

 YORK [®] BY JOHNSON CONTROLS	WATER-COOLED SCREW LIQUID CHILLERS	
SERVICE MANUAL	Supersedes: 201.30-M1 (612)	Form 201.30-M1 (912)

MODEL YVWA
Dual Compressor
Style A
50 Hz and 60 Hz
200 - 300 Tons
703 - 1055 kW



LD16421

R-134a

Issue Date:
 September 25, 2012



IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

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

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

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

SAFETY SYMBOLS

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



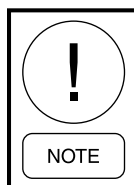
Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.



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



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



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



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

CHANGEABILITY OF THIS DOCUMENT

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

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

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

CHANGE BARS

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

ASSOCIATED LITERATURE

MANUAL DESCRIPTION	FORM NUMBER
YVWA Installation, Operation, and Maintenance	201.30-ICOM2
YVWA Wiring and Field Connections	201.30-PW2
YVWA Unit Renewal Parts	201.30-RP1
YVWA Chiller Installation Checklist	201.30-CL1
YVWA Chiller Start-up Checklist	201.30-CL2
Long-Term Storage Requirements-Field Preparations for YR, YS, and YVWA Screw Chillers	50.20-NM9
Limited Warranty	50.05-NM2
Shipping Damage Claims Form	50.15-NM
Long-Term Storage Periodic Checklist and Logs for YR, YS, and YVWA Screw Chillers	50.20-CL9
Electrical Connectors - All Products Renewal Parts	50.20-RP1
Fittings - Steel Tube, O-ring Face Seal (ORFS and Straight Port Thread O-ring Renewal Parts	50.20-RP2



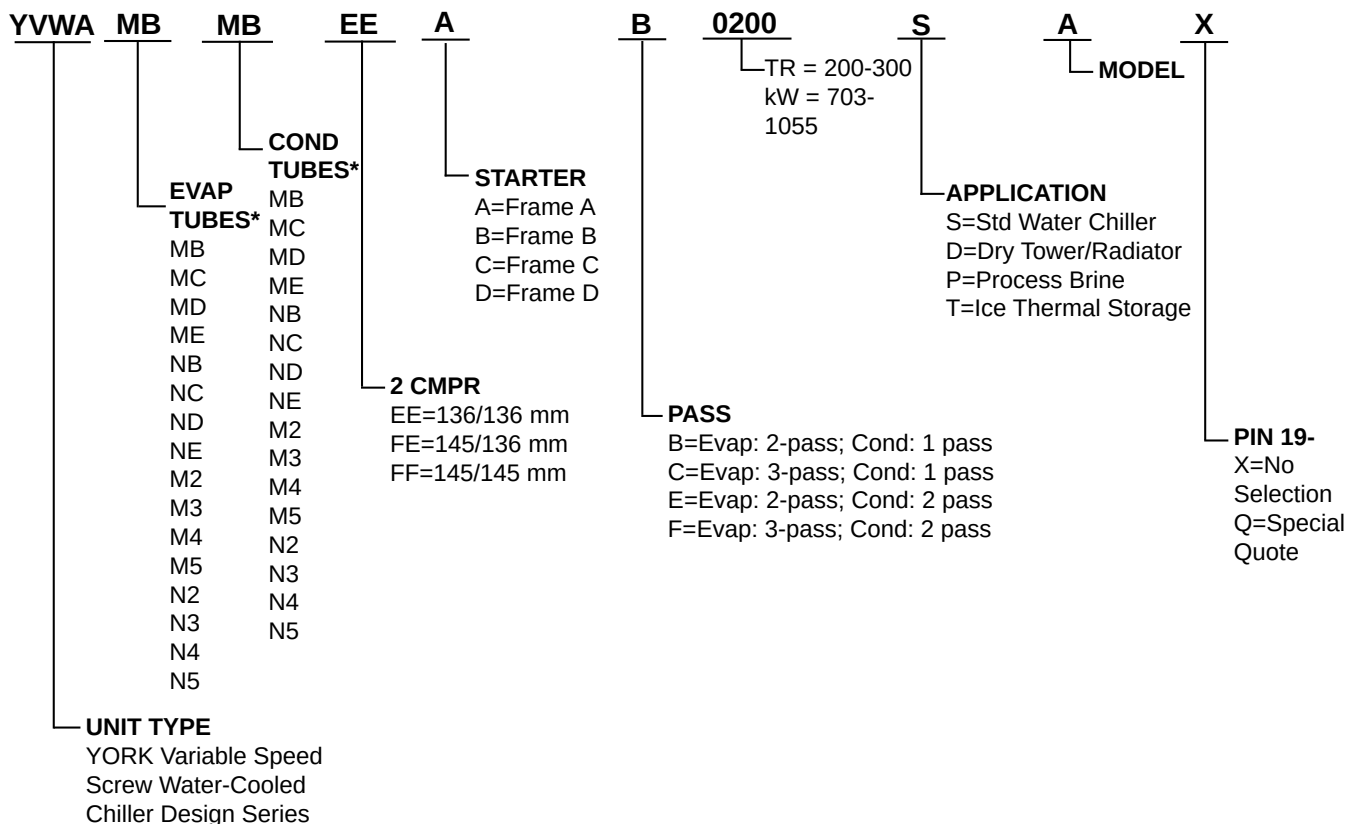
The Control/VSD Cabinet contains lethal High AC and DC voltages. Before performing service inside the cabinet, remove the AC supply feeding the chiller and verify using a non-contact voltage sensor.

The DC Voltage on the VSD DC Bus will take 5 minutes to bleed off, after AC power is removed. Always check the DC Bus Voltage with a Voltmeter to assure the capacitor charge has bled off before working on the system.

- ***NEVER short out the DC Bus to discharge the filter capacitors.***
- ***NEVER place loose tools, debris, or any objects inside the Control Panel/VSD Cabinet.***

- ***NEVER allow the Control Panel VSD Cabinet doors to remain open if there is a potential for rain to enter the panel. Keep doors closed and assure all latches are engaged on each door unless the unit is being serviced.***
- ***ALWAYS lockout the disconnect supplying AC to the chiller.***
- ***The 1L Line Inductor will reach operating temperatures of over 300° F. DO NOT open panel doors during operation. Assure the inductor is cool whenever working near the inductor with power off.***

NOMENCLATURE



*First letter represents tube size. The second letter designates the number of tubes.

VARIABLE SPEED DRIVE NOMENCLATURE

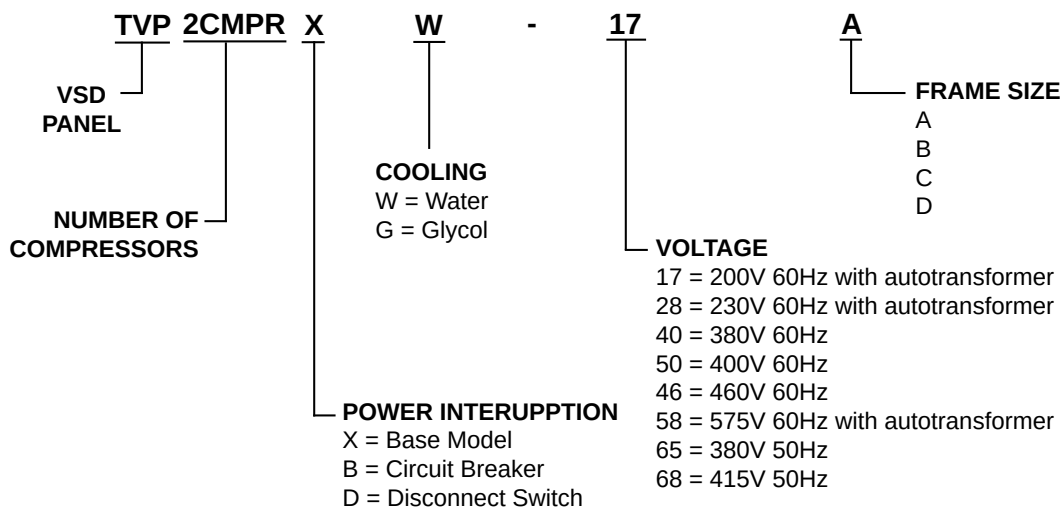


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SECTION 1 - GENERAL INFORMATION AND SAFETY

INTRODUCTION

YORK YVWA chillers are manufactured to the highest design and construction standards to ensure high performance, reliability and adaptability to all types of air conditioning installations.

The unit is intended for cooling water or glycol solutions, and is not suitable for purposes other than those specified in this manual.

ABOUT THIS MANUAL

This manual and any other document supplied with the unit are the property of Johnson Controls which reserves all rights. This manual may not be reproduced, in whole or in part, without prior written authorization from an authorized Johnson Controls representative.

In addition, this manual:

- Includes suggested best working practices and procedures, which are issued for guidance only, and they do not take precedence over the above stated individual responsibility and/or local safety regulations.
- Contains all the information required for correct installation and commissioning of the unit, together with operating and maintenance instructions.
- Should be read thoroughly before attempting to operate or service the unit.
- Contains detailed procedures, including installation, commissioning and maintenance tasks that must only be performed by suitably trained and qualified personnel.

The manufacturer will not be liable for any injury or damage caused by incorrect installation, commissioning, operation or maintenance resulting from a failure to follow the procedures and instructions detailed in the manual.

WARRANTY

Johnson Controls warrants YVWA chillers in accordance with the Limited Warranty Engineered Systems Equipment procedure. Refer to *Limited Warranty (Form 50.05-NM2)*.

Johnson Controls warrants all equipment and materials against defects in workmanship and materials for a period of 18 months from the date of shipment or 12 months from the date of start-up, whichever comes first, unless labor or extended warranty has been purchased as part of the contract.

The warranty is limited to parts only replacement and shipping of any faulty part, or subassembly, which has failed due to defects in workmanship and materials. All claims must be supported by evidence that the failure has occurred within the warranty period, and that the unit was operated within the designed parameters specified.

All warranty claims must specify the unit model, serial number, order number, and run hours/starts. Model and serial number information is printed on the unit identification plate.

The unit warranty will be void if any modification to the unit is carried out without prior written approval from Johnson Controls. For warranty purposes, the following conditions must be satisfied:

- The initial start of the unit must be carried out by trained personnel from an authorized Johnson Controls Service Center.
- Only genuine YORK approved spare parts, oils, coolants, and refrigerants must be used.
- All of the scheduled maintenance operations detailed in this manual must be performed at the specified times by suitably trained and qualified personnel.
- Failure to satisfy any of these conditions will automatically void the warranty. Refer to *Limited Warranty (Form 50.05-NM2)* for complete details.

QUALITY ASSURANCE

Units conform with the following European Directives:

- Equipment Directive (2006/42/EC)
- EMC Directive (2004/108/EC)
- Pressure Equipment Directive (97/23/EC)
- Low Voltage Directive (2006/95/EC)
- Safety Code for Mechanical Refrigeration (EN378-2 (2008))

FLUORINATED GREENHOUSE GASES

- This equipment contains fluorinated greenhouse gases covered by the Kyoto Protocol.
- The global warming potential of the refrigerant (R-134a) used in this unit is 1300. The refrigerant quantity is stated in this document.
- The fluorinated greenhouse gases in this equipment may not be vented to the atmosphere.

RESPONSIBILITY FOR SAFETY

Every care has been taken in the design and manufacture of the unit to ensure compliance with the safety requirements. However, the individual operating or working on any equipment is primarily responsible for:

- Personal safety, safety of other personnel, and the equipment.
- Correct utilization of the equipment in accordance with the procedures detailed in the manual.

MISUSE OF EQUIPMENT

Suitability For Application

The unit is intended for cooling water or glycol solutions and is not suitable for purposes other than those specified in these instructions. Any use of the equipment other than its intended use, or operation of the equipment contrary to the relevant procedures may result in injury to the operator, or damage to the equipment. The unit must not be operated outside the design parameters specified in this manual.

Brine Applications

When the chiller is not running, cold brine should NOT be run through the evaporator. However, if there is brine running through the evaporator, there must be flow through the condenser to prevent tubes from freezing.

Structural Support

Structural support of the unit must be provided as indicated in these instructions. Failure to provide proper support may result in injury to the operator, or damage to the equipment and/or building.

Mechanical Strength

The unit is not designed to withstand loads or stresses from adjacent equipment, pipework, or structures. Additional components must not be mounted on the unit. Any such extraneous loads may cause structural failure and may result in injury to the operator, or damage to the equipment.

General Access

There are a number of areas and features, which may be a hazard and potentially cause injury when working on the unit unless suitable safety precautions are taken. Make sure access to the unit is restricted to suitably qualified personnel, who are familiar with the potential hazards and precautions necessary for safe operation and maintenance of equipment containing high temperatures, pressures, and voltages.

Pressure Systems

The unit contains refrigerant vapor and liquid under pressure, release of which can be a danger and cause injury. The user should make sure that care is taken during installation, operation, and maintenance to avoid damage to the pressure system. No attempt should be made to gain access to the component parts of the pressure system other than by suitably trained and qualified personnel.

Electrical

The unit must be grounded. No installation or maintenance work should be attempted on the electrical equipment without first switching the power OFF, isolating and locking-off the power supply. Servicing and maintenance on live equipment must not be attempted. No attempt should be made to gain access to the control panel or electrical enclosures during normal operation of the unit.

Components may also have sharp edges. Reasonable care should be taken when working in contact with any components to avoid risk of minor abrasions and lacerations.

Refrigerants and Oils

Refrigerants and oils used in the unit are generally non-toxic, non-flammable, and non-corrosive, and pose no special safety hazards. Use of gloves and safety glasses is recommended when working on the unit. The build-up of refrigerant vapor, from a leak for example, does pose a risk of asphyxiation in confined or enclosed spaces and attention should be given to good ventilation.

High Temperature and Pressure Cleaning

High temperature and pressure cleaning methods (e.g., steam cleaning) should not be used on any part of the pressure system as this may cause operation of the pressure relief device(s). Detergents and solvents, which may cause corrosion, should also be avoided.

Emergency Shutdown

In case of emergency, the control panel is fitted with an incoming supply circuit breaker with a red and yellow handle as shown in *Figure 1*, which can be used as the emergency stop the device. When operated, it removes the electrical supply to the inverter, fans, and control circuit, thus shutting down the unit.



FIGURE 1 - EMERGENCY SHUTDOWN HANDLE

Safety Labels



For safe operation, read the Instructions first.



Warning: This machine may start automatically without prior warning



Warning: Hot surface.



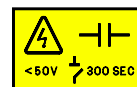
Warning: Safety relief valve may discharge gas or liquid without prior warning.



Warning: Isolate all electrical sources of supply before opening or removing the cover, as lethal voltages may exist.



General attention symbol.



Warning: On isolating the supply it may take up to 300 seconds for the capacitor voltage to fall below 50 volts.

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SECTION 2 - PRODUCT DESCRIPTION

COMPONENT DESCRIPTION

The YVWA chiller is a liquid-cooled variable speed screw compressor chiller. The model includes dual compressors with independent refrigerant circuits. The key components are discussed following:

Evaporator: Shell and Tube, hybrid falling film and flooded

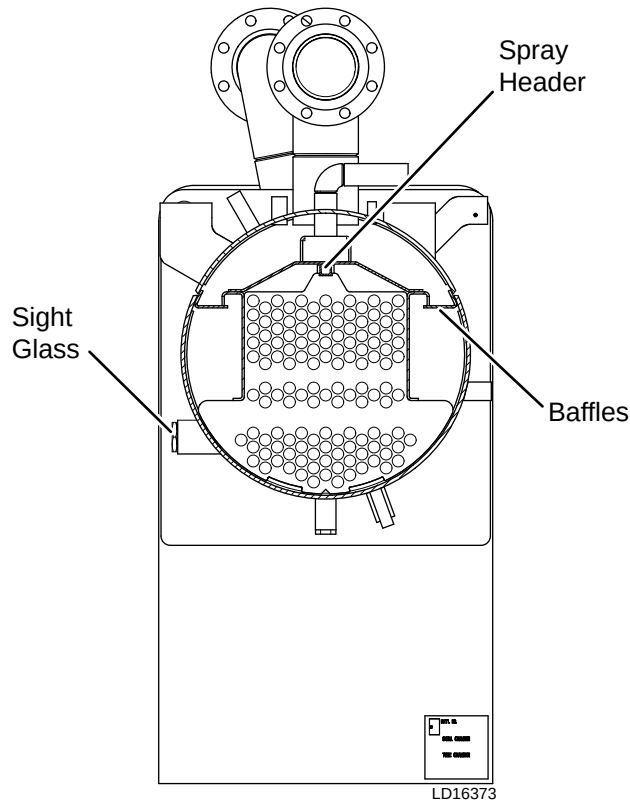


FIGURE 2 - EVAPORATOR CROSS SECTION

Condenser: Shell and Tube with integral subcooler

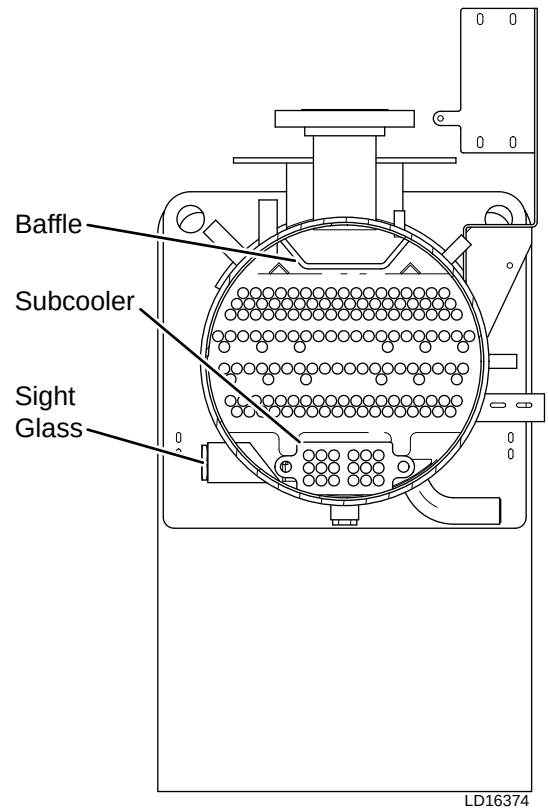


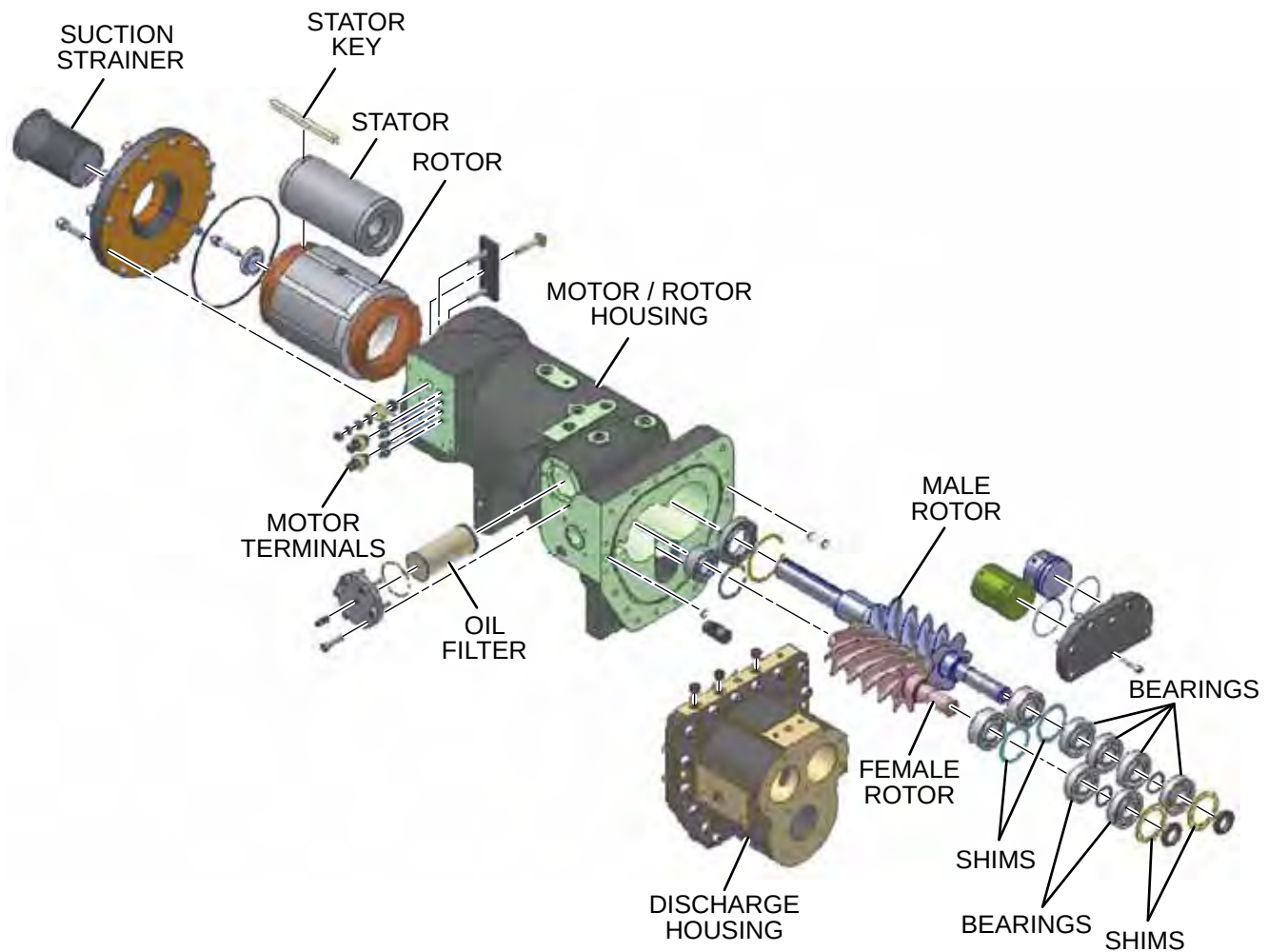
FIGURE 3 - CONDENSER CROSS SECTION

Compressor: Direct drive, semi-hermetic rotary screw. The compressors combinations are of 136 mm rotor and 145 mm rotor. Standard application uses the WTS compressor. High head applications use the CTS compressor, which includes variable volume ratio control. The compressor porting is as follows for the support systems:

Oil return from eductor system = Suction volume ratio

Economizer outlet = 1.1 X suction for WTS and 1.3 X suction for CTS

Liquid Injection = Suction volume ratio



LD16375

FIGURE 4 - COMPRESSOR COMPONENTS

Compressors will not be rebuilt in the field. Should it be necessary, a replace and return process is set up to replace the entire compressor/motor assembly according to the replacement parts manual.

Variable Speed drive: The compressor motors are powered from a variable frequency drive. The VSD cabinet also contains the chiller control electronics and keypad interface.

Economizer: Flat plate heat exchanger with electric expansion valve feed control.

Refrigerant Circuit: Dual refrigerant circuits. Electric Expansion valve throttling refrigerant to evaporator. The flow path is gas from compressor discharge through a muffler to the oil separator. Gas from the oil separator flows to the condenser. Gas entering the condenser leaves as liquid through the integral subcooler then one circuit of the economizer. A sidestream at the economizer outlet passes through an expansion valve, the secondary circuit of the economizer and on to the

compressor at a port located as discussed above for the compressor. The other flow from the economizer is to the liquid line throttling valve to the evaporator. Liquid entering the evaporator sprays over the falling film tubes, some pools in the flooded section, and all leaves as vapor to the compressor suction.

Oil dropped in the bottom of the oil separator from the compressor discharge gas is forced by pressure differential to the compressor to lubricate bearings and rotors.

An eductor system returns oil from the evaporator refrigerant to the compressor. The eductor throttles gas from the condenser back to the compressor at a port located at suction. The venturi of the eductor draws mixed liquid refrigerant and oil from the evaporator pool in to its discharge stream.

A liquid injection option controls liquid refrigerant from the economizer outlet into compressor suction through a solenoid valve for high head applications.

SYSTEM DIAGRAMS

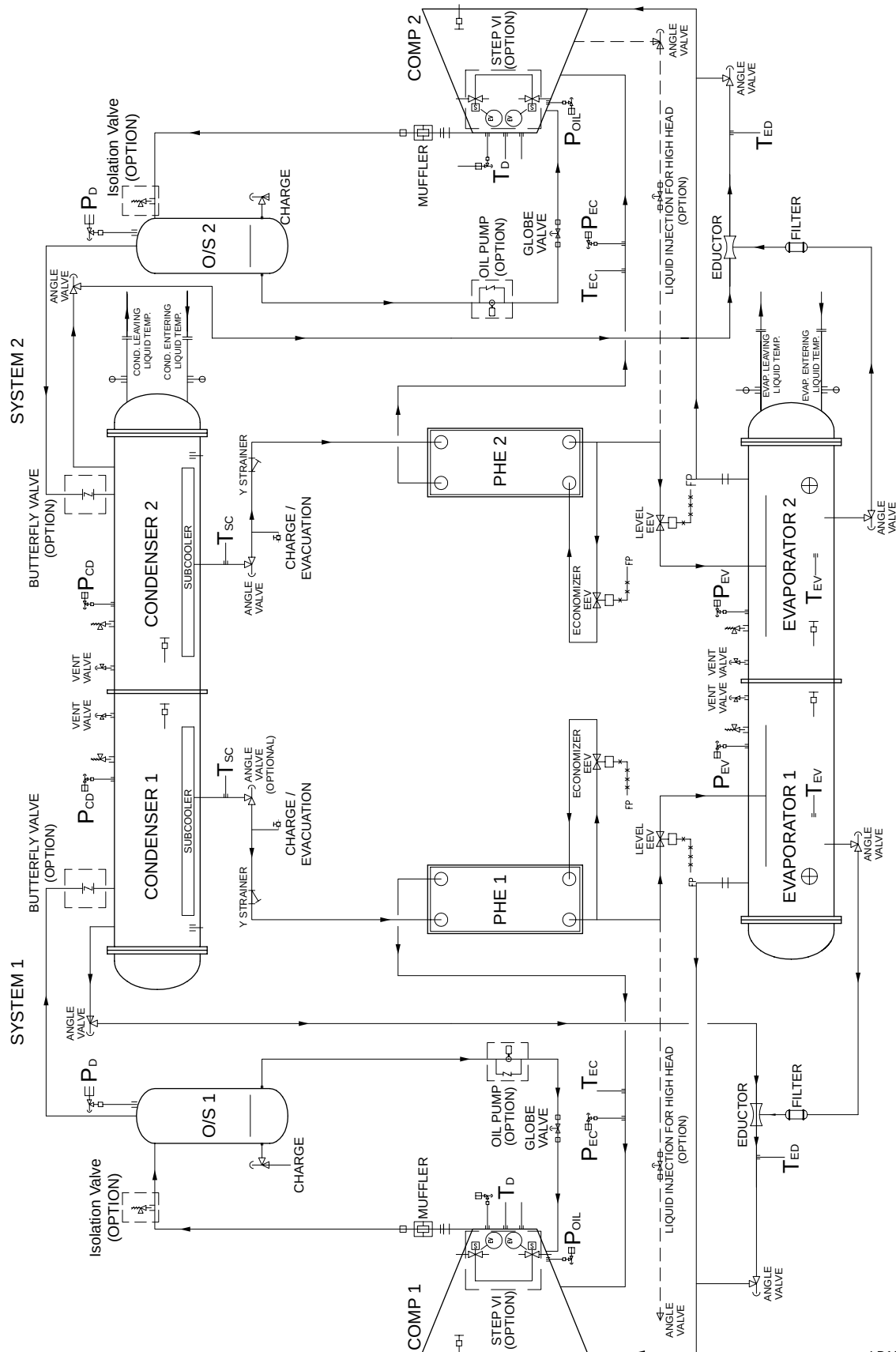
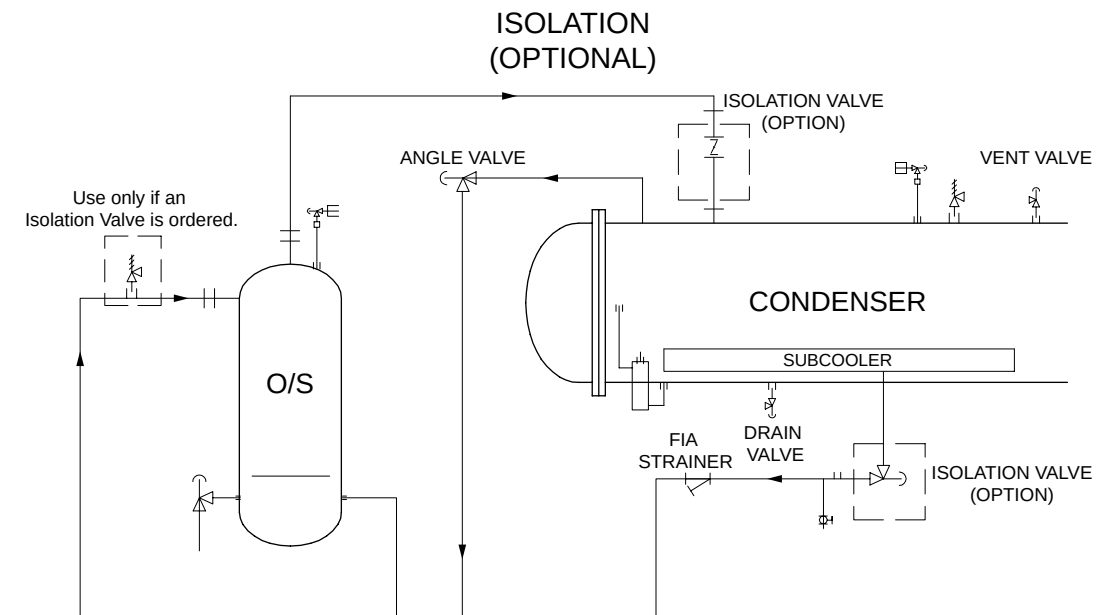
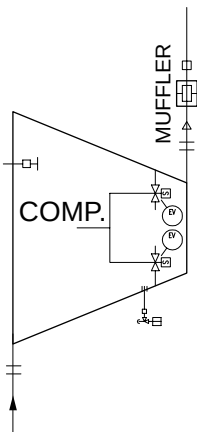


FIGURE 5 - SYSTEM DIAGRAM

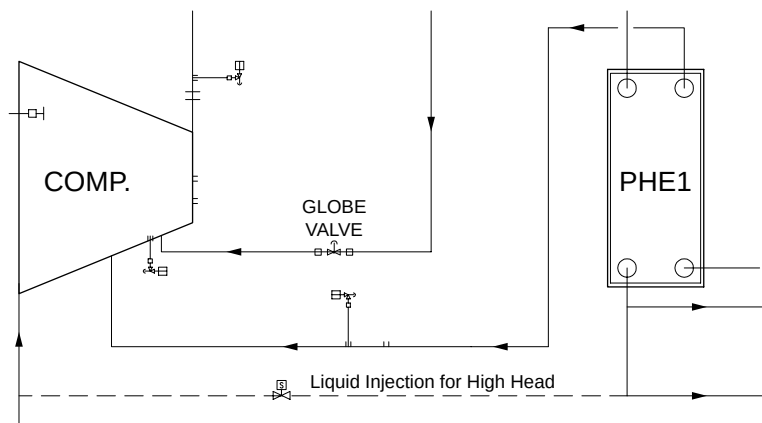
LD16376



STEP VI (OPTIONAL)



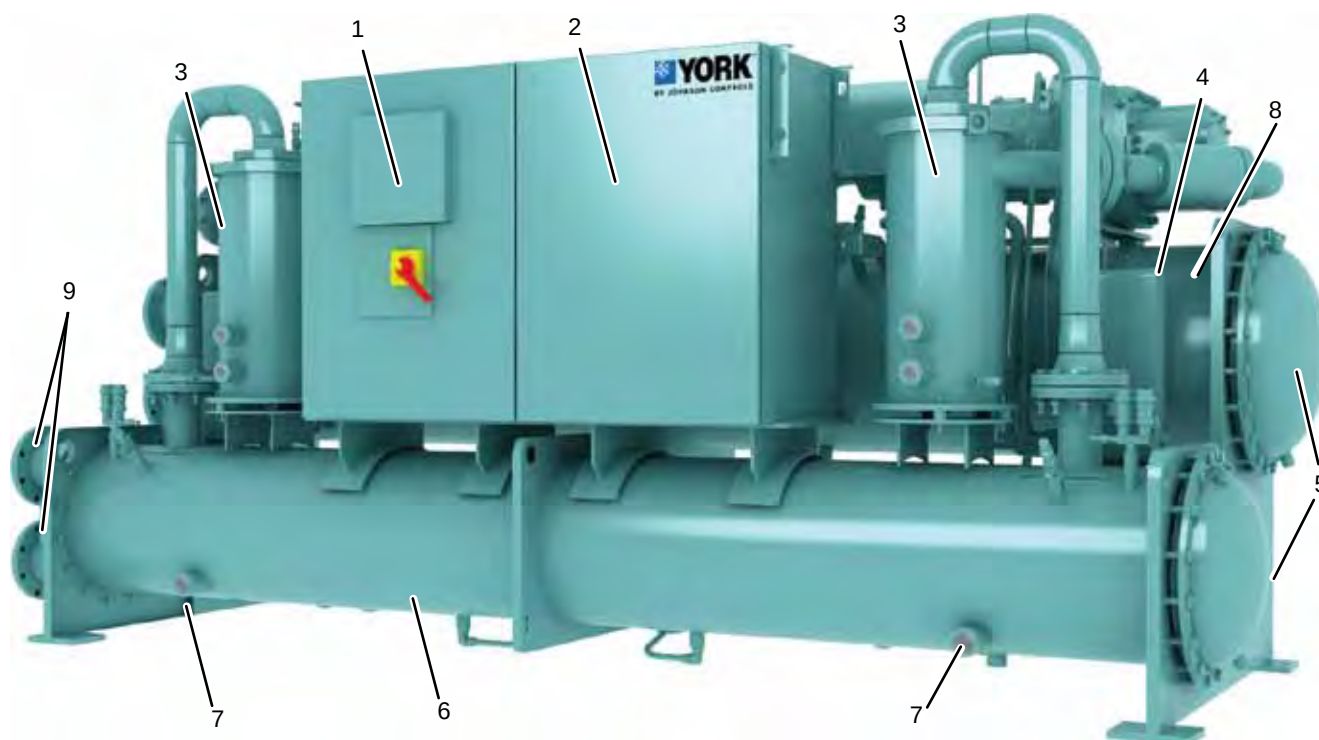
LIQUID INJECTION (OPTIONAL)



LD16432a

FIGURE 6 - SYSTEM DIAGRAM

COMPONENT LOCATION



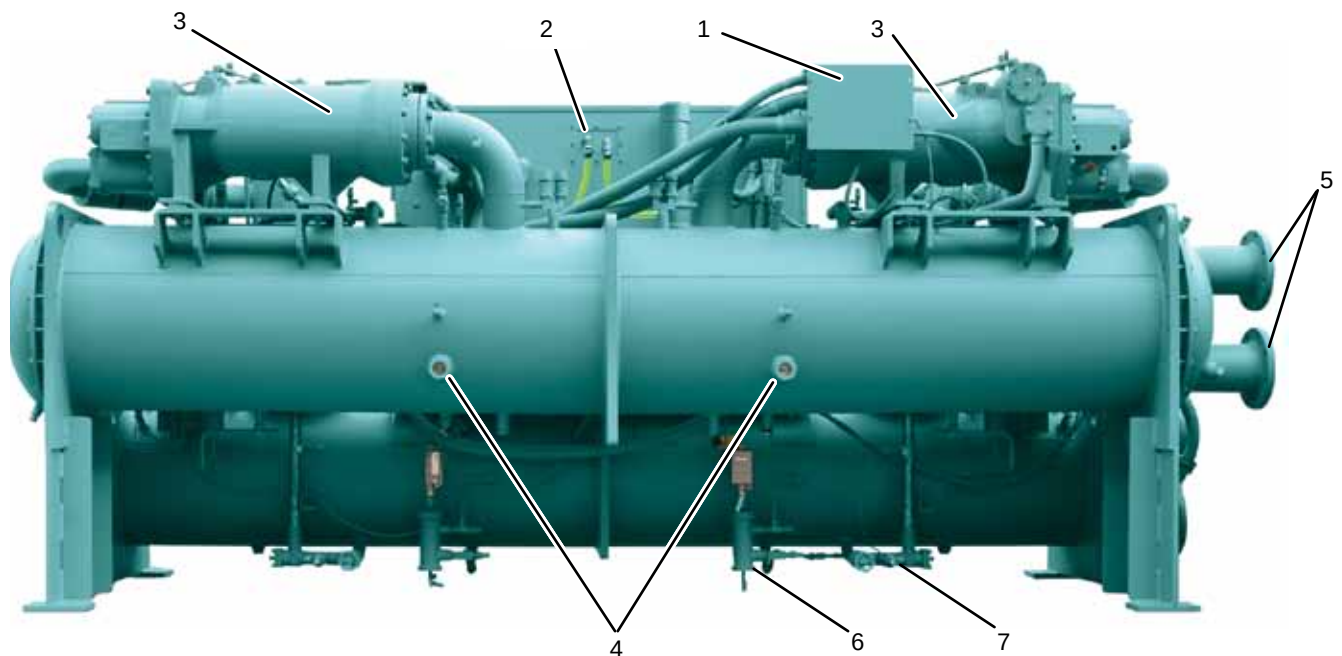
LD16421

- | | | |
|-------------------------------|------------------------------|--------------------------|
| 1. Control Panel | 4. Economizer Heat Exchanger | 7. Condenser Sight Glass |
| 2. Variable Speed Drive (VSD) | 5. Water Box | 8. Evaporator |
| 3. Oil Separator | 6. Condenser | 9. Condenser Nozzle |

FIGURE 7 - YVWA CHILLER MAJOR COMPONENTS (FRONT VIEW)

COMPONENT LOCATION (CONT'D)

2



LD16423

1. Terminal Box
2. Coolant Piping
3. Compressor

4. Evaporator Sight Glass
5. Evaporator Nozzle
6. Liquid Level Sensor

7. Liquid Line

FIGURE 8 - YVWA CHILLER MAJOR COMPONENTS (REAR VIEW)

T_{EV} Evaporator Temperature
 T_{SC} Subcooled Liquid Temperature
 T_D Compressor Discharge Temperature
 T_{EC} Economizer Outlet Temperature
 T_{ED} Eductor Outlet Temperature

T_{ECHLT} Entering Chiller Liquid Temperature
 T_{LCHLT} Leaving Chilled Liquid Temperature
 T_{ECLT} Entering Condenser Temperature
 T_{LCLT} Leaving Condenser Temperature

P_{EV} Evaporator Pressure
 P_{CD} Condenser Pressure
 P_D Compressor Discharge Pressure
 P_{OIL} Compressor Oil Pressure
 P_{EC} Economizer Outlet Pressure

Level EEV Condenser Level Control Expansion Valve
 Econ EEV Economizer Feed Expansion Valve

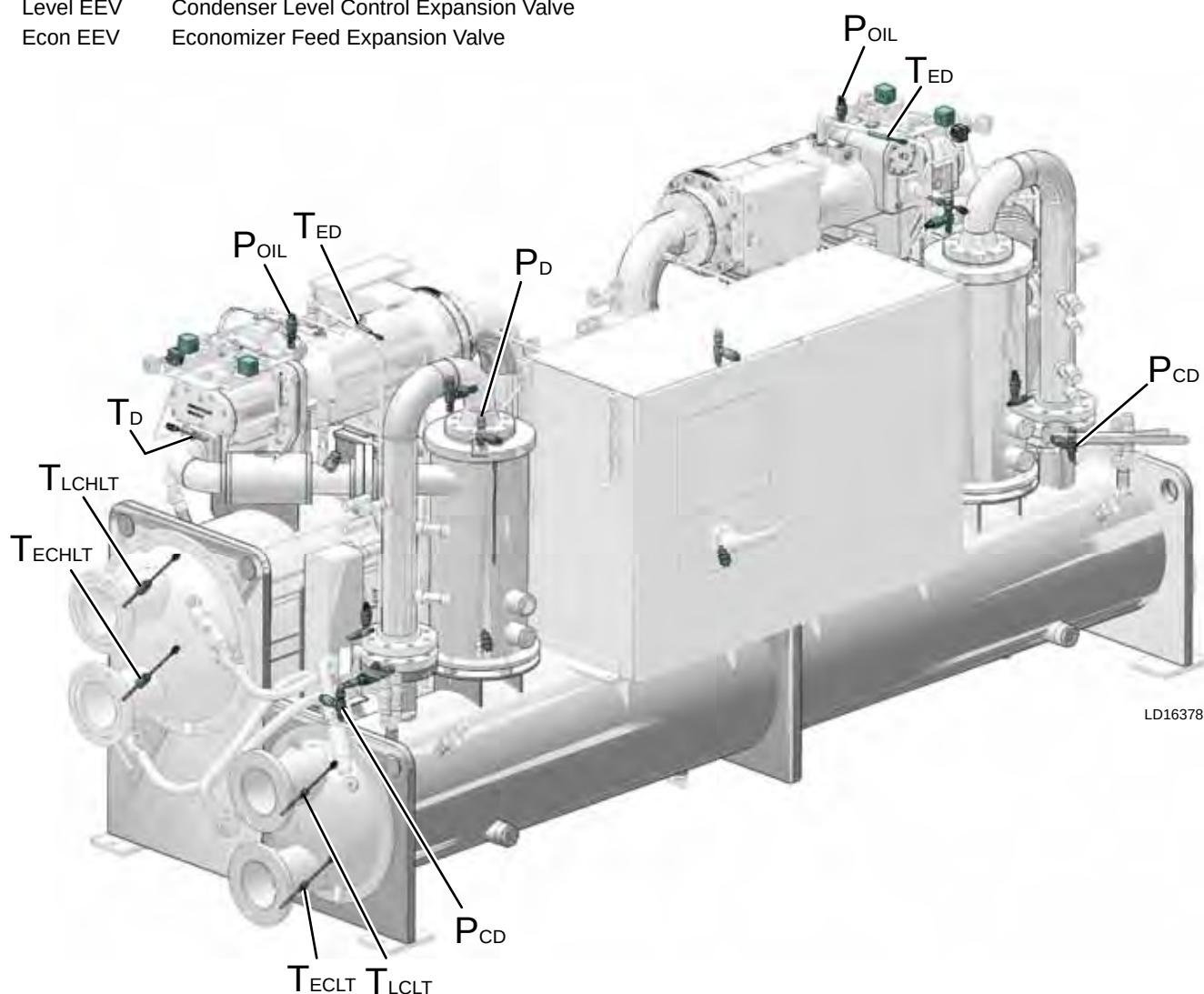


FIGURE 9 - SENSOR LOCATIONS

T_{EV} Evaporator Temperature
 T_{SC} Subcooled Liquid Temperature
 T_D Compressor Discharge Temperature
 T_{EC} Economizer Outlet Temperature
 T_{ED} Eductor Outlet Temperature

T_{ECHLT} Entering Chiller Liquid Temperature
 T_{LCHLT} Leaving Chilled Liquid Temperature
 T_{ECLT} Entering Condenser Temperature
 T_{LCLT} Leaving Condenser Temperature

P_{EV} Evaporator Pressure
 P_{CD} Condenser Pressure
 P_D Compressor Discharge Pressure
 P_{OIL} Compressor Oil Pressure
 P_{EC} Economizer Outlet Pressure

Level EEV Condenser Level Control Expansion Valve
 Econ EEV Economizer Feed Expansion Valve

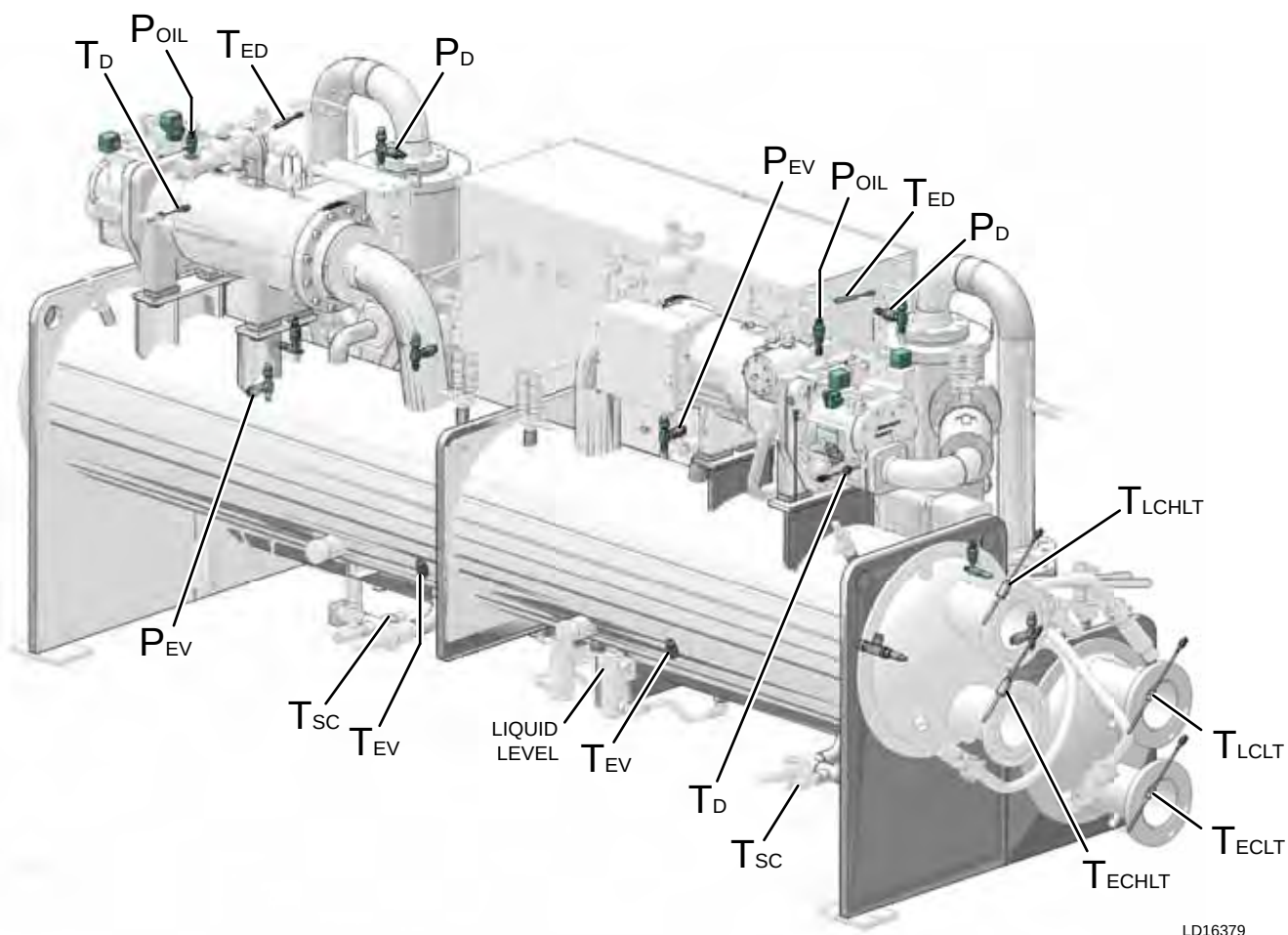


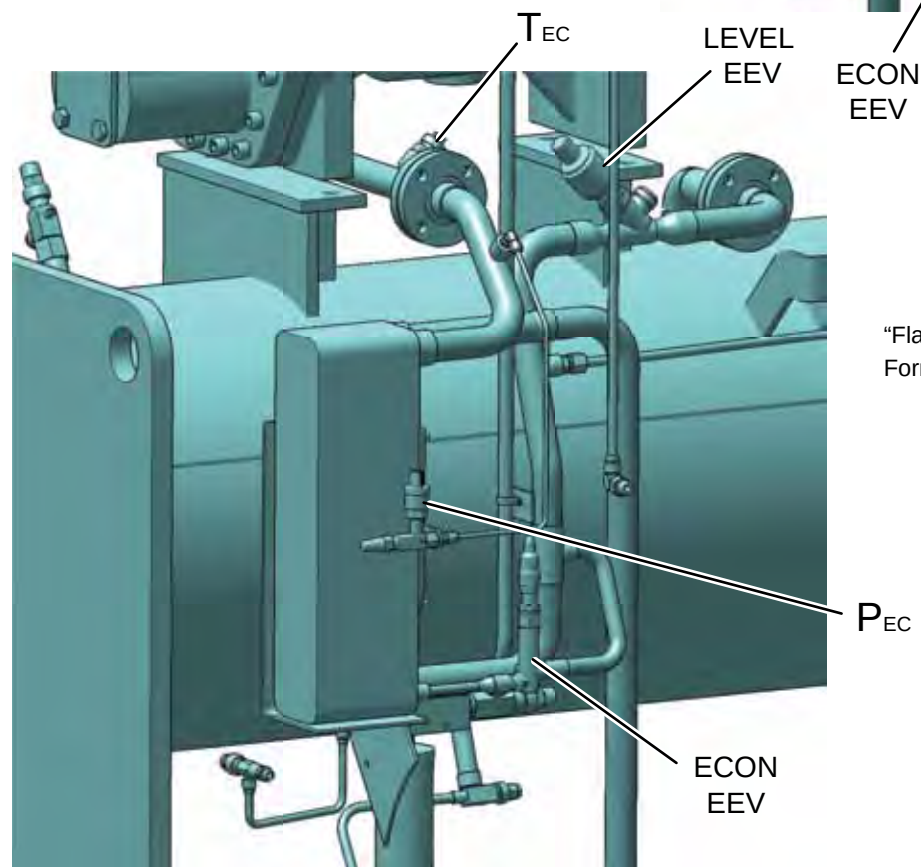
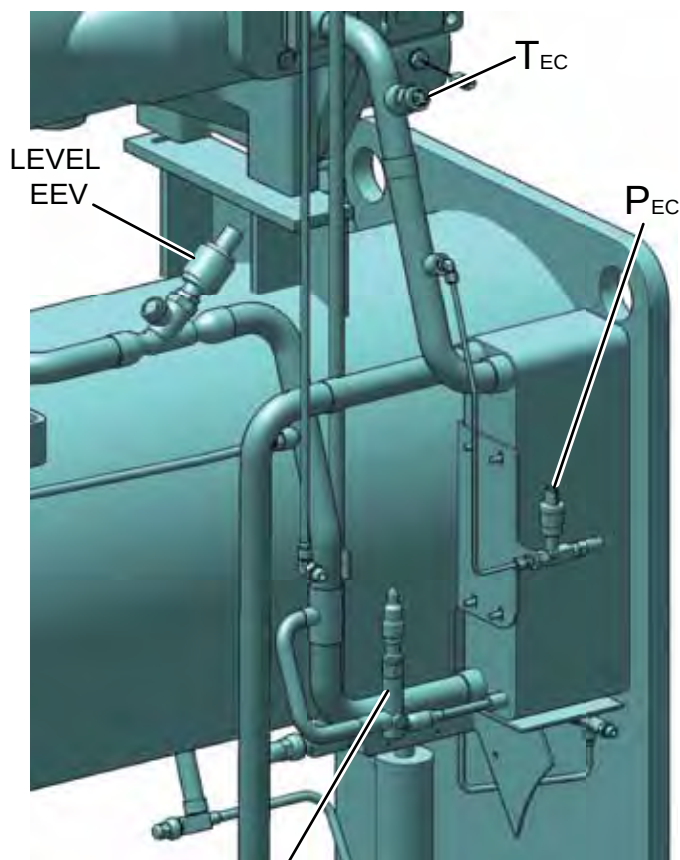
FIGURE 9 - SENSOR LOCATIONS (CONT'D)

T_{EV} Evaporator Temperature
 T_{SC} Subcooled Liquid Temperature
 T_D Compressor Discharge Temperature
 T_{EC} Economizer Outlet Temperature
 T_{ED} Eductor Outlet Temperature

T_{ECHLT} Entering Chiller Liquid Temperature
 T_{LCHLT} Leaving Chilled Liquid Temperature
 T_{ECLT} Entering Condenser Temperature
 T_{LCLT} Leaving Condenser Temperature

P_{EV} Evaporator Pressure
 P_{CD} Condenser Pressure
 P_D Compressor Discharge Pressure
 P_{OIL} Compressor Oil Pressure
 P_{EC} Economizer Outlet Pressure

Level EEV Condenser Level Control Expansion Valve
 Econ EEV Economizer Feed Expansion Valve



"Flanges Shown For
Form 7 Option"

LD16377

FIGURE 9 - SENSOR LOCATIONS (CONT'D)

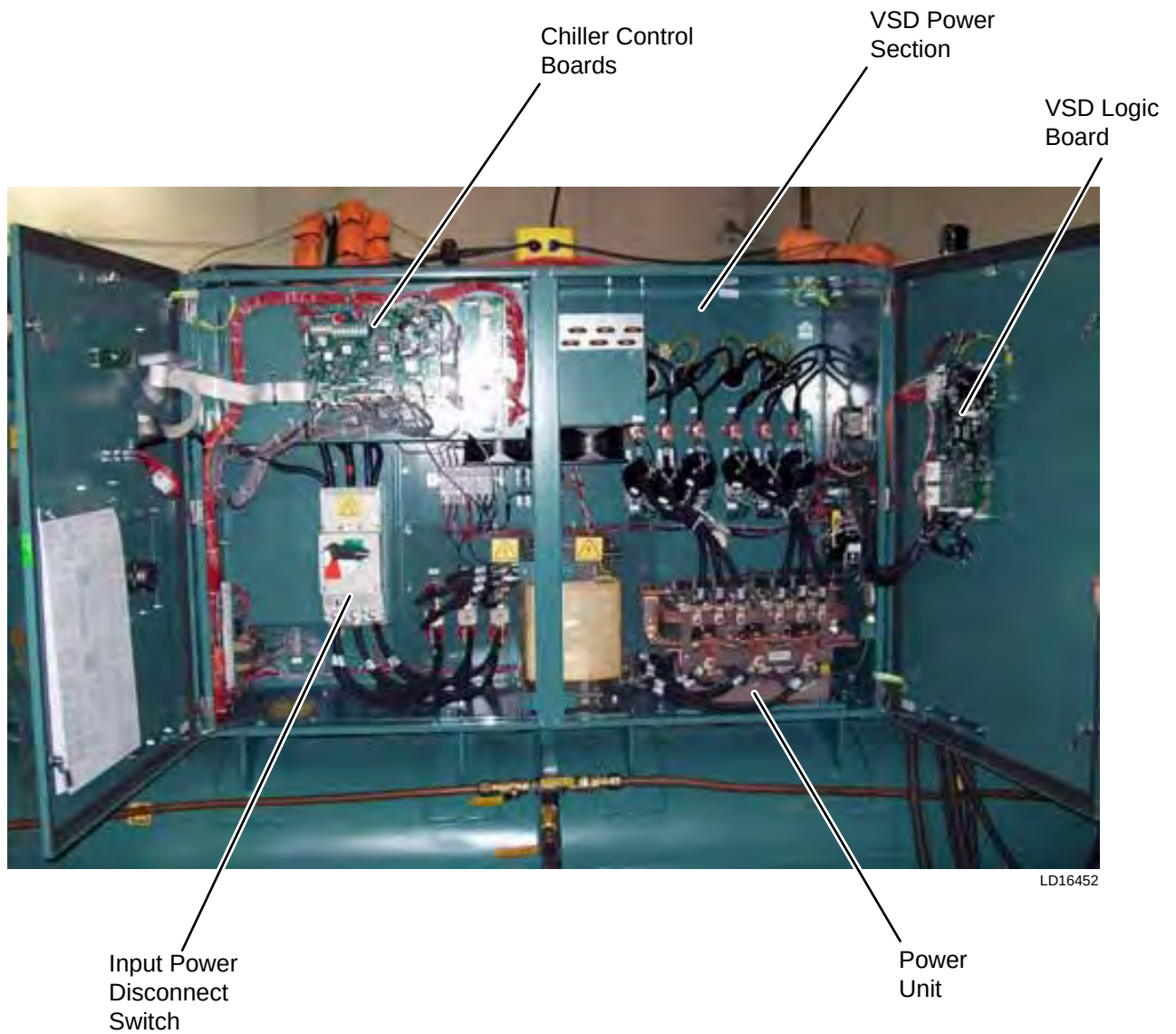
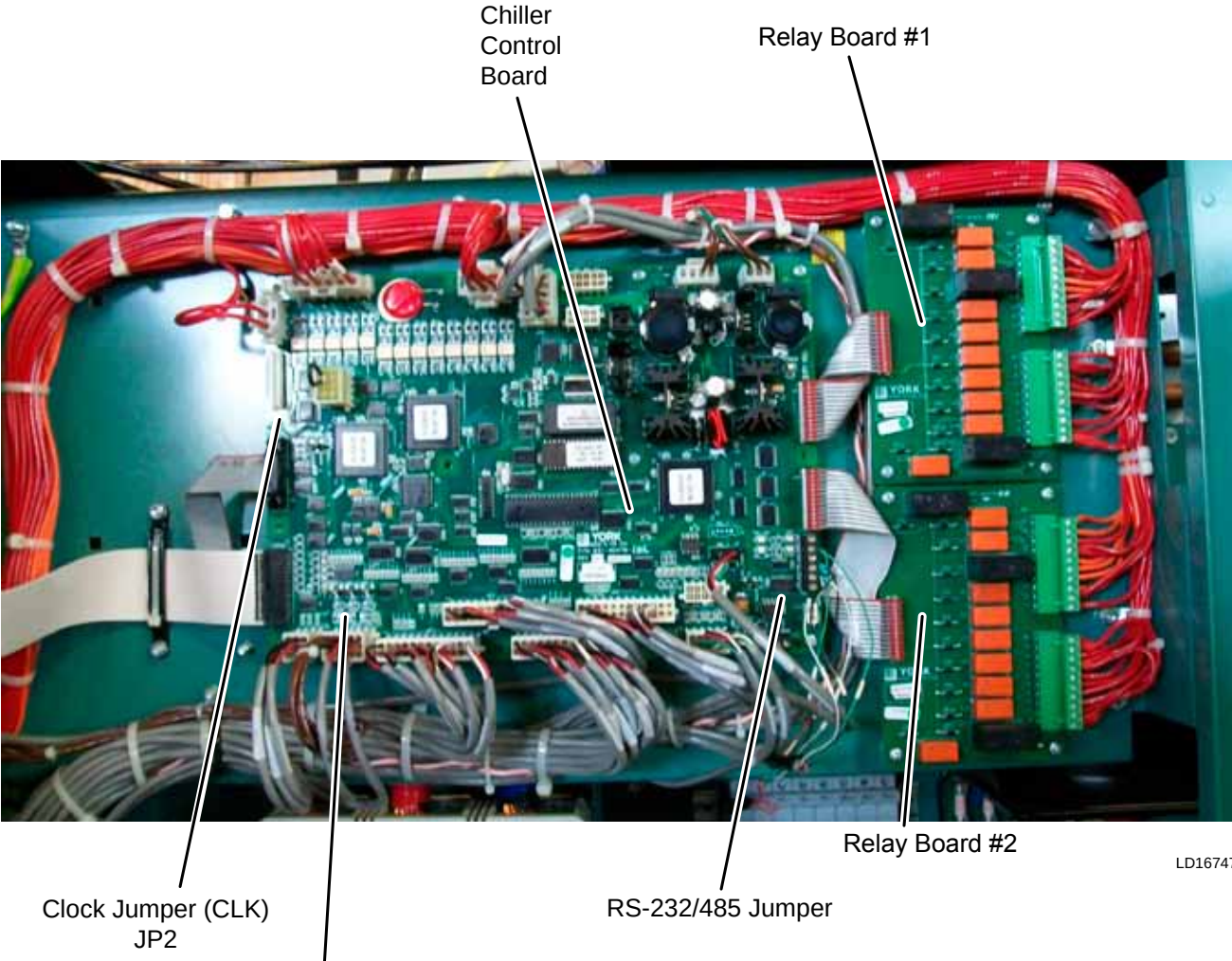


FIGURE 10 - CONTROL AND VSD CABINET COMPONENTS



LD16747

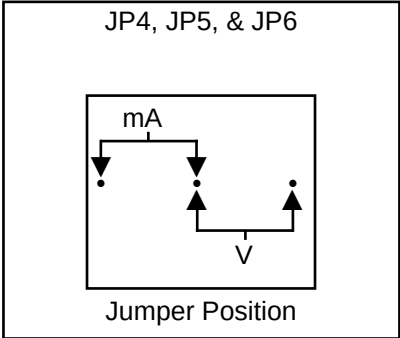


FIGURE 11 - CHILLER CONTROL BOARD AND RELAY BOARDS

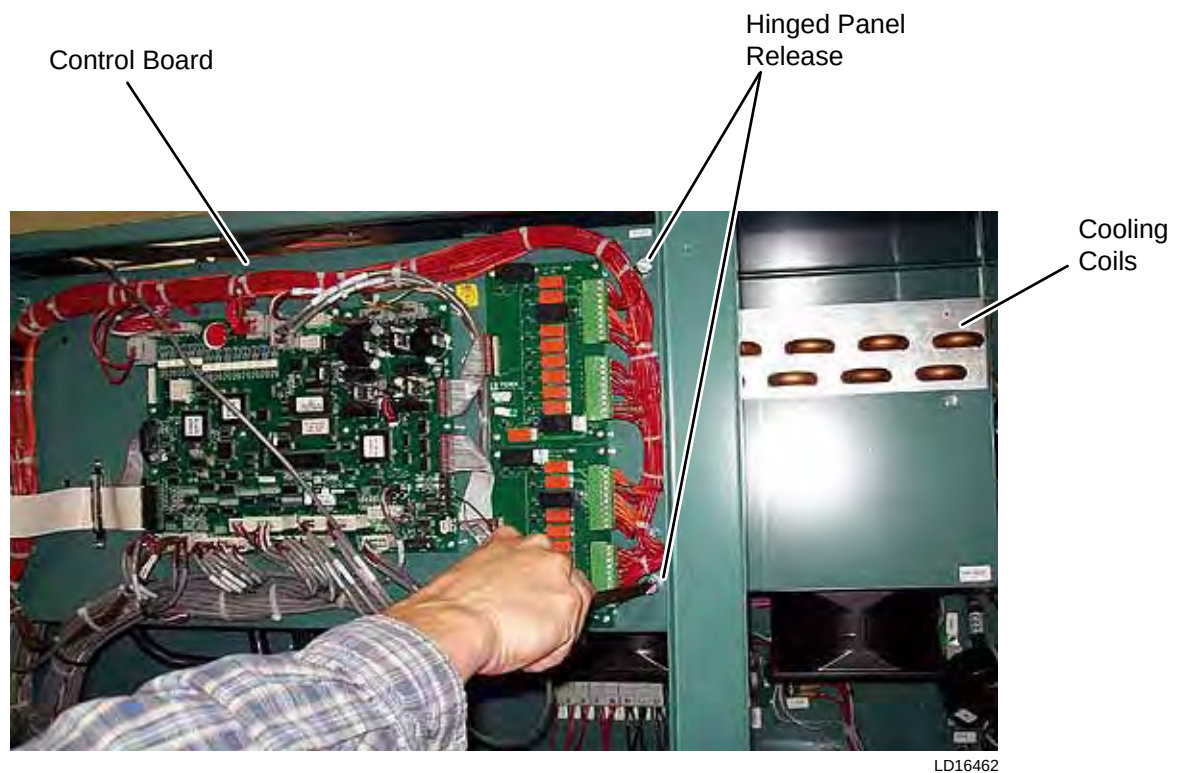
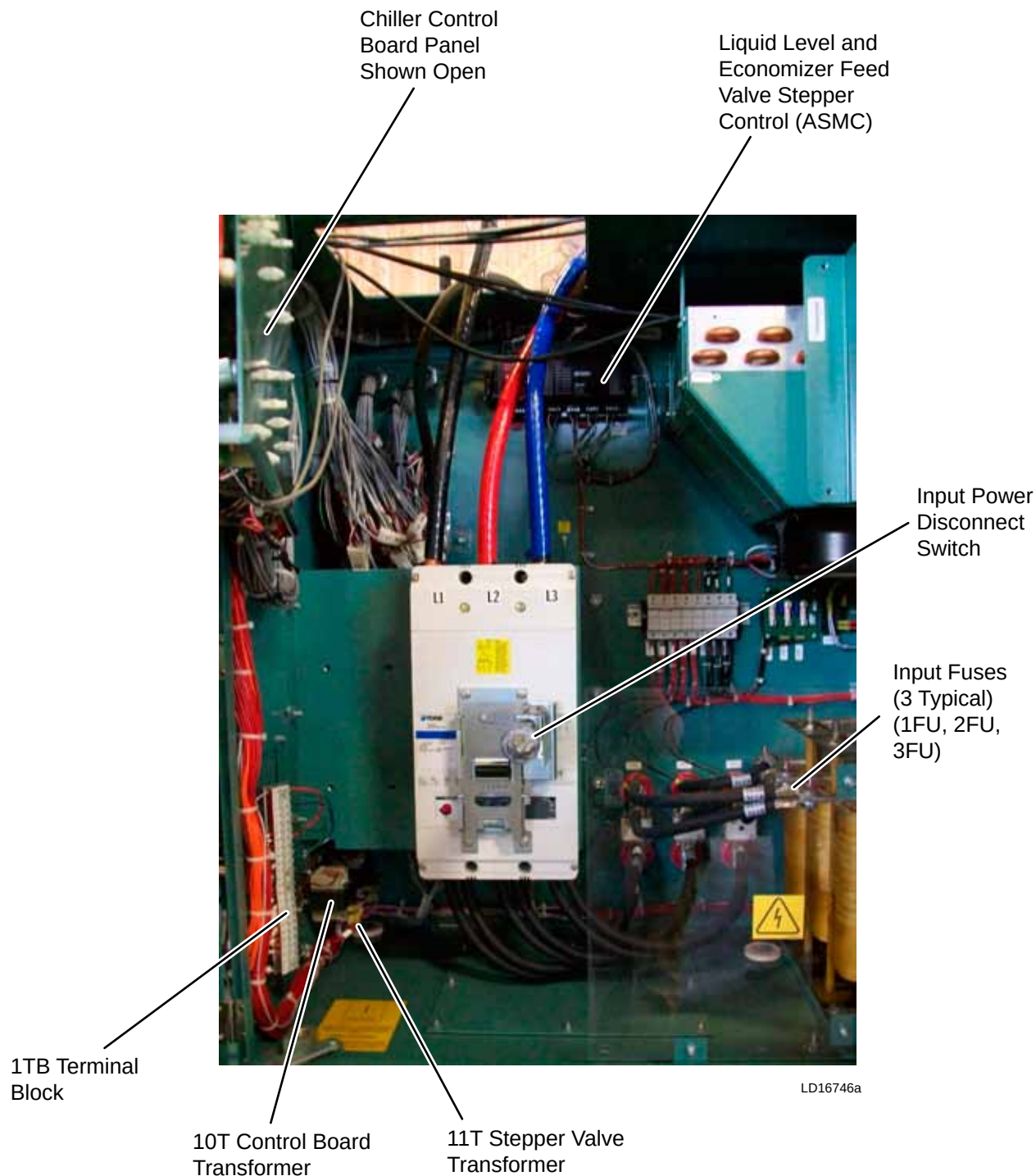


FIGURE 12 - ACCESS BEHIND CONTROL BOARDS

**FIGURE 13 - INSIDE CONTROL SECTION**

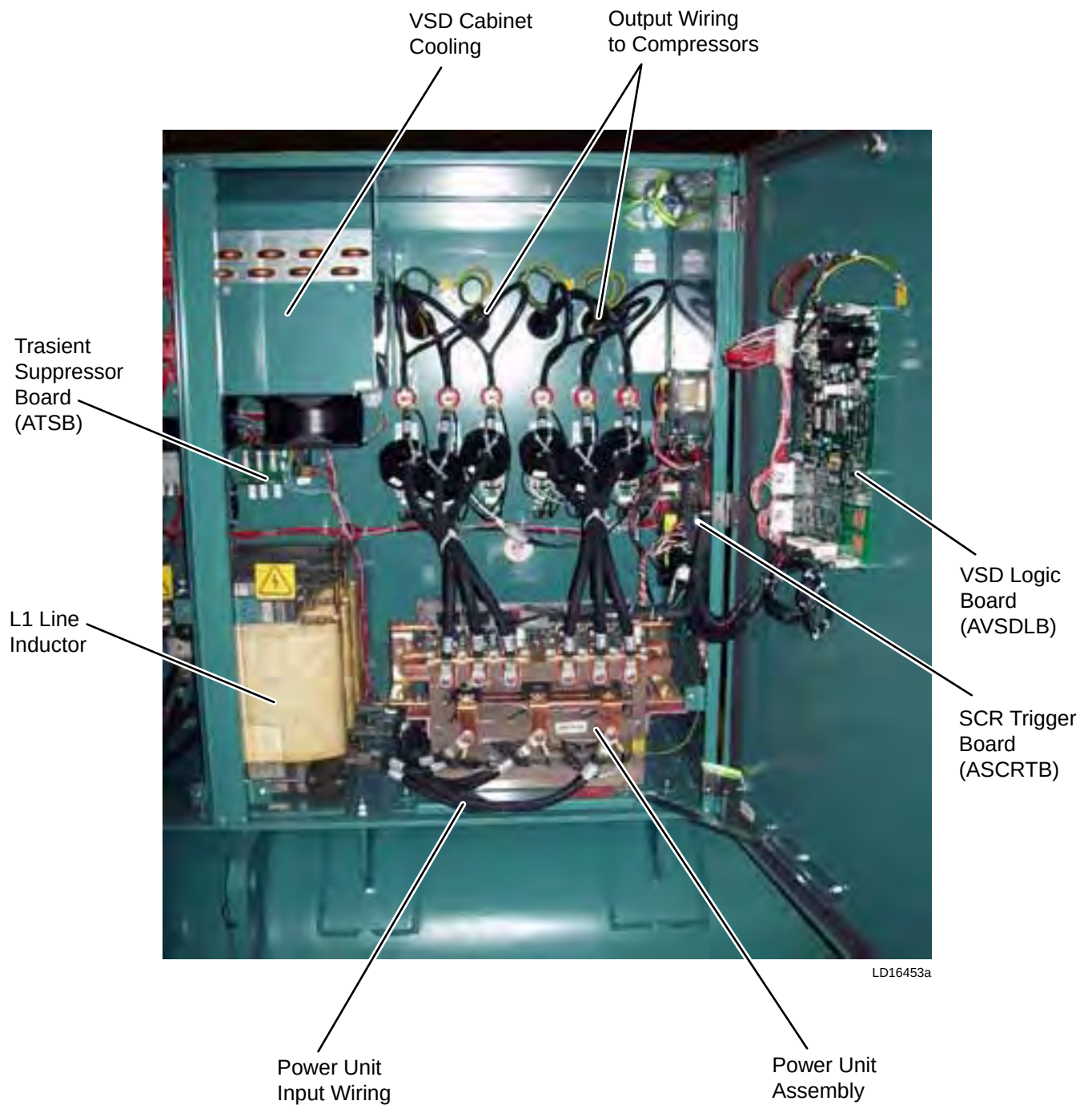
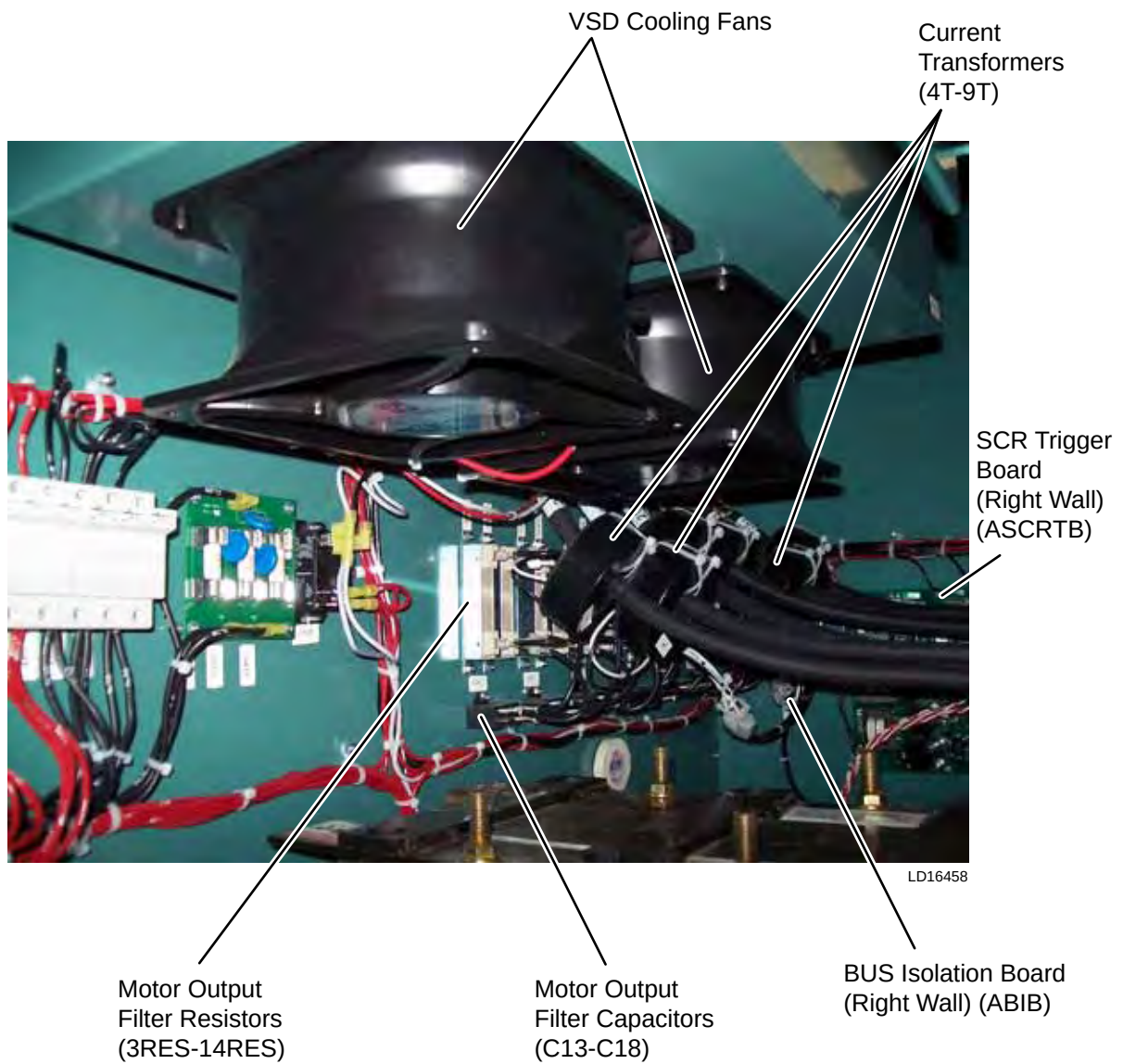
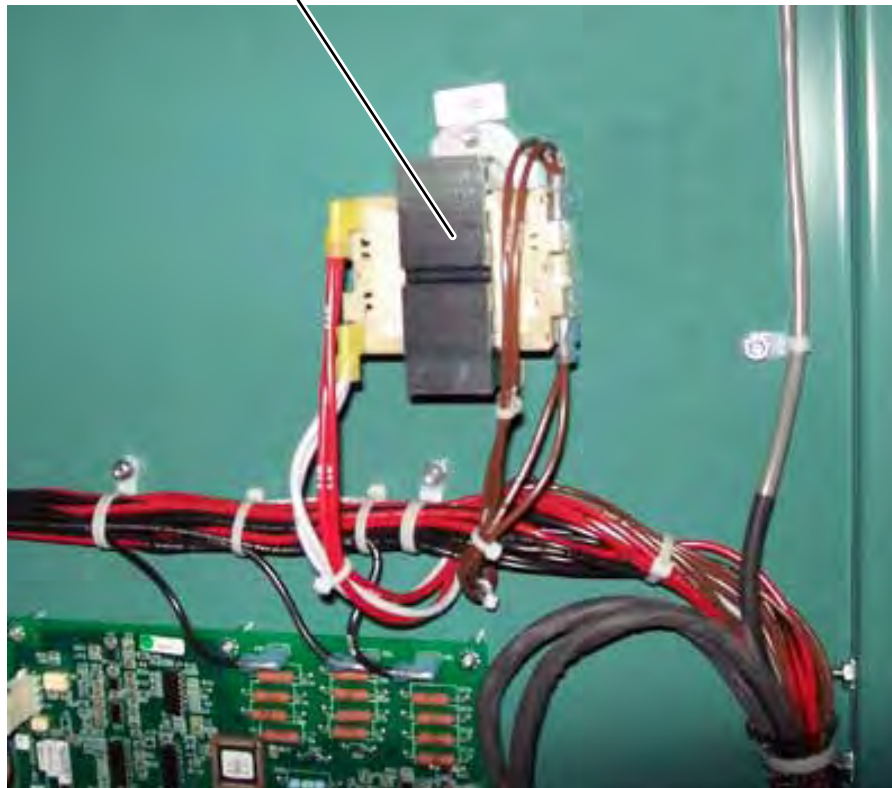


FIGURE 14 - VSD POWER SECTION

**FIGURE 15 - VSD LOWER BACK WALL**

3T (VSD Logic Board and
SCR Trigger Board 24VAC
Supply Transformer)



LD16456

SCR Trigger Board
(ASCRTB)

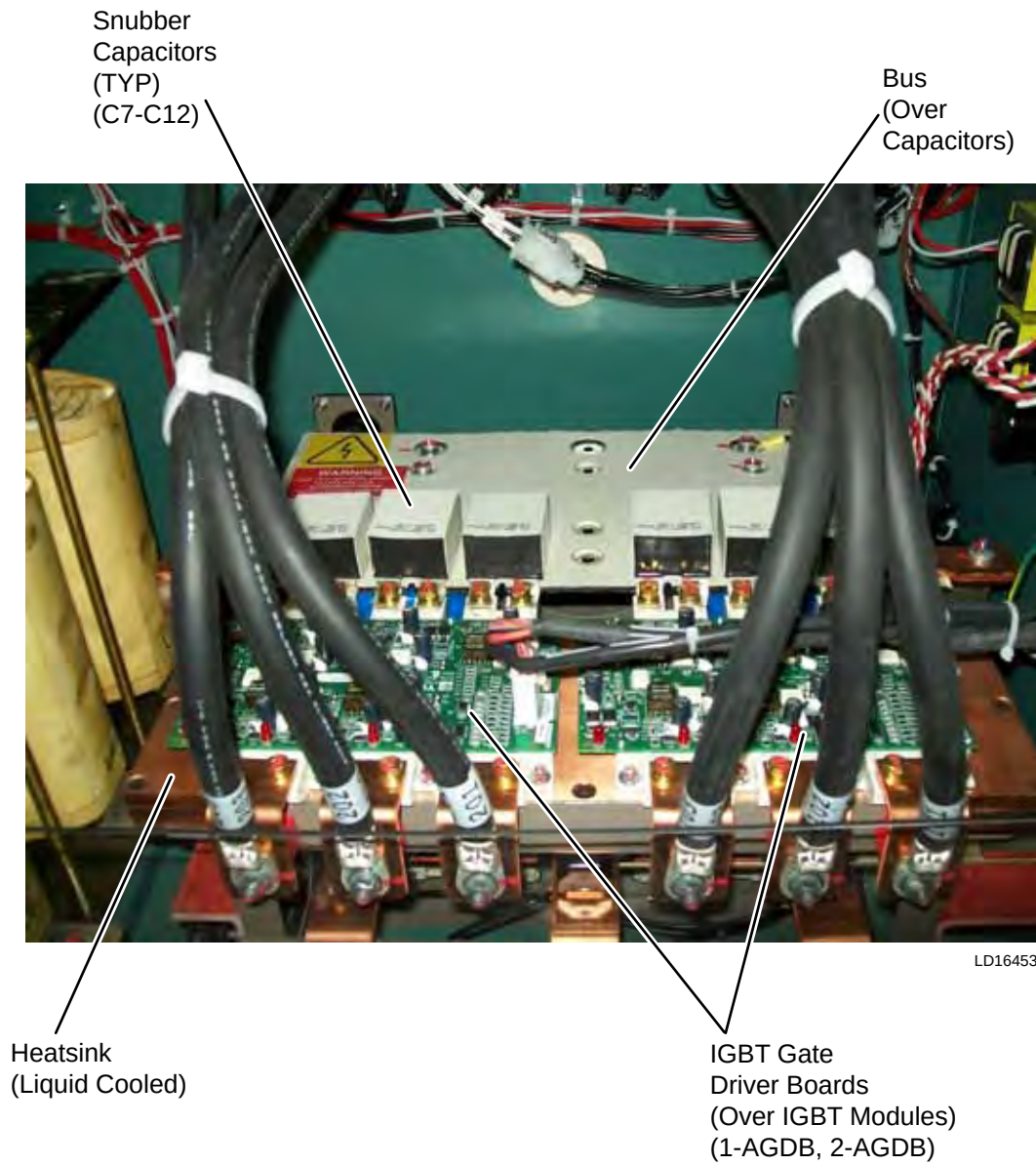
FIGURE 16 - RIGHT SIDE WALL AND 3T TRANSFORMER



FIGURE 17 - INPUT INDUCTOR



FIGURE 18 - POWER UNIT ASSEMBLY (INPUT)

**FIGURE 19 - POWER UNIT ASSEMBLY (OUTPUT)**

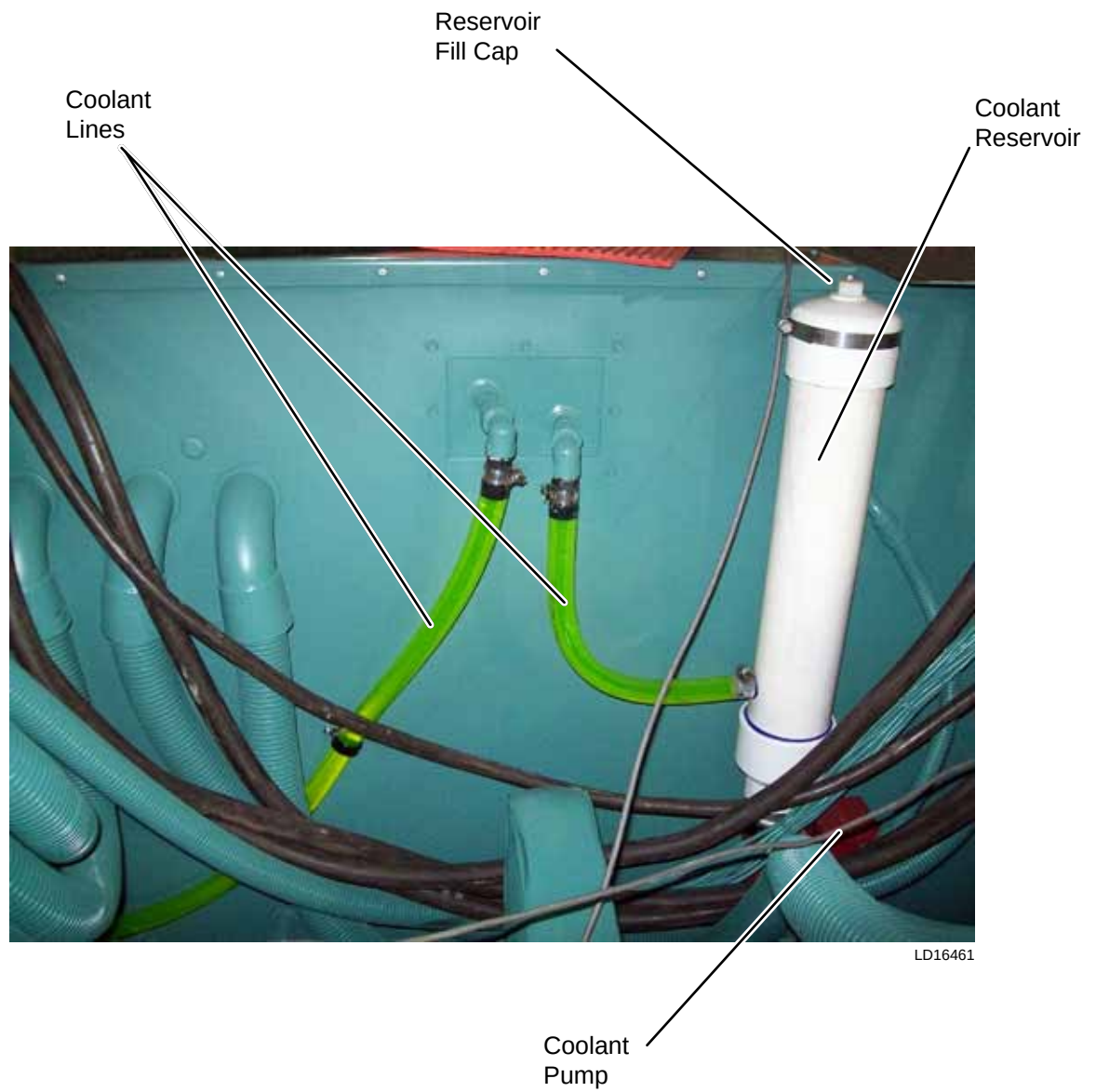
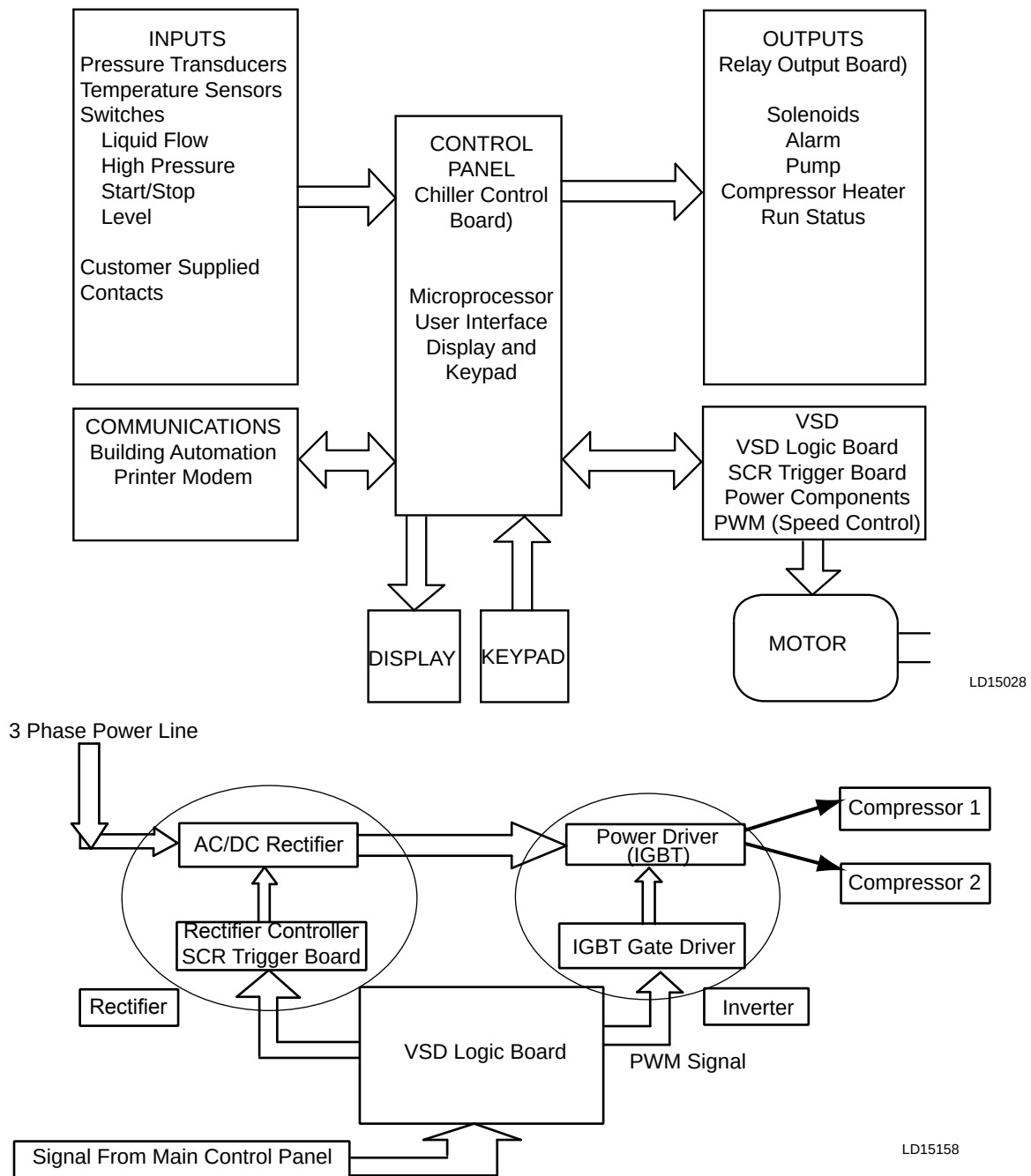


FIGURE 20 - VSD COOLANT RESERVOIR

**FIGURE 21 - CHILLER CONTROL SYSTEM**

KEYPAD

An operator keypad allows complete control of the system from a central location. The keypad offers a multitude of command keys on the left and right side of the keypad to access displays, program setpoints, history data, and initiate system commands. Most keys have multiple displays that can be accessed by repetitively pressing the key or by pressing the ▲, ▼, ◀, and ▶ (ARROW) keys. The keypad utilizes an overlay to convert the keypad to various languages.



