifies proper operation and compatibility of the Microboard Display Controller with the display. Four vertical bars of green, dark blue, light blue and yellow, outlined by a red border are displayed. If the vertical bars are not stable or straight, or the red border is not completely visible, then either the Microboard Program Jumpers are not configured correctly for the installed display or the Microboard Display controller is defective. Refer to Figure 53.
 - **All Red** - This test verifies the operation of all of the red pixels. All of the red pixels are turned on

to create a completely red screen. Any red pixels that do not turn on will appear as black dots on the display. If any black dots appear, first ascertain it is not caused by dirt that is lodged between the display surface and the protective plastic cover. It is normal for a small number of randomly spaced pixels to not illuminate. It is not necessary to replace the display if a small number of black dots appear. They will not be visible on the normal screens displayed outside of this diagnostic mode. However, large black areas would be indicative of a defective display.

- **All Green** - This test verifies the operation of all of the green pixels. All of the green pixels are turned on to create a completely green screen. Refer to description of “All Red” test above.
- **All Blue** - This test verifies the operation of all of the blue pixels. All of the blue pixels are turned on to create a completely blue screen. Refer to description of “All Red” test above.
- **All White** - This test verifies the display’s ability to turn on all pixels to display a completely white screen. Any pixel that does not turn on will appear as a black dot. Refer to description of “All Red” test above.
- **All Black** - This test verifies the display’s ability to turn off all pixels to display a completely black screen. Any pixel that does not turn off will appear as a red, green, blue or white dot. Refer to description “All Red” test above.

BIT PATTERNS TEST SCREEN

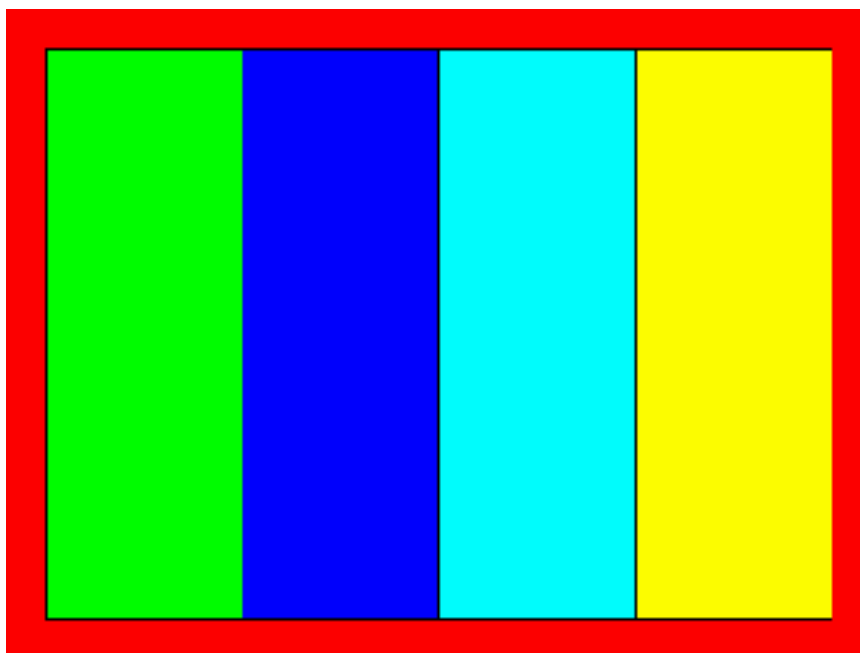


FIG. 52 – BIT PATTERNS TEST SCREEN

00214VIP

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TROUBLESHOOTING

If any of the above tests do not perform correctly as described above, perform the applicable procedure below:

Test Failed:

Bit Patterns - If the vertical bars are not straight or if the red border is not completely visible, either the Microboard Program Jumpers are not configured correctly or for the installed Display or the Microboard is defective.

All Red, All Green, All Blue, All White or All Black:

If these tests do not produce appropriate solid color screens, the Display Ribbon Cable, Display Interface Board, Microboard or Display could be defective. To locate the defective component perform tests in the following order:

1. Display Ribbon Cable:

Using an Ohmmeter, perform a continuity test on all conductors in the ribbon cable. An open circuit would indicate the ribbon cable is defective.

2. Display Interface Board:

Using an Ohmmeter, perform a continuity test on all conductors of the Interface Board. An open circuit would indicate the Interface Board is defective.

3. Microboard:

- a. With the “All Red” test selected, the voltage at Microboard J5-6 through J5-11 (Red drivers bits 0-5), as measured to Gnd, should be $> 3.0\text{VDC}$. If not, the Microboard is defective.
- b. With the “All Green” test selected, the voltage at Microboard J5-13 through J5-18 (Green drivers bits 0-5), as measured to Gnd, should be $> 3.0\text{VDC}$. If not, the Microboard is defective.
- c. With the “All Blue” test selected, the voltage at Microboard J5-20 through J5-25 (Blue drivers bits 0-5), as measured to Grid, should be $> 3.0\text{VDC}$. If not, the Microboard is defective.
- d. With the “All White” test selected, the voltage at Microboard J5-6 through J5-11, J5-13 through J5-18 and J5-20 through J5-25 should be $> 3.0\text{VDC}$. If not, the Microboard is defective.
- e. With “All Black” selected, the voltage at Microboard J5-6 through J5-11, J5-13 through J5-18 and J5-20 through J5-25 should be $< 1.0\text{VDC}$. If not, the Microboard is defective.

4. Display:

If the Display Ribbon Cable, Display Interface Board and Microboard check OK per the above procedures, the Display is most likely the cause of the problem.