FIGURE 22 - OPERATOR KEYPAD

The keypad also contains keys in the center section for data entry in the various program modes.

CHILLER CONTROL BOARD

The Chiller Control Board is the controller and master decision maker in the control panel. The on-board microprocessor control is capable of controlling both compressors. System inputs from pressure transducers and temperature sensors are connected directly to the Chiller Control Board. The Chiller Control Board circuitry multiplexes all of the analog inputs, digitizes them, and scans the inputs to keep a constant watch on chiller operating conditions. Based on this information, the Chiller Control Board issues commands to the Relay Output Board(s), Electronic Expansion Valve Controllers, and VSD Logic Board to activate and deactivate contactors, solenoids, control valves, set compressor speeds, etc., for chilled liquid and safety control. Keypad commands are acted upon by the Chiller Control Board to change setpoints, cutouts, scheduling, operating requirements, and to provide displays.

The software resides on an Eprom chip on the control board. The chip is replaceable for software upgrades. The software for YVWA is of the format C.WCS.30.xx where xx is the revision level. When control board Eproms are ordered as replacement parts, the latest revision is loaded.

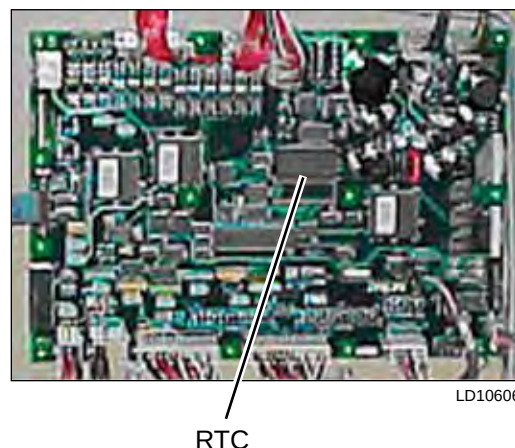


FIGURE 23 - CHILLER CONTROL BOARD

The Chiller Control Board contains a Real Time Clock integrated circuit chip with an internal battery back up of 8K x 8 bit RAM. The purpose of the battery backed RAM is to assure any programmed values (setpoints, clock, cutouts, history data etc.) are not lost during a power failure, regardless of the time involved in a power outage or shutdown period.

The Chiller Control (Microprocessor) Board contains an onboard power supply, which provides 5VDC regulated to sensors, transducers, display, and other circuit boards. The supply also provides +12VDC to the Relay Output Boards and the +34VDC to the level sensors.

The Chiller Control Board is capable of directly receiving analog inputs from temperature sensors and transducers. An analog to digital converter (A/D) with an onboard 4 channel multiplexer (MUX) allows up to 48 analog inputs to be read. The A/D Converter converts the analog signals to digital signals, which can be read by the onboard microprocessor. On a 2 system chiller, approximately half of these inputs are utilized.

Three integrated circuits on the microprocessor can be configured for digital inputs or outputs (Digital I/O). As inputs, they can read digital (2 level, on/off) inputs like keypad keys, unit switch, high pressure cut-out, flow switch, etc. As inputs, they are at logic HIGH with voltage on them from the control board in standby. When connected to common (ground, neutral) they

signal logic LOW as a valid input condition present. As outputs they are used for controls like turning on fans, controlling compressor heaters, controlling chiller valves, or other devices requiring on/off control. Up to 72 Digital I/O will be utilized to control the chiller.

The Chiller Control (Microprocessor) Board contains a dual UART (Universal Asynchronous Receiver Transmitter) for RS-485 and RS-232 communications. UART1 is configured for RCC and BAS (ISN) communications on the external chiller RS-485 port. Data is sent and received at 4800 baud with 1 start bit, 8 data bits, odd parity, and 1 stop bit. The port is shared with the RS-232 interface and at start-up will be initialized to RS-485 communications. UART2 is configured for VSD communications over an internal chiller RS-485 port located within the Control/Power cabinet. UART2 has a higher priority interrupt than UART1. The data is sent and received at a rate of 9600 baud and serves only as the communications between the Chiller Control Board and the VSD Logic Board. Both of these boards are located within the Control/Power panel.

On power-up, the Chiller Control Board will attempt to initialize communications with the VSD Logic Board. The Chiller Control Board will request the number of compressors select and VSD software version. If for some reason the information is not provided, the request will be made over and over again until it is received. Once the data has been received, the Chiller Control Board will not ask for it again. If the communications is not established, a VSD Loss Of Comms fault message will appear on the STATUS display.

Two 8 channel, 8 bit Digital to Analog Converters (D/A Converter) on the Chiller Control Board supply the Feed and Drain Valve Controller signals to allow the controller to position the Flash Tank Feed and Drain Valves. The Feed Valve controls the refrigerant level in the flash tank while the Drain Valves controls superheat. The control voltage to the Feed and Drain Valve Controller has a range of 0-10.28 VDC.

RELAY OUTPUT BOARDS

Two or three Relay Output Boards are required to operate the chiller. These boards convert 0-12VDC logic levels outputs from the Chiller Control Board to 115VAC levels used by contactors, relays, solenoid valves, etc., to control system and chiller operation. The common side of all relays on the Relay Output Board is connected to +12VDC.

The open collector outputs of the Chiller Control Board energize the DC relays on the Relay Output Board by pulling one side of the relay coil to ground. When not energized, both sides of the relay coils will be at +12VDC potential.



LD10607

FIGURE 24 - OUTPUT BOARD (ARB1, ARB2)

CHILLER CONFIGURATION JUMPERS

There are a number of chiller configuration jumpers that are factory wired into wire harnesses or plugs. These jumpers typically never need to be reviewed unless in some unlikely situation, a chiller is incorrectly configured or a loose connection occurs.

Number of Compressors Configuration Jumper

Software packs (EPROM's) are common between 2, 3, and 4 compressor chillers. As a result, the VSD Logic Board must be configured for the actual number of compressors. The chiller is configured for the number of compressors through the use of jumpers, factory plugged into the J1 plug on the VSD Logic Board. This hard wiring configures the VSD Logic Board

for the number of compressors on the chiller, avoiding mis-programming. The jumpers are only checked at power-up. If no jumpers are sensed, or an invalid combination is sensed and communicated to the Chiller Control Board, start-up of the unit will be inhibited and an "INVALID NUMBER OF COMPRESSORS SELECTED" warning message will be displayed in the Status display.

Table 2 shows the chiller number of compressors and the associated location of the jumpers to program the appropriate compressor configuration.

TABLE 1 - COMPRESSORS AND THE APPROPRIATE JUMPER POSITIONS

# OF COMPRESSORS	VSD LOGIC BOARD JUMPER POSITION
2	J1-10 to J1-9
3	J1-11 to J1-9
4	J1-12 to J1-9

VSD LOGIC TO CHILLER MICROPROCESSOR BOARD RS-485 COMMUNICATION CONFIGURATION JUMPERS

The Chiller Control Board and the VSD Logic Boards communicate over an RS-485 link. The communications link requires a matching address to be set up at both ends. The VSD Logic Board communications bus is configured through the use of jumpers, factory plugged into the J5 plug on the VSD Logic Board. The VSD Logic Board will only check the jumper positions once at power-up.

Table 3 shows the VSD Logic Board Address configuration and the associated location of the jumpers. The jumpers will vary according to the number of VSD Logic Boards installed. All chillers utilize a single VSD Logic Board and will use VSD Logic Board Address 1.

TABLE 2 - VSD LOGIC BOARD ADDRESS JUMPER

VSD LOGIC BOARD'S ADDRESS	VSD LOGIC BOARD JUMPER POSITION
1	J5-1 to J5-2 and J5-3 to J5-4

VALVE CONTROLLER AND CONTROL ALGORITHM OPERATION

The Economizer Feed and Condenser Level Control Valve PI Controller(s) plays a dual role of supplying drive signals to control the opening and closing of both the Economizer Feed and Condenser Level Control Valve. These valves control the liquid level in the condenser and the suction superheat of the compressor. The Economizer Feed and Condenser Level Control Valve Controller receives analog signals from the Chiller Control Board to position the Economizer Feed and Condenser Level Control Valves. The Chiller Control Board PI (Proportional plus Integral) control algorithm in the Chiller Control Board software determines the open % for the Economizer Feed and Condenser Level Control Valves. A D/A converter on the Chiller Control Board converts the 0-100% signal to an output voltage between 0 VDC and 10.28 VDC and sends it to the Economizer Feed and Condenser Level Control Valve Controller. This voltage is then converted to a valve position by the Economizer Feed and Condenser Level Control Valve Controller and a 2 phase (4 wire), signal drives the Economizer or condenser level Valve open or closed. Power for the Valve Controller comes from a 30VDC supply from the Chiller Control Board.

The Condenser Level Control Valve is a stepper motor valve that controls the liquid flow from the condenser to assure the liquid level in the evaporator is maintained at a proper rate.

The Level Sensor is a rod inserted into the reservoir connected to the side of the condenser. The sensing rod has an active range of about 6". The control algorithm looks at feedback from the Level Sensor and compares it to the level setpoint in the control algorithm. This control strategy attempts to keep the level in the condenser approximately 1" above subcooler. As the level in the condenser fluctuates, the control algorithm varies the voltage to the Controller, which in turn sends a 2 phase stepped drive signal to open or close the Level Control Valve as needed. As the Condenser level varies farther from the setpoint, the gain of the control algorithm increases for faster response. In some cases, the Level Control Valve will fully open or fully close if the levels become too low or too high. When properly charged, the condenser subcooler will be covered as the Level Control Valve controls refrigerant flow from the Condenser.

The Economizer Feed Valve controls flow of liquid through the economizer to maintain proper heat exchange.

Valve Controller LED's

The Economizer Feed and Condenser Level Control Valve stepper motor controller is equipped with a pair of LED's on the left side of the module and 10 LED's in the center of the module (Figure 25 on page 42). These LED's may be useful during troubleshooting.



LD10629

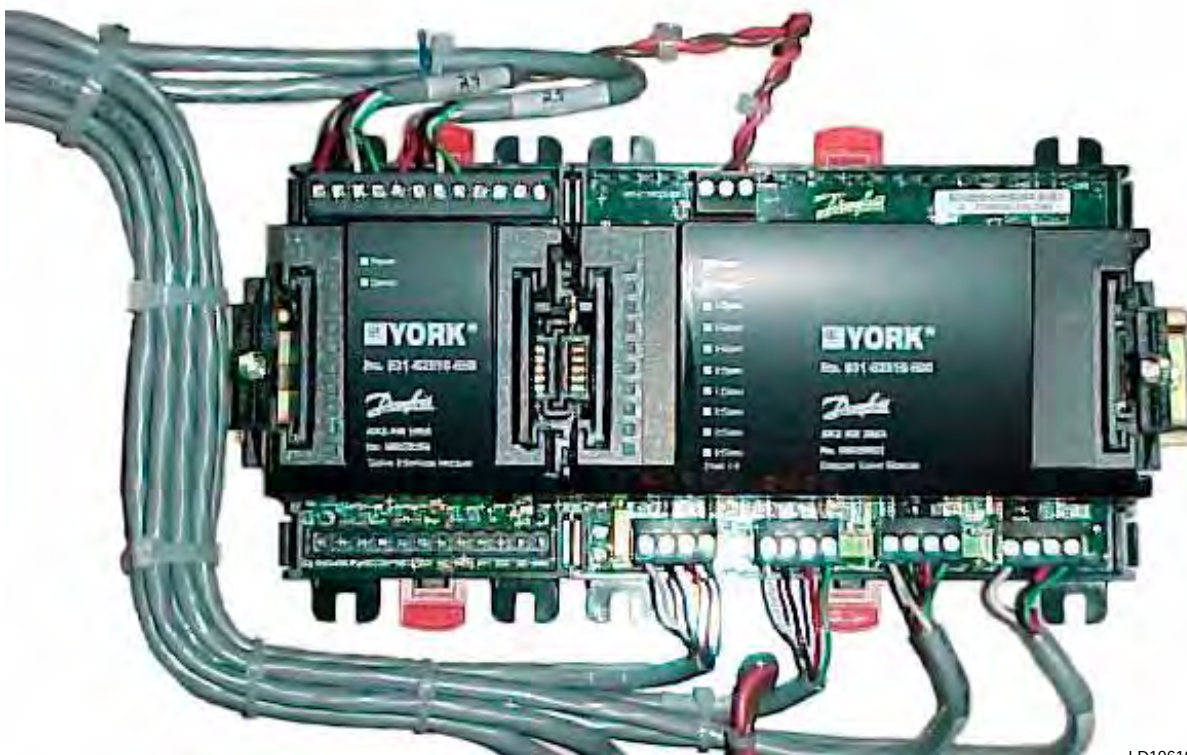
FIGURE 25 - LED LOCATIONS

A pair of LED's on the left side of the module (Figure 27 on page 42) indicate when the module is powered. The Power LED should be lit at all times.



LD10630

FIGURE 27 - POWER AND COMMS LED'S



LD10619

FIGURE 26 - EEV STEPPER CONTROLLER

A column of 10 LED's runs from top to bottom on the right side module (Figure 28 on page 43).



LD10631

FIGURE 28 - POWER, COMMS AND SYSTEM OPEN/CLOSE LED'S

A pair of LED's on the top of the module (Figure 28 on page 43) indicate when the module is powered and when the module is communicating with the Chiller Control Board. The Power LED should be lit at all times.

The Open and Close LED's on each system indicate when the Economizer Feed and Condenser Level Control Valves are being driven open or closed in an effort to control condenser level and economizer operation. These LED's will light "momentarily" when the valves are being pulsed. In most cases other than start-up, they may appear to not light at all. The valves that are controlled by the outputs associated with the LED's are decoded using the table below:

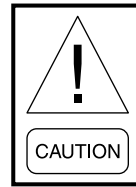
- 1 Open = System #1 Condenser Level Valve Open
- 2 Open = System #1 Economizer Feed Valve Open
- 3 Open = System #2 Condenser Level Valve Open
- 4 Open = System #2 Economizer Feed Valve Open
- 5 Close = System #1 Condenser Level Valve Close

6 Close = System #1 Economizer Feed Valve Close

7 Close = System #2 Condenser Level Valve Close

8 Close = System #2 Economizer Feed Valve Close

Due to the short duration of the open and close step-pulse pulses, LED lighting will be difficult to observe. In rare cases where validation of the controller output and valve movement needs to be checked, the valves can be operated in Service Mode. When operated in Service Mode, visual indication of the LED's lighting will be more obvious. Generally, no audible noise is evident as the valves open and close unless the valve is being run against it's stop. It is possible to obtain an indication of valve movement by touch, when a valve is opening or closing. If the valve has a sight glass, the pulg movement can be observed through the glass.



Manually operating the Econimzer Feed and Condenser Level Control Valves in Service Mode can drain or overfill the evaporator. This could cause valve movements and levels to act out of the ordinary when a system first starts, until the Chiller Control Board brings the system under control. This may also be evident in the condenser level and open/close % on the displays.

Careless use of manual control could cause liquid damage to the compressor when it is started.

SERIAL PORT CONNECTIONS

Table 3 on page 44 lists the serial ports and the circuit board they are located on. The serial communications lines provide communications to external devices outside the chiller and between microprocessors located in the chiller control panel.

TB2 allows connectiong to a remote OptiView RCC or E-Link Gateway. The OptiView RCC option is not yet available. The OptiView RCC and E-Link Gateway option cannot both be used. Only one or the other is permitted to be connected to the chiller.

TABLE 3 - SERIAL PORT CONNECTIONS

BOARD	HEADER	PORT TYPE	PORT USE
Chiller Control Board	TB1 / TB2	RS-232 / RS-485	Printer/RCC and BAS (ISN)
Chiller Control Board	J2 / J1	RS-485	Control Panel <-> VSD #1 / #2
VSD Logic Board	J12	Opto- Coupled RS-485	VSD <-> Control Panel

TRANSDUCER AND THERMISTOR CONVERSION**TABLE 4 - TRANSDUCER GAGE PRESSURE (PSIG) TO DC VOLTAGE CONVERSION**

PRESSURE MEASUREMENT	TRANSDUCER	RANGE	VOLTAGE (V) =	PRESSURE (P) =
Evaporator	025 29583 001	0-125 psig	$(P+16.625)/31.25$	$(31.25 \times V) - 15.625$
Condenser, Oil, Discharge	025 29139 001	0-400	$(P+34.375)/68.75$	$(68.75 \times V) - 34.375$
Economizer Outlet	025 29139 003	0-275	$(P+50)/100$	$(100 \times V) - 50$

TABLE 5 - 3KΩ THERMISTOR RESISTANCE
(VOLTAGE VARIES WITH CHANNEL SEE
FOLLOWING TABLES)

TEMP°F	TEMP°C	Ohms
15	-9.4	6906
20	-6.7	6573
25	-3.9	6239
30	-1.1	5925
35	1.7	5572
40	4.4	5239
45	7.2	4905
50	10.0	4571
55	12.8	4258
60	15.6	3944
65	18.3	3649
70	21.1	3355
75	23.9	3080
80	26.7	2806

**TABLE 6 - COMPRESSOR DISCHARGE
TEMPERATURE SENSOR INPUT VOLTAGE**

50KΩ THERMISTOR 025-32924-000			
TEMP°F	TEMP°C	VOLTAGE	OHMS
50	10.0	0.4297	54624
55	12.8	0.4883	53924
60	15.6	0.5525	53156
65	18.3	0.6240	52302
70	21.1	0.6990	51405
75	23.9	0.7855	50372
80	26.7	0.8739	49315
85	29.4	0.9700	48167
90	32.2	1.0717	46951
95	35.0	1.1792	45666
100	37.8	1.2930	44306
105	40.6	1.4113	42892
110	43.3	1.5357	41405
115	46.1	1.6610	39919
120	48.9	1.7915	38348
125	51.7	1.9232	36774
130	54.4	2.0558	35189
135	57.2	2.1920	33561
140	60.0	2.3240	31984
145	62.8	2.4563	30402
150	65.6	2.5877	28832
155	68.3	2.7154	27306
160	71.1	2.8420	25792
165	73.9	2.9643	24331
170	76.7	3.0840	22900
175	79.4	3.1978	21540
180	82.2	3.3063	20243
185	85.0	3.4124	18979
190	87.8	3.5112	17794
195	90.6	3.6068	16652
200	93.3	3.6965	15579
205	96.1	3.7817	14561
210	98.9	3.8619	13602
215	101.7	3.9420	12645
220	104.4	4.0082	11854
225	107.2	4.0925	10846
230	110.0	4.1659	9969
235	112.8	4.2576	8873
240	115.6	4.2921	8460
245	118.3	4.3265	8049
250	121.1	4.3610	7637

**TABLE 7 - EVAPORATOR REFRIGERANT
TEMPERATURE SENSOR INPUT VOLTAGE**

3KΩ THERMISTOR		
TEMP°F	TEMP°C	VOLTAGE
-4.87	-20.48	1.231
-2.31	-19.06	1.309
0.17	-17.68	1.387
2.59	-16.34	1.465
4.97	-15.02	1.543
7.29	-13.73	1.621
9.57	-12.46	1.699
11.82	-11.21	1.777
14.05	-9.97	1.856
16.25	-8.75	1.934
18.44	-7.53	2.012
20.62	-6.32	2.090
22.79	-5.12	2.168
24.96	-3.91	2.246
27.13	-2.71	2.324
29.32	-1.49	2.402
31.51	-0.27	2.481
33.72	0.96	2.559
35.95	2.19	2.637
38.2	3.44	2.715
40.48	4.71	2.793
42.8	6.00	2.871
45.16	7.31	2.949
47.57	8.65	3.027
59.03	15.02	3.106
52.56	11.42	3.184
55.15	12.86	3.262
57.82	14.34	3.340
60.59	15.88	3.418
63.45	17.47	3.496
66.43	19.13	3.574
69.53	20.85	3.652
72.8	22.67	3.731
76.24	24.58	3.809
79.87	26.59	3.887
83.73	28.74	3.965
87.88	31.04	4.043
92.34	33.52	4.121
97.21	36.23	4.199
102.58	39.21	4.277
108.54	42.52	4.356
115.26	46.26	4.434
123.06	50.59	4.512
132.29	55.72	4.590
143.62	62.01	4.668
158.34	70.19	4.746

**TABLE 8 - CONDENSER AND CHILLED
LIQUID, EDUCTOR, SUBCOOLED LIQUID, AND
ECONOMIZER OUTLET TEMPERATURE SENSOR
INPUT VOLTAGE**

3KΩ THERMISTOR		
TEMP°F	TEMP°C	VOLTAGE
18.83	-7.32	1.611
21.22	-5.99	1.690
23.57	-4.68	1.768
25.89	-3.39	1.846
28.2	-2.11	1.924
30.49	-0.84	2.002
32.76	0.42	2.080
35.03	1.68	2.158
37.3	2.94	2.236
39.58	4.21	2.315
41.85	5.47	2.393
44.14	6.74	2.471
46.45	8.03	2.549
48.78	9.32	2.627
51.13	10.63	2.705
53.52	11.96	2.783
55.94	13.30	2.861
58.41	14.67	2.940
60.93	16.07	3.018
63.5	17.50	3.096
66.13	18.96	3.174
68.84	20.47	3.252
71.64	22.02	3.330
74.52	23.62	3.408
77.52	25.29	3.486
80.63	27.02	3.565
83.86	28.81	3.643
87.28	30.71	3.721
90.85	32.69	3.799
94.63	34.79	3.877
98.68	37.04	3.955
103	39.44	4.033
107.64	42.02	4.111
112.72	44.84	4.190
118.28	47.93	4.268
124.45	51.36	4.346
131.45	55.25	4.424
139.5	59.72	4.502
149.01	65.01	4.580
160.64	71.47	4.658
175.61	79.78	4.736

TABLE 9 - MOTOR TEMPERATURE SENSOR RESISTANCE (CHECK AT THE MOTOR)

TEMP. (°C)	RNOMINAL (OHMS)	RTOL (± %)	RMIN (OHMS)	RMAX (OHMS)
-20	97,062	5.00	92,209	101,915
-15	77,941	4.60	69,586	76,296
-10	55,391	4.20	52,996	57,643
-5	42,324	3.85	40,695	43,954
0	32,654	3.50	31,511	33,797
5	25,396	3.15	24,596	26,196
10	19,903	2.80	19,346	20,461
15	15,713	2.50	15,321	16,106
20	12,493	2.20	12,218	12,768
25	10,000	2.00	9,800	10,200
30	8,056	2.40	7,863	8,250
35	6,531	2.70	6,354	6,707
40	5,326	3.00	5,166	5,485
45	4,368	3.25	4,226	4,510
50	3,602	3.50	3,476	3,728
55	2,986	3.75	2,874	3,098
60	2,488	4.00	2,389	2,588
65	2,083	4.25	1,995	2,172
70	1,753	4.50	1,674	1,832
75	1,481	4.75	1,411	1,551
80	1,257	5.00	1,194	1,321
85	1,071	5.20	1,016	1,127
90	916.9	5.40	867.4	966.4
95	787.7	5.60	743.6	831.9
100	679.3	5.80	639.9	718.7
105	587.9	6.00	552.6	623.2
110	510.6	6.20	479.9	542.3
115	445.0	6.40	416.5	473.5
120	389.0	6.60	363.4	414.7
125	341.2	6.70	318.4	364.1
130	300.2	6.90	279.5	320.9
135	264.9	7.10	246.1	283.7
140	234.4	7.30	217.3	251.5
145	208.0	7.40	192.6	223.3
150	185.0	7.50	171.1	198.9

R-134A CONVERSION TABLES

The following table can be used for converting R-134A pressures to their equivalent saturated temperatures.

TABLE 10 - R-134A PRESSURE TO SATURATED TEMPERATURE CONVERSION

PRESSURE (PSIG)	DEW POINT TEMP. (°F)	PRESSURE (PSIG)	DEW POINT TEMP. (°F)	PRESSURE (PSIG)	DEW POINT TEMP. (°F)
0.0	-14.9	135.0	105.0	270.0	152.0
5.0	-3.0	140.0	107.2	275.0	153.4
10.0	6.7	145.0	109.4	280.0	154.7
15.0	14.9	150.0	111.5	285.0	156.1
20.0	22.2	155.0	113.6	290.0	157.4
25.0	28.7	160.0	115.6	295.0	158.7
30.0	34.6	165.0	117.6	300.0	160.0
35.0	40.0	170.0	119.6	305.0	161.3
40.0	45.0	175.0	131.5	310.0	162.5
45.0	49.6	180.0	123.3	315.0	163.8
50.0	54.0	185.0	125.2	320.0	165.0
55.0	58.1	190.0	126.9	325.0	166.2
60.0	62.0	195.0	128.7	330.0	167.4
65.0	65.7	200.0	130.4	335.0	168.6
70.0	69.2	205.0	132.1	340.0	169.8
75.0	72.6	210.0	133.8	345.0	171.0
80.0	75.9	215.0	135.5	350.0	172.1
85.0	79.0	220.0	137.1	355.0	173.3
90.0	82.0	225.0	138.7	360.0	174.4
95.0	84.9	230.0	140.2	365.0	175.5
100.0	87.7	235.0	141.8	370.0	176.6
105.0	90.4	240.0	143.3	375.0	177.7
110.0	93.0	245.0	144.8	380.0	178.8
115.0	95.5	250.0	146.3	385.0	179.9
120.0	98.0	255.0	147.7	390.0	180.9
125.0	100.4	260.0	149.2	395.0	182.0
130.0	102.7	265.0	150.6	400.0	183.0

ANALOG INPUT CONNECTIONS

The following table lists the Analog inputs and the circuit board they are located on. Not all of the sensors are installed in every unit, as some of them are optional. The software must read the optional sensors if installed. The Analog input signals are typically referenced to the common (return, ground) in the system.

J12-3 can also be used as common, as well as chassis ground, or the common terminal point on the Chiller Control Board. See the wiring diagrams. The +DC Bus, -DC Bus and ½ DC Bus voltages are measured in reference to one of the other DC Bus points. For example: +DC Bus measured to ½ DC Bus.

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TABLE 11 - ANALOG INPUT CONNECTIONS

BOARD	HEADER	ANALOG INPUT
Control Board	J17-11	Remote Temperature Reset
Control Board	J17-12	Remote Current Limit
Control Board	J17-13	Spare
Control Board	J17-14	Sys1 Eductor Temperature
Control Board	J17-15	Sys 2 Eductor Temperature
Control Board	J18-7	Leaving Chilled Liquid Temp
Control Board	J18-8	Entering Chilled Liquid Temp
Control Board	J18-9	Spare
Control Board	J19-1	Sys1 Compressor Motor Temperature 1
Control Board	J19-2	Sys1 Compressor Motor Temperature 2
Control Board	J19-3	Sys1 Compressor Motor Temperature 3
Control Board	J19-6	Sys 2 Compressor Motor Temperature 1
Control Board	J19-7	Sys 2 Compressor Motor Temperature 2
Control Board	J19-8	Sys 2 Compressor Motor Temperature 3
Control Board	J21-13	Leaving Condenser Liquid Temperature
Control Board	J21-3	Sys1 Evaporator Refrigerant Temperature
Control Board	J21-16	Sys1 Compressor Discharge Temperature
Control Board	J21-6	Sys1 Condenser Liquid Refrigerant Level Sensor
Control Board	J21-20	Sys1 Evaporator Pressure Sensor
Control Board	J21-22	Sys1 Oil Pressure Sensor
Control Board	J21-24	Sys1 Compressor Discharge Pressure
Control Board	J22-13	Entering Condenser Liquid Temperature
Control Board	J22-3	Sys 2 Evaporator Refrigerant Temperature
Control Board	J22-16	Sys 2 Compressor Discharge Temperature
Control Board	J22-6	Sys 2 Condenser Liquid Refrigerant Level
Control Board	J22-20	Sys 2 Evaporator Pressure Sensor
Control Board	J22-22	Sys 2 Oil Pressure Sensor
Control Board	J22-24	Sys 2 Compressor Discharge Pressure
Control Board	J20-1	Spare
Control Board	J20-2	Spare
Control Board	J20-3	Spare
Control Board	J20-6	Spare
Control Board	J20-7	Spare
Control Board	J20-8	Spare

TABLE 11 - ANALOG INPUT CONNECTIONS (CONT'D)

BOARD	HEADER	ANALOG INPUT
Control Board	J23-13	Sys1 Subcooled Liquid Refrigerant Temp Sensor
Control Board	J23-3	Sys1 Economizer Temperature
Control Board	J23-16	Spare
Control Board	J23-6	Spare
Control Board	J23-20	Sys1 Economizer Pressure Sensor
Control Board	J23-22	Sys1 Condenser Pressure Sensor
Control Board	J23-24	Spare
Control Board	J24-13	Sys 2 Subcooled Liquid Refrigerant Temp Sensor
Control Board	J24-3	Sys 2 Economizer Temperature
Control Board	J24-16	Spare
Control Board	J24-6	Spare
Control Board	J24-20	Sys 2 Economizer Pressure Sensor
Control Board	J24-22	Sys 2 Condenser Pressure Sensor
Control Board	J24-24	Spare
VSD Logic Board	J1-1,2	Comp 1 Phase A Motor Current
VSD Logic Board	J1-3,4	Comp 1 Phase B Motor Current
VSD Logic Board	J1-5,6	Comp 1 Phase C Motor Current
VSD Logic Board	J1-13,14	Comp 3 Phase A Motor Current (Future Use)
VSD Logic Board	J1-15,16	Comp 3 Phase B Motor Current (Future Use)
VSD Logic Board	J1-17,18	Comp 3 Phase C Motor Current (Future Use)
VSD Logic Board	J2-1,2	Comp 2 Phase A Motor Current
VSD Logic Board	J2-3,4	Comp 2 Phase B Motor Current
VSD Logic Board	J2-5,6	Comp 2 Phase C Motor Current
VSD Logic Board	J2-9,10	Comp 4 Phase A Motor Current (Future Use)
VSD Logic Board	J2-11,12	Comp 4 Phase B Motor Current (Future Use)
VSD Logic Board	J2-13,14	Comp 4 Phase C Motor Current (Future Use)
VSD Logic Board	J3-1	+DC Bus Voltage 1
VSD Logic Board	J3-2	½ DC Bus Voltage 1
VSD Logic Board	J3-3	-DC Bus Voltage 1
VSD Logic Board	J3-4	-DC Bus Voltage 2 (Future Use)
VSD Logic Board	J3-5	½ DC Bus Voltage 2 (Future Use)
VSD Logic Board	J3-6	+DC Bus Voltage 2 (Future Use)
VSD Logic Board	J6-8	Comp 1 IGBT Baseplate Temperature
VSD Logic Board	J8-8	Comp 2 IGBT Baseplate Temperature
VSD Logic Board	R19	Comp 1 Overload Adjust
VSD Logic Board	R64	Comp 2 Overload Adjust

DIGITAL INPUT CONNECTIONS

The following table lists the digital inputs and the circuit board they are located on. The Digital input are at their logic HIGH in standby with voltage on them from the board. They must be connected to the common (return, ground) to reach logic LOW and signal a valid input to the control. Voltage is shown in the table.

J12-3 can also be used as common, as well as chassis ground, or the common terminal point on the Chiller Control Board. See the wiring diagrams.

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TABLE 12 - DIGITAL INPUT CONNECTIONS

BOARD	HEADER	ANALOG OUTPUT
Control Board	J4-2	Unit Switch 1
Control Board	J4-3	Unit Switch 2
Control Board	J4-4	Sys 1 HPCO
Control Board	J4-5	Sys 2 HPCO
Control Board	J4-6	VSD Fault Relay
Control Board	J5-1	Sys 1 Oil Level Switch
Control Board	J5-2	Sys 2 Oil Level Switch
Control Board	J5-3	Remote Mode Select
Control Board	J6-2	Chilled Liquid Flow Switch
Control Board	J6-3	Print
Control Board	J6-4	Sys 1 Run Permissive
Control Board	J6-5	Sys 2 Run Permissive
Control Board	J6-6	Condenser Liquid Flow Switch
Control Board	J7-1,2	(Used to indicate Heat Pump Capability)
Control Board	J7-3,4	Spare
Control Board	J7-5,6	Spare
Control Board	J7-7,8	Spare
Control Board	J7-9,10	Spare
VSD Logic Board	J1-10	2 Compressor Select
VSD Logic Board	J1-11	3 Compressor Select (N/A)
VSD Logic Board	J1-12	4 Compressor Select (N/A)
VSD Logic Board	J5-1,2	MODBUS Address Bit 0
VSD Logic Board	J5-3,4	MODBUS Address Bit 1
VSD Logic Board	J6-2	Comp 1 Phase A Gate Driver Fault
VSD Logic Board	J6-5	Comp 1 Phase C Gate Driver Fault
VSD Logic Board	J6-12	Comp 1 Phase B Gate Driver Fault
VSD Logic Board	J7-2	Comp 3 Phase A Gate Driver Fault
VSD Logic Board	J7-5	Comp 3 Phase B Gate Driver Fault
VSD Logic Board	J7-12	Comp 3 Phase C Gate Driver Fault
VSD Logic Board	J8-2	Comp 2 Phase A Gate Driver Fault
VSD Logic Board	J8-5	Comp 2 Phase C Gate Driver Fault
VSD Logic Board	J8-12	Comp 2 Phase B Gate Driver Fault
VSD Logic Board	J9-2	Comp 4 Phase A Gate Driver Fault
VSD Logic Board	J9-5	Comp 4 Phase B Gate Driver Fault
VSD Logic Board	J9-12	Comp 4 Phase C Gate Driver Fault

TABLE 12 - DIGITAL INPUT CONNECTIONS (CONT'D)

BOARD	HEADER	ANALOG OUTPUT
VSD Logic Board	J11-2	Phase Loss Fault 1
VSD Logic Board	J11-6	Phase Loss Fault 2
VSD Logic Board	SW1	Test Pushbutton
VSD Logic Board	J10-5,6	Comp 1 Run (from control panel)
VSD Logic Board	J10-7,8	Comp 2 Run (from control panel)

ANALOG OUTPUT CONNECTION

The following table lists the analog outputs and the circuit board they are located on. The analog output signals are feed to the associated control device from the 2 wires in the associated plug.

TABLE 13 - ANALOG OUTPUT CONNECTIONS

BOARD	HEADER	ANALOG OUTPUT
Control Board	J15-1,2	Sys 1 Condenser Liquid Refrigerant Level Control Valve
Control Board	J15-3,4	Sys 1 Economizer Feed Valve
Control Board	J15-5,6	Sys 2 Condenser Liquid Refrigerant Level Control Valve
Control Board	J15-7,8	Sys 2 Economizer Feed Valve
Control Board	J14-1,6	Spare
Control Board	J14-2,7	Spare
Control Board	J14-3,8	Spare
Control Board	J14-4,9	Spare
Control Board	J25-1,5	Spare
Control Board	J25-2,6	Spare
Control Board	J25-3,7	Spare
Control Board	J25-4,8	Spare

DIGITAL OUTPUT CONNECTION

The following table lists the digital outputs and the plug/terminals of the circuit board they originate from. Not all of the outputs will be used on every unit. Signal levels may be 12VDC, 120VAC, or a dry contact (no voltage) closure). 120VAC signals typically may show only one connection point; the other will be neutral (Wire 2). Outputs which reference multiple boards, such as “Chiller Control Board / Relay Board 1” indicate the signal originates on the Chiller Control Board as a 0-12VDC digital signal (example: J9-1) that is then fed to the Relay board and output as a dry contact closure between TB1-20 and 19. In this case, outputs from both boards are called out in the table.

The 0-120VAC single digital outputs from the Relay Output Boards are referenced to neutral (Wire 2). For example, the fan output on TB1-6 is a single 120VAC output. 0-12VDC outputs from the Chiller Control Board are referenced to common (return, ground) in the system. J12-3 can also be used as common, as well as chassis ground, or the common terminal point on the Chiller Control Board. See the wiring diagrams. Refer to the wiring diagrams whenever there is a requirement for tracing out these signals.

TABLE 14 - DIGITAL OUTPUT CONNECTIONS

BOARD	HEADER	ANALOG OUTPUT
Control Board / Relay Board 1	J9-1 / TB1-20/19	Spare
Control Board / Relay Board 1	J9-2 / TB1-18/17	Sys 1 VSD Run
Control Board / Relay Board 1	J9-3 / TB1-16/15	Sys 1 Alarm
Control Board / Relay Board 1	J9-4 / TB1-14/13	Spare
Control Board / Relay Board 1	J9-5 / TB1-12/11	Sys 1 VI Step 1
Control Board / Relay Board 1	J9-6 / TB1-10/9	Sys 1 VI Step 2
Control Board / Relay Board 1	J9-7 / TB1-8/7	VSD Aux coolant Pump(at water side)
Control Board / Relay Board 1	J9-8 / TB1-6	Sys1 Liquid Refrigerant Injection Valve
Control Board / Relay Board 1	J9-9 / TB1-5	Sys 1 Hot Gas Bypass Valve
Control Board / Relay Board 1	J9-10 / TB1-4	Spare
Control Board / Relay Board 1	J9-11 / TB1-3	Sys 1 Compressor Heater
Control Board / Relay Board 1	J9-12 / TB1-2	Sys 1 Oil Pump
Control Board / Relay Board 2	J10-1 / TB1-20/19	Evaporator / Condenser Pump
Control Board / Relay Board 2	J10-2 / TB1-18/17	Sys 2 VSD Run
Control Board / Relay Board 2	J10-3 / TB1-16/15	Sys 2 Alarm
Control Board / Relay Board 2	J10-4 / TB1-14/13	Chiller Run
Control Board / Relay Board 2	J10-5 / TB1-12/11	Spare
Control Board / Relay Board 2	J10-6 / TB1-10/9	Sys 2 VI Step 1
Control Board / Relay Board 2	J10-7 / TB1-8/7	Sys 2 VI Step 2
Control Board / Relay Board 2	J10-8 / TB1-6	Sys 2 Liquid Refrigerant Injection Valve
Control Board / Relay Board 2	J10-9 / TB1-5	Sys 2 Hot Gas Bypass Valve
Control Board / Relay Board 2	J10-10 / TB1-4	Spare
Control Board / Relay Board 2	J10-11 / TB1-3	Sys 2 Compressor Heater
Control Board / Relay Board 2	J10-12 / TB1-2	Sys 2 Oil Pump
Control Board / Relay Board 3	J11-1 / TB1-20/19	Spare
Control Board / Relay Board 3	J11-2 / TB1-18/17	Spare
Control Board / Relay Board 3	J11-3 / TB1-16/15	Spare
Control Board / Relay Board 3	J11-4 / TB1-14/13	Spare
Control Board / Relay Board 3	J11-5 / TB1-12/11	Spare

TABLE 14 - DIGITAL OUTPUT CONNECTIONS (CONT'D)

BOARD	HEADER	ANALOG OUTPUT
Control Board / Relay Board 3	J11-6 / TB1-10/9	Spare
Control Board / Relay Board 3	J11-7 / TB1-8/7	Spare
Control Board / Relay Board 3	J11-8 / TB1-6	Spare
Control Board / Relay Board 3	J11-9 / TB1-5	Spare
Control Board / Relay Board 3	J11-10 / TB1-4	Spare
Control Board / Relay Board 3	J11-11 / TB1-3	Spare
Control Board / Relay Board 3	J11-12 / TB1-2	Spare
VSD Logic Board	J6-1	Comp 1 Phase A+ IGBT Gating Signal
VSD Logic Board	J6-3	Comp 1 Phase B- IGBT Gating Signal
VSD Logic Board	J6-4	Comp 1 Phase C+ IGBT Gating Signal
VSD Logic Board	J6-10	Comp 1 Phase A- IGBT Gating Signal
VSD Logic Board	J6-11	Comp 1 Phase B+ IGBT Gating Signal
VSD Logic Board	J6-13	Comp 1 Phase C- IGBT Gating Signal
VSD Logic Board	J6-14	Comp 1 Enable
VSD Logic Board	J7-1	Comp 3 Phase A+ IGBT Gating Signal
VSD Logic Board	J7-3	Comp 3 Phase B- IGBT Gating Signal
VSD Logic Board	J7-4	Comp 3 Phase C+ IGBT Gating Signal
VSD Logic Board	J7-10	Comp 3 Phase A- IGBT Gating Signal
VSD Logic Board	J7-11	Comp 3 Phase B+ IGBT Gating Signal
VSD Logic Board	J7-13	Comp 3 Phase C- IGBT Gating Signal
VSD Logic Board	J7-14	Comp 3 Enable
VSD Logic Board	J8-1	Comp 2 Phase A+ IGBT Gating Signal
VSD Logic Board	J8-3	Comp 2 Phase B- IGBT Gating Signal
VSD Logic Board	J8-4	Comp 2 Phase C+ IGBT Gating Signal
VSD Logic Board	J8-10	Comp 2 Phase A- IGBT Gating Signal
VSD Logic Board	J8-11	Comp 2 Phase B+ IGBT Gating Signal
VSD Logic Board	J8-13	Comp 2 Phase C- IGBT Gating Signal
VSD Logic Board	J8-14	Comp 2 Enable
VSD Logic Board	J9-1	Comp 4 Phase A+ IGBT Gating Signal
VSD Logic Board	J9-3	Comp 4 Phase B- IGBT Gating Signal
VSD Logic Board	J9-4	Comp 4 Phase C+ IGBT Gating Signal
VSD Logic Board	J9-10	Comp 4 Phase A- IGBT Gating Signal
VSD Logic Board	J9-11	Comp 4 Phase B+ IGBT Gating Signal
VSD Logic Board	J9-13	Comp 4 Phase C- IGBT Gating Signal
VSD Logic Board	J9-14	Comp 4 Enable
VSD Logic Board	J11-3	Pre-charge Enable 1
VSD Logic Board	J11-7	Pre-charge Enable 2
VSD Logic Board	J10-1,2	VSD Cooling Fan / Pump Run
VSD Logic Board	J10-3,4	VSD Fault Relay (to control panel)

Using a multimeter the resistance between power wires of unit components in the VSD/control panel can be checked. The resistance measured should be as shown in the table below.

TABLE 15 - RESISTANCE

ITEM	PLUG	LOCATION		RESISTANCE	
		END "A"	END "B"	DISCONNECT PLUG	CONNECT PLUG
SYS1 HPCO	P38	Wire 112 at TB-18 on ARB1	Wire 113 at J4-4 on AMB	∞	0
SYS1 VI SV1 (Option)	P73	Wire 115 at TB-12 on ARB1	Wire 2	∞	≈135Ω±20%
SYS1 VI SV2 (Option)	P73	Wire 116 at TB-10 on ARB1	Wire 2	∞	≈135Ω±20%
SYS1 Comp Heater	P38	Wire 119 at TB-3 on ARB1	Wire 2	∞	≈36Ω±20%
SYS1 Liquid Injection SV (Option)	P38	Wire 117 at TB-6 on ARB1	Wire 2	∞	≈135Ω±20%
SYS1 HGBV(Option)	P38	Wire 118 at TB-5 on Wire 2 ARB1	Wire 2	∞	≈135Ω±20
SYS1 Oil Pump (Option)	P41	Wire 120 at TB-2 on ARB1	Wire 2	∞	≈1Ω±20%
Cooling Pump (Option)	P40	Wire 29 at TB-8 on ARB1	Wire 2	∞	≈1Ω±20%
EVAP Heater 1 (Option)	P36	Wire 114 at TB-20 on ARB1	Wire 2	∞	≈47Ω±20%
EVAP Heater 2 (Option)	P36	Wire 214 at TB-14 on ARB1	Wire 2	∞	≈47Ω±20%
SYS2 HPCO	P39	Wire 212 at TB-18 on ARB2	Wire 213 at J4-5 on AMB	∞	0
SYS2 VI SV1 (Option)	P74	Wire 215 at TB-12 on ARB2	Wire 2	∞	≈135Ω±20%
SYS2 VI SV2 (Option)	P74	Wire 216 at TB-8 on ARB2	Wire 2	∞	≈135Ω±20%
SYS2 Comp Heater	P39	Wire 219 at TB-3 on ARB2	Wire 2	∞	≈36Ω±20%
SYS2 Liquid Injection SV (Option)	P39	Wire 217 at TB-6 on ARB2	Wire 2	∞	≈135Ω±20%
SYS2 HGBV (Option)	P39	Wire 218 at TB-5 on ARB2	Wire 2	∞	≈135Ω±20%
SYS2 Oil Pump (Option)	P42	Wire 220 at TB-2 on ARB2	Wire 2	∞	≈1Ω±20%
COND Heater 1 (Option)	P37	Wire 121 at TB-11 on ARB2	Wire 2	∞	≈47Ω±20%
COND Heater 1 (Option)	P37	Wire 221 at TB-4 on ARB2	Wire 2	∞	≈47Ω±20%

BAS (ISN) COMMUNICATIONS

General

The Chiller Control Board communicates with an optional E-Link using the ISN YORKTALK protocol. The E-Link then translates the information to the desired BAS protocol. UART1 is a dual UART capable of RS-485 and RS-232 communications. The JP-1 Jumper selects the type of communications. The RS-485 port is configured for 4800 band, 1 start bit, 8 data bits, ODD parity and 1 stop bit.

When a BAS is communicating with a E-Link Gateway, always follow the guidelines provided in the YORK E-Link Gateway instruction form for application to the specific chiller model type.

Received Data (Setpoints)

The chiller control panel receives 7 data values from the E-Link. The first 4 are analog values and the last 3 are digital values. These 7 data values are used as

control parameters when in REMOTE mode. When the unit is in LOCAL mode, these 7 values are ignored. If the unit receives no valid E-Link transmission for 5 minutes it will revert back to all local control values. Table 17 lists the 7 control parameters.

TABLE 16 - TRIDENT CHILLER YORK TALK CONTROL DATA

ISN PAGE	LCHLT CONTROL
P03	Chiller Setpoint
P04	BAS Current Limit
P05	--
P06	HP Setpoint
P07	Start / Stop Command
P08	--
P09	Operating Mode 0=Chiller, 1= HP (Only If Heat Pump control enabled Config0)
P10	History Buffer 1 Request

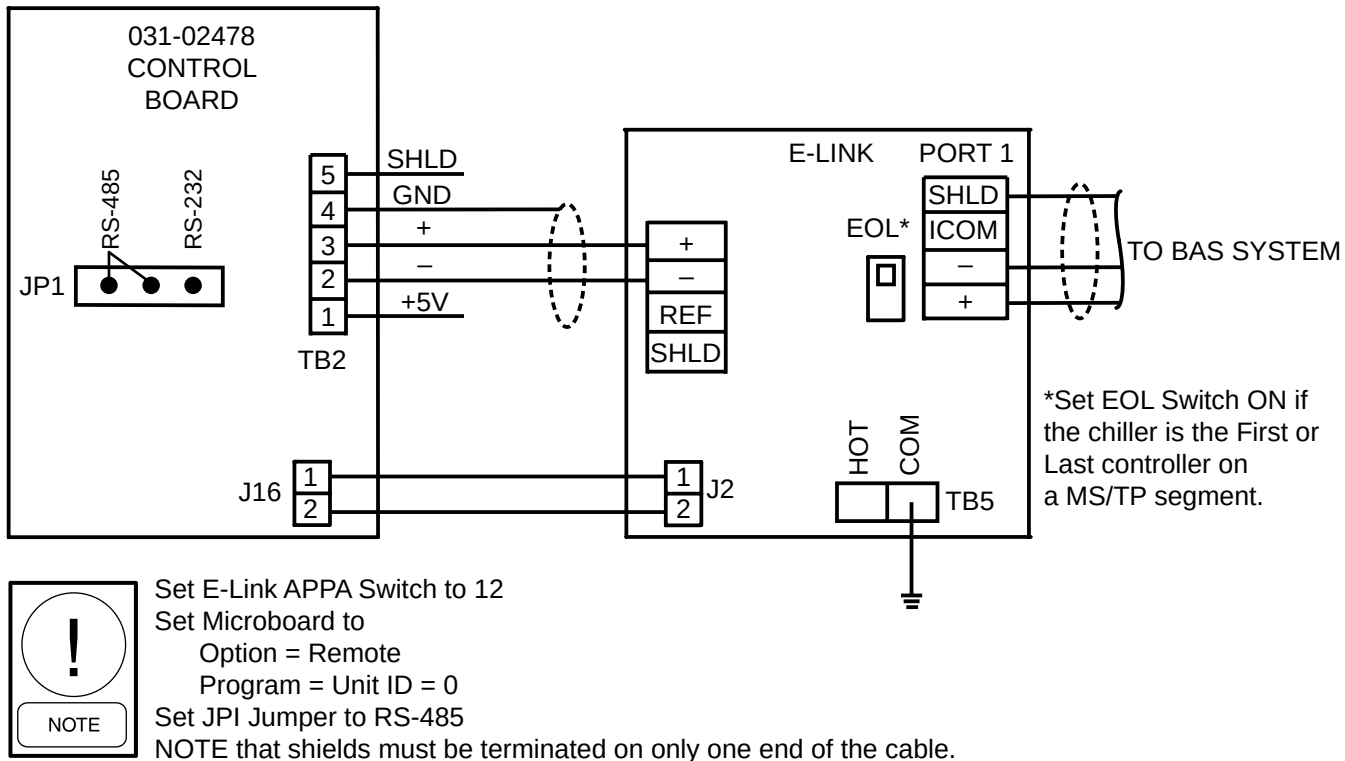


FIGURE 29 - CHILLER CONTROL BOARD

BAS TRANSMITTED DATA

After receiving a valid transmission from the E-Link, the unit will transmit either operational data or history buffer data if requested.

NOTE: To ensure that the following information is totally correct, refer to the integration information on the JCI portal.

TABLE 17 - DXST / ISN TRANSMITTED DATA (UNIT, SYS 1, SYS 2)

Item	Ref.	Version	Date	YORK P N	Checksum	Baud	COMMENTS										ENG PAGE REF																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Read/ Write	BACnet Object Typ/Ins	BACnet Object Name	LON Profile Name	LON SNVT Type	N2 Metasys	MODBUS		ENG UNITS		POINT LIST CODE: S = STANDARD O = OPTIONAL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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TABLE 17 - DXST / ISN TRANSMITTED DATA (UNIT, SYS 1, SYS 2) (CONT'D)

Read/ Write	BACnet Object Type/Ins	BACnet Object Name	LON Profile Name	LON SNVT Type	N2 Meta/Ins	MODBUS		ENG UNITS	POINT LIST CODE: S = STANDARD O = OPTIONAL N = NOT AVAILABLE										ENG PAGE REF
						Address	Scale		SI	1	2	3	4	5	6	7	8	9	10
R	BV12	Y2_ S01_ P43	hvoYTS01p043	SNVT_switch (95)	BD 12	0072	N/A	O/1	O/1	Sys 2 V1 Step Solenoid Valve 1 Status (0=Off, 1=On)	S								P43
R	BV13	Y2_ S01_ P44	hvoYTS01p044	SNVT_switch (95)	BD 13	0073	N/A	O/1	O/1	Sys 1 V1 Step Solenoid Valve 2 Status (0=Off, 1=On)	S								P44
R	BV14	Y2_ S01_ P45	hvoYTS01p045	SNVT_switch (95)	BD 14	0074	N/A	O/1	O/1	Sys 2 V1 Step Solenoid Valve 2 Status (0=Off, 1=On)	S								P45
R	BV15	Y2_ S01_ P46	hvoYTS01p046	SNVT_switch (95)	BD 15	0075	N/A	O/1	O/1	Sys 1 Oil Level Switch Status (0=Open, 1=Closed OK)	S								P46
R	BV16	Y2_ S01_ P47	hvoYTS01p047	SNVT_switch (95)	BD 16	0076	N/A	O/1	O/1	Sys 2 Oil Level Switch Status (0=Open, 1=Closed OK)	S								P47
R	BV17	Y2_ S01_ P48	hvoYTS01p048	SNVT_switch (95)	BD 17	0077	N/A	O/1	O/1	Sys 1 Liquid Refrigerant Injection Valve Status (0=Off, 1=On)	S								P48
R	BV18	Y2_ S01_ P49	hvoYTS01p049	SNVT_switch (95)	BD 18	0078	N/A	O/1	O/1	Sys 2 Liquid Refrigerant Injection Valve Status (0=Off, 1=On)	S								P49
R	BV19	Y2_ S01_ P50	hvoYTS01p050	SNVT_switch (95)	BD 19	0079	N/A	O/1	O/1	Cooling Type: (0=Water, 1=Glycol)	S								P50
R	BV20	Y2_ S01_ P51	hvoYTS01p051	SNVT_switch (95)	BD 20	0080	N/A	O/1	O/1	Local/Remote Control Mode: (0=Local, 1=Remote)	S								P51
R	BV21	Y2_ S01_ P52	hvoYTS01p052	SNVT_switch (95)	BD 21	0081	N/A	O/1	O/1	Display Units Mode: (0=Imperial, 1=SI)	S								P52
R	BV22	Y2_ S01_ P53	hvoYTS01p053	SNVT_switch (95)	BD 22	0082	N/A	O/1	O/1	Sys 1 Hot Gas Bypass Valve Status (0=Off, 1=On)	S								P53
R	BV23	Y2_ S01_ P54	hvoYTS01p054	SNVT_switch (95)	BD 23	0083	N/A	O/1	O/1	Sys 2 Hot Gas Bypass Valve Status (0=Off, 1=On)	S								P54
R	BV24	Y2_ S01_ P55	hvoYTS01p055	SNVT_switch (95)	BD 24	0084	N/A	O/1	O/1	Operating Mode: (0=Chiller, 1=Heatpump)	S								P55
R	MV1	Y2_ S01_ P56	hvoYTS01p056	SNVT_count f (51)	ADI 1	0030	X 1	enum	enum	*Sys 1 Operational Code	S								P56
R	MV2	Y2_ S01_ P57	hvoYTS01p057	SNVT_count f (51)	ADI 2	0031	X 1	enum	enum	*Sys 1 Fault Code	S								P57
R	MV3	Y2_ S01_ P58	hvoYTS01p058	SNVT_count f (51)	ADI 3	0032	X 1	enum	enum	*Sys 2 Operational Code	S								P58
R	MV4	Y2_ S01_ P59	hvoYTS01p059	SNVT_count f (51)	ADI 4	0033	X 1	enum	enum	*Sys 2 Fault Code	S								P59
R	MV5	Y2_ S01_ P60	hvoYTS01p060	SNVT_count f (51)	ADI 5	0034	X 1	count	count										P60
R	MV6	Y2_ S01_ P61	hvoYTS01p061	SNVT_count f (51)	ADI 6	0035	X 1	count	count										P61
R	MV7	Y2_ S01_ P62	hvoYTS01p062	SNVT_count f (51)	ADI 7	0036	X 1	count	count										P62
R	MV8	Y2_ S01_ P63	hvoYTS01p063	SNVT_count f (51)	ADI 8	0037	X 1	count	count										P63
R	MV9	Y2_ S01_ P64	hvoYTS01p064	SNVT_count f (51)	ADI 9	0038	X 1	count	count	Lead System Number	S								P64
R	MV10	Y2_ S01_ P65	hvoYTS01p065	SNVT_count f (51)	ADI 10	0039	X 1	enum	enum										P65
R	AV31	Y2_ S01_ P66	hvoYTS01p066	SNVT_count f (51)	ADF 30	0040	X 1	*F	*F	Local Leaving Chilled/ Condenser Liquid Setpoint	S								P66
R	AV32	Y2_ S01_ P67	hvoYTS01p067	SNVT_count f (51)	ADF 31	0041	X 1	*F	*F	Low Leaving Chilled/ Condenser Liquid Temp Cutout	S								P67
R	AV33	Y2_ S01_ P68	hvoYTS01p068	SNVT_count f (51)	ADF 32	0042	X 1	%	%	Sys 1 Economizer Valve % Open	S								P68
R	AV34	Y2_ S01_ P69	hvoYTS01p069	SNVT_count f (51)	ADF 33	0043	X 1	%	%	Sys 2 Economizer Valve % Open	S								P69
R	AV35	Y2_ S01_ P70	hvoYTS01p070	SNVT_count f (51)	ADF 34	0044	X 10	PSI	BAR	Low Evaporator Pressure Cutout	S								P70
R	AV36	Y2_ S01_ P71	hvoYTS01p071	SNVT_count f (51)	ADF 35	0045	X 1	volts	volts	VSD DC Bus Voltage	S								P71
R	AV37	Y2_ S01_ P72	hvoYTS01p072	SNVT_count f (51)	ADF 36	0046	X 1	*F	*F	Remote Leaving Chilled Liquid/Condenser Liquid Setpoint	S								P72
R	AV38	Y2_ S01_ P73	hvoYTS01p073	SNVT_count f (51)	ADF 37	0047	X 1	*F	*F	Sys 1 Subcooled Liquid Temperature	S								P73
R	AV39	Y2_ S01_ P74	hvoYTS01p074	SNVT_count f (51)	ADF 38	0048	X 1	*F	*F	Cooling Range/Heating Range	S								P74
R	AV40	Y2_ S01_ P75	hvoYTS01p075	SNVT_count f (51)	ADF 39	0049	X 1	*F	*F										P75
R	AV41	Y2_ S01_ P76	hvoYTS01p076	SNVT_count f (51)	ADF 40	0050	X 1	*F	*F	Sys 2 Discharge Temperature	S								P76
R	AV42	Y2_ S01_ P77	hvoYTS01p077	SNVT_count f (51)	ADF 41	0051	X 1	*F	*F	Sys 2 Subcooled Liquid Temperature	S								P77
R	AV43	Y2_ S01_ P78	hvoYTS01p078	SNVT_count f (51)	ADF 42	0052	X 1	*F	*F										P78
R	AV44	Y2_ S01_ P79	hvoYTS01p079	SNVT_count f (51)	ADF 43	0053	X 1	*F	*F										P79
R	BV25	Y2_ S01_ P80	hvoYTS01p080	SNVT_switch (95)	BD 25	0085	N/A	O/1	O/1	Sys 1 Lockout (0=Not Locked Out, 1=Locked Out)	S								P80
R	BV26	Y2_ S01_ P81	hvoYTS01p081	SNVT_switch (95)	BD 26	0086	N/A	O/1	O/1	Sys 2 Lockout (0=Not Locked Out, 1=Locked Out)	S								P81
R	BV27	Y2_ S01_ P82	hvoYTS01p082	SNVT_switch (95)	BD 27	0087	N/A												P82
R	BV28	Y2_ S01_ P83	hvoYTS01p083	SNVT_switch (95)	BD 28	0088	N/A												P83
R	BV29	Y2_ S01_ P84	hvoYTS01p084	SNVT_switch (95)	BD 29	0089	N/A												P84

NOTES

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NOTE: The Operational/Fault/Inhibit Codes listings must accompany this document

FAULT AND INHIBIT CODES

The following table contains the fault and inhibit codes with it's associated meaning to be used for decoding the chiller Operational and Fault Codes.

The table also classifies each fault/inhibit as a unit or system type and lists which board (Chiller Control Board (panel) or VSD Logic Board) generates the fault/inhibit.

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TABLE 18 - FAULT AND INHIBIT CODES

CODE	TYPE	SOURCE	FAULT OR INHIBIT CODES
0	Sys	Panel	No Abnormal Condition
1	Unit	Panel	Reserved 1
2	Unit	Panel	Reserved 2
3	Unit	Panel	Low Chilled Evap Water Temperature
4	Unit	Panel	Smart Freeze Point Protection
5	Unit	Panel	Low RTC Battery Voltage
6	Unit	Panel	Invalid Number of Compressors Selected
7	Unit	Panel	VSD Communications Failure
8	Unit	VSD	Pre-charge Low DC Bus Voltage
9	Unit	VSD	Pre-charge DC Bus Voltage Imbalance
10	Unit	VSD	High DC Bus Voltage
11	Unit	VSD	Low DC Bus Voltage
12	Unit	VSD	DC Bus Voltage Imbalance
13	Unit	VSD	High VSD Ambient Temperature
14	Unit	VSD	Single Phase Input
15	Unit	VSD	VSD Power Supply Fault
16	Unit	VSD	VSD Logic Board Fault
17	Unit	VSD	Motor Current Overload (Hardware)
18	Unit	VSD	CT Plug Fault
19	Unit	Panel	Reserved 19
20	Unit		Reserved 20
21	Unit		Reserved 21
22	Unit		Reserved 22
23	Unit		Reserved 23
24	Unit		Reserved 24
25	Unit		Reserved 25
26	Unit		Reserved 26
27	System	Panel	High Discharge Pressure
28	System	Panel	High Oil Filter Differential Pressure
29	System	Panel	Low Differential Oil Pressure
30	System	Panel	Low Evaporator Pressure
31	System	Panel	High Discharge Temperature
32	System	Panel	High Leaving Condenser Temperature
33	System	Panel	Eductor Clog Fault
34	System	Panel	Sensor Failure
35	System	Panel	Low Motor Current
36	System	Panel	High Motor Temperature

TABLE 19 - FAULT AND INHIBIT CODES (CONT'D)

CODE	TYPE	SOURCE	FAULT OR INHIBIT CODES
37	System	VSD	Pre-charge Low DC Bus Voltage
38	System	VSD	Pre-charge DC Bus Voltage Imbalance
39	System	VSD	High DC Bus Voltage
40	System	VSD	Low DC Bus Voltage
41	System	VSD	DC Bus Voltage Imbalance
42	System	VSD	High Motor Current
43	System	VSD	Motor Current Overload (Software)
44	System	VSD	IGBT Gate Driver Fault
45	System	VSD	High Baseplate Temperature
46	System	VSD	Single Phase Input le Phase Input
47	System	VSD	VSD Run Signal Fault
48	System	Panel	High Discharge Press (Hardware – HPCO)
49	System	Panel	Reserved 49
50	System	Panel	Control Voltage Fault
51	System	Panel	Low Discharge Superheat
52	System	Panel	Low Economizer Superheat
53	System	Panel	Oil Level Low
54	System	Panel	Reserved 54
55	System		Reserved 55
56	System		Reserved 56
57	System		Reserved 57
58	System		Reserved 58
59	System		Reserved 59
60	System		Reserved 60
61	System		Reserved 61
62	System		Reserved 62

OPERATIONAL STATUS CODES

The following table contains the operational status code with it's associated meaning.

The table also classifies each status as a unit or system type and lists which board (Chiller Control Board (panel) or VSD logic board) generates the status condition.

2

TABLE 19 - OPERATIONAL STATUS CODES

CODE	TYPE	SOURCE	FAULT OR INHIBIT CODES
63	Unit	Panel	Manual Override
64	Unit	Panel	Daily Schedule Shutdown
65	Unit	Panel	Unit Switch OFF
66	Unit	Panel	Remote Controlled Shutdown
67	Unit	Panel	Loss of External Communications
68	Unit	Panel	Chilled Evap Water Flow Switch Shutdown
69	Unit	Panel	VSD Cooling Shutdown
70	Unit	Panel	Serial Number Shutdown
71	Unit	Panel	Condenser Water Flow Switch Shutdown
72	Unit		Reserved 72
73	Unit		Reserved 73
74	Sys	Panel	No Run Permissive
75	Sys	Panel	Anti-Recycle Timer Active
76	Sys	Panel	System Switch OFF
77	Sys	Panel	System Not Running
78	Sys	Panel	System Running
79	Sys	Panel	Discharge Pressure Limiting
80	Sys	Panel	Evaporator Pressure Limiting
81	Sys	Panel	Motor Current Limiting
82	Sys	Panel	Reserved 82
83	Sys	Panel	BAS Motor Current Limiting
84	Sys	Panel	Remote Motor Current Limiting
85	Sys	Panel	System Pumping Down
86	Sys	VSD	VSD PreCharging
87	Sys	Panel	VSD Baseplate Temp Limiting
88	Sys	Panel	VSD Internal Ambient Temp Limiting
89	Sys	Panel	Reserved 89
90	Sys	Panel	Reserved 90
91	Sys	Panel	Reserved 91
92	Sys	Panel	Pulldown Motor Current Limiting
93	Sys	Panel	Cooling Demand Shutdown
94	Sys	Panel	Reserved 94
95	Sys	Panel	Reserved 95
96	Sys	Panel	Reserved 96
97	Sys	Panel	Reserved 97
98	Sys	Panel	Reserved 98
99	Sys	Panel	Reserved 99
100	Sys	Panel	Reserved 100

VSD OPERATION AND CONTROLS

VSD Logic Board

The VSD Logic Board communicates with the chiller Chiller Control Board via comms and controls the VSD functions. It converts the frequency and run commands from the Chiller Control Board into the necessary voltage and frequency commands to operate the inverter section. It also controls the converter section of the drive (AC Line to DC Bus conversion).

The VSD Logic Board contains a 2nd microprocessor (motor controller) that generates the PWM signals that control the IGBT outputs in the inverter section of the VSD. It includes hardware safeties that can shut down the VSD much faster than the software safeties. The VSD Logic Board handles all of the VSD related safeties, which includes motor current, BUS voltage, and other safeties.

The VSD Logic Board reports shutdown information back to the Chiller Control Board via the RS-485 communication link.

If the Chiller Control Board does not receive initialization data from the VSD Logic Board in 8 seconds or loses communications with the VSD for 8 seconds at any time, the chiller will fault on a communications failure. The Chiller Control Board will continue to send messages to the VSD Logic Board in an attempt to establish communications while the chiller is faulted.

The VSD Logic Board will also monitor a communications loss. If the VSD Logic Board loses communications with the Chiller Microprocessor Board for 8 seconds at any time, the VSD will shut off all compressors and wait for valid comms from the Chiller Control Board.

VSD Start/Run Initiation

Following a successful precharge of the DC Bus and a run command from the Chiller Control Board, the VSD Logic Board microprocessor will determine the motor output voltage (% modulation) and the output frequency required based on the operating frequency

command from the Chiller Control Board. This information will then be sent to the PWM generator located on the VSD Logic Board.

On start-up, the output frequency from the VSD to the motor(s) will be increased from 0 Hz to the operating frequency commanded by the Chiller Control Board. The rate of change of the frequency will also be controlled by the VSD Logic Board.

The rate of change of the output frequency at start-up, during acceleration is 10 Hz/sec between 0 and 50 Hz and 30.4 Hz/sec above 50 hertz. The maximum rate of change of the output frequency during deceleration between 200-100 Hz is 30.4 Hz/sec, and 100-0 Hz is 10 Hz/sec.

The VSD Logic Board and its PWM generator will receive operating frequency and voltage commands from the Chiller Control Board based on the load. When a frequency (speed) change is requested from the Chiller Control Board, the chiller micro will send the change to the VSD Logic Board and the VSD Logic Board will acknowledge it accepted the change. Loading and unloading will take place at the rate of 0.1-1Hz every 2 seconds.

MAXIMUM VSD FREQUENCY

The maximum VSD frequency is 203Hz. The microprocessor board determines the frequency according to a program setpoint. The setpoint is factory-set for the speed required for the sales order application.

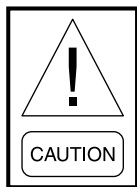
VSD % Modulation

The voltage and frequency commands issued by the VSD Logic Board microprocessor are determined by the frequency command from the Chiller Control Board. The VSD output is a PWM signal, which has effects on the motor comparable to an AC voltage sinusoidal waveform. To change the speed of an AC motor, the frequency of the AC voltage must be changed. Whenever frequency is changed, the voltage is changed in a linear ratio. Maintaining a relatively constant V/F ratio as speed changes assures motor losses and overheating do not occur.

VSD COOLING AND COOLING LOOP

The VSD generates heat in the IGBT power modules and the SCR/Diode assemblies, which must be removed. The heat not only heats the modules but also the Micro/VSD cabinet.

The VSD is cooled by a coolant loop and circulating pump. The coolant cooling loop feeds a liquid cooled heatsink called a chillplate that cools the IGBT's and SCR/Diode modules. The coolant is pumped by a circulator pump through the heatsink where it absorbs heat in several passes of tubes. The heat is picked up from the modules. The coolant is then pumped back to the modules. The coolant loop also provides cooling for the Micro/VSD cabinet. The baseplates of the power components are mounted to the coolant cooled heatsinks in the cooling loop. The cooling loop also circulates the coolant through a cooling coil in the cabinet. A fan blows air from the cabinet across the cooling coil to cool the electronics in the cabinet.



Never run the coolant pump without coolant! Running the coolant pump without coolant may damage the pump seals

Always fill the system with approved coolant to avoid damage to the pump seals and other components.

Heat transfer characteristics of the coolant are very critical. Substituting coolant or adding water will result in cooling loop performance loss and chiller shutdown.

The coolant level in the VSD cooling system should be maintained one inch (2.5 cm) from the top of the fill tube. This check should be performed prior to running the pump. The pump can be test run by placing the chiller in Service Mode. It is advisable to fill the tube to the required level before starting the coolant pump because it may empty when the pump starts. The level should be topped off as needed while running. Be sure to re-install the cap before stopping the coolant pump to avoid overflowing the fill tube when the coolant pump is turned off.

Coolant has a defined operating life. System coolant should be changed 1 year from date of shipment of the equipment. Mixing other coolants or water with the special coolant will reduce the life of the coolant, and cause VSD overheating and damage.



LD16741

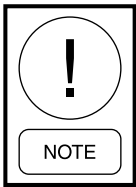
FIGURE 30 - VSD COOLANT PUMP

The VSD fan and coolant pump will run if any of the following conditions listed below are true, provided the VSD has been powered up for less than 30 seconds and the pump has not run in the last 30 seconds. The 30 second limitations prevent pump motor overheating.

- IGBT Baseplate temp is > Cutout (218°F) – 10°F.
- Pre-charge Enable 1 from the chiller Logic Board is ON.
- Pre-charge Enable 2 from the chiller Logic Board is ON.
- VSD Internal Ambient Temp > Cutout – 10°F.
- Any compressor is running.
- Service Mode Fan/Pump Run is enabled.

The VSD fan/coolant pump will turn off when ALL of the following conditions are true:

- Compressor 1 IGBT Baseplate temp is < Cutout – 15°F.
- Compressor 2 IGBT Baseplate temp is < Cutout – 15°F.
- Pre-charge Enable 1 from the chiller Logic Board is OFF.
- Pre-charge Enable 2 from the chiller Logic Board is OFF.
- VSD Internal Ambient Temp < Cutout – 15°F.
- No compressors are running.
- Service Mode Fan/Pump is disabled.



In some cases, the condenser fans may be turned on by the micro, when no compressors are running, to keep the power components and Control/VSD Cabinet from overheating.

IGBT Module Baseplate Temperature Sensing

Each IGBT module has an internal 5Kohm thermistor built in to measure the temperature of the module. Two thermistors are connected to the VSD logic board (one per compressor). The highest module temperature of compressors 1 and 2 are sent to the logic board. If the temperature exceeds the software trip point, the unit will shut down on a safety.

VSD Internal Ambient Temperature Sensing

A internal ambient air temperature sensor located on the VSD Logic Board is used to measure the internal ambient temperature of the Control Panel/VSD enclosure. It has an output voltage that is linearly proportional to the temperature in degrees Fahrenheit. If the temperature exceeds the software trip point, the unit will shut down on a safety. See High VSD Ambient Temperature Fault for details.



Ambient
Air Temp
Sensor

LD16744

FIGURE 31 - SENSOR

Pre-charge

When cooling is required, the chiller Control Board will send a Pre-Charge Enable via comms to the VSD Logic Board. The VSD's DC bus voltage(s) across the Bus Filter Capacitors will slowly be increased to the proper level (>500VDC) through firing of the SCR Trigger Board(s) and the associated pre-charge enable control signal(s). The threshold is only true for 60 Hz units with logic board eeprom 031-02649-010. For 50Hz/60Hz units with logic board eeprom 031-02649-011 and -012, the minimum required DC bus voltage after precharge is 414VDC. The pre-charge time interval is fixed at 20 seconds. The purpose of the precharge is to limit current when charging an uncharged capacitor bank. When uncharged, the capacitor bank looks like an electrical short. The bus is brought up slowly by only turning on the SCR's during the trailing half of the + and - portion of the incoming AC sine wave. Following is the status message displayed while the precharge is taking place.

UNIT VSD DC BUS PRECHARGE

Following successful completion of the pre-charge interval, the SCR's on the AC to DC semi-converter (SCR/Diode Modules) will be gated fully on by the SCR Trigger Board and the DC bus will be brought up to its full potential. After pre-charge has been successfully completed, the SCR's will stay fully on until the Chiller Control Board turns off the Pre-Charge Enable via comms.