SERIAL INPUTS / OUTPUTS TESTS

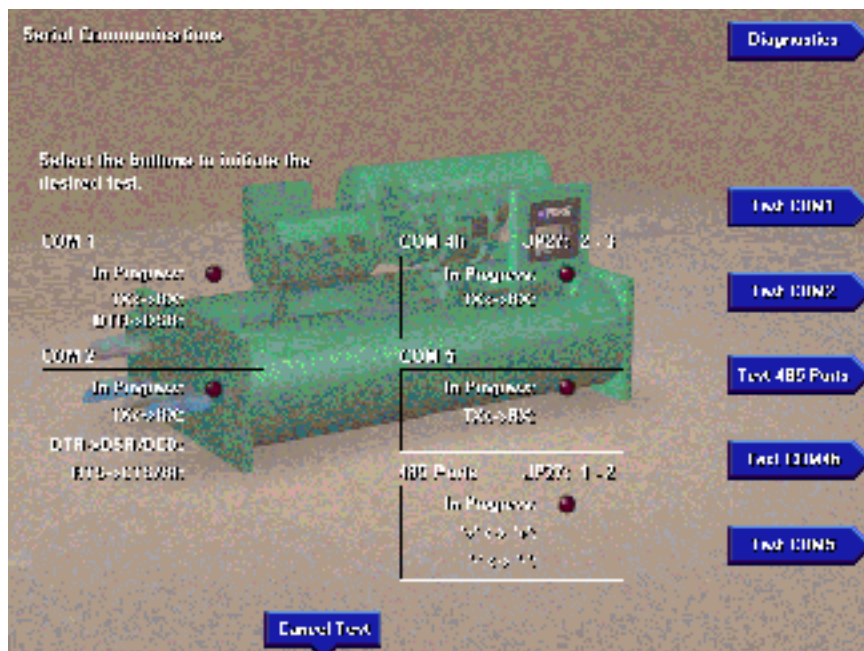


FIG. 53 – SERIAL INPUTS / OUTPUTS TEST SCREEN

00215VIP

This diagnostic is used to verify correct operation of the Serial Data Ports. There is a test for each of the five Serial Data Ports. Each RS-232 port (COM 1, 2 and 4b) is tested by transmitting serial test data from outputs to inputs of each port. Both the transmit and receive functions as well as the control lines are tested. The RS-485 ports (COM 3 and 4a) are tested by transmitting serial test data from one RS-485 port to another. The TX/RX opto-coupled port (COM 5) is tested by transmitting serial test data from the TX output to the RX input. If the received data matches the transmitted data, PASS is displayed, indicating the serial port is OK. Otherwise, FAIL is displayed, indicating the serial port is defective. Prior to performing each test, the Service Technician must install a wire loop-back connection as described below. Refer to Section 3 and Figure 9 of this book for description of the Serial data Ports.

PROCEDURE

- Using small gauge wire, fabricate loop-back connections and install as follows for each port to be tested. Failure to install the loop-back connection or configure the Microboard Program jumper as noted will result in a FAIL outcome for the test.

	From	To
COM 1	J2-4 (TX)	J2-3 (RX)
	J2-5 (DTR)	J2-2 (DSR)

	From	To
COM 2	J13-5 (TX)	J13-3 (RX)
	J13-7 (DTR)	J13-1 (DCD) & J13-2 (DSR)
	J13-4 (RTS)	J13-6 (CTS) & J13-8 (RI)

	From	To
RS-485 (COM 3 & 4a)	J12-3 (+)	J11-3 (+)
	J12-2 (-)	J11-2 (-)

Microboard Program Jumper JP27 must be installed in position 1 & 2.

	From	To
COM 4b	J2-7 (GTX)	J2-6 (GRX)

Microboard Program Jumper JP27 must be installed in position 2 & 3.

	From	To
COM 5	J15-1 (TX)	J15-4
	J15-2 (RX)	J15-5
	J15-3 (Common)	J15-6

Make individual wire connections or use YORK loop-around diagnostic connector 025-33778-000 as depicted in Figure 55. This connector is available from the YORK Parts Distribution Center.

2. After connecting appropriate loop-back connections above, press the appropriate key to initiate the desired test. An LED will illuminate indicating the test is in progress. If it is desired to terminate the test, press the CANCEL TEST key. Test data is sent from an output to an input as described below. At the completion of each test, if the data received matches the data sent, the Serial Port operates properly and PASS is displayed. Otherwise, FAIL is displayed, indicating the Serial Port is defective. A FAIL result would be indicative of a defective Microboard. The following is a description of each test.

COM 1 – Two tests are performed. Test data is sent from TX (J2-4) to RX (J2-3) at 9600 Baud and DTR (J2-5) is set to a Logic High level and read at DSR (J2-2). If any test fails, COM 1 tests are terminated.

COM 2 – Three tests are performed. Test data is sent from TX (J13-5) to RX (J13-3) at 19200 Baud. DTR (J13-7) is set to a Logic High and

read at DSR (J13-2) & DCD (J13-1). RTS (J13-4) is set to a Logic High and read at CTS (J13-6) & R1 (J13-8). If any test fails, COM 2 tests are terminated.

RS-485 (COM 3 & 4a) – Test data is sent from COM 3 RS-485 port to COM 4a RS-485 Port at 19200 Baud. Test data is then sent from COM 4a to COM 3 at the same rate. If either test fails, RS-485 tests are terminated.

COM 4b – Test data is sent from GTX (J2-7) to GRX (J2-6) at 19200 Baud.

COM 5 – Test data is sent from TX (J15-1) to J15-4 at 1200 Baud. This output turns the Microboard's loop-around test Transistor on and off, applying 0/+5VDC pulses from J15-5 to RX (J15-2) input.

3. After all desired tests have been performed, press the **DIAGNOSTICS** key to return to the **MAIN DIAGNOSTICS** Screen.

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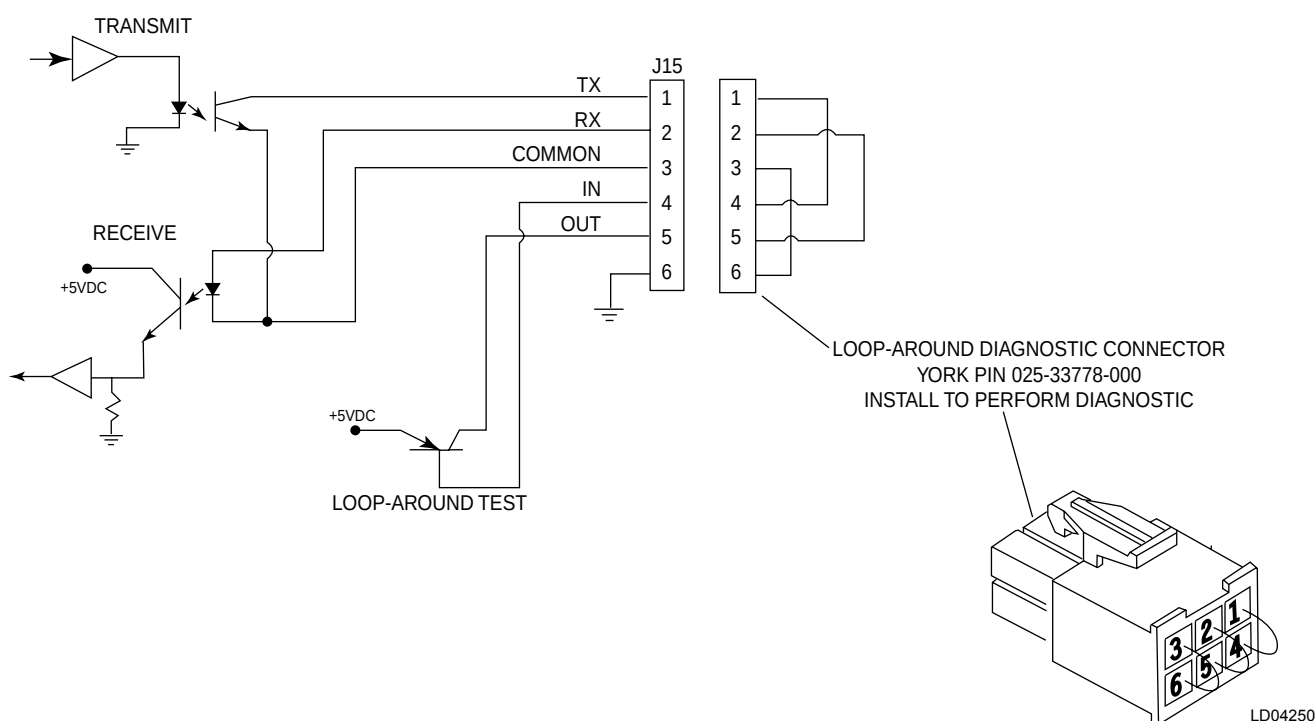


FIG. 54 – MICROBOARD - COM 5 SERIAL DATA PORT

DIGITAL INPUTS / OUTPUTS TESTS

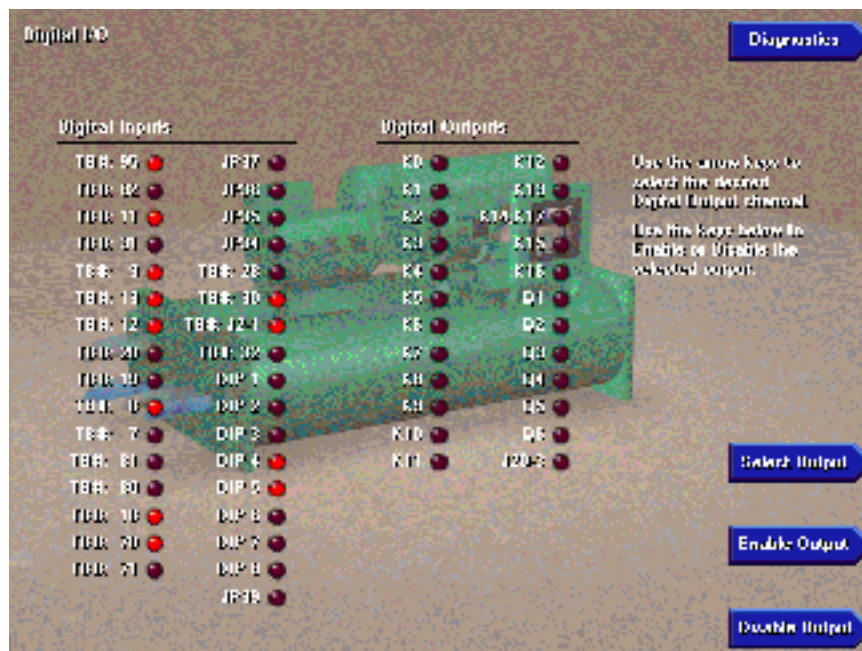


FIG. 55 – DIGITAL INPUTS / OUTPUTS TEST SCREEN

00216VIP

This diagnostic is used to analyze the digital inputs and outputs of the Microboard. Refer to description of I/O Board in Section 4 of this book.

The state of each Microboard Digital Input, Program Jumper and Program DIP Switch, as interpreted by the Microboard, is depicted by an LED. If the Microboard interprets its input as being at a Logic Low (<1.0VDC) level, the LED is illuminated. If interpreted as being at a Logic High (>4.0VDC) level, the LED is extinguished.

The state of the Microboard's intended drive signals to each of the Relays on the I/O Board is depicted by an LED. If the intended output is a Logic Low level (<1.0VDC), the LED is illuminated. If the intended output is a Logic High level (>10.0VDC), the LED is extinguished. Logic Low outputs energize the Relays. Logic High outputs de-energize the Relays. The state of any output can be manually set to either the ENABLED (Logic Low) or DISABLED (Logic High) state.

PROCEDURE

Digital Inputs:

1. The Digital Inputs are listed on this screen according to a.) Terminal number on the I/O Board and b.) Microboard Program Jumpers and Program DIP Switches. Figure 12 shows the devices con-

nected to these terminals. Tables 1 and 2 list the functions of the Program Jumpers and Switches.

2. With 115VAC applied to a particular I/O Board Digital Input, the applicable LED should be illuminated. If the LED is not illuminated, perform appropriate Troubleshooting procedure below.
3. With 0VAC applied to a particular I/O Board Digital Input, the applicable LED should be extinguished. If the LED is not extinguished, perform appropriate Troubleshooting procedure below.
4. If a Program Jumper is present, the applicable LED should be extinguished. If the LED is not extinguished, the Microboard is defective.
5. If a Program Jumper is not present, the applicable LED should be illuminated. If the LED is not illuminated, the Microboard is defective.
6. If a Program Switch (DIP) is in the ON position, the applicable LED should be illuminated. If the LED is not illuminated, the Microboard is defective.
7. If the Program Switch (DIP) is in the OFF position, the applicable LED should be extinguished. If the LED is not extinguished, the Microboard is defective.
8. When all desired tests have been performed, press DIAGNOSTICS key to return to MAIN DIAGNOSTICS Screen.