The pre-charge will only take place when all of the following conditions are true, otherwise it is disabled:

- Daily Schedule is ON.
- Unit Switch is ON.
- System Switch(es) are ON.
- Run Permissive(s) are Enabled.
- Flow Switches indicate flow.
- LCHLT > Setpoint High Limit.
- Unit not faulted / locked out.

Run Mode / Unit Restart

In order to initiate a system run, two conditions must be met. At least 1 of the 2 systems run signals from the control panel must be present and at least 1 of the 4 possible Compressor RUN bits must be set in the serial communications link between the VSD Logic Board and the Chiller Control Board. Following successful completion of pre-charge and receipt of the system run signals, the motor output voltage (% modulation) and output frequency commands will be determined by the VSD microprocessor located on the VSD Logic Board. These two parameters will be sent to the PWM generator located on the VSD Logic Board for waveform processing at a rate of once every 10 msec.

The voltage and frequency commands issued by the VSD microprocessor are determined by the operating frequency command received on the communications link from the Chiller Control Board and by the present operating frequency of the drive. Upon receipt of a legitimate run command communication, the VSD's output frequency will be increased from 0 Hz to the operating frequency command from the communications link.

DC Bus Voltage Sensing and Scaling

Full DC Bus voltage and ½ DC Bus voltages are sensed for up to 2 DC Buses. The DC Bus is wired to the DC Bus Isolation Board, the voltage is divided down through a resistance voltage divider, and the reduced voltage is fed to the VSD Logic Board for safety monitoring.

Current Sensing and Scaling

Individual current transformers on each leg sense three phases of output current on each compressor. The highest of the currents in the three phases of each compressor monitored by the VSD Logic Board overload and high current protection circuitry, and sent to the Chiller Control Board for display as the compressor current.

VSD TRANSMITTED OPERATING PARAMETERS

VSD operating parameters are transmitted to the Chiller Control Board over the RS-485 communications link between the 2 boards. These values are displayed on the control panel display. The data and display format are outlined below:

TABLE 20 - VSD OPERATING DISPLAY PARAMETERS

DATA	DISPLAY FORMAT
Highest Phase of Compressor Motor Current in Amperes RMS (per Compressor)	XXX Amps
VSD Output Frequency	XXX.X Hz
Motor Overload Setting (105% FLA potentiometer setting) in amperes RMS (per Compressor)	XXX Amps
DC Bus Voltage in DC Volts (maximum of 2)	XXX Volts
VSD Internal Ambient Temperature	XXX.X°F (or °C)
IGBT Power Assembly Power Module Highest Baseplate Temperature (maximum of 2)	XXX.X°F (or °C)
Pre-Charge Enable Signal (maximum of 2)	On or OFF
VSD cooling Fan/Pump	On or OFF
Compressor Run Status (maximum of 4)	On or OFF

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WIRING DRAWINGS

NOTES

TABLE 21 - NOTES FOR DRAWINGS

NO.	DESCRIPTION
1	All field wiring shall be in accordance with the relevant electrical code as well as all other applicable codes and specifications.
2	Contacts must be suitable for switching 115VAC at 5 MA.
3	Contacts are rated at 115V, 100VA, resistive load only, and must be suppressed at load by user.
4	See installation, operation and maintenance manual when optional equipment is used.
5	Not applicable
6	Not applicable
7	Applied to models ending in 65B, 65C, 50B, 50C, 68B, 68C, and all models ending in D.
8	Fuses -F(4FU & 5FU) are 12 A for 380V, 400V and 415V models.
9	Fuses F(4FU & 5FU) are 10 A for 200V, 230V, 460V and 575V models. Fuses F(1FU, 2FU and 3FU) are 800 A for models ending in C. Fuses F(1FU, 2FU and 3FU) are 900 A for models ending in 46D and 58D. Fuses F(1FU, 2FU and 3FU) are 1000 A for models ending in 40D, 65D, 50D, and 68D.
10	See Detail B for units with autotransformer.
11	Not applicable.
12	For Detail E for CE units.
13	Options not applicable to all units, remote temp reset, remote current limit.
14	Not applicable.
15	For models ending in A or B - AGDB P/N is 031-02061-003. For models ending in C OR D - AGDB P/N is 031-02061-001.
16	Accessory E-Link Gateway consisting of AMGB (cannot be used with RCC accessory)
17	Not applicable.
18	Not applicable.
19	Models ending in A get capacitors C1, C5, C2 and C6. Models ending in B and C get capacitors C1, C3, C5, C2, C4 and C6. Models ending in D get capacitors C1, C3, C5, C7, C2, C4, C6 and C8.
20	See Detail C for optional circuit breaker or disconnect switch.

For information on the notes in the following wiring diagrams not listed here, refer to the notes legend on the language kit that ships with the unit, which is located on the inside of the panel door.

LEGEND

- ES Transient Voltage Suppression
-  Terminal Block for Customer Connections (1TB)
-  Terminal Block for YORK Connections
- Wiring Components by YORK
- Optional Equipment
- - - Wiring and/or Components by Others
-  NB Note Well
- EXT A Component Marked Thus is External to the Control Panel

***=NOT REQUIRED
FOR ALL MODELS**

CONTROL ELEMENTARY DIAGRAM
2 COMP VSD CHILLER
095-29178-001 REV C



2



CONTROL ELEMENTARY DIAGRAM (CONT'D)

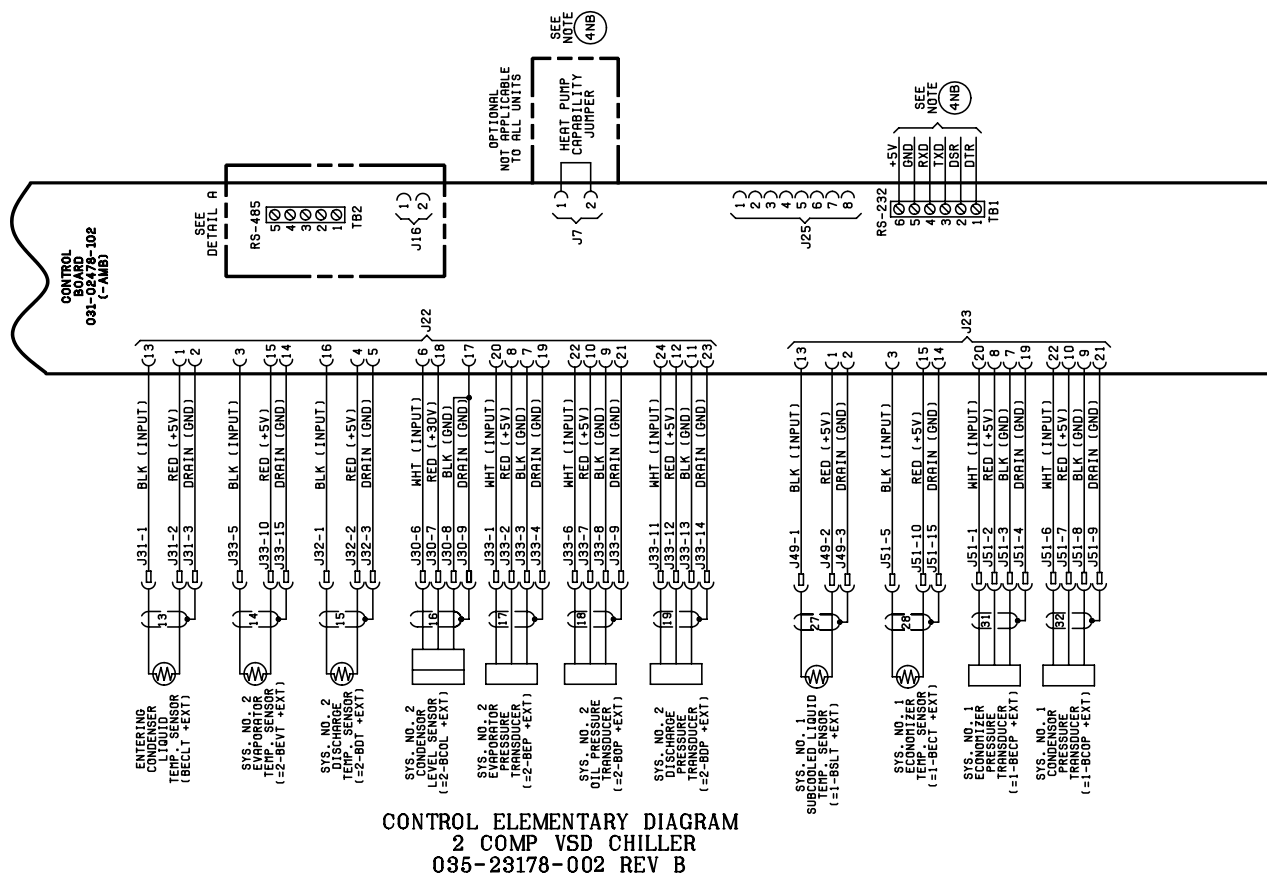


FIGURE 33 - CONTROL ELEMENTARY DIAGRAM

CONTROL ELEMENTARY DIAGRAM (CONT'D)

2

LD10087A

*Set EOL Switch ON if the chiller is the First or Last controller on a MS/TP segment.

Set E-Link APPA Switch to 12

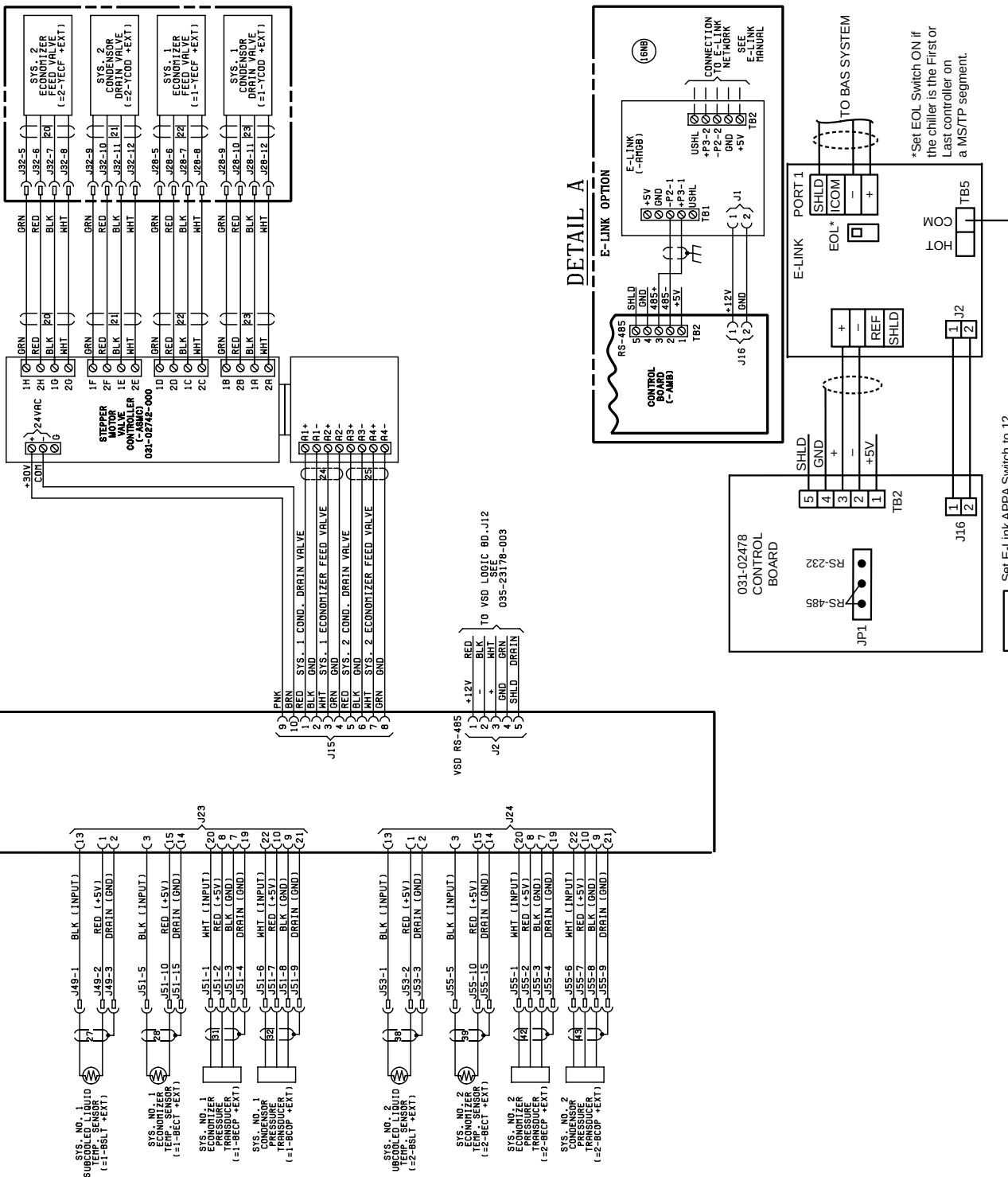
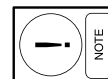
Set Microboard to

Option = Remote

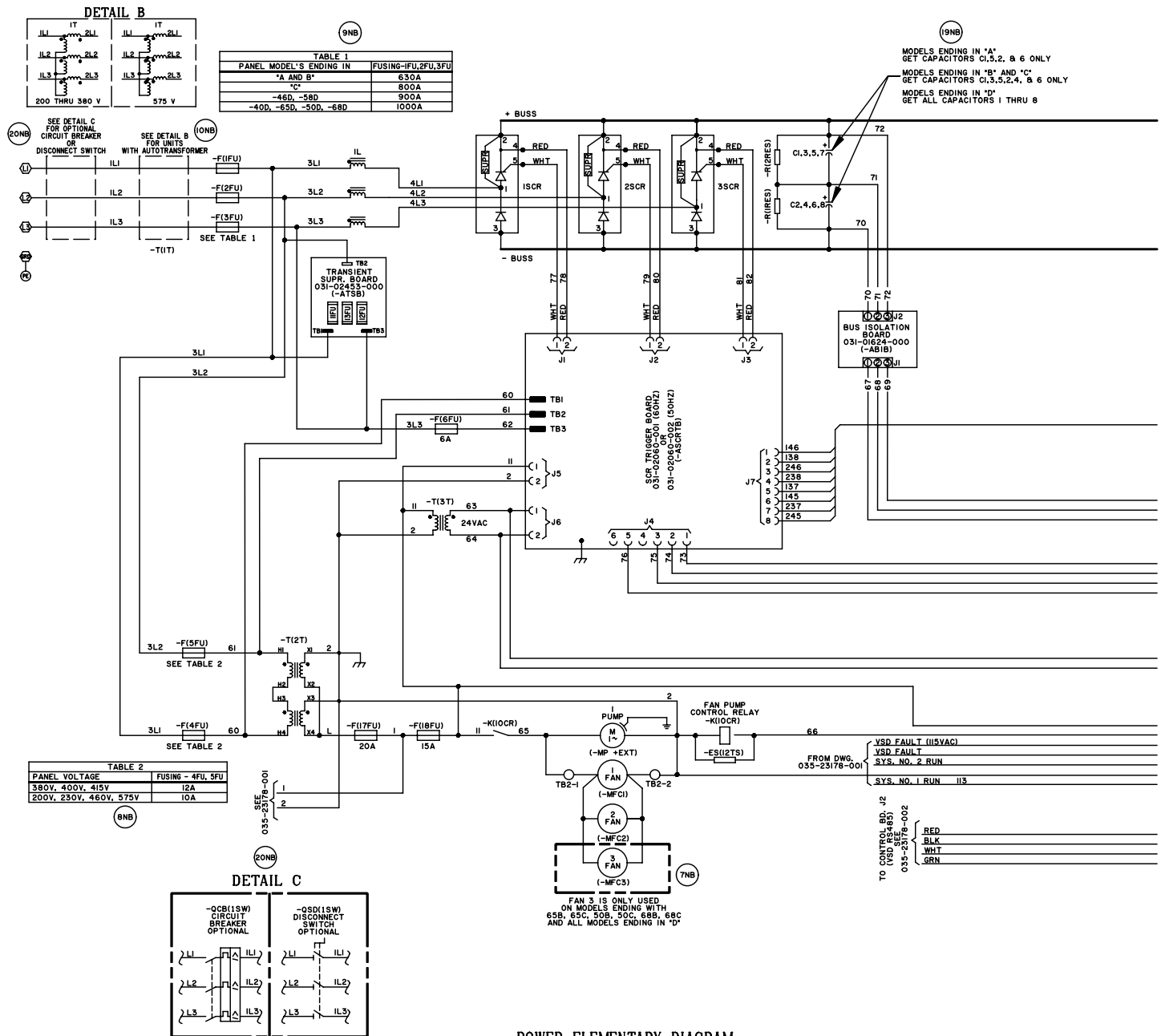
Program = Unit ID = 0

Set JPI Jumper to RS-485

NOTE that shields must be terminated on only one end of the cable.

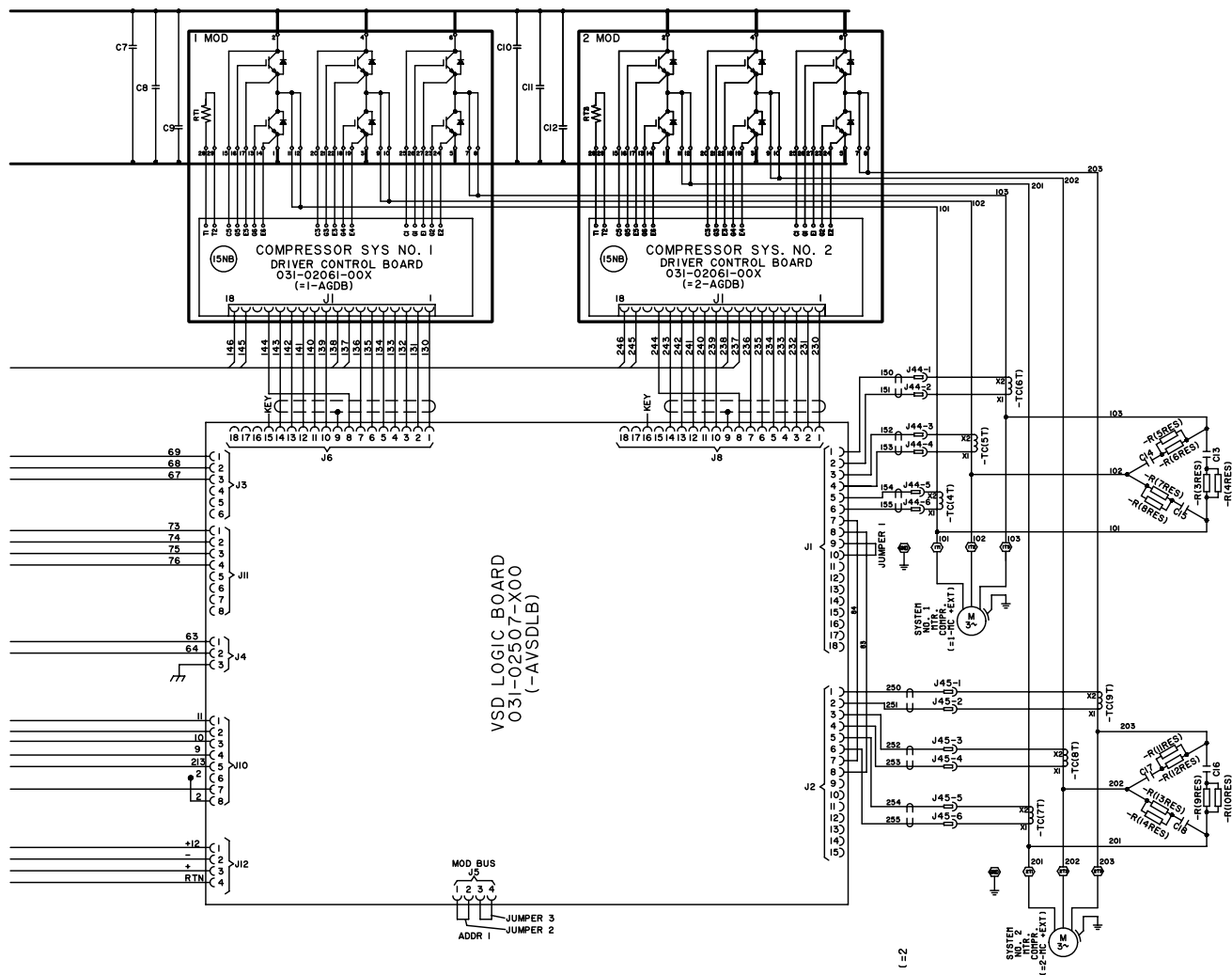


POWER ELEMENTARY DIAGRAM



POWER ELEMENTARY DIAGRAM (CONT'D)

2



POWER ELEMENTARY DIAGRAM
2 COMPR VSD CHILLER
035-23178-003 REV C

LD16131b

FIGURE 34 - POWER ELEMENTARY DIAGRAM (CONT'D)

FIGURE 35 - CONTROL WIRING - CONNECTION DIAGRAM



CONTROL WIRING - CONNECTION DIAGRAM (CONT'D)

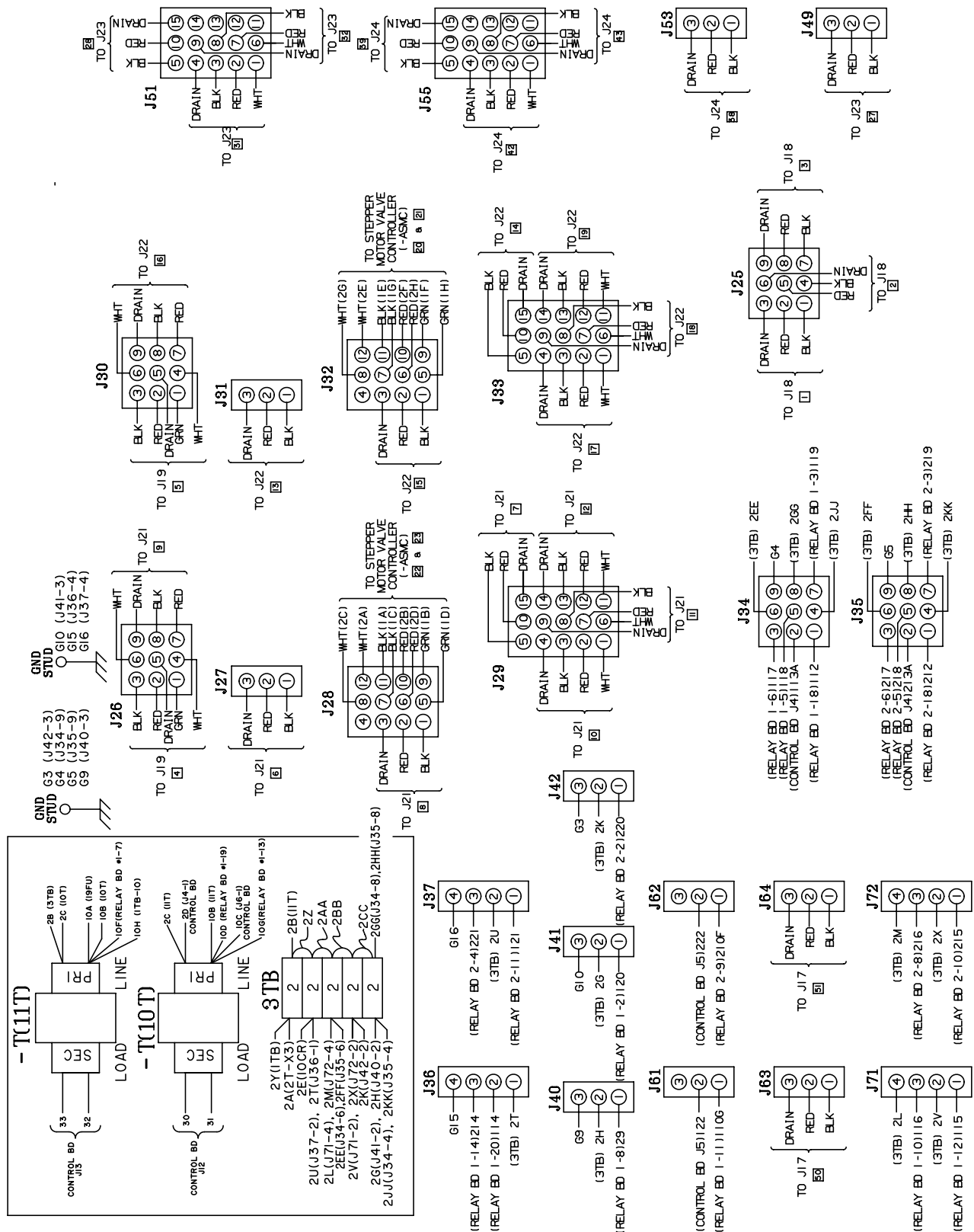


FIGURE 35 - CONTROL WIRING - CONNECTION DIAGRAM (CONT'D)

FIGURE 36 - POWER WIRING - CONNECTION DIAGRAM



2

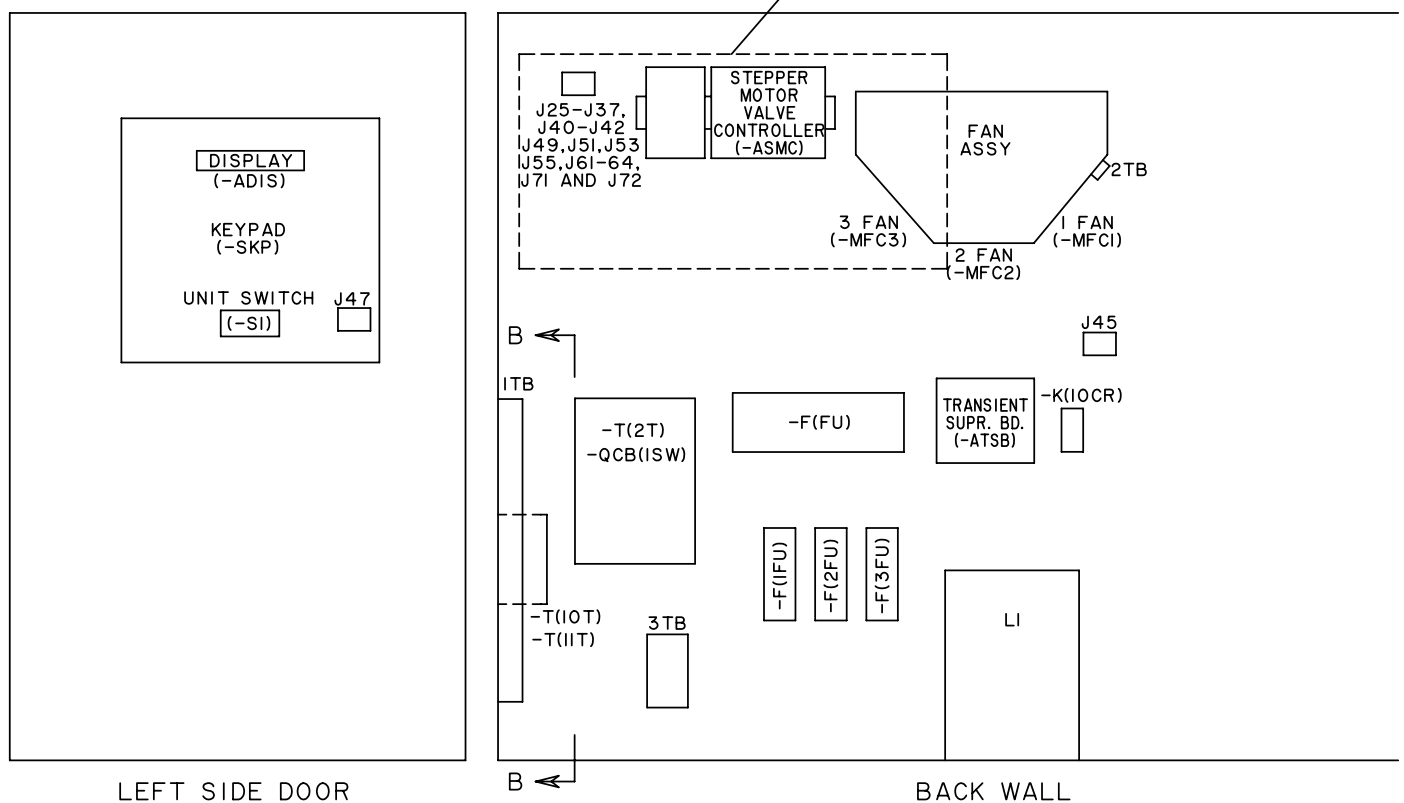


JOHNSON CONTROLS

The diagram illustrates the layout of the control panel. It features a large rectangular frame with a wavy top edge. Inside, the components are arranged as follows:

- ITB**: A tall, narrow vertical rectangle on the left side.
- T(IOT)** and **-T(IIT)**: Two small squares positioned below the ITB, side-by-side.
- MICRO GATEWAY (-AMGB)**: A vertical rectangle located in the center-left area.
- CONTROL BOARD (-AMB)**: A large horizontal rectangle in the center-right area.
- HINGED PANEL**: A label at the top center of the panel area.
- RELAY BD. NO. 1 (-ARB1)** and **RELAY BD. NO. 2 (-ARB2)**: Two vertical rectangles stacked on the far right side.

VIEW B-B



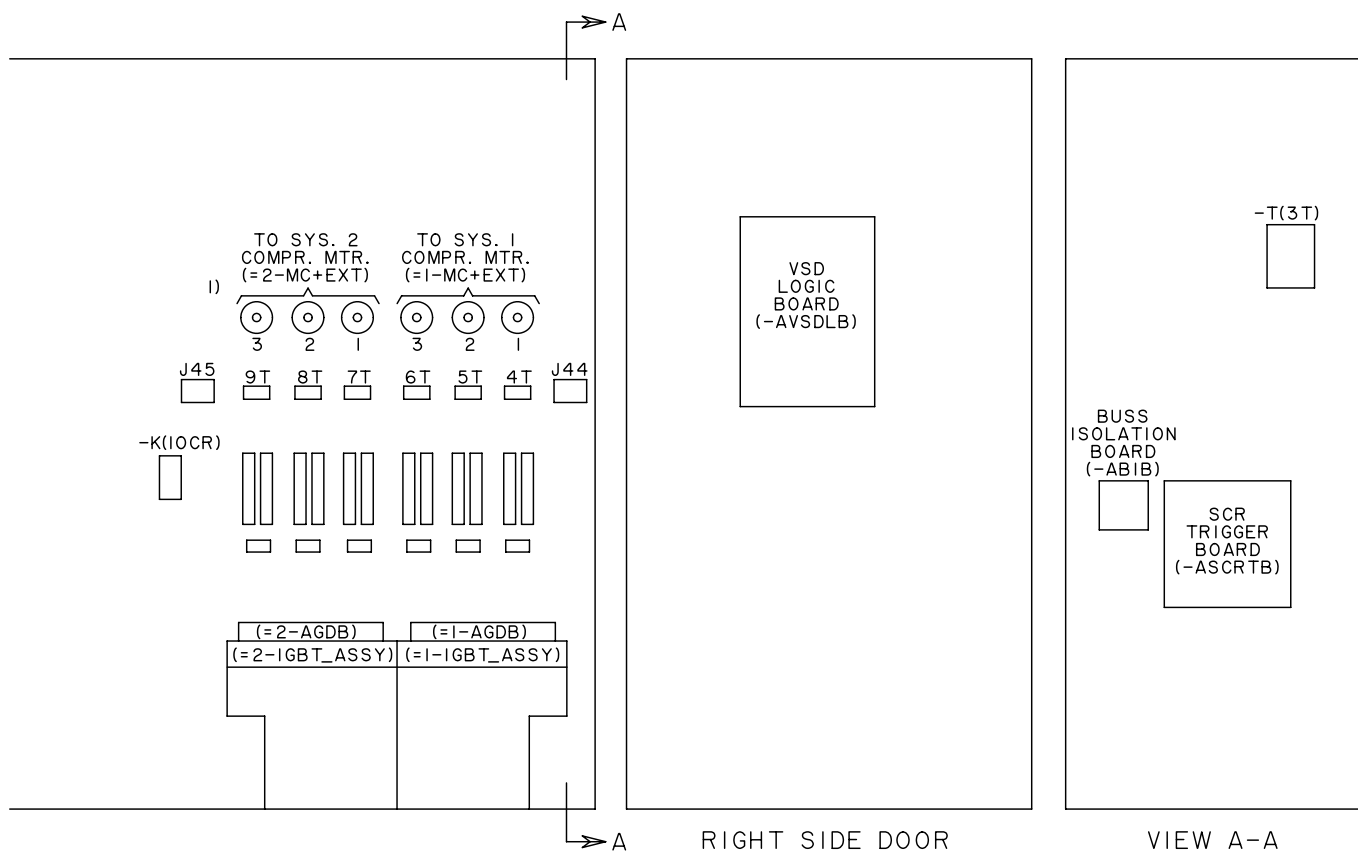
PANEL LAYOUT
2 COMPR VSD CHILLER
035-23178-006 REV. B

LD16134a

FIGURE 37 - PANEL LAYOUT

PANEL LAYOUT (CONT'D)

2



PANEL LAYOUT
2 COMPR VSD CHILLER
035-23178-006 REV. B

LD16134b

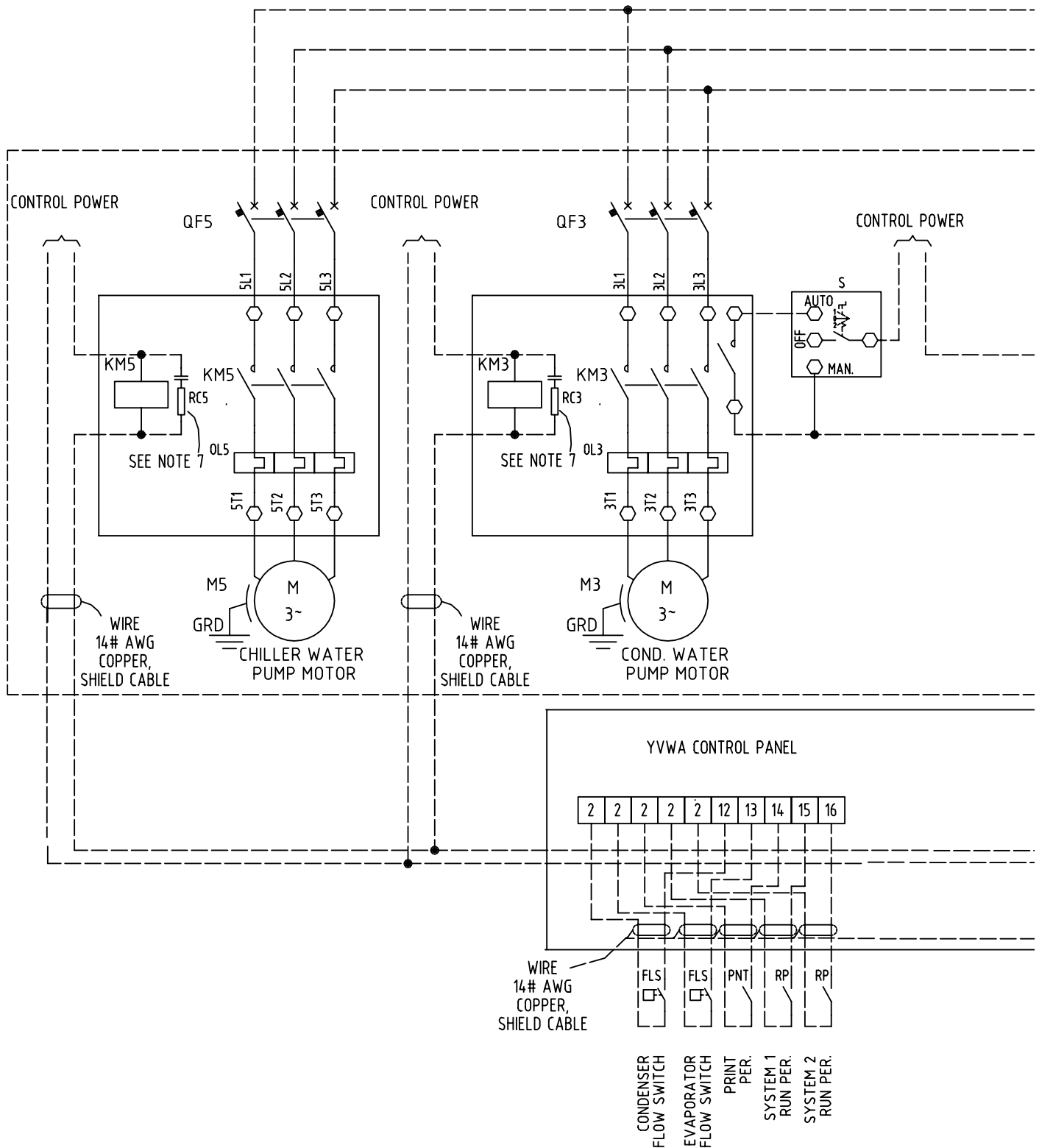
FIGURE 37 - PANEL LAYOUT – (CONT'D)

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FIELD CONNECTIONS

NOTES

1. All field wiring shall be in accordance with the current edition of the relevant electric code as well as other applicable codes and specifications.
2. The Variable Speed Drive (VSD) shall be grounded in accordance with the related standards.
3. The branch circuit over current protection device for the YORK VSD must be a time delay type with a rating, which is the standard fuse/circuit breaker size required to protect the field supply wiring conductors per the relevant electric code as well as other applicable codes and specifications.
4. The main power transformer should be adequately sized such that the transformer voltage does not exceed 10% during unit start-up.
5. The YORK VSD power supply wiring ampacity shall be calculated as follows: Model YVWA Minimum Circuit Ampacity: $1.25 (\text{JOB FLA})$ where $125 \times (\text{System 1 (RLA0)} + (\text{System 2 RLA0}) + \text{control transformer amps})$.
6. A removable cover plate with pilot knockouts is supplied for connection of power supply conduits.
7. Each field-conducted inductive load, i.e. relay coil, motor starter coil, etc. shall have a transient suppressor wired (by others) in parallel with its coil, physically located at the coil.
8. Control wiring and input power wiring out the VSD/Control Panel by the customer.
9. Water pump and cooling fan are the customer's equipment, referenced only as wiring here.
10. The autotransformer is an option, which is used only for a 200V/3P/60 Hz, 230/3P/60 Hz or 575V/3P/60 Hz power system. For additional information such as weight, size, wiring lugs, and the installation location, contact the Johnson Controls application engineer for your project.

FIELD CONNECTIONS

LD16135a

FIGURE 38 - FIELD CONNECTIONS

FIELD CONNECTIONS (CONT'D)

2

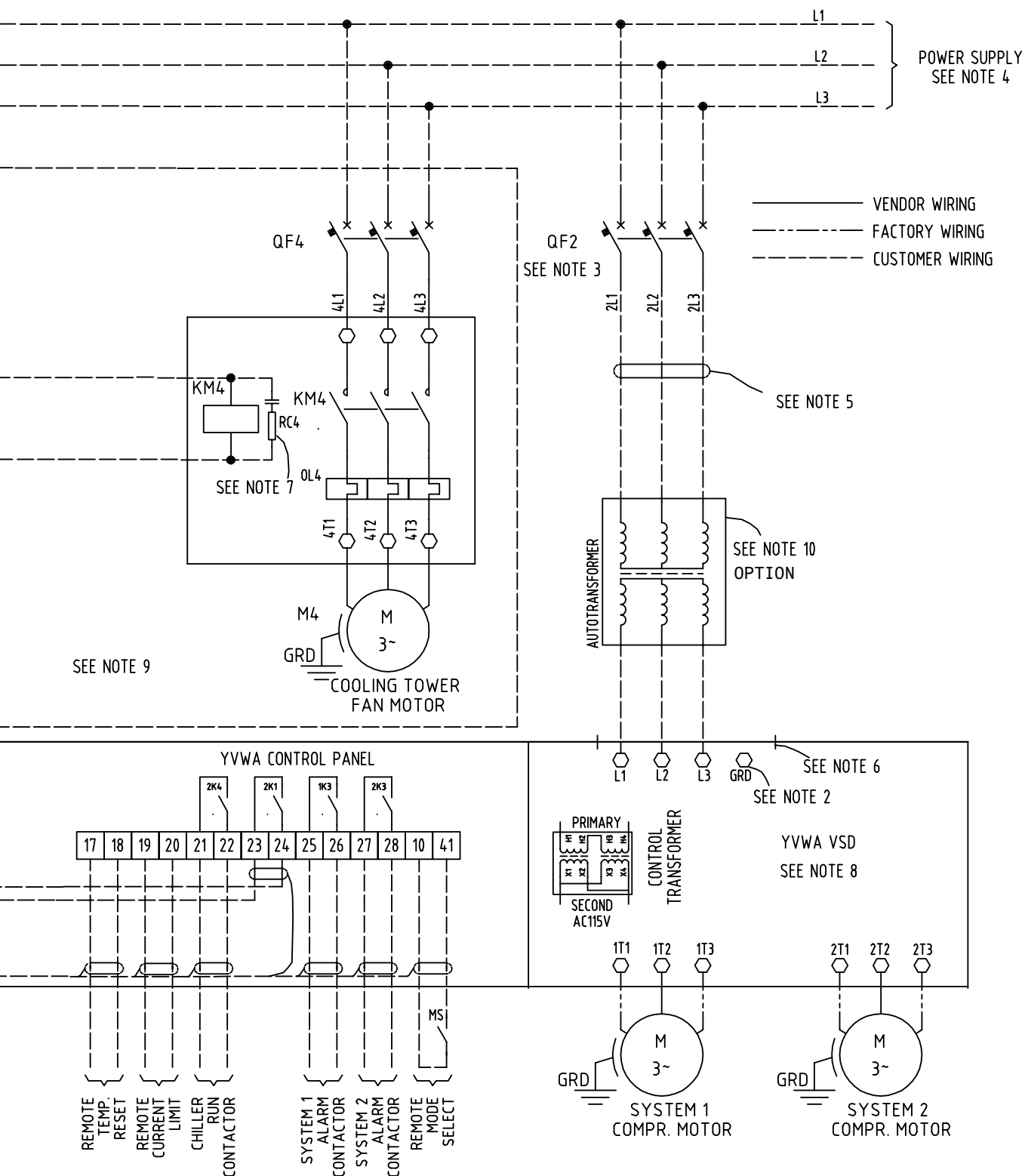
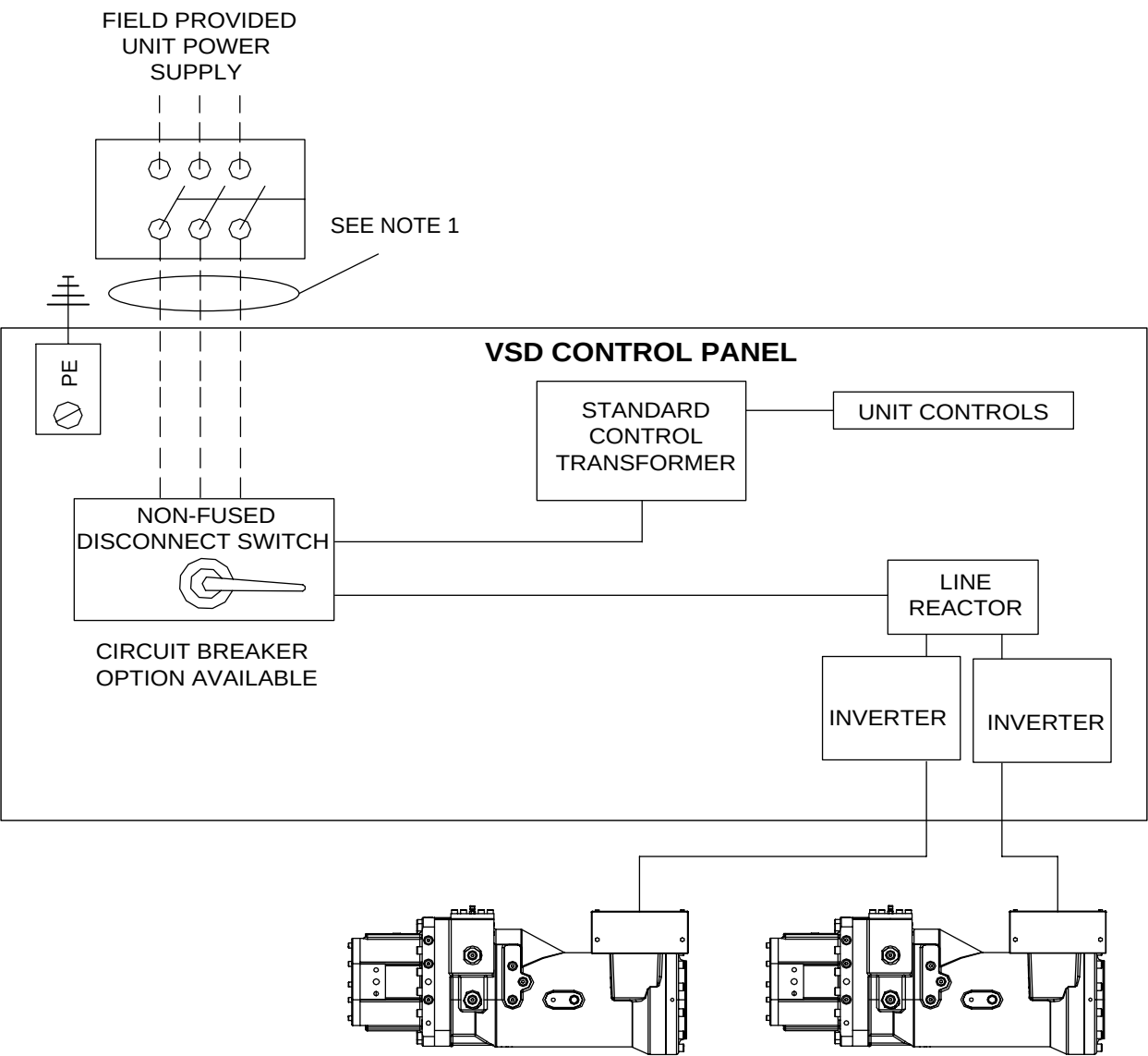


FIGURE 38 - FIELD CONNECTIONS (CONT'D)

POWER WIRING



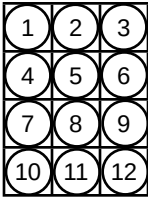
- NOTES:
- 1. ----- Dashed Line = Field Provided Wiring

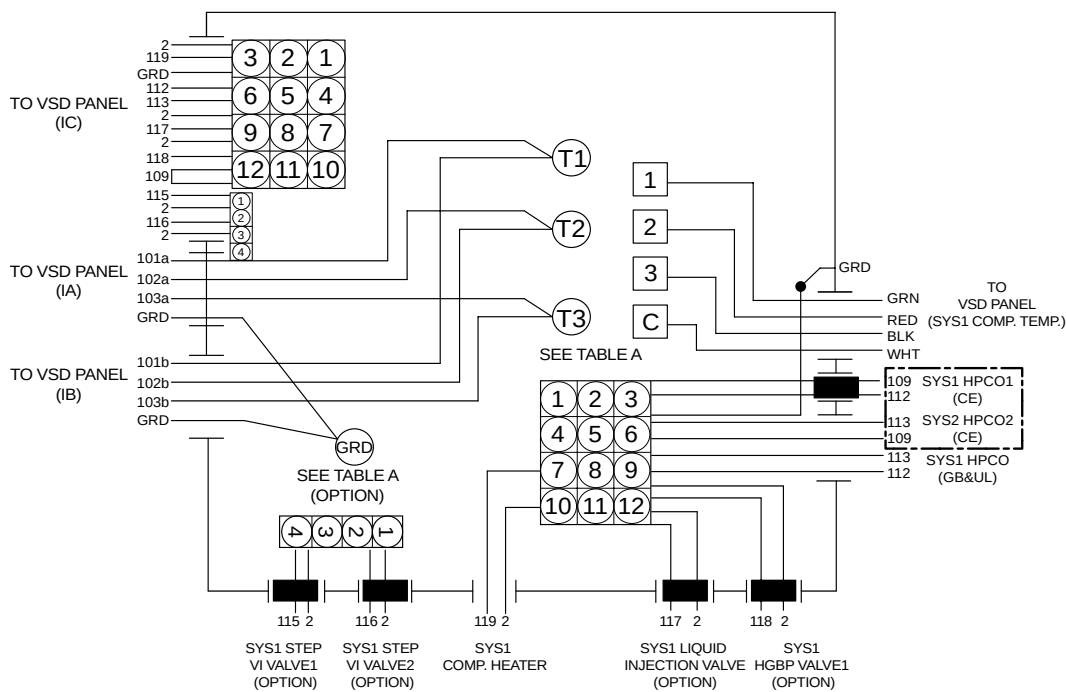
LD16136

FIGURE 39 - POWER WIRING

COMPRESSOR ELECTRICAL ASSEMBLY

TABLE 22 - SYSTEM 1 COMPRESSOR ELECTRICAL ASSEMBLY

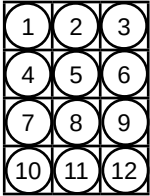
SYS 1 COMPRESSOR SUB WIRING (CONNECTS TO CONTROL DEVICES)								
CAP DETAIL	CAP P/N	CAP "J" NUMBER	GB AND UL			CE (DUAL HPCO)		
			CAP PIN NUMBER	WIRING NUMBER	FUNCTION	CAP PIN NUMBER	WIRING NUMBER	FUNCTION
	025-20787-000 (White)	J38	1	112	SYS1 HPCO	1	112	SYS1 HPCOI
			2	113		2	109	
			3	117	SYS1 Liquid Injection Valve	3	117	SYS1 Liquid Injection Valve
			4	2		4	2	
			5	118	SYS1 HGBP Valve	5	118	SYS1 HGBP Valve
			6	2		6	2	
			7	119	SYS1 Compressor Heater	7	119	SYS1 Compressor Heater
			8	2		8	2	
			9	GND		9	GND	
			10			10		N/A
			11		N/A	11	113	SYS1 HPCO2
			12			12	109	
	025-21756-000 (White)	J73 (Option)	1	115	SYS1 Step VI Valve 1	1	115	SYS1 Step VI Valve 1
			2	2		2	2	
			3	116	SYS1 Step VI Valve 2	3	116	SYS1 Step VI Valve 2
			4	2		4	2	

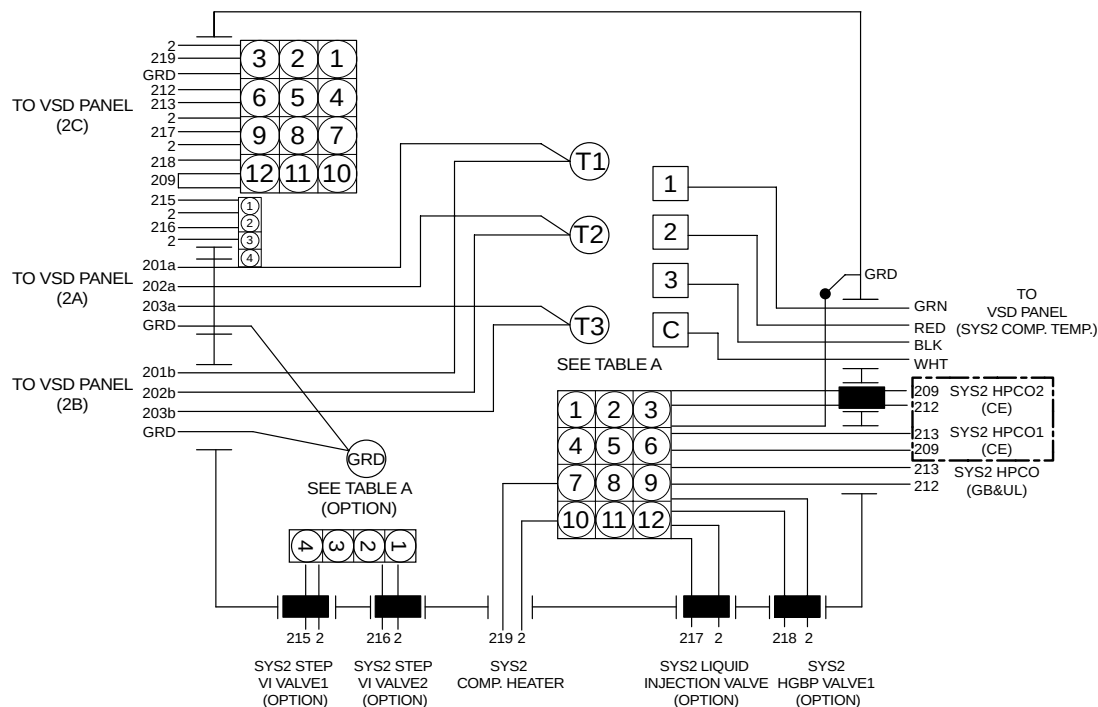


LD16464a

FIGURE 40 - SYSTEM 1 COMPRESSOR ELECTRICAL ASSEMBLY

COMPRESSOR ELECTRICAL ASSEMBLY (CONT'D)**TABLE 23 - SYSTEM 2 COMPRESSOR ELECTRICAL ASSEMBLY**

SYS 2 COMPRESSOR SUB WIRING (CONNECTS TO CONTROL DEVICES)								
CAP DETAIL	CAP P/N	CAP "J" NUMBER	GB AND UL			CE (DUAL HPCO)		
			CAP PIN NUMBER	WIRING NUMBER	FUNCTION	CAP PIN NUMBER	WIRING NUMBER	FUNCTION
	025-20787-000 (White)	J39	1	212	SYS1 HPCO	1	212	SYS2 HPCOI
			2	213		2	209	
			3	217	SYS2 Liquid Injection Valve	3	217	SYS2 Liquid Injection Valve
			4	2		4	2	
			5	218	SYS2 HGBP Valve	5	218	SYS2 HGBP Valve
			6	2		6	2	
			7	219	SYS2 Compressor Heater	7	219	SYS2 Compressor Heater
			8	2		8	2	
			9	GND	N/A	9	GND	N/A
			10			10		
			11			11	213	SYS2 HPCO2
			12			12	209	
	025-21756-000 (White)	J74 (Option)	1	215	SYS2 Step VI Valve 1	1	215	SYS2 Step VI Valve 1
			2	2		2	2	
			3	216	SYS2 Step VI Valve 2	3	216	SYS2 Step VI Valve 2
			4	2		4	2	



LD16465a

FIGURE 41 - SYSTEM 2 COMPRESSOR ELECTRICAL ASSEMBLY

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
CONTRACT	Contract Number	NUM	Contract Number = {contract/num}
ORDER	Order Quantity	QTY	Order quantity = {ord/qty}
USA	USA Origin	N	USA origin not required
		Y	USA origin required
TLOC	Test Location	M	Test @ Monterrey factory
		S	Test @ San Antonio factory
		G	Test @ Grantley factory
		W	Test @ Wuxi factory
		E	Test @ Sabadell factory
		N	Test @ Nantes factory
		A	Test @ alternate location
ASHRAE	ASHRAE 90.1 Compliance	Y	90.1 compliant as per YW
		N	Not 90.1 compliant as per YW
SYS1RLA	System 1 Rated Loaded Amps	A	System 1 YW RLA = {sys1rla/a}
SYS2RLA	System 2 Rated Loaded Amps	A	System 2 YW RLA = {sys2rla/a}
OPER WT	Operating Weight	LBS	Operating Weight = {lbs}
		KG	Operating Weight = {kg}
SHIP WT	Shipping Weight	LBS	Shipping Weight = {lbs}
		KG	Shipping Weight = {kg}
MODEL	Model (PIN 1)	Y	YORK
COMPR TYP	Compressor Type (PIN 2)	V	Variable Speed Screw
CHILLERTYP	Chiller Type (PIN 3)	W	Water-Cooled Chiller
DESIGNER	Design Series (PIN 4)	A	Design Series
EVAPTUBES Evaporator Tube Count (PIN 5, 6)		MB	12 ft (3.6 m) x 24 in (610 mm), 160 x 0.75 in (19 mm)
		MC	12 ft (3.6 m) x 24 in (610 mm), 200 x 0.75 in (19 mm)
		MD	12 ft (3.6 m) x 24 in (610 mm), 230 x 0.75 in (19 mm)
		ME	12 ft (3.6 m) x 24 in (610 mm), 260 x 0.75 in (19 mm)
		NB	14 ft (4.2 m) x 24 in (610 mm), 160 x 0.75 in (19 mm)
		NC	14 ft (4.2 m) x 24 in (610 mm), 200 x 0.75 in (19 mm)
		ND	14 ft (4.2 m) x 24 in (610 mm), 230 x 0.75 in (19 mm)
		NE	14 ft (4.2 m) x 24 in (610 mm), 260 x 1 in (25 mm)
		M2	12 ft (3.6 m) x 24 in (610 mm), 80 x 1 in (25 mm)
		M3	12 ft (3.6 m) x 24 in (610 mm), 95 x 1 in (25 mm)
		M4	12 ft (3.6 m) x 24 in (610 mm), 110 x 1 in (25 mm)
		M5	12 ft (3.6 m) x 24 in (610 mm), 129 x 1 in (25 mm)
		N2	14 ft (4.2 m) x 24 in (610 mm), 80 x 1 in (25 mm)
		N3	14 ft (4.2 m) x 24 in (610 mm), 95 x 1 in (25 mm)
		N4	14 ft (4.2 m) x 24 in (610 mm), 110 x 1 in (25 mm)
		N5	14 ft (4.2 m) x 24 in (610 mm), 129 x 1 in (25 mm)

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
CONDTUBES Condenser Tube Count (PIN 7, 8)		MB	12 ft (3.6 m) x 20 in (508 mm), 162 x 0.75 in (19 mm)
		MC	12 ft (3.6 m) x 20 in (508 mm), 191 x 0.75 in (19 mm)
		MD	12 ft (3.6 m) x 20 in (508 mm), 211 x 0.75 in (19 mm)
		ME	12 ft (3.6 m) x 20 in (508 mm), 248 x 0.75 in (19 mm)
		NB	14 ft (4.2 m) x 20 in (508 mm), 162 x 0.75 in (19 mm)
		NC	14 ft (4.2 m) x 20 in (508 mm), 191 x 0.75 in (19 mm)
		ND	14 ft (4.2 m) x 20 in (508 mm), 211 x 0.75 in (19 mm)
		NE	14 ft (4.2 m) x 20 in (508 mm), 248 x 0.75 in (19 mm)
		M2	12 ft (3.6 m) x 20 in (508 mm), 72 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		M3	12 ft (3.6 m) x 20 in (508 mm), 90 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		M4	12 ft (3.6 m) x 20 in (508 mm), 107 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		M5	12 ft (3.6 m) x 20 in (508 mm), 123 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		N2	14 ft (4.2 m) x 20 in (508 mm), 72 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		N3	14 ft (4.2 m) x 20 in (508 mm), 90 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		N4	14 ft (4.2 m) x 20 in (508 mm), 107 x 1 in (25 mm), 18 x 0.75 in (19 mm)
		N5	14 ft (4.2 m) x 20 in (508 mm), 123 x 1 in (25 mm), 18 x 0.75 in (19 mm)
CMPR	Compressor Driveline (PIN 9, 10)	EE	2 CMPR (136mm/136mm)
		FE	2 CMPR (145mm/136mm)
		FF	2 CMPR (145mm/145mm)
		QQ	Special Quote
STARTER	Starter (PIN 11)	A	2 CMPR Frame A
		B	2 CMPR Frame B
		C	2 CMPR Frame C
		D	2 CMPR Frame D
		Q	Special Quote
PASS	Pass Arrangement (PIN 12)	B	Evap: 2pass; Cond: 1pass
		C	Evap: 3pass; Cond: 1pass
		E	Evap: 2pass; Cond: 2pass
		F	Evap: 3pass; Cond: 2pass
		H	Evap: 2pass; Cond: 3pass
		I	Evap: 3pass; Cond: 3pass
		Q	Special Quote
NOMCAP	Nominal Capacity (PIN 13, 14, 15, 16)	ASIA	Asia Region
		####	kW for Europe
		####	TR for NA Region

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
APPL	Application (PIN 17)	S	Standard water chiller
		D	Dry tower
		P	Process brine
		T	Ice thermal storage
		A	Heat pump(<55C/131F)
		F	Heat recovery(<55C/131F)
		I	Process brine and dry tower
		Q	Special Quote
MODLVL	Modification Level A (PIN 18)	A	Modification Level A
PIN19	PIN19	X	No Selection
		Q	Special Quote
VOLTS	Voltage (PIN 20, 21)	17	200/3/60
		28	230/3/60
		40	380/3/60
		46	460/3/60
		65	380/3/50
		50	400/3/50
		68	415/3/50
		58	575/3/60
		Q	Special Quote
POWER	Power Field (PIN 22)	SX	NF Disconnect Switch, Lockable
		BX	Circuit Breaker, Lockable
		SS	Supply Terminal Block
		CS	Special Quote
FILTER	Harmonic Filter (PIN 23)	X	No Selection
		Q	Special Quote
SYSPARM	System Parameter (PIN 24)	X	No Selection
		Q	Special Quote
CONTENCL	Control Panel and VSD Enclosure Type (PIN 25)	S	Ctrl/VSD:N1/IP33, AT:N1/IP33
		Q	Special Quote
NEMA	Unit NEMA Type (PIN 26)	S	Unit: NEMA1 or IP10
		Q	Special Quote
VSDCOOL	VSD Cooling Source (PIN 27)	X	No Selection
		S	Std VSD Cooling (via Condenser)
		H	Hi-temp VSD Cooling (via Evaporator)
		Q	Special Quote
		X	No Selection
PANEL	Panel Options (PIN 28)	X	No Selection
		Q	Special Quote
BAS	BAS Interface (PIN 29)	X	No BAS Reset/Offset required
		T	BAS/EMS Temp Reset/Offset
		C	BAS/EMS Current Reset/Offset
		B	BAS/EMS Both Temp and Current Reset/Offset
		Q	Special BAS Reset/Offset required

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
LANGDESP	Language Display (PIN 30)	X	English
		S	Spanish
		F	French
		G	German
		I	Italian
		P	Portuguese
		L	Polish
		H	Hungarian
SAFETY	Safety Code (PIN 31)	L	China Safety Code (GB)
		C	European Safety Code (CE)
		Q	N American Safety Code (cUL/cETL)
		Q	Special Quote
REMOTEPNL	Remote Ctrl Panel (PIN 32)	X	Special Remote
		Q	Special Quote
SEQ	Sequence Kit (PIN 33)	X	No Selection
		Q	Special Quote
UNLOAD	PIN 34	X	No option required
		Q	Special Quote
PIN35	PIN 35	X	No option required
		Q	Special Quote
PIPING	Piping Code (PIN 36)	X	No Selection
		R	Dual relief valves
		C	Chicago relief code
		Q	Special Quote
METERDEV	Metering Device (PIN 37)	E	EEV
		Q	Special Quote
VALVE	Valve Options (PIN 38)	X	No Selection
		B	Condenser isolation valves
		Q	Special Quote
BYPASS	Hot Gas Bypass (PIN 39)	X	No Selection
		Q	Special quote
PIN40	PIN 40	X	No Selection
		Q	Special Quote
REF	R-134a (PIN 41)	X	No Selection
CPRVAR	Compressor Variation (PIN 42)	W	2.3 Vi compressor
		C	Optimized 2.3 Vi compressor
		S	Standard 3.2 Vi compressor
		V	Optimized 3.2 Vi compressor
		Q	Special Quote
CPRFQ	Compressor Frequency (PIN 43, 44, 45)	X	Compressor Frequency
		Q	Special Quote
ECON	Economizer (PIN 46)	E	Economizer
		Q	Special Quote
		X	No Selection

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
PIN47	PIN 47	X	No Selection
		Q	Special Quote
FLOW	Flow Switch per Chiller (PIN 48)	X	No selection
		S	One flow switch
		T	Two flow switches
		D	One diff pressure switch
		E	Two diff pressure switches
		G	One thermal dispersion switch
		H	Two thermal dispersion switches
		Q	Special Quote
INS	Thermal Insulation (PIN 49)	X	No Selection
		S	3/4 in insulation evaporator
		D	1-1/2 in insulation evaporator
		E	3/4 in insulation evap and cond
		C	1-1/2 in ins evap and 3/4 in cond
		Q	Special Quote
VESSEL	Vessel Codes (PIN 50)	G	GB Pressure Vessel Codes
		E	PED Pressure Vessel Codes
		A	ASME Pressure Vessel Codes
		Q	Special Quote
PIN51	PIN 51	X	No Selection
		Q	Special Quote
TEMP	Evaporator Water Temp (PIN 52, 53)	##	Lvg Evap Wat Temp = {LWT} deg
		QQ	Special Quote
EVAPTUBETYPE	Evaporator Tube Type (PIN 54, 55, 56)	321	R-1158 .025 Wall MT#321
		322	R-1158 .028 Wall MT#322
		323	R-1158 .035 Wall MT#323
		326	R-1158 .025 Wall MT#326
		327	R-1158 .028 Wall MT#327
		328	R-1158 .035 Wall MT#328
		QQQ	Special Quote
EVAPWB	Evaporator Water Box Type (PIN 57)	C	Compact water boxes
		Q	Special Quote
EVAPCOAT	Evaporator Epoxy Coating (PIN 58)	C	Compact water boxes
		Q	Special Quote
EVAPHG	Evaporator Hinges (PIN 59)	X	No Selection
		Q	Special Quote
EVAPDWP	Evaporator Waterside DWP (PIN 60)	1	150 psig DWP waterside
EVAPPARR	Evaporator Nozzle Arrangement (PIN 61)	A	AH
		H	HA
		C	CB
		K	KJ
		G	GN
		P	PF
		Q	Special Quote

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
EVAPWBCON	Evaporator Water Connection (PIN 62)	G	Groove
		D	DIN/PN weld flanges (field)
		P	DIN/PN weld flanges (factory)
		A	ANSI welded flanges (field)
		N	ANSI welded flanges (factory)
		H	HG welded flanges (factory)
		V	DIN/PN Vict flanges (field)
		C	ANSI Victaulic flanges (field)
		Q	Special Quote
EVPPFL	Evaporator Fluid (PIN 63)	W	Water
		C	Calcium Chloride
		S	Sodium Chloride
		E	Ethylene Glycol
		P	Propylene Glycol
		Q	Special Quote
PIN64	PIN 64	X	No Selection
		Q	Special Quote
CTEMP	Condenser Leaving Water Temperature (PIN 65, 66)	X	No Option
		1	Cond Lvg Wat Temp = {CLWT} deg
		S	Special Quote
CONDTUBETYPE	Condenser Tube Type (PIN 67, 68, 69)	201	R-1077 .028 Wall MT#201
		203	R-1077 .035 Wall MT#203
		260	R-1130 .025 Wall MT#260
		261	R-1130 .028 Wall MT#261
		262	R-1130 .035 Wall MT#262
		266	R-1130 .025 Wall MT#266
		267	R-1130 .028 Wall MT#267
		268	R-1130 .035 Wall MT#268
		162	R-1118 .025 Wall MT#162
		QQQ	Special Quote
CONDWB	Condenser Water Box Type (PIN 70)	C	Compact water boxes
		Q	Special Quote
CONDCOAT	Condenser Epoxy Coating (PIN 71)	X	No Selection
		Q	Special Quote
CONDHG	Condenser Hinges (PIN 72)	X	No Selection
		Q	Special Quote
CONDDWP	Condenser Waterside DWP (PIN 73)	C	150 psig DWP waterside
		K	Special Quote
CNDARR	Condenser Nozzle Arrangement (PIN 74)	A	AH
		H	HA
		C	CB
		K	KJ
		G	GN
		P	PF
		Q	Special Quote

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
CONDWBCON	Condenser Water Box Connection (PIN 75)	G	Groove
		D	DIN/PN weld flanges (field)
		P	DIN/PN weld flanges (factory)
		A	ANSI welded flanges (field)
		N	ANSI welded flanges (factory)
		H	HG welded flanges (factory)
		V	DIN/PN Vict flanges (field)
		C	ANSI Victaulic flanges (field)
		Q	Special Quote
CONPFL	Condenser Fluid (PIN 76)	W	Water
		C	Calcium Chloride
		S	Sodium Chloride
		E	Ethylene Glycol
		P	Propylene Glycol
		Q	Special Quote
PIN 77	PIN 77	X	Elastomeric pad
		Q	1-in deflection spring isol
NOISERDCT	Noise Reduction Kit (PIN 78)	X	No Selection
		B	Sound Kit No. 1
		Q	Special Quote
ISOL	Vibration Isolation (PIN 79)	X	No selection
		E	Elastomeric pad
		1	1-in deflection spring isol
		Q	Special Quote
PAINT	Paint Options (PIN 80)	S	Caribbean Blue
		Q	Special Quote
STRMOD	Structural Modification (PIN 81)	X	No Selection
		Q	Special Quote
PIN 82	PIN 82	X	No Selection
		Q	Special Quote
SHIP	Ship Instructions (PIN 83)	E	Special Quote
		1	Buy America Act Compl w Bag
		Q	Amer Act and Cont w/o Bag (Prep)
		S	Cont Ship w/o Bag (Load US)
		Q	Cont Ship w Bag (Load US)
		X	Cont Ship w Bag (Load Mex)
		Q	Cont Ship w Bag (Fact Prep)
		G	Amer Act and Cont w Bag (Prep)
		M	Cont Ship w/o Bag (Load Mex)
		N	No Cont w/o Bag
		P	Cont Ship w/o Bag (Fact Prep)
		U	Buy America Act Compl w/o Bag
		Q	Special Quote

TABLE 24 - COMPLETE PIN NUMBER DESCRIPTION (CONT'D)

FEATURE	DESCRIPTION	OPTION	DESCRIPTION
FORM	Form Shipment Options (PIN 84)	1	Form 1
		2	Form 2
		3	Form 3
		7	Form 7
		Q	Special Quote

SECTION 3 - HANDLING, STORAGE, AND INSTALLATION

DELIVERY AND STORAGE

To ensure consistent quality and maximum reliability, all units are tested and inspected before leaving the factory. The chiller may be ordered and shipped in any of the following forms:

- Form 1 (shipped complete)
- Form 2 (shipped complete without refrigerant charge)
- Form 7 (shipped in split assemblies without refrigerant, which can be ordered as a special order)

Forms 1 and 2

A YVWA chiller shipped as Form 1 includes the refrigerant charge. Refrigerant charge is shipped separately for Form 2 YVWA chillers. Miscellaneous loose items are shipped with both forms.

Form 2

Make arrangements with the Johnson Controls Field Service Office to make sure refrigerant is on-site when unit is ready to be charged.

Chiller Unit

The unit is completely assembled at the factory.

- The driveline (compressor/motor assembly) is mounted and all the necessary interconnecting piping is assembled.
- The complete unit is factory leak-tested, evacuated, and shipped charged with R-134a refrigerant.
- The VSD is mounted, wired, and shipped with glycol.

Miscellaneous Items

The following items are shipped together:

- Four vibration isolation pads (or optional spring isolators and brackets)
- VSD inhibitor
- Other shipped loose items, including piping, water temperature controls, wiring, etc.

Form 7 (Special Order)

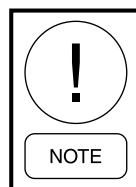
The chiller is shipped in split assemblies without the refrigerant charge, and can be specially ordered.

Units are shipped without export crating unless crating has been specified on the sales order. Observe the following precautions, if the unit is to be stored prior to installation:

- The chiller must be blocked under end sheets.
- Ensure that all openings, such as water connections, are securely capped.
- Store the unit in a location where:
 - It will NOT be exposed to ambient air temperatures exceeding 110°F (43°C).
 - There is minimal activity to limit the risk of accidental physical damage.
 - It is protected from rain or mist. Cover with a tarp, if the unit will be located outside.
- If the unit is stored longer than six months, the requirements from *Long-Term Storage Periodic Checklist and Logs for YR, YS, and YVWA Screw Chillers (Form 50.20-NM9)* must be followed.
- Inspect the unit periodically during storage.
- To prevent inadvertent operation of the pressure relief devices, the unit must not be steam cleaned.

INSPECTION, DAMAGE, AND SHORTAGE

The unit shipment should be checked on arrival to see that all major pieces, boxes and crates are received. Each unit should be checked on the trailer or rail car when received, before unloading, for any visible signs of damage. Any damage or signs of possible damage must be reported to the transportation company immediately for their inspection.



JOHNSON CONTROLS WILL NOT BE RESPONSIBLE FOR ANY DAMAGE OR LOSS OF PARTS IN SHIPMENT OR AT JOB SITE. Refer to Shipping Damage Claims Form (Form 50.15-NM).

LIFTING WEIGHTS

For detailed unit weights and weight distribution, refer to the data shipped in the chiller information packet and unit nameplate.

TABLE 25 - APPROXIMATE UNIT WEIGHT

COMPRESSORS	SHELLS	SHIPPING WEIGHT RANGE MIN - MAX		OPERATING WEIGHT RANGE MIN - MAX		REFRIGERANT CHARGE RANGE MIN - MAX		LOADING PER ISOLATOR MIN - MAX	
		(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)	(LBS)	(KG)
EE	M-M	10,541 - 11,693	4,782 - 5,304	11,497 - 12,950	5,215 - 5,874	573 - 595	260 - 270	2,875 - 3,279	1,304 - 1,469
	N-N	12,180 - 12,450	5,525 - 5,647	13,251 - 13,880	6,011 - 6,296	617 - 639	280 - 290	3,314 - 3,370	1,503 - 1,574
FE	M-M	10,610 - 11,762	4,813 - 5,335	11,566 - 13,019	5,246 - 5,905	584 - 606	265 - 275	2,892 - 3,254	1,312 - 1,476
	N-N	12,248 - 12,519	5,556 - 5,678	13,319 - 13,948	6,042 - 6,327	628 - 650	285 - 295	3,329 - 3,428	1,510 - 1,582
FF	M-M	10,678 - 11,830	4,844 - 5,366	11,634 - 13,087	5,277 - 5,396	595 - 617	270 - 280	2,908 - 3,272	1,319 - 1,484
	N-N	12,317 - 12,587	5,587 - 5,709	13,388 - 14,017	6,073 - 6,358	639 - 661	290 - 300	3,347 - 3,503	1,518 - 1,589

NOTE: Weights are shown for base unit; selected options tube count variations, and/or quantity of refrigerant charge may add weight to unit.

MOVING THE CHILLER

Prior to moving the unit, make sure that the installation site is suitable for installing the unit and is easily capable of supporting the weight of the unit and all associated services.

The unit is designed to be lifted using cables. The unit is provided with lifting eyes in the corners of the end sheets, which can be attached directly using shackles or safety hooks.



Lift the unit by the end sheets ONLY at the points provided. Never lift the unit using a forklift truck.

Each unit has four lifting holes (two on each end) in the end sheets, which should be used to lift the unit. Be careful during rigging and handling to avoid damage to the unit and its external connections. Lift only using the holes provided.

If necessary to rig a unit by one end to permit lifting or dropping through a vertical passageway, such as an elevator shaft, the unit must be special ordered.



Never lift the unit with slings around compressor/motor assembly or by eyebolts in the tapped holes of the compressor/motor assembly. Do not turn a unit on its side for rigging or rig with the driveline in a vertical orientation.

RIGGING

The complete standard unit (Forms 1 and 2) is shipped without skids. When optional skids are used, it may be necessary to remove the skids so that the riggers skates can be used under the unit end sheets to reduce the overall height.

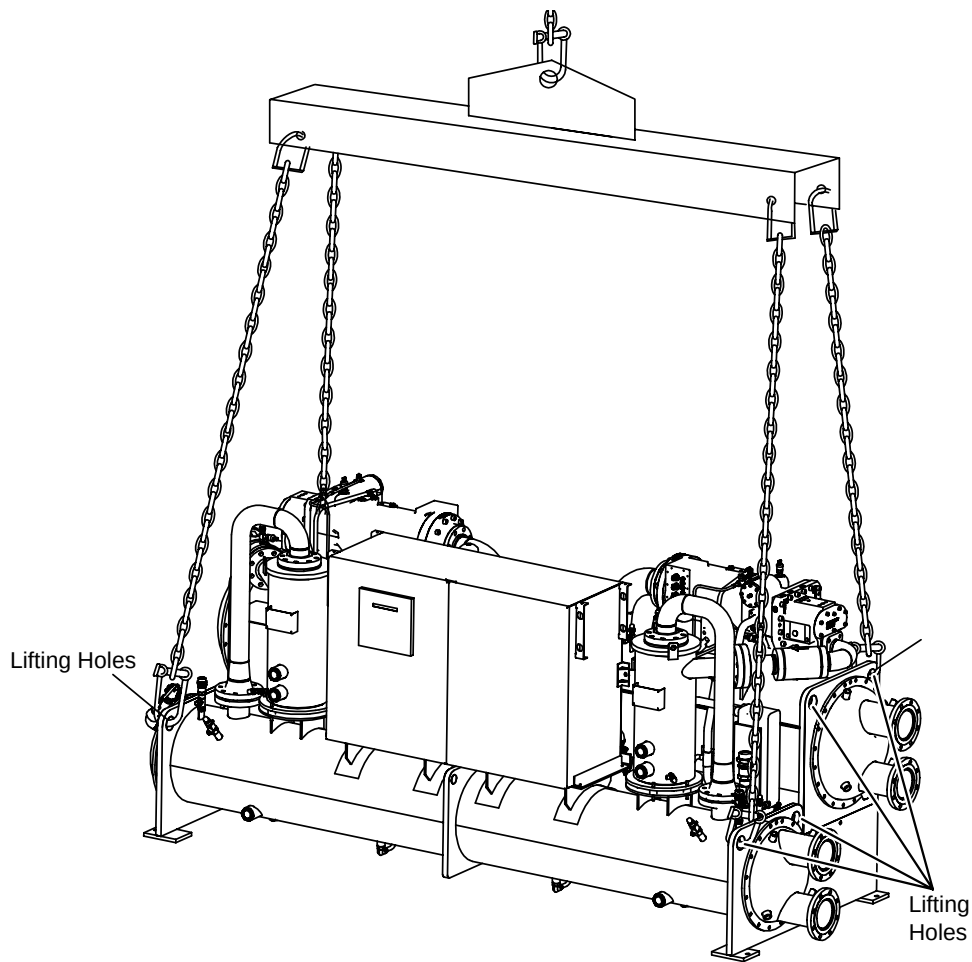


FIGURE 42 - UNIT RIGGING

LD16424

LOCATION

Locate the chiller in an indoor location where temperature ranges from 40°-110°F (4°-43°C) with adequate ventilation that meets the all ANSI, state, and local codes.



If the temperature is outside of the 40°-110°F (4°-43°C) range, make sure the water boxes and VSD heat exchanger are completely drained of all liquid, which could freeze. Make sure the condenser and evaporator tubes are completely dry. The VSD coolant must be drained and replaced with anti-freeze solution.

FOUNDATION

A level floor, mounting pad, or foundation must be provided by the customer, which is capable of supporting the unit operating weight.

CLEARANCE FOR SERVICE

To ensure adequate space for servicing the unit, adhere to the following clearances:

- Rear, ends, and top of unit – 2 ft (610 mm)
- Front of unit – 3 ft (914 mm)
- Tube removal (See Table 26 on page 97 for clearance)

TABLE 26 - SERVICE CLEARANCE REQUIREMENTS

SHELL CODE	TUBE REMOVAL SPACE		ADD MARINE WATER BOXES	
	ft-in	mm	ft-in	mm
M	12-1	3683	2-2	660
N	14-1	4293	2-2	660

If optional shipping skids are used, remove them before lowering the unit to its mounting position. Use an overhead lift to rig the unit to its final location on the floor or mounting pad by lifting the unit, and lowering it to its mounting position.

LOCATING AND INSTALLING NEOPRENE VIBRATION ISOLATOR PADS

Locate the neoprene vibration isolator pads as shown in *Figure 43 on page 98*. After placing the isolator pads into position on the floor, lower the unit onto the pads. Make sure the pads are even with the edges of the mounting feet. When the unit is in place, remove the rigging equipment, and check that the chiller is level, longitudinally and transversely.

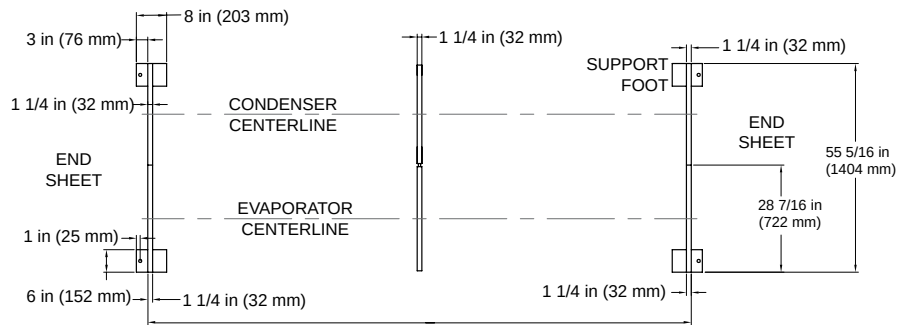
Check the Unit Alignment

Check the longitudinal alignment by placing a level on the top center of the evaporator shell under the compressor/motor assembly. Check the transverse alignment by placing a level on top of the shell end sheets at each end of the unit.