Digital Outputs:

1. **IMPORTANT!** - The following steps cannot be performed until the Motor Controller connection between TB6-1 and TB6-53 has been removed. This connection could be a jumper or it could be a connection from external devices in the starter. The Program will prevent manual control of Digital Output devices until this connection is removed.
2. The Digital Outputs are listed on this Screen according to Relay and Triac number (KI, Q3, etc.). Figure 15 shows the external devices that are connected to these Relays and Triacs and the functions of each one.
3. Press SELECT key. An arrow will appear adjacent to Relay KO.
4. Select a relay or triac for manual control by using the ▲ and ▼ keys to place the arrow adjacent to the desired device.
5. Press the ENABLE OUTPUT key to enable the selected output. The LED adjacent to the selected output should illuminate. If it does not, perform KEYPAD Diagnostics test. If a relay is selected, it should energize, closing its contacts. If a triac is selected, it will turn on, energizing the device it is connected to. If the relay does not energize or triac does not turn on, perform appropriate troubleshooting procedure below.
6. Press the DISABLE OUTPUT key to disable the selected output. The LED adjacent to the selected output should extinguish. If it does not, perform KEYPAD diagnostic test. If a relay is selected, it should de-energize, opening its contacts. If a triac is selected, it will turn off, de-energizing the device it is connected to. If relay does not de-energize or triac does not turn off, perform appropriate troubleshooting procedure below.
7. When all desired tests have been performed, press DIAGNOSTICS key to return to the MAIN DIAGNOSTICS Screen.
8. Install Motor Controller connection from TB6-I to TB6-53 removed in step 1.

Digital Inputs Troubleshooting:

If any of the Digital Inputs tests fail to perform as described above, perform the following steps in sequence. Refer to Figure 12 and applicable wiring diagram referenced at the beginning of Section 21. If a defective component is found during any of the following steps, replace the component as instructed and repeat the digital

Inputs Procedure above to determine if the problem has been resolved.

1. Remove I/O Board ribbon cable. Using an Ohmmeter, perform a continuity check on I/O Board ribbon cable J1-21 to J19-21, J1-22 to J19-22 and applicable output pin of function that failed in Procedure above. If an open circuit is detected, replace ribbon cable. Otherwise, install ribbon cable and proceed to next step.
2. Measure the +5VDC supply voltage to the I/O Board on I/O Board between J1-21 and J1-22. If >4.5VDC, proceed to next step. If < 4.5VDC, disconnect ribbon cable at I/O Board J1 and repeat the measurement at J1. If <4.5VDC, replace the Microboard. Re-install the ribbon cable.
3. With 115VAC ($\pm 10\%$) applied to the I/O Board digital input that failed in Procedure above, the applicable I/O Board output at J1 should be at a Logic low level (<1.0VDC). If it is >1.0VDC, replace the I/O Board. If the output is at a Logic Low level, the applicable LED should be illuminated. If the LED is not illuminated, replace the Microboard.
4. With 0VAC applied to the I/O Board digital input that failed in Procedure above, the applicable I/O Board output at J1 should be at a Logic High level (>4.0VDC). If it is <4.0VDC, replace the I/O Board. If the output is at a Logic High level, the applicable LED should be extinguished. If it is not extinguished, replace the Microboard.

Digital Outputs Troubleshooting:

If any of the Digital outputs tests fail to perform as described above, perform the following steps in sequence. Refer to Figure 15 and applicable wiring diagram referenced at the beginning of Section 21. If a defective component is found during any of the steps, replace the component as instructed and repeat the Procedure above to determine if the problem has been resolved.

1. Remove I/O Board ribbon cable. Using an Ohmmeter, perform a continuity test on the cable J1-25 to J19-25, J1-26 to J19-26 and applicable output pin of function that failed in Procedure above. If an open circuit is detected, replace ribbon cable. Otherwise, install ribbon cable and proceed to next step.
2. Measure the +12VDC supply voltage to the I/O Board on I/O Board between J1-26 (+12VDC) and J1-25 (Gnd). If >11.0VDC, proceed to next step. If <11.0VDC, disconnects ribbon cable at I/O Board J1 and repeat measurement at J1. If <11.0VDC, replace the Microboard. Reinstall the ribbon cable.

3. Using the Digital Outputs Procedure above, select the output that failed the digital Output test above.
4. Press ENABLE OUTPUT key. The LED adjacent to the selected output will illuminate. The appropriate Microboard output pin at J19 for the selected output should be at a Logic Low level (<1.0VDC). If it is >1.0VDC, replace the Microboard. With the output at a Logic Low, the following should occur:
 - a. If a Relay is selected as the output, the contacts of the relay should be closed. If they are not closed, replace the I/O Board.
 - b. If a Triac is selected as the output, the Triac should be turned on. If the Triac has not turned on, replace the I/O Board. See note 1 below for Triac testing.
5. Press DISABLE OUTPUT key. The LED adjacent to the selected output will extinguish.
 - a. If a Relay is selected as the output, the appropriate Microboard output pin at J19 for the selected output should be at a Logic High (>10.0VDC) level. With the output at a Logic High level, the relay contacts should be open. If they are not open, replace the I/O Board. If it is <10.0VDC, remove the ribbon cable from J1 of the I/O Board. On the I/O Board, measure the resistance from J1-26 to the appropriate pin of J1 on the I/O Board for the selected relay. If the resistance is >100 Ohms, replace the I/O Board. If the resistance is <100 Ohms, replace the Microboard.
 - b. If a Triac is selected as the output, the appropriate Microboard output pin at J19 for the selected output should be at a Logic High (>10.0VDC) level. If it is <10.0VDC, replace the Microboard. With the output at a Logic High level, the Triac should be turned off. If the Triac has not turned off, replace the I/O Board. See note 1 below for Triac testing.

Notes:

1. The load (actuator) must be connected across the Triac to determine the on/off state of the Triac. The on/off state of the Triac can be determined by measuring across the device (for example, TB1-3 to TB1-59 or TB1-58 to TB1-59) with an AC Voltmeter. If the Triac is turned on, the voltage will be <10VAC. If the Triac is turned off, the voltage will be >100VAC (Slide Valve actuator).

ANALOG INPUTS TEST

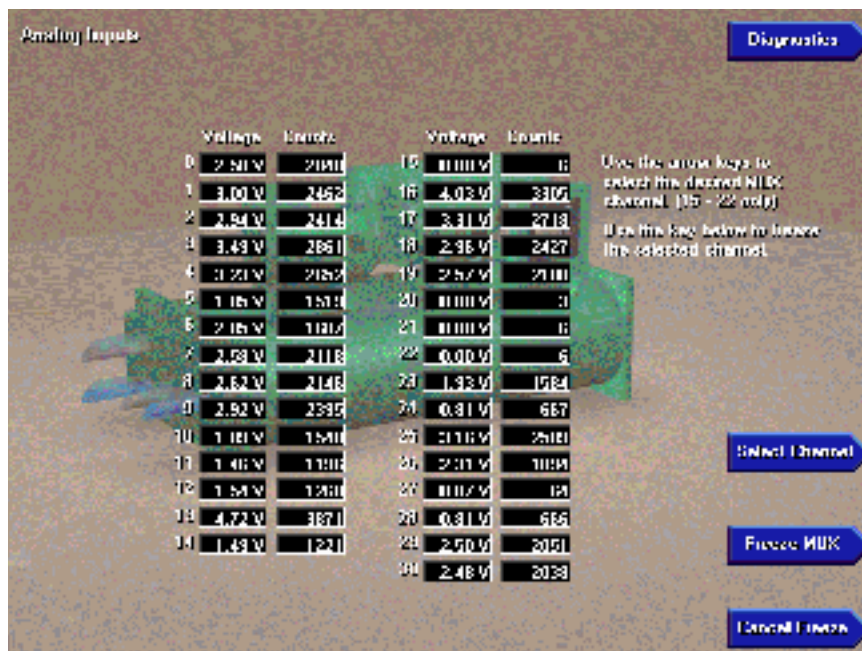


FIG. 56 – ANALOG INPUTS TEST SCREEN

00217VIP

This diagnostic is used to analyze the Analog Inputs to the Microboard. The voltage level of each Analog input, as interpreted by the Microboard, is displayed. The “Counts” listed for each parameter is the Analog-to-Digital (A/D) converter value and is for manufacturing and engineering use only.

If the chiller is shutting down on an Analog Safety or is prevented from starting because of an Analog input, there is probably an Analog Input problem. This Screen can be used in the investigation of this problem.

Important! This test does not apply to the Leaving Chilled Liquid Temperature analog input or a 0-10VDC Remote Setpoint input at channels 27 and 28.

The following is a list of the Analog inputs displayed. Refer to the appropriate Section of this book for an explanation of each: Pressure Transducers - Section 14, Thermistors - Section 15, Solid State Starter - Section 11 (Mod “A”) and Current Module (CM-2) - Section 10.

Channel

- 0 - +2.5VDC Analog supply voltage reference. Microboard TP6.
- 1 - Not Used.
- 2 - Return Chilled Liquid Temperature
- 3 - Leaving Condenser Liquid Temperature
- 4 - Return Condenser Liquid Temperature

- 5 - Not Used.
- 6 - Discharge Temperature
- 7 - Oil Temperature
- 8 - Evaporator Refrigerant Temperature
- 9 - Condenser Pressure
- 10 - Evaporator Pressure
- 11 - Filter Oil Pressure
- 12 - Oil Pressure
- 13 - Not Used.
- 14 - Seal Oil Pressure
- 15 - Mod “A” Solid State Starter/CM-2 MUX output Channel 0
- 16 - Mod “A” Solid State Starter/CM-2 MUX output Channel 1
- 17 - Mod “A” Solid State Starter/CM-2 MUX output Channel 2
- 18 - Mod “A” Solid State Starter/CM-2 MUX output Channel 3
- 19 - Mod “A” Solid State Starter/CM-2 MUX output Channel 4
- 20 - Mod “A” Solid State Starter/CM-2 MUX output Channel 5
- 21 - Mod “A” Solid State Starter/CM-2 MUX output Channel 6
- 22 - Mod “A” Solid State Starter/CM-2 MUX output Channel 7

- 23 - Not Used.
- 24 - Slide Valve Potentiometer
- 25 - Not Used.
- 26 - Not Used.
- 27 - Remote Leaving Chilled Liquid Temperature Setpoint (0-20mA or 4-20mA)
- 28 - Remote Current Limit Setpoint (0-20mA or 4-20mA)
- 29 - Not Used
- 30 - Not Used

Procedure:

1. From the chart above, select the analog input that is malfunctioning. All inputs except channel 0, 15 through 22, 27 and 28 are sensors that connect directly to the Microboard via shielded cable. Channel 0 is a reference voltage for the Analog circuits on the Microboard. Channels 15 through 22 are multiplexed outputs from the Mod "A" Solid State Starter (Solid State Starter applications) or CM-2 Current Module (Electro-Mechanical Starter applications). Channels 27 and 28 are Remote Setpoint inputs used in Analog Remote mode.

2. Refer to Wiring Diagrams listed in front of this Section to identify the device that performs this function and the jack and pin connection to the Microboard.

3. • Channel 0:

Using a Voltmeter, measure the voltage between Microboard TP6 (+2.5VDC) and TP1 (Gnd).

Compare this measured value to the displayed value. If the value is not within $\pm 10\%$, replace the Microboard.

• All channels except 0, 1, 15-22:

Using a Voltmeter, measure the analog input to the Microboard. Make the measurement between the device output and Ground connection to the device. For example, measure the output of the Evaporator Transducer at Microboard J8-18 (signal) to J8-9 (Gnd).

• Channels 15-22:

Select the desired channel by pressing the SELECT CHANNEL key and using the ▲ and ▼ keys to place the arrow head next to the desired channel. Then, freeze the address of that channel to the Mod "A" Solid State Starter or CM-2 Mux. Then measure MUX output at Microboard J10-6 (signal)

to J10-5 (Gnd). When completed, press CANCEL FREEZE key.

• Channels 27,28:

IMPORTANT! This procedure only applies to 4-20mA inputs. It does not apply to 0-10VDC inputs. Using a Voltmeter, measure the Remote Current Limit setpoint input at J22-2 (signal) or Remote Leaving Chilled Liquid Temperature setpoint input at J22-4 (signal) to J22-5 (Gnd).