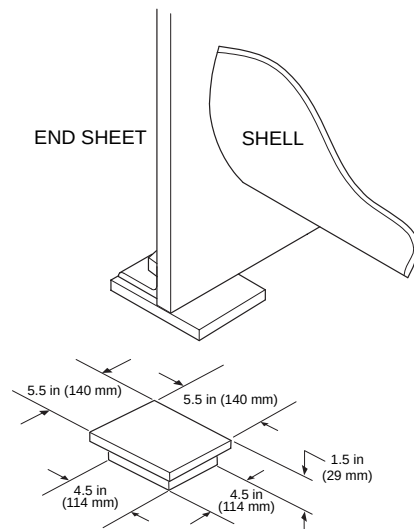
The unit should be level within 0.25 in (6 mm) from one end to the other end, and from front to the rear. If the chiller is not level within the amount specified, lift it and place as many shims as needed between the isolation pad and the end sheets.

Check the Isolator Pad Deflection

Check all isolator pads for the proper deflection, which is approximately 0.15 in (4 mm). If an isolator pad is under-deflected, shims should be placed between the unit end sheet and the top of the pad to equally deflect all pads.



DIMENSIONS ARE TYPICAL FOR ALL PADS



ELASTOMERIC ISOLATOR

LD16425

FIGURE 43 - ELASTOMERIC VIBRATION ISOLATOR PAD MOUNTS (STANDARD) - INCHES (MM)

INSTALLING OPTIONAL SPRING ISOLATORS

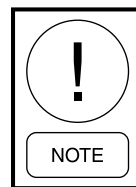
If ordered, four identical spring type isolator assemblies are furnished with the unit as shown in *Figure 44 on page 99*. Use the following instructions to install the optional isolators:

1. While the unit is suspended by the rigging, bolt the isolators to the unit by inserting the cap screw(s) through the hole(s) in the mounting bracket into the tapped hole in the top of the isolator leveling bolt(s). then the unit can be lowered onto the floor.
2. Rotate the leveling bolts one turn at a time, in sequence, until the unit end sheets are clear of the floor according to the dimensions.
3. Check that the unit is level, both longitudinally and transversely. If the leveling bolts are not long enough to level unit due to an uneven or sloping floor or foundation, add as many shims as necessary (grouted, if necessary) beneath the isolator.

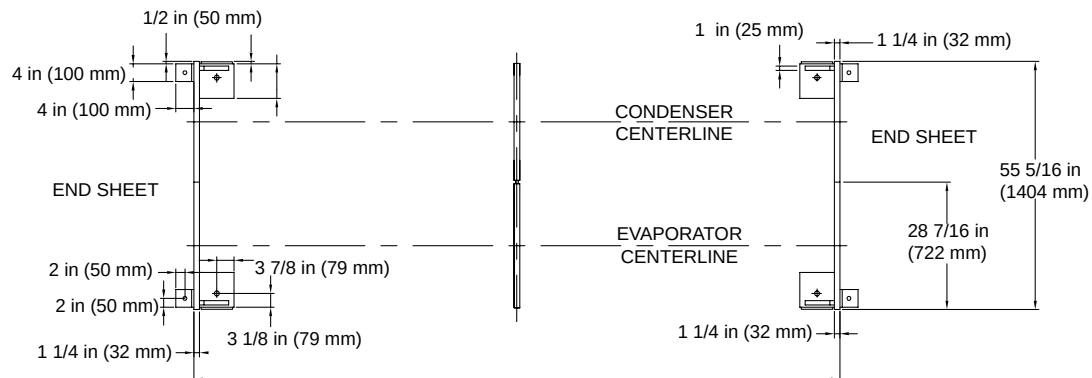
4. After the unit is leveled, wedge and shim under each corner to solidly support the unit in this position while:
 - Piping connections are being made.
 - Pipe hangers are adjusted.
 - Connections are checked for alignment.

5. Fill the unit (waterside) with water and check for leaks.

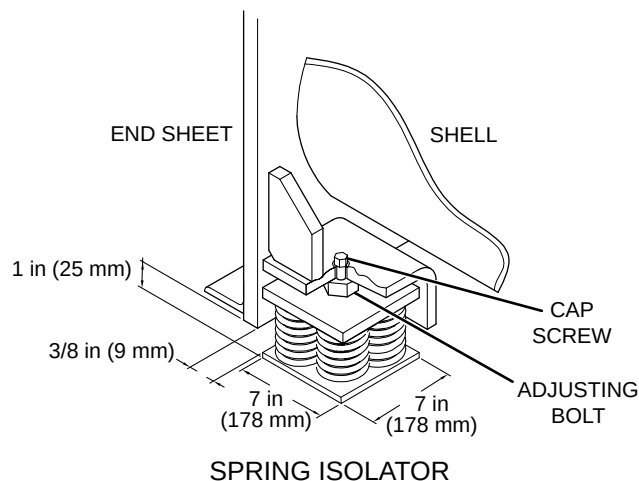
6. Adjust the leveling bolts and the remove the shims. The unit should now be in a correctly leveled position, clear of the floor or foundation, and without any effect from the weight of the piping.



Spring isolators are used in ASME applications; elastomeric isolators are available. Refer to Figure 44 on page 99.



DIMENSIONS ARE TYPICAL FOR ALL PADS



SPRING ISOLATOR

LD16471

FIGURE 44 - SPRING ISOLATORS (OPTIONAL) - INCHES (MM)

PIPING CONNECTIONS

After the unit is leveled (and wedged in place for optional spring isolators) the piping connections may be fabricated. Arrange the piping with offsets for flexibility, and are adequately supported and braced independently of the unit to avoid strain on the unit and vibration transmission. Hangers must allow for alignment of pipe. Isolators (by others) in the piping and hangers are highly desirable, and may be required per specifications.

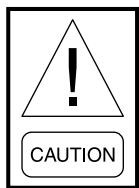
CHECK FOR PIPING ALIGNMENT

When piping is complete, check for alignment. Open a connection in each line, as close to the unit as possible, by removing the flange bolts or coupling. If any bolt is bound in its hole, or if the connection springs are out of alignment, correct the misalignment by properly supporting the piping or by applying heat to anneal the pipe.

It may be necessary to weld chilled or condenser water piping directly to the water pipe nozzles. Since chilled and condenser water temperature sensor wells are often in close proximity to these connection points, sensors in the wells may often see temperatures of several hundred degrees, which can potentially damage them. Establish a good clean welding ground connection near the point of weld to prevent stray current from damaging other sensors or chiller control wiring. Any damage will likely show up as error in the sensor.



As a precautionary measure, remove the sensors from the wells during the welding process. If the sensor is removed, make sure that it bottoms out when it is placed back in the well.



If the piping is annealed to relieve stress, clean the scale out of the pipe before it is bolted in place.

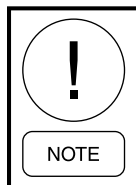
CONDENSER AND CHILLED LIQUID PIPING

General Requirements

The following piping recommendations are intended to ensure satisfactory operation of the unit. Failure to follow these recommendations could cause damage to the unit, and may invalidate the warranty.



The maximum flow rate and pressure drop for the condenser and cooler must not be exceeded at any time. The liquid must enter the water box at the inlet connection, which is typically the lower connection.



A flow switch must be installed in the customer piping at the outlet of the cooler, and the condenser and wired back to the control panel using shielded cable.

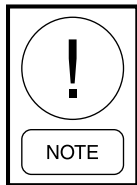
A straight run of piping of at least five pipe diameters is recommended on either side of the flow switch. The chilled liquid flow switch should be wired to Terminals 2 and 13 on the 1TB Terminal Block, and is required to prevent damage to the cooler caused by the unit operating without adequate liquid flow.

The condenser flow switch, which lets the chiller shut down to avoid excess head until flow is restored, should be wired to Terminals 2 and 12 on the 1TB Terminal Block.

The flow switches must have gold plated contacts for low voltage/current operation. Paddle type flow switches suitable for 150 psig (1030kPa) working pressure that have a 1" NPT connection can be obtained from Johnson Controls as an accessory for the unit. Alternatively, a differential pressure switch fitted across an orifice plate may be used, preferably of the high/low limit type.

The liquid pump installed in the piping system(s) should discharge directly into the unit. The pump(s) may be controlled by the chiller controls or external to the unit.

Piping and fittings immediately next to the chiller should be readily demountable to enable cleaning before operation, and to facilitate visual inspection of the exchanger nozzles.



The tubes must be protected by a strainer, preferably 40 mesh, and must fit as close as possible to the liquid inlet connection, and be provided with a means of local isolation.

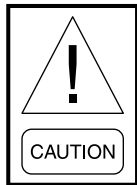
The chiller must not be exposed to flushing velocities or debris released during flushing. Install a suitably sized bypass and valve arrangement to allow flushing of the piping system. The bypass can be used during maintenance to isolate the heat exchanger without disrupting flow to other units.

Piping Connections

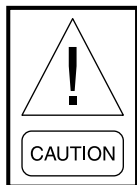
Thermometer and pressure gauge connections should be provided on the inlet and outlet connections of each cooler. Gauges and thermometers are not provided with the unit, and are to be furnished by others.

Drain and air vent connections should be provided at all low and high points in the piping to permit drainage of the system and to vent any air in the pipes.

Stop valves may be provided (by others) in the piping adjacent to the unit to facilitate maintenance.



Any debris left in the water piping between the strainer and cooler could cause serious damage to the tubes in the chiller and must be avoided. Be sure the piping is clean before connecting it to the water boxes. Keep nozzles and chilled liquid piping capped prior to installation to make sure construction debris is not allowed to enter.



Make sure that the water quality in circulation is adequate, without any dissolved gases, which can cause oxidation of steel or copper parts within the chiller.

Condenser Water Circuit

To properly operate the unit, condenser refrigerant pressure must be maintained above evaporator pressure. If operating conditions will fulfill this requirement, do not attempt to control condenser water temperature by means of automatic valves, cycling of the cooling tower fan, or other means. YVWA chillers are designed to function efficiently when condenser water is allowed to seek its own temperature level at reduced loads, and at off-peak seasons of the year. YVWA chillers can be operated with entering condensing water temperature that is less than design conditions.



Operating the chiller below its minimum ECW could result in low oil differential shutdowns. Different methods are used to maintain minimum ECW; however, the most effective method is to install a three-way bypass valve in the leaving condenser water line.



Operating below the minimum entering condensing water will not provide energy savings, and will result in oil management problems. However, if the entering water temperature can go below the required minimum, the condenser water temperature must be maintained equal to, or slightly higher than the required minimum.

Checking Piping Circuits and Venting Air

After the water piping is completed, but before any water box insulation is applied, tighten and torque the nuts on the liquid head flanges (to maintain between 30-60 ft-lb (41-81 Nm)). Gasket shrinkage and handling during transit may cause nuts to loosen. If water pressure is applied before this is done, the gaskets may be damaged and have to be replaced. Fill the chilled and condenser water circuits, operate the pumps manually and carefully check the evaporator and condenser water heads and piping for leaks. Repair leaks as necessary.

WATER TREATMENT

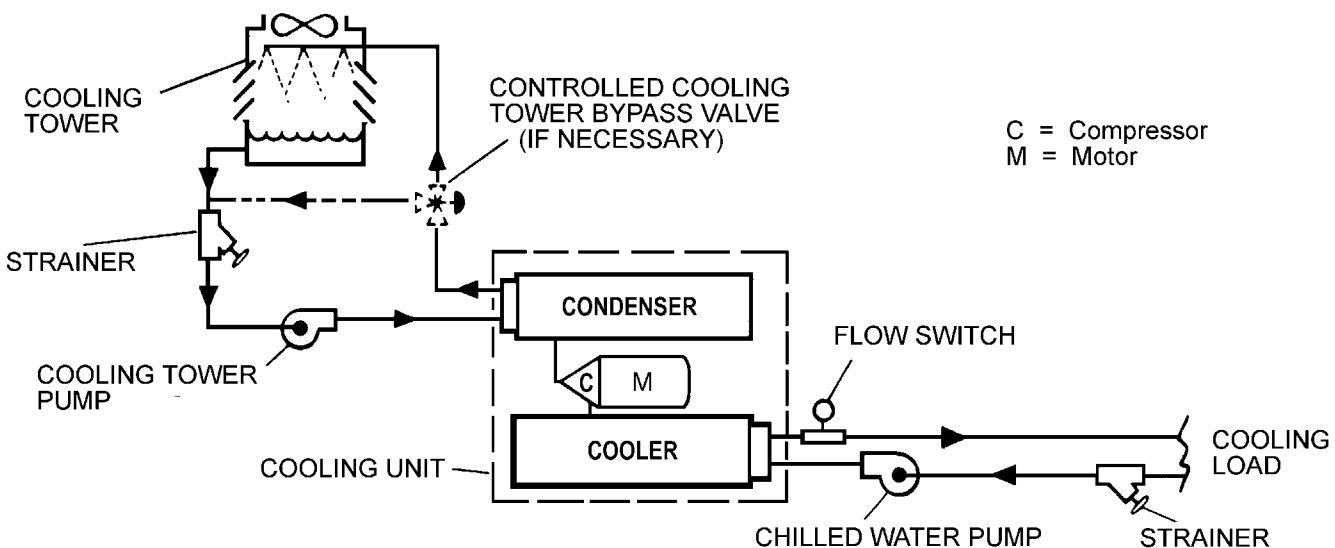
The unit performance provided in the design guide is based on a fouling factor that is AHRI-specified. Dirt, scale, grease and certain types of water treatment will adversely affect the heat exchanger surfaces, and therefore the unit's performance.

Foreign matter in the water system(s) can increase the heat exchanger pressure drop, which can reduce the flow rate and can cause potential damage to the heat exchanger tubes.

Aerated, brackish, or salt water is not recommended for use in the water system(s). Johnson Controls recommends that a water treatment specialist should be consulted to determine whether the proposed water composition will adversely affect the evaporator materials of carbon steel and copper. The pH value of the water flowing through the evaporator must be kept between 7 and 8.5.

PIPEWORK ARRANGEMENT

Piping arrangement vary according to design and facility application. *Figure 45 on page 102* is a suggested piping arrangement for single unit installations. For multiple unit installations, each unit could be piped as shown below.



LD07069

FIGURE 45 - SCHEMATIC OF A TYPICAL PIPING ARRANGEMENT

MINIMUM WATER VOLUME

Include as much water volume as possible in a chilled water loop, which increases the thermal mass and fly-wheel effect within the system. More water promotes stable water temperature control and increases reliability by reducing compressor cycling.

TABLE 27 - WATER VOLUME FOR APPLICATIONS

APPLICATION	GALLON/TON RATIO	L/KW RATIO
Air Conditioning	5-8 (min of 3)	5.5-8.8 (min of 3.3)
Process	7-11 (min of 6)	7.7-12.3 (min of 4.4)

Install a tank or increase pipe sizes to provide sufficient water volume.

LEAVING WATER TEMPERATURE OUT OF RANGE

The YVWA chiller line has a maximum leaving water temperature of 60°F (15.6°C). Where process applications require a chilled water temperature higher than what the chiller provides, a simple piping change can fix the problem. By using a mixture of chiller-cooled water and returning process water, the chilled water entering the process can be held at the desired temperature as shown in *Figure 46 on page 103*. A tank can also be used to meet high leaving liquid temperature requirements.

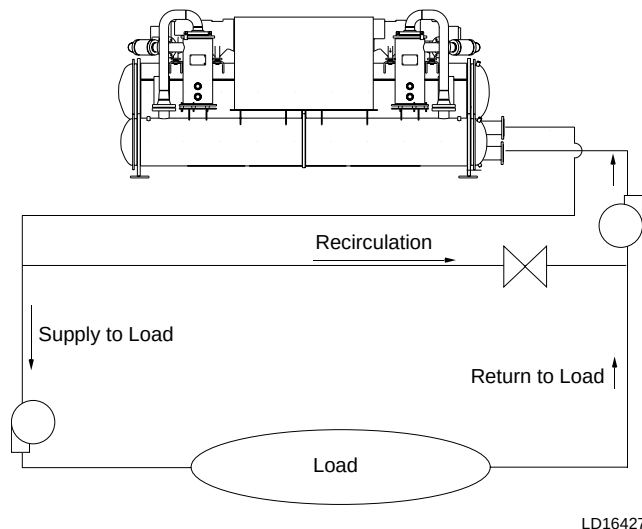


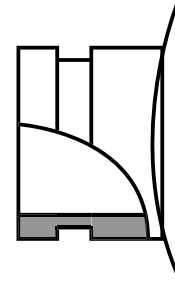
FIGURE 46 - LEAVING WATER TEMPERATURE OUT OF RANGE SUGGESTED LAYOUT.

VARIABLE PRIMARY FLOW

Johnson Controls recommends a maximum 10% per minute flow rate of change, based on design flow, for variable primary flow applications. Provide system water volume using *Table 27 on page 103*. Insufficient system volume and rapid flow changes can cause control problems or chiller shutdowns. There are many other design issues to evaluate with variable primary flow systems. Consult the Johnson Controls Sales Office for more information about successfully applying YVWA chillers.

NOZZLE CONNECTIONS

Standard chilled liquid connections on all coolers and condensers are the victaulic groove type as shown in *Figure 47 on page 103*.



LD10494

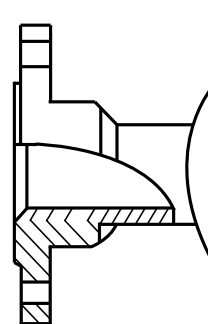
FIGURE 47 - VICTAULIC GROOVE

OPTIONS FOR FLANGES

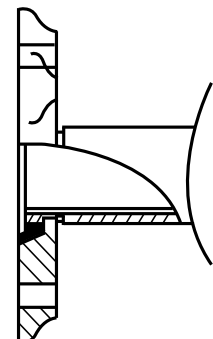
Two types of flanges may be fitted, depending on the customer or local pressure vessel code requirements as shown in *Figure 48 on page 103*:

- Victaulic adapters are supplied loose.
- Weld flanges are supplied loose or ready-fitted.

The flange dimensions are to ISO 7005 - NP10.



WELD FLANGE



VICTAULIC ADAPTER

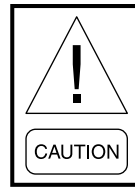
LD10495

FIGURE 48 - FLANGE ATTACHMENT

REFRIGERANT RELIEF PIPING

In case of an emergency, each unit is equipped with a relief valve on the evaporator, condenser and oil separators discharge line to quickly relieve excess pressure of the refrigerant charge to the atmosphere. The relief valves are furnished in accordance with the American Society of Heating, Refrigeration and Air Conditioning Engineers Standard 15 (ASHRAE 15) in North America, or PED code in Europe. Valve specifications are shown in *Table 28 on page 105*.

Refrigerant relief vent piping (by others), from the relief valves to the outside of the building, is required by code, and must be installed on all units as shown in *Figure 49 on page 104*. For additional information on relief valve discharge line sizing, refer to ASHRAE 15 Addendum 15C and 15D-2000, Section 9.7.8.5.



Piping must be properly supported to prevent any strain on relief valve mounting.

If relief piping is common to more than one valve, its cross-sectional area must be at least the total required by each valve. Valve types should not be mixed on a common pipe. Take precautions to make sure that the outlets of relief valves or relief valve vent pipes remain clear of obstructions at all times.

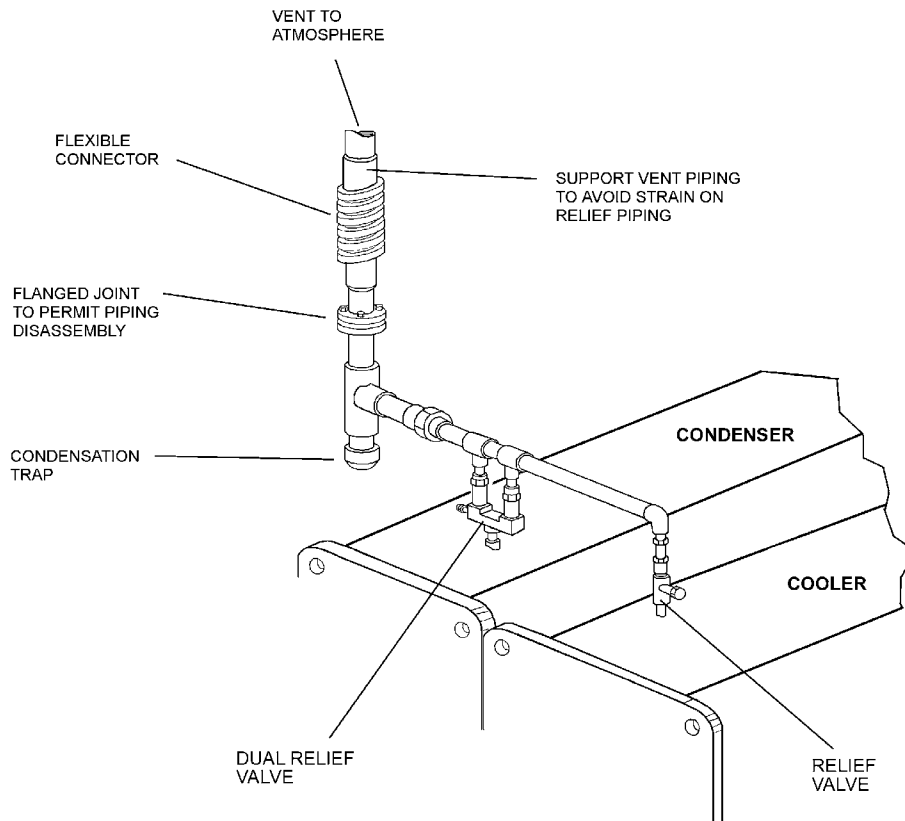


FIGURE 49 - TYPICAL COMPONENTS OF RELIEF PIPING

TABLE 28 - REFRIGERANT RELIEF CHARACTERISTICS (PER VALVE)

EVAPORATOR				
SHELL CODE	PIN 50/VESSEL CODE	PRESSURE	LBS AIR PER MIN	OUTLET SIZE
M, N	G = GB	1.55 MPa	42.8	1 1/4 in-12 UNF-2B
M, N	E = PED, A = ASME	235 PSIG	39.6	3/4 in NPTF
CONDENSER				
SHELL CODE	PIN 50/VESSEL CODE	PRESSURE	LBS AIR PER MIN	OUTLET SIZE
M, N	G = GB	2.65 MPa	71.6	1 1/4 in-12 UNF-2B
M, N	E = PED, A = ASME	388 PSIG	69.4	3/4 in NPTF
DISCHARGE				
SHELL CODE	PIN 50/VESSEL CODE	PRESSURE	LBS AIR PER MIN	OUTLET SIZE
M, N	G = GB	2.65 MPa	71.6	1 1/4 in-12 UNF-2B
M, N	E = PED without Refrigerant Isolation	388 PSIG	59.4	3/4 in NPTF
M, N	A = ASME, E PED with Refrigerant Isolation	388 PSIG	90.3	1 in NPTF

NOTES:

1. Dual relief valve consists of one three-way shut-off valve and two single relief valves. The valve configuration will not allow both valves to be shut off at the same time, and valves are sized such that each relief valve has sufficient discharge capacity when used alone, which permits safe removal of either relief valve for repair or replacement, while maintaining vessel protection.
2. ASHRAE 15-1994 Section 9.8 and Appendix F describe relief requirements for positive displacement compressors, which means the unit must be equipped with a relief device suitable for relieving the entire compressor capacity.
3. For PED with refrigerant isolation option selected, three sets of valves (single or dual) are used to meet flow requirements for the discharge relief.

UNIT PIPING

Compressor lubricant piping and system refrigerant piping are factory installed on all units shipped assembled. On units shipped dismantled, the lubricant piping and system oil return should be completed under the supervision of a Johnson Controls representative, using furnished material.

ELECTRICAL CONNECTION

The following connection recommendations are intended to make sure the unit is operated safely. Failure to follow these recommendations could cause harm to persons or damage the unit, and may invalidate the warranty.



No additional controls (relays, etc.) should be mounted in the control panel. Power and control wiring not connected to the control panel should not be run through the control panel. If these precautions are not followed, it could lead to a risk of electrocution. In addition, electrical noise could cause malfunctions or damage the unit and its controls.



After wiring the power connection, do not switch on main power to the unit. Some internal components are live when the main power is switched on, which must only be done by authorized persons familiar with starting, operating, and troubleshooting this type of equipment.

POWER WIRING

All electrical wiring should be carried out in accordance with local regulations. Route properly sized cables to cable entries on the unit.

In accordance with local codes, NEC codes, UL and CE standards, it is the user's responsibility to install over current protection devices between the supply conductors and the power supply terminals on the unit.

To ensure that no eddy currents are set up in the power panel, the cables forming the 3-phase power supply must enter via the same cable entry.



All sources of supply to the unit must be taken via a common point of isolation (not supplied by Johnson Controls).

POWER SUPPLY WIRING

Units require one 3-phase supply, plus earth. The circuit breaker is only available as an option and not standard.

115VAC CONTROL SUPPLY TRANSFORMER

A 3-wire line voltage to 115VAC supply transformer is standard in the chiller. This transformer is mounted in the cabinet and steps down the high voltage supply to 115VAC to be used by the controls, VSD, feed and drain valve controller, valves, solenoids, heaters, etc. The controls, VSD, feed and drain valve controller are supplied by 115/24VAC step down transformers (3T, 10T, 11T) not by 2T directly.

The transformer primary is taken from the chiller input. Fusing is provided for the transformer.



Removing high voltage power to the chiller will remove the 115VAC supply voltage to the control panel circuitry.

CONTROL WIRING

All control wiring utilizing contact closures to the control panel terminal block is nominal 115VAC and must be run in shielded cable, with the shield grounded at the panel end only, and run in water tight conduit. Run shielded cable separately from mains cable to avoid electrical noise pick-up. Use the control panel cable entry to avoid the power cables.

Voltage-Free Contacts

Voltage-free contacts connected to the panel must be suitable for 115VAC 10 mA (gold contacts recommended). If the voltage-free contacts form part of a relay or contactor, the coil of the device must be suppressed using a standard R/C suppressor such as P/N 031-00808-000. The above precautions must be taken to avoid electrical noise, which could cause a malfunction or damage to the unit and its controls.

Chilled Liquid and Condenser Pump Starter

Terminals 23 and 24 on 1TB close to start the chilled liquid and/or condenser water pumps. This contact can be used as a master start/stop for the pumps in conjunction with the daily start/stop schedule.

Run Contact

Terminals 21 and 22 on 1TB close to indicate that a system is running.

Alarm Contacts

Each system has a single voltage-free contact, which will operate to signal an alarm condition whenever any system locks out, or there is a power failure. To obtain the system alarm signal, connect the alarm circuit to voltage-free Terminals 25 and 26 (Sys 1), Terminals 27 and 28 (Sys 2) of 1TB.

CUSTOMER DIGITAL INPUTS

The circuitry for the following system inputs is a 115VAC circuit. Contacts must be gold and rated for low current (5mA). Connect the switches per instructions below. Refer to *Table 29 on page 107* for the terminal connections.

Chilled Liquid Flow Switch

Connect this switch between Terminals 2 and 13 of 1TB to provide protection against loss of liquid flow, which will cause evaporator freeze-up, if the chiller is permitted to run.

Condenser Liquid Flow Switch

This switch is expected across Terminals 2 and 12 of 1TB to indicate loss of liquid flow, which can result in a rapid high head transient on the chiller.

Remote Run Permissive

A remote run permissive input is available for each system, and requires a dry contact to start and stop each system. System 1 remote dry contacts are connected between Terminals 2 and 15 of 1TB, and System 2 dry contacts are connected between Terminals 2 and 16 of 1TB. If remote run permissive is not utilized, place a jumper across the terminals to allow the system to run.

Remote Print

Closure of suitable contacts connected to Terminals 2 and 14 of 1TB will cause a hard copy of Operating Data/Fault History to be printed, if an optional serial printer is connected to the RS-232 port.

Optional Heat Pump Remote Mode Selection

A remote mode selection input is available when the chiller is purchased with heat pump option is enabled. If the option is enabled and remote mode selection is desired, connect a switch across Terminals 10 and 40 of 1TB to switch between chiller and heat pump operation remotely.

- Contacts Open = Chiller mode
- Contacts Closed = Heat Pump mode

TABLE 29 - SYSTEM INPUT CONNECTIONS

INPUT	1TB TERMINALS
Chilled Liquid Flow Switch	2 and 13
Condenser Liquid Flow Switch	2 and 12
Remote Run Permissive	System 1: 2 and 15
Remote Run Permissive	System 2: 2 and 16
Remote Print	2 and 14
Remote Heat Pump Mode	10 and 40

Optional Remote Setpoint Offset

The control panel provides for external input to reset:

- Compressor current limits
- Liquid temperature setpoints for Leaving Chilled Liquid, and Heat Pump Leaving Condenser Liquid.

CUSTOMER ANALOG INPUTS

The circuitry for the following analog inputs is for 10 VDC or 20mA current inputs when remote setpoint control options are purchased and enabled.

Leaving Chilled Liquid Temperature Reset Control

Install input for Leaving Chilled Liquid Temperature Control remote reset across Terminals 17 (+) and 18 (-) of the 1TB Terminal Block.

How To Receive Voltage Or Current Signal

The control board JUMPER JP4 must be positioned correctly to receive a voltage (0-10 VDC or 2-10 VDC) or a current (0-20 mA or 4-20 mA) signal. Place the jumper in the *V* position for a *voltage* signal, or *mA* for a *current* signal. Configure the software under the **OPTIONS** key for the specific type of input signal to be used.

The maximum temperature reset (100%) is achieved at either 10 VDC or 20 mA. Sending the minimum signal (0 or 2 VDC, 0 or 4 mA, based on the OPTIONS key) causes the setpoint to revert back to its local programmed value. If the setpoint reset causes the setpoint to go over the maximum programmable value, it will be set to the maximum programmable setpoint.

0-10 or 2-10 VDC Reset Input

A 0 or 2 VDC signal produces a 0°F (0°C) reset. A 10 VDC signal produces a 100% (max.) reset (SETPOINTS key). The setpoint reset is ramped linearly between these limits as the input varies between 0 or 2 VDC and 10 VDC. For this input to work properly, the Remote Temperature Reset must be programmed for 0–10 or 2-10 VDC input (OPTIONS key) and control board JUMPER JP4 placed in the V position.

0–20 or 4-20 mA Reset Input

A 0 or 4 mA signal produces a 0°F (0°C) reset. A 20 mA signal produces 100% (max.) reset (SETPOINTS key). The setpoint reset is ramped linearly between these limits as the input varies between 0 mA or 4 mA and 20 mA. In order for this input to work properly, program the Remote Temperature Reset for 0–20 mA or 4-20 input (OPTIONS) and control board JUMPER JP4 placed in the mA position.

Leaving Condenser Liquid Temperature Reset Control

The same input used for Leaving Chilled Liquid Temperature Reset is used for Leaving Condenser Liquid Temperature Reset when the heat pump option is installed. The function of the input is controlled by selecting the operating mode described in *SECTION 9 - OPERATIONS* in this manual.

Current Limit Reset Control

Install input for Current Limit Reset Control across Terminals 19 (+) and 20 (-) of the 1TB Terminal Block.

How to Receive Voltage or Current Signal

The control board JUMPER JP5 must be positioned correctly to receive a voltage (0-10VDC or 2-10VDC) or a current (0-20mA or 4-20mA) signal. Place the jumper in the V position for a voltage signal or mA for a current signal. Configure the software under the OPTIONS key for the type of input signal to be used.

The minimum current limit setpoint is achieved at either 10 VDC or 20 mA. Sending the minimum signal (0 or 2 VDC, 0 or 4 mA, based on the OPTIONS key) causes the current limit to revert back to its maximum value.

0-10 or 2-10 VDC Reset Input

A 0 or 2 VDC signal produces a 0°F (0°C) reset. A 10 VDC signal produces a 100% (max.) reset (SETPOINTS key). The setpoint reset is ramped linearly between these limits as the input varies between 0 or 2 VDC and 10 VDC. In order for this input to work properly, the Remote Temperature Reset must be programmed for 0–10 or 2-10 VDC input (OPTIONS key) and control board JUMPER JP5 placed in the V position.

0–20 or 4-20 mA Reset Input

A 0 or 4 mA signal produces a 0°F (0°C) reset. A 20 mA signal produces 100% (max.) reset (SETPOINTS key). The setpoint reset is ramped linearly between these limits as the input varies between 0 mA or 4 mA and 20 mA. In order for this input to work properly, the program the Remote Temperature Reset for 0–20 mA or 4-20 input (OPTIONS) and control board JUMPER JP5 placed in the mA position.

INSTALLATION CHECKLIST – REQUEST FOR START-UP SERVICE

When all items on the *Installation Checklist and Request for Authorized Start-up Technician (Form 201.30-CL1)* are completed satisfactorily, and before any attempt is made to start the unit, contact the Johnson Controls Field Service Office to schedule the start-up service.

Supersedes: 201.30-CL1 (312)

Form 201.30-CL1 (912)

 BY JOHNSON CONTROLS		MODEL – YVWA
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INSTALLATION CHECKLIST AND REQUEST FOR AUTHORIZED START-UP TECHNICIAN

CUSTOMER: _____	JOB NAME: _____
ADDRESS: _____	LOCATION: _____
PHONE: _____	CUSTOMER ORDER NO: _____
JCI TEL NO: _____	JCI ORDER NO: _____ JCI CONTRACT NO: _____

CHILLER MODEL NO: _____	UNIT SERIAL NO: _____
The work (as checked below) is in process and will be completed by: _____ / _____ / _____ Month Day Year	

The following work must be completed in accordance with installation instructions:

A. YORK CHILLER

1. Unit checked for shipping damage ☐

NOTE: Any damage MUST be reported to Johnson Controls immediately for inspection.

Initials: _____

Company Name: _____

Date: _____

2. Unit assembled (if shipped dismantled) and refrigerant piping installed ☐
3. Vibration isolator mounted so that the unit is level and isolators are equally deflected ☐
4. If applicable, monitoring alarm is installed, functional, and operational ready for service ☐

B. WATER PIPING

1. Condenser water piping installed between condenser, pumps and cooling tower. ☐
2. Chilled water piping installed between cooler, pumps, and cooling coils. ☐
3. Make-up and fill lines installed to cooling tower and chilled water system. ☐
4. All water piping checked for strain. **NOTE:** Piping should not spring at unit. ☐
5. Water piping leak tested and flushed; water systems filled with water and trapped air is vented. ☐
6. Chilled and condenser water flow available to meet unit design requirements. ☐

7. Verify the chilled and condenser liquid systems have been connected correctly, and commissioned with the correct direction of water flow. The inlet should be at the bottom connection on a two-pass shell. Purge air from the top of the water box, using the plugged air vent, mounted on the top of the water box. ☐

C. REFRIGERANT RELIEF PIPING (When Required)

1. Refrigerant relief piping installed from unit to atmosphere (per local building code) ☐

D. ELECTRICAL WIRING

1. Variable Speed Drive (VSD):
- a. Main power supply available. ☐
 - b. Wiring completed from main power supply up to VSD. **NOTE:** DO NOT cut to length or connect to drive without JCI supervision. ☐
2. External control wiring completed according to the wiring diagram shipped with the unit. ☐
3. Power available, wiring completed, and rotation checked to the following drives and motors:
- a. Chilled water pump(s) ☐
 - b. Condenser water pump(s) ☐
 - c. Cooling tower fan ☐
- NOTE:** DO NOT check compressor motor.
4. Megohm tester available for checking motor windings. Tester not necessary unless start-up indicates a motor winding short. ☐
5. Connect the following system inputs to their respective terminals of 1TB Terminal Box: ☐
- a. Chilled Liquid Flow Switch - Terminals 2 and 13 ☐
 - b. Condenser Liquid Flow Switch - Terminals 2 and 12 ☐

c. System 1 Remote Run Permissive -
Terminals 2 and 15 ☐

d. System 2 Remote Run Permissive -
Terminals 2 and 16 ☐

NOTE: If remote run permissive is not used,
place a jumper across the terminals to allow
the system to run.

e. Remote Print - Terminals 2 and 14 ☐

6. Connect the following optional analog inputs
to their respective terminals of 1TB Terminal
Block ☐

a. Leaving Chilled and Condenser Temperature
Reset Control - Terminals 17 and 18 ☐

b. Current Limit Reset Control -
Terminals 19 and 20 ☐

c. Remote Mode Selection (Optional Heat
Pump) - Terminals 40 and 41 ☐

E. TESTING, EVACUATION AND CHARGING (Under Johnson Controls Supervision)

NOTE: This section does not apply for chillers
shipped with refrigerant installed at the factory.

1. R-134a available for testing ☐

2. Dry nitrogen available for testing (Grade B or
better) ☐

3. A high vacuum pump available to evacuate
and dehydrate system ☐

4. Refrigerant (supplied by Johnson Controls) is
available for charging ☐

5. Unit has been or is ready to be been pressure
tested, evacuated, dehydrated, and charged ☐

F. CONDITIONS

1. YORK oil for compressor available ☐

2. Cooling load available for testing and
operating unit ☐

3. Personnel available for final wiring
connections ☐

4. Personnel available for start-up and testing ☐

Owner's operating personnel:

Name: _____ Phone _____

Name: _____ Phone _____

CONTRACTOR'S RESPONSIBILITIES AND INSTRUCTIONS TO USE FORM

This installation checklist provides a quick way to check if all necessary installation work was completed in accordance with all applicable installation instructions in Form 201.30-ICOM2, and when completed, acts as a request for Johnson Controls to furnish start-up supervision.

Complete this form as follows:

1. Fill out the top of the page.
2. Check off each item as required. Cross out (x) items that do not apply.
3. Enter names, initials, and date of the operating personnel who completed the checklist.
4. **Bottom of Form:** Enter the date that the Johnson Controls start-up technician should be at the job site and the name(s) of the supervisor(s) to be contacted. Retain one copy in files and send one copy to customer.

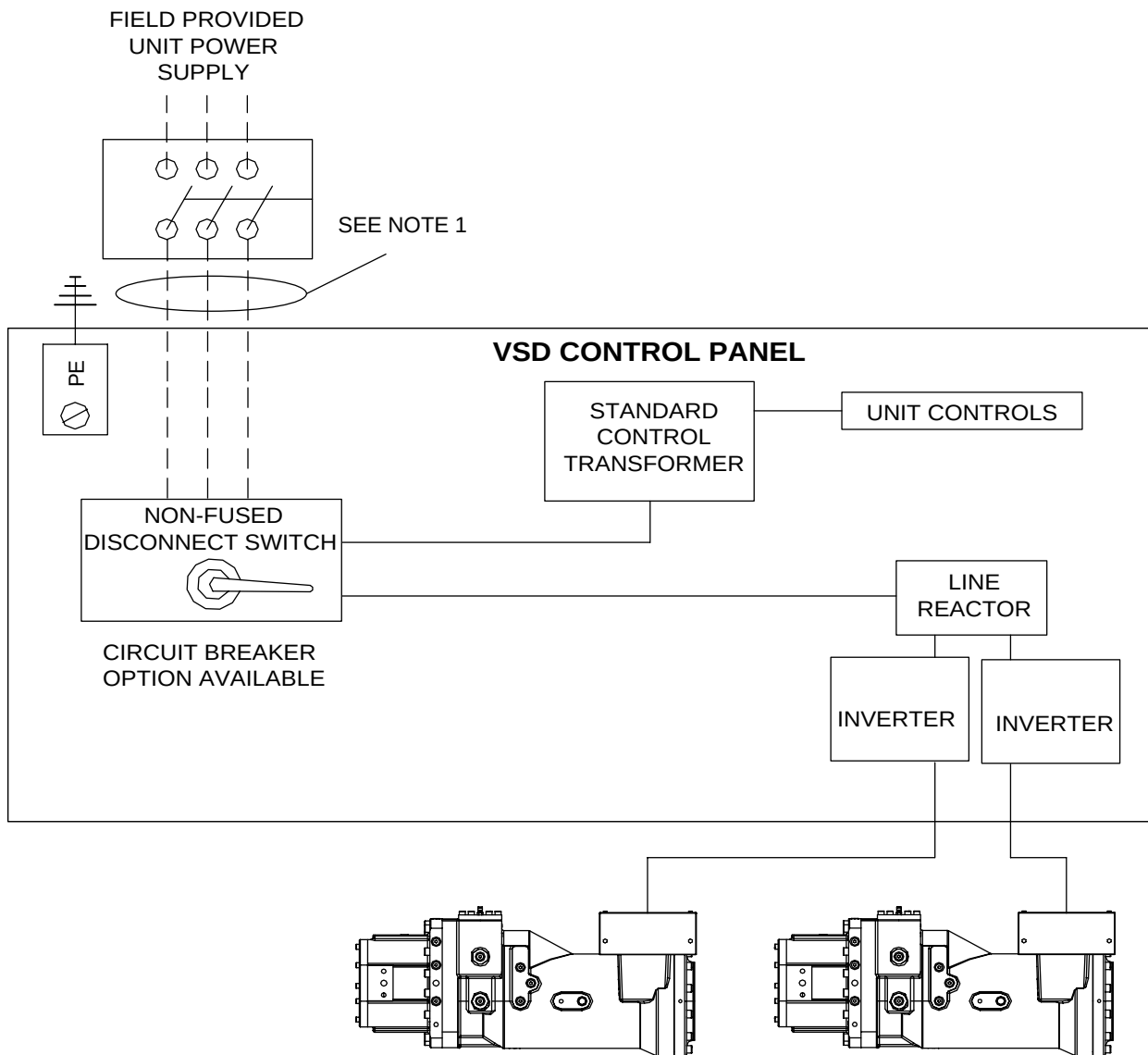
With reference to the terms of the above contract, we are requesting the presence of your JCI Authorized Representative at the job site on

_____/_____/_____ to start the system and instruct operating personnel. Have the JCI representative contact: _____
Month Day Year Name/Phone

We understand that the services of the Johnson Controls Authorized Representative will be furnished in accordance with the contract for a period of time of not more than _____ consecutive normal working hours, and we agree that a charge of _____ per diem plus travel expenses will be made to Johnson Controls if services are required for longer than _____ consecutive normal hours or if repeated calls are required, through no fault of Johnson Controls.

Customer/Contractor Signature: _____ **Title:** _____

Form Completed by: _____ **Date:** _____



NOTES:

1. ----- Dashed Line = Field Provided Wiring

LD16428

FIGURE 50 - POWER CONNECTIONS

TABLE 30 - LUG DATA (UL/ASME/CE) -PIN 22 / POWER FIELD

VSD DETAILS			TERMINAL BLOCK			CIRCUIT BREAKER			NON-FUSED DISCONNECT SWITCH		
VSD FRAME	INPUT VOLTS	INPUT FREQ.	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE
A	200	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	230	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	380	60	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	#2 AWG - 600kcmil
	380	50	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	#2 AWG - 600kcmil
	400	50	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	35-300 mm ²
	415	50	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	#2 AWG - 600kcmil
	460	60	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
	575	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B	200	60	1	4	#2 AWG - 600kcmil	1	4	#4/0AWG-500KCMIL	N/A	N/A	N/A
	230	60	1	4	#2 AWG - 600kcmil	1	4	#4/0AWG-500KCMIL	N/A	N/A	N/A
	380	60	1	2	#2 AWG - 600kcmil	1	2	#1/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
	380	50	1	2	#2 AWG - 600kcmil	1	2	#1/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
	400	50	1	2	#2 AWG - 600kcmil	1	2	#1/0AWG-500KCMIL	1	2	35-300 mm ²
	415	50	1	2	#2 AWG - 600kcmil	1	2	#1/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
	460	60	1	2	#2 AWG - 600kcmil	1	2	#1/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
	575	60	1	2	#2 AWG - 600kcmil	1	2	#1/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
C	200	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	230	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	380	60	1	3	#2 AWG - 600kcmil	1	3	#3/0AWG-400KCMIL	2	2	#2 AWG - 600kcmil
	380	50	1	3	#2 AWG - 600kcmil	1	3	#3/0AWG-400KCMIL	2	2	#2 AWG - 600kcmil
	400	50	1	3	#2 AWG - 600kcmil	1	3	#3/0AWG-400KCMIL	2	2	35-300 mm ²
	415	50	1	3	#2 AWG - 600kcmil	1	3	#3/0AWG-400KCMIL	2	2	#2 AWG - 600kcmil
	460	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	575	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 30 - LUG DATA (UL/ASME/CE) (CONT'D) - PIN 22/POWER FIELD

VSD DETAILS			TERMINAL BLOCK			CIRCUIT BREAKER			NON-FUSED DISCONNECT SWITCH		
VSD FRAME	INPUT VOLTS	INPUT FREQ.	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE
D	200	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	230	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	380	60	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	#2 AWG - 600kcmil
	380	50	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	#2 AWG - 600kcmil
	400	50	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	35-300 mm ²
	415	50	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-400KCMIL	1	2	#2 AWG - 600kcmil
	460	60	1	2	#2 AWG - 600kcmil	1	2	#2/0AWG-500KCMIL	1	2	#2 AWG - 600kcmil
	575	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 31 - LUG DATA - GB - PIN 22/POWER FIELD

VSD DETAILS			NON-FUSED DISCONNECT SWITCH		
VSD FRAME	INPUT VOLTS	INPUT FREQ.	LUG/ PHASE	WIRES PER LUG	LUG WIRE RANGE
A	380	50	1	2	1/0 AWG - 500kcmil
	400	50	1	2	1/0 AWG - 500kcmil
	415	50	1	2	1/0 AWG - 500kcmil
B	380	50	1	2	1/0 AWG - 500kcmil ²
	400	50	1	2	1/0 AWG - 500kcmil
	415	50	1	2	1/0 AWG - 500kcmil
C	380	50	1	2	1/0 AWG - 500kcmil ²
	400	50	1	2	1/0 AWG - 500kcmil
	415	50	1	2	1/0 AWG - 500kcmil
D	380	50	1	2	1/0 AWG - 500kcmil ²
	400	50	1	2	1/0 AWG - 500kcmil
	415	50	1	2	1/0 AWG - 500kcmil

TABLE 32 - VOLTAGE VARIATIONS

FREQ.	RATED VOLTAGE VAC	INPUT FREQ. Hz	OPERATING VOLTAGE VAC	
			MIN	MAX
60 Hz	380	60	342	402
	460	60	414	508
50 Hz	380	50	342	402
	400	50	360	440
	415	50	374	456

RIGGING THE COMPRESSOR OR VSD CONTROL CABINET

When it becomes necessary to remove a compressor from a unit or base, proper rigging methods must be used to avoid damage to the equipment and/or injury to service personnel. Portable cranes must be of adequate capacity and properly positioned and blocked to prevent tipping or slipping while lifting the compressor or motor. Be sure chains are of adequate strength. Compressor weights are shown in *Table 31*.

TABLE 33 - COMPRESSOR WEIGHTS

COMPRESSOR CODE	WEIGHT
CTS/WTS51	1383 lbs (630 Kg)
CTS/WTS45	1150 lbs (520 Kg)
CTS/WTS36	1135 lbs (515 Kg)

NOTE – Motor weights (lbs.) (Located on Motor Data Plate)

TABLE 34 - TORQUE VALUES

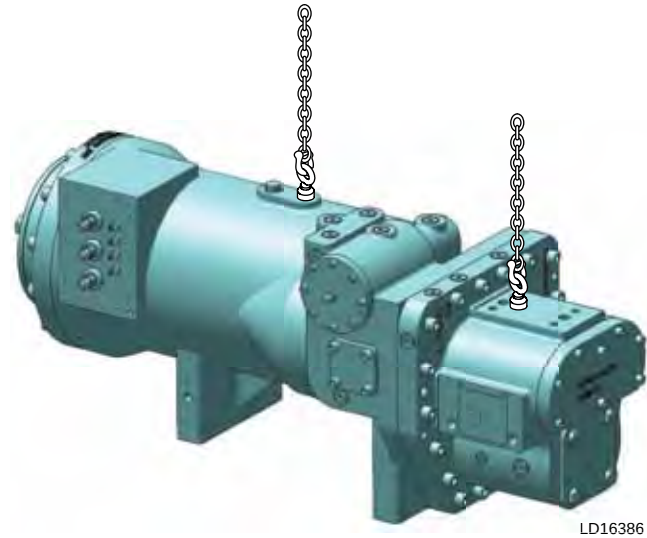
BOLT SIZE INCHES		TORQUE POUND FOOT
1/4"	HEX HD	10
	12PT OR SOC HD	14
3/8"		35
1/2"		85
5/8"		200**
3/4"		300

Unless otherwise specified, all screws must be tightened to the following torque values with lightly oiled threads.

** Lubricated with oil and graphite on male and female threads and under bolt heads. Moly-kote not acceptable.

TABLE 35 - VARIABLE SPEED DRIVE WEIGHTS

VSD FRAME	WEIGHT (LBS)	WEIGHT(KG)
A	980	445
B	980	445
C	980	445
D	1190	540

**FIGURE 51 - RIGGING GUIDE**

SECTION 4 - TECHNICAL DATA

COMPRESSOR UNIT DIMENSIONS

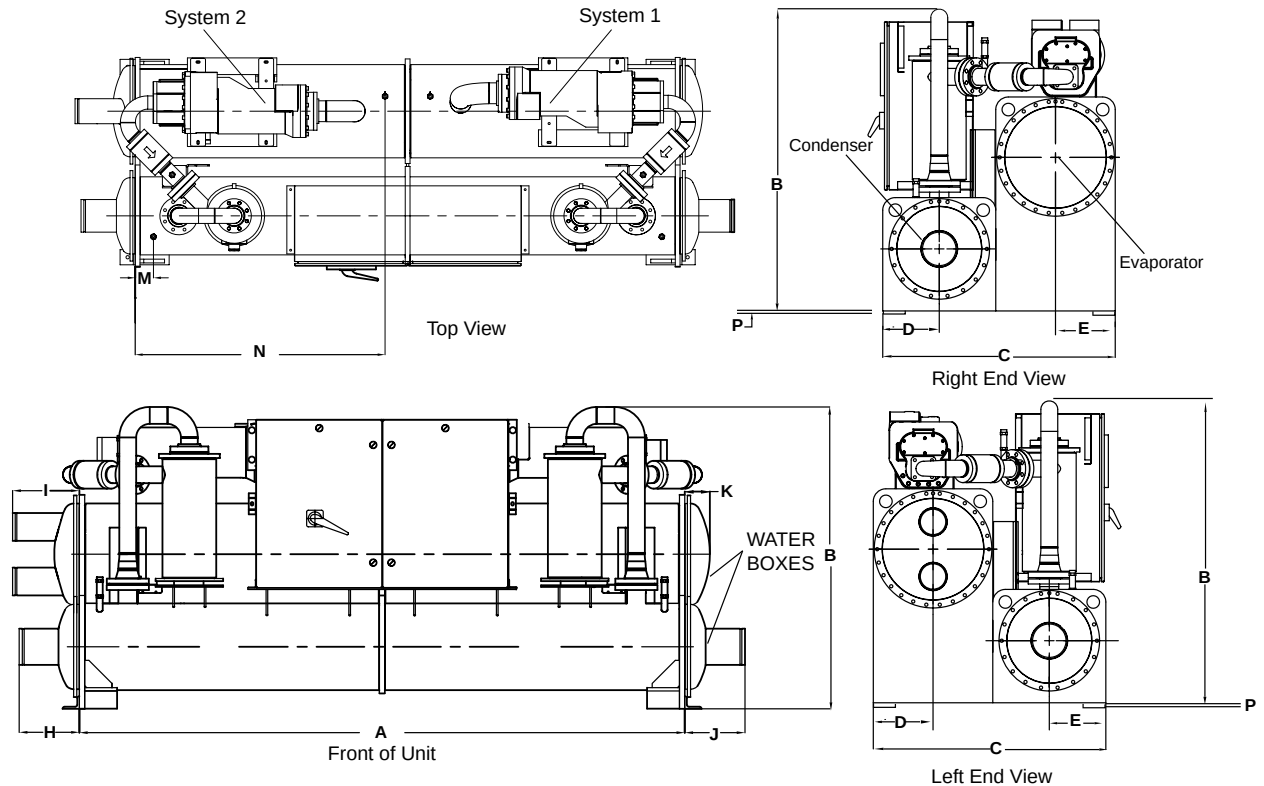


FIGURE 52 - COMPRESSOR UNIT DIMENSIONS

DIM.	COMPRESSOR (PINS 9 AND 10)	
	EVAPORATORS (PINS 5 AND 6) AND CONDENSERS (PINS 7 AND 8)	
	M-M	N-N
A	12 ft (3657 mm)	14 ft (4267 mm)
B	6 ft (1824 mm)	6 ft (1824 mm)
C	55-5/16 in (1405 mm)	55-5/16 in (1405 mm)
D	13-3/8 in (342 mm)	13-3/8 in (342 mm)
E	14-3/16 in (361 mm)	14-3/16 in (361 mm)
M	4-3/4 in (123 mm)	10 3/4 (275 mm)
N	5 1/2 ft (1678 mm)	6 ft (1524 mm)

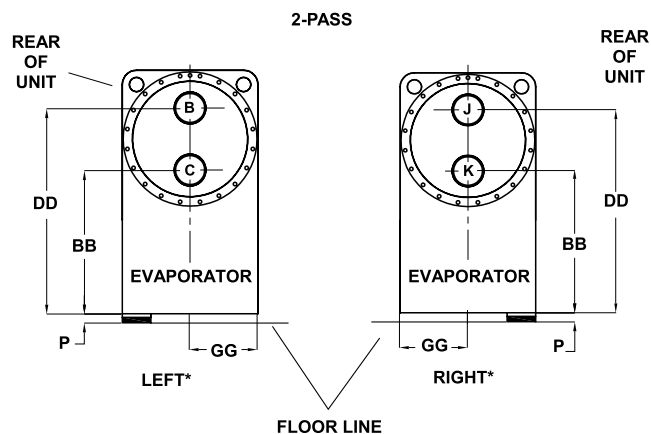
WATER BOX DIMENSIONS (MM)					
DIM.	EVAPORATORS (M, N)		CONDENSERS (M, N)		
	2-PASS	3-PASS	1-PASS	2-PASS	3-PASS
H	—	—	14 1/2 (369)	14 1/2 (369)	14 1/2 (369)
I	16 (409)	16 (409)	—	—	—
J	—	—	14 1/2 (369)	5 3/4 (146)	14 1/2 (369)
K	6 (156)	16 (409)	—	—	—

ADDITIONAL OPERATING HEIGHT FOR VIBRATION ISOLATION - IN (MM)	
TYPE OF CHILLER MOUNTING	P
Neoprene Pad Isolators	1-3/4 (44)
Spring Isolators Deflection	1 (25)
Direct Mount	3/4 (19)

NOTES:

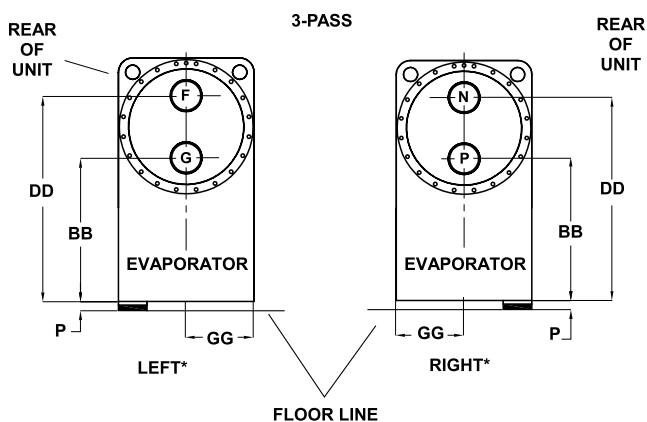
1. All dimensions are approximate. Certified dimensions are available upon request.
2. Water nozzles are located on either end of unit.
3. Standard 150 PSI (1030kPa) design pressure boxes shown.
3. Front of unit is defined as side where control center is mounted.
4. Evaporator and condenser water must enter the water box through the bottom connection to achieve rated performance.
5. Connected piping should allow for the removal of the compact water boxes for tube access and cleaning.
6. To determine overall height, add Dimension P to the appropriate isolator type.

DIMENSIONS OF EVAPORATOR NOZZLE ARRANGEMENTS



NOZZLE ARRANGEMENTS		
NUMBER OF PASSES	EVAPORATOR	
	IN	OUT
2	C	B
	K	J

FIGURE 53 - EVAPORATORS - COMPACT WATER BOXES (2-PASS)



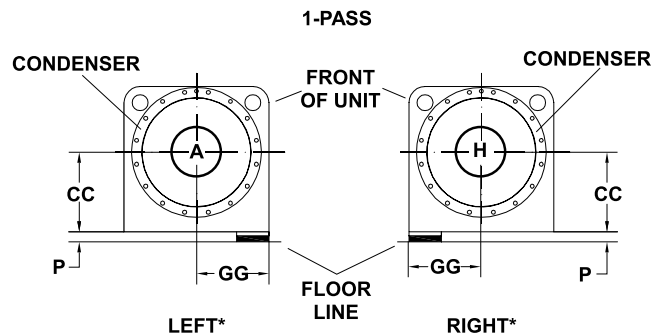
NOZZLE ARRANGEMENTS		
NUMBER OF PASSES	EVAPORATOR	
	IN	OUT
3	G	N
	P	F

FIGURE 54 - EVAPORATORS - COMPACT WATER BOXES (3-PASS)

TABLE 36 - EVAPORATOR NOZZLE DIMENSIONS - IN(MM)

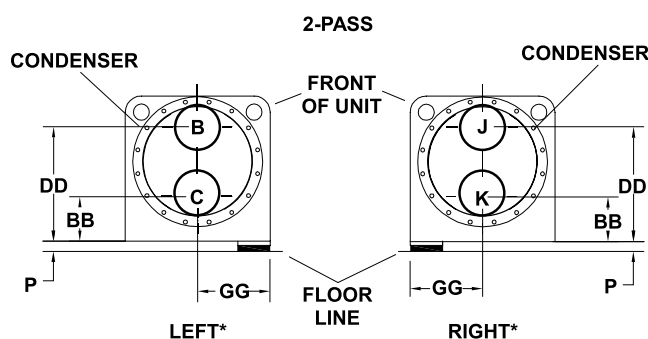
EVAPORATOR SHELL CODE (PINS 5 AND 6)	EVAPORATOR NOZZLE DIMENSIONS (in)		2-PASS			3-PASS		
	2-PASS	3-PASS	BB	DD	GG	BB	DD	GG
M OR N	6	6	30 (762)	43 (1092)	14-7/32 (362)	30 (762)	43 (1092)	14-7/32 (362)

DIMENSIONS OF CONDENSER NOZZLE ARRANGEMENTS



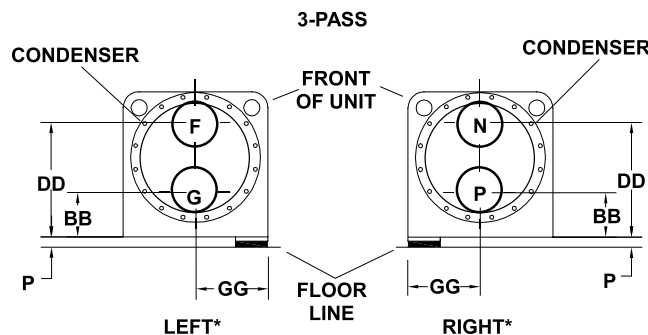
NOZZLE ARRANGEMENTS		
NUMBER OF PASSES	CONDENSER	
	IN	OUT
1	A	H
	H	A

FIGURE 55 - CONDENSERS - COMPACT WATER BOXES (1-PASS)



NOZZLE ARRANGEMENTS		
NUMBER OF PASSES	EVAPORATOR	
	IN	OUT
2	C	B
	K	J

FIGURE 56 - CONDENSERS - COMPACT WATER BOXES (2-PASS)



NOZZLE ARRANGEMENTS		
NUMBER OF PASSES	CONDENSER	
	IN	OUT
3	G	N
	P	F

FIGURE 57 - CONDENSERS - COMPACT WATER BOXES (3-PASS)

TABLE 37 - CONDENSER NOZZLE DIMENSIONS - IN (MM)

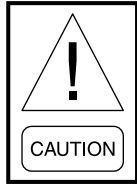
CONDENSER SHELL CODE (PIN 7 AND 8)	CONDENSER NOZZLE DIMENSIONS (in)			1-PASS		2-PASS			3-PASS		
	1-PASS	2-PASS	3-PASS	CC	GG	BB	DD	GG	BB	DD	GG
M OR N	8	6	6	14-3/4 (375)	13-7/16 (342)	8-3/32 (210)	21-1/4 (540)	13-7/16 (342)	8-3/32 (210)	21-1/4 (540)	13-7/16 (342)

TABLE 38 - WATER FLOW RATE LIMITS (GPM/L/S) (BASED ON STANDARD TUBES AT DESIGN FULL LOAD CONDITIONS)

EVAP CODE	EVAPORATOR				COND CODE	CONDENSER					
	2 PASS		3 PASS			1 PASS		2 PASS		3 PASS	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX	MIN	MAX
MB/NB	230 (15)	910 (57)	160 (10)	600 (38)	MB/NB	470 (30)	1850 (117)	240 (15)	920 (58)	160 (10)	610 (38)
MC/NC	290 (18)	1140 (72)	190 (12)	750 (47)	MC/NC	550 (35)	2190 (138)	280 (18)	1090 (69)	190 (12)	720 (45)
MD/ND	330 (21)	1310 (83)	220 (14)	870 (55)	MD/ND	610 (38)	2420 (153)	310 (20)	1200 (76)	210 (13)	800 (50)
ME/NE	380 (24)	1490 (94)	250 (16)	980 (62)	ME/NE	720 (45)	2840 (179)	360 (23)	1420 (90)	240 (15)	940 (59)
M2/N2	230 (15)	890 (56)	150 (9)	580 (37)	M2/N2	460 (29)	1820 (115)	230 (15)	890 (56)	160 (10)	600 (38)
M3/N3	270 (17)	1050 (66)	180 (11)	690 (44)	M3/N3	560 (35)	2220 (140)	280 (18)	1100 (69)	190 (12)	740 (47)
M4/N4	310 (20)	1230 (78)	210 (13)	800 (50)	M4/N4	660 (42)	2600 (164)	330 (21)	1300 (82)	220 (14)	850 (54)
M5/N5	370 (23)	1460 (92)	250 (16)	960 (61)	M5/N5	750 (47)	2960 (187)	380 (24)	1480 (93)	250 (16)	980 (62)

SECTION 5 - COMMISSIONING

PREPARATION



Commissioning of this unit should only be carried out by Johnson Controls authorized personnel. Proper electrical lock out/tag out procedures must be followed.

Make sure all checks are completed in the *Start-up Checklist* on the next page. The chiller is then ready to be placed into operation.

Commissioning personnel should be thoroughly familiar with the information contained in this document before starting the unit.

For helpful tips about commissioning the unit, refer to the following information.

Refrigerant Charge

Packaged units are normally shipped as standard with a full refrigerant operating charge. Refer to the following instructions to make sure the refrigerant is handled correctly.

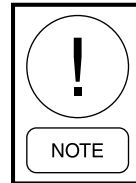
- Do not evacuate or liquid charge with static water in the cooler or condenser.
- Turn the pumps on.
- Liquid charge slowly to avoid excessive thermal stress at the charging point, and to make sure the refrigerant temperature does not go below the freezing point with liquid refrigerant in the evaporator and condenser.
- Evacuation and charging should always be done according to *SECTION 6 - MAINTENANCE*.

Service and Oil Line Valves

If valves are of the back-seat type, open them fully (counterclockwise), then close one turn of the stem.

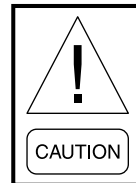
Compressor Oil

While the compressor is running at design speed, the oil level should be visible between the bottom of the lower and middle of the upper sight glass of the oil separator.



Make sure that the compressor oil heaters have been energized at least 24 hours before starting the chiller.

FIRST TIME START-UP



During the commissioning period, there should be sufficient heat load to run the unit under stable full load operation to enable the unit controls, and system operation to be set up correctly, and a commissioning log taken.

When a compressor is running, the controller monitors oil pressure, motor current, and various other system parameters, such as discharge pressure, chilled liquid temperature, etc. Should any problems occur; the control system will immediately take appropriate action and display the nature of the fault.

Loading

Once the unit has been started, all operations are fully automatic. After an initial period at minimum capacity, the control system will adjust the unit load depending on the chilled liquid temperature and rate of temperature change. If a high heat load is present, the controller will increase the speed of the compressor(s).

Supersedes Form 201.30-CL2 (412)

Form 201.30-CL2 (912)

**MODEL – YVWA****START-UP CHECKLIST**

CUSTOMER: _____ JOB NAME: _____
 ADDRESS: _____ LOCATION: _____
 PHONE: _____ CUSTOMER ORDER NO: _____
 JCI TEL NO: _____ JCI ORDER NO: _____ JCI CONTRACT NO: _____

CHILLER MODEL NO: _____ UNIT SERIAL NO: _____

The work (as checked below) is in process and will be completed by: _____ / _____ / _____
 Month Day Year

The following work must be completed in accordance with start-up instructions contained in the Installation, Operation, and Maintenance Manual (Form 201.30-ICOM2):

A. GENERAL:

The following basic checks should be made with the customer power to the unit switched off.

1. Review the Installation Checklist (Form 201.30-CL1). ☐
2. Inspect the unit for installation damage that may have occurred. If damage is found, take action and/or repair as appropriate. ☐
3. Water connection inlet and outlet are at proper locations, have hangers nearby that would support their weight and show no visible strain on chiller nozzles. ☐
4. Wiring is complete (power feed terminations in the VSD), and all sources of electrical supply to the unit are taken from a single point of isolation per 201.30-PW2. ☐
5. Confirm any field control wiring modifications are in accordance with Form 201.30-PW2 ☐
6. Verify the chiller is charged with refrigerant (pressures match R-134a saturation for ambient temp). ☐
7. Verify that the unit's protective ground terminal(s) are properly connected to a suitable grounding point. Ensure that all unit internal ground connections are tight. ☐
8. Verify the following isolation valves are open.
 - a. Compressor 1 discharge (optional) ☐
 - b. System 1 condenser subcooler outlet (optional) ☐
 - c. System 1 main oil supply inline ball valve ☐
 - d. System 1 condenser pressure transducer ☐
 - e. System 1 condenser gas to oil eductor ☐
 - f. System 1 evaporator pressure transducer ☐
 - g. System 1 evaporator oil return to eductor ☐
 - h. System 1 oil return eductor to compressor ☐
 - i. System 1 liquid injection to compressor (optional) ☐
 - j. System 1 economizer pressure transducer ☐
 - k. Compressor 2 discharge (optional) ☐
 - l. System 1 condenser subcooler outlet (optional) ☐
 - m. System 2 main oil supply inline ball valve ☐
 - n. System 2 condenser pressure transducer ☐
 - o. System 2 condenser gas to oil eductor ☐
 - p. System 2 evaporator pressure transducer ☐
 - q. System 2 evaporator oil return to eductor ☐
 - r. System 2 oil return eductor to compressor ☐
 - s. System 2 liquid injection to compressor (optional) ☐
 - t. System 2 economizer pressure transducer ☐
9. Verify the shipping anti-freeze solution has been drained from the VSD, and replaced with the proper amount of inhibited water coolant that shipped loose with the chiller. Refer to SECTION 7 - MAINTENANCE in the 201.30-ICOM2 for filling process. ☐
10. Verify electrical connections in the VSD are tight, especially motor leads to terminals. ☐

(Continued on following page)

11. If the VSD provides an optional circuit breaker at the incoming power connection to the VSD, make sure the settings are properly set per the information on the next page.

Find your VSD model from the list on the next page, and set the adjustments to the setting values in the following table. If your model is not listed below, look for it in the table of drive model numbers in the table with the ratings plug value.

- a. TV2CMPRBW-40A
- b. TV2CMPRBW-65A
- c. TV2CMPRBW-50C
- d. TV2CMPRBW-68A
- e. TV2CMPRBW-46A

ADJUSTMENT	SETTING VALUE
Long Time Pickup IR~	G
Long Time Delay TLD(S) LONG	2
Short Time Delay ISD(XIR) SHORT	2
Ground Fault Pickup IG(XIN) GND	0.2
Ground Fault Delay TSD/TG(MS) SHORT/GND	J

Find your model from the list below, check the ratings plug values in the first table, and set the setting values for the adjustments listed in the second table:

DRIVE MODEL NO.	RATINGS PLUG VALUE
TV2CMPRBW-40B	600
TV2CMPRBW-40C	800
TV2CMPRBW-65B	600
TV2CMPRBW-65C	800
TV2CMPRBW-50B	600
TV2CMPRBW-50C	800
TV2CMPRBW-68B	600
TV2CMPRBW-68C	800
TV2CMPRBW-46B	600
TV2CMPRBW-58B	600

ADJUSTMENT	SETTING VALUES
Short Delay Pick-up	2
Short Delay Time	INST
Ground Fault Pick-up	1
Ground Fault Time	150



The settings for the circuit breaker should not be changed from the settings. The warranty will be voided if the breaker settings are changed.

12. Check the chiller for refrigerant leaks at joints or water piping leaks. ☐
13. Make sure 9 liters (2.38 gallons) of compressor oil were added to both circuits. ☐
14. Make sure the control panel is free of foreign material (wires, metal chips, tools, documents, etc.). Check for signs of water or moisture. ☐
15. Make sure the leaving liquid temperature sensor is coated with the heat conductive compound (P/N 013-00890-000), and is inserted to the bottom of the water outlet sensor well in the cooler. This sensor must always be fully inserted in the water outlet sensor well. ☐
16. Make sure the flow switches are connected between Terminals 2 and 12 and 2 and 13 on Terminal Block 1TB in the control panel. ☐
17. Check whenever the pump contacts are used, the coil of the pump starter should be suppressed with an RC suppressor (P/N 031-00808-000). ☐

B. START-UP

Panel Check



Only qualified individuals are permitted to service this product, and are to be knowledgeable of, and adhere to, all safe work practices as required by local codes. Use proper personal protection where and when required.

1. Verify that the voltage supply corresponds to the unit requirement, and is within the limits as specified in SECTION 4 - TECHNICAL DATA in Form 201.30-ICOM2. ☐
2. Make sure the unit switch at the bottom of the keypad is in the OFF (O) position. ☐
3. Apply 3-phase power to the chiller. Turn on the optional panel circuit breaker, if supplied. ☐
4. Verify the control panel display is illuminated. To prevent the compressors from starting, make sure that the SYSTEM SWITCHES key is off for both systems. ☐
5. Use a clamp-on ammeter to make sure the both compressor heaters are turned on. Heater current draw is approximately 3A. ☐

(Continued on following page)

6. Confirm that the compressor overload current settings have been correctly adjusted by the factory. These are not normally required to be reset. Use the VSD DATA key on the control panel, navigate to the COMP1 MOTOR OVERLOAD = ### AMPS and COMP2 MOTOR OVERLOAD = ### AMPS screens. The values should match the values on the overload setting label, which is located inside of the VSD cabinet. If the values do not match, an adjustment is required inside the VSD cabinet by qualified service personnel. ☐

7. Record the overload settings below:

System 1: _____ Amps

System 2: _____ Amps



Setting the potentiometers incorrectly may cause damage to the equipment.

8. Press the STATUS key. If the following UNIT WARNING message appears, immediately contact Johnson Controls Product Technical Support to request the password to reprogram the serial number, and any other important factory programmed information that was lost. ☐

**UNIT WARNING: INVALID SERIAL NUMBER
ENTER UNIT SERIAL NUMBER**

Programmed Options

Program the required options in the control panel for the desired operating requirements, then record the values below. Refer to the PROGRAM key in SECTION 6 - OPERATION in Form 201.30-ICOM2 for more information:

1. Display Language = _____
2. Chilled Liquid Mode = _____
3. Local/Remote Mode = _____
4. Display Units = _____
5. Lead/Lag Control = _____
6. Remote Temp Reset = _____
7. Remote Current Reset = _____
8. Compressor Selection = _____
9. Operating Mode (Heat Pump) = _____

Programmed Operating Values

Program the required operating values into the microprocessor. then record them below. Refer to the PROGRAM key in SECTION 6 - OPERATION in 201.30-ICOM2 for low and high limits, and default values.

1. Chilled Liquid Leaving Temperature Cutout = _____ °F (°C)
2. Motor Current Limit = _____ % FLA

3. Pulldown Motor Current Limit = _____ % FLA
4. Pulldown Motor Current Limit Time = _____ MIN
5. Motor Temp Unload = _____ °F (°C)
6. Unit ID Number = _____
7. Sys 1 Condenser Liquid Ref Level = _____
8. Sys 2 Condenser Liquid Ref Level = _____

Liquid Control Setpoint

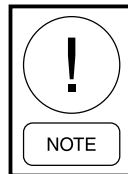
Program the chilled and condenser liquid (optional heat pump) setpoints and ranges, then record them below:

1. Leaving Chilled Liquid Temp Setpoint = _____ °F (°C)
2. Leaving Chilled Liquid Temp Control Range = _____ °F (°C)
3. Maximum Leaving Chilled Liquid Remote Temp Reset = _____ °F (°C)
4. Leaving Condenser Liquid Temp Setpoint = _____ °F (°C)
5. Leaving Condenser Liquid Temp Control Range = _____ °F (°C)
6. Maximum Leaving Condenser Liquid Remote Temp Reset = _____ °F (°C)

Date/Time and Daily Schedule

1. Program the date and time by making sure that the CLK Jumper JP2 on the control board is in the ON position. Press the DATE/TIME key to set the date and time. ☐
2. Program the daily and holiday start/stop by pressing the SCHEDULE key. ☐

C. CHILLER SYSTEM



After completion of the following checks for System 1, switch off the System 1 switch on the keypad and repeat the process for System 2. When both systems are running correctly, stop the unit, switch all applicable switches ON, and restart the unit.

1. Ensure power is on the chiller to energize the compressor heaters 24 hours prior to start-up. .. ☐
2. Ensure the SYSTEM SWITCHES key is OFF for both systems. ☐
3. Turn the unit switch to the ON position. ☐
4. If the chilled and condenser liquid pumps are manually operated, start the pumps. The control center will not allow the chiller to start unless flow is established through the unit. If the pumps are wired to the control center, override the contact to start the pumps to verify the flow. ☐

(Continued on following page)

5. Throttle back flow to make sure the flow switch opens with a loss of flow. If the pump is turned off during chiller operation, it is recommended that auxiliary pump contacts be placed in series with the flow switch for additional protection. ☐
6. Evaluate cooler and condenser water flow indication compared to design information found on the sales order. If shell pressure drop is used, it should be within +/- 15% of the rating information. ☐
7. If the chilled water and condenser pump run contacts on the chiller were overridden to check flow, remove overrides. Pumps will get start command when chiller initiates run. ☐
8. Press the SYSTEM SWITCHES key, and turn on System 1 or 2 SWITCH. There may be a few seconds delay before the compressor starts because of the anti-recycle timer. Be ready, when each compressor starts, to switch the UNIT switch to the OFF position immediately, if any unusual noises or other adverse conditions develop. ☐
9. When the compressor starts, press the relevant SYSTEM PRESSURES key to verify that oil differential pressure develops immediately. If oil pressure does not develop, the automatic controls will shut down the compressor. Under no circumstances should a restart attempt be made on a compressor, which does not develop oil pressure immediately. Switch the UNIT switch to the OFF position. ☐
10. As the chiller is started, verify the refrigerant level sensor tracks level from empty condenser to fully flooded level sensor probe over the range of less than 10% to almost 100%. ☐
11. Adjust condenser refrigerant liquid level setpoint to a value that covers the subcooler top and provides proper evaporator performance with the chiller running steady. ☐
12. After the chiller is at full load at Design Leaving Chilled Liquid Temperature, capture the operating data to print or save to text file. ☐

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SECTION 6 - MAINTENANCE

GENERAL REQUIREMENTS

The maintenance requirements for YVWA chillers are shown below. The procedure is in the left-hand column and the required frequency is marked with an *X* in the right-hand column. Refer to the notes at the bottom of the table to maintain warranty validation.

Compressor vibration analysis is not prescribed. Due to the compressor design, a typical vibration analysis can be misleading.

Periodic oil filter changes are not recommended. Change the oil, filter, and filter driers only when an oil analysis indicates moisture or acid content, or loss of lubricity.

TABLE 39 - OPERATION/INSPECTION /MAINTENANCE REQUIREMENTS FOR YVWA CHILLERS

PROCEDURE	DAILY	WEEKLY	MONTHLY	ANNUALLY
Record operating conditions (on applicable log form)	X			
Check oil level in oil level sight glass	X			
Check refrigerant levels		X		
Check oil return system operation			X	
Check operation of motor starter			X	
Check oil heater operation			X	
Check 3-phase voltage and current balance			X	
Check programmable operating setpoints and safety cut-outs. Make sure they are correct for the application.				X
Verify condenser and evaporator liquid flows			X	
Check and repair leaks as needed ¹			X	
Check and tighten all electrical connections				X
Check the motor windings resistance				X
Clean or back flush VSD heat exchanger tubes				X ¹
Replace VSD coolant (after cleaning heat exchanger)				X
Perform oil analysis on compressor lube oil				X ¹
Perform refrigerant analysis				X
Perform Eddy current testing and inspect tubes				X ²
Clean evaporator and condenser tubes				X ²

For operating and maintenance requirements listed above, refer to appropriate service literature, or contact your local Johnson Controls Field Service Office.

¹This procedure must be performed at the specified time interval by an industry certified technician, who has been trained and qualified to work on this type of YORK equipment. A record of this procedure being successfully carried out must be maintained on file by the equipment owner should proof of adequate maintenance be required at a later date for warranty validation purposes.

²More frequent service may be required, depending on local operating conditions or relaxed with good engineering controls (water quality).

For procedures in this section, "Dry Nitrogen" refers to Grade B or better industrial nitrogen.

DAILY OPERATING INSPECTIONS

Routine Inspections

Avoid serious operating difficulties by conducting regular inspections. Use the following list of daily inspections and procedures as a guide.

Check or verify the following:

1. Control center displays.
2. If the compressor is in operation,
 - a. Check the oil pressure.
 - b. Check the oil level in the oil reservoir.
 - c. Drain or add oil, as necessary.
3. Entering and leaving condenser water pressure and temperatures for comparison with job design conditions.
4. Entering and leaving chilled liquid temperatures and evaporator pressure for comparison with job design conditions.
5. Condenser saturation temperature (based upon condenser pressure sensed by the condenser transducer).
6. Signs of dirty or fouled condenser tubes. (The temperature difference between water leaving condenser and condenser refrigerant saturation should not exceed the difference recorded for a new unit by more than 4°F (2°C)).
7. Compressor discharge temperature. During normal operation, discharge temperature should not exceed 212°F (100°C).
8. Compressor motor voltage and current (amps) on the control center display.
9. Proper water treatment.

Press the STATUS key whenever the display indicates to do so, which allows any warning messages to be displayed.

COMPRESSOR OIL

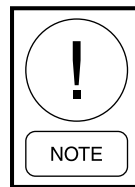
Check Operational Oil Level

The compressor requires 9 liters (2.4 gallons) of YORK L oil per system.

Oil Level

The YVWA chiller DOES NOT HAVE an oil pump. System oil flow is dependent on the pressure differential between the condenser and evaporator. Therefore, the oil flow rate, and oil level in the separator will vary as the system pressures and compressor speeds change. It is normal for the oil level to be at the bottom of the lower sight glass, or near the top of the upper sight glass on the oil separator, depending on conditions.

Oil should NOT be added unless the oil level cannot be seen in the lower sight glass when the compressor is operating at least 100 Hz. At lower loads, oil level may be below the lower sightglass, but with the proper amount of oil in the chiller, an adequate amount of oil is provided to compressor at those loads even with partial refrigerant in the stream. Oil should not be removed unless the oil level is above the upper sight glass. If oil needs to be added, use the procedure below to manage the oil level.



Oil should NOT be added unless the oil level cannot be seen in the lower sight glass, or removed unless the oil level is above the upper sight glass. If oil needs to be added, use the procedure below to manage the oil level.

Start-Up

1. **Oil level cannot be seen in the lower or upper sight glass:** For chillers shipped with a factory charge of oil and refrigerant with no oil level obvious at start-up, a qualified technician should add only enough oil to create a visible level in the bottom of the lower sight glass.

Start the chiller and run a load condition between 65% and 80% FLA for a minimum of one hour and observe the oil level. The oil level should become visible in the lower or upper sight glass, depending on conditions. A qualified technician should then remove the approximate amount added to start the chiller.