4. Compare the measured value in the previous step with the value displayed on the Analog Inputs Screen for that value.
5. If the measured value is not within $\pm 15\%$ of the displayed value, replace the Microboard. Otherwise, proceed to the troubleshooting procedure below to find the cause of the problem.
6. When all desired tests have been performed, press DIAGNOSTICS key to return the MAIN DIAGNOSTICS Screen.

Troubleshooting :

• All Channels except 0, 1, 15-22, 27, 28:

1. Disconnect both ends of the cable of the Analog input that is malfunctioning. Using an Ohmmeter, perform a continuity test on all conductors in the cable. An open circuit would indicate the cable is defective.
2. Using a Voltmeter, measure the +12VDC supply voltage input at the Microboard J1-3 (+12VDC) to J1-2 (Gnd). If voltage is $< 11.5\text{VDC}$, check wiring to Power Supply. If wiring is OK, the Power supply is most likely defective.
3. Using a Voltmeter, measure the supply voltage (+5VDC, +1 2VDC or +24VDC) to the sensor. If voltage is not within $\pm 10\%$ of specified voltage, disconnect J7, J8 and J9 from the Microboard. This disconnects all analog devices from the Microboard. If the voltage increases to the correct level, a Thermistor or Transducer is shorted. Locate the shorted device and replace. If, after disconnecting the connectors the supply voltage is still not within 10% of the specified value, the voltage supply source (Microboard or Power Supply) is most likely defective.
4. Verify sensor accuracy using appropriate test device. Replace sensor if necessary.

• **Channels 15 - 22:**

1. Disconnect both ends of ribbon cable connected to Microboard J10. Using an Ohmmeter, perform a continuity test on all conductors in the cable. An open circuit would indicate the cable is defective.
2. Using a Voltmeter, measure the +12VDC supply voltage input at the Microboard J1-3 (+12VDC) to J1-2 (Gnd). If voltage is <11.5VDC, check wiring to Power Supply. If wiring is OK, the Power Supply is most likely defective.
3. Using a Voltmeter, measure the +5VDC supply voltage to the Solid State Starter Logic Board or CM-2 Board. Make measurement at Microboard J10-4(+5VDC) to J10-5 (Gnd). If voltage is <4.5VDC, replace the Microboard.
4. Using a Voltmeter, verify the correct address is being sent from the Microboard to the Mod "A" Solid State Starter Logic Board or CM-2 Board. Freeze address as described above. If the address is correct, the Solid State Starter Logic Board or CM-2

Board or input devices to these boards is most likely the cause of the problem. If address is not correct, the Microboard is most likely the cause of the problem.

5. Press CANCEL FREEZE key.

• **Channels 27, 28:**

1. Refer to Table 1 "Microboard Program Jumpers" and verify Program Jumpers JP23 and JP24 are configured correctly for the type of input (0-10VDC or 4-20mA).
2. Disconnect both ends of the cable of the remote input that is malfunctioning. Using an Ohmmeter, perform a continuity check on all conductors in the cable. An open circuit would indicate the cable is defective.
3. If steps are OK, problem most likely is in the remote device that supplies the remote signal.

SECTION 23

SYSTEM COMMISSIONING CHECKLIST

Use the following checklist during commissioning to assure all Setpoints have been programmed to the desired value and all calibrations have been performed. The programming of some of the Setpoints require a **SERVICE** access level. To assure access to all Setpoints, log in at **SERVICE** access level before beginning. The Setpoints are grouped under the Display Screen in which they appear. The indented screens are subscreens of the numbered screens and are accessed from the numbered screens. An explanation of each setpoint or Calibration Procedure below is contained in the reference document listed in parenthesis adjacent to each item. If any of the Setpoints have to be changed, use the standard programming procedures in Operation Manual Form 160.80-O1. Thresholds, values and calibrations of items marked with an asterisk "*" have been determined and entered/set at the YORK Factory at the time of manufacture.

1. **PROGRAM JUMPERS/SWITCHES:**

(160.80-M1)

____ Verify Microboard Program Jumpers and Program Switches are configured appropriately. If equipped with Microboard 031-01730-000, refer to Section 3 Tables 1 and 2. If equipped with Microboard 031-02430-000, refer to Section 3A Table 3 and 4.

2. **EVAPORATOR Screen:** (160.80-O1)

Enter the following Setpoints:

____ Leaving Chilled Liquid Temp (except ISN Remote mode)

____ Remote Leaving Chilled Liquid Temp Setpoint Range (except ISN Remote mode)

____ Low Chilled Liquid Temp cycling shutdown temperature

____ Low Chilled Liquid Temp cycling shutdown Restart temperature

____ Leaving Chilled Liquid Temp Control Sensitivity (160.80-M1)

____ Brine Low Evaporator Pressure Cutout threshold* (160.80-M1)

____ Ice Storage Mode On/Off (160.80-O1)

____ Smart Freeze Protection On/Off (160.80-M1)

____ Refrigerant Temp sensor Enable/Disable (160.80-M1)

3. **CONDENSER Screen:** (160.80-M1)

____ Enter the High Pressure Limit/Warning threshold Setpoint

____ Freeze Warning (standby chiller freeze protection) - Enable/Disable (160.80-M1)

____ Freeze Warning Time Delay (160.80-M1)

VARIABLE ORIFICE CONTROL

____ Enter the Delta P Setpoint.

4. **COMPRESSOR Screen:** (160.80-M1)

____ Maximum Load

____ Maximum Load Temperature

____ Maximum Load FLA

____ Select Minimum Load Control Source (Slide Valve or Motor FLA).

____ If Motor FLA selected, enter Minimum Load FLA

HOT GAS BYPASS Screen: (160.80-M1)

If chiller is equipped with optional Hot Gas Bypass, enable operation on the **OPERATIONS** screen and enter the following setpoints:

____ On Setpoint

____ Off Setpoint

SLIDE VALVE CALIBRATE Screen:

____ Perform Slide Valve calibration

5. **OIL SUMP (SEPARATOR) Screen:**

(160.80-M1)

____ Auto Zero Enable/Disable

____ Seal Pressure Enable/Disable

____ Oil Recovery Enable or Disable (Flash Memory Card version C.MLM.03.03.xxx and later). Should only be enabled if oil recovery is required.