2. **Oil level is above the upper sight glass:** Conditions can exist where the evaporator pressure is higher than the condenser pressure, which occurs when the evaporator (or chilled) water loop is warmer than the condenser (or cooling tower) water loop, which can cause refrigerant in the oil separator to condense, creating a liquid level (oil and refrigerant mixture) that exceeds the top of the upper sight glass.

When the chiller motor is not running, a qualified technician should confirm the compressor oil heater is working properly, and is energized. If it is the first start-up for the cooling season, the technician should confirm the oil heater has been energized for at least 24 hours prior to start-up. During start-up, the chiller should be manually unloaded until a discharge superheat temperature (displayed on the SYSTEM DATA key) of 18°F (10°C) or greater is maintained and liquid level drops below the top of the upper sight glass on the oil separator. The chiller should continue to be held in part-load operation until the foaming in the oil separator is minimized. The chiller can then be returned to the position or load control to meet the cooling load requirements.

Operation

1. **Oil level should be visible in or below the upper sight glass:** If the chiller operates in a low discharge superheat condition for an extended period of time, refrigerant can condense in the oil separator. Unload and hold the chiller at a capacity that allows the discharge superheat to increase above 18°F (10°C), and until the level drops below the top of the upper sight glass and foaming is minimized. The chiller can then be loaded normally as the building/process load requires.
2. If there is no visible oil in either sight glass, a problem may exist with the oil return system. If load is such that the compressor is operating at least 100 Hz, the oil should be present in the sight-glass. At lower loads, oil level may be below the lower sight glass. If the proper amount of oil is in the chiller, the bearings will be adequately lubricated. The chiller should be loaded when validating oil capacity in the chiller. A qualified technician should add only enough oil to create a visible level in the bottom of the lower sight glass.

Start the chiller and run a load condition between 65% and 80% FLA for a minimum of one hour, and then observe the oil level. The oil level should become visible in either the lower or upper sight glass, depending on conditions. A qualified technician should then remove the approximate amount added to start the chiller.

Oil Analysis

An annual oil analysis is recommended to verify the continued use of the compressor oil.



The oil sample should not be exposed to the atmosphere for more than 15 minutes because it will absorb moisture from the atmosphere and may yield erroneous results.

Change the compressor oil when the oil analysis indicates that the oil has moisture, and the acid numbers exceed the limits set in *Table 40 on page 127*.

TABLE 40 - COMPRESSOR OIL LIMITS

MOISTURE YORK OIL TYPE	MOISTURE CONTENT (KARL FISHER METHOD) PPM	TAN (TOTAL ACID NUMBER) MGKOH/ML
L	< 300	< 0.5

6

The YVWA chiller compressors use rolling element bearings (ball and roller bearings); no sleeve bearings are used. Oil analysis that include metals, such as iron, copper, titanium, zinc, lead, tin and silicon, may cause confusion when the results are compared to other equipment that utilize different bearing types. Ignore these metals in the oil analysis because they are acceptable if <100 ppm. If an oil analysis indicates >300 ppm of iron, combined with >50 ppm of chromium and nickel, consult the Johnson Controls field service office because these amounts could indicate bearing damage and wear.

Removing the Compressor Oil

Use the following instructions to remove the compressor oil. Run the unit at high load if possible prior to removing oil to maximize the amount of oil in the separator and keep the temperature up to reduce refrigerant in solution. Drain the existing oil in the oil separator, which is under positive pressure at ambient temperature, into an approved refrigerant recovery container.

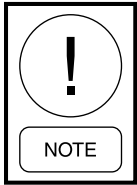
1. Connect one end of a refrigeration charging hose to the service valve located at the bottom of the oil separator; connect the other end to an approved container.
2. Open the valve, and drain the existing oil from the oil separator.

3. Additional oil is in the compressor that can be drained through the plug under the motor housing if the refrigerant is removed and the unit brought to atmospheric pressure with dry nitrogen.

Adding Compressor Oil

Add the new YORK L oil into the oil separator with the YORK oil charging pump (P/N 470-10654), and proceed as follows :

1. Shut down the unit.



If adding oil restores the correct level, the unit may keep operating.

2. Immerse the suction connection of the oil charging pump in a clean container of new oil. Connect the pump discharge connection to the oil charging valve. Do not tighten the connection at the valve until after the air is forced out by pumping a few strokes of the oil pump, which fills the lines with oil and prevents air from being pumped into the system as shown in *Figure 58 on page 128*.

3. Open the oil charging valve and pump oil into the system until the oil level in the oil separator is about midway in the upper sight glass, and then, close the charging valve and disconnect the hand oil pump as shown in *Figure 58 on page 128*. If the oil is added due to a complete oil replacement, charge only the same amount of oil that has been drained before to avoid oil overcharge.
4. As soon as oil charging is complete, close the power supply to the VSD to energize the compressor oil heater, which will keep the refrigerant concentration in the oil to a minimum.

Oil Filter

A single oil filter, a replaceable 3-micron cartridge, is provided in each compressor. Use only YORK approved oil filter elements.

The oil filter element should only be changed if a problem exists. Always replace the oil filter element and O-ring together.

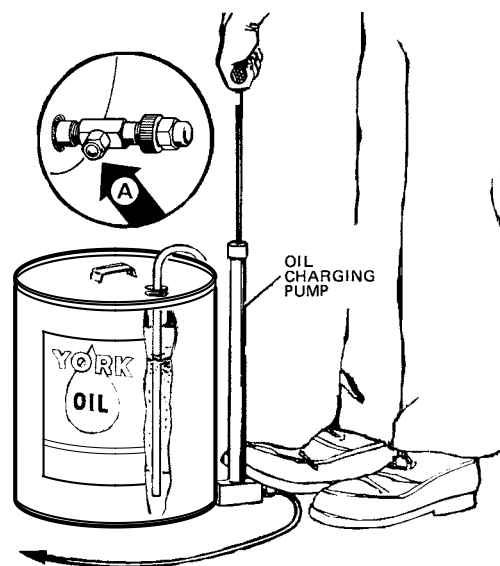
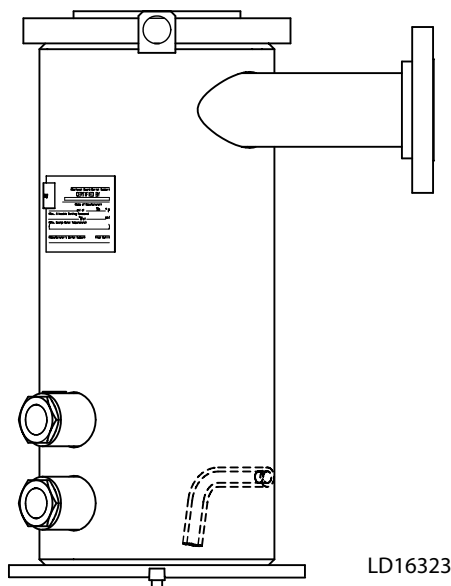


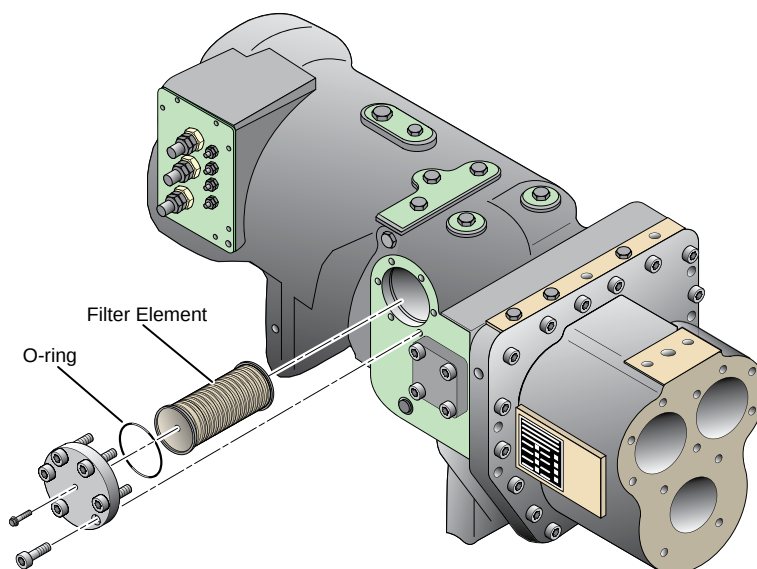
FIGURE 58 - CHARGING OIL

The control panel will automatically display the warning message OIL FILTER CLOGGED when the differential pressure reaches the programmable setpoint across the oil filter (10-100 psid, default 20 psid (69-690 kPa, default 138 kPa)). A safety shutdown will initiate if the differential gets to 65 psid (448 kPa).

OIL FILTER REPLACEMENT

Turn off the chiller, and secure it from starting by using the standard lock out/tag out procedure.

1. Isolate and remove refrigerant from the compressor.
2. Bring the compressor up to atmospheric pressure with dry nitrogen.
3. Remove the six cap screws that secure the oil filter cover to the compressor housing.
4. Remove the oil filter housing cover and O-ring seal.
5. Remove the oil filter. Examine any debris from the filter, which could indicate wear in the compressor or other parts of the unit.
6. Replace the oil filter element and the cover O-ring with new parts. Refer to *Model YVWA Renewal Parts (Form 201.30-RP1)* to get the new part numbers. Seat the element and properly to prevent filter bypass. Lightly lubricate the O-ring with compressor oil.
7. Reinstall the oil filter housing cover, and torque the cap screws to 18 ft-lb (24.4 Nm).
8. Leak check the cover by pressurizing the system.
9. Evacuate the isolated compressor and applicable portions of the chiller. Reinstall refrigerant.



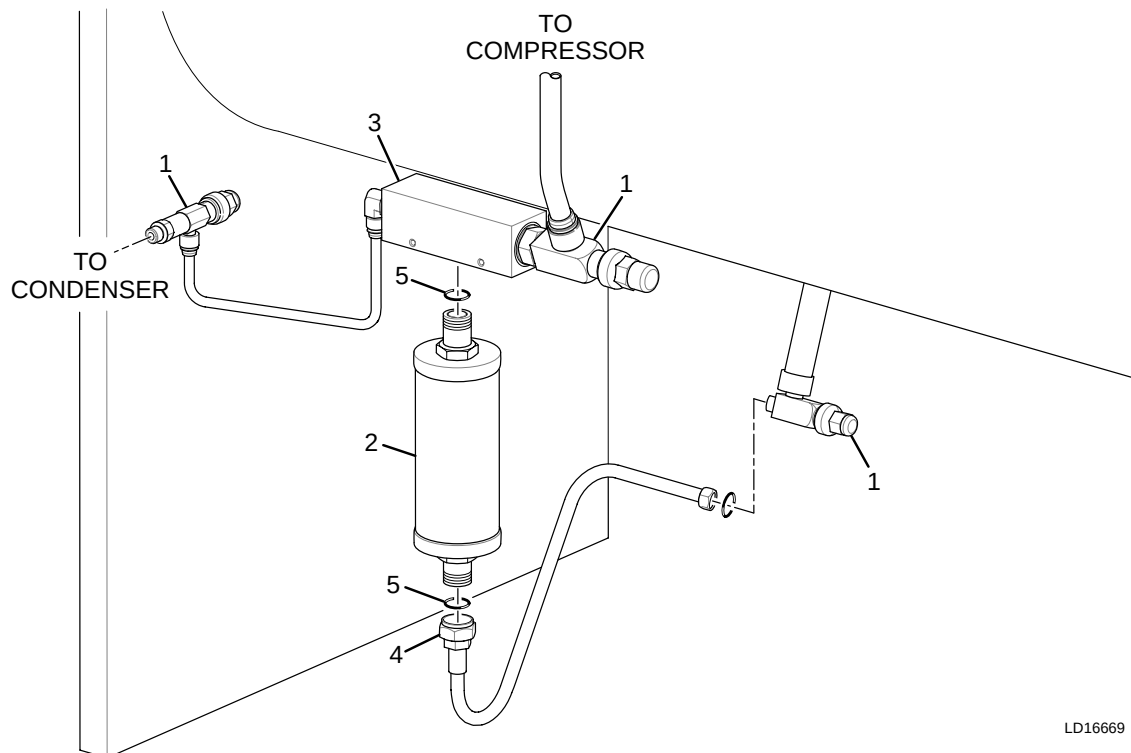
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FIGURE 59 - OIL FILTER ASSEMBLY

Replacing the Filter Drier

If the eductor flow seems restricted by high eductor outlet temperatures or if the oil is replaced, replace the filter using the following instructions to replace the drier as shown in *Figure 60 on page 130*.

1. Power down the chiller.
2. Close all 3 service isolation valves (items 1).
3. Carefully remove any insulation on the filter drier (item 2), located at the eductor block (item 3).
4. Relieve the pressure from the circuit into a suitable refrigerant recovery container. Filter drier (item 2) contains a Schraeder valve for this purpose.
5. Loosen the roto lock nut (item 4) at the piping end of the filter drier (item 2).
6. Remove the filter drier from the eductor block and discard filter drier and Teflon seals (item 5).
7. Install the new Teflon seals (items 5) and filter drier (item 2).
8. Torque nuts (items 4) at each end of filter drier (item 2) to 60 ft-lb (81 Nm), and replace the filter drier insulation.
9. Evacuate the air from the lines to 500 microns.
10. Open all 3 service isolation valves (items 1).
11. Restore power to the chiller, the chiller is now ready to be placed back into service.

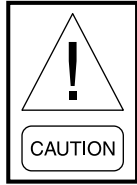


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FIGURE 60 - OIL EDUCTOR ASSEMBLY

Determining Correct Refrigerant Charge Level

The refrigerant charge level is correct when the condenser level is about 1 inch above the subcooler, and the measured Evaporator Approach and Discharge Refrigerant Gas Superheat are at the design values for the condition. The equations (below) define these parameters.



The chiller must be at design operating conditions and full load operation before the correct refrigerant charge level can be properly determined.

Equations:

- Evaporator Approach = (LELT) - (SET)
- Discharge Superheat = (CDGT) - (SCT)

Definitions Of Temperatures:

- SET = Saturated Evaporator Temperature
- LELT = Leaving Evaporator Liquid Temperature
- CDGT = Compressor Discharge Gas Temperature
- SCT = Saturated Condensing Temperature

The parameters can be obtained from the control center.

Liquid refrigerant will be visible in the evaporator sight glass, but, the refrigerant level cannot be properly determined by viewing the liquid refrigerant level in the evaporator sight glass.

Form 1 YVWA chillers are charged with the correct amount of refrigerant. Under some operating conditions, the chiller may appear to be overcharged or undercharged with refrigerant. Consult with a Johnson Controls office prior to removing or adding refrigerant.

REFRIGERANT CHARGING

If necessary, add refrigerant charge to the YVWA chiller until the evaporator approach and discharge superheat values are within design values.

A charging valve is located in the liquid line below the evaporator. The charging connection is a 3/4 in male flare. Purge air and non-condensables from the charging hose. Add only new refrigerant, or refrigerant that has been tested and certified to meet American Refrigeration Institute Standard (ARI-700).

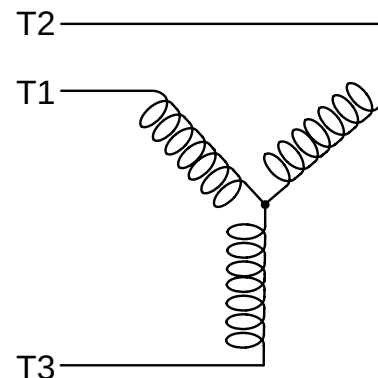
HANDLING REFRIGERANT FOR DISMANTLING AND REPAIRS

If it becomes necessary to open any part of the refrigerant system for repairs, remove the charge first.

To avoid the possibility of freezing liquid within the evaporator tubes when charging an evacuated system, only refrigerant vapor from the top of the drum or cylinder must be admitted to the system until the system pressure is raised above the point corresponding to the freezing point of the evaporator liquid. For water, the pressure corresponding to the freezing point is 29 psig (200 kPa) for R-134a (at sea level).

While charging, take every precaution to prevent air from entering the system. Make up a suitable charging connection from new copper tubing or approved refrigerant hose to fit between the system charging valve and the fitting on the charging cylinder. This connection should be as short as possible but long enough to permit sufficient flexibility for changing cylinders. The charging connection should be purged each time a full container of refrigerant is connected and changing containers should be done as quickly as possible to minimize the loss of refrigerant. Best practice is to include an isolation valve at the end of the line as close to the refrigerant cylinder as possible to minimize refrigerant lost when changing cylinders.

Checking the Motor Windings



LD16148

FIGURE 61 - MOTOR WINDINGS DIAGRAM

Make sure the motor power leads are marked and disconnect them from the output terminals in the VSD.

- Use a resistance meter to measure the winding resistance phase-to-phase. The nominal values are listed below, but the preventive maintenance program should trend the values for gross changes.
 - 400VAC application: 24 mΩ for T1-T2, T2-T3, T3-T1.
 - 460VAC application: 40 mΩ for T1-T2, T2-T3, T3-T1.
- Use a reliable battery-powered megohm tester, which provides a consistent test voltage to test winding resistance to ground.
 - Test no greater than 500 volts.
 - Always test with refrigerant or nitrogen pressure in the motor.
 - Never test in a vacuum.
 - Values should be above 5 megohm.
 - Trend readings for gross changes.

If values indicate a potential problem, remove the external leads from the motor, and repeat the test directly at the motor terminals.



Never have power on the input to the VSD, nor perform megohm testing with the motor in a vacuum.

CHECKING SYSTEM FOR LEAKS

Leak Testing During Operation

The refrigerant side of the system is carefully pressure tested and evacuated at the factory.

After the chiller is installed and charged, it should be carefully leak tested with a leak detector to make sure all joints are tight. If a leak exists, the refrigerant will be lost. Large leaks can lead to oxygen displacement and asphyxiation.

REFRIGERANT LEAK CHECKING

Check for refrigerant leaks regularly as part of a comprehensive maintenance program.

- Leak check the entire chiller, using a calibrated electronic leak detector.

- If leaks are detected, use a soap solution to confirm leaks that were found by the leak detector.
- Check refrigerant relief valve piping and evaporator and condenser tube rolled joints.

PRESSURE CONNECTIONS

All threaded pressure connections used on the YVWA chillers should be checked, NPT, Flare, SAE straight thread, O-ring face seal fittings or Primore Roto lock fittings.

The O-ring straight thread and face seal fittings are designed and used in accordance with SAE J1926 and J1453. When a fitting is removed, replace the O-ring(s). Use only genuine replacement O-rings, which can be ordered from the local Johnson Controls Field Service Office.

Pipe sealant compounds are not required with SAE O-ring fittings. The O-ring seal accomplishes the pressure sealing. Lubricate the O-ring with compressor oil prior to assembly.

Filter driers and angle service valves on the top of the cooler and condenser use roto lock fittings, which use a teflon fiber seal washer. Replace the washers when these parts are removed.

If any leaks are indicated, repair them immediately. A cracked flare can break completely if its tightened further. A flange connection should not be tightened beyond the maximum torque value. Repair of welded joints may require recertification / retesting according to PED.

CONDUCT PRESSURE TEST

With the R-134a charge removed and all known leaks repaired, charge the system with dry nitrogen to 150 psig to (1 MPa) detect any leaks using a liquid soap solution test. The test can be enhanced with the use of an ultrasonic leak detector.

OPTIONAL TRACE GAS PRESSURE TEST

- With no pressure in the system and R-134a removed, charge a trace gas (helium may be used) and dry nitrogen mixture into the chiller until pressure is at least 100 psig (700 kPa).
- One method is to charge 5 to 10 lbm of the environmentally-appropriate trace gas and then add dry nitrogen into the system to a pressure of 100 psig (700 kPa).

- To make sure that the concentration of refrigerant reached all parts of the system, slightly open the service valve and test for the presence of gas with a leak detector.
- Test around each joint and factory weld carefully and thoroughly.
- To check for tube or tube joint leaks,
 - Isolate and drain the condenser and evaporator waterboxes
 - Purge the waterboxes and tubes with dry nitrogen through the vents or drains until the detector does not indicate
 - Close the vents and drains and wait an hour
 - Open a vent or drain and insert the leak detector. If a leak is detected, the heads must be removed and the source of the leak determined as outlined in the Condenser and Evaporator maintenance section of this manual.
- Recover the test gas as applicable, make necessary repairs, repeat leak tests, evacuate the chiller and perform time hold test. Always consider the effect of temperature change when performing any time-based hold test. For an ideal gas, at time 1, pressure over temperature (absolute unit system) = the ratio at time 2.

CONDUCT R-134A PRESSURE TEST

If a pressure test indicates all joints are not leaking, proceed to test with R-134a as follows:

- With no pressure in the system, charge R-134a vapor into the chiller until pressure is at least 29 psig (200 kPa) so pressure is above the saturation temperature for water to freeze.
- Add refrigerant until the saturation pressure for the prevailing ambient temperature of the chiller is achieved, leak checking repaired joints with a refrigerant leak detector as pressure is increased.
- Test around each joint and factory weld carefully and thoroughly.

- To check for tube or tube joint leaks,
 - Isolate and drain the condenser and evaporator waterboxes
 - Purge the waterboxes and tubes with dry nitrogen through the vents or drains until the detector does not indicate
 - Close the vents and drains and wait an hour
 - Open a vent or drain and insert the leak detector. If a leak is detected, the heads must be removed and the source of the leak determined as outlined in the Condenser and Evaporator maintenance section of this manual.

TESTING FOR EVAPORATOR AND CONDENSER TUBE LEAKS

Evaporator and condenser tube leaks in R-134a systems may result in refrigerant leaking into the water circuit, or water leaking into the shell depending on the pressure levels.

If refrigerant is leaking into the water, it can be detected at the liquid head vents after a period of shutdown. If water is leaking into the refrigerant, system capacity and efficiency will drop off sharply.

If a tube is leaking and water has entered the system, the evaporator and condenser waterboxes should be valved off from the rest of the water circuit and drained immediately to prevent severe rusting and corrosion. The refrigerant charge should be recovered and dry nitrogen purge initiated. If a tube leak is indicated, the exact location of the leak may be determined as follows:

1. Dry nitrogen (pressure not to exceed 150 psig [1 MPa]) may be admitted to the unit to increase pressure in the shell. Remove the heads and listen at each tubes' section for a hissing sound that would indicate gas leakage, which will help to find the section that needs to be further investigated. If the location of the leaky tubes has been found, treat that section using the following instructions. If the location is not definite, investigate all of the tubes.
 - a. Wash off both tube heads and ends with water.

- b. With nitrogen or dry air, blow out the tubes to clear them of traces of refrigerant laden moisture from the circulation water. As soon as the tubes are clear, drive a cork into each end of the tube. Repeat this process with the other tubes in the suspected section, or if necessary, with all the tubes in the evaporator or condenser. Allow the evaporator or condenser to remain corked for 12-24 hours before proceeding. Depending upon the amount of leakage, the corks may blow from the end of a tube, indicating the location of the leakage. If not, it will be necessary to make a very thorough test with the halide torch.
- c. After the tubes have been corked for 12-24 hours, two men working at both ends of the evaporator carefully test each tube – one man removes corks at one end and the other at the opposite end removes the corks and handles the test torch. Start with the top row of tubes in the section being investigated. Remove the corks at the ends of one tube simultaneously and insert the exploring tube for five seconds – this should be long enough to draw into the detector any refrigerant gas that might have leaked through the tube walls. A fan placed at the end of the evaporator opposite the detector will assure that any leakage will travel through the tube to the detector.
- d. Mark any leaking tubes for later identification.
- e. If any of the tube sheet joints are leaking, the leak should be indicated by the detector. If a tube sheet leak is suspected, its exact location may be found using a soap solution. A continuous buildup of bubbles around a tube indicates a tube sheet leak.

EVACUATION AND DEHYDRATION OF UNIT



Make sure the power is removed from the input side of the VSD at all times when the chiller is under vacuum (less than atmospheric pressure). The VSD maintains voltage to ground on the motor when the chiller is off while voltage is available to the VSD. Insulating properties in the motor are reduced in vacuum and may not insulate this voltage sufficiently.

Vacuum Dehydration

If the chiller is opened to the atmosphere for lengthy repair or service, follow the guidelines to ensure that all air, moisture and non-condensable gases are removed prior to placing the chiller into service.

The equipment required to follow this method of dehydration consists of a wet bulb indicator or vacuum gauge, a table showing the relation between dew point temperature and pressure in of mercury (vacuum) as shown in *Table 41 on page 135*.

Dehydration of a refrigerant system can be obtained by this method because the water present in the system reacts much as a refrigerant would. By pulling down the pressure in the system to a point where its saturation temperature is considerably below that of room temperature, heat will flow from the room through the walls of the system and vaporize the water, allowing a large percentage of it to be removed by the vacuum pump. The length of time necessary to dehydrate a system depends on the following:

- Size or volume of the system
- Capacity and efficiency of the vacuum pump
- Room temperature
- Quantity of water present in the system.

TABLE 41 - SYSTEM PRESSURES

*GAUGE	ABSOLUTE			DEW POINT TEMPERATURES OF WATER °F
In OF MERCURY (HG) BELOW ONE STANDARD ATMOSPHERE	PSIA	MILLIMETERS OF MERCURY (HG)	MICRONS	
0	14.696	760.	760,000	212
10.24"	9.629	500.	500,000	192
22.05"	3.865	200.	200,000	151
25.98"	1.935	100.	100,000	124
27.95"	0.968	50.	50,000	101
28.94"	0.481	25.0	25,000	78
29.53"	0.192	10.0	10,000	52
29.67"	0.122	6.3	6,300	40
29.72"	0.099	5.0	5,000	35
29.842"	0.039	2.0	2,000	15
29.882"	0.019	1.0	1,000	+1
29.901"	0.010	0.5	500	-11
29.917"	0.002	0.1	100	-38
29.919"	0.001	0.05	50	-50
29.9206"	0.0002	0.01	10	-70
29.921"	0	0	0	0

WATER
FREEZES

6

*One standard atmosphere = 14.696 PSIA
= 760 mm Hg. absolute pressure at 32°F
= 29.921 in Hg. absolute at 32°F

NOTE: PSIG = Lbs. per sq. in. gauge pressure
= Pressure above atmosphere
PSIA = Lbs. per sq. in. absolute pressure
= Sum of gauge plus atmospheric pressure

To improve evacuation, circulate hot water (not to exceed 125°F (52°C)) through the evaporator and condenser tubes to thoroughly dehydrate the shells. If a source of hot water is not readily available, use a portable water heater. **DO NOT USE STEAM.** A suggested method is to connect a hose between the source of hot water under pressure and the evaporator head drain connection, out the evaporator vent connection, into the condenser head drain and out the condenser vent. To avoid causing leaks, the temperature should be brought up slowly so that the tubes and shell are heated evenly.

If the system has been pressure tested and found to be tight prior to evacuation, then the saturation temperature recordings should follow a curve similar to the typical saturation curve as seen in *Figure 62 on page 136*.

The temperature of the water in the chiller will drop as the pressure decreases, until the boiling point is reached, at which point the temperature will level off and remain at this level until all of the water in the shell is vaporized. When this final vaporization has taken place the pressure and temperature will continue to drop until eventually a temperature of 35°F (1.6°C) or a pressure of 5 mm Hg is reached.

When this point is reached, most of the air has been evacuated from the system, but there is a small amount of moisture left. To provide a medium for carrying this residual moisture to the vacuum pump, introduce nitrogen into the system to bring it to atmospheric pressure and the indicator temperature will return to approximately ambient temperature. Close off the system again, and start the second evacuation.

The small amount of moisture left will be carried out through the vacuum pump and the temperature or pressure shown by the indicator should drop uniformly until it reaches a temperature of 35°F (1.6°C) or a pressure of 5 mm Hg.

When the vacuum indicator registers this temperature or pressure, it is a positive sign that the system is evacuated and dehydrated to the recommended limit. If this level cannot be reached, there is a leak somewhere in the system, which must be corrected before the indicator can be pulled down to 35°F (1.6°C) or 5 mm Hg in the primary evacuation.

During the primary pulldown, carefully watch the wet bulb indicator temperature, and do not let it fall below 35°F (1.6°C). If the temperature is allowed to fall to 32°F (0°C), the water in the test tube will freeze, and the result will be a faulty temperature reading.

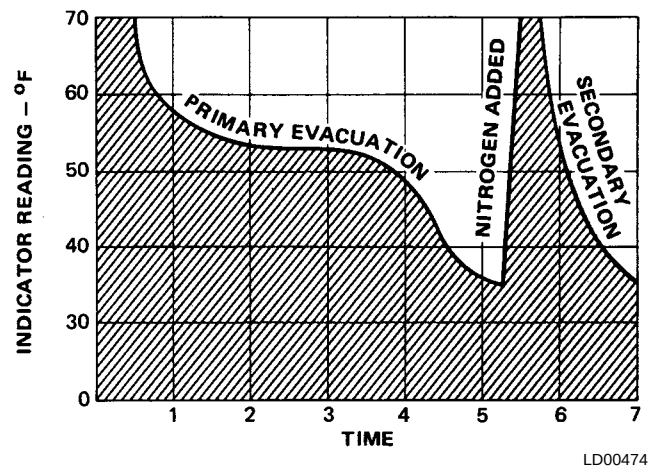


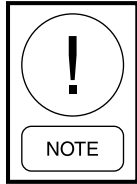
FIGURE 62 - SATURATION CURVE

Vacuum Testing

After completing the pressure test, the vacuum test should be conducted as follows:

1. Connect a high capacity vacuum pump, with indicator, to the system charging valve or shell service valve and start the pump. Refer to the *Vacuum Dehydration* section on the previous page.
2. Open wide all system valves, including the purge and gauge valves. Be sure all valves to the atmosphere are closed and flare caps installed on outlets.
3. Operate the vacuum pump in accordance with *Vacuum Dehydration* until a wet bulb temperature of 32°F (0°C) or a pressure of 5 mm Hg is reached. Refer to *SECTION 3 - HANDLING, STORAGE, AND INSTALLATION* for corresponding values of pressure.
4. Close the system charging valve and the stop valve between the vacuum indicator and the vacuum pump, then disconnect the vacuum pump leaving the vacuum indicator in place.
5. Hold the vacuum wet bulb temperature obtained in Step 3 in the system for eight hours; the slightest rise in pressure indicates a leak or the presence of moisture, or both. It is important to check for pressure change with the chiller at the same temperature. Pressure will change proportional to

temperature and affect results. If, after eight hours the wet bulb temperature in the vacuum indicator has not risen above 40°F (4.4°C) or a pressure of 6.3 mm Hg, the system may be considered tight.



Be sure the vacuum indicator is valved off while holding the system vacuum. Open the valve between the vacuum indicator and the system when checking the vacuum after eight hours.

6. If the vacuum does not hold for eight hours within the limits specified in Step 5, find and repair the leak.

CONDENSERS AND EVAPORATORS

General

Maintenance of the condenser and evaporator shells is important to provide trouble free operation of the unit. The waterside of the shell tubes must be kept clean and free from scale. Proper maintenance, such as tube cleaning, is covered on the following pages.

Chemical Water Treatment

Since the mineral content of the water circulated through evaporators and condensers varies with almost every supply source, the water being used may corrode the tubes or deposit heat resistant scale in them.

Reliable water treatment companies are available in most large cities who can supply a water treating process, which will greatly reduce the corrosive and scale forming properties of almost any type of water.

As a preventive measure against scale and corrosion and to prolong the life of the evaporator and condenser tubes, a chemical analysis of the water should be made, before the system is installed. Consult a reliable water treatment company to determine if water treatment is necessary, and if so, to furnish the proper treatment for the particular water condition.

CLEANING EVAPORATOR AND CONDENSER TUBES

Standard construction materials for YVWA chiller condensers and evaporator are copper tubes and mild carbon steel water boxes.

Condenser Tubes

Proper condenser water treatment can eliminate or significantly reduce the formation of scale on the waterside of the condenser tubes.

Maintain a minimum condenser water flow rate through the tubes of at least 3.33 ft/second (1 meter/second). Tube water velocity should not exceed 12 ft/second (3.6 meter/second).

Condenser tubes must be maintained to provide proper chiller operation. The condenser approach temperature, which is the difference between the condenser leaving water and the saturated condenser temperatures, is a useful tool to monitor the performance of the condenser. Recording and logging the condenser approach temperature, as part of the chiller maintenance program, warns the operator that the waterside condenser tubes are fouled and require cleaning.

If the approach increases more than 4°F (2°C) above the approach when the tubes were clean, or during the annual condenser inspection the tubes are observed to be fouled, the tubes require cleaning.

In a condenser, a problem due to fouled tubes is usually indicated by:

- A steady rise in head pressure over a period of time
- A steady rise in condensing temperature
- Increase in required lift, which could show as increased power consumption or noisy operation

Tube Fouling

Fouling of the tubes can be due to two types of deposits:

1. *Rust or sludge* – which finds its way into the tubes and accumulates there. This material usually does not build up on the inner tube surfaces like scale, but does interfere with the heat transfer. Remove the rust or sludge from the tubes using a thorough brushing process.
2. *Scale* – due to mineral deposits. These deposits, although thin and scarcely detectable upon physical inspection, are highly resistant to heat transfer. Remove the scale with commercial methods as described in the following paragraphs.

NON-CONDENSABLE GAS

Non-condensable gas that seeped into the chiller during incorrect evacuation or charging will also cause high condenser approach conditions. Purge the refrigerant vapor from the condenser shell service valve on the top of the condenser into a refrigerant container to reveal non-condensable gas.

Evaporator Tubes

Maintain evaporator water or brine flow rates through the evaporator tubes for which the chiller was designed. Refer to the engineering data on the sales order form for the correct flow rates.

Generally, the water or brine that is circulated through the evaporator is part of a closed loop circuit that is treated with chemicals to prevent the formation of scale and debris.

The evaporator's lack of performance is indicated by cooling capacity decreases and the approach (temperature difference between the water leaving the evaporator and the refrigerant temperature in the evaporator) increases. It is difficult to determine if the lack of performance is due to fouled tubes alone or due to a combination of problems, such as:

- Refrigerant leaks from the system.
- A shortage of refrigerant charge.
- An excessive quantity of oil in the evaporator.

Waterside Tube Cleaning Procedure

Two methods are used for waterside tube cleaning to remove scale: chemical or mechanical. The scale composition will determine which method is most effective to remove the scale and dirt.

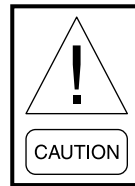
Contact a Johnson Controls Field Service Office for a recommended method that is used locally.

Chemical Cleaning Procedure

Acid Cleaning of Tubes – If the tubes are fouled with a hard scale deposit, they may require acid cleaning. Before acid cleaning, clean the tubes by the brushing process described in Mechanical Tube Cleaning Procedure. If the loose foreign material is removed before the acid cleaning, the acid solution will clean the tubes more efficiently, and in a shorter amount of time.

Chemical cleaning is an effective method to remove scale from internally enhanced copper tubes. However, a company knowledgeable with the chemical cleaning procedure should be contracted or consulted. Follow the chemical cleaning company recommendations concerning solution cleaning strength and time duration of the cleaning process.

Commercial Acid Cleaning – If acid cleaning is required, Johnson Controls recommends using a commercial organization that offers a special service to acid clean evaporators and condensers, such as the Dow Industries Service Division, Dow Chemical Co., Tulsa, OK, which has branches in principal cities.

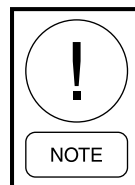


Serious damage to the condenser tubes will result if the chemical cleaning procedure is improperly applied.

When chemical cleaning of the tubes is required, calculate the internal volume of the waterside condenser tubes with the following equation to properly mix the correct concentration of cleaning solution.

$$\text{Vol (gal)} = [\text{Nominal tube size (in)}] \times 3.14 \times \text{shell length (ft)} \times \text{number of tubes} / 77$$

Contact a Johnson Controls Field Service Office for the size and number of tubes.



Mechanical tube cleaning must always follow a chemical cleaning procedure.

Mechanical Tube Cleaning Procedure

1. Drain the water from the condenser.
2. Remove the water boxes from both ends of the condenser with proper lifting equipment. Use caution not to damage the threads on the mounting studs that are welded to the tube sheet.
3. Select a tube cleaning brush for 5/8 inch ID copper condenser tubes. If tubes other than those with 5/8 inch ID are used, select a tube cleaning brush that is made for the tube size. Generally, brushes made of hard plastic or brass bristled wires are preferred for cleaning copper tubes. **DO NOT** use a steel bristle brush.

4. Attach the tube cleaning brush to the end of a cleaning machine or rod.
5. Flush the condenser with clean water to remove the debris.
6. Replace the water box gasket with a new gasket, and reassemble the water box onto the condenser.

MAINTAINING COMPRESSOR

Perform maintenance on the compressor assembly by:

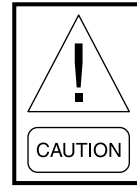
1. Checking the operation of the oil return system and changing the dehydrator.
2. Checking and changing the oil, and oil filters.
3. Checking the operation of the oil heater.
4. Observing the operation of the compressor.

Internal wearing of compressor parts could be a serious problem caused by improper lubrication, brought about by restricted oil lines, passages, or dirty oil filters. If the unit is shutting down on low oil pressure (LOP), change the oil filter element and examine it for foreign material. If foreign material is noticeable and the same conditions continue to stop the unit operation after a new filter element is installed, contact a Johnson Controls Field Service Office.

ELECTRICAL CONTROLS

For information covering the control center operation, refer to *SECTION 9 - OPERATIONS* in this manual, and *Field Connections and Controls for Model YVWA Chiller (Form 201.30-PW2)*.

Checking VSD Coolant Level



Never run the coolant pump without coolant! Running the coolant pump without coolant may damage the pump.

Always fill the system with approved YORK coolant to avoid damage to the pump seals and the chiller.

1. Remove the cap on the fill tube and run the coolant pump to verify the level in the fill tube.
2. Make sure the coolant level in the VSD cooling system is 1/2 in (2 cm) from the top of the fill tube while running.
3. Run the pump by placing the chiller in SERVICE mode. Refer to *SECTION 9 - OPERATIONS*.
4. Add new coolant, if necessary.
5. Reinstall the cap before stopping the coolant pump to avoid overflowing the fill tube when the coolant pump is turned off. The coolant system holds about 2 gallons (7.6 L) of coolant.

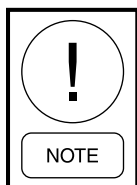
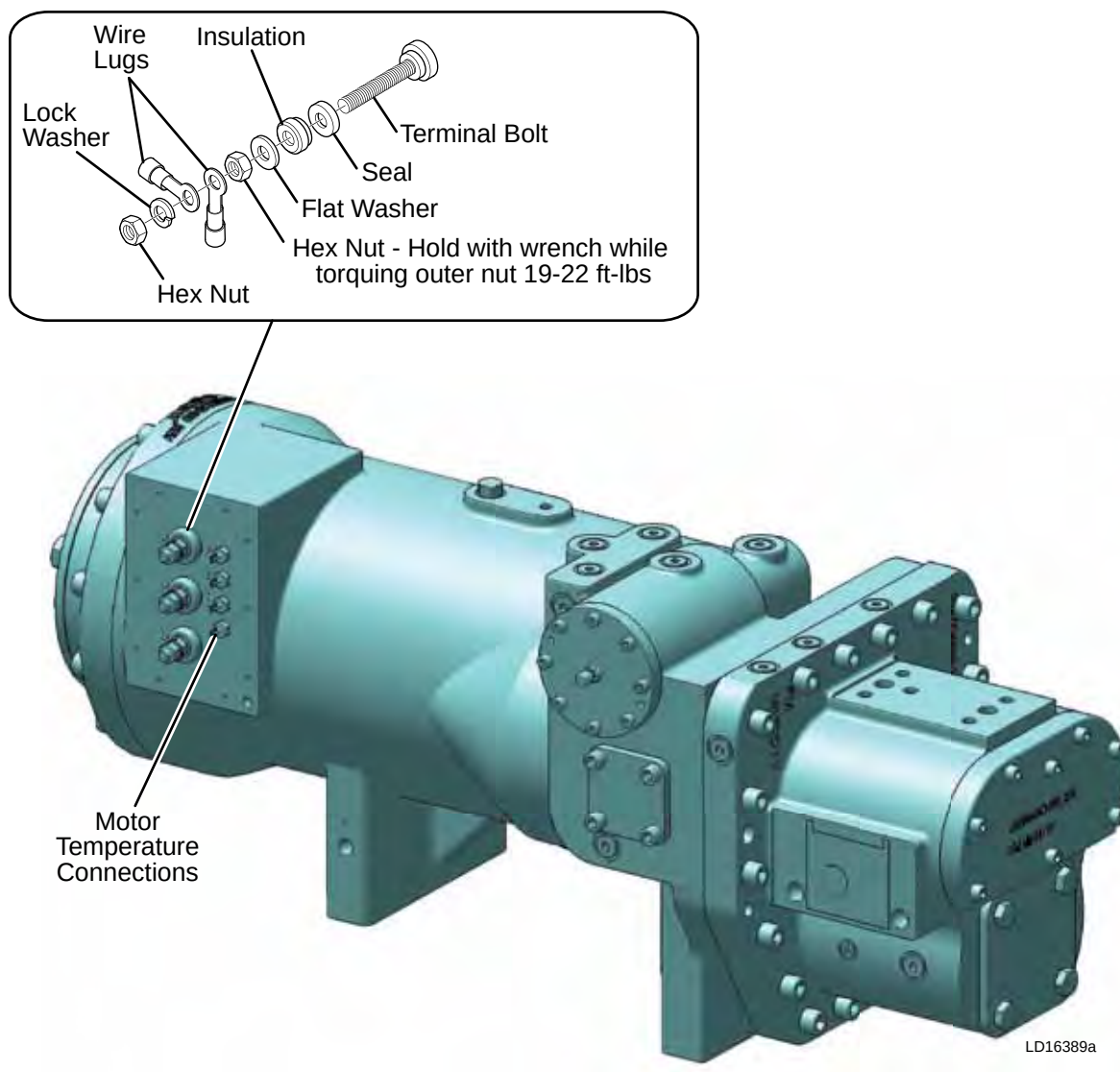
Preventive Maintenance

It is the owner's responsibility to fulfill the necessary daily, monthly and yearly system maintenance requirements to keep the unit operating at its peak efficiency. Follow the maintenance schedule in *Table 39 on page 125*.



If a unit fails due to improper maintenance during the warranty period, Johnson Controls will NOT be liable for costs incurred to return the system to satisfactory operation.

COMPRESSOR POWER CONNECTION



The motor thermistor terminals are part of the system pressure boundary. They have wires connected internally. They are sealed with an o-ring that comes as part of the assembly. If they need replaced, ensure the new ones have the seal and torque to 11 ft-lb.

FIGURE 63 - COMPRESSOR ELECTRICAL CONNECTION

TROUBLESHOOTING GUIDE

Successful problem solving requires an organized approach to define the problem, identify the cause, and make the proper corrections. Sometimes two relatively obvious problems combine to provide a set of symptoms that can mislead the troubleshooter. Be aware of this possibility and avoid repairs that do not solve the problems. Refer to *Table 42 on page 141* for specific troubleshooting information.

ABNORMAL OPERATION, ANALYSIS AND CORRECTION

Use the following steps to analyze an operational problem effectively and make the necessary corrections:

1. Define the problem and its limits.
2. Identify all possible causes.

3. Test each cause until the source of the problem is found.

4. Make the necessary corrections.

When an operating problem develops, compare all operating information on the OPERATING DISPLAY key with normal operating conditions. If an operating log has been maintained, the log can help determine what constitutes normal operation for the compressor unit in that particular system.

TROUBLESHOOTING THE ROTARY SCREW COMPRESSOR AND OIL SEPARATION SYSTEM

Troubleshooting the compressor is limited to identifying the probable cause. If a mechanical problem is suspected, contact the Johnson Controls Field Service Office. **DO NOT DISASSEMBLE COMPRESSOR.**

6

TABLE 42 - TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	ACTION
No Display on Control Panel. Unit Will NOT Run	Electric supply to the panel is missing.	Electrical power supply to the chiller is missing.
		Check 1FU, 2FU, 3FU, 4FU, 5FU, 14FU, 15FU, 17FU, or 19FU.
		Check 2T or 10T Transformer.
	Line fuse is blown.	Check fuses.
	Control board is defective.	Replace control board.
	Display board is defective.	Replace display board.
Line Fuse Blows	VSD assembly is defective.	Replace VSD components diagnosed to be the cause.
Chiller Fault: Low Leaving Chilled Liquid Temperature	Leaving chilled liquid temperature drops faster than the unit can unload.	Check for restricted flow.
		Check for rapid flow changes.
		Water loop is too small.
		Flow is below minimum for chiller.
	Chilled water sensor is defective.	Check sensor against temperature gauge in water line.
		Check sensor for intermittent operation.
		Check wiring for shorts or opens.
System Fault: Control Voltage	System fuse is blown.	Check respective system Fuse 20FU or 21FU.

TABLE 42 - TROUBLESHOOTING GUIDE (CONT'D)

PROBLEM	POSSIBLE CAUSE	ACTION
System Fault: Abnormally High Discharge Temperature	Discharge temperature sensor is defective.	Check sensor.
	Condenser tubes are dirty or scaled.	Check and clean tubes. Check water conditioning.
	Condenser water flow low.	Check site pumps, valves, and strainers. Increase quantity of water through the condenser to the proper value.
	Condenser water too warm.	Check tower fan motor/blade, valve, and water circulation.
	Compressor issue.	Measure superheat with gauges and thermocouple. Determine cause.
	Air in condenser.	Purge unit and clean the charge.
System Fault: High Motor Temperature	High motor temperature input from one of the sensors.	Refrigerant charge low. Check evaporator approach.
		Excess charge in system. High discharge pressure. Check superheat.
		High superheat. Feed valves NOT controlling. Isolate cause.
		Motor sensor reading incorrectly. Program panel to ignore a single sensor.
System Fault: Abnormally Low Suction Pressure	Low charge.	Check evaporator approach.
	Transducer reads incorrectly.	Check transducer against a gauge.
	Insufficient refrigerant charge.	Check for leaks and charge refrigerant into system.
	Low flow.	Check flow.
	Feed or flow valve defective.	Repair or replace valve or control.
	Evaporator tubes dirty or restricted.	Clean evaporator tubes.
	Insufficient load for system capacity.	Check setting of low water temperature cutout.
System Fault: Motor Current Limiting	High motor current has activated current limiting.	Ambient temperature is high, normal response from controller
		Remote or panel limiting is in effect. Normal response.
		Excess charge in system, Adjust charge.
VSD Fault: High Baseplate Temperature	Coolant level low.	Add coolant.
	Coolant pump is defective.	Replace coolant pump.
	VSD board is defective.	Replace VSD logic board.
	Sensor is defective.	Replace defective power unit.

TABLE 42 - TROUBLESHOOTING GUIDE (CONT'D)

PROBLEM	POSSIBLE CAUSE	ACTION
VSD Fault: Low DC Bus Voltage	Live voltage sag.	Evaluate indicators of power feed at time of event.
	SCR or trigger board is defective.	Check VSD.
System unable to meet setpoint for leaving chilled water (or condenser water for heat pump)	System overload.	Make sure the compressors are loaded (without overloading the motor) until the load decreases.
System Fault: Compressor Starts then Stops on Oil Pressure Fluctuation	Unusual starting conditions exist, i.e., oil foaming in reservoir and piping, due to lowered system pressure.	Drain the oil from the oil separator and charge new oil into the oil separator.
	Burned out oil heater.	Replace oil heater.
System Fault: Oil Pressure Gradually Decreases	Oil filter is dirty.	Change oil filter.
	Extreme bearing wear.	Call Johnson Controls field service office to evaluate compressor.
System Fault: Oil Return System Ceases to Return an Oil Refrigerant Sample	Filter in oil return system dirty.	Replace old oil filter with a new filter.
	Oil return eductor jet or orifice is clogged.	Remove eductor, inspect for dirt. Remove dirt, using solvent and replace.
System Fault: System Fails to Deliver Oil Pressure	Faulty oil pressure transducer. Faulty wiring/connectors.	Replace oil pressure transducer.
Excessive Noise and Vibration	Bearing damage or excessive wear.	Call Johnson Controls field service office to evaluate compressor.
	Refrigerant flood back.	Correct system problem.
	Chiller vibration isolators installed improperly	Install isolators properly according to instructions in this manual.
	Room acoustics are poor.	Evaluate sound attenuation.
	Piping supports not supporting load.	Adjust.
Gradual Oil Loss with an Oil Level in the Separator Sight Glass	Oil level is too high.	Lower oil level.
	Refrigerant carryover or liquid injection overfeeding.	Adjust refrigerant level setpoint. Check control valves.

Note: Always turn OFF power to the chiller and make sure the DC Bus voltage has bled off when opening the VSD cabinet.

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SECTION 7 - CHILLER SYSTEM SERVICE

SERVICE TROUBLESHOOTING REFRIGERANT CIRCUIT

Liquid Line Strainer

A strainer exists in the liquid line leaving each condenser subcooler. This strainer is designed to capture any construction debris missed during fabrication that could otherwise travel to components in the system. The strainer basket is accessible when refrigerant is removed from the system. Remove the bolts on the strainer cover, empty the contents, replace the gasket and restore. The gasket part is identified in the replacement parts manual.

Compressor Suction Strainer

The compressor suction inlet includes a strainer for compressor protection. This strainer is of sufficient area that it is not expected to load with debris. If it ever needs accessed, it can be removed by pulling out when the compressor is removed for access.

Compressor Oil System

Operational Oil Level

The compressor requires 9 liters (2.4 gallons) of YORK L oil per system. Refer to *SECTION 6 - MAINTENANCE* of this manual for oil service procedures.

Level Sensor

The condenser refrigerant level sensor for each system is located in an external canister piped with fill and vent lines from the condenser. The sensor is described in the condenser level control part of the Basic Operation section of this manual. The sensor is not intended for field calibration, but can be replaced when refrigerant is removed. The sensor connects to the piping canister with $\frac{3}{4}$ " NPT.

Condenser Level EE V and Economizer Feed EEV

The electronic expansion valves used for condenser level control and economizer feed are hermetic stepper motor valves. The valves are brazed in the piping. The motor and plug of the valve can be replaced in unusual cases where the valve has failed by obtaining a replacement valve. The seal from motor to body is a brass knife-edge seal and must not be broken more than once for jeopardy of not resealing.

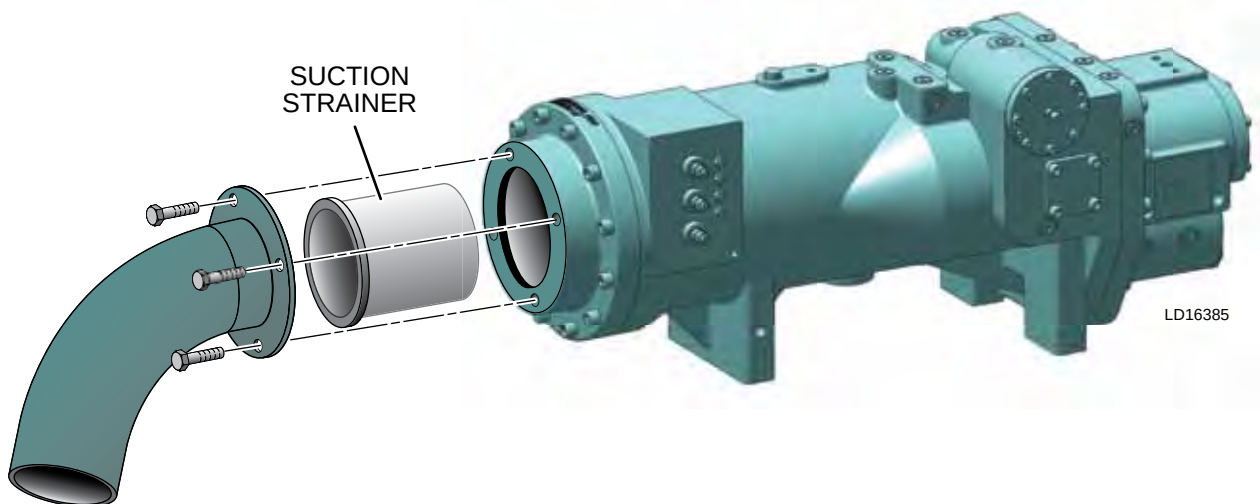


FIGURE 64 - COMPRESSOR SUCTION STAINER

PIPING JOINT ASSEMBLY**Assembly of Fasteners and Piping****TABLE 43 - ASSEMBLY COMPOUNDS**

LOCTITE GRADE	DESCRIPTION	ESG P/N	CONTAINER SIZE
243	Blue Threadlocker Studs, Threadlocking, Flare fittings	013-01678-000	50 mL
554	Red Refrigerant Sealant Pipe Threads – Permanent, Refrigerant service	013-03089-000	10 mL
		013-02894-000	250 mL
565	White Thread Sealant Pipe Threads – Non-permanent, refrigerant service Pipe Threads –Water or coolant service	013-02023-000	250 mL
		013-03090-000	50 mL
7070	Cleaner	013-02899-000	16 oz
N7649	General Purpose Primer	013-02982-000	1 gal
		013-01753-000	1.75 oz

PIPE THREAD JOINTS**NOTES:**

1. Primer recommended with dissimilar metals.
2. Use primer on both male and female components of pipe threads 3" and larger.
3. A small amount may be placed on the threads of the male portion of the fitting.
4. Loctite 554 is to be used on all pipe thread fittings with the following exceptions: It is NOT to be used on straight thread "O-RING" fittings. Also Loctite 554 is NOT to be used on refrigerant level sensors. Refrigerant level sensors require Loctite 565.
5. Care must be taken to not use excessive material, resulting in unnecessary contamination of refrigeration system.

PROCEDURES**Cleaning**

Parts visually contaminated with oil, grease, or dirt are to be cleaned with a generous spray of cleaner 7070. Wipe dry with a clean towel while still wet.

Priming

- A. If required, use N7649 general purpose primer. Primers are generally required when assembling dissimilar metals. In this case, apply primer to the inactive surface.
 1. Active surfaces (Primer optional): Brass, copper, bronze, iron, soft steel, nickel.
 2. Inactive surfaces (Primer required): Aluminum, stainless steel, magnesium, zinc, black oxide, cadmium, titanium, others.
- B. After application, allow primer to visibly dry (3-5 minutes) before assembling joint.
- C. Primer can also be used at the discretion of the facility to accelerate curing of sealer on any surface. This is often helpful in low temperature conditions.

NOTE: Primer will greatly accelerate the cure time for the sealant. Complete joint assembly quickly if primer is used.

GASKET JOINTS**Assembly of gasket joints****PROCEDURE**

All screw threads shall be clean and lubricated, unless plated, before tightening. All threaded fasteners (bolts, nuts or cap screws) shall be tightened per sequence shown in *Figure 65 on page 147* for an 8 fastener joint. A similar sequence shall be used for joints with a greater number of bolts.

The torque shall be applied evenly in gradual increments until the desired torque limit is reached, to assure proper applied gasket loading.

Relaxation of the gasket after tightening, in a properly torqued gasketed joint, is expected. Bolts must be re-tightened, as necessary prior to final testing and start-up, for refrigerant joints to eliminate gasket relaxation.

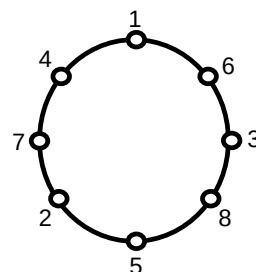


FIGURE 65 - TORQUE PATTERN

LD16438

TABLE 44 - ANSI 150 LB. FLANGE

NOM. SIZE	BOLT SIZE	QUANTITY	APPLIED TORQUE IN FT-LBS.		APPLIED TORQUE IN NM	
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/2"	1/2"-13	4	9	35	12	47
3/4"	1/2"-13	4	10	53	14	72
1"	1/2"-13	4	15	69	20	94
1-1/4"	1/2"-13	4	24	108	33	146
1-1/2"	1/2"-13	4	32	120	43	163
2"	5/8"-11	4	61	238	83	323
2-1/2"	5/8"-11	4	71	238	96	323
3"	5/8"-11	4	108	238	146	323
3-1/2"	5/8"-11	8	59	238	80	323
4"	5/8"-11	8	75	238	102	323
5"	3/4"-10	8	110	415	149	563
6"	3/4"-10	8	138	415	187	563
8"	3/4"-10	8	186	415	252	563
10"	7/8"-9	12	176	665	239	902
12"	7/8"-9	12	241	665	327	902
14"	1"-8	12	293	995	397	1349

TABLE 45 - ANSI 300 LB. FLANGE

NOM. SIZE	BOLT SIZE	QUANTITY	APPLIED TORQUE IN FT-LBS.		APPLIED TORQUE IN NM	
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/2"	1/2"-13	4	11	35	15	47
3/4"	5/8"-11	4	20	67	27	91
1"	5/8"-11	4	25	86	34	117
1-1/4"	5/8"-11	4	40	134	54	182
1-1/2"	3/4"-10	4	64	219	87	297
2"	5/8"-11	8	42	143	57	194
2-1/2"	3/4"-10	8	58	198	79	268
3"	3/4"-10	8	88	302	119	409
3-1/2"	3/4"-10	8	97	329	132	446
4"	3/4"-10	8	122	417	165	565
5"	3/4"-10	8	152	417	206	565
6"	3/4"-10	12	129	417	175	565
8"	7/8"-9	12	233	667	316	904
10"	1"-8	16	273	709	370	961
12"	1-1/8"-8	16	441	1088	598	1475
14"	1-1/8"-8	20	399	932	541	1264

Torque

All threaded fasteners shall be torqued to the values shown in Tables for appropriate bolt material and gasket. *Tables 44 through 50* are applicable only to fiber reinforced, fiber, graphite impregnated, Teflon, spiral, jacketed and solid metal gaskets. *Table(s) 49 and 50* state metric bolt size and torque values. Cork and low

seating stress gaskets, below 1500 psi, are normally over-bolted and require less torque. Sealing of joints utilizing Bulb gaskets, require control of the gasket squeeze. For a gasket extending 3/8" above the groove, the squeeze is limited by maintaining the gap between surfaces at 3/16" +/- 1/16". Use same torque for metal to metal contact outside of bolt circle. Use same torque for O-ring gaskets.

TABLE 46 - ASME SA193 GR B7 BOLTS

W/SA194 GR 2H HEAVY DUTY NUTS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads/ inch	13	11	10	9	8	8	8	8	8	8	8	8	8
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	1.980	2.304	2.652
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads & Surf	25-30	45-50	55-65	95-110	145-165	215-240	310-345	425-470	570-630	735-810	935-995	1170	1440
Threads only	30-35	45-55	65-75	110-125	170-190	250-280	360-400	490-545	655-725	850-940	1085	1350	1660
CAD Plated	30-40	50-60	70-80	120-135	180-200	265-295	385-430	525-580	700-770	905-995	1155	1440	1770
Dry	40-45	60-70	90-105	150-170	230-255	335-375	480-530	655-725	875-965	1140	1445	1800	2215

Note: Torque > 1000 ft-lbs use value plus 10% for range.

1. Joints with Bulb Gaskets are controlled by gasket squeeze, not Bolt Torque Gap between Flanged Joint = 3/16" +/- 1/32"

2. Self-Energizing gaskets with a metal to metal contact area, provided there is no metal contact outside of bolt circle, can use listed values.

TABLE 47 - ASTM A325 STRUCTURAL BOLTS

W/HEAVY DUTY NUTS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads/ inch	13	11	10	9	8	8	8	8	8	8	8	8	8
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	1.980	2.304	2.652
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads & Surface	5-10	20-25	25-30	40-45	55-65	85-100	120-135	165-185	225-250	295-330	370-410	465-515	570-630
Threads only	15-20	20-25	30-35	45-50	65-75	95-110	140-160	195-220	260-290	335-375	430-475	535-595	660-730
CAD Plated	15-20	25-30	30-35	50-55	70-80	105-120	150-170	205-230	275-305	360-400	455-505	570-630	705-780
Dry - No lubricant	20-25	30-35	40-45	55-65	90-105	130-150	190-215	260-290	345-385	450-500	575-640	710-790	880-970

TABLE 48 - SAE J429 GR 5 BOLTS

W/HI-STRESS HEAVY DUTY NUTS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads/ inch	13	11	10	9	8	8	8	8	8	8	8	8	8
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	1.980	2.304	2.652
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads & Surface	20-30	40-50	55-65	90-105	140-160	190-210	270-305	375-420	500-555	--	--	--	--
Threads only	25-35	45-55	65-75	105-120	165-185	220-245	315-350	430-470	575-635	--	--	--	--
CAD Plated	30-40	45-55	70-85	115-130	175-195	235-260	340-380	460-510	615-680	--	--	--	--
Dry - No lubricant	35-45	60-70	90-105	145-165	220-245	295-330	420-465	575-635	770-850	--	--	--	--

Note: Torque > 1000 use value plus 10% for range.

TABLE 49 - SAE J429 GR 2 BOLTS

W/HI-STRESS HEAVY DUTY NUTS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads/ inch	13	11	10	9	8	8	8	8	8	8	8	8	8
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	1.980	2.304	2.652
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	--	--	--	--
Threads & Surface	10-20	20-30	25-35	40-50	65-75	90-105	130-145	185-210	245-275	--	--	--	--
Threads only	15-20	25-35	30-40	50-60	80-90	105-120	155-175	210-235	285-320	--	--	--	--
CAD Plated	15-20	25-35	35-45	55-65	85-95	115-130	165-185	225-250	305-340	--	--	--	--
Dry - No lubricant	20-30	30-40	45-55	70-80	105-120	145-165	205-230	285-320	380-420	--	--	--	--

TABLE 50 - SAE J429 GR 8 BOLTS

W/Hi-STRESS HEAVY DUTY NUTS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	1-7/8"	2"
Threads/ inch	13	11	10	9	8	8	8	8	8	8	8	8	8
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	1.980	2.304	2.652
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	--	--	--	--
Threads & Surface	19-20	39-41	70-74	113- 119	170- 179	253- 266	358- 377	490- 516	651- 685	--	--	--	--
Threads only	23-24	45-47	81-85	130- 137	197- 207	292- 307	413- 435	566- 596	750- 790	--	--	--	--
CAD Plated	24-25	48-51	87-91	140- 147	209- 220	312- 328	442- 465	603- 635	801- 843	--	--	--	--
Dry - No lubricant	30-32	60-63	107- 113	174- 183	262- 276	390- 410	552- 581	754- 794	1001- 1054	--	--	--	--

TABLE 51 - DIN 933 OR ANSI B 18.2.3.1M GR 8.8 BOLTS (METRIC)

W/Hi-STRESS HEAVY DUTY NUTS													
BOLT SIZE	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	--	--	--
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	--	--	--
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	--	--	--
Threads & Surface	18-19	45-47	89-94	157- 165	253- 266	399- 420	546- 575	784- 825	1083- 1140	1359- 1430	--	--	--
Threads only	21-22	52-54	104- 109	181- 190	292- 307	461- 485	631- 664	904- 952	1250- 1316	1568- 1650	--	--	--
CAD Plated	23-24	55-58	110- 116	193- 203	312- 328	491- 517	673- 708	964- 1015	1333- 1403	1672- 1760	--	--	--
Dry - No lubricant	28-29	70-73	138- 145	241- 254	390- 410	614- 646	841- 885	1206- 1269	1666- 1754	2090- 2200	--	--	--

TABLE 52 - DIN 933 OR ANSI B 18.2.3.1M GR 10.9 BOLTS (METRIC)

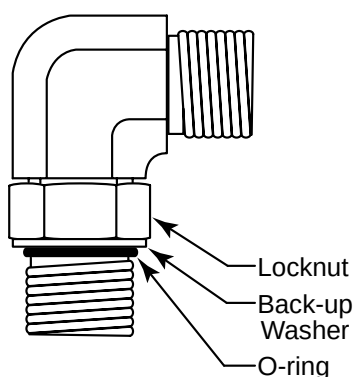
W/Hi-STRESS HEAVY ALLOWABLE DUTY NUTS													
BOLT SIZE	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	--	--	--
Thread Root Area	0.126	0.202	0.302	0.419	0.551	0.728	0.929	1.155	1.405	1.680	--	--	--
LUBRICATION STATUS BOLT TORQUE - TORQUE STATED IN FT-LBS													
BOLT SIZE	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	--	--	--
Threads & Surface	23-24	56-59	112- 118	196- 206	316- 333	499- 525	683- 719	979- 1031	1354- 1425	1698- 1787	--	--	--
Threads only	27-28	65-68	131- 138	226- 238	365- 384	576- 606	789- 830	1131- 1190	1563- 1645	1959- 2062	--	--	--
CAD Plated	28-29	69-73	138- 145	241- 254	390- 410	614- 646	841- 885	1206- 1269	1666- 1754	2090- 2200	--	--	--
Dry - No lubricant	35-37	86-91	172- 181	301- 317	486- 512	768- 808	1051- 1106	1508- 1587	2083- 2193	2613- 2750	--	--	--

O-RING JOINTS

Assembly of O-ring Joints

The male and female ends of SAE straight thread O-ring ports have UN/UNF straight threads. An elastomeric O-ring is fitted to the male end. During assembly, the O-ring is firmly sandwiched between the angular sealing surface of the female port and the shoulder of the male end. Sealing is thus affected and maintained by the O-ring compression which results from the clamping force generated by tightening. The straight threads do NOT offer sealing action; they provide the resistance (holding power) for service pressure.

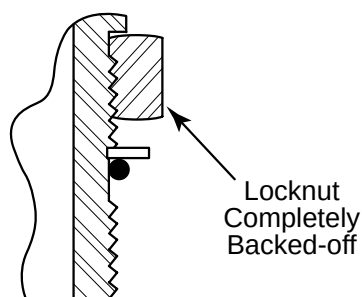
Adjustable End Assembly



LD14838a

FIGURE 66 - ADJUSTABLE END FITTING

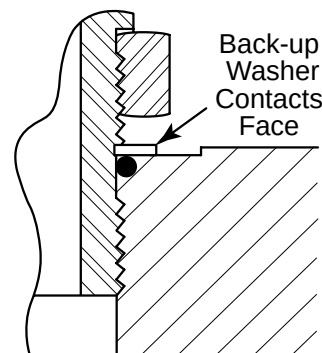
1. Inspect to ensure that both matching parts are free of burrs, nicks, scratches or any foreign particles.
2. Install O-ring on port end of fitting, if it is NOT pre-installed, take care NOT to nick the O-ring.
3. Lubricate O-ring with a light coat of synthetic Polyolester (POE) oil or POE grease.
4. Back off locknut as far as possible. Make sure back-up washer is NOT loose and is pushed up as far as possible.



LD14838

FIGURE 67 - BACK OFF LOCKNUT

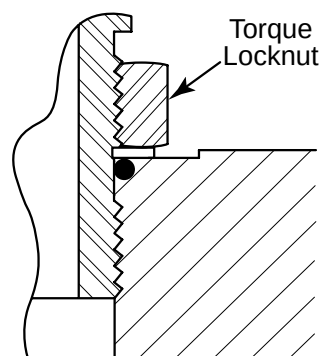
5. Screw fitting into port until the back-up washer contacts the face of the port. Light wrenching may be necessary.



LD14838a

FIGURE 68 - SCREW FITTING INTO PORT

6. To align the tube end of fitting to accept incoming tube or hose assembly, unscrew by required amount, but NOT more than one full turn.
7. Using two wrenches, hold fitting in desired position and tighten locknut to the appropriate torque value shown in *Table 53 on page 152*.
8. Inspect to ensure that O-ring is NOT pinched and the back-up washer seats flat on face of port.

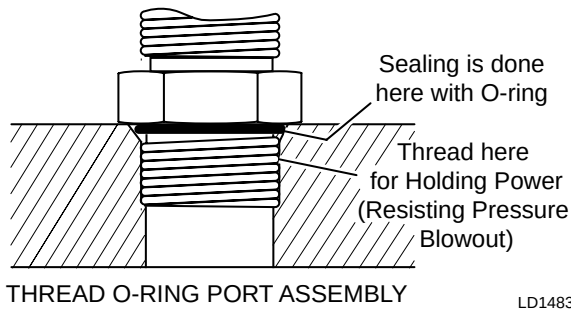


LD14838a

FIGURE 69 - TORQUE FITTING

Straight Non-Adjustable End Assembly

1. Inspect to ensure that both matching parts are free of burrs, nicks, scratches or any foreign particles.
2. Install O-ring on port end of fitting, if it is NOT pre-installed, use care NOT to nick the O-ring.
3. Lubricate O-ring with a light coat of synthetic Polyolester (POE) oil or POE grease.
4. Screw fitting into port until the hex flat contacts the port face. Light wrenching may be necessary.
5. Tighten to give torque for the specified size as specified in *Table 53 on page 152*.

**FIGURE 70 - SAE STRAIGHT THREAD O-RING PORT**

Assembly of O-ring Face Seal Fittings

The male end and female nut of face seal fittings have UN/UNF straight threads. An elastomeric O-ring is fitted into the grooved male end. During assembly, the O-ring is firmly sandwiched between the sealing surfaces. Sealing is thus affected and maintained by the O-ring compression which results from the clamping force generated by tightening the nut. The straight threads do NOT offer sealing action; they provide the resistance (holding power) for service pressure.

O-ring Face Seal Assembly

1. Inspect to ensure that both matching parts are free of burrs, nicks, scratches or any foreign particles.
2. Install O-ring in grooved face seal end of fitting, if it is NOT pre-installed, use care NOT to nick the O-ring.
3. Lubricate O-ring with a light coat of synthetic Polyolester (POE) oil or POE grease.
4. Thread the nut by hand, and tighten nut to the appropriate torque value shown in *Table 53 on page 152*.

TABLE 53 - ASSEMBLY TORQUE

TUBE SIZE	SAE STRAIGHT THREAD SIZE (O-RING PART NUMBER)	SAE STRAIGHT THREAD TORQUE (FT-LBS.)	FACE SEAL TUBE-SIDE THREAD SIZE (O-RING PART NUMBER)	FACE SEAL TUBE-SIDE TORQUE (FT-LBS.)
1/4"	7/16-20 (028-12961-001)	25	9/16-18 (028-12961-011)	18
3/8"	9/16-18 (028-12961-003)	35	11/16-16 (028-12961-012)	30
1/2"	3/4-16 (028-12961-004)	60	13/16-16 (028-12961-013)	40
5/8"	7/8-14 (028-12961-005)	100	1-14 (028-12961-014)	60
3/4"	1 1/16-12 (028-12961-006)	135	1-3/16-12 (028-12961-015)	85
1"	1 5/16-12 (028-12961-008)	200	1-7/16-12 (028-12961-016)	110
1-1/4"	1 5/8-12 (028-12961-017)	250	1-11/16-12 (028-12961-022)	140
1-1/2"	1 7/8-12 (028-12961-020)	305	2-12-UN2A (028-12961-019)	180
**	2 1/4-12 (028-12961-036)	225	-	-

NOTE:

** = SAE SIGHTGLASS

BRAZE JOINTS

Assembly of Brazed Joints

Tubing ends shall be cut square to permit full insertion into the female part of the joint, shall have circular cross-section and shall be free of flat spots, dents, or wrinkles. Fitting cups shall be circular cross-section and free of flat spots. Joint insertion depth shall conform to dimensions shown in *Figure 43 on page 153* except for butt joints using filler metal suitable for a butt joint.



For personnel safety: No brazing or heat working shall be done unless refrigerant is removed and inert gas installed in the system.

TABLE 54 - BRAZED JOINTS

ACTUAL O.D. TUBE SIZE (IN.)	MALE END			FEMALE END		
	OUTSIDE DIAMETER A (IN.)		LENGTH K (IN.)	INSIDE DIAMETER F (IN.)		DEPTH G (IN.)
	MIN.	MAX.	MIN.	MIN.	MAX.	MIN.
1/4	0.248	0.251	0.38	0.252	0.256	0.31
3/8	0.373	0.376	0.38	0.377	0.381	0.31
1/2	0.497	0.501	0.44	0.502	0.506	0.38
5/8	0.622	0.626	0.56	0.627	0.631	0.50
3/4	0.747	0.751	0.69	0.752	0.756	0.62
7/8	0.872	0.876	0.81	0.877	0.881	0.75
1-1/8	1.122	1.127	0.97	1.128	1.132	0.91
1-3/8	1.372	1.377	1.03	1.378	1.382	0.97
1-5/8	1.621	1.627	1.16	1.628	1.633	1.09
2-1/8	2.121	2.127	1.41	2.128	2.133	1.34
2-5/8	2.621	2.627	1.53	2.268	2.633	1.47
3-1/8	3.121	3.127	1.72	3.128	3.133	1.66
3-5/8	3.621	3.627	1.97	3.628	3.633	1.91
4-1/8	4.121	4.127	2.22	4.128	4.133	2.16
5-1/8	5.121	5.127	2.72	5.128	5.133	2.66
6-1/8	6.121	6.127	3.22	6.128	6.133	3.09
8-1/8	8.119	8.127	4.09	8.128	8.133	3.97

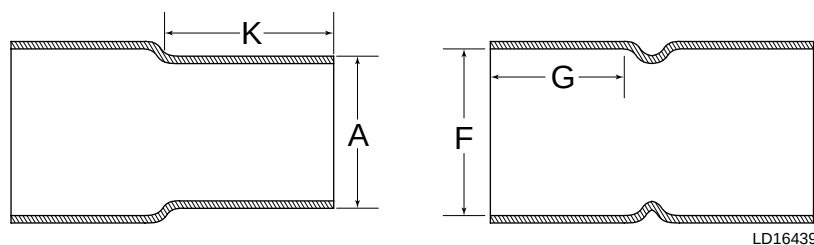


FIGURE 71 - BRAZED JOINTS

Cleaning

All joints shall be cleaned prior to brazing to a bright metal surface (mandatory for refrigerant tubing. Care shall be given to avoid getting loose residue into tubing.

Fluxing

The use of the various brazing fluxes shall be as follows:

- Copper to copper joints using Copper-Phosphorous alloy brazing rod are self-fluxing and do not require use of paste flux.
- Copper to copper alloy, steel (carbon and stainless), Monel, and nickel joints using one of the silver bearing brazing filler metals require the use of flux per ASO Standard R-733 or ASO Standard R-737.

R-733, a white flux, is used for all brazing operations where the mass of metal being heated is small, permitting a rapid rise to brazing temperature of parts being brazed.

R-737, a black flux, is used for all brazing operations where the mass of metal being heated is great requiring prolonged heating with a slow rise to brazing temperature with the possibility of hot spots being caused.

Apply flux sparingly by brush, to male part only.

Procedure

Have a constant flow of inert gas through parts being heated and brazed in quantity sufficient to prevent discoloration. This is mandatory for refrigerant tubing, but at the discretion of service for water tubing.

In brazing, protect all heat damageable parts by wrapping such parts with wet rags, partially immersing in water, or use of chill blocks and directing flame away from such parts.

Whenever possible dismantle heat damageable devices prior to brazing to minimize damage.

Heat damageable parts are:

- All valve bodies
- Couplings (containing non-metallic parts or low temp. solder)
- Driers
- Oil Pres. Reg. Valves
- Reverse cycle valves
- Check valves (containing non-metallic parts)
- Sight glasses (if glass not removable)
- Flexible metallic hoses

Repair Of Defective Joints

Copper to copper joints which leak shall be taken apart, recleaned and the clearance gap checked. If the parts are usable, rebraze.

All other brazed joints, other than copper to copper, which are defective shall be completely removed and cleaned. If parts have not been damaged by previous brazing, they may be rebrazed.

SECTION 8 - COMPRESSOR DRIVE SERVICE

COMPRESSOR DRIVE

The YORK Compressor Drive is a liquid cooled, transistorized, PWM inverter in a highly integrated package.

It is not an option to the chiller as with other YORK compressor drives. It has a maximum output of 200 Hz at 460 VAC OR 400 VAC (400 VAC if input voltage is 380-415 VAC), 460 VAC for all others.

The power section of the drive is composed of four major blocks:

- an AC to DC rectifier section with an integrated pre-charge circuit,
- a DC link filter section,
- a three phase DC to AC inverter section, and,
- an output suppression network.

An electronic circuit breaker with ground fault sensing or non-fused disconnect switch is an option on this product. An input lug connection is standard for all models other than 400VAC. The lugs are connected from the AC line to the input fuses then to an AC line choke, and then to the AC-DC converter. The following description of operation is specific for the 2 compressor drive.



FIGURE 72 - AC TO DC RECTIFIER

The AC to DC semi-converter uses 3 Silicon Controlled Rectifiers (SCR's) and 3 diodes. One SCR and one diode are contained in each module. Three modules are required to convert the 3 phase input AC voltage into DC voltage (1SCR-3SCR) in a three-phase bridge configuration. Refer to *Figure 72 on page 155*. The modules are mounted on a liquid cooled heatsink. The use of the SCR's in the semi-converter configuration permits pre-charging of the DC link filter capacitors

when the chiller enters start mode, and it also provides a fast disconnect from the AC line when the chiller has a unit fault condition.

When the chiller enters the unit fault condition or is shut down via the unit rocker switch is turned off. The SCR's in the semi-converter are no longer turned on and remain in a turned off or non-conducting mode. The DC link filter capacitors will start to discharge through the bleeder resistors. When the chiller enters the start cycle, it is commanded to pre-charge, the SCR's are gradually turned on with a delay angle to slowly charge the DC link filter capacitors. This is called the pre-charge period, which last for 20-seconds. After the 20-second time period has expired, the SCR's are gated fully on.

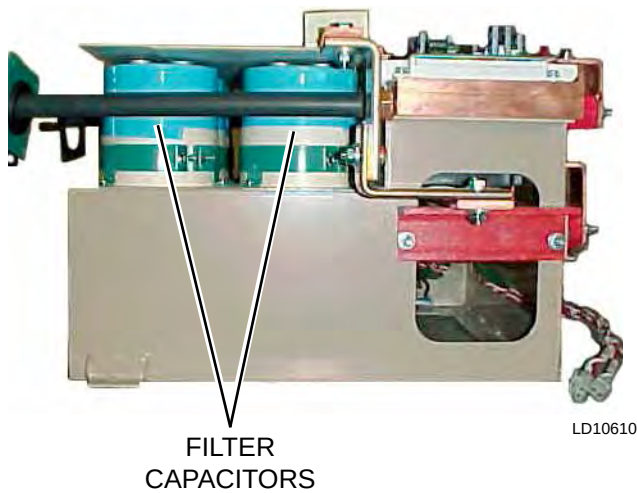
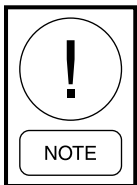


FIGURE 73 - SCR TRIGGER BOARD

The SCR Trigger board provides the turn on commands for the SCR's during precharge, and during normal running condition as commanded by the Logic board. See *Figure 85 on page 161*

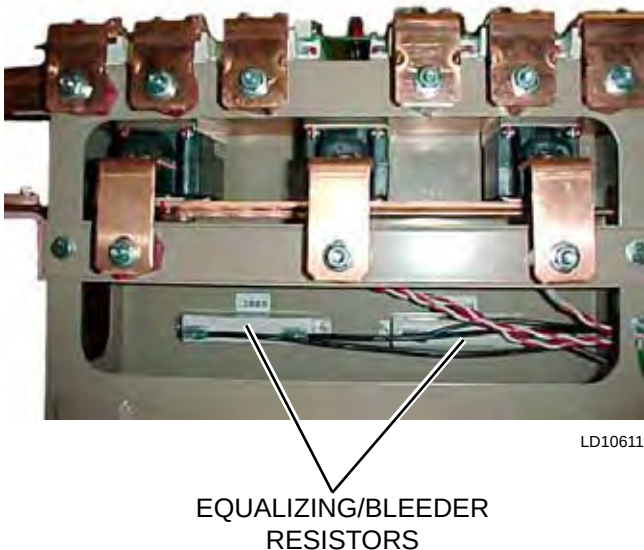


Although many of the parts used in the Compressor Drive are similar to the parts used in previous Variable Speed Drive (VSD) designs, the parts are only compatible with drives as indicated in the product repair parts manual.

**FIGURE 74 - DC LINK FILTER**

The figures included in this form are for the 2 compressor drive.

The DC Link filter section of the drive consists of one basic component, a series of filter capacitors (C1-C6). These capacitors provide a large energy reservoir for use by the DC to AC inverter section. The capacitors are contained in the Power Unit. In order to not exceed the voltage rating of each capacitor, two capacitors are placed in series to form a “pair”. Capacitors “pairs” are paralalled to achieve the current rating needed thus forming a capacitor “bank”.