6. **MOTOR Screen:** (160.80-O1)

____ Local Motor Current Limit

____ Pulldown Demand Limit

____ Pulldown Demand Time

Solid State Starter applications: (160.80-M1)

Mod "B" Solid State Starter:

Verify the following Setpoints have been programmed:

____ Full Load Amps*

____ Start Current*

____ Supply Voltage Range*

____ Enable Open SCR Detection

____ Enable Shorted SCR Detection (Flash Memory Card version C.MLM.03.01 or later)

____ KWH Reset

Mod "A" Solid State Starter:

Verify the following Setpoints have been programmed:

- ☐ Full Load Amps*
- ☐ Supply Voltage Range*
- ☐ Current Unbalance Check - Enable/Disable*

Logic Board:

- ☐ Verify location of 300V/600V Jumper*
- ☐ Verify Start Current calibration*
- ☐ Verify 105% FLA calibration*

Electro-Mechanical Starter applications:
 (160.80-M1)
Current Module:

- ☐ Verify Switch S1 (Y-delta/57% or all others) setting*
- ☐ Verify Pot R16 (LRA/FLA ratio) setting*
- ☐ Verify slide bar resistor "RES" setting*
- ☐ Verify 105% FLA calibration*
- ☐ Verify 100% FLA display*

7. SETPOINTS Screen: (160.80-O1)

The setpoints listed on the **SETPOINTS** Screen have already been programmed above on Previous Screens. The values shown reflect the previously programmed values. However, the setpoints listed here can be changed on this screen if desired. This screen is used primarily as a central location from which most setpoints can be programmed. If it is not desired to change any of the listed setpoints, proceed to the **SETUP** Screen below.

SETUP Screen:

- ☐ 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. These were configured in step 1 above. Confirm they are correct. (160.80-M1 Section 3)

Microboard 031-02430-000:

- ☐ The state of Program Switches SW1-1 (Refrigerant Selection) and SW1-2 (Liquid Type) is displayed. These were configured in step 1 above. Confirm they are correct. (160.80-M1)

Enter the following Setpoints: (160.80-M1)

- ☐ Chilled Liquid Pump Operation
- ☐ Motor Drive Type
- ☐ Anti-Recycle

- ☐ Power Failure Restart

SCHEDULE Screen:

- ☐ Enable or Disable Daily start/stop schedule as required.

- ☐ Enter chiller **START/STOP** schedule if required.

USER Screen:

- ☐ Select desired Display language
- ☐ Select desired Display units; **ENGLISH** or **METRIC**

- ☐ If desired, establish custom **USER IDs** and **PASSWORDS** (160.80-M1)

COMMS Screen:

If Modem and or Printer is connected to the Microboard Serial data ports, enter the following parameters as required for each device connected:

- ☐ Baud rate
- ☐ Number of data bits
- ☐ Number of stop bits
- ☐ Parity

Enter appropriate number for Modem, Printer or ISN Remote application:

- ☐ Chiller ID (identification)

PRINTER Screen:

If Printer is connected to Microboard serial ports, enter the following:

- ☐ Automatic print logging Enable/disable
- ☐ Automatic printer logging start time
- ☐ Automatic print logging interval
- ☐ Printer type
- ☐ Report type; STATUS, SETPOINTS, SCHEDULE or SALES ORDER

SALES ORDER Screen:

- ☐ Enter system commissioning date

OPERATIONS Screen:

- ☐ Select desired Control Source (operating mode); LOCAL, ISN Remote, DIGITAL Remote or ANALOG Remote
- ☐ Hot Gas Bypass Control (optional) Enable/Disable
- ☐ Edit regional phone number if necessary (Flash memory Card version C.MLM.03.02.xxx and later)
- ☐ Enter Local phone number (Flash memory Card version C.MLM.03.02.xxx and later)

SECTION 24

SERVICE INFORMATION LETTERS / BULLETINS

SI0007 - SOFTWARE ENHANCEMENTS EFFECTIVE MAY 2001

GENERAL

Beginning May 2001, an enhanced Flash Memory Card will be supplied with new production Nema 1-4 and CE chillers. New features are outlined below and are also included in YORK Operation Manual 160.80-O1 and Service Manual 160.80-M1.

Flash Memory Card versions and part numbers are applied as follows:

- Nema 1-4 Chillers C.MLM.03.02A.101 (031-02005-001)
- CE Chillers C.MLM.03.02A.201 (031-02005-002)

The enhanced flash cards are also available from the Baltimore Parts Distribution Center for retrofit to existing chillers.

TREND SCREEN – TRIGGERED CHART

A “TRIGGERED” chart can now be created. This is in addition to the ONE SCREEN and CONTINUOUS chart types that can be created in previous Flash Memory Card versions. With the TRIGGERED chart type, data collection can be set to START or STOP based upon the status of up to two Operator selected conditions (TRIGGERS) and a selected TRIGGER DELAY. If START is selected, data collection will not begin until all triggers have been satisfied and any selected TRIGGER DELAY has elapsed. Data collection will stop at the completion of one screen of data. If STOP is selected, data collection will begin when manually initiated, and will stop when all triggers have been satisfied and any selected TRIGGER DELAY has elapsed.

This feature is a valuable troubleshooting tool for Service technicians. It allows an event that occurs during unattended hours to be captured for viewing at a later time. The trigger event results in a screen of frozen trend data that will remain on the screen until manually cleared.

DISPLAY OF SERVICE PHONE NUMBERS

Two service phone numbers (Regional and Local), with labels, can be displayed on the OPERATIONS Screen. The Default value for the Regional number is the North American Toll Free number. However, the label and number can be changed to any desired value. The Local label and number can also be entered.

“EVAPORATOR-TRANSDUCER OR TEMPERATURE SENSOR” SAFETY SHUTDOWN

In Previous Flash Memory Card versions, the conditions for this safety shutdown were checked after the first 10 minutes of chiller run. Under certain operating conditions this would result in unnecessary shutdowns. In this version, in addition to the previous criteria, the shutdown conditions are not checked unless Smart Freeze is enabled and the Evaporator Refrigerant Temperature RT7 (if enabled) or Evaporator Saturation Temperature (derived from the evaporator pressure transducer) is $< 32^{\circ}\text{F}$.