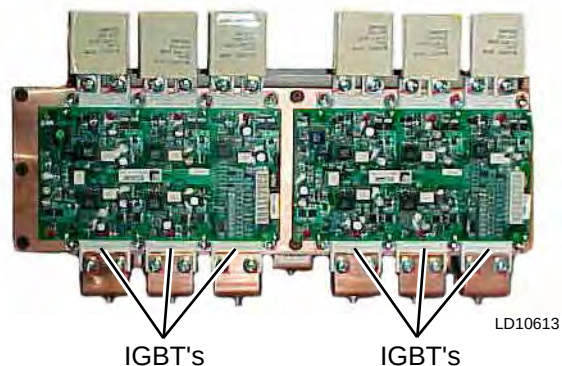
**FIGURE 75 - EQUALIZING/BLEEDER RESISTORS**

When servicing, always check the DC Bus Voltage across the top and bottom, banks of capacitors with a known functioning voltmeter correctly set to the proper scale before performing service on the inverter. DO NOT rely on the Bleeder Resistors to discharge the capacitor banks without checking for the purpose of safety.

NEVER short out a capacitor bank to discharge it during servicing. If a bleeder resistor is open and a capacitor bank will not discharge, immediately contact YORK Product Technical Support.

**FIGURE 76 - 1L LINE INDUCTOR**

In order to assure an equal sharing of the voltage between the series connected capacitors and to provide a discharge path for the capacitor bank when it is powered off, “bleeder” resistors (1RES and 2RES) are connected across the capacitor banks. The “Bleeder” resistors are mounted on the front of the Power Unit under the SCR’s.

**FIGURE 77 - DC TO AC INVERTER**

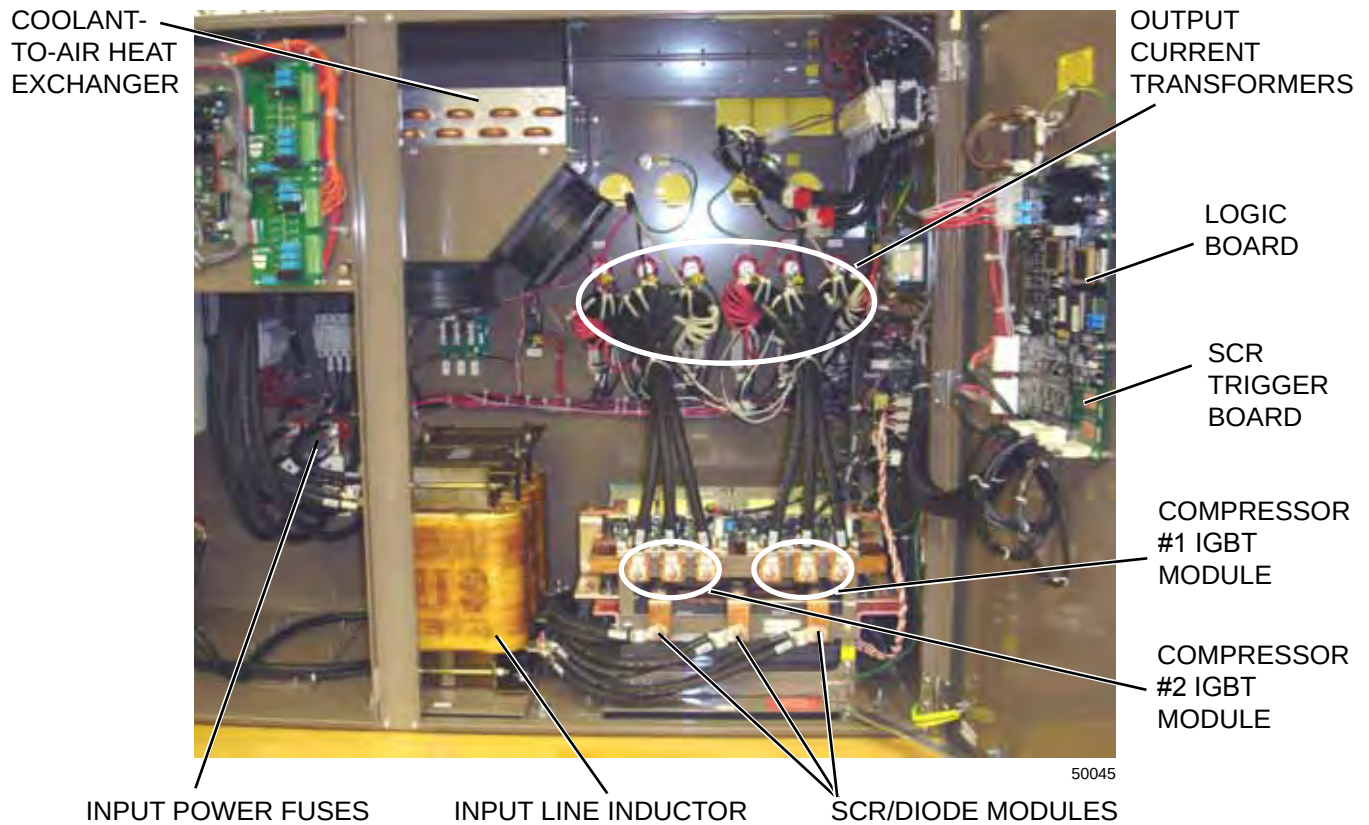


FIGURE 78 - CONTROL PANEL

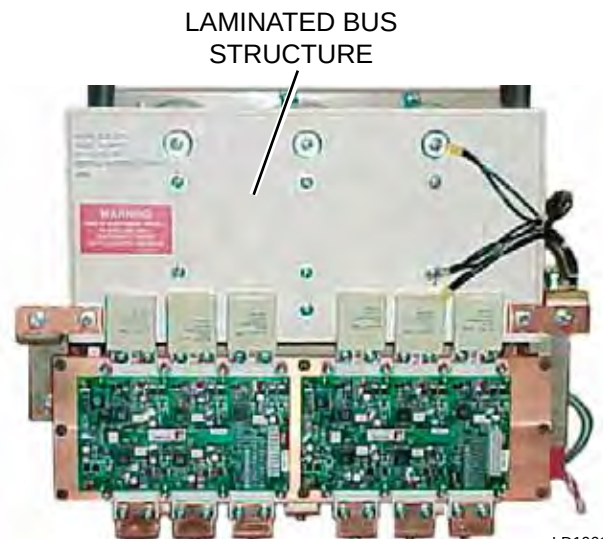
The DC to AC inverter section converts the DC voltage back to AC voltage at the proper magnitude and frequency as commanded by the Logic board. The inverter section is composed of one power unit. This power unit is composed of very fast switching transistors called an Insulated Gate Bipolar Transistor (IGBT) module (1MOD and 2MOD) mounted on the same liquid cooled heatsink as the semi-converter modules, the DC Link filter capacitors (C1-C6), a semi-converter, and a Gate Driver board (031-02061) mounted directly to the IGBT module.



LD10613

FIGURE 79 - IGBT GATE DRIVER BOARDS

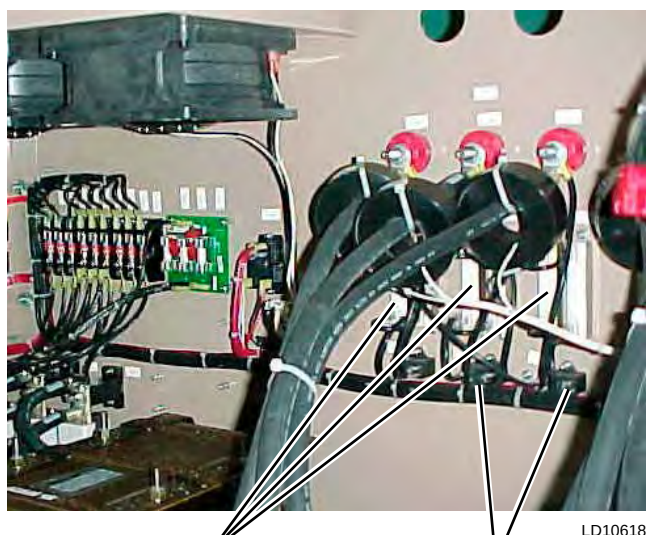
The Gate Driver Board provides the turn on and turn off commands to the IGBT's output transistors. The Compressor Drive Logic board determines when the turn on, and turn off commands should occur. The gate driver board is mounted directly on top of the IGBT module, and it is held in place with mounting screws and soldered to the IGBT module.



LD10614

FIGURE 80 - LAMINATED BUS STRUCTURE

If the IGBT modules and the capacitor bank were connected together with wire a large amount of inductance from the wire would cause a failure in the IGBT. To reduce the inductance of the bus assembly YORK employs a “laminated bus” structure technology. The “laminated bus” structure connects the IGBT module to the capacitor bank through 2 copper plates that are insulated from each other. When an insulator separates 2 copper plates they form a capacitor, which will counteract the inductance of the bus assembly. To further cancel the inductances in the laminated bus structure, a series of small capacitors (C7-C12) are connected between the positive and negative plates at the IGBT modules connections.



DV/DT
RESISTORS

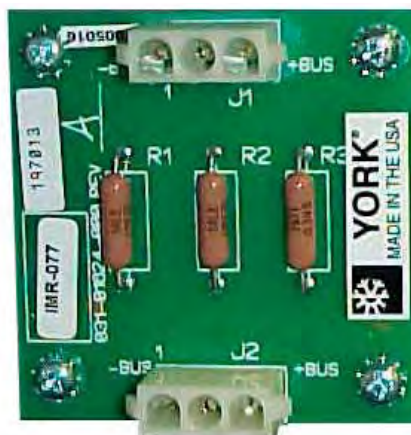
DV/DT
CAPACITORS

FIGURE 81 - DV/DT OUTPUT SUPPRESSION NETWORK

The output suppression network is composed of several capacitors (C13-C18) and resistors (3RES-14RES). The parameters of the suppression network components are chosen to work in unison with the inductance of the DC to AC inverter sections in order to simultaneously limit both the rate of change in voltage and the peak voltage applied to the motor windings.

By limiting the peak voltage to the motor windings, as well as the rate-of-change in motor voltage, problems commonly associated with PWM motor drives, such as stator-winding end-turn failures and electrical fluting of motor bearings can be avoided.

Other sensors and boards are used to convey information back to the Logic board and provide safe operation of the Compressor Drive. The IGBT modules contain a thermistor temperature sensor (RT1 and RT2) that provides temperature information back to the logic board via the gate driver boards.



LD10620

FIGURE 82 - DC BUS VOLTAGE ISOLATION BOARD

The Bus Voltage Isolator board (031-01624) utilizes three resistors on the board to provide a “safe” resistance between the DC link filter capacitors located in the power unit and the logic board. It provides the means to sense the positive, midpoint and negative voltage connection points of the DC link.



LD10617

CURRENT
TRANSFORMERS

FIGURE 83 - CURRENT TRANSFORMERS

Six Current Transformers (4T-9T) monitor the output current from the power unit and are used to protect the motor from overcurrent conditions.



LD10623

FIGURE 84 - CHILLER CIRCUIT BREAKER

An Optional Circuit Breaker may be supplied on the input of the system. The incoming power will be fed to the terminals on the circuit breaker. If the circuit breaker option is not selected, incoming power will be fed to terminal blocks. The breaker also provides ground fault protection. 2 compressor chillers utilize one circuit breaker.

COMPRESSOR DRIVE CONTROL SYSTEM OVERVIEW

It is housed in the same cabinet as the rest of the chiller control system. The chiller control board dictates to compressor drive the RPM to run the compressor based upon the leaving chilled liquid temperature control or any limiting controls. The only time it will override the control system is when a shutdown condition occurs.

The control system is composed of various components located within the Chiller Control Center which allows integration between the Chiller Control Center. The system utilizes various microprocessors and Digital Signal Processors (DSPs) which are linked together through a serial communications link.

The Chiller Control Center

The Chiller Control Center contains 2 main boards. The first main board, the chiller control board, controls all aspects of the chiller as well as the output speed. The logic board, the second main board, determines precharge, evaluates fault conditions, and determines how and when to turn on or off the output.

The chiller control board and the logic board communicate via a serial communications cable. Under normal conditions the chiller control board sends an RPM command to the logic board. The logic board determines the correct output frequency and voltage to rotate the compressor motor. It determines that a fault condition is present, the logic board will open its fault relay, turn off the output of the drive and then report the fault along with fault data to the chiller control board.

Compressor Drive Logic Board

The logic board performs numerous functions. These functions include control of the cooling fans and pump, pre-charging of the bus capacitors, and generation of the PWM. Refer to *Figure 85 on page 161* for the location of the various connectors on the logic board.

- The internal cooling fans and pump are commanded to turn on whenever the drive is commanded to run via J10 pins 1 and 2. They will turn off when the drive is commanded to stop. If a shutdown is due to a high-temperature condition, the internal cooling fans and pump will continue to run until the value of the internal temperature has dropped below a specified value.

In an attempt to keep the internal temperature cool enough to start, internal cooling fans and pump will turn on without the chiller running if the internal temperature is within 10°F of the fault value. This fault value will change depending on the number of compressors on the chiller. The internal cooling fans and pump will turn off when the internal temperature of the drive is 15°F below the fault value.

The fans and pump will also turn on if the chiller is placed in service mode and the status of the VSD cooling fans/pump is enabled. The Logic board sends a command signal to the SCR trigger board to precharge the bus capacitors. The pre-charge command is sent to SCR trigger board on J11 pin 3-4.

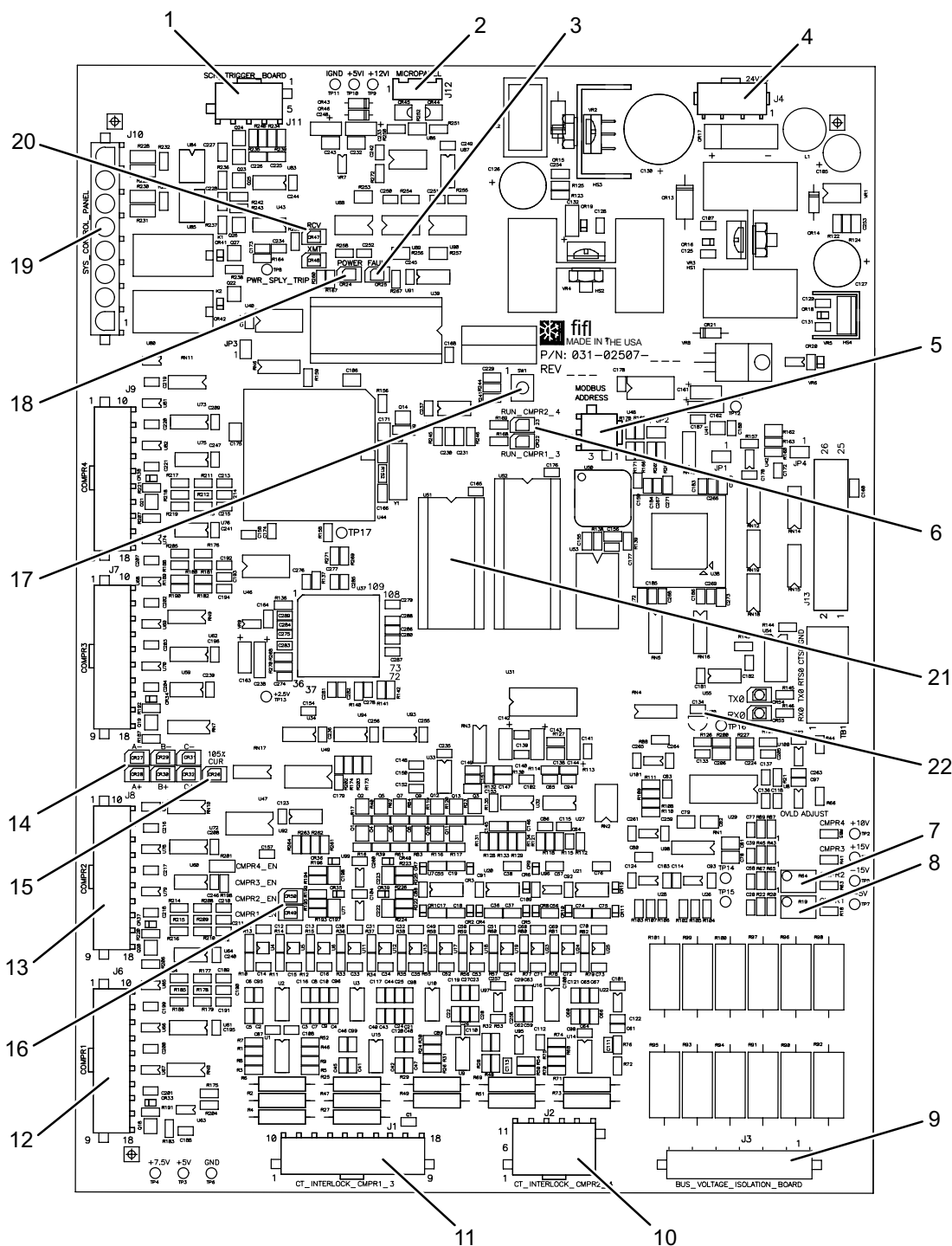
- The PWM generation is required so that the output will provide the proper voltage to the motor for a given output frequency. The PWM signals are sent to the IGBT gate driver board via J6 for compressor #1, and J8 for compressor #2.

The logic board determines shutdown conditions by monitoring all three phases of motor current for each compressor, baseplate temperature for each IGBT module, internal ambient temperature, and the DC Link voltage.

- Current transformers, mounted on the output motor wiring to the compressors, monitor the output motor current on each of the three phases and send this information to the J1 and J2 connectors.
- The baseplate temperature is monitored by a thermistor mounted inside each IGBT module. Any one of the thermistors can cause a high temperature fault. The thermistor voltage is read at the J6 and J8 connector.
- The internal ambient temperature is monitored by a temperature sensing device mounted on the Logic board.
- The DC link isolator board monitors the DC link voltage and is connected to J3.

The logic board also contains many LED's to indicate various conditions of the drive. These LED's are used to monitor system operation during the manufacturing process of the system. Refer to *Figure 85 on page 161* for the location of various LEDs.

- 105% LED will light whenever any phase of motor current is 2% greater than 100% current rating as set by the percent FLA adjustment pot.
- A-, A+, B-, B+, C-, C+ LEDs light whenever the IGBT gate driver is turned on, and will not light whenever the IGBT gate driver is turned off. At low motor output frequencies these LEDs will flash. They will remain on constantly when the drive is running at high output frequency.
- RCV (receive) and XMT (transmit) LEDs will flash when the logic board is communicating with the chiller control board. Each should flash about once a second.
- Power LED will light any time power is applied to the logic board.
- Fault LED will light whenever the fault relay is open indicating a fault condition.
- Compressor Enable LEDs will light when the drive has received the hardware and software run signal from the chiller control logic board for that compressor. Four LEDs are located on the logic board 1 for each compressor.
- Compressor Run LEDs will light when the drive has received the hardware run signal from the chiller control logic board. Two LEDs are located on logic board 1 for each chiller system.



1 SCR Trigger Output J11	9 BUS Voltage Feedback J3	17 Gate Driver Test Switch SW1
2 COMMS To Microboard J12	10 MTR Current Feedback Compr #2 J2	18 Power LED
3 Fault LED	11 MTR Current Feedback Compr #1 J1	19 Run CMD, Fault Relay Output, Fan and Pump Control J10
4 Input Power Supply J4	12 IGBT Gate Drive Compr #1 J6	20 Send and Receive COMMS LED'S
5 MODBUS Address J5	13 IGBT Gate Drive Compr #2 J8	21 BRAM U51
6 Compressor Run LED'S	14 Gate Driver LED'S	22 Internal Temperature Sensor
7 Overload Set Pot Compr #2	15 Overload LED	
8 Overload Set Pot Compr #1	16 Compressor Enable LED'S	

FIGURE 85 - COMPRESSOR DRIVE LOGIC BOARD DETAILS

TROUBLESHOOTING AND UNIT SHUTDOWN

This product contains voltages that could cause injury! Before performing any of these procedures, place the unit switch in the “STOP” position. Wait 5 minutes, ensure the DC bus voltage is 50 VDC, or less, on the display of the chiller. Remove all AC power sources and perform lockout tagout procedures. Using a non-contact voltage sensor, ensure no AC power is present in the enclosure. Measure the DC bus voltage at J3 pins 1-3 on the logic board using a dvm to ensure that the bus voltage is less than 50 VDC.

General Information

The Unit Shutdowns are organized in alphabetical order based on the Chiller Control Center messages.

Whenever a Unit Shutdown is generated a series of events will occur.

- Any shutdown that occurs while the chiller is not running will cause a start inhibit. The chiller cannot start until the shutdown is cleared.
- If the chiller is running when the shutdown occurs the logic board will turn off all of the IGBT gate drivers.
- The fault relay for the faulted system on the logic board will de-energize causing a momentary open circuit between J10-3 and J10-4. This open circuit will indicate to the Chiller Control Center the VSD has shutdown. The fault relay will remain de-energized until the Chiller Control board has acknowledged the cause of the shutdown. Once the Chiller Control board has acknowledged the shutdown the fault relay will close.
- The logic board will send a shutdown code via the serial communications link to the Chiller Control board. The Chiller Control board will interpret the shutdown code, and display a shutdown message on the display of the Chiller Control Center.

After the reason for the shutdown has been corrected, the chiller may auto restart, but will lock out the operation of the chiller if the same shutdown were to occur 3 times within a 90-minute window unless otherwise noted in the shutdown information.

DC Bus Voltage Imbalance

The DC bus voltage is filtered by many large capacitors, which are rated for 450 VDC. Two capacitors are wired in series to achieve a 900 VDC capability for the DC bus voltage. It is important that the voltage is shared equally across each capacitor.

The voltage across each half of the bank is monitored and if the voltage on either half of the bank is greater than ± 100 VDC from $\frac{1}{2}$ of the total DC link voltage, then this shutdown will occur.

The DC Bus Voltage Imbalance shutdown will lockout the operation of the chiller on the first event.

Possible Causes:

- Bleeder resistor failure. Verify the two bleeder resistors are the same value. The value should be 2.4K ohms. Ensure that a thermal pad is installed beneath each resistor and the mounting nuts of the bleeder resistor are tight. A new thermal pad should be installed when the resistors are replaced.
- Intermittent wiring connection. Verify continuity of the wiring between the large capacitors, bus isolator board, logic board and the bleeder resistors.
- Failure of the bus voltage isolation board. Use an ohmmeter to measure from J1 pin 1 to J2 pin 1 on the bus voltage isolation board. The ohm reading should be 150k ohm. Repeat this measurement for pin 2 and pin 3. The resistance reading should be the same for all 3 measurements. If the measurements are not 150k ohms, then the bus isolator board needs to be replaced.
- Shorted DC link capacitor. Using an analog ohmmeter on the Rx10 scale, take an ohm reading across half of the bus. The needle of the meter should first go to the right, and then gradually move to the left as the capacitor charges up to the meter's output voltage. A shorted capacitor will keep the needle to the right and will not charge up. Repeat this test for the other half of the capacitor bank. Replace the complete power assembly with the bus capacitors included if a shorted capacitor is present.
- Open DC link capacitor. Using an analog meter on the Rx10 scale, take an ohm reading across half of the bus. The needle of the meter should first go to the right, and then gradually move to the

left as the capacitor charges up to the meter's output voltage. An open capacitor will not charge up, but the needle will remain to the left, or discharge very little. Repeat this test for the other half of the capacitor bank. Replace the complete power assembly with the bus capacitors included if an open capacitor is present.

- Failed logic board. Replace the logic board.

High DC Bus Voltage

While the chiller is running, the DC bus voltage is continuously monitored by the logic board through the bus voltage isolation board. If the level of the bus voltage exceeds 766 VDC a shutdown is initiated. This shutdown will protect the capacitors from a voltage that exceeds their rating.

Possible Causes:

- Supply voltage not within the chiller's voltage utilization range. Have the customer verify that the supply voltage to the chiller is within specification.
- Transient voltage surge. The shutdown may be a result of a storm or power grid switching. Speak with a person on site at the time of the shutdown to determine if a voltage anomaly occurred.
- Meg the compressor motor. If a phase has gone to ground this shutdown may be displayed. Wiring to the motor must be disconnected before megging the motor. Failure may result if motor wires are not removed.
- Failure of the bus voltage isolation board. Use an ohmmeter to measure from J1 pin 1 to J2 pin 1 on the bus voltage isolation board. The ohm reading should be 150k ohms. Repeat this measurement for pin 2 and pin 3. The resistance measurements should be the same for all 3 measurements. If the measurements are not 150k ohms, then the bus isolator board needs to be replaced.
- Failed logic board. Replace the logic board.

High VSD Internal Ambient Temperature

The ambient temperature is monitored by a temperature sensing device mounted on the logic board. The high ambient trip threshold is set for 158°F (70°C). If this shutdown occurs, the internal cooling fans and-coolant pump will remain on until the internal ambient temperature has fallen to 143°F (62°C).

The chiller will auto-restart when the internal temperature has dropped below the shutdown level.

Possible Causes:

- Improper coolant level. Refer to *SECTION 6 - MAINTENANCE* for the proper coolant level.
- Failure of a coolant hose or clamp. Perform a visual inspection for a coolant leak. Ensure the coolant hoses at the drive or coolant pump are not kinked.
- Excessive coolant temperature. Coolant temperature entering should not exceed 140°F or 60°C. Failure of plant condenser heat rejection system, such as pump or cooler fan could cause excessive coolant temperature.
- Failure of the coolant pump or internal fans. Perform ohm check for the fan and the coolant pump fuses using the wiring diagram for your chiller model and an ohmmeter. Refer to *Digital Output Connection on page 53* of this manual for instructions to manually control the coolant pump and fans. Listen to verify the coolant pump and fans are running.
- Dirty VSD shell and tube heat exchanger is causing higher than normal coolant liquid temperatures. Regular maintenance of the heat exchanger tubes are required.

Low DC Bus Voltage

While the chiller is running, the DC bus voltage is continuously monitored by the logic board through the bus voltage isolation board. If the line voltage were to quickly drop the current seen by the motor could exceed it's rating or the rating of the IGBT. The low bus voltage shutdown will prevent this from happening. This shutdown is generated when the bus voltage drops below the thresholds defined in the Unit Safety Faults (see *Table 62 on page 204*) table of this manual.

Possible Causes:

- Supply voltage not within the chiller's specified voltage utilization range. Have the customer verify that the supply voltage to the chiller is within specification.
- Transient voltage surge. This shutdown may be a result of a storm or power grid switching. Speak with a person on site at the time of the shutdown to determine if a voltage anomaly occurred.

- Intermittent wiring connection. Verify continuity of the wiring between the large bus capacitors, the bus isolation board, the logic board and the bleeder resistors. There could also be an intermittent wiring connection between the SCR trigger board and the SCR's or between the SCR trigger board and the logic board. Refer to the wiring diagram for the wire numbers.
- Failed bus isolator board. Use an ohmmeter to measure from J1 pin 1 to J2 pin 1 on the bus isolator board. The reading should be 150k ohms. Repeat this measurement for pins 2 and 3. The resistance readings should be the same for all 3 measurements. If the readings are not 150k ohms, then the bus isolator board needs to be replaced.
- Perform an ohm check between the + bus connection on the power assembly and J3 pin 1 of the logic board. The reading should be 150k ohms. At the same time, gently try to move the connectors at the bus isolation board and the logic board. Repeat this test for the center bus connection and J3 pin 2, and the – bus connection and J3 pin 3. The ohm value should not change. If the value does change determine where the bad connection is and replace that board.
- Failed SCR trigger board. Replace the SCR trigger board.
- Failed SCR. Replace the SCR module.
- Failed logic board. Replace the logic board.

Motor Current Overload

This shutdown is generated when the logic board has detected that the highest of the three output phase currents for any compressor has exceeded 102% of the programmed 100% rated load amps (RLA) value for more than 30 seconds. The 102% RLA setpoint is determined by adjustment of the FLA trimpots on the logic board. Each compressor motor has its own trimpot. This shutdown will lockout the operation of the chiller on the first event.

Possible Causes:

- RLA value not properly set. For details on how to view the overload values refer to the logic board replacement procedure in this form for information on how to adjust the RLA value, if required.
- Excessive operating condenser pressure. Possible causes are reduced cooling from the plant.
- Restriction in the refrigerant circuit. Refer to *SECTION 7 - CHILLER SYSTEM SERVICE* for possible causes.
- The economizer valve not working properly or stuck open. Refer to *Valve Controller and Control Algorithm Operation on page 41* for possible causes.
- Feed and drain valves not working properly. Refer to *Valve Controller and Control Algorithm Operation on page 41* for possible causes.

Precharge - DC Bus Voltage Imbalance

The definition for this shutdown is identical to “DC Bus Voltage Imbalance”, except this shutdown occurs during the precharge period. Refer to “DC Bus Voltage Imbalance” shutdown for possible problems. This shutdown will lockout operation of the chiller on the first event.

Precharge - Low DC Bus Voltage

The logic board determines this shutdown with information from the bus isolator board. This shutdown has two different timing events. First, the DC Bus voltage must be equal to or greater than 41 VDC four seconds after pre-charge has begun. Second, the DC Bus voltage must be equal to or greater than 500 VDC 19 seconds after pre-charge has begun. This shutdown is important to determine if the converter is not working properly or if the capacitor bank is shorted.

Possible Causes:

- Input power fuses open. Use an ohmmeter to verify the input power fuses are not open.
- Intermittent wiring connection. Verify continuity of the wiring between the large capacitors, the bus isolator board, the logic board and the bleeder resistors. There could also be an intermittent wiring connection between the SCR trigger board and the SCR's or between the SCR trigger board and the logic board. Refer to the wiring diagram for wire numbers.
- Shorted DC link capacitor. Using an analog ohmmeter on the Rx10 scale, take an ohm reading across half of the bus. The needle of the meter should first go to the right, and then gradually move to the left as the capacitor charges up to the meter's output voltage. A shorted capacitor will keep the needle to the right and will not charge up. Repeat this test for the other half of the capacitor

bank. Replace the complete power assembly with the bus capacitors included if a shorted capacitor is present.

- Unseated connector. Verify that J4 on the SCR trigger board is properly installed. Verify that J11 on the logic board is properly installed. Verify that the sockets are properly seated in the housings and that none of the sockets are spread open.
- Failed SCR trigger board. Replace the SCR trigger board.
- Failed logic board. Replace the logic board.
- Failure of an input diode/SCR pair. Replace the input SCR/Diode module.

Single Phase Input Voltage

This shutdown is generated by the SCR Trigger board and relayed to the logic board to initiate a unit shutdown. The SCR trigger board uses circuitry to detect the loss of any one of the three input voltage phases. The SCR trigger board will detect the loss of a phase within one half line cycle of the phase loss. This shutdown is always an auto-restart when the fault has cleared.

Possible Causes:

- Loss of power. This message is displayed every time power is restored or if the input power dips to a very low level. This is not an indication of a problem.
- Transient voltage surge. The shutdown may be a result of a storm or power grid switching. Speak with a person on site at the time of the shutdown to determine if a voltage anomaly occurred.
- Input power fuses are open. Use an ohmmeter to verify the three input power fuses are not open.
- Input fuse to the SCR trigger board open. Use an ohmmeter to verify the input fuse feeding TB3 of the SCR trigger board is not open. Refer to the wiring diagram for the fuse designation.
- Intermittent wiring connection. Verify continuity of the wiring between the SCR trigger board terminals TB1, TB2 and TB3 to the input power fuses. Refer to the wiring diagram for the wire numbers.

- Unseated connectors. Verify connector J4 on the SCR trigger board and connector J11 on the logic board are properly seated. Verify the sockets are properly seated in the connector housings and none of the sockets are spread open.
- Failed SCR trigger board. Replace the SCR trigger board.
- Failed logic board. Replace the logic board.

VSD Communications Failure

At power-up, the logic board will go through a process called initialization. At this time, memory locations are cleared, jumper positions are checked and the serial communication link is established between the VSD logic board and the chiller control logic board. If at any time the chiller control logic board does not receive valid data from the VSD logic board for a period of 8 seconds this shutdown will occur.

Possible Causes:

- Unseated connectors. Verify the communication wire harness connectors are properly seated on the VSD logic board at J12 and the chiller control logic board at J2. Ensure that the shield is only connected at the chiller control logic board. Check for continuity and also check to see that none of the conductors are shorted together or shorted to ground.
- Incorrect Modbus address setting. Verify the Modbus address jumper plug is properly installed in J5 of the logic board. The default address is address #1. The table shows the J5 jumper configurations for all of available Modbus addresses. The chiller control must be programmed with the identical address as set per the J5 jumper on the logic board. The default address for both J5 on the logic board and the address programmed into the chiller control is 1.

LOGIC BOARD MODBUS ADDRESS	LOGIC BOARD JUMPER POSITION
1	J5-1 to J5-2 J5-3 to J5-4

- Unseated or incorrect EPROMs. Verify all EPROMs are properly seated in their sockets and none of the pins are bent over. Refer to *SECTION 7 - CHILLER SYSTEM SERVICE*.
- Improper powering of the chiller control center. The chiller control logic board and the VSD logic board must be energized at the same time. Do not pull fuses in the control center to make wiring changes. Use the main disconnect device to remove and apply power to the chiller control center with all fuses installed.
- Poor grounding. The source of the incoming earth ground for the chiller system. Ground is then conducted to the rest of the chiller by the mounting connections and the ground wiring to the compressor motors. All mechanical connections in the enclosure to the chiller frame are made with external tooth lock washers. These washers cut through the paint on the chiller and provide a ground connection. Check the tightness of all ground wires within all the compressor motor terminal boxes. Ensure the green earth wire from J4 logic board is attached to the enclosure. Check and tighten as needed the mounting bolts that attach to the chiller frame.
- Failed RS-485 communication driver. Replace the RS-485 communications driver on both the logic (U86) and the chiller control (U5) boards.
- Failed logic board. Replace the logic board.
- Failed chiller control board. Replace the chiller control board.

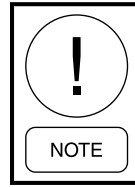
VSD CT Plug Fault

This shutdown is generated by the logic board. Connectors J1 and J2 on the logic board contain jumpers between the 2 connectors. If either of the connectors is loose or missing a fault will occur. This ensures that the VSD logic board always has current feedback information from each compressor motor.

Possible Causes:

- Unseated connector. Check to ensure J1 and J2 on the logic board are properly seated.
- Loose or intermittent wiring connection. Verify continuity of the wiring between connector J1 sockets 7 or 8 and connector J2 sockets 7 or 8 on

the VSD logic board. Refer to wiring diagram for wire reference designators. Verify that the sockets are not spread out and the sockets are properly installed in the connector housing.



Do not insert meter probes inside the sockets. Although, this is a simple way to hold the probes, this practice will spread the socket and may cause intermittent problems in the future. A better practice is to insert the probe into the back of the connector to make a measurement.

VSD Logic Board Failure

This shutdown is generated by the VSD logic board. If a communications problem occurs between the two microprocessors on the logic board, this fault will occur. This fault is only verified during precharge and run conditions.

Possible Causes:

- Failed VSD logic board. Replace the VSD logic board.

VSD Logic Board Power Supply

This shutdown is generated by the VSD logic board. This shutdown indicates that one of the VSD logic board DC power supplies has fallen outside their allowable operating limits. The power supplies for the VSD logic board are derived from the secondary of the 120 to 24 VAC transformer 3T which in turn is derived from the 480 or 400V at 50Hz to 120 VAC control transformer 2T.

Possible Causes:

- Momentary loss of power. This message is displayed every time power is applied or if the input power dips to a very low level. This is not an indication of a problem unless this shutdown does not clear.
- Unseated connector. Reseat the power supply connector J4 on the logic board.
- Open fuse(s). Use an ohmmeter to verify fuses 4FU, 5FU, 17FU, and 18FU are not open.
- Intermittent wiring connection. Use an ohmmeter to verify continuity of the wiring between transformers 2T and 3T and the VSD logic board. Refer to the wiring diagram for wire numbers.
- Failed logic board. Replace the VSD logic board.

TROUBLESHOOTING SYSTEM SHUTDOWNS



This product contains voltages that could cause injury! Before performing any of these procedures, place the unit switch in the “STOP” position. Wait 5 minutes. Ensure the DC bus voltage is 50 VDC, or less on the display of the chiller panel. Remove all AC power sources and perform lockout/tagout procedures. Use a non-contact voltage sensor to ensure no AC power is present in the enclosure. Measure the DC bus voltage at J3 pins 1-3 on the logic board using a dvm to ensure the bus voltage is less than 50 VDC.

General Information

The System Shutdowns are organized in alphabetical order based on the Chiller Control Center messages.

Whenever a System Shutdown is generated a series of events will occur.

- Any shutdown that occurs while the chiller is not running will cause a start inhibit for that system. That chiller system cannot be started until the shutdown has been cleared.
- If the chiller is running when the shutdown occurs the logic board will turn off the IGBT gate drivers for the failed system.
- The fault relay for the faulted system on the VSD logic board will de-energize causing an open circuit between J10-3 and J10-4. This action will indicate to the Chiller Control Center has shutdown. The fault relay will remain de-energized until the Chiller Control board has acknowledged the cause of the shutdown. Once the Chiller Control board has acknowledged the shutdown the fault relay will close.
- The VSD logic board will send a shutdown code via the serial communications link to the Chiller Control board. The Chiller Control board will interpret the shutdown code, and display a shutdown message on the display of the Chiller Control Center.

After the reason for the shutdown has been corrected, the chiller may auto restart, but will lock out the operation of the chiller if the same shutdown were to occur 3 times within a 90-minute window, unless otherwise noted in the shutdown information.

Gate Driver

The unit has 2 methods of detecting an over current condition. One is from the output current transformers and the second is the gate driver fault. The gate driver fault is detected on the gate driver board. The on-state or collector-to-emitter voltage of each IGBT is checked while the device is turned on. This is also called the collector-to-emitter saturation voltage. If the voltage across the IGBT is greater than a set threshold as defined by the gate driver board, the IGBT is turned off and a shutdown pulse is sent to the logic board shutting down the chiller system. This fault can indicate that too much current is flowing through the IGBT when the device is being commanded to turn on. This fault can also be caused if an IGBT is turned off when it should be turned on or if the gate drive power supply falls below permissible limits.

Possible Causes:

- Unseated connector. Reseat connectors on the VSD logic board, SCR trigger board and the IGBT gate drive board.
- Failure of the SCR trigger board. Inspect part Q10 on the SCR trigger board. When an IGBT module fails it may cause Q10 to fail and the part may be burned and/or cracked. Replace the SCR trigger board if damage is noted to part Q10.
- Intermittent wiring connection. Use an ohmmeter to verify the wiring between the VSD logic board, SCR trigger board and the IGBT gate driver board. Also, verify the motor is properly wired inside the logic board and motor terminal box and that all connections are tight.
- Compressor motor snubber failure. On the back wall of the VSD logic board near the motor connections there are a series of resistors and capacitors that make up the motor snubber network. Use an ohmmeter to verify the proper wiring of these components. Refer to the wiring diagram. Also ensure with an ohmmeter that the value of the resistors is 10 ohms and the capacitors are not shorted. If a resistor does not have a value of 10 ohms, then it should be replaced. If a capacitor is shorted, it should be replaced.
- Motor stator winding failure. Remove the motor wires between the logic board and the compressor motor. Meg the motor phase to phase and phase to ground. Replace the motor if this test fails.

- Failure of the IGBT module. Refer to *Verifying Failure of the IGBT Module on page 173* of this form to check an IGBT module.
- How to determine if a fault lies within the logic board or with the compressor/motor. Note the system (#1 or #2) causing the fault. Swap the three phases of output motor wiring, between system #1 and system #2, at the IGBT modules. Also, swap the CT feedback plugs J44 and J45 (refer to wiring diagram). **Do not run the chiller for a long period of time since the condenser temperature control will not work correctly.** If the opposite system indicates a fault, the problem lies with the compressor or compressor motor on the system now indicating the fault. Replace the compressor/motor. If the original system is still indicating a fault then the fault lies within the logic board. Replace the IGBT assembly for that system. If the IGBT assembly is not failed, replace the logic board.

High Motor Current

This shutdown is generated by the logic board. If any one phase of motor current as measured by the Output Current Transformers exceeds a pre-determined instantaneous level, a shutdown will occur. The current values displayed by the panel are averaged RMS values so the displayed value may not be indicative of the instantaneous value of current which causes a high motor current trip.

Possible Causes:

- Momentary line voltage sag. This message may be displayed if the input power sags below the specified sag voltage rating for this product. This is especially true if the chiller was running at, or near, full load. The chiller cannot unload quickly enough to correct for this sudden increase in current. If this is the case, the chiller will auto restart. This is not an indication of a problem with the logic board
- Unseated connector. Reseat the connectors on the logic board and the IGBT gate drive board.
- Intermittent wiring connection. Use an ohmmeter to verify the wiring between the logic board and the IGBT gate driver board. Refer to the wiring diagram
- Failure of an output current transformer. Disconnect the connector for each of the output current transformers and take an ohm reading at the con-

nector. Each current transformer should have an ohm reading of 125 ± 19 ohms. **Note: Readings at connectors should be taken from the back of the connector so that the socket is not spread apart.** If the reading is within range, then reinstall the connector. If the reading is not within range, replace the faulty current transformer.

- Motor stator winding failure. Meg the motor phase to phase and phase to ground. **Wiring between the logic board and the motor must be disconnected before megging the motor. Failure may result if motor wires are not removed.** Replace faulty motor if the motor fails the test.
- Failure of the IGBT module. Refer to *Verifying Failure of the IGBT Module on page 173* of this form to check an IGBT module.
- Restriction in the refrigeration circuit. Refer to *SECTION 7 - CHILLER SYSTEM SERVICE* for possible causes. Failure of the logic board. Replace the logic board.
- Economizer valve is not working properly or stuck open. Refer to *Valve Controller and Control Algorithm Operation on page 41* for possible causes.
- Feed and drain valves not working properly. Refer to *Valve Controller and Control Algorithm Operation on page 41* for possible causes.

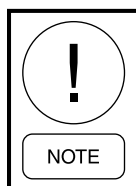
High VSD Baseplate Temperature

A 5K ohm (at 77°F) thermistor sensor is embedded inside each IGBT Module on the power unit. If at any time this thermistor detects a temperature in excess or a predetermined limit, a shutdown will occur. The internal cooling fans and coolant pump will continue to run after the shutdown, until the thermistor temperature has dropped to an acceptable level. Refer to *Table 55 on page 169* for detailed thermistor values.

Possible Causes:

- Improper coolant level. Refer to *SECTION 6 - MAINTENANCE* for the proper coolant level.
- Failure of a coolant hose or clamp. Perform a visual inspection for a coolant leak. Also, check for a kinked coolant hose.
- Excessive coolant temperature. The coolant temperature entering the logic board is not to exceed 140°F or 60°C. High entering condenser water temperature or very low condenser water flow could cause excessive coolant temperature.

- Failure of the coolant pump. Perform an ohm check for the coolant pump fuses using the wiring diagram for your chiller model and an ohmmeter. Refer to *Digital Output Connection on page 53* of this manual for instructions to manually control the coolant pump. Listen to verify the coolant pump is running.
- Failure of the IGBT assembly or logic board. Remove the gate driver connector from the logic board (J6 for system #1 and J8 for system #2). Take an ohm reading between pins 6 and 8 on J6 and J8 and compare the readings with the values shown in *Table 55 on page 169*. If the values are in accordance with *Table 55 on page 169*, then replace the drive logic board. If the values are not in accordance with *Table 55 on page 169*, then repeat this test at the J1 connector on the IGBT module between pins 6 and 15. If the values are not in accordance with *Table 55 on page 169*, then replaced the appropriate IGBT assembly.
- No thermal grease used on the IGBT module. The IGBT module requires that a thin even layer of thermal grease be used to aid in the transfer of heat to the chill plate.
- Clogged chill plate.
- The SCR module or IGBT module is not properly torqued. The proper torque value is 48 in.-lbs. or 5.5 Nm



DO NOT insert the probes of the ohmmeter into the front side of any connector. This will cause the sockets in the connector to spread apart and cause an intermittent connection. Instead insert the probes into the back of the connector.

TABLE 55 - IGBT - THERMISTOR CHARACTERISTICS

TEMP°F NOMINAL	TEMP°C NOMINAL	R-THERMISTOR IN OHMS *
40	4.4	11314
45	7.2	10080
50	10.0	8996
55	12.8	8031
60	15.6	7193
65	18.0	6447
70	21.1	5793
75	23.9	5212
80	26.7	4698
85	29.4	4242
90	32.2	3835
95	35.0	3471
100	37.8	3150
105	40.5	2859
110	43.3	2602
120	48.9	2162
130	54.4	1807
140	60.0	1515
150	65.6	1278
160	71.1	1085
170	76.7	924
180	82.2	791
190	87.8	679
200	93.3	587
210	98.9	508
220	104.4	442

Motor Current Overload

This shutdown is generated when the logic board has detected that the highest of the three output phase currents for any compressor has exceeded 102% of the programmed 100% rated load amps (RLA) value for more than 20 seconds. The 100% RLA setpoint is determined by adjustment of the FLA pots on the logic board. Each compressor motor has its own FLA pot. This shutdown will lockout the operation of the chiller on the first event.

Possible Causes:

- FLA pot not adjusted properly. Refer to *SECTION 8 - COMPRESSOR DRIVE SERVICE* for details on how to view the overload value. See the logic board replacement segment of this document for instructions on how to adjust the RLA setting, if necessary.
- Excessive operating condenser pressure. Possible causes are loss of plant cooling flow or fans.
- Restriction in the refrigerant circuit. Refer to *SECTION 7 - CHILLER SYSTEM SERVICE* for possible causes.
- The economizer valve not working properly or stuck open. Refer to *Valve Controller and Control Algorithm Operation on page 41* for possible causes.
- Feed and drain valves not working properly. Refer to *Valve Controller and Control Algorithm Operation on page 41* for possible causes.
- Failure of an output current transformer. Remove the current transformer connector and take an ohmmeter reading. Note: Readings at connectors should be taken from the back of the connector so that the socket is not spread apart. Each current transformer should read 125 ± 19 ohms. If the reading is within range, reinstall the connector. If not, replace the faulty current transformer.
- Chiller refrigerant charge is too low or too high. Refer to *SECTION 6 - MAINTENANCE*.

VSD Run Relay

Two run signals are generated by the Chiller Control Board for each compressor system. One is through the communication system, and the other is through the wiring between the chiller control board, the relay interface board and the logic board. Upon receipt of either of the two run signals by the logic board, a 5-second

timer will begin timing on the logic board. If the second run signal is not received within the 5-second window, the logic board will not start the chiller.

Possible Causes:

- Intermittent wiring connection. Use an ohmmeter to verify the run signal wiring between the Chiller Control Board and the logic board. System #1 hardware run signal is sent on wire #113 to the logic board at J10 pin 7. System #2 hardware run signal is sent on wire #213 to the logic board at J10 pin 5. Also, perform a continuity check on the communication link between logic board connector J12 pin #1 and chiller control board connector J2 pin #1. On the same 2 connectors, check continuity from pin #2 to pin #2, pin #3 to pin #3 and pin #4 to pin #4. Refer to the wiring diagram.
- Unseated connector(s). Reseat the J12 connector on the logic board and the J2 connector on the chiller control board.
- Failure of the relay board. Replace the relay board.
- Failure of the logic board. Replace the logic board.
- Failure of the chiller control board. Replace the chiller control board.

WARNING MESSAGES

General Information

A WARNING message will indicate that the operation of the Compressor drive or chiller is affected in some manner, but the logic board is still functioning.

Invalid Number of Compressor Selected

This message is displayed when the compressor selection jumpers are not properly configured or missing. The jumpers are located on the J1 connector of the logic board.

Possible Causes:

- Incorrect J1 wiring. Verify that the proper wire connections are made at the J1 connector. See *Table 2 on page 41*.
- Unseated connector. Reseat connector J1 on the logic board.
- Intermittent or loose wiring. Verify that the sockets are not spread out and the sockets are properly installed in the connector housing.

START-UP PREPARATIONS

Circuit Breaker Setup

Optional Circuit Breaker Setup

If the chiller has the optional circuit breaker at the incoming power connection to the VSD, verify the all settings are correct on the breaker.

Two types of breakers are used. Both require all settings to be verified, one type uses an additional rating plug that also needs verified. The rating plug value required is listed in the row for the model. Rating plugs are supplied with the breaker. All circuit breakers settings should be set to the following table:

TABLE 56 - VSD CIRCUIT BREAKER SETTINGS

DRIVE MODEL NUMBER	SETTING							
	LONG TIME PICKUP "IR~"	LONG TIME DELAY "TLD(S) LONG"	SHORT TIME DELAY "ISD(XIR) SHORT"	GROUND FAULT PICKUP "IG(XIN) GND"	GROUND FAULT DELAY "TSD*/TG(MS) SHORT/GND"	SHORT DELAY PICK-UP	GROUND FAULT TIME	RATING PLUG VALUE
TV2CMPRBW-40A	G	2	2	0.2	J	-	-	-
TV2CMPRBW-40B	-	-	INST	1	-	2	150	600
TV2CMPRBW-40C	-	-	INST	1	-	2	150	800
TV2CMPRBW-46A	G	2	2	0.2	J	-	-	-
TV2CMPRBW-46B	-	-	INST	1	-	2	150	600
TV2CMPRBW-50A	G	2	2	0.2	J	-	-	-
TV2CMPRBW-50B	-	-	INST	1	-	2	150	600
TV2CMPRBW-50C	-	-	INST	1	-	2	150	800
TV2CMPRBW-58B	-	-	INST	1	-	2	150	600
TV2CMPRBW-65A	G	2	2	0.2	J	-	-	-
TV2CMPRBW-65B	-	-	INST	1	-	2	-	600
TV2CMPRBW-65C	-	-	INST	1	-	2	150	800
TV2CMPRBW-68A	G	2	2	0.2	J	-	150	-
TV2CMPRBW-68B	-	-	INST	1	-	2	150	600
TV2CMPRBW-68C	-	-	INST	1	-	2	150	800

FREQUENTLY ASKED QUESTIONS

Why doesn't the measured input amps of the logic board agree with the rated RLA?

The rated RLA is the motor current at full load. The input current to the logic board is comprised of motor current, fan and pump contactor current and control circuitry current.

How is the control/VSD panel cooled?

The control/VSD panel contains a liquid coolant loop that flows through the shell side of a shell and tube heat exchanger on the back of the cabinet. Cooling water from the condenser water circuit of chilled water in some cases is routed through the tubes of the heat exchanger. The loop is closed. A pump is used to move the coolant from and through the control/VSD panel and the heat exchanger shell.

How often should the coolant be changed?

The coolant should be changed every year.

What is the function of the TEST Button on Logic Board?

The TEST button is used to test the system operation during the manufacturing process of the system.

How is the RPM of the compressor motor controlled?

As with other YORK drive products, control of the RPM comes from the chiller control system. The chiller control board determines the optimum RPM of the compressors by monitoring the status of various chiller pressures and temperatures.

What is the maximum RPM of the compressor motor?

The maximum RPM of the compressor motor is a function of the size of the chiller but does not exceed 6000 RPM. This allows the compressor and motor to be directly coupled without the use of gears.

VSD TROUBLESHOOTING AND COMPONENT REPLACEMENT PROCEDURES



This product contains voltages that could cause injury! Before performing any of these procedures, place the unit switch in the “STOP” position. Wait 5 minutes. Ensure the DC bus voltage is 50 VDC or less on the display of the chiller. Remove all AC power sources and perform lockout tagout procedures. Using a non-contact voltage sensor, ensure no AC power is present in enclosure. Measure the DC bus voltage at J3 pins 1-3 on the logic board using a dvm to ensure the bus voltage is less than 50 VDC.

General Information

The following procedures are designed to guide the service technician along the path that leads to the identification of a problem. The service technician should understand the operation of the Compressor Drive and function of each major component. It is recommended that the service technician read and understand the information contained in this instruction prior to troubleshooting this product. Also, the service technician must understand the system interface, and be able to utilize system wiring diagrams to follow signal flow throughout the system. Due to the integration of the logic board and the chiller control system, a good working knowledge of the chiller control system is also necessary (Refer to the operating description earlier in this manual).

Several levels of documentation are required for the troubleshooting process. The control panel wiring diagram, supplied with every chiller is the top-level document. It provides the overall wiring and configuration. Sections of this instruction provide the required lower levels. Specifically, block diagrams provide signal flow and simplified representations of all board circuitry.

Begin the troubleshooting process by selecting the appropriate procedure. It is not necessary to sequentially perform all of them. Perform a procedure only if there is a problem with that function.

VSD Test Mode

The VSD logic board contains a manual test pushbutton, which enables Service personnel to check for proper gating of the IGBT power switches in the VSD.

The unit is permitted to enter the test mode if all five of the following conditions are met:

- The system is not in Pre-charge
- The trigger SCR signal is disabled
- The system is not in the Run mode
- There are no system faults
- The four minute timer is not running

Once test mode is enabled, the processor will enable all compressor run signals to test. The VSD PWM generator is programmed to pulse the output phases of the drive for all compressors in the following manner when the pushbutton is depressed:

1. Upper three phases on for 1 second
2. All phases off for 1 second
3. Lower three phases on for 1 second
4. All phases off for 1 second

Verifying Failure of the IGBT Module

General Information



Personnel not familiar with AC drives and proper electrical safety procedures should not be working on this product.

- Follow DC bus discharge validation procedure at the beginning of this section.
- It is not necessary to remove any wiring to perform this test.
- Test instructions will be given for both an analog meter and a digital meter. The analog meter must be set to the Rx1 scale and the meter should also be adjusted for a 0 ohm reading with the probes connected together. The digital meter must be placed on the diode check scale. In this test, we are not looking for exact resistance measurements but rather to verify if the semi-conductor switches are open or shorted.
- The details of this procedure are for the compressor #2 IGBT module. Other IGBT modules are tested in the same manner by using the right side of the IGBT module as a reference point.

Test Procedure:

- Place the positive probe of the meter on the first right hand terminal of the IGBT module at the bus structure. This is the negative bus connection. Place the negative probe of the meter on the first right hand terminal of the IGBT module. This is one phase of the motor output. The wire should be marked 201. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC. Refer to *Figure 86 on page 174*.
- Place the positive probe of the meter on the next terminal to the left on the IGBT module at the bus structure. This is the positive bus connection. The

analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize.

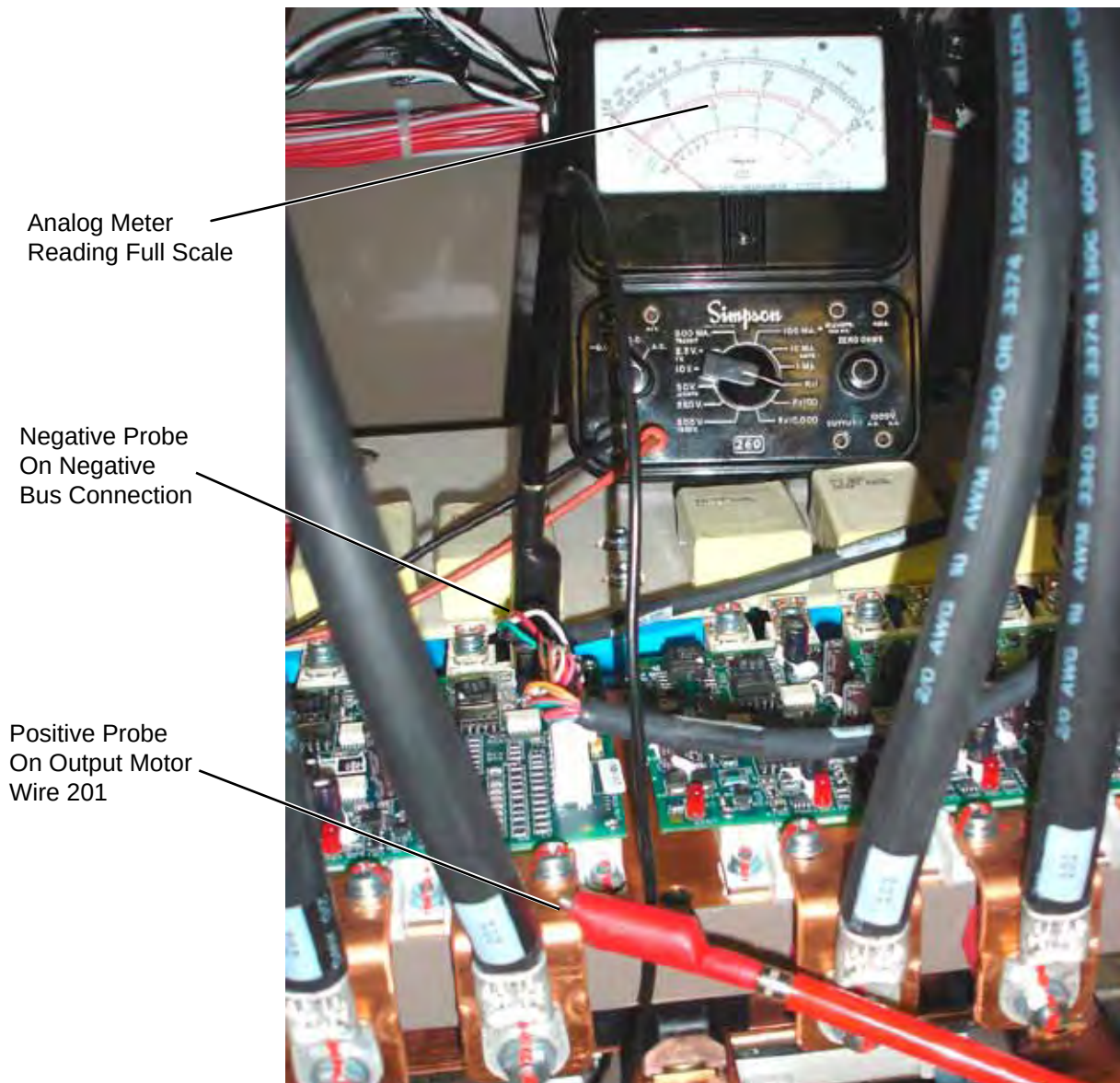
- Place the positive probe of the meter on the 3rd right hand terminal of the IGBT module at the bus structure. This is the negative bus connection. Place the negative probe of the meter on the 3rd right hand terminal of the IGBT module. This is the next phase of the motor output. The wire should be marked 202. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC.



50048

FIGURE 86 - IGBT MODULE VERIFICATION #1

- Place the positive probe of the meter on the 4th right hand terminal of the IGBT module at the bus structure. This is the positive bus connection. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize.
- Place the positive probe of the meter on the 5th right hand terminal of the IGBT module. This is the negative bus connection. Place the negative probe of the meter on the 5th left hand terminal of the IGBT module. The wire should be marked 203. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC.
- Place the positive probe of the meter on the 6th right hand terminal of the IGBT module. This is the positive bus connection. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize.
- Place the negative probe of the meter on the first right hand terminal of the IGBT module at the bus structure. This is the negative bus connection. Place the positive probe of the meter on the first right hand terminal of the IGBT module. This is one phase of the motor output. The wire should be marked 201. The digital meter reading will be OL.



50049

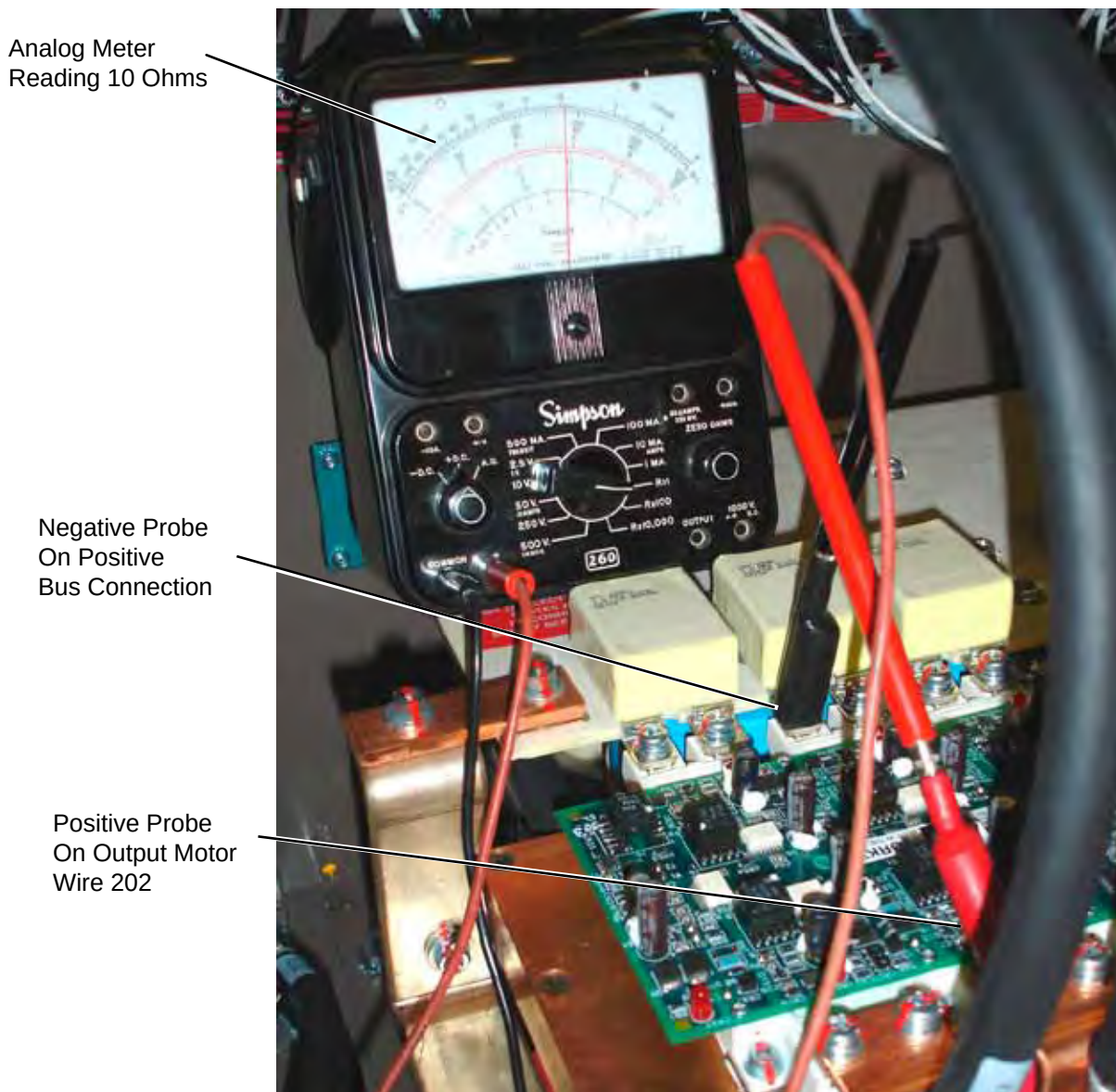
FIGURE 87 - IGBT MODULE VERIFICATION #2

The analog meter reading will be near full scale to the left of the meter movement. The 2 readings will take several seconds to stabilize. Refer to *Figure 87 on page 175*.

- Place the negative probe of the meter on the next terminal to the left of the IGBT module at the bus structure. This is the positive bus connection. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC.
- Place the negative probe of the meter on the 3rd right hand terminal of the IGBT module at the bus structure. This is the negative bus connection.

tion. Place the positive probe of the meter on the 3rd right hand terminal of the IGBT module. This is the next phase of the motor output. The wire should be marked 202. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize.

- Place the negative probe of the meter on the 4th right hand terminal of the IGBT module at the bus structure. This is the positive bus connection. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC. Refer to *Figure 88 on page 176*.

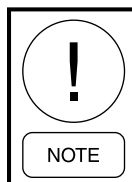


50050

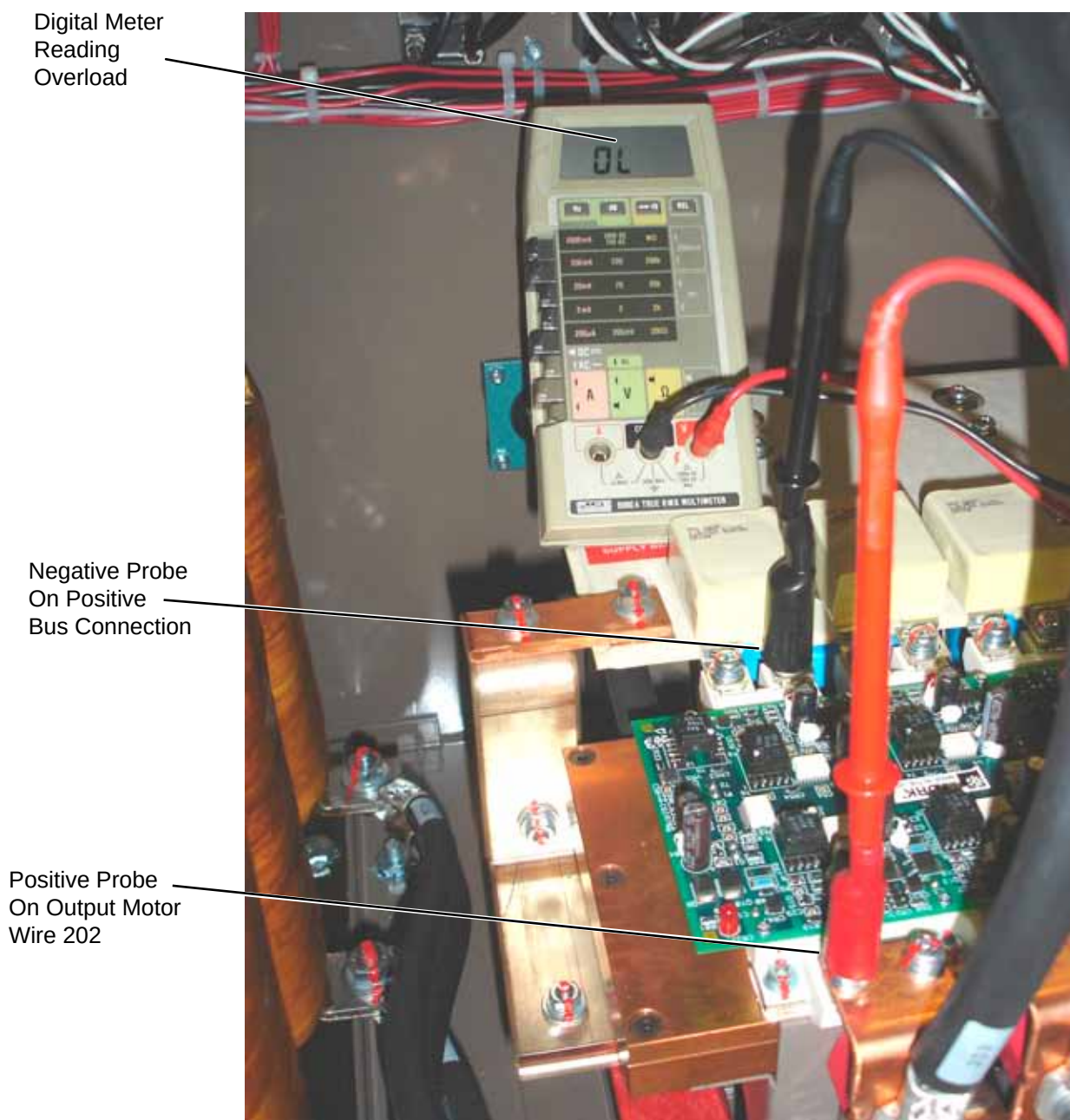
FIGURE 88 - IGBT MODULE VERIFICATION #3

- Place the negative probe of the meter on the 5th right hand terminal of the IGBT module. This is the negative bus connection. Place the positive probe of the meter on the 5th right hand terminal of the IGBT module. The wire should be marked 203. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize. Refer to *Figure 89 on page 177*.

- Place the negative probe of the meter on the 6th right hand terminal of the IGBT module. This is the positive bus connection. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC.



If any one of the readings is not correct, then the IGBT module and gate driver board must be replaced.



50051

FIGURE 89 - IGBT MODULE VERIFICATION #4

Verify Failure of the SCR/Diode Module**General Information:**

Personnel not familiar with AC drives, and proper electrical safety procedures should not be working on this product.

- Follow drive discharge procedure at the beginning of this section.
- It is not necessary to remove any wiring to perform this test.
- This test will be conducted for an analog meter and a digital meter. The analog meter must be adjusted to ohms on the Rx1 scale, and the meter should also be adjusted for a 0 ohm reading with the probes connected together. The digital meter must be placed on the diode check scale. In this test, we are not looking for exact resistance measurements, but rather to verify if the semi-conductor switches are open or shorted.

- The details of this procedure are for the SCR/Diode module used for system #1. All SCR/Diode modules are tested in the same manner.

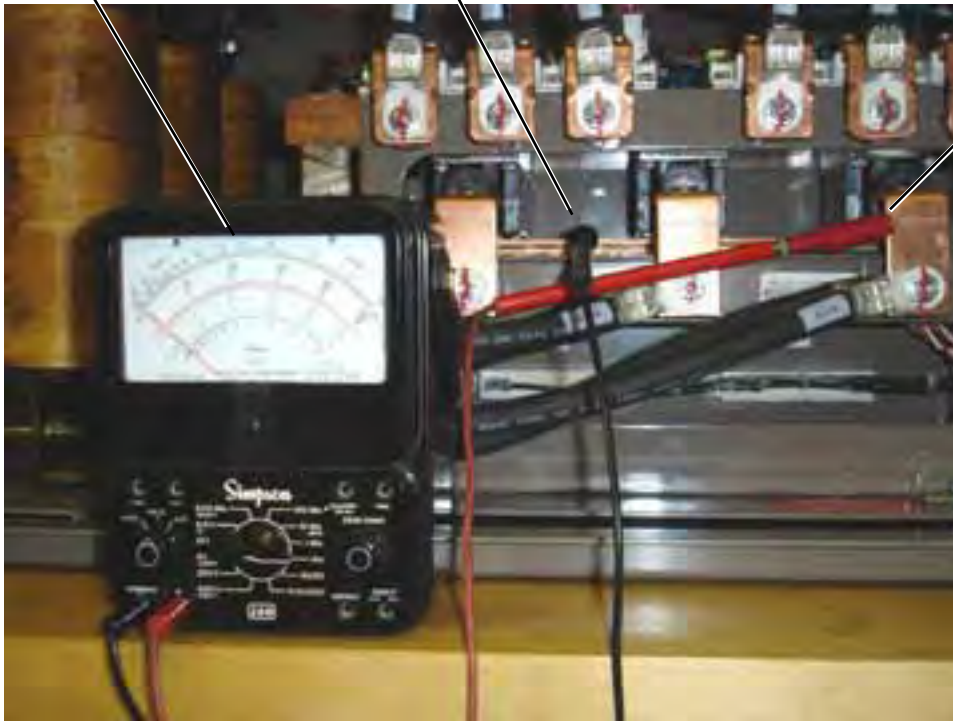
Test Procedure:

- Place the positive probe of the meter at the connection of the input line voltage and the SCR/Diode module the wire is marked 4L1. Place the negative probe on the bus bar to the right of the assembly. This is the positive bus. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize. Refer to *Figure 90 on page 178* and *Figure 91 on page 179*.
- Reverse the position of the 2 probes. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize.
- Repeat this test for the other 2 input wire 4L2, and 4L3. The results should be the same as the above test.

Analog Meter Reading
Full Scale

Negative Probe Connected
To Positive Bus

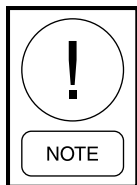
Positive Probe
Connected To
Input Wire 412



50052

FIGURE 90 - SCR / DIODE MODULE VERIFICATION #1

- Place the positive probe of the meter at the connection of the input line voltage and the SCR/Diode module the wire is marked 4L1. Place the negative probe on the bus bar to the left of the assembly. This is the negative bus. An analog meter reading will read approximately 5-10 ohms. A digital meter reading will read approximately 0.36 VDC. Refer to *Figure 92 on page 180 and 95.*
- Reverse the position of the 2 probes. The analog meter reading will be near full scale to the left of the meter movement. The digital meter reading will be OL. The 2 readings will take several seconds to stabilize.
- Repeat this test for the other 2 input wire 4L2, and 4L3. The results should be the same as the above test.



If a test for a SCR or diode fails, then that SCR/diode module will need to be replaced.

Replacement of the IGBT Module

The following step by step procedure includes several helpful hints which should make the process easier, and minimize the possibility of damage to other components or to the logic board.

Save all of the packing material. This material is to be re-used when returning a defective power module as required for warranty.



Personnel not familiar with AC drives, and proper electrical safety procedures should not be working on this product.

- Follow drive discharge procedure at the beginning of this section.
- Remove the 18-pin connector on the IGBT Gate Driver Board.
- Remove and discard the 6 screws from the IGBT module at the motor output connector tangs, and the remaining 6 screws from the bus connections. Keep the 3 capacitors which will be reused.

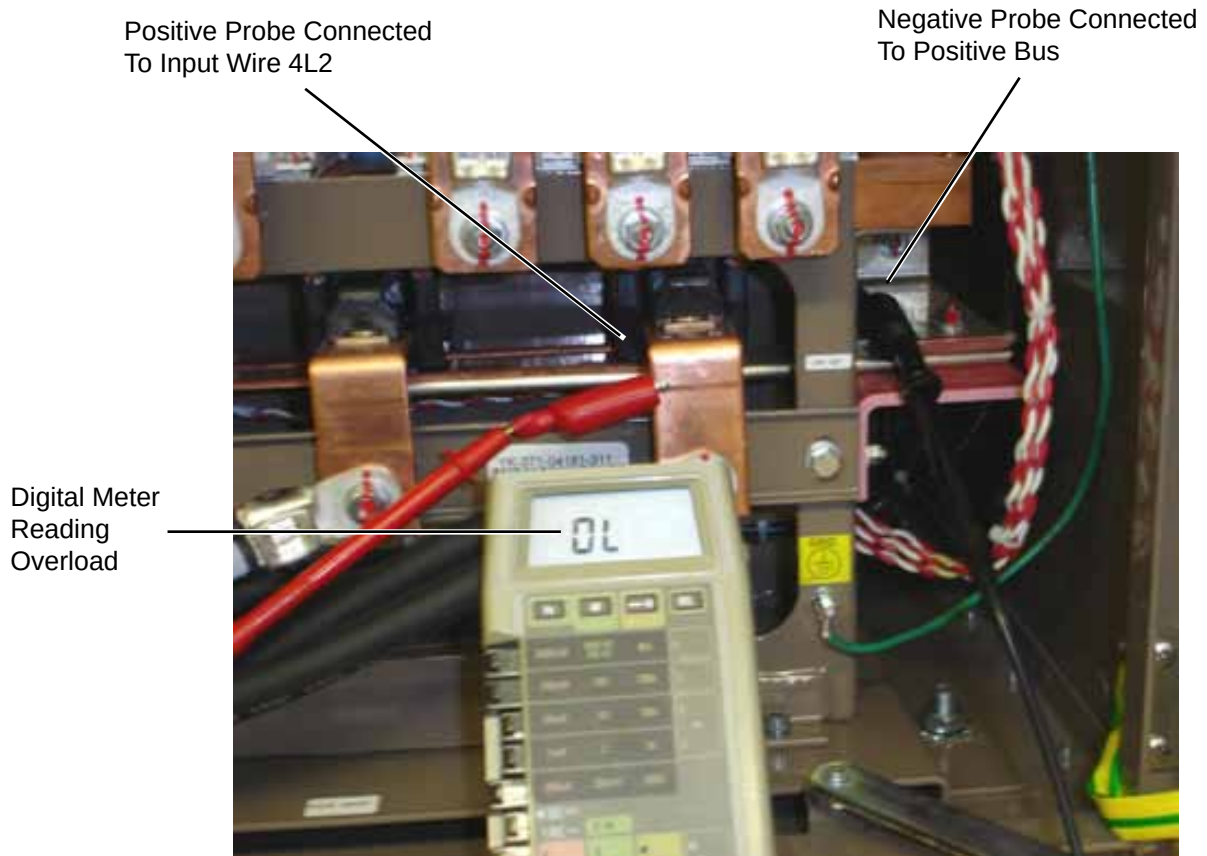


FIGURE 91 - SCR / DIODE MODULE VERIFICATION #2

Negative Probe Connected To
Input Wire 4L3

Positive Probe Connected
To Positive Bus



Analog Meter
Reading
10 OHMS

50054

FIGURE 92 - SCR / DIODE MODULE VERIFICATION #3

Positive Probe Connected
To Negative Bus

Negative Probe Connected To
Input Wire 4L2



Digital Meter
Reading
0.38 VDC

50055

FIGURE 93 - SCR / DIODE MODULE VERIFICATION #4

- Remove the bolt holding the power wire to the output power tangs.
- Remove and discard the 8 screws holding the IGBT module in place.
- Carefully remove the IGBT power module by sliding it away from the bus structure while lifting slightly. **DO NOT** place any stress on the bus structure.
- Wipe the chill plate clean with a clean soft cloth. **DO NOT** leave lint or any materials on the chill plate. **DO NOT** clean using compressed air. Rubbing alcohol works well to remove the thermal grease from the chill plate.
- Apply a thin and even coat of thermal grease on to the back side of the IGBT module. The thermal grease should be provided in the service kit. The use of too much grease may cause IGBT failure.
- Place the new IGBT module on the chill plate so that the connector is towards the right of the logic board enclosure. Carefully slide the IGBT module power connections under the bus structure.
- Insert the 8 screws through the new IGBT module and engage a few threads in the chill plate, but **DO NOT** tighten. The new IGBT module should still be loose.
- Align the IGBT module so that 6 screws can be installed through the 3 square capacitors, then bus structure and into the IGBT module. **DO NOT** tighten these screws.
- Tighten the IGBT mounting screws to 48 in.-lbs. (5.5 Nm) $\pm$ 10% in the sequence shown in Refer to Figure 94 on page 181.
- Install the 3 power wire connectors tangs using 6 screws, and torque the screws to 48 in.-lbs. (5.5 Nm) $\pm$ 10%. Install the output power wire to the copper power tangs using the nut that was saved. Torque the bolt to 40-50 in.-lbs.

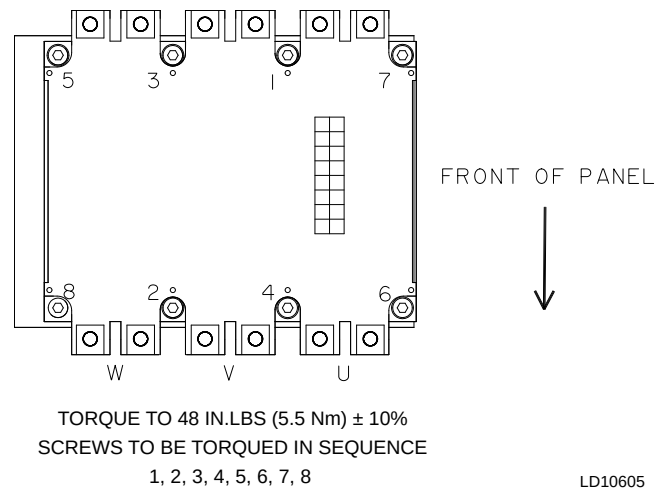


FIGURE 94 - IGBT MODULE TORQUE SEQUENCE

- The screws at the bus structure need to be tighten to 48 in.-lbs. (5.5 Nm) $\pm$ 10%.
- Install the 18 pin connector on the IGBT Gate Driver Board.

Replacement of the SCR/Diode Module

The following step by step procedure includes several helpful hints which should make the process easier, and minimize the possibility of damage to other components or to the logic board. Save all hardware, as it will be reused.



Personnel not familiar with AC drives, and proper electrical safety procedures should not be working on this product.

- Follow drive discharge procedure at the beginning of this section.
- Remove the bolt holding the input power wire to the copper tang.
- Remove the bolt holding the power tang to the SCR/diode module.
- Remove the 6 bolts between the 3 SCR/diode modules and the bus bars. Note the position of the bus bars.
- Remove hardware supporting the bus bars, and disconnect the bus bars from the bus structure on the left and right of the assembly.
- Remove the four Allen head mounting bolts from the failed SCR/diode module.

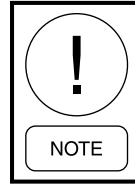
- Gently remove the gate wires from the SCR/diode module. Note locate of the gate wires.
- Wipe the chill plate clean with a clean soft cloth. DO NOT leave lint or any materials on the chill plate. DO NOT clean using compressed air. Rubbing alcohol works well to remove the thermal grease from the chill plate.
- Apply a thin even coat of thermal grease on to the back side of the SCR/diode module. The thermal grease should be provided in the service kit. The use of too much grease may cause the SCR/diode module to fail.
- Gently install the gate wires onto the SCR/diode module. Ensure that these connections are tight. The white wire is installed toward the center of the module. Refer to *Figure 95 on page 183*.
- Place the new SCR/diode module on the chill plate install the 4 Allen head screws. Do not tighten the screws at this time.
- Reinstall the bus bars. Be sure that the bolt holes are aligned with the new SCR/diode module.
- Tighten the SCR/diode mounting screws to 48 in.-lbs. (5.5 Nm) $\pm$ 10% in the sequence shown in *Figure 95 on page 183*.
- Tighten the all bus bar bolts to 88 in.-lbs. (10 Nm) $\pm$ 10%.
- Install the copper power tang to the SCR/diode module tighten the bolt to 88 in.-lbs. (10 Nm) $\pm$ 10%.
- Install the input power wire to the copper power tang using the nut that was saved. Torque the bolt to 88 in.-lbs. (10 Nm) $\pm$ 10%.

Replacement of the Logic Board

The logic board is shipped without software installed and with the RLA values set to minimum. If the failure of the logic board is related to the power supplies on the logic board, then it is recommended that the software be replaced.

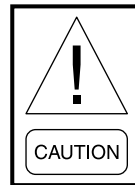
- Before the logic board is removed from the drive write down the programmed RLA for each compressor.
- Follow drive discharge procedure at the beginning of this section.
- Remove the existing logic board from the VSD.

COMPRESSOR OVERLOAD SETTINGS



If the compressor overload current settings have been correctly adjusted by the factory, these should not require reset.

If the logic board is changed, overload settings need reset and verified. Using the VSD DATA key on the control panel, navigate to the COMP1 MOTOR OVERLOAD = ### AMPS and COMP2 MOTOR OVERLOAD = ### AMPS screen. The value shown should match the values on the overload setting label inside the VSD cabinet. If the values shown under VSD DATA do not match the label, such as for replacement of the logic board, an adjustment is required. The overload potentiometers, located on the right edge of the VSD Logic Board control this setting. They are labelled % FLA Adjust.



The VSD should never be opened with power applied unless proper personal protective equipment is donned. Adjustment of the overload potentiometers can be done incrementally with power removed following the bulleted steps on the next page.

While observing the values on the motor overload screen under VSD DATA key, adjust each potentiometer with a small flat blade screwdriver until the value on the screen is set to the overload setting label value. The potentiometer for Compressor 1 Motor Overload is labeled "CMPR1". The potentiometer for Compressor 2 Motor Overload is labeled "CMPR2".

Place a small drop of Glyptal or equivalent on the head of the potentiometer adjust screw when complete to secure the setting.

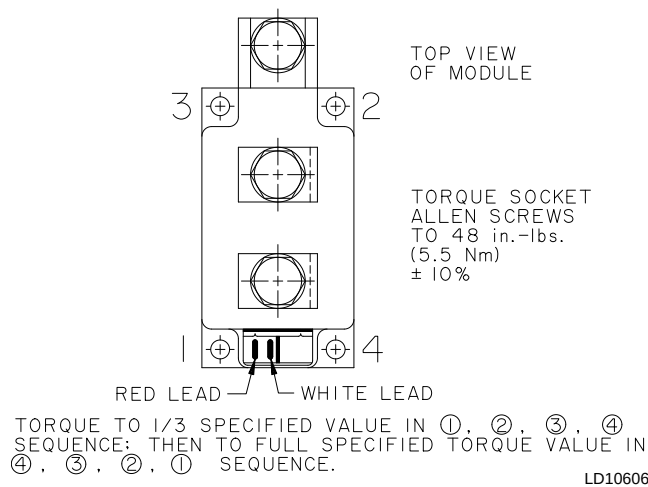


FIGURE 95 - SCR / DIODE MODULE TORQUE SEQUENCE

- Install the new logic board.
- Ensure that all connectors are installed including the J5 connector.
- Install the 2 EPROM's and the PROM into the logic board.
- Rotate the FLA pots to their full counter clockwise position. The pots will start to click when they hit the end stop. Close the enclosure door and apply power to the chiller, and note the value of the RLA.
- Remove power from the chiller. Rotate the FLA pots to their full clockwise position. The pots will start to click when they hit the end stop. Close the enclosure door and apply power to the chiller, and note the value of the RLA.
- Subtract the 2 values and divide the different by 25. For example: The first reading was 45 amps. The second reading was 300 amps. $(300-45)/25 = 10.2$. or for every turn of the FLA pot the RLA value will increase by 10.2 amps.
- Remove power from the chiller.
- Rotate the FLA pots to their full counter clockwise position.
- Take the compressor RLA rating, then subtract 45 and divide by the amps per turn value from above. This answer is the number of the turns clockwise on the FLA pot for the compressor RLA rating. For example: The compressor rating is 250 amps. $(250-45)/10.2 = 20.1$ turns on the FLA pot.
- Adjust the pots per the previous step.
- Close the enclosure door and apply power to the chiller, and note the value of the RLA.
- Remove power from the chiller. If the programmed RLA is lower then the required value, then the FLA pot will need to be adjusted clockwise. If the programmed RLA is higher then the required value, then the FLA pot will need to be adjusted counter clockwise. Make these fine adjustments to the FLA pot with power removed, and then close the enclosure door and apply power to the chiller. At no time should the door of the logic board enclosure door be opened when power is applied.

SOFTWARE REFERENCE LIST 50 HZ AND 60 HZ

LOCATION	PART NUMBER
Logic Board U39	031-02522-010
Logic board with latest software:	331-02507-xxx

The Logic board with latest software on its Eeproms installed is available as a service kit in format as: 331-02507-xxx. Refer to the parts manual for specific kit for the VSD model.

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SECTION 9 - OPERATIONS

OPERATING CONTROLS

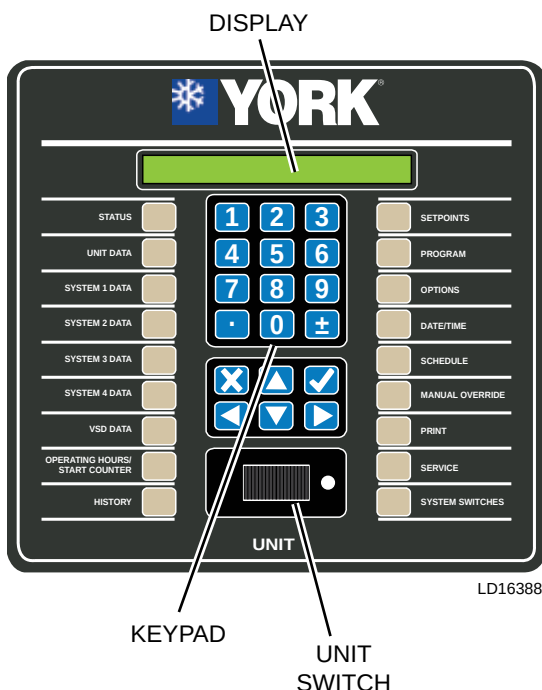


FIGURE 96 - KEYBOARD AND DISPLAY

Unit Switch

A double pole single throw ON/OFF rocker switch on the front of the control panel is used to turn the entire chiller on and off as shown in *Figure 96 on page 185*.

When the switch is placed in the OFF (O) position, the system shuts down immediately, and all systems will be disabled. One unit switch pole is for System 1, and the other is for System 2. When the switch is ON (I), both switch poles have continuity through it for the 115VAC run signal from the control relay board to the VSD board. A secondary circuit for each system also gets power here for an input to the control to indicate that the UNIT SWITCH 1 or 2 is ON.

Keypad

An operator keypad allows complete control of the system from a central location.

Access the following command keys on the left and right side of the keypad:

- Displays
- Program setpoints
- History data, and
- To initiate system commands.

Use the following keys in the center to enter data in the various program modes:

- 0-9 is a NUMERIC KEYPAD which allow keying numeric values into memory.
- PERIOD/DECIMAL allows keying a decimal point into numeric values.
- +/- (PLUS/MINUS) allows making numeric values negative or positive.
- ✓ (ENTER) stores program changes into memory.
- ✕ (CANCEL) cancels the data entry operation, and returns the programmed value to the original value, before any programming changes were made or when an error is made.
- ▲ (UP) and ▼ (DOWN) ARROW allow scrolling (▲) backward and (▼) forward under keys such as
 - PROGRAM
 - OPTIONS
 - UNIT or SYSTEM DATA
 - HISTORY
 - OPTIONS
- ◀ (LEFT) and ▶ (RIGHT) ARROW keys allow scrolling between non-numeric program choices under the OPTION, DATE/TIME, and SCHEDULE keys. The ◀ key allows programming the default value when programming numeric values. For changing numeric values, the ▶ key has no function. The ◀ ▶ keys also allow scrolling sideways between the same displays on System 1 and System 2. Press the ▶ key to move the display to System 2. Pressing the ◀ key moves the display in the opposite direction. The arrow keys also allow fast scrolling through subgroups of data under keys, such as HISTORY.

Use the ▲, ▼, ◀, and ▶ keys to see the multiple displays under a key. Once the ▲ ▼ keys are pressed and used for scrolling, pressing the original data key will return to the first display message displayed under the data keys.

The keypad utilizes an overlay to convert the keypad to various languages.

Keypad Data Entry Mode

Enter DATA ENTRY Mode

For numeric programmable items, enter DATA ENTRY by pressing any numbered key, the decimal point, or the +/- key. The data will be entered, and the cursor will appear under the position where the data is being entered.

For non-numeric programmable items, enter DATA ENTRY by pressing the ◀ or ▶ key. The cursor will appear under the first position of the non-numeric string. Press the ◀ or ▶ key to change the programmable choice.

Exit DATA ENTRY Mode

To exit DATA ENTRY, press the ✓ key or X, then the cursor will disappear. If the user presses any other key while in DATA ENTRY, the user has two seconds to accept or cancel the change:

XXXXXXXXXXXX PRESS ✓ TO ACCEPT VALUE OR
X TO CANCEL DATA ENTRY

If the ✓ key was pressed while in DATA ENTRY, and the numeric value entered was out of range, the following message will appear for two seconds followed by the original data display.

XXXXXXXXXXXX OUT OF RANGE TRY AGAIN!
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Display

The 80-character (two lines of 40 characters) display is a LIQUID CRYSTAL DISPLAY used for displaying unit, system parameters, and operator messages. The display has an LED backlight for night viewing, and is viewable in direct sunlight.

BASIC OPERATION

Leaving Chilled Liquid Control

The chiller intent is to control Leaving Chilled Liquid Temperature (LCHLT) to the operator-programmable LCHLT setpoint. The programmable range depends whether the chiller is set for water cooling or glycol (brine) cooling. The chiller uses a fuzzy logic proportion and rate control in effort to maintain LCHLT exactly at setpoint. Compressor VSD speed is manipulated by the control to achieve this. Another operator-programmable setpoint called the Control Range (CR) defines how far above and below the LCHLT setpoint

the chiller will stop compressors or the entire unit and restart them to maintain LCHLT within the range. The programmable CR defines the Setpoint High Limit and Setpoint Low Limit as shown in *Figure 97 on page 187*. In this example, LCHLT setpoint is 44°F and the CR is 2°F. The programmable ranges are in *Table 57 on page 187*.

Chiller Start

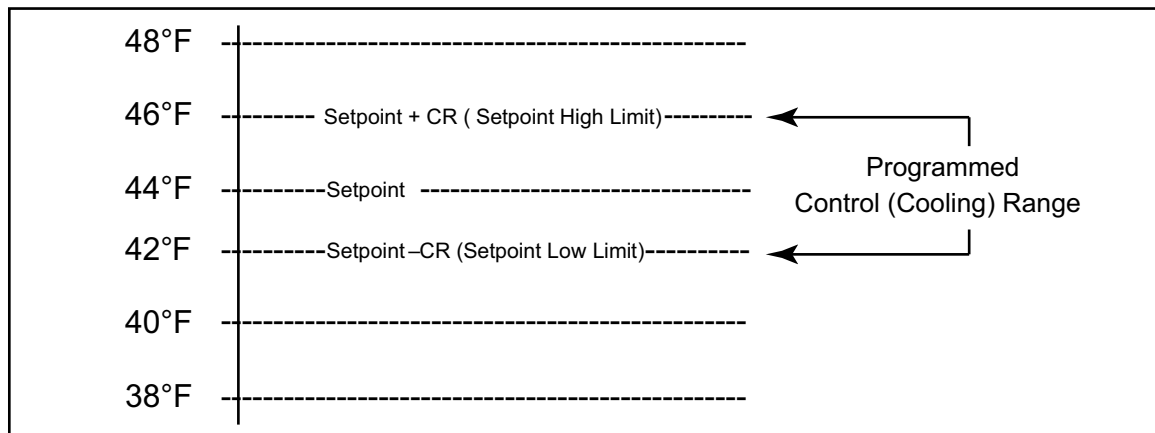
In order for the chiller to start, all of the following must be true:

- Unit switch must be on
- Run permissive inputs (Remote Cycling Contacts) must be satisfied
- No unit or system faults exist
- No unit or system start inhibits exist
- The Daily Schedule is calling for the chiller to run
- The Chilled Liquid flow switch input is satisfied (switch is closed)
- The Condenser Liquid flow switch is satisfied (switch is closed)
- Leaving Chilled Liquid Temperature (LCHLT) is above the Setpoint High Limit (LCHLT setpoint + Control Range)

Compressor Control

The Optimized IPLV Chiller Capacity Control Logic is designed to control multiple compressors in a variable speed drive application as efficiently as possible. The logic was developed to achieve optimum high efficiency control, even when light loads are experienced. In addition, compressor cycling is reduced to a minimum to satisfy the load. While each compressor has a VSD inverter output module of its own, they are linked together with a common DC bus and output command frequency. So, the compressors are always commanded the same speed. The chiller control must bring all running compressors to zero speed to stop any or to prepare to start any.

The control initiates a system run to the VSD logic board by two means. A hardwire system run signal is sent from the control panel and the compressor RUN bit must be set in the serial communications link from the panel to the VSD logic board. Following successful receipt of the system run signals the VSD initiates pre-charge to energize the DC bus followed by full regulation of the DC bus.



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FIGURE 97 - CHILLER CONTROL (COOLING) RANGE

Then the output frequency is increased from 0 Hz to the operating frequency commanded by the communications link. If the rate commanded by the communications link exceeds the maximum rate of change for the VSD, the VSD microprocessor shall limit it to the maximum rate of change.

The maximum rate of change of the output frequency depends on direction and existing frequency as follows:

- 10 Hz / sec as the frequency is increasing between 0 and 50 Hz.
- 30.4 Hz / sec as the frequency is increasing between 50 and 203 Hz.
- 30.4 Hz / sec as the frequency is decreasing between 203 and 100 Hz.
- 10 Hz / sec as the frequency is decreasing between 100 and 0 Hz.

At start-up of the entire unit, the logic determines how many compressors to start. It is desirable to run as many compressors as possible to reduce cycling and compressor starting once the unit is running.

Start-up Number of Compressors

The control decides how many compressors to start from the chiller off state based on;

- how long the chiller last ran
- how long ago the chiller last ran
- how far the leaving chilled liquid temperature is from setpoint
- whether the leaving chilled liquid temperature is trending down presently

The chiller will start two compressors unless any of the following are true, in which case only one starts;

If the cumulative run time before the last shutdown was less than 5 minutes, the control will only start one compressor at the present time.

If the time elapsed since the last shutdown was less than 5 minutes, the control will only start one compressor.

In Automatic LEAD/LAG Control, the logic leads with the compressor with lowest run time.

TABLE 57 - PROGRAMMABLE RANGES

PROGRAM VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Leaving Chilled Liquid Temp Setpoint	Water Cooling	38.0 °F	60.0 °F	44.6 °F
		3.3 °C	15.6 °C	7.0 °C
	Glycol Cooling	8.0 °F	60.0 °F	44.6 °F
		-13.3 °C	15.6 °C	7.0 °C
Leaving Chilled Liquid Temp Control Range	--	1.5 °F	2.5 °F	2.0 °F
		0.8 °C	1.4 °C	1.1 °C

If the Leaving Chilled Liquid Temperature is less than 5 °F above the setpoint high limit (top of the control range), the control will only start one compressor.

If the Leaving Chilled Liquid Temperature is decreasing at a rate faster than 3 °F per minute while the chiller is not running, the control will only start one compressor.

Running Number of Compressors

The logic looks at the number of compressors running and the present VSD Frequency. If the logic determines that fewer compressors are needed to handle the load, a compressor will be shut down. If the logic determines that both compressors running at a lower frequency could handle the load, it will start another compressor. The following equations are used to determine when to start and stop a compressor and to determine the new running frequency.

When only one compressor is running, the second compressor is also started when the running compressor frequency increases to 15 Hz + two times the service-programmable setpoint Minimum Start Frequency (50Hz to 95 Hz, default 50 Hz).

When a second compressor is started, the two compressors are brought to 1/2 of the frequency the single compressor was running when it crossed over the threshold to bring the other one online.

When two compressors are running, one is stopped when all of the following are met:

- LCHLT has dropped to the Setpoint Low Limit (LCHLT setpoint – Control Range)
- VSD Frequency is at the service-programmable Minimum VSD Frequency setpoint (50Hz to 95 Hz, default 50 Hz)
- LCHLT is ramping toward a lower value (not constant nor increasing)

Capacity Control Load and Unload

VSD speed change is how compressor capacity is regulated. Speed is increased to gain capacity to lower LCHLT and decreased to reduce capacity to increase LCHLT. Speed is operated between the service-programmable Minimum VSD Frequency setpoint (50Hz to 95 Hz, default 50 Hz) and the maximum (factory set for application, limited to 203Hz maximum) Change to number of operating compressors is related to speed

as explained above. The chiller capacity control has a Load and Unload delay timer. These timers prevent a change to VSD speed until they have timed out after either of the following events to prevent excess cycling of the control.

- Whenever a compressor is started or stopped the chiller load and unload timers are set to 30 seconds.
- Whenever the control has made a change to VSD speed to adjust capacity to follow LCHLT, the load and unload timers are set to two seconds.

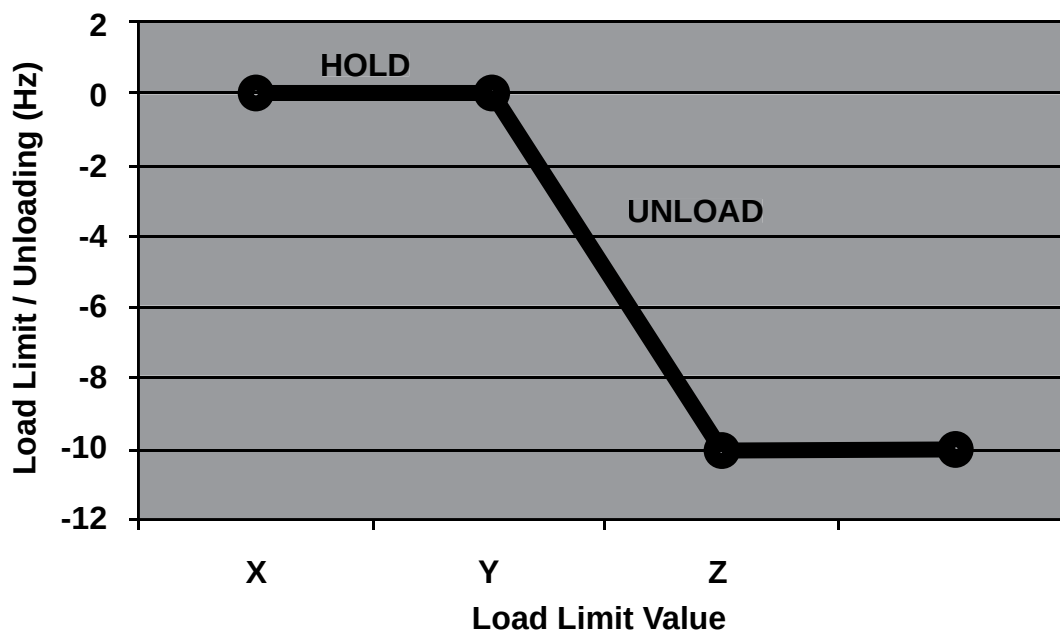
Normally, the maximum step of loading or unloading is 1.0 Hz. Therefore the chiller will not change speed faster than 1.0 Hz/2 seconds. However unloading rate is increased at two specific LCHLT temperature ranges as follows;

- When the LCHLT is less than LCHLT Setpoint – (Control Range / 2), unload steps from the control are doubled allowing the maximum step of unloading to be 2.0 Hz every 2 seconds.
- When the LCHLT is less than 1°F over the Low LCHLT Cutout, unload steps from the control are quadrupled allowing the maximum step of unloading to be 4.0 Hz every 2 seconds.

Load Limiting and Over-ride Unload Control

The load limiting controls are intended to prevent a system from reaching a safety trip level. Load limiting controls act when any of the parameters listed in *Table 58 on page 189* is approaching its safety shutdown threshold to prevent any loading by the capacity control logic. Over-ride unload controls act when a parameter goes beyond the load limit threshold and is close to the safety shutdown threshold to unload the chiller regardless of the capacity control logic. The following graphic represents the control operation. The change to VSD speed command is never allowed above the limit line each 2 second control cycle.

The normal operating region of the parameter is to the left of the X point, with the value of the parameter approaching its limit heading right toward Y and Z. For instance increasing condenser pressure, or decreasing evaporator pressure is represented moving to the right. Prior to reaching the X point capacity control is not limited and is allowed to load and unload as needed. Load Limiting prevents capacity control from loading when the parameter value is between the X point and Y point.



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FIGURE 98 - VSD

Capacity control is still allowed to unload as needed when the value is between these points. When the value is between the Y and Z points, capacity control is overridden, and the compressor is unloaded by the Load Limiting function. At the Y point, the unloading

amount is 0 Hz. At the Z point, the unloading amount is 10 Hz speed reduction. Any point between the Y and Z unloads based on a linear ramp between the two points. The thresholds for each parameter is provided in *Table 58 on page 189*:

TABLE 58 - PARAMETER

PARAMETER (X AXIS UNITS)	X POINT	Y POINT	Z POINT
MOTOR CURRENT (%FLA)	Active Current Limit Setting – 2% FLA	Active Current Limit Setting	Active Current Limit Setting + 5% FLA
DISCHARGE PRESSURE	High Discharge Pressure Cutout – 20 PSIG	High Discharge Pressure Cutout – 15 PSIG	High Discharge Pressure Cutout
EVAPORATOR PRESSURE	Low Evaporator Pressure Cutout + 10 PSIG	Low Evaporator Pressure Cutout + 5 PSIG	Low Evaporator Pressure Cutout
VSD INTERNAL AMBIENT TEMP	VSD Internal Ambient Cutout – 3°F	VSD Internal Ambient Cutout – 2°F	VSD Internal Ambient Cutout
VSD BASEPLATE TEMP	VSD Baseplate Temp – 8°F	VSD Baseplate Temp – 4°F	VSD Baseplate Temp
LEAVING CHILLED LIQUID TEMPERATURE (HEAT PUMP MODE ONLY)	Low Leaving Chilled Liquid Temp Cutout – + 8°F	Low Leaving Chilled Liquid Temp Cutout – +4°F	Low Leaving Chilled Liquid Temp Cutout – +1°F

NOTE: All of the controls above are active immediately at start-up.

Condenser Liquid Refrigerant Level Control

The condenser level control valve controls the refrigerant level by controlling the flow of refrigerant into the evaporator from the condenser. The controller is based on the condenser liquid level sensor and a programmable level setpoint (20.0% to 80.0%, default 50.5%). When a system is not running, set its level control valve to the programmable Condenser Level Control Valve Hold Position (5 to 50%, default 30%). The valve is a stepper motor-operated electric expansion valve (EEV). The control opens the valve to decrease refrigerant level and closes it to increase refrigerant level. Output to the stepper motor controller is reverse acting.

When the system enters the running state, the following is evaluated;

- As long as the condenser level is less than the programmed condenser level setpoint, the level control valve is held at its programmed Hold Position until the programmable Condenser Level Control Hold Delay time (0 to 10 min, default 5 min) elapses.
- After the hold period, if the condenser level is less than the programmed condenser level setpoint, the active level setpoint is set to the present condenser level. The condenser level valve position is controlled to maintain this active level setpoint in proportional-integral logic, which is ramped to the programmed condenser level setpoint over the service-programmed start-up ramp time (0 to 10 min, default 5 min). When the start-up ramp time is done, or if at any time during this start-up ramp time period the condenser level becomes greater than the programmed condenser level setpoint, the start-up ramp time is terminated and the active level setpoint is set equal to the programmed level setpoint.
- If the condenser level is greater than the programmed condenser level setpoint, the active setpoint is set to the programmed level setpoint. The condenser valve position is then controlled to this active level setpoint in proportional-integral logic.

The level controller is a PI (Proportional plus Integral) controller. A proportional gain constant is used. The integration time sets the integral gain. When level is outside $\pm 5\%$ of the setpoint, proportional gain and integration time constants are the programmable start-up values. When level is within $\pm 5\%$ of the setpoint, proportional gain and integration time constants switch to fixed running values. The output from the PI control-

ler is the Level Control valve output percentage that is shown on the display and printouts. This output is converted from 0 - 100% to 0 - 10.28V and output via a digital to analog controller (DAC). This voltage is converted to a valve position by the stepper motor controller. Changes to the valve position, if necessary, are made every second.

Condenser Level Control Oil Pressure Interaction:

Condenser level control is used at very low condenser temperature and load situations to maintain a minimum suction to discharge pressure difference required for good oil flow by reducing refrigerant flow to the evaporator to reduce the evaporator pressure for a given chilled water temperature. After the compressor has been running longer than 5 min and the logic is controlling the condenser level to the intended setpoint, if the differential oil pressure is $<$ service-programmable oil differential pressure control setpoint (20 to 40 PSID, default 30 PSID) + 1, the active condenser level setpoint (which the logic is controlling to) will have an offset added to it every one second control cycle;

- If evaporator pressure $>$ Low Evaporator Safety Shutdown pressure + 5 PSI, the active condenser level setpoint is incremented by the operator-programmable Level Control Increment 1 (0% to 10%, default 2%)
- If evaporator pressure $<$ Low Evaporator Safety Shutdown pressure + 5 PSI, the active condenser level setpoint is incremented by the operator-programmable Level Control Increment 2 (0% to 10%, default 0.5%)

The incrementing continues until either case below;

- If the evaporator pressure $<$ Low Evaporator Pressure Cutout +2 PSIG, the active condenser level setpoint is decremented down toward the local programmed setpoint by the operator-programmable level control decrement 2 (0% to 10%, default 0.5%)
- If the differential oil pressure is $>$ Oil Differential Pressure Control setpoint + 1, the active condenser level setpoint is decremented down toward the local programmed setpoint by the operator-programmable Level control decrement 1 (0% to 10%, default 2%)

The decrementing continues until the condition is met or active setpoint equals the programmed normal operating level setpoint.

Condenser level sensor:

The condenser level sensor is a capacitance-type sensor with 4-20mA transmitter output proportional to refrigerant level on the probe. 0% of probe coverage is 4.00 mA + 5% and full 100% coverage is 20.00 mA + 5%. The sensor is factory calibrated and not adjusted in the field. The sensor DIN connector pinout scheme is :

- Terminal 1 (RED) = Power +
- Terminal 2 (WHT) = Signal Output
- Terminal 3 (BLK) = Power -

Economizer Valve Control (If option enabled)

Note: If Economizer function is not enabled the economizer feed valve remains closed at all times.

The economizer valve controls the economizer superheat. The controller is based on the VSD speed, economizer superheat and a programmable motor temperature setpoint. The economizer feed valve is positioned to the the operator-programmable Economizer Hold Position (0.0 to 50.0%, default 2.0%) when the system is not running or VSD frequency is below the operator-programmable Economizer Off Frequency (45 Hz to 203 Hz, default 45 Hz). This position is needed to allow the sensors to read a gas temperature and pressure.

Economizer Superheat = Economizer temp – Saturated Economizer temp (calculated from economizer pressure)

When the following conditions are met, the Economizer feed valve will be operated according to the sequence described below:

- VSD frequency increases to the operator-programmable Economizer On Frequency (50 Hz to 204 Hz, default 50 Hz)
- Motor temp is less than operator-programmable Economizer Max Motor Temp setpoint .
- Economizer option is enabled (service-programmable)

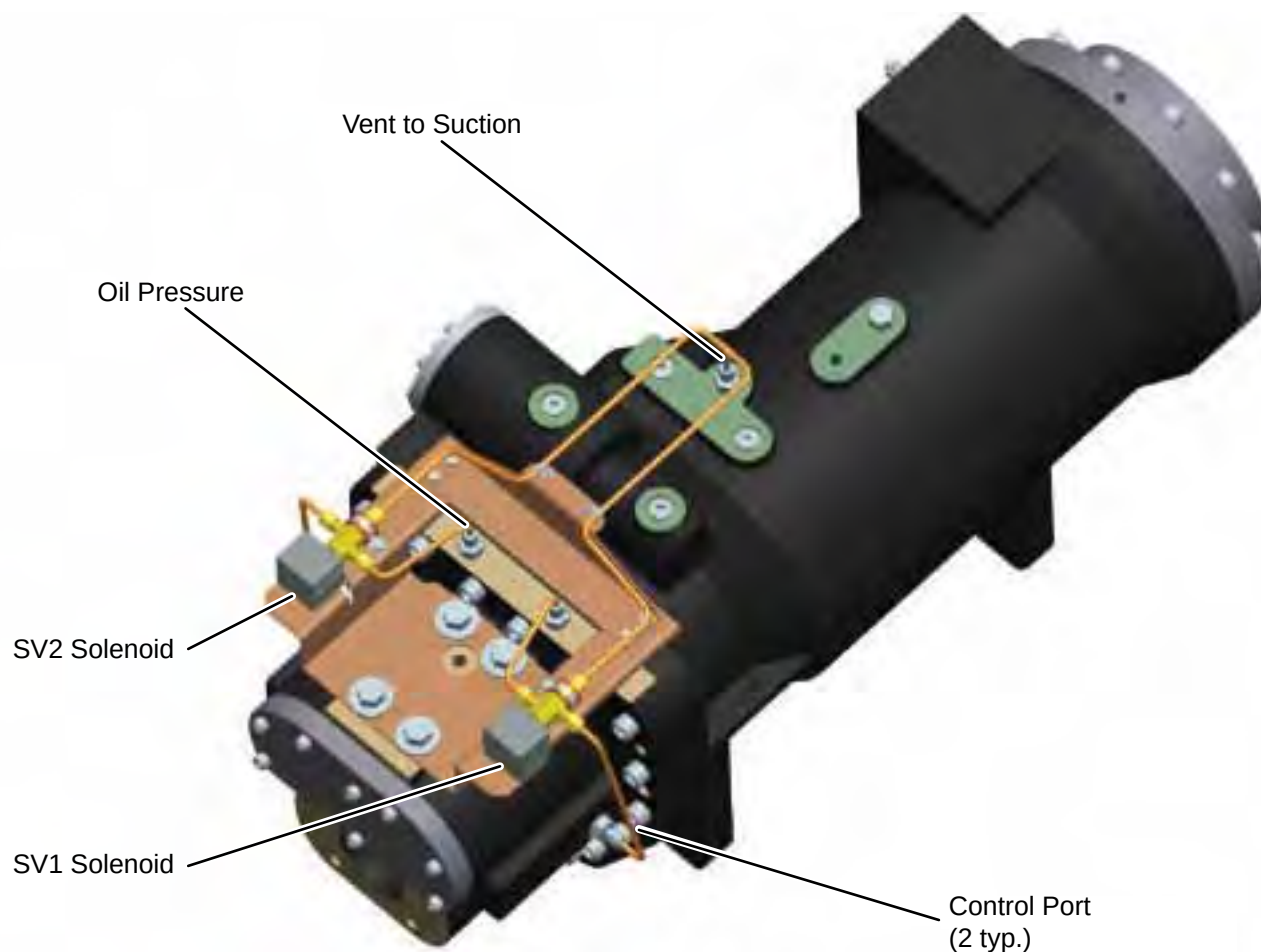
The economizer feed valve is opened from the operator-programmable Economizer Hold Position and controlled by the economizer feed valve PI controller to maintain the superheat. If the superheat is less than the operator-programmable Economizer Superheat

setpoint, the valve will close, but it is not limited to not less than the programmed Hold Position. If the superheat is greater than the Economizer Superheat setpoint, the valve will open. When the VSD frequency drops below the operator-programmable Economizer Off Frequency (45 Hz to 203 Hz, default 45 Hz) or the motor temp => Economizer Max Motor Temp setpoint the Economizer feed valve will close to the Economizer Hold Position. If the valve is at the hold position due to the Economizer Max Motor Temp => setpoints, then the PI controller will start controlling the valve again after (the Economizer Max Motor Temp < (Setpoint - 10°F)

The economizer valve controller is a PI controller. A constant proportional gain is used. The integration time sets the integral gain. The economizer control valve function is called every 1 second. The valve is a stepper motor-operated EEV The control opens the valve to decrease superheat and closes the valve to increase superheat. Output to the stepper motor controller from the control is reverse acting.

Volume Index (VI) Step Solenoid Control (for CTS compressor applications)

High head applications such as heat pump typically use the CTS model compressor. The Volume Index (VI) of that compressor from suction to the standard discharge port is designed for the higher head. Volume index is the ratio of contained volume of the gas from suction to discharge. The screw compressor is most efficient when the gas compression done by the compressor from suction to exit matches the compression needed by the system, without over- or under-compression. To improve part load efficiency at lower condenser pressures in widely variable head applications, two ports are provided in the discharge casing of the CTS compressor that communicate between the discharge and a point on the meshed rotors prior to the discharge port at the desired VI. In each port is a sealed piston that opens or blocks the port depending on its position. The VI step solenoids change the effective VI while running to better match the condenser pressure. The 3-way solenoids pilot oil pressure from the compressor to the back of the piston normally to hold it closed along with a coiled spring. They change the internal porting by venting that oil to suction when they are energized, allowing discharge pressure to push the piston, opening the port. The compressor VI is 3.2 when both solenoids are de-energized. When only SV solenoid 1 is energized, the VI is 2.5. When both solenoids SV1 and SV2 are energized, the VI is 1.9.

**FIGURE 99 - STEP VI COMPONENTS**

The control uses the saturated temperature difference to determine when to energize the solenoids. The saturated temperature difference is defined as saturated discharge temperature minus saturated evaporator temperature. It reflects the shell pressures. The control compares this to service-programmable setpoints listed and described below:

The control logic prevents unnecessary cycling of the VI solenoid when the compressor starts, or when conditions result in rapid changes in operating pressures by including fixed time delays for solenoid state changes. The VI step solenoids are controlled according to the saturated temperature difference as follows:

TABLE 59 - SETUP MODE

SETUP MODE VALUE	LOW LIMIT	HIGH LIMIT	DEFAULT
Sys 1 VI Differential Temp Setpt	60.0 °F	90.0 °F	73.0 °F
	33.3 °C	50.0 °C	40.5 °C
Sys 2 VI Differential Temp Setpt	60.0 °F	90.0 °F	73.0 °F
	33.3 °C	50.0 °C	40.5 °C
VI Dead band	2.0 °F	10.0 °F	4.0 °F
	1.1 °C	5.5 °C	2.2 °C
VI Differential Temp Setpt Offset	2.0 °F	40.0 °F	20.0 °F

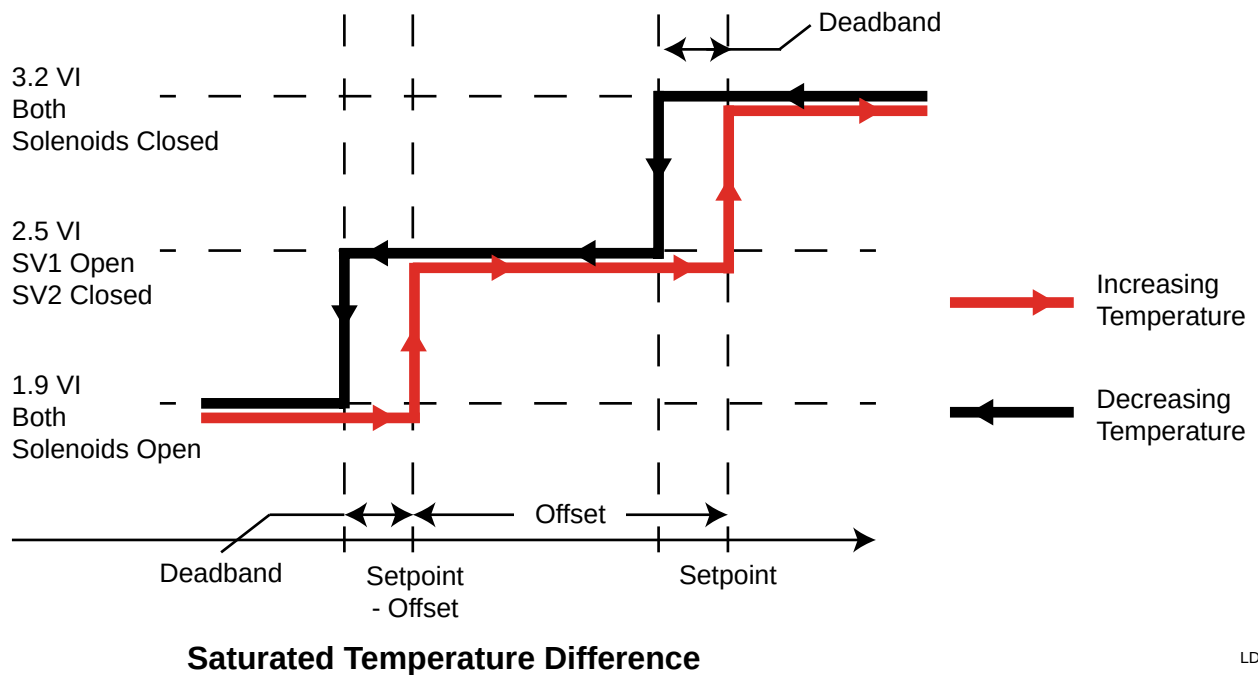


FIGURE 100 - DIAGRAM OF SOLENOID CONTROL VERSUS SATURATED TEMPERATURE DIFFERENCE

Both solenoids SV1 and SV2 are kept closed during the first 10 minutes of run time. Every time the temperature crosses a threshold that would result in the state of either of the solenoids changing, a five-minute delay timer must elapse before the solenoid commands change.

If the saturated temperature difference is greater than the programmable differential setpoint, both solenoids are de-energized.

If the saturated temperature difference drops below the programmable differential setpoint – Dead band, Solenoid 1 is energized and Solenoid 2 is de-energized.

If the saturated temperature difference drops below the programmable setpoint – Programmable Offset – Programmable Dead band, Solenoid 1 and 2 are energized.

If the saturated temperature difference increases above the programmable setpoint – Programmable Offset, Solenoid 1 is energized and Solenoid 2 is de-energized.

If the saturated temperature difference increases above the programmable setpoint, both solenoids are de-energized.

BASIC OPERATION - HEAT PUMP APPLICATION

Heat Pump Enable

The heat pump intent is to control Leaving Condenser Liquid Temperature (LCLT) to the operator-programmable LCLT setpoint. Heat Pump capability is enabled when the heat pump jumper plug is installed on the control board J7 connector. This plug shorts J7 pins 1 and 2 together for the software to recognize the heat pump capability is enabled, see *Figure 101 on page 194*. If the jumper plug is out, Heat Pump capability is disabled. When Heat Pump capability is enabled, the chiller can operate as a chiller or as a heat pump by selecting the operating mode:

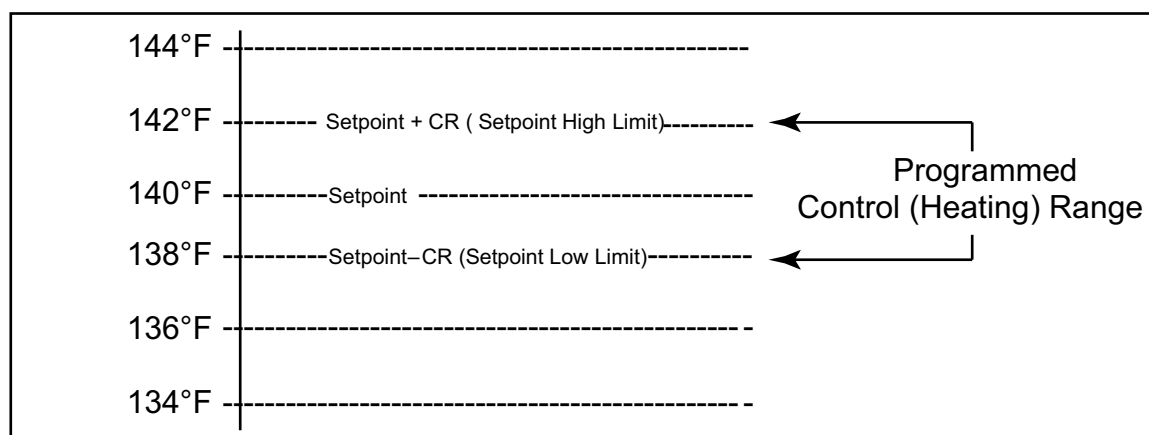
Locally, this is set under the panel OPTIONS key. The choices for this are as follows:

- CHILLER
- HEAT PUMP

Remote Operating mode is also selectable in Remote mode only by external contacts across control panel terminal block 1TB, Terminals 10 and 41.

- Open = Chiller mode
- Closed = Heat Pump mode





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FIGURE 102 - CHILLER CONTROL (HEATING) RANGE

Leaving Condenser Liquid Control - Heat Pump

In Heat Pump operation, the chiller uses a fuzzy logic proportion and rate control in an effort to maintain LCLT exactly at setpoint. Compressor VSD speed is manipulated by the control to achieve this. Another operator-programmable setpoint called the Control Range (CR) defines how far above and below the LCLT setpoint the chiller will stop compressors or the entire unit and restart them to maintain LCLT within the range. The programmable CR defines the Setpoint High Limit and Setpoint Low Limit as shown in the example above. In this example, LCLT setpoint is 140°F and the CR is 2°F.

Chiller Start - Heat Pump

In order for the chiller to start, all of the following must be true:

- Unit switch must be on
- Run permissive inputs (Remote Cycling Contacts) must be satisfied
- No unit or system faults exist
- No unit or system start inhibits exist
- The Daily Schedule is calling for the chiller to run

- The Chilled Liquid flow switch input is satisfied (switch is closed)
- The Condenser Liquid flow switch is satisfied (switch is closed)
- Leaving Condenser Liquid Temperature (LCLT) is below the Setpoint Low Limit (LCLT setpoint - Control Range)

COMPRESSOR CONTROL - HEAT PUMP

Compressor control is identical to running in chiller mode with the same limits on VSD ramp rate versus frequency.

Start-up Number of Compressors - Heat Pump

The control decides how many compressors to start from the chiller off state based on;

- How long the chiller last ran
- How long ago the chiller last ran
- How far the leaving chilled liquid temperature is from setpoint
- Whether the leaving chilled liquid temperature is trending down presently

TABLE 60 - PROGRAMMABLE RANGES

PROGRAM VALUE MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Leaving Condenser Liquid Temp Setpoint Heat Pump	86.0 °F	160.0 °F	131.0 °F
	30.0 °C	71.1 °C	55.0 °C
Leaving Condenser Liquid Temp Control Range Heat Pump	1.5 °F	2.5 °F	2.0 °F
	0.8 °C	1.4 °C	1.1 °C
Max Remote Temp Reset Heat Pump	2 °F	40 °F	20 °F
	1 °C	22 °C	11 °C

The chiller will start two compressors unless any of the following are true, in which case only one starts;

- If the cumulative run time before the last shutdown was less than 5 minutes, the control will only start one compressor.
- If the time elapsed since the last shutdown was less than 5 minutes, the control will only start one compressor.
- If the Leaving Condenser Liquid Temperature is less than 5 °F below the setpoint low limit (bottom of the control range), the control will only start one compressor.
- If the Leaving Condenser Liquid Temperature is increasing at a rate faster than 3 °F per minute while the chiller is not running, the control will only start one compressor.

Running Number of Compressors - Heat Pump

The logic looks at the number of compressors running and the present VSD Frequency. If the logic determines that fewer compressors are needed to handle the load, a compressor will be shut down. If the logic determines that both compressors running at a lower frequency could handle the load, it will start another compressor. The following equations are used to determine when to start and stop a compressor and to determine the new running frequency.

When only one compressor is running, the second compressor is also started when the running compressor frequency increases to 15 Hz + two times the service-programmable setpoint Minimum Start Frequency (50Hz to 95 Hz, default 50 Hz).

When a second compressor is started, the two compressors are brought to 1/2 of the frequency the single compressor was running when it crossed over the threshold to bring the other one online.

When two compressors are running, one is stopped when all of the following are met:

- LCLT has increased to the Setpoint High Limit (LCLT setpoint + Control Range)
- VSD Frequency is at the service-programmable Minimum VSD Frequency setpoint (50Hz to 95 Hz, default 50 Hz)
- LCLT is ramping toward a higher value (not constant nor decreasing)

Capacity Control Load and Unload - Heat Pump

VSD speed change is how compressor capacity is regulated. Speed is increased to gain capacity to raise LCLT and decreased to reduce capacity to decrease LCLT. Speed is operated between the service-programmable Minimum VSD Frequency setpoint (50Hz to 95 Hz, default 50 Hz) and the maximum (factory set for application, limited to 203Hz maximum). Change to the number of operating compressors is related to speed as explained above. The chiller capacity control has a Load and Unload delay timer. These timers prevent a change to VSD speed until they have timed out after either of the following events to prevent excess cycling of the control.

- Whenever a compressor is started or stopped the chiller load and unload timers are set to 30 seconds.
- Whenever the control has made a change to VSD speed to adjust capacity to follow LCLT, the load and unload timers are set to 2 seconds.

Normally, the maximum step of loading or unloading is 1.0 Hz. Therefore the chiller will not change speed faster than 1.0 Hz/2 seconds. However unloading rate is increased when the LCLT is greater than LCLT Setpoint + (Control Range / 2). Then the unload steps from the control are doubled allowing the maximum step of unloading to be 2.0 Hz every 2 seconds.

Load Limiting and Over-ride Unload controls continue to apply in heat pump mode as for chiller mode.

OPERATING CONTROLS

Anti-Recycle Timer

The anti-recycle timer prevents short cycling of systems in the chiller and allows the Economizer feed and Condenser level control stepper valves to be zeroed on power-up before starting a compressor. On power up of the control panel, the anti-recycle timer for each system will be set to 120 seconds. Whenever a system starts up, the anti-recycle timer for all systems will be set to 120 seconds. Whenever a system shuts down, the anti-recycle timer for that system will be set to 120 seconds.

Evaporator / Condenser Pump Start Contact Control

The Evaporator / Condenser pump start dry contacts are energized when any of the following conditions are true once the panel has been powered up for at least

30 seconds and the pump contacts have not been energized in the last 30 seconds (to prevent pump starter overheating):

- Low Leaving Chilled Liquid Fault
- Leaving Condenser Liquid temperature is less than 36°F (2.2°C)
- Daily Schedule is ON and Unit Switch is ON
- On initiating pre-charge for any compressor start

Compressor Heater Control

Each compressor has its own heater. The purpose of the heater is to boil refrigerant out of the oil. The heater will be off whenever the respective compressor is running. The heater will turn on when the compressor is off and all valid motor temperatures are less than 158°F (70°C). The heater will turn off when the compressor is off and any valid motor temperature is greater than 160°F (71°C).

Alarm Contacts

Each system or unit has its own alarm contact. The Alarm contact is closed (output is ON) when no fault condition is present and open (OFF) when an alarm situation is active. The contacts are turned off if any of the following are true.

- A system is faulted or inhibited for longer than 5 seconds
- The Unit is faulted or inhibited for longer than 5 seconds
- A system is locked out
- The Unit is locked out

Chiller Run Contacts

The Chiller Run output is turned on whenever any compressor is running. It is turned off when no compressors are running. This output is available to the customer as a dry contact.

Hot Gas Bypass (Option)

The Hot Gas Bypass solenoid is energized open when the chilled liquid temperature difference between leaving and entering is less than the service-programmable setpoint (2.0°F to 40.0°F, default 20.0 °F). The valve provides a flow path for uncondensed refrigerant vapor from the top of the condenser to the evaporator above the tube space. When the system is not running or chiller is off this valve will remain closed.

Liquid Refrigerant Injection Valve Control (Option)

The liquid refrigerant injection valve control is active only when its system is running. The liquid Refrigerant injection solenoid valve opens when either of the following is true to provide liquid refrigerant from the liquid line between the economizer and the evaporator spray inlet to the compressor at a port near suction pressure;

- Discharge temp is greater than the operator- programmable Liquid Refrigerant Injection Valve Open Setpoint (135.0°F to 200.0°F, default 165 °F)
- Any Motor temperature is greater than the Motor Temperature Unload programmable setpoint (150°F to 250°F, default 240°F) minus 10°F and Discharge Superheat is greater than 18°F

The liquid refrigerant injection valve closes when both of the following are true;

- Discharge temp is less than the Liquid Refrigerant Injection Valve Open programmable setpoint minus the Liquid Refrigerant Injection Valve Closing Threshold programmable setpoint (5.0°F to 30.0°F, default 10.0°F)
- All Motor temperatures are less than the Motor Temperature Unload programmable setpoint (150°F to 250°F, default 240°F) minus 30°F

VSD Aux Coolant Pump At Water Side (Option)

The VSD Aux coolant Pump control is active only when the Aux coolant Pump feature is enabled. The VSD Aux coolant pump will run when the Unit Switch is on.

Oil Pump (Option)

An optional oil pump would exist when necessary. The oil pump would turn on when the (discharge pressure - evaporator pressure) is less than the programmable setpoint and turn off when the (discharge pressure - evaporator pressure) is greater than the programmable setpoint.

Leaving Chilled Liquid Temperature (LCHLT) Reset Control

The LCHLT RESET CONTROL is used to reset the actual LCHLT setpoint used in capacity control. Refer to the three methods below to reset the LCHLT setpoint:

- **Local Cooling Reset:** Reprogram the local cool-

ing setpoint under the SETPOINTS key, which is the value to which the unit will control the LCHLT, if no other method is active.

REMOTE TEMPERATURE LIMIT RESET is only possible if the option is enabled by selecting OPTIONS key, and programmable password protected UNIT SETUP MODE from the factory.

- **Remote BAS Comms Reset:** Set the LCHLT setpoint via the BAS COMMS. The control panel will only accept a remote setpoint from the BAS, if the control panel is in REMOTE CONTROL mode (under OPTIONS). If the control panel is in LOCAL CONTROL mode, the BAS setpoint will be ignored, and the remote LCHLT setpoint is set to the local setpoint. The minimum and maximum allowable reset values will be the same as those allowable programmable values for the local setpoint. If these values are exceeded by the BAS, the minimum or maximum value will be used.
- **Remote Analog Reset:** Reset the remote LCHLT setpoint via the REMOTE TEMPERATURE RESET analog input. A zero signal input (0%) equates to a 0°F (0°C) offset to the local setpoint. A full scale signal input (100%) equates to a positive offset to the local setpoint equal to the programmable maximum REMOTE TEMP RESET. The offset is linear and may be adjusted between 0% and 100% points. The maximum setpoint allowed is the maximum programmable local setpoint, which will be capped at this value, if the calculated setpoint with temperature offset exceeds this value.

This input may be used either in LOCAL or REMOTE CONTROL mode, which will only operate if enabled under the UNIT SETUP mode and the OPTIONS key. The input will be ignored if the REMOTE TEMP RESET is disabled under the OPTIONS key, or if there are valid BAS COMMS while in REMOTE CONTROL mode. Once a change to the input is registered, a timer is set to the value of the REMOTE INPUTS SERVICE TIME as programmable under the UNIT SETUP mode at the factory for the 15 minutes (default). The low limit is five min. and the high limit is 60 minutes. The remote input will be ignored until this timer expires. The timer assures that rapid changes in a remote reset signal don't result in poor temperature control or excessive compressor cycling. In most instances, this timer will not need to be changed, since resetting it more often

than every 15 minutes will create problems with chilled liquid temperature control. A Johnson Controls Factory Service Center should be contacted if a timer change is required.

Optional Heat Pump Mode Selection

If the chiller was purchased with the heat pump option, there are two ways to toggle operation between the controlling leaving chilled liquid temperature to setpoint in chiller mode, or controlling leaving condenser liquid temperature to setpoint in heat pump mode.

Local Heat Pump Mode: Use the OPTIONS key to set the operating mode to CHILLER or HEAT PUMP.

Remote Heat Pump Mode: In the REMOTE MODE only, select Chiller Mode (OPEN CONTACTS) or Heat Pump Mode (CLOSED CONTACTS) using external contacts across control panel Terminals 40 and 41 in Terminal Block 1TB.

Optional Heat Pump Leaving Condenser Liquid Temperature (LCLT) Reset Control

LCLT Reset Control is used to reset the actual LCLT setpoint used in capacity control. Refer to the three methods below to reset the LCLT setpoint:

- **Local Condenser Reset:** Reprogram the local cooling setpoint under the SETPOINTS key, which is the value to which the unit will control the LCLT, if no other method is active.

REMOTE TEMPERATURE LIMIT RESET is only possible if the option is enabled by selecting OPTIONS key, and programmable password protected UNIT SETUP MODE from the factory.

- **Remote BAS Comms Reset:** Set the LCLT setpoint via the BAS COMMS. The control panel will only accept a remote setpoint from the BAS, if the control panel is in REMOTE CONTROL MODE (under the OPTIONS key). If the control panel is in LOCAL CONTROL MODE, the BAS setpoint will be ignored, and the LCLT setpoint is set to the local setpoint.

The minimum and maximum allowable reset values will be the same as those allowable programmable values for the local setpoint. If these values are exceeded by the BAS, the minimum or maximum value will be used.

- **Remote Analog Reset:** Reset the remote LCLT via the REMOTE TEMPERATURE RESET analog input. A zero signal input (0%) equates to a

0°F (0°C) offset to the local setpoint. A full scale signal input (100%) equates to a negative offset to the local setpoint equal to the programmable minimum REMOTE TEMP RESET. The offset is linear and may be adjusted between 0% and 100% points. The minimum setpoint allowed is the minimum programmable local setpoint, which will be capped at this value, if the calculated setpoint with temperature offset exceeds this value.

Current Limit Reset Control

CURRENT LIMIT RESET is used to reset the actual CURRENT LIMIT setpoint used in current limit control. Refer to the three methods below to reset the current limit setpoint:

- **Local Current Limit Reset:** Reprogram the LOCAL CURRENT LIMIT setpoint under the PROGRAM key. This is the value to which the unit will control the current limit and override capacity control, if none of the other methods are active.

REMOTE CURRENT LIMIT RESET is only possible, if the option is enabled by selecting both the OPTIONS key, while in the factory programmable password protected UNIT SETUP MODE.

- **Remote BAS Current Limit Reset:** Set the BAS CURRENT LIMIT via the BAS COMMS. The control panel will only accept a CURRENT LIMIT setpoint from the BAS if the control panel is in REMOTE CONTROL MODE (OPTIONS key). If the control panel is in LOCAL CONTROL MODE, the BAS setpoint will be ignored. The minimum and maximum allowable values will be the same as the minimum and maximum allowable reset values for the CURRENT LIMIT setpoint under the PROGRAM key. If these values are exceeded, the minimum or maximum value will be used.
- **Remote Current Limit Analog Reset:** Set the CURRENT LIMIT setpoint via the REMOTE CURRENT LIMIT analog input. A zero signal input (0%) equates to the maximum current limit setpoint as defined under the PROGRAM key CURRENT LIMIT setpoint. A full scale signal input (100% input) equates to the minimum current limit setpoint as defined under the PROGRAM key CURRENT LIMIT setpoint. The current limit value is linear and may be adjusted anywhere between the maximum and minimum points of 0% (no offset) and 100% (max. current limiting).

This input may be used in LOCAL or REMOTE CONTROL MODE. This input will be ignored if the REMOTE CURRENT LIMIT is disabled under the OPTIONS key. Once a change to the input is registered, a timer is set to the value of the REMOTE INPUTS SERVICE TIME as programmable under the UNIT SETUP MODE at the factory for the default value of 15 minutes. The low limit is five minutes, and the high limit is 60 minutes.

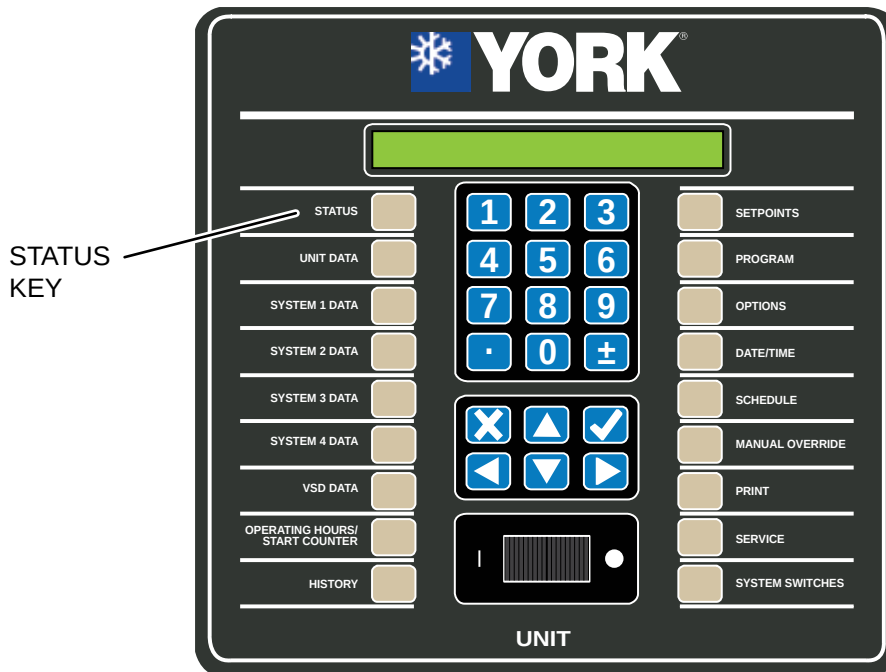
The remote input will be ignored until this timer expires. The timer assures that rapid changes in a remote reset signal don't result in poor temperature control or excessive compressor cycling. In most instances, this timer will not need to be changed, since reset more often than 15 minutes will create problems with chilled liquid temperature control. Contact a Johnson Controls Factory Service Center if a timer change is required.

USER INTERFACE

The keys, detailed in the following pages, provide various displays of unit related data. Press the ▲ or ▼ key repeatedly to select multiple display messages. The display messages that contain a number symbol (#) will be replaced with the chiller's present value, which are listed below:

- SYS X = 1 or 2
- ###.# °F = Temperature Data
- #####.# % = Percent (0 to 100%)
- ### = :
 - Time Data, i.e. seconds (SEC)
 - PSIG/PSID = Pressure
 - Hz = Hertz
 - AMPS = Amperage
 - FLA = Full Load Amperage

STATUS KEY



LD16388

FIGURE 103 - STATUS DATA KEY ON CONTROL PANEL

Press the STATUS key to display the current whole or individual system's operational status, which include:

- Running status
- Cooling demand
- General or fault status
- External device and unit/system switches status
- Load limiting

The display will show the highest priority message as determined by the microprocessor.

When power is first applied to the control panel, the following message displaying Johnson Controls, EPROM version, date, and time will be displayed for two seconds, followed by the general status message:

(C)2012 JOHNSON CONTROLS
C.XXX.XX.XX 12-JAN-2012 12:45: AM

Unit status messages occupy two lines of the status message display. If no unit status message applies, individual system status messages will be displayed.

Anytime the STATUS key is pressed, or after the EPROM message disappears at power-up, a display indicating chiller or system status will appear.

Multiple STATUS messages may appear, and can be viewed by pressing the STATUS key repeatedly to allow scrolling through up to three messages, which

could be displayed at any time on a two-compressor chiller. STATUS messages fall into two categories: GENERAL UNIT AND SYSTEM STATUS or FAULT STATUS messages, which are listed below.

General Unit and System Status Messages

UNIT STATUS
MANUAL OVERRIDE

Manual override is activated by the keypad, and is a priority message and cannot be overridden by any other STATUS message. When in this mode, no other STATUS messages can be seen.

UNIT STATUS
UNIT SWITCH OFF

Unit is not allowed to run because the unit switch is in the OFF position.

UNIT STATUS
DAILY SCHEDULE SHUTDOWN

The programmed daily or holiday schedule is keeping the chiller from running.

UNIT STATUS
REMOTE CONTROLLED SHUTDOWN

BAS is not allowing the unit to run.

UNIT STATUS
CHILLED LIQUID FLOW SWITCH SHUTDOWN

The flow switch is open, which is preventing the unit from running. There is a one second delay until the unit shuts down.

UNIT STATUS

CONDENSER LIQUID FLOW SWITCH SHUTDOWN

The flow switch is open, which is preventing the unit from running. There is a one second delay until the unit shuts down.

UNIT STATUS

VSD COOLING SHUTDOWN

The chiller is shutdown, but is running the auxiliary coolant pump, to bring the VSD ambient temperature down to an acceptable level before allowing the unit to start.

SYS X REMOTE RUN CONTACT IS OPEN

The system remote run permissive input is open, preventing that system from running. There is a one second delay until the unit shuts down.

SYS X SYSTEM SWITCH IS OFF

The system is prevented from running by selecting OFF with the SYSTEM SWITCHES key.

SYS X NOT RUNNING

The chilled liquid temperature is below the setpoint (condenser is above, for heat pump), or the microprocessor has not loaded the lead system far enough into the loading sequence to bring on the lag system. This message will be displayed on the lag system until the loading sequence is ready for the lag system to start. This message also applies to the Leaving Condenser Liquid Temperature and setpoint in the HEAT PUMP MODE.

SYS X COOLING DEMAND SHUTDOWN

This message is only displayed in NORMAL SHUTDOWN HISTORY to indicate a capacity controlled shutdown based on cooling and heating demand.

SYS X COMPRESSOR RUNNING

The system is running due to demand.

SYS X SHUTTING DOWN

The system is ramping down to shut down. This message is displayed after the software run signal is disabled until the VSD notifies the control board that the compressor is no longer running.

JOHNSON CONTROLS

SYS X ANTI-RECYCLE TIMER = ### SEC

The amount of time remaining on the anti-recycle timer is shown, and the system is unable to start due to the timer being active.

SYS X OPD MITIGATION

Condenser level control is repositioning the level setpoint to reduce evaporator pressure and overcome low differential pressure to maintain oil flow.

Load or Unloading Limit Messages

The following messages show that the designated load limit or unloading is in effect.

SYS X DISCHARGE PRESSURE LIMITING

SYS X EVAPORATOR PRESSURE LIMITING

SYS X MOTOR CURRENT LIMITING

SYS X PULLDOWN MOTOR CURRENT LIMITING

SYS X BAS CURRENT LIMITING

The motor current load limit or unloading is in effect through the use of the BAS setpoint offset. The BAS current limit must be activated for this function to operate.

SYS X REMOTE MOTOR CURRENT LIMITING

The motor current load limit or unloading is in effect through the use of the remote setpoint offset, which may be offset using a remote voltage or a current signal. The remote current limit must be activated for this function to operate.

SYS X VSD BASEPLATE TEMP LIMITING

The VSD baseplate temperature is high resulting in load limiting or unloading.

SYS X VSD INTERNAL AMBIENT TEMP LIMITING

The VSD internal ambient temperature is high resulting in load limiting or unloading.

SYS X CHILLED LIQ LEAVE TEMP LIMITING

Applicable in HEAT PUMP mode only.

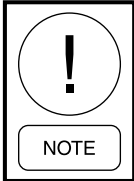
FAULT MESSAGES

A number of possible fault messages may appear when the STATUS key is pressed. Whenever a fault message appears, the safety thresholds on the unit have been exceeded, the unit or a single system will be shut down, and, in some cases, locked out. The shutdown thresholds and associated information relating to each fault are explained in the UNIT WARNINGS, UNIT SAFETIES (FAULTS) and SYSTEM SAFETIES (FAULTS) sections.

Unit Warnings

Unit warnings as shown in the table below are caused when a condition is present requiring operator intervention to restart the unit. Check all setpoints, program values, and options before operating the unit. Warnings are not logged to the history buffer. If a unit warning is in effect, the message will be displayed when the operator presses the STATUS key.

TABLE 61 - UNIT WARNINGS

MESSAGE	DESCRIPTION
OIL FILTER CLOGGED	This message alerts low oil flow, possibly from a clogged oil filter. A system will not shutdown when its HIGH OIL FILTER DIFFERENTIAL PRESSURE (Oil Pressure - Discharge Pressure) rises above the programmable setpoint (10 to 100 psid, default 20 psid). The message will be cleared when the pressure drops below setpoint or the compressor is stopped. The message, SYS X, applies to System 1 or 2.
INVALID NUMBER OF COMPRESSORS SELECTED	This message, which will be displayed indefinitely, checks a jumper in the VSD wiring harness, which indicates the number of compressors. The message will occur after the VSD has been initialized on power-up, if no jumpers are installed, or if more than one jumper is installed. To clear this warning, turn off the control panel and VSD control voltage, and install the jumpers properly in the VSD wiring harness.  <i>These jumpers are factory installed in the wire harness plug and should not require changes.</i>
INVALID SERIAL NUMBER	If this message appears, which indicates an invalid letter or number exists in a location in the serial number string, the chiller may have lost important factory programmed information. Contact Johnson Controls Product Technical Support immediately to get the password to enter the serial number using the SERVICE key. Bypass this status message to view additional messages by pressing the STATUS key repeatedly. Up to three STATUS messages can be displayed at any time.
LOW BATTERY	On power-up, the control system checks the RTC battery to see if it is still operational. If it is, normal unit operation is allowed. If the battery voltage is low, the warning message is displayed indefinitely. If a low battery condition exists, all programmed setpoints, program values, time, schedule, and history buffers were lost, which will be reset to their default values, which may not be the desired operating values. Once a bad battery is detected, the unit will be prevented from running until the MANUAL OVERRIDE key is pressed. After the key is pressed, the anti-recycle timers will reset to allow the operator sufficient time to check setpoints, program values, etc. If a low battery is detected, replace it as soon as possible. The unit will be prevented from running on the next power interruption.

Unit Safeties (Faults)

Unit safeties, as shown in *Table 62 on page 204*, are:

- Faults that cause all running compressors to be shut down, if a safety threshold is exceeded for three seconds.
- Recorded in the history buffer along with all unit data and system operating conditions.
- Auto reset faults where the unit will be allowed to restart automatically after the fault condition is no longer present.

The only exception is any VSD related unit fault. If any combination of three VSD unit faults occur within 90 minutes, the unit will be locked out on the last fault. A VSD lockout condition requires a manual reset, using the SYSTEM SWITCHES key on the keypad. They must be cycled off and on to clear a VSD unit lockout fault. If a unit safety is in effect, the message will be displayed when the STATUS key is pressed.

Shutdowns due to faults are one of two types:

- Immediate - Power to run the compressor is stopped immediately.
- Ramped - The speed of the compressor is ramped to zero quickly, and then power is stopped immediately.

VSD Fault Data

When a VSD fault has occurred, three types of fault data are captured by the VSD logic board. This data is stored in the board battery-backed RAM for safekeeping and is transferred to the panel via the communications link.

First Fault Code

The first fault code will be set for the fault that initiated the system shutdown.

All Fault Bits

Any faults, which occur within the communications transmission time frame, following the inception of the first fault, is stored and transmitted to the panel together with the first fault data, as ALL FAULT information.

Fault Data

A snapshot of the operating parameters of the unit is continuously updated in the battery-backed memory once every program loop. Upon receipt of a first fault code, a snapshot of the operating parameters, which are stored in memory, is transmitted to the panel as the fault data.

If a control panel safety occurs after the VSD fault, but before the fault is reset, the control panel fault is added as an ALL FAULT of the VSD fault, meaning it will be registered in the history because it occurred while the VSD was shutting down, or while the systems were shut down. ALL FAULTS do not store operating data at the time of the fault.

If a VSD fault occurs during the fault rampdown or while the systems are shut down, the VSD fault will be registered as a new fault because any VSD fault needs to be registered with a full account of the systems data at the time of the fault.

TABLE 62 - UNIT SAFETIES (FAULTS)

MESSAGE	DESCRIPTION
UNIT YYYYYYY DC BUS VOLTAGE IMBALANCE	Software-Initiated Fault - The voltage magnitude of each half of the DC bus shall remain within +/- 100 VDC of the total DC bus voltage divided by two. If the magnitude exceeds the +/- 100 volt window the unit shall initiate a shutdown. This safety will lock out on the first occurrence. The VSD shutdown type is immediate. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
UNIT YYYYYYY HIGH DC BUS VOLTAGE TRIP	Hardware-Initiated Fault - The high DC bus over voltage trip level is determined by hardware on the logic board, and it is designed to trip the unit if the DC bus exceeds 766 +/- 30 VDC. This is an auto-restart safety that will lock out on the third fault in 90 minutes. The VSD shutdown type is immediate. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
UNIT YYYYYYY HIGH LEAVING CONDENSER LIQUID TEMP	This fault protects the chiller from a high pressure cutout. This situation could occur under low flow/high head conditions or if the control setpoint values are improperly programmed. Any time the leaving condenser liquid temperature (water or brine) increases above the programmable cutout point, the chiller will shutdown. Restart can occur, if demand allows, when condenser leaving liquid temperature falls 4°F (2.2 °C) below the cutout. This fault cannot cause a lockout. The unit will be inhibited from starting if the leaving condenser liquid temp is above the cutout plus 4°F (2.2 °C). YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out.
UNIT YYYYYYY HIGH VSD INTERNAL AMBIENT TEMP	Software-Initiated Fault - The VSD logic board contains a temperature sensor, which monitors the unit's internal ambient temperature. The magnitude of the unit's internal temperature is compared to a limit of 158°F (70°C). If this limit is exceeded, the unit initiates a shutdown. The VSD cooling fan and coolant pump will remain energized until the internal temperature drops below 148°F (64.4°C) at which time the unit will be allowed to restart. The VSD cooling fan and water pump are de-energized when the internal temperature drops below 143°F (61.6°C). This fault will not cause a lockout. The VSD shutdown type is ramped. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out.
UNIT YYYYYYY LOW DC BUS VOLTAGE	Software-Initiated Fault - The DC bus under voltage trip level is dependent on the configuration of the VSD is as follows: Shutdown is set at 500 VDC on 460V, 60 Hz VSD, or 414 VDC on 380V 50/60Hz and 400/415V 50 Hz VSD. This is an auto-restart safety that will lock out on the third fault in 90 minutes. The VSD shutdown type is immediate. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
UNIT YYYYYYY LOW LEAVING CHILLED LIQUID TEMP	This fault helps to protect the chiller from an evaporator freeze-up should the chilled liquid temperature drop below the freezing point. This situation could occur under low flow conditions or if the setpoint values are improperly programmed. Any time the leaving chilled liquid temperature (water or brine) drops below the programmable cutout point, the chiller will fault and shut down with a ramped shutdown. The water trip temperature is 36° F (2.2°C) or programmable for brine from 5°F to 36°F, default 36.0° (-15°C to 2.2°C, default is 2.2°C). Restart can occur, if demand allows, when the chilled liquid temperature rises 4°F (2.2°C) above the cutout. This fault does not cause a lockout. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out.
UNIT YYYYYYY MOTOR CURRENT OVERLOAD	Hardware-Initiated Fault - This fault compares the highest of the three phases of motor current per compressor to the compressor's 105% FLA ADJUST (overload) potentiometer setting. If the current exceeds the setting continuously for 30 seconds, all compressors will shut down. This safety will lockout a system on the first occurrence. The VSD shutdown type is immediate. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
UNIT YYYYYYY PRE-CHARGE DC BUS VOLTAGE IMBALANCE	The voltage magnitude of each half of the DC bus shall remain within +/- 100 VDC of the total DC bus voltage divided by two. If the magnitude exceeds the +/- 100 volt window the unit shall initiate a shutdown. This safety will lock out on the first occurrence. YYYYYYY will show LOCKOUT, and will not restart until the operator clears the condition using the keypad

TABLE 65 - UNIT SAFETIES (FAULTS) (CONT'D)

MESSAGE	DESCRIPTION
UNIT YYYYYYY PRE-CHARGE LOW DC BUS VOLTAGE	Software-Initiated Fault - This fault protects the chiller from conditions outside of the tolerances required to produce proper output power to the compressor motor. Several conditions must be met during the pre-charge operation. The DC bus voltage shall reach at least: 41 VDC within four seconds after the pre-charge signal has been asserted for 50 and 60 Hz VSD, 500 VDC within 19 seconds after the pre-charge signal has been asserted on the 460V, 60Hz VSD, and 414 VDC within 19 seconds on the 380V 50/60Hz and 400/415V, 50Hz VSD. If the unit fails to make pre-charge, the signal shall be deasserted for 10 seconds, during which time the units fan(s) and water pump(s) shall remain energized. Following this 10-second period, the pre-charge shall again be initiated. The unit shall attempt to make pre-charge three consecutive times. If the unit fails to make pre-charge on three consecutive times, the unit shall shut down and lock out. YYYYYYY will show LOCKOUT, and will not restart until the operator clears the condition using the keypad
UNIT YYYYYYY SINGLE PHASE INPUT VOLTAGE	Hardware-Initiated Fault - The VSD's SCR trigger control board contains circuitry that checks the three phase mains for the presence of all three-line voltages. If any line voltage is not present, the unit initiates a shutdown. The unit shall remain in shutdown until all voltage on all three phases is present. This fault will not cause a lockout. The VSD shutdown type is immediate. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out.
UNIT YYYYYYY VSD COMMUNICA- TIONS FAILURE	This fault prevents the unit from trying to run, if the control board never initializes communications with the VSD logic board. The unit will also shut down with a ramped shutdown, if the control board loses communications with the VSD logic board while the chiller is operating. On power-up, the microprocessor board will attempt to initialize communications with the VSD logic board. The control panel will request data from the VSD, which includes the number of compressors and the VSD software version. Once these data points have been received by the control board, and successfully initialized, the control board will not request them again. If the communications connection fails to occur and a reply from the VSD logic board does take place in eight seconds, the control board will prevent the chiller from operating, and a fault message will be displayed. During normal operation, if the control board receives no valid response to messages for eight seconds, the unit will shut down all compressors. The control board will continue to send messages to the VSD while faulted. The unit will be inhibited from starting until communications are established. The fault will automatically reset when the control board receives a valid response from the VSD for a data request. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out.
UNIT YYYYYYY VSD CT PLUG FAULT	Hardware-Initiated Fault - Jumpers are located in each CT plug on the VSD logic board to feedback a digital signal to indicate if all of the plugs are installed. If a plug is not installed, a low value is read on the digital input, and the unit will trip. This auto-restart safety will lock out on the third fault in 90 minutes. The VSD shutdown type is immediate. YYYYYYY will show FAULT to indicate that a system is in a FAULT condition, and will restart when the condition clears; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
UNIT YYYYYYY VSD LOGIC BOARD FAULT	Upon receipt of the voltage and frequency commands, the VSD PWM generator shall acknowledge receipt of the command by toggling a port on the system microprocessor. If the system microprocessor does not receive the handshake within 1.5 seconds of issuing the command (due to the TEST mode of operation) the unit shall initiate a trip. This auto-restart safety will lock out on the third fault in 90 minutes. The VSD shutdown type is immediate. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
UNIT YYYYYYY VSD LOGIC BOARD POWER SUPPLY	Hardware-Initiated Fault - The various DC power supplies which power the logic board are monitored via hardware located on the logic board. If any power supply falls outside its allowable limits, the unit initiates a shutdown. This auto-restart safety will lock out on the third fault in 90 minutes. The VSD shutdown type is immediate. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.

System Safeties

System safeties, as shown in *Table 63 on page 206*, are:

- Faults that cause all running compressors to be shut down, if a safety threshold is exceeded for three seconds.
- Recorded in the history buffer along with all unit data and system operating conditions.
- Auto reset faults where the unit will be allowed to restart automatically after the fault condition is no longer present.

If any combination of three faults on the same system occurs within 90 minutes, that system will be locked out on the last fault, which requires a manual reset using the system switches on the keypad and must be cycled off and on to clear the lockout fault.

Multiple Systems

When multiple systems are operating and a system fault occurs, the running systems will ramp down and the faulted system will be shut off. The previously operating system will restart, if required, after the fault clears and/or the 120-second anti-recycle timer times out.

If a system safety is in effect, the message will be displayed when the operator presses the STATUS key.

TABLE 63 - SYSTEM SAFETIES (FAULTS)

MESSAGE	DESCRIPTION
SYS 1 or 2 YYYYYYY CONTROL VOLTAGE	This fault alerts the user that the system's control voltage is not present, which could be due to a blown or missing control fuse. This safety will shut down a system if the unit switch input is low and the other system's unit input is high. A shutdown will not occur if both systems' unit switch inputs are low. This fault occurs immediately, and does not wait for three seconds. This safety will not cause a lockout. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, will restart when the condition clears, and the 120-second anti-recycle timer times out.
SYS 1 or 2 YYYYYYY EDUCTOR CLOG	This fault is designed to detect low flow of oil in the oil return eductor line. This safety will shut down a system or unit if the eductor temperature rises above the saturated evaporator temperature more than the programmed setpoint (5.0 to 50.0°F, default 5.0°F (2.7 °C to 27.7 °C, default 2.7 °C)) for the programmed eductor safety time (one to 1000 minutes, default 10 minutes). This fault causes a lockout on the first occurrence. YYYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY GATE DRIVER FAULT	Hardware-Initiated Fault - The VSD IGBT gate driver control board (one per compressor VSD) monitors the saturation voltage drop across each IGBT while it commands it gated on. If the IGBT's saturation voltage exceeds the prescribed limit, the gate driver shall determine that a short circuit is present, which causes a system shutdown. Also, if the gate driver board's power supply voltage falls below its permissible limit, this same fault is generated. This auto-restart safety will lock out on the third fault in 90 minutes. The VSD shutdown type is immediate. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 OR 2 YYYYYYY HIGH DIFF OIL PRESSURE	The high differential oil pressure cutout protects the compressor from low oil flow, possibly from a clogged oil filter. The system will shutdown when its differential oil to discharge pressure rises above the cutout of 65 psid (450 kPa). This safety is ignored for the first 90 seconds of run time. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, will restart when the condition clears, and the 120-second anti-recycle timer times out. If three faults occur within 90 minutes, LOCKOUT will appear, and will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY HIGH DISCHARGE PRESSURE	Software-Initiated Fault - A system will fault and shut down with a ramped shutdown when the high discharge pressure rises above 333 psig (2300 kPa) for 0.5 seconds. The system will be allowed to restart when the discharge pressure falls to 293 psig (20.2 kPa). The system will also be inhibited from starting if the pressure is above 293 psig (2020 kPa). YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, will restart when the condition clears, and the 120-second anti-recycle timer times out. If three faults occur within 90 minutes, LOCKOUT will appear, and will not restart until the operator clears the fault using the keypad.

TABLE 66 - SYSTEM SAFETIES (FAULTS) (CONT'D)

MESSAGE	DESCRIPTION
SYS 1 or 2 YYYYYYY HIGH DISCHARGE TEMP	This fault protects the motor and compressor from overheating. A system will fault and shut down with a ramped shutdown when its discharge temperature rises above 225°F (107°C). A system will be inhibited from starting, if the discharge temperature is above 175°F (79°C). YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, will restart when the condition clears, and the 120-second anti-recycle timer times out; or YYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY HIGH MOTOR CURRENT	Hardware-Initiated Fault - The three output lines to each compressor motor are monitored via three current transformers within the drive. The unit's three phases of instantaneous output current are compared to a prescribed limit, contained in hardware. The nominal peak current trip level is dependent on the configuration of the VSD as follows: 460V 60Hz, VSD Frames, A and B shutdown is 575.5 amps (554 amps (min) 597 amps (max)), 380V 50/60Hz and 400/415V 50Hz, VSD Frames A and B shutdown is 649.5 amps (626 amps (min), 674 amps (max)), and 380V 50/60 Hz and 400/415V 50Hz, VSD Frames C and D, and 460V 60 Hz Frame D shutdown is 863.3 amps (831 amps (min), 896 amps (max)). This auto-restart safety will lock out on the third fault in 90 minutes. The VSD shutdown type is ramped. The VSD shutdown type is immediate. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY HIGH MOTOR TEMP Z	This fault prevents a system compressor from running when its motor temperature is too high. A system will shut down when any of its two or three compressor motor temperature sensors rises above 250°F (115 °C). The system will be inhibited from starting if any of its motor temperature sensors is above 240°F (120°C). This fault causes a lockout on the third fault in 90 minutes. If any motor temperature sensor is being ignored (as selectable under UNIT SETUP MODE) that sensor will not be used in evaluating the high motor temperature safety and start inhibit. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad. Z is the MOTOR TEMP SENSOR NO.
SYS 1 or 2 YYYYYYY HIGH VSD BASEPLATE TEMP	Software-Initiated Fault - The VSD phase bank assembly contain one heat sink to cool both the inverter power modules and the converter SCR/Diode modules. Each module contains an internal temperature sensor (5K ohm at 77°F (25°C)) to monitor its baseplate temperature. The highest of the two inverter power module's baseplate temperatures on Compressors 1 and 2 is compared in software to a limit dependent on the VSD configuration as follows. When the limit is exceeded the unit is shut down: 218°F (103.3°C) for Frames A and B, and 226°F (103.3°C) for Frames C and D. This auto-restart safety will lock out on the third fault in 90 minutes. The VSD shutdown type is ramped.
SYS 1 or 2 YYYYYYY HPCO	Hardware-Initiated Fault - The mechanical High Pressure Cutout (HPCO) protects the system from experiencing dangerously high discharge pressure. A system will fault and shut down immediately when the mechanical high pressure cutout contacts open. The fault will occur immediately and not wait three seconds. The HPCO is wired in series with the VSD run signal and will only be checked by the control board when the system is running. The mechanical cutout opens at 333 to 348 psig (2.3 MPa to 2.4 MPa) and closes at 197 psig ± 10 psig (1.36 MPa ± 0.07 MPa). YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad for CE units the switch must be manually reset first.
SYS 1 or 2 YYYYYYY LOW DISCHARGE SUPERHEAT	This fault protects against excessive liquid refrigerant carryover from the evaporator, in cases which may be a result of overcharge of refrigerant or another refrigerant inventory problem. It also protects the system compressor from liquid refrigerant flooding back from the economizer feed line, in cases where the economizer valve fails to close. This safety is ignored for the first 10 minutes of system run time. If the discharge superheat falls below 5.0°F (2.8°C) for five minutes, the system will shutdown. This fault causes a lockout on the third fault in 90 minutes. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.