SI0024 - SOFTWARE ENHANCEMENTS EFFECTIVE MARCH 2002

GENERAL

Beginning March 2002, an enhanced Flash Memory Card will be supplied in new production YS Nema 1-4 and CE chillers. The new features are outlined below.

The Flash Memory Card versions and part numbers are as follows:

- Nema 1-4 Chillers C.MLM.03.03.100 (031-02005-001)
- CE Chillers C.MLM.03.03.200 (031-02005-002)

These versions are also available from the Baltimore Parts Distribution Center for retrofit to existing chillers.

RECORD SETPOINT CHANGES

This feature provides a record of the last 75 Setpoint changes. The date and time the Setpoint was changed, the new Setpoint value and the Access Level and User ID used to make the change are stored in the BRAM. The Security Log Screen and the Security Log Details Screen display levels of this information. Both screens are available in Service Access level or higher.

On the Security Log Screen, accessible from the History Screen, the Setpoint, Setpoint Category and new Setpoint value are listed and numbered in reverse order in which they were changed. The most recent is listed as number 1; the next most recent as number 2, etc. A PRINT key allows printing this entire list. Since 15 changes can be displayed at one time, multiple pages could be necessary to display all the changes. PAGE-UP and PAGE-DOWN keys are provided to view the entire list. If it is desired to view the details of a particular Setpoint change, select the Setpoint change number with the LOG ENTRY key and then press the VIEW DETAILS key. This moves to the Security Log details Screen.

The Security Log Details Screen, accessible from the Security Log Screen, displays the following Setpoint change details. The Setpoint is selected from the list on the Security Log Screen as explained in the previous paragraph. A PRINT key is provided to print this information.

- Setpoint Category
- Setpoint
- Date and time of change
- Access Level and User ID used to make the change
- Old Value
- New Value

SI0091 - SOFTWARE ENHANCEMENTS EFFECTIVE MAY 2004**General**

Beginning May 2004, enhanced software will be supplied in all new production YS chillers. It is backward compatible to all previous YS chillers. The enhancements are outlined below.

The versions and part numbers for 031-01730-000 Microboards are:

- NEMA 1-4 chillers C.MLM.03.04.104 (p/n 031-02005-001)
- CE chillers C.MLM.03.04.204 (p/n 031-02005-002)

The version and part number for 031-02430-000 Microboards is:

- NEMA 1-4 & CE Chillers C.OPT.03.04.301 (p/n 031-02488-001)

High Condenser Pressure Fault While Shutdown

High temperature condenser water flowing through the condenser while the chiller is shutdown can cause a condenser high pressure condition resulting in loss of refrigerant. Therefore, an anticipatory safety fault has been created to annunciate condenser high pressure conditions when the chiller is not running as follows:

While the chiller is stopped, if the condenser pressure exceeds 245.0 PSIG, a safety fault occurs and “Condenser – High Pressure - Stopped” is displayed.

The chiller can be started after the condenser pressure decreases to less than 245.0 PSIG and a special reset procedure is performed as follows:

1. Place the COMPRESSOR switch in the Stop-reset position.
2. At the keypad, login at Service access level using code 1 3 8 0.
3. Select COMPRESSOR screen.
4. Press the FAULT ACKNOWLEDGE key on the COMPRESSOR Screen. A dialog box appears displaying “Enter Password to Clear Fault”.
5. Enter 1 3 9 7 and press the ENTER key (✓).

This anticipatory fault is only performed while the chiller is stopped. If a “Condenser – High Pressure” fault is detected while the chiller is in Start Sequence Initiated, System Run or Coastdown, the fault is handled in the normal way and does not require the special reset procedure.

Style B Solid State Starter Faults

The following changes apply to faults detected by the Style B Liquid Cooled Solid State Starter (LCSSS):

Open SCR (Silicon Controlled Rectifier) Fault

When the Solid State Starter initiates a shutdown, the fault data transferred to the Optiview Control Center is a function of the eprom (U16) in the starter Logic/Trigger Board.

SI0091 - SOFTWARE ENHANCEMENTS EFFECTIVE MARCH 2004 (CONT'D)

Previously, in starters equipped with eeprom version C.SSS.01.00 through C.SSS.01.02, when an Open SCR fault occurred, the fault data returned from the starter did not identify the phase in which the fault occurred. Therefore, the message displayed by the Optiview Control Center was “LCSSS – OPEN SCR”. New version C.SSS.01.03 eeprom now supplied in the starter Logic/Trigger Board, returns fault data that identifies the phase in which the Open SCR condition is detected.

This Flash Memory Card version interprets this fault data and displays a message that identifies the defective phase. Therefore, when this Flash Memory Card version is used with a starter Logic/Trigger Board equipped with version C.SSS.01.03 (and later) eeprom, “LCSSS – Phase X Open SCR” (X replaced by A, B or C as appropriate) is displayed when the fault occurs.

Start Inhibit Faults

The following Start Inhibit Faults are no longer logged on the History Screen. They will continue to be displayed on the System Details line of the display and transferred to the MicroGateway.

“LCSSS – Phase X Heatsink Temperature – Stopped” (X replaced by A, B or C as appropriate)

Diagnostics Screen

The communications error counters now count up to 65535 (was 255).

Invalid System Details Messages

In previous Flash Memory Card versions, there have certain operating conditions that could cause messages on the System Details line of the display to become “stuck”. The most prevalent one was “Motor – High Current Limit”. This has been corrected in this version.

Microgateway Induced Reboots

With previous Flash Memory Card versions, Microgateway communications could cause the Microboard to randomly reboot. This has been corrected in this version.

History Data Storage

The data capture has been modified to assure that all data is that which is valid at the instant of the event.

Microgateway Interface

This version uses Yorktalk 3 version 6.0. This version transfers Start Inhibit and Modified Run codes into the correct Microgateway slots. In previous versions, these were transferred into cycling and safety shutdown slots. This caused the third-party device to interpret these events as safety or cycling events.

The ISN number conversion routine has been modified to correctly interpret Leaving Chilled Liquid Temperature Setpoint resets from the Microgateway in metric mode. Setpoints of 1.6 to 1.9 °C were not interpreted correctly.

NOTES:

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