TABLE 66 - SYSTEM SAFETIES (FAULTS) (CONT'D)

MESSAGE	DESCRIPTION						
SYS 1 or 2 YYYYYYY LOW DIFF OIL PRESSURE	This fault protects the compressor from low oil flow causing insufficient lubrication. A system will fault and shut down with a ramped shutdown when its differential between oil and suction pressure falls below the fault. The safety is ignored for the first 60 seconds of run time. If restart transition has occurred, the timer is set according to <i>Table 65</i> with a maximum limit of 73 seconds. The timer calculation allows for 60 seconds of run time after the time it takes to ramp the running compressor from its existing speed to shutdown speed. TABLE 64 - TIMER SETTINGS <table> <tr> <th>CURRENT FREQUENCY</th><th>INCREASE TIMER BY:</th></tr> <tr> <td>>100 Hz</td><td>60 sec. + (100 Hz - 5 Hz)/30.4 Hz/sec + 9.5 sec.</td></tr> <tr> <td>< or = 100 Hz</td><td>60 sec. + (Current freq - 5 Hz)/10 Hz/sec</td></tr> </table> Note: 9.5 sec = (100 Hz-5 Hz/10 Hz sec), the time it takes to ramp from 100 Hz to 5 Hz. After the timer expires, the fault is linearly ramped from 0 psid (0 kPa) to the programmable threshold (20-60 psid, default 21 psid (137-413 kPa, default 145 kPa) in 10 minutes. If the VSD frequency is less than 50 Hz when the differential pressure falls below the limit, the three second start-up bypass time will be increased to 30 seconds. This is to prevent false tripping during a start-up or shutdown restart needed under conditions where another compressor is being brought on due to load requirements, and the running compressor is being ramped down to 5 Hz to add the additional compressor. Under these conditions, the slow speed of the running compressor(s) causes the oil differential to become very low, especially if the water temperature and the suction pressure are high. The bypass make sure the compressor(s) will not trip on a nuisance low oil differential fault. This auto-restart safety will lock out on the third fault in 90 minutes. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.	CURRENT FREQUENCY	INCREASE TIMER BY:	>100 Hz	60 sec. + (100 Hz - 5 Hz)/30.4 Hz/sec + 9.5 sec.	< or = 100 Hz	60 sec. + (Current freq - 5 Hz)/10 Hz/sec
CURRENT FREQUENCY	INCREASE TIMER BY:						
>100 Hz	60 sec. + (100 Hz - 5 Hz)/30.4 Hz/sec + 9.5 sec.						
< or = 100 Hz	60 sec. + (Current freq - 5 Hz)/10 Hz/sec						
SYS 1 or 2 YYYYYYY LOW ECONOMIZER SUPERHEAT FAULT	This fault protects against excessive liquid refrigerant carryover from the economizer, in cases which may be a result of EEV, sensor or other problems. It also protects the system compressor from liquid refrigerant flooding back from the economizer feed line, in cases where the economizer valve fails to close. This safety is ignored for the first five minutes of system run time. If the economizer superheat falls below a programmable setpoint (0°F to 20°F, default 5°F (0°C to 11°C, default 2.8°C)) for five minutes, the system or unit will shutdown. This fault causes a lockout on the third fault in 90 minutes. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.						
SYS 1 or 2 YYYYYYY LOW EVAP PRESS	This fault protects against operation with low refrigerant charge, which helps protect the chiller from an evaporator freeze-up, should the system attempt to run with a pressure below freezing for the application. When SMART FREEZE POINT PROTECTION is disabled, this safety fault is set whenever the evaporator pressure is less than or equal to the programmable cutout, and is released when the evaporator pressure becomes greater than the programmable cutout. This fault causes a lockout on the third fault in 90 minutes. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad. When SMART FREEZE POINT PROTECTION is enabled, this safety fault is set whenever the evaporator refrigerant temperature is less than 25.0°F, and is released when the evaporator refrigerant temperature becomes greater than or equal to 25.0°F. This fault causes a lockout on the first fault. YYYYYYY will show LOCKOUT and will not restart until the operator clears the fault using the keypad.						

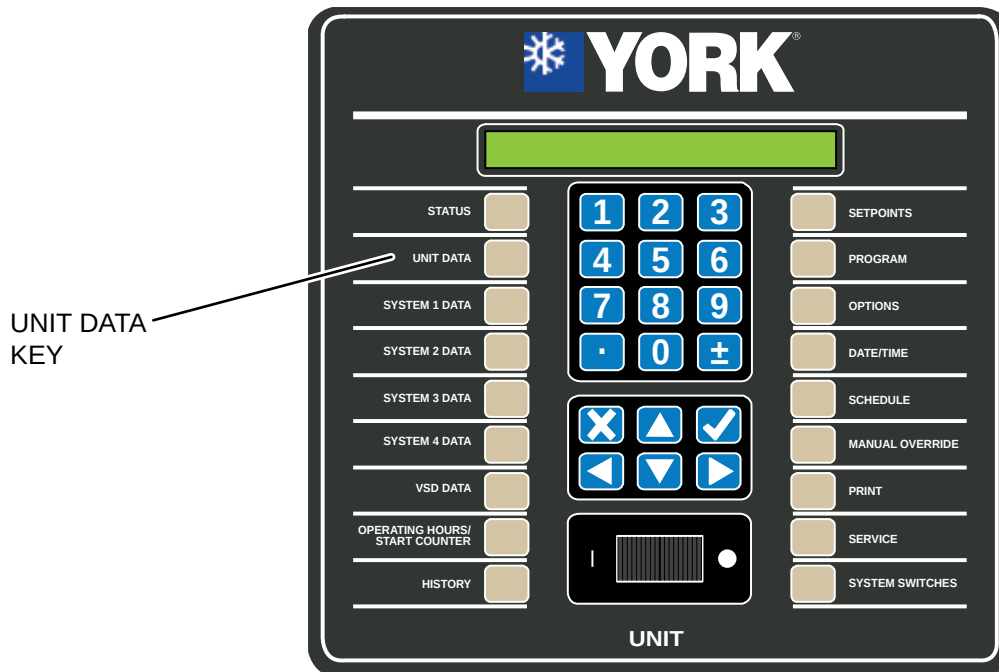
TABLE 66 - SYSTEM SAFETIES (FAULTS) (CONT'D)

MESSAGE	DESCRIPTION
SYS 1 or 2 YYYYYYY LOW EVAP PRESS LCHLT	This safety fault causes a lockout on the first fault, and is bypassed for the first 10 minutes of chiller run time. It is set if the leaving chilled liquid temperature is less than the evaporator saturation temperature by at least 2.5°F or greater than the evaporator saturation temperature by at least 25.0°F for at least 10 consecutive minutes. This fault is released when the chiller stops running, or the leaving chilled liquid temperature is within - 2.5° F and + 25.0°F of evaporator saturation temperature. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY LOW EVAP PRESS REFRIG TEMP	This safety fault is bypassed for the first ten minutes of chiller run time and is available only whenever the SMART FREEZE PROTECTION is enabled. This fault is disabled for glycol applications. This fault causes a lockout on the first fault. This fault is set when the evaporator refrigerant temperature or the evaporator saturation temperature is less than 32°F (0°C) and the evaporator refrigerant temperature is at least 3.0°F (1.6°C) above or below the evaporator saturation temperature for at least 60 consecutive seconds. This fault is released when any of the following is true: Chiller stops running, SMART FREEZE PROTECTION is disabled, Evaporator refrigerant temperature is greater than 32°F (0°C), Evaporator saturation temperature is greater than 32°F (0°C), and evaporator refrigerant temperature is within 3.0°F (1.6°C) (plus or minus) of the evaporator saturation temperature. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY LOW EVAP PRES SMART FREEZE	This fault is considered active when SMART FREEZE is turned on via the enable/disable setting, and the active LCHLT control setpoint is less than or equal to 38.0°F (3.3°C). SMART FREEZE can only be enabled or disabled while the chiller is stopped, and is only available in water applications. It is a lockout fault on the first occurrence. While Smart Freeze Point Protection is enabled, a timer starts incrementing when any system evaporator saturation temperature is less than 32.8°F (0.44°C) and decrementing when all system evaporator saturation temperatures are greater than 32.8°F (0.44°C). The timer is reset to zero when Smart Freeze is inactive. The system will be able to start after the evaporator temperature is greater than freeze threshold or the timer is less than the calculated time to freezing. The number of seconds it will take the water in the evaporator tubes to freeze is calculated from the system evaporator saturation temperature and the freeze threshold of 32.8°F (0.44°C) as follows: $\text{Time (seconds) to freezing} = (4053.7) / (\text{freeze threshold} - \text{lowest system evaporator saturation temperature})$ If the lowest system evaporator saturation temperature is 26.0 °F, water in the evaporator would freeze in nine minutes and 56 seconds. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY LOW MOTOR CURRENT	This fault shuts the system down with a ramped shutdown when the microprocessor detects the absence of motor current (less than 10% FLA), indicating that a compressor is not running. This safety is ignored for the first 10 seconds of operation. YYYYYYYY will show FAULT to indicate a system is in a FAULT condition, will restart when the condition clears, and the 120-second anti-recycle timer times out. If three faults occur within 90 minutes, LOCKOUT will appear, and will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY LOW OIL LEVEL	This fault is only active when the oil level switch control is enabled under the PROGRAM key with a service password. It senses when voltage is removed from control board input J5-1 (System 1) or J5-2 (System 2). These inputs are designated for future use for proposed oil level switches that are currently not included in this design. This fault prevents the system from starting. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.

TABLE 66 - SYSTEM SAFETIES (FAULTS) (CONT'D)

MESSAGE	DESCRIPTION
SYS 1 or 2 YYYYYYY MOTOR CURRENT OVERLOAD	Software-Initiated Fault - This fault compares the highest of the three phases of motor current per compressor to the compressor's 105% FLA ADJUST (overload) potentiometer setting. If the current exceeds the setting continuously for 20 seconds, all compressors will shut down. This safety will lockout a system on the first occurrence. The VSD shutdown type is immediate. YYYYYYY will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.
SYS 1 or 2 YYYYYYY SENSOR FAIL: ZZZZZZZZZZZZ	This fault prevents the system/unit from running when critical sensors are not functioning properly or are reading out of range. This safety is reviewed on start-up and the system or unit will be inhibited from starting, if one of the sensors inputs is out of range. This fault will shutdown a system or unit if any of the sensor inputs goes out of range. Ranges are: evaporator, condenser, oil, discharge and economizer pressure transducer: < 0.3V or > 4.7V, level sensor: < 3.0mA or > 21mA, eductor temperature sensor: < 0.86V (~ -5°F) or > 4.67V (~ 161°F), Motor temperature sensors reads greater than 1015 AD counts, which will prevent the unit from starting or running if a motor temp sensor is unplugged or has failed to open. If any motor temperature sensor is being ignored (under UNIT SETUP MODE) that sensor will not be used in evaluating this safety. The display will indicate which sensor failed in the ZZZZZZZ field as follows: EVAP PRESS, OIL PRESS, COND PRESS, DISCH PRESS, ECONO PRESS, COND LEVEL, and MOTOR TEMP. Z is the MOTOR TEMP SENSOR NO.
SYS 1 or 2 YYYYYYY VSD RUN RELAY	Software-Initiated Fault - The control sends the VSD logic board a start command over communications and over hardwire run. Upon receipt of the two types of run commands (hardwire or communications) a five second timer starts timing. The other run signal must be asserted within the five second window or the system will shut down. If either run signal is disabled while the VSD is running, the remaining run signal must be disabled within five seconds after the VSD has shut down or the system will shut down. This is an auto-restart safety that will lock out on the third fault in 90 minutes. YYYYYYY will show FAULT to indicate a system is in a FAULT condition, and will restart when the 120 second anti-recycle timer times out; or will show LOCKOUT, and the system will not restart until the operator clears the fault using the keypad.

UNIT DATA KEY



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FIGURE 104 - UNIT DATA KEY

The UNIT DATA key displays unit temperatures, and related data. Select the displays, which are listed sequentially, by repeatedly pressing the UNIT DATA, or the ▲ or ▼ key.

UNIT CHILLED LIQUID LEAVE = ###.# °F
ENTER = ###.# °F

UNIT CONDENSER LIQUID LEAVE = ###.# °F
ENTER = ###.# °F

UNIT LOAD TIMER = ### SEC
UNLOAD TIMER = ### SEC

UNIT TEMP ERROR = ###.# °F
RATE = ###.# °F/M

The message (above) displays the error in temperature between the actual leaving chilled liquid and setpoint temperatures. RATE = ###.#°F/M shows the rate of change of the chilled liquid temperature.

UNIT LEAD SYSTEM NUMBER = 1 OR 2

UNIT CHILLED LIQUID FLOW SW = ON OR OFF
CONDENSER LIQUID FLOW SW = ON OR OFF

UNIT EVAP/COND PUMP RUN = ON OR OFF
VSD COOLANT AUX PUMP = ON OR OFF

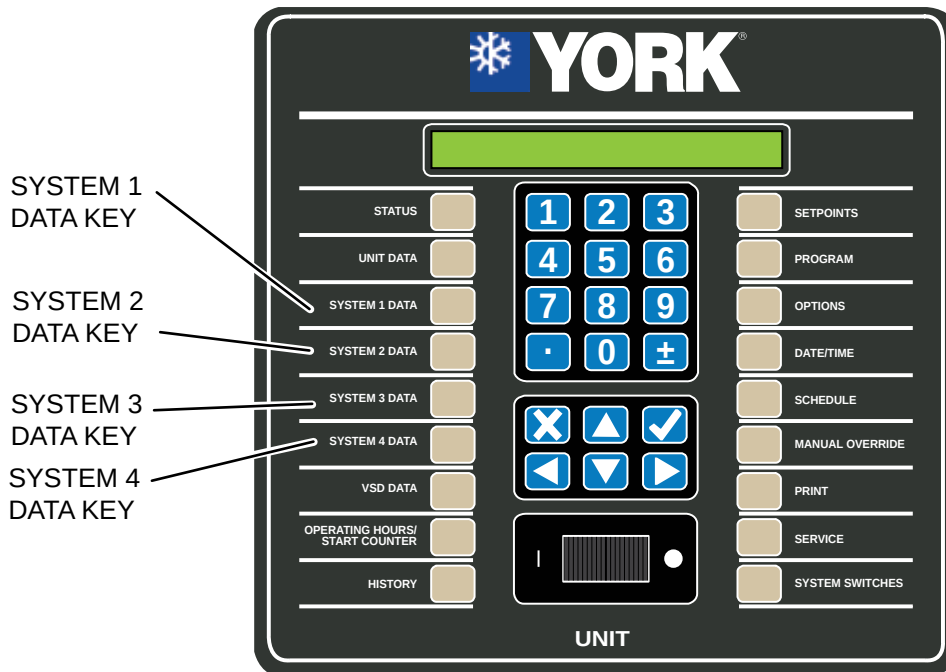
If the control is enabled, the VSD coolant aux pump messages will display ON or OFF.

UNIT ACTIVE REMOTE CONTROL = ACTIVE OR NONE
TYPE: BAS CURR TEMP MODE

If ACTIVE REMOTE CONTROL is NONE, the items on the second line (TYPE) are blank. If ACTIVE REMOTE CONTROL is ACTIVE, the following items will be displayed, and are listed below:

- NONE - No remote control is active; however, remote monitoring may be active.
- BAS - (remote mode).
- CURR - Remote Current Limiting is enabled.
- TEMP - Remote Temperature Reset is enabled.
- MODE - Remote MODE SELECT. (REMOTE MODE)

SYSTEM DATA KEYS (1-4)



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FIGURE 105 - SYSTEM DATA KEYS (1-4)

System 1 Data Key Operation

The SYSTEM 1 DATA key gives access to SYSTEM 1 operating parameters. The following list shows the data in the order in which they appear.

Pressure Messages

SYS 1 PRESSURES	OIL = ### PSIG
EVAP = ###.# PSIG	OIL DIFF = ### PSID

SYS 1 PRESSURES	CONDENSER = ### PSIG
DISCH = ### PSIG	ECONOMIZER = ### PSIG

Temperature Messages

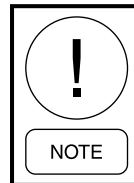
SYS 1 ECONOMIZER	TEMP = ###.# °F
SUPERHEAT = ###.# °F	SAT TEMP = ###.# °F

SYS 1 SUBCOOLED LIQ REF	TEMP = ###.# °F
-------------------------	-----------------

SYS 1 EVAPORATOR	TEMP = ###.# °F
SUPERHEAT = ###.# °F	SAT TEMP = ###.# °F

SYS 1 DISCHARGE	TEMP = ###.# °F
SUPERHEAT = ###.# °F	SAT TEMP = ###.# °F

SYS 1 MOTOR TEMPS	T1 = ###.# °F
T2 = ###.# °F	T3 = ###.# °F



If any motor temp sensor is being ignored, (select under UNIT SETUP MODE), that sensor's value will be displayed as #####.

Miscellaneous Messages

SYS 1 COMPRESSOR	SPEED = ###.# %
LIQ INJ = ON OR OFF	HEATER = ON OR OFF

Display Liquid Injection, if control is enabled.

SYS 1 CONDENSER	LEVEL = ###.# %
LEVEL CONTROL VALVE OPEN = ###.# %	

SYS 1 ECONOMIZER	SUPERHEAT = ###.# °F
FEED VALVE = %	

Display, if control is enabled.

SYS 1	VI STEP SOLENOID 1 = ON OR OFF
	VI STEP SOLENOID 2 = ON OR OFF

SYS 1	OIL FILTER = ### PSID
-------	-----------------------

SYS 1 RUN TIME

DAYS ## HOURS ## MINUTES ## SECONDS

SYS 1 RUN SIGNALS

RELAY = ON OR OFF

RUN PERM = ON OR OFF SOFTWARE = ON OR OFF

SYS 1 EDUCTOR TEMP

= ###.# °F

SYS 3 DATA NOT AVAILABLE

SYS 4 DATA NOT AVAILABLE

On a two compressor system, SYSTEMS 3 and 4 data keys will display NOT AVAILABLE.

System 2 Data Key Operation

SYSTEM 2 keys function the same as the SYSTEM 1 DATA keys except that it displays data for System 2.

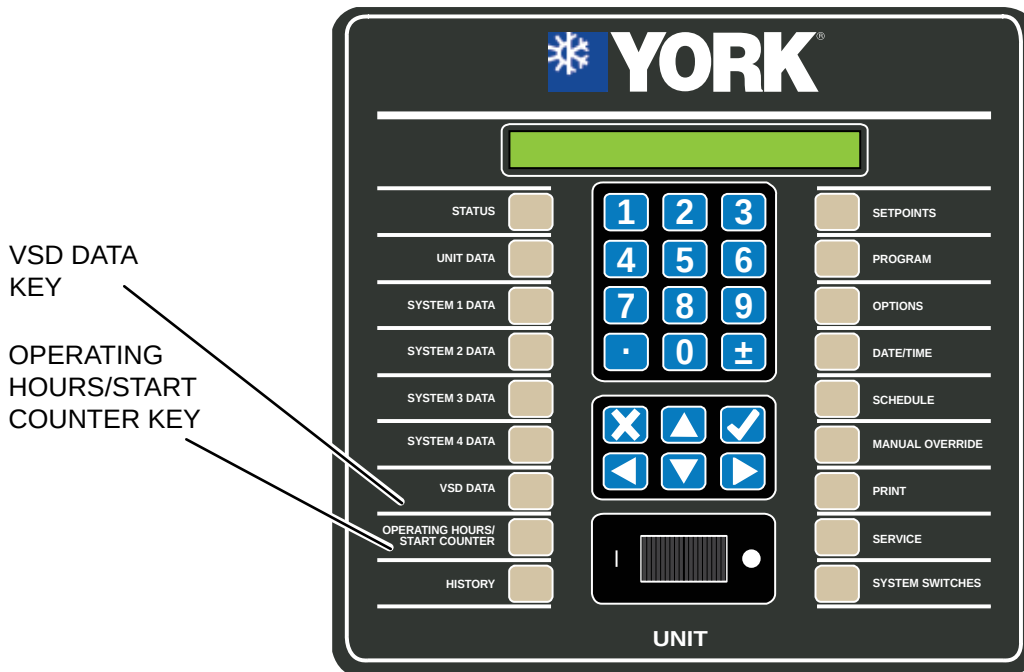
Sensor Displays

Table 65 on page 213 lists all the sensors attached to the control board associated with SYSTEM DATA keys. The minimum and maximum values displayed are provided. If these values exceed the limits, a < (less than) or > (greater than) sign will be displayed.

TABLE 65 - SENSOR MINIMUM/MAXIMUM OUTPUTS

SENSOR/INPUT	TYPE	MINIMUM VALUE	MAXIMUM VALUE
Condenser Pressure	Transducer	0 psig/0 kPa	400.0 psig (2.76 MPa)
Discharge Pressure	Transducer	0 psig/0 kPa	400.0 psig (2.76 MPa)
Oil Pressure	Transducer	0 psig/0 kPa	400.0 psig (2.76 MPa)
Economizer Pressure	Transducer	0 psig/0 kPa	275 psig (1.89 MPa)
Evaporator Pressure	Transducer	0 psig/0 kPa	125.0 psig (.086 MPa)
Cond Liquid Refrig Level	Capacitance	0%	100%
Economizer Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Leaving Condenser Liquid Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Entering Condenser Liquid Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Leaving Chilled Liquid Temp	3 K Thermistor	-19.1°F (-28.49°C)	110.2°F (43.4°C)
Entering Chilled Liquid Temp	3 K Thermistor	-19.1°F (-28.49°C)	110.2 °F (43.4°C)
Compressor Motor Temp	10 K Thermistor	-30.2°F (-34.56°C)	302.0° F (150°C)
Discharge Temp	50 K Thermistor	40.3°F (4.61°C)	302.0° F (150°C)
Evaporator Temp	3 K Thermistor	-4.87°F (-20.3°C)	158.34°F (70.2°C)
Subcooled Liquid Refrig Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Remote Temp Reset	4-20mA/2-10V 0-20mA/0-10V	0%	100%
Remote Current Limit	4-20mA/2-10V 0-20mA/0-10V	0%	100%
Condenser Hot Water Leaving Temp	3 K Thermistor	0%	100%
Condenser Hot Water Entering Temp	3 K Thermistor	0%	100%
Remote Heat Recovery Temp Reset Option	4-20mA/2-10V 0-20mA/0-10V	0%	100%
Eductor Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)

VSD DATA AND OPERATING HOURS/START COUNTER KEYS



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FIGURE 106 - VSD DATA AND OPERATING HOURS/START COUNTER KEYS

The VSD DATA key provides multiple displays of VSD operating data, such as voltages and currents. Press the VSD DATA, or ▲ or ▼ key to view multiple messages, which are explained below.

VSD FREQUENCY **ACTUAL = ###.# HZ**
COMMAND = ###.# HZ

VSD COMP 1 = ### AMPS **= ### % FLA**
COMP 2 = ### AMPS **= ### % FLA**

This key displays the calculated COMPRESSOR 1 and 2 motor currents.

VSD CURRENT LIMIT **LOCAL = ### %FLA**
BAS = ### **REMOTE = ### %FLA**

CURRENT LIMIT displays the current limit values as set under the PROGRAM key, remotely by a BAS, and REMOTE CURRENT LIMIT input. Inactive current limits will display XX instead of a numeric value.

VSD **DC BUS VOLTAGE = ### VDC**

VSD **INTERNAL AMBIENT TEMP = ###.# °F**
COOLING SYSTEM STATUS = ON OR OFF

VSD IGBT BASEPLATE TEMPS T1 = ### °F
T2 = ### °F

VSD **PRECHARGE SIGNAL = ON OR OFF**

VSD **COMP 1 MOTOR OVERLOAD = ### AMPS**
COMP 2 MOTOR OVERLOAD = ### AMPS

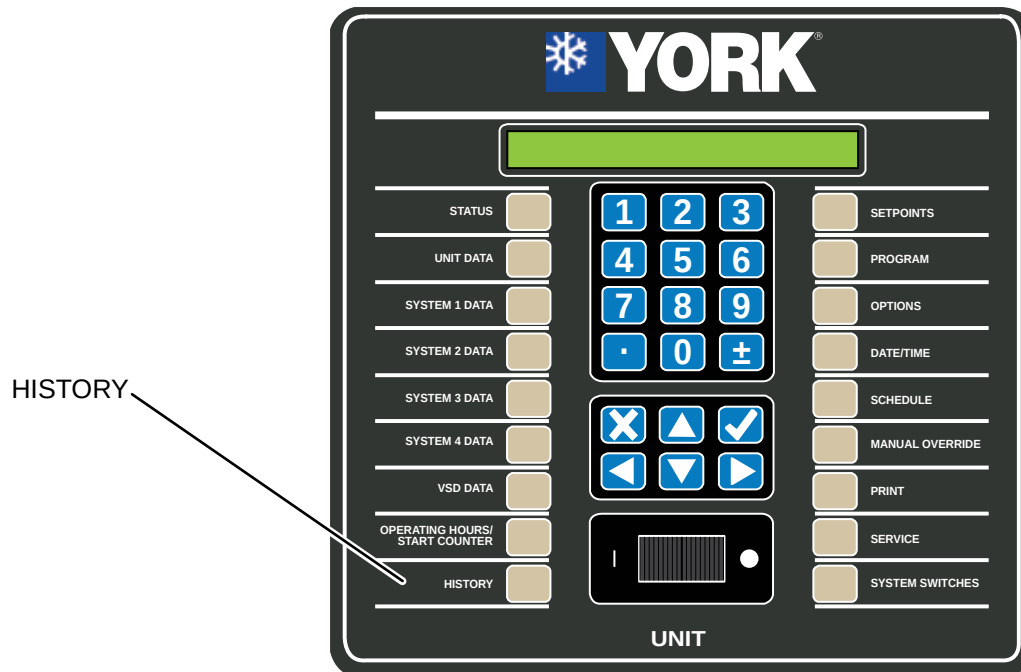
This message (above) displays the setting of the VSD's 105% FLA potentiometer for Compressors 1 and 2. The settings are determined by the adjustment of the overload potentiometers on the VSD logic board, which are factory set, and should not require changing unless the circuit board is replaced.

Operating Hours/Start Counter Key

HOURS 1=###, 2=###
START 1=###, 2=###

Compressor operating HOURS and STARTS are displayed with a single key press. The maximum value is 99,999, at which point both values roll over to zero.

HISTORY KEY



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FIGURE 107 - HISTORY KEY

To access the HISTORY FAULT or NORMAL SHUT-DOWN information, use the following steps:

1. Press the HISTORY key to display the initial history message (above). FAULT SHUTDOWN appears under CHOOSE HISTORY TYPE.

HISTORY	CHOOSE HISTORY TYPE
◀ ▶	FAULT SHUTDOWN

2. To choose NORMAL SHUTDOWNS, use the ◀ key.

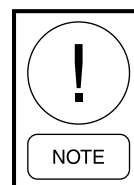
HISTORY	CHOOSE HISTORY TYPE
◀ ▶	NORMAL SHUTDOWN

To return to FAULT SHUTDOWN, use the ▶ key.

3. Press the ✓ key. If FAULT HISTORY is selected, the screen (below) will be displayed.

FAULT HIST ## 18-MARCH-2012 10:34:58 AM
YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY

The FAULT HISTORY contains data from the last 10 shutdowns, where ## is the history buffer number between one and 10, and YYYY is the fault description. Buffer 01 gives the most recent fault information, and 10 is the oldest fault shutdown saved.



For all faults generated by the control panel, a snapshot of all system data will be stored immediately before shutting down. For VSD generated faults, the VSD captures and transmits the VSD data, and the control panel saves the control panel data when the VSD opens the fault relay.

To access the next FAULT HISTORY buffer number, use the ▶ key; to return to the previous buffer number, use the ◀ key.

To scroll backwards and forwards through the FAULT HISTORY SHUTDOWN data, press the ▼ key. The first screen will show the status of SYSTEM 1 and SYSTEM 2. Refer to the example below:

SYSTEM 1 COMPRESSOR RUNNING
SYSTEM 2 COMPRESSOR RUNNING

The next press the ▼ key displays the ALL FAULTS screen. The list below explains the configurations:

- ## is the FAULT HISTORY number.
- YYY is the ALL FAULT description.
- ZZ is the ALL FAULT number .
- WW is the total number of ALL FAULTS for the current history.

If there are no ALL FAULTS for the current history, the following message will be displayed for the ALL FAULTS screen.

```
FAULT HIST ## ALL FAULTS
NONE
```

Use the ▲ ▼ keys to scroll forwards and backwards through the FAULT HISTORY SHUTDOWN data within each section, i.e. UNIT.

- UNIT
 - Chilled Liquid
 - Compressor 1 and 2, etc.
- SYSTEM 1 OR 2
 - Oil Pressure
 - Condenser Pressure message, etc.
- VSD
 - Frequency
 - VSD Current
- SETPOINTS
 - Local Cooling Setpoint
 - Local Cooling Range, etc.
- OPERATING HOURS/START COUNTER
 - Day of Week
 - Day of Month, etc.
- OPTIONS
 - Display Language
 - Liquid Type, etc.
- PROGRAM
 - Chilled Liquid Leaving Temp Cutout
 - Motor Current Limit, etc.

Refer to the specific section of this manual for a complete list of messages.

```
NORM HIST ## 18-JUN-2011 10:34:58 AM
```

```
YYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
```

If NORMAL SHUTDOWNS is selected, the NORM HIST ## will be displayed, where ## is the normal shutdown number. YYYY explains the reason for the shutdown. The normal shutdown history contains limited data from the last 20 normal (non-fault) shutdowns.

From the initial NORMAL HISTORY SHUTDOWN screen, the ► key scrolls to the initial screen of the next buffer, and the ◀ key to the initial screen of the last buffer. Buffer 01 is the most recent fault shutdown, and 20 is the oldest fault shutdown saved.

SETPOINTS KEY

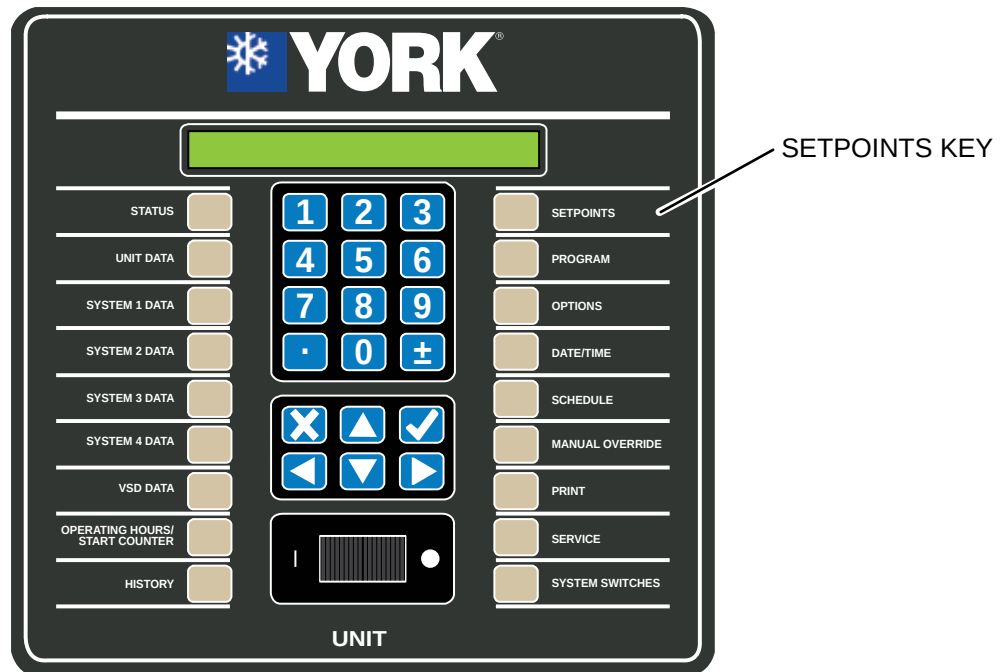


FIGURE 108 - SETPOINTS KEY

Press the SETPOINTS key to program:

- Non-heat pump application cooling setpoints and ranges.
- Heat pump application cooling/heating setpoints and ranges.

The SETPOINT entry screen is shown below. DEF shows the chiller default, LO/HI show minimum and maximum acceptable values. Press the SETPOINTS or the ▼ key to display the next message.

Non-Heat Pump Applications

SETPOINTS ◀DEF #### LO #### HI ####
LOCAL COOLING SETPOINT = ###.# °F

SETPOINTS ◀DEF #### LO #### HI ####
LOCAL CONTROL RANGE = +/- .#. # °F

SETPOINTS REMOTE SETPOINT = ###.# °F
REMOTE CONTROL RANGE = +/- .#. # °F

This message (above) will display the remote setpoint and control, which automatically updates. If there is no remote setpoint or range, these values will display as ###.

SETPOINTS ◀DEF #### LO #### HI ####
MAXIMUM REMOTE TEMP RESET = ###.#°F

Heat Pump Applications

SETPOINTS ◀DEF #### LO #### HI ####
LOCAL HEATING SETPOINT = ###.# °F

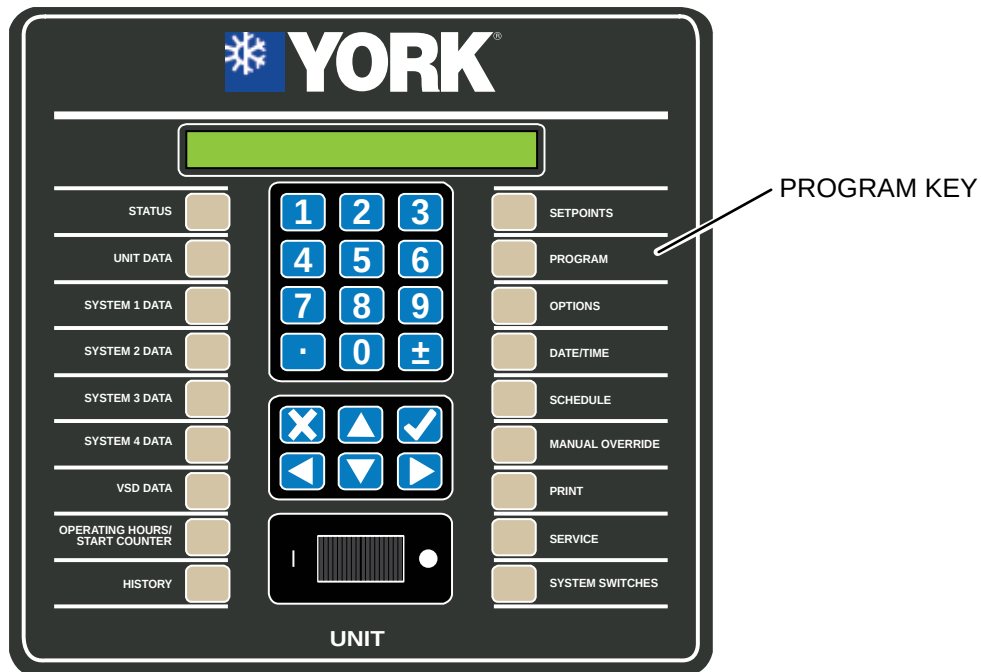
SETPOINTS ◀DEF #### LO #### HI ####
LOCAL HEATING CONTROL RANGE = +/- .#. # °F

SETPOINTS REMOTE SETPOINT = ###.# °F
REMOTE HEATING CONTROL RANGE = +/- .#. # °F

This message (above) displays the remote setpoint and hot water range, which automatically update. If there is no remote setpoint or range, these values will display as ###.

SETPOINTS ◀DEF #### LO #### HI ####
MAX. REMOTE HEATING TEMP RESET = ###.#°F

PROGRAM KEY



LD16388

FIGURE 109 - PROGRAM KEY

Press the PROGRAM key to modify the following numeric operating parameters, which are displayed when this key is pressed.

PROGRAM MODE #####
PRESS ENTER KEY TO CONTINUE

Press the ✓ key to display the first programmable selection, where DEF is the default, LO is the low limit, and HI is the high limit. Refer to *Table 66 on page 219* for the programmable values.

PROGRAM ◀DEF ##### LO ##### HI #####
CHILLED LIQUID LEAVING TEMP CUTOUT = ##.# °F

PROGRAM ◀DEF ##### LO ##### HI #####
MOTOR CURRENT LIMIT = ### % FLA

PROGRAM ◀DEF ##### LO ##### HI #####
PULLDOWN CURRENT LIMIT = ### % FLA

PROGRAM ◀DEF ##### LO ##### HI #####
PULLDOWN CURRENT LIMIT TIME = # MIN

PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX
MOTOR TEMPERATURE UNLOAD = ### °F

PROGRAM ◀DEF ### LO ### HI ###
REMOTE UNIT ID NUMBER = #

With Service Level password access, navigate to the following setup parameters and set them properly to maintain approximately 1 inch coverage above the top of the condenser subcooler in accordance with the refrigerant charge level description.

PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX
SYS 1 CONDENSER LIQUID REF LEVEL = ###

PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX
SYS 2 CONDENSER LIQUID REF LEVEL = ###

Default Values

A listing of the low and high limits, and default programmable values is noted in each display and can be found in *Table 66 on page 219*. The English units are exact values while the metric units are approximate.

TABLE 66 - PROGRAMMABLE OPERATING PARAMETERS

PROGRAM VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Chilled Leaving Chilled Liquid Temp. Cutout: Sets the threshold for the system safety shutdown.	Water Cooling	-	-	36.0°F
		-	-	2.2°C
	Glycol Cooling	5.0°F	36.0°F	36.0°F
		-15.0°C	2.2°C	2.2°C
Motor Current Limit: Sets the local motor current limit threshold.	-	30% FLA	103% FLA	103% FLA
Pulldown Motor Current Limit: Sets the % FLA limit used by the start-up pulldown routine to limit current draw to this value for customer peak energy control.	-	30% FLA	100% FLA	100% FLA
Pulldown Motor Current Limit Time: Sets the time period that the pulldown current limit is in effect upon start-up. At the end of this period, the pulldown motor current limit is released to 100% FLA.	-	0 Min	255 Min	0 Min
Motor Temperature Unload: Sets a threshold that activates the liquid refrigerant injection system if enabled on high motor temperature. The liquid refrigerant injection valve opens when any Motor Temp > (Motor Temp Unload - 10°F) and discharge superheat is > 18°F. This valve is permitted to close when all Motor Temps < Motor Temp Unload - 30°F.	-	150.0°F	250.0°F	240°F
		65.6°C	121.1°C	115.6°C
Unit ID Number: Sets a unit identification number, which will show on the output reports and delineate multiple chillers on single communication networks.	-	0	7	0

SERVICE LEVEL UNIT SETUP

Unit setup mode will allow programming all of the programmable values that the user should never change. These will either be programmed at the factory or by service personnel on the job. This mode may be entered by pressing the PROGRAM key, entering the password 4245, and then pressing ✓.

The following table lists the values that can be programmed in this mode. Following are the messages for the Setup Mode values in the order they appear.

TABLE 67 - SERVICE LEVEL UNIT SETUP

SETUP MODE VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Compressor 1 or 2 Operating Hours Allows reset or change to recorded lifetime operating hours. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX COMP 1 and 2 OPERATING HOURS = XXXXX	All	0	99,999	0
Compressor 1 or 2 Starts Allows reset or change to recorded lifetime number of starts. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX COMP 1 STARTS = XXXXX	All	0	99,999	0
Clear History Buffers Clears fault records from the buffer. SETUP MODE CLEAR HISTORY BUFFERS? ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX = YES or NO, selectable via the LEFT/RIGHT arrow keys.	All	NO	YES	-
Remote Temp Reset Directs the chiller to respect the remote temperature reset input or not. SETUP MODE REMOTE TEMP RESET ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX = ENABLED or DISABLED, selectable via the LEFT/RIGHT arrow keys. When this is enabled, its remote input type should be reset to DISABLED.	All	DISABLED	ENABLED	DISABLED
Remote Current Limit Directs the chiller to respect the remote current reset input or not. SETUP MODE REMOTE CURRENT LIMIT ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX = ENABLED or DISABLED, selectable via the LEFT/RIGHT arrow keys. When this is enabled, its remote input type should be reset to DISABLED.	All	DISABLED	ENABLED	DISABLED
Remote Inputs Service Time Sets the length of delay time a change to any remote input must persist before the chiller considers the change valid and reacts. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX REMOTE INPUTS SERVICE TIME = XX MIN	All	5 Min	60 Min	15 Min
Maximum Compressor Speed Sets the upper limit the VSD will operate to. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX MAXIMUM COMPRESSOR SPEED = XXX.X HZ	All	140 Hertz	203 Hertz	203 Hertz

TABLE 70 - SERVICE LEVEL UNIT SETUP (CONT'D)

SETUP MODE VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Minimum Running Speed Sets the minimum speed the VSD will operate in normal run. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX MINIMUM RUNNING SPEED = XXX HZ	All	50 Hertz	100 Hertz	50 Hertz
Sys 1 or Sys 2 Motor Sensor To Ignore Each compressor motor has a 3 thermistors embedded in the motor to measure motor temperature. The high motor temperature safety, start inhibit, and sensor failure safeties use these sensors. In the event that a sensor fails, this setting provides the ability to select 1 sensor per compressor motor to ignore if necessary. SETUP MODE SYS 1 and 2 MOTOR SENSOR TO IGNORE ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	NONE	TEMP SENSOR T1 TEMP SENSOR T2 TEMP SENSOR T3	NONE
Sys 1 or Sys 2 VI Differential Temp Setpt Defines a saturated temperature differential from suction to discharge where the CTS compressor step VI control maintains maximum VI. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX SYS 1 and 2 VI DIFF TEMP SETP = XX.X °F	Step VI	60.0 °F	90.0 °F	73.0 °F
		33.3 °C	50.0 °C	40.5 °C
VI Dead band Defines a hysteresis band for step VI transition. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX VI DEADBAND = XX.X °F	Step VI	2.0 °F	10.0 °F	4.0 °F
		1.1 °C	5.5 °C	2.2 °C
VI Differential Temp Setpt Offset Defines the saturated temperature differential for the second step of step VI control. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX VI DIFF TEMP OFFSET = XX.X °F	Step VI	2.0 °F	40.0 °F	20.0 °F
		1.1 °C	22.2 °C	11.1 °C
Minimum VSD Frequency Sets the frequency threshold to determine to reduce the number of running compressors in Basic Operation. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX MIN VSD FREQ SETP = XXX Hz	All	50Hz	95Hz	50Hz
Minimum Start Frequency Sets the frequency threshold to determine to increase the number of running compressors in Basic Operation. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX MIN START FREQ SETP = XXX Hz	All	50Hz	95Hz	50Hz
Sys 1 or Sys 2 Low Differential Oil Pressure Sets the threshold for the System Safety shutdown. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX SYS 1 and 2 LOW DIF OIL PRS SETP = XX PSID	All	20 Psid	60 Psid	21 Psid
		1.37 Bard	4.14 Bard	1.45 Bard
Sys 1 or Sys 2 Low Economizer Superheat Sets the threshold for the System Safety shutdown. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX SYS 1 and 2 LOW ECON SHEAT SETP = XXX.X °F	All	0.0 °F	20.0 °F	5.0 °F
		0.0 °C	11.1 °C	2.7 °C

TABLE 70 - SERVICE LEVEL UNIT SETUP (CONT'D)

SETUP MODE VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Min Oil Pump Diff Setpoint Sets the threshold of discharge pressure minus evaporator pressure below which an optional oil pump runs, when enabled. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX MIN OIL PUMP DIFF SETP = XX PSID	All	20 Psid	60 Psid	20 Psid
		1.37 Bard	4.14 Bard	1.37 Bard
Evaporator Pressure Cutout Sets the threshold for the System Safety shutdown. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX EVAPORATOR PRESSURE CUTOUP = XX.X PSIG	Water Cooling	24.0 Psig	36.0 Psig	25.0 Psig
		1.65 Barg	2.48 Barg	1.72 Barg
	Glycol Cooling	5.0 Psig	36.0 Psig	25.0 Psig
		0.34 Barg	2.48 Barg	1.72 Barg
High Leaving Condenser Liquid Tmp Cutout Sets the threshold for the System Safety shutdown. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX HIGH LEAVING COND TMP CUTOUP = XXX.X °F	Water Cooling	113.0 °F	159.8 °F	140.0°F
		45.0 °C	71.0°C	60.0 °C
Sys 1 or Sys 2 Condenser Liquid Ref Level Sets the % coverage on the refrigerant liquid level sensor which will be the setpoint level is maintained at during operation. This should be set so the subcooler is fully submerged. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX SYS 1 and 2 CONDENSER LEVEL SETP = XXX %	All	20.0%	80.0%	50.0%
Sys 1 or Sys 2 Economizer Superheat Sets the economizer vapor outlet line superheat value the economizer liquid control valve will be regulated to maintain during operation. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX SYS 1 and 2 ECONO SUPERHEAT SETP = XX.X °F	All	8.0 °F	50.0 °F	13.0 °F
		4.4 °C	27.8 °C	7.2 °C
Liquid Ref Injection Valve Close Threshold Sets a parameter used to determine when the liquid refrigerant injection valve is requested to close. Applies only when liquid injection is enabled. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX LIQUID REF INJ VALVE CLOSE = XXX.X °F	High Head	5.0 °F	30.0 °F	10.0 °F
		2.8 °C	16.67 °C	5.6 °C
Liquid Ref Injection Valve Open Sets a parameter used to determine when the liquid refrigerant injection valve is requested to open. Applies only when liquid injection is enabled. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX LIQUID REF INJECT VALVE OPEN = XXX.X °F	High Head	135.0 °F	200.0 °F	165.0 °F
		57.2 °C	93.3 °C	73.9 °C
Sys 1 or Sys 2 Economizer Hold Position Sets the position the economizer feed valve is set to when not in superheat control. This allows the sensors to remain conditioned. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX SYS 1 and 2 ECON HOLD POS SETP = XXX.X %	Economizer	0.0%	50.0%	2.0%
Sys 1 or Sys 2 Economizer Max Motor Temp Sets a motor temperature threshold above which the economizer operation is prohibited. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX SYS 1 and 2 ECON MAX MTR TEMP = XXX.X °F	Economizer	150.0 °F	250.0 °F	240.0 °F
		65.6 °C	121.1 °C	115.6 °C

TABLE 70 - SERVICE LEVEL UNIT SETUP (CONT'D)

SETUP MODE VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Economizer On Frequency Sets the compressor drive frequency above which economizer operation is activated. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX ECONOMIZER ON FREQUENCY = XXX HZ	Economizer	50 Hz	204 Hz	50 Hz
Economizer Off Frequency Sets the compressor drive frequency below which economizer operation is de-activated. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX ECONOMIZER OFF FREQUENCY = XXX HZ	Economizer	45 Hz	203 Hz	45 Hz
Eductor Temp Differential Sets the Eductor Clog System Safety fault level when the eductor temperature minus evaporator temperature exceeds this value. PROGRAM ◀DEF XXXXX LO XXXXX HI XXXXX EDUCTOR TEMPERATURE DIFF = XXX.X °F	--	5.0 °F	50.0 °F	5.0 °F
		2.7 °C	27.7 °C	2.7 °C
Eductor Safety Time Sets the time period the eductor temperature differential must be exceeded to initiate the safety fault. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX EDUCTOR SAFETY TIME = XXX MINS	--	1 Min	1000 Min	10 Min
High Oil Filter Differential Sets the threshold below which an oil flow warning is posted. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX HIGH OIL FILTER PRESS SETP = XXX.X PSID	Oil Filter	10.0 Psid	100.0 Psid	20 Psid
Oil Differential Condenser Level Control Setpt Sets the differential oil pressure threshold below which the condenser level setpoint is manipulated by the control to decrease evaporator pressure in effort to restore oil flow. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX OIL DIFF COND LVL CTRL SETP = XX.X PSID	Oil Pressure Mitigation	20.0 Psid	30.0 Psid	24 Psid
Level control decrement 1 Setting for how the control returns condenser level to its normal control value during low oil pressure mitigation routine. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX LVL CTRL DECREMENT 1 SETP = XXX.X %	Oil Pressure Mitigation	0.1%	10.0%	2.0%
Level control decrement 2 Setting for how the control returns condenser level control to its normal control value during low oil pressure mitigation routine. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX LVL CTRL DECREMENT 2 SETP = XXX.X %	Oil Pressure Mitigation	0.1%	10.0%	0.5%
Level control increment 1 Setting for how the control raises condenser level to starve the evaporator during low oil pressure mitigation routine. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX LVL CTRL INCREMENT 1 SETP = XXX.X %	Oil Pressure Mitigation	0.1%	10.0%	2.0%
Level control increment 2 Setting for how the control raises condenser level to starve the evaporator during low oil pressure mitigation routine. PROGRAM ◀DEF XXXXX LO XXXXX HI XXX LVL CTRL INCREMENT 2 SETP = XXX.X %	Oil Pressure Mitigation	0.1%	10.0%	0.5%

TABLE 70 - SERVICE LEVEL UNIT SETUP (CONT'D)

SETUP MODE VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Level Control Start-up Kp Sets the proportional gain for the start-up control for condenser refrigerant level.	--	0.5	3.0	0.7
Level Control Start-up Tn Sets the integral time for the start-up control for condenser refrigerant level.	--	75	250	115
Smart Freeze Sets the functionality status. SETUP MODE SMART FREEZE ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	DISABLED	ENABLED	DISABLED
Oil Pump Sets the functionality status. SETUP MODE OIL PUMP ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	DISABLED	ENABLED	DISABLED
Oil Level Switch Sets the functionality status. SETUP MODE OIL LEVEL SW ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	DISABLED	ENABLED	DISABLED
VSD Aux coolant Pump Sets the functionality status. SETUP MODE VSD AUX COOLANT PUMP ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	DISABLED	ENABLED	DISABLED
Hot Gas Bypass Sets the functionality status. SETUP MODE HOT GAS BYPASS ◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	DISABLED	ENABLED	DISABLED
Hot Gas Bypass Setpoint Difference between entering and leaving chilled water temperature below which the optional Hot Gas Bypass solenoid will open. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX HOT GAS BYPASS SETPT = XXX.X °F	All	2.0 °F	40.0 °F	20.0 °F
		1.1 °C	22.2 °C	11.1 °C
Condenser Level Control Valve Hold Position Sets the standby position for the condenser refrigerant level control valve when the system is not running. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX COND LVL VLV HOLD SETP = XXX %	All	5 %	50 %	30 %
Condenser Level Control Hold Delay Sets the delay period between start of a system and active level control to setpoint. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX COND LVL CTRL HOLD DLY = XX MIN	All	0 Minutes	10 Minutes	5 Minutes
Condenser level Ramp Time Sets the length of time to ramp from start-up refrigerant level to the active setpoint. SETUP MODE ◀DEF XXXXX LO XXXXX HI XXXXX COND LVL RAMP SETP = XX MIN	All	0 Minutes	10 Minutes	5 Minutes

TABLE 70 - SERVICE LEVEL UNIT SETUP (CONT'D)

SETUP MODE VALUE	MODE	LOW LIMIT	HIGH LIMIT	DEFAULT
Refrigerant Injection Sets the functionality status. SETUP MODE REFRIG INJ ◀▶XXXXXXXXXXXXXXXXXXXXXXXXXXXX	All	DISABLED	ENABLED	DISABLED
VI Step valve Sets the functionality status. SETUP MODE VI STEP VALVE ◀▶XXXXXXXXXXXXXXXXXXXXXXXXXXXX The choices for these above are as follows: • DISABLED • ENABLED	All	DISABLED	ENABLED	DISABLED

Default Programmable Values

To reset most of the programmable values to their default settings, press PROGRAM, enter the password 6140, then press ✓. The following message will be displayed giving a choice to reset program values to their defaults.

DEFAULTS SET PROG VALUES TO DEFAULT?

◀▶ XXX

XXX = YES or NO, selectable via the LEFT/RIGHT arrow keys.

Below is a list of all the setting that will be reset to their default values.

- Evaporator Pressure Cutout
- Leaving Chilled Liquid Temp Cutout
- High Motor Current Limit
- Pulldown Current Limit
- Pulldown Current Limit Time
- Motor Temperature Unload
- Eductor Differential

- Eductor Safety Time
- Low Economizer Superheat
- Economizer Hold Position
- Level Control Decrement 1 and 2
- Level Control Increment 1 and 2
- Condenser Level Control Hold Delay
- Condenser Level Ramp Time

BRAM Clear - (Access code 5851) - Provides the ability to reset the Battery Backed Ram.

Where XXX...X is DISABLED each time it enters. The user can select ENABLED/DISABLED the same as other setup/option keys. However it will revert back to DISABLED if the user does not have the unit switch in the off position. If the unit switch is in the off position when ENABLED is displayed and the “ENTER” key is pressed, the reset will execute placing “0” in all bram addresses. After resetting, the ENABLED will be overwritten by REBOOT. The user must then cycle power to the chiller in order to ensure values are set properly.

OPTIONS KEY

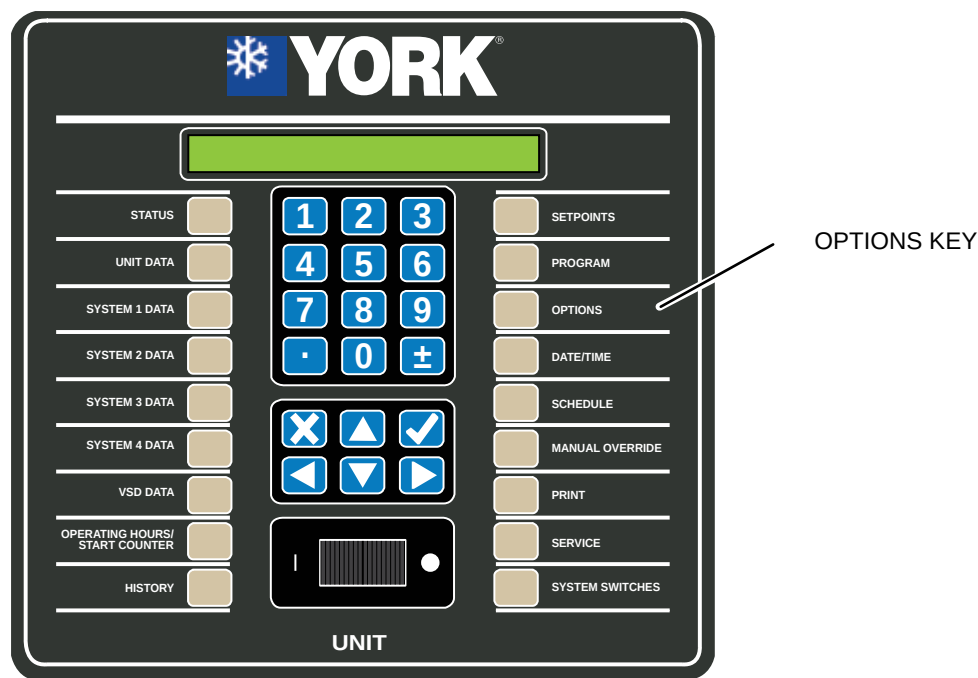


FIGURE 110 - OPTIONS KEY

The OPTIONS key displays unit configuration and the capability to modify it. To view the current settings, press this key. Press the ▲ or ▼ key to scroll to the next option, and the ◀ and ▶ keys to change the options, then the ✓ key to save the changes. Each message is explained below.

OPTIONS DISPLAY LANGUAGE
◀ ▶ #####

Choose English, French, Italian, German, Spanish, Portuguese, Polish, or Hungarian; default is English.

OPTIONS LIQUID TYPE
◀ ▶ WATER OR GLYCOL COOLING

OPTIONS LOCAL/REMOTE CONTROL MODE
◀ ▶ LOCAL OR REMOTE CONTROL

OPTIONS DISPLAY UNITS
◀ ▶ ENGLISH OR SI

System Lead/Lag Control Mode Selection

Choose one MODE below:

OPTIONS LEAD / LAG CONTROL MODE
◀ ▶ AUTOMATIC

Automatic leads based on least run time.

OPTIONS LEAD / LAG CONTROL MODE
◀ ▶ MANUAL SYS 1 LEAD

OPTIONS LEAD / LAG CONTROL MODE
◀ ▶ MANUAL SYS 2 LEAD

Remote Temperature Reset Input

The display will only appear if the TEMP RESET option is enabled under UNIT SETUP MODE. Choose one RESET INPUT below, default is DISABLED:

OPTIONS REMOTE TEMP RESET INPUT
◀ ▶ DISABLED

OPTIONS REMOTE TEMP RESET INPUT
◀ ▶ 0.0 TO 10.0 VOLTS DC

OPTIONS REMOTE TEMP RESET INPUT
◀ ▶ 2.0 TO 10.0 VOLTS DC

OPTIONS REMOTE TEMP RESET INPUT
◀ ▶ 0.0 TO 20.0 MILLIAMPS

OPTIONS REMOTE TEMP RESET INPUT
◀ ▶ 4.0 TO 20.0 MILLIAMPS

Remote Current Limit Input

Choose one LIMIT INPUT below, default is DISABLED:

OPTIONS	REMOTE CURRENT LIMIT INPUT
◀ ▶	DISABLED

OPTIONS	REMOTE CURRENT LIMIT INPUT
◀ ▶	0.0 TO 10.0 VOLTS DC

OPTIONS	REMOTE CURRENT LIMIT INPUT
◀ ▶	2.0 TO 10 VOLTS DC

OPTIONS	REMOTE CURRENT LIMIT INPUT
◀ ▶	0.0 TO 20.0 MILLIAMPS

OPTIONS	REMOTE CURRENT LIMIT INPUT
◀ ▶	4.0 TO 20.0 MILLIAMPS

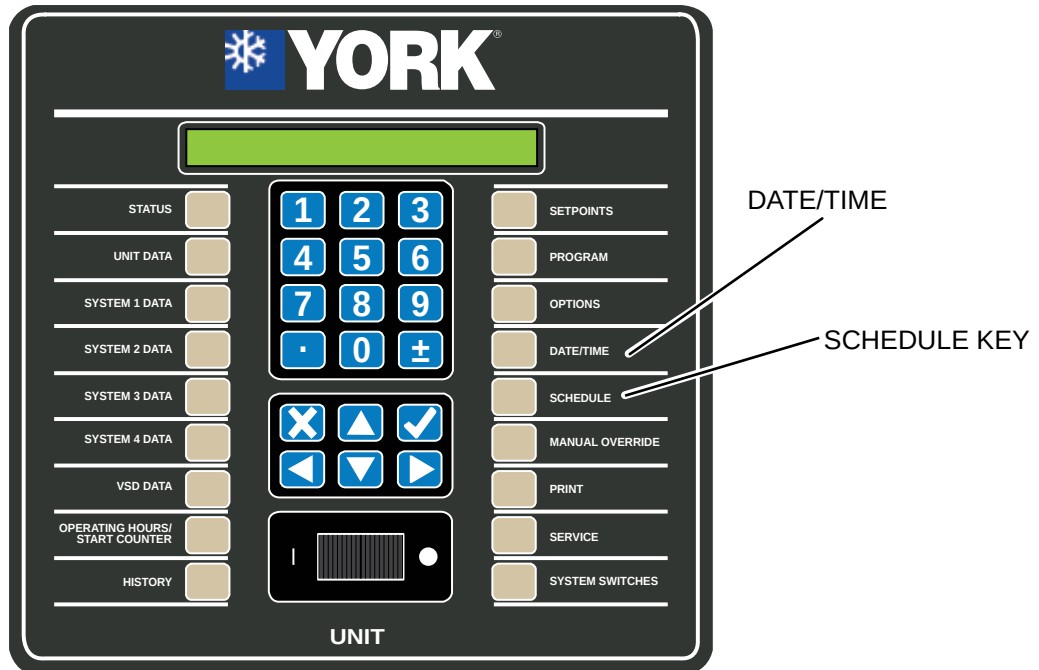
OPTIONS	COMPRESSOR SELECT
◀ ▶	WITHOUT VI STEP OR WITH VI STEP

The display (above) will only appear if the CURRENT LIMIT option is enabled under the UNIT SETUP MODE.

OPTIONS	OPERATING MODE
◀ ▶	CHILLER OR HEAT PUMP

If the heat pump option is enabled, choose between chiller and heat pump operating mode.

DATE/TIME AND SCHEDULE KEYS



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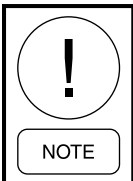
FIGURE 111 - DATE/TIME AND SCHEDULE KEYS

CLOCK FRI 13-APR-2012 10:15:33 AM
DAY OF WEEK ◀ ▶ = ###

Press DATE/TIME key to display the DATE and TIME, which is required for using the DAILY SCHEDULE. It is a valuable troubleshooting tool to determine the time of the fault, which is stored in the history memory buffers. Press this key to display CLOCK and DAY OF WEEK.

Press the ▼ ▲ keys to go to the next or previous item.
Press the ✓ key to store the data.

CLOCK FRI APR-2012 10:15:33 AM
DAY OF MONTH = ###



Type a zero to select dates for days one through nine.

CLOCK FRI 18-JUN-2011 10:15:33 AM
YEAR = ###

CLOCK FRI 18-JUN-2011 10:15:33 AM
HOUR = ###

CLOCK FRI 18-JUN-2011 10:15:33 AM
MINUTE = ###

CLOCK FRI 18-JUN-2011 10:15:33 AM
AM/PM ◀ ▶ = ###

CLOCK FRI 18-JUN-2011 10:15:33 AM
TIME FORMAT ◀ ▶ = ###

Schedule Key Operation

SCHEDULE CHOOSE SCHEDULE TYPE
◀ ▶ UNIT OPERATING SCHEDULE

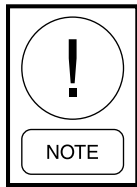
Press this key (above) to access the UNIT OPERATING SCHEDULE (default).

The message enables/disables the chiller unit based on time of day. The chiller can be enabled and disabled once each day or it can be programmed to run continuously. When the daily or holiday schedule shuts the chiller down, the running system(s) will go through a controlled ramped shutdown.

SCHEDULE UNIT OPERATING
MON START = 06:00 AM STOP = 10:00 PM

The line under the zero is the cursor. If the start time is wrong, change it by keying in the new time from the numeric keypad. Once the correct values for the START hour and minute are entered, press the ✓ key. The cursor will move to the AM/PM selection. Change the meridian (AM/PM) value with the ◀ or ▶ key, and enter by pressing the ✓ key. Repeat this process for STOP. Once a schedule is entered, the schedule for the next day will appear. The start and stop time of each day may be programmed differently.

To view the schedule without making a change, press the SCHEDULE key until the day appears. The ▲ key will scroll to the previous screen.



If the schedule is changed for Monday, all other days will change to the Monday schedule, which means if the Monday times are not applicable for the whole week, then the exceptional days need to be reprogrammed to the desired schedule.

SCHEDULE	UNIT OPERATING
HOL	START = 00:00 AM STOP = 00:00 PM

To program the chiller for 24-hour operation, program the start and stop times of each day at 00:00.

After the SUN (Sunday) schedule appears on the display,, a ▲ key will display the holiday schedule, which is a two-part display. The first display reads:

SCHEDULE	UNIT OPERATING
S M T W T F S	HOLIDAY NOTED BY *

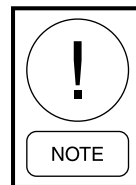
Set the holiday times using the same procedure described for the days of the week. Press the ✓ key after setting the HOL START and STOP times to save the change in memory. Press the SCHEDULE key a second time to show the individual days:

The line below the empty space is the cursor, which will move to the next or previous empty space when the ◀ or ▶ key is pressed.

To set a day for the HOLIDAY NOTED BY:

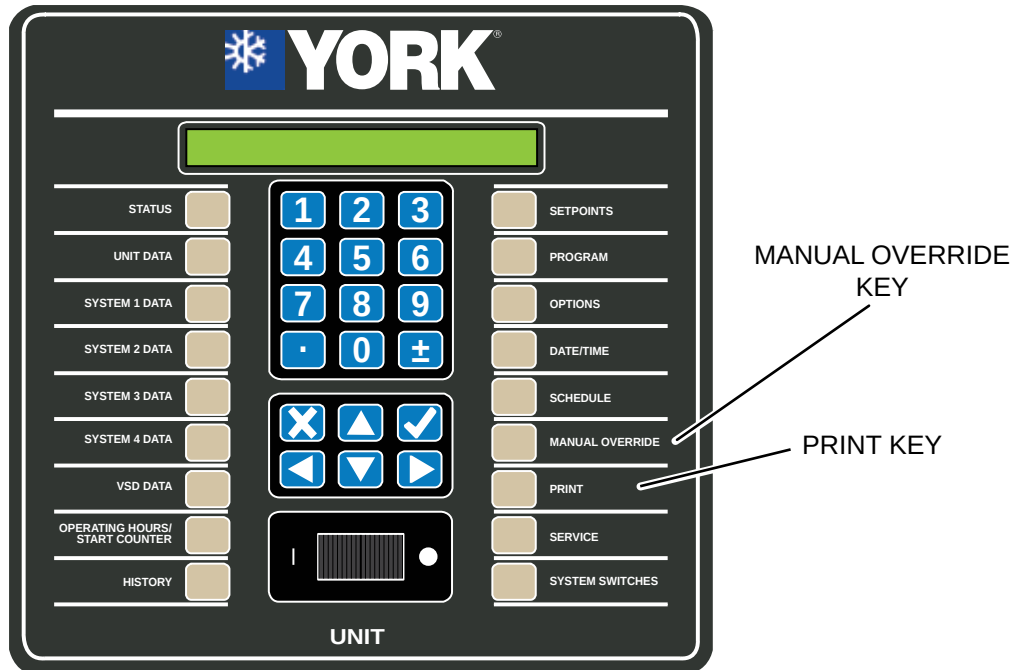
1. Move the cursor to the space following the day of the week.
2. Press the asterisk (*) key, and an * will appear in the space signifying that day as a holiday.

The holiday schedule must be programmed weekly. If there is no holiday, use the * key to delete the *. Use the ✓ key to accept the holiday schedule for the entire week.



The HOLIDAY SCHEDULE is temporary. Once the schedule is executed, the selected holidays will be cleared from memory for the following week.

MANUAL OVERRIDE AND PRINT KEYS



LD16388

FIGURE 112 - MANUAL OVERRIDE AND PRINT KEYS

MANUAL OVERRIDE

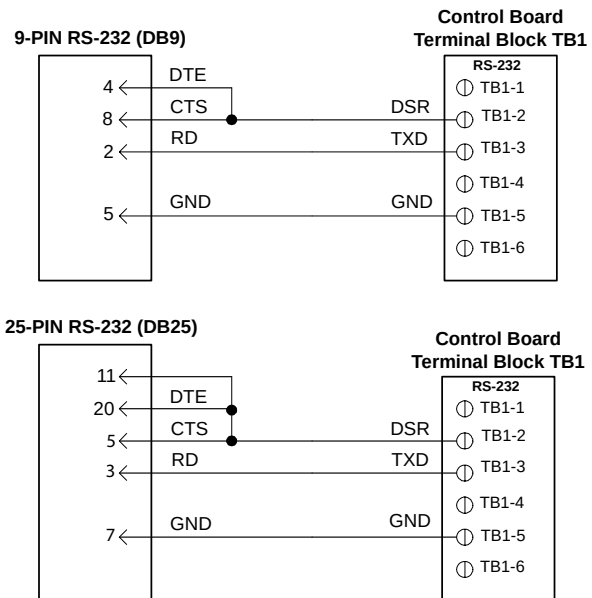
If this key is pressed during a scheduled shutdown, the STATUS key will display MANUAL OVERRIDE, which indicates that the DAILY SCHEDULE is being ignored, and the chiller will start when chilled liquid temperature allows; REMOTE CONTACTS, UNIT SWITCH and SYSTEM SWITCHES permitting. This is a priority message which cannot be overridden by anti-recycle or fault messages. Only use this key in emergencies or for servicing, which will automatically disable itself after 30 minutes.

PRINT CHOOSE PRINT REPORT
 ◀ ▶ XXXXXXXXXXXXXXXXXXXXXXXX

PRINT is used to print any of the following:

- Current operating data (real time data)
- A complete history of all history (fault) buffers
- All normal shutdowns (compressor cycling, chiller shutdown, etc.)
- History (fault) data of a specific fault. History Buffer 1 will always be the most recent fault history printout.

Use the following connections to set up the chiller to print to a computer (see Figure 114) or printer (see Figure 115).



LD16467

FIGURE 113 - PRINTER CABLE CONNECTION FROM YVWA CHILLER TO A COMPUTER

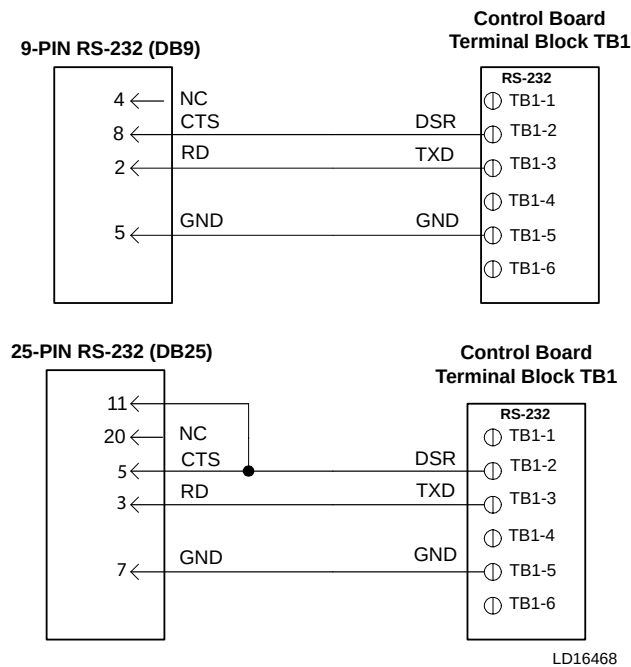


FIGURE 114 - PRINTER CABLE CONNECTION FROM YVWA CHILLER TO A SERIAL PRINTER

ACCEPTABLE PRINTERS

The following printers can be used. Printers must be equipped with an RS-232 Serial interface.

Okidata –

Models: OKIPOS 441

- Dimensions:
6.9 in. wide x 9.64 in. deep x 5.98 in. high
- Paper: 3.0 in. wide
- Type: Dot Matrix Impact
- Purchase: 800-OKIDATA
Spare printer Ribbon Okidata 52119001 Black

The Control Center provides the required formatting control codes for the printers above when the printer is selected on the PRINTER Screen in the instructions below. These codes are transmitted through the serial interface to the printer to provide a proper print format.

Different printers require different formatting control codes. Other printers might provide proper operation when connected to the Control Center. However, the print format may not be correct or as desired.

Proceed with caution and use the following guidelines if an unlisted printer is selected:

1. All must be capable of RS-232 serial communications.
2. Primary differences between printers involve the formatting control codes required by the printer. These codes are sent from the Control Center to the printer. For example, Weigh-Tronix printers require a control code to select 40 column width. This same code is interpreted by the Okidata printer as an instruction to print wide characters. In some instances, a printer will ignore a code it cannot interpret.
3. The Control Center requires a busy signal from the printer when the printer receive buffer is full. This causes the Control Center to momentarily terminate data transmission until the printer can accept more data. The busy signal polarity must be asserted low when busy.

PRINTER CONNECTIONS

Connect the printers to the Control Center Microboard as follows. Only one printer can be connected at a time.

TABLE 68 - OKIDATA OKIPOS 441

MICROBOARD	PRINTER	FUNCTION
TB1-3	pin 3	Tx (data to printer)
TB1-2	pin 20	DSR (busy signal from printer)
TB1-5	pin 7	Gnd
Cabinet		Shield

Hardware required:

Cable

- #18 AWG stranded 50 ft. maximum length.

Connectors

Microboard

- None. Strip 1/4" insulation from wire and insert into screw terminal block.

Printers

- Okidata - 25 pin plug DB-25P or equivalent; Shell DB-C2-J9 or equivalent.

PRINTER SETUP

The selected printer must be configured as follows. Refer to manual provided by printer manufacturer with respective printer.

OKIDATA OKIPOS 441

1. With the printer power off, remove the two screws which hold the RS232 Interface Module.
2. Pull the RS232 Interface Module out of the printer.
3. Set DIP switch SW2-2 to OFF to select 19200 BPS. Do not change any other switch settings.
4. Re-install the RS232 Interface Module and two mounting screws.
5. Load paper and install the printer ribbon into the printer.
6. Connect the printer cable to the printer and the microboard.
7. Connect the printer power cable to the printer and plug into a 100 to 240VAC power source.

Cancel printing by selecting the CANCEL PRINTING option. CHOOSE PRINT REPORT will display when the PRINT key is pressed.

PRINTING A REPORT

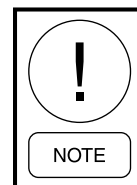
After pressing the PRINT key, press the ◀ or ▶ key until the desired printout is displayed. The available printout types are listed below.

TABLE 69 - PRINTOUT TYPES

PRINTOUT TYPES
Operating Data (Default)
All History Buffers
Normal Shutdowns
History Buffer 1
History Buffer 2
History Buffer 3
History Buffer 4
History Buffer 5
History Buffer 6
History Buffer 7
History Buffer 8
History Buffer 9
History Buffer 10
Cancel Printing

Press the ✓ key to initiate the printout.

When OPERATING DATA is selected, the data at that instant will be temporarily stored in memory, and then transmitted through the print port. HISTORY BUFFER data is captured at the instant of that particular fault, and selected buffer data is then transmitted through the print port. Refer to the example of the information includes in these printouts.



Bold italic text below a line of print is not on the actual printout. It indicates information that may not be available on all printouts, or is additional information to help explain the difference in a two -circuit printout.

Operating Data Printout	
Johnson Controls	
YVWA SCREW CHILLER	
OPERATING DATA	
2:04:14 PM 9 MAR 12	
SYS 1	NOT RUNNING
SYS 2	COMPRESSOR RUNNING
OPTIONS	
CHILLED LIQUID	WATER
CHILLED MODE	CHILLER
LOCAL/REMOTE MODE	REMOTE
LEAD/LAG CONTROL	AUTOMATIC
REMOTE TEMP RESET	DISABLED
REMOTE CURRENT LIMIT	0 TO 10 V
SMART FREEZE	DISABLED
OIL PUMP CONTROL	DISABLED
VSD AUX PUMP CONTROL	DISABLED
OIL LEVL SW CONTROL	DISABLED
REFRIG INJ CONTROL	DISABLED
PROGRAM VALUES	
EVAP PRESS CUTOUT	44 Psig
MOTOR CURRENT LIMIT	100 %FLA
PULLDOWN CURRENT LIMIT	100 %FLA
PULLDOWN LIMIT TIME	0 MIN
MOTOR TEMP UNLOAD	250.0 DEGF
UNIT ID NUMBER	0
EDUCTOR DIFFERENTIAL	50.0 DEGF
EDUCTOR SAFETY TIME	10 MIN
UNIT DATA	
LEAVING WATER TEMP	49.0 DEGF
RETURN WATER TEMP	58.2 DEGF
TEMP RATE	XXX.X DEGF/MIN
COOLING RANGE	42.0+/-2.0 DEGF
REMOTE SETPOINT	44.0 DEGF
LEAD SYSTEM	SYS 2
CHILLED LIQUID FLOW SW	ON
CONDENSER LIQUID FLOW SW	ON
EVAP/COND PUMP RUN	ON
VSD AUX COOLANT PUMP RUN	ON
(if control enabled)	
LEAVE COND LIQUID TEMP	49.0 DEGF
ENTER COND LIQUID TEMP	58.2 DEGF
ACTIVE REMOTE CONTROL	NONE
OPERATING HOURS	1=XXXXX, 2=XXXXX

START COUNTER	1=XXXXX, 2=XXXXX
SOFTWARE VERSION	C.WCS.30.00
UNIT SERIAL NUMBER	YYYY XXXZZZ
VSD DATA	
ACTUAL FREQUENCY	XXX.X HZ
COMMAND FREQUENCY	XXX.X HZ
DC BUS VOLTAGE	XXX VDC
INTERNAL AMBIENT TEMP	XXX.X DEGF
COOLING SYSTEM STATUS	XXX
BASEPLATE TEMPS	XXX XXX DEGF
PRE-CHARGE SIGNAL	XXX
MOTOR OVERLOADS 1/2	XXX XXX AMPS
SOFTWARE VERSION	C.VSD.XX.00
SYSTEM 1 DATA	
COMPRESSOR STATUS	OFF
RUN TIME	0- 0- 0- 0 D-H-M-S
MOTOR CURRENT	0 AMPS 0 %FLA
EVAPORATOR PRESSURE	125 Psig
DISCHARGE PRESSURE	131 Psig
OIL PRESSURE	130 Psig
CONDENSER LIQUID TEMP	68.4 DEGF
DISCHARGE TEMPERATURE	68.8 DEGF
CONDENSER PRESSURE	71.8 DEGF
SUBCOOLING	3.4 DEGF
EVAP TEMP	120.3 DEGF
MOTOR TMP	XXX.XXXX.XXXX.X
COMPRESSOR SPEED	XXX.X %
COND LEVEL % OPEN	XXX.X %
ECONOMIZER % OPEN	XXX.X %
ECONOMIZER TEMP	120.3 DEGF
ECONOMIZER PRESSURE	71.7 PSIG
COMPRESSOR HEATER	OFF
VI STEP SOLENOID 1	OFF
(if control enabled)	
VI STEP SOLENOID 2	OFF
(if control enabled)	
LIQUID REF INJ	OFF
(if control enabled)	
HOT GAS BYPASS	OFF
(if control enabled)	
OIL PUMP	ON
(if control enabled)	
OIL LEVEL SWITCH	ON
(if control enabled)	
RUN PERMISSIVE	ON
VSD RUN RELAY	OFF

FIGURE 115 - SAMPLE PRINTOUT (CONT'D)

FIGURE 115 - SAMPLE PRINTOUT

```

VSD SOFTWARE RUN SIGNAL          OFF
EDUCTOR TEMPERATURE              68.8 DEGF

      SYSTEM 2 DATA
COMPRESSOR STATUS                 OFF
RUN TIME                         0- 0- 0- 0 D-H-M-S
MOTOR CURRENT                    0 AMPS 0 %FLA
EVAPORATOR PRESSURE              125 Psig
DISCHARGE PRESSURE               131 Psig
OIL PRESSURE                     130 Psig
CONDENSER LIQUID TEMP            68.4 DEGF
DISCHARGE TEMPERATURE            68.8 DEGF
CONDENSER PRESSURE               71.8 DEGF
SUBCOOLING                       3.4 DEGF
EVAP TEMP                       120.3 DEGF
MOTOR TMP                       XXX.XXXX.XXXX.X
COMPRESSOR SPEED                 XXX.X %
COND LEVEL % OPEN                XXX.X %
ECONOMIZER % OPEN                XXX.X %
ECONOMIZER TEMP                  120.3 DEGF
ECONOMIZER PRESSURE              71.7 PSIG
COMPRESSOR HEATER                OFF
VI STEP SOLENOID 1               OFF
(if control enabled)
VI STEP SOLENOID 2               OFF
(if control enabled)
LIQUID REF INJ                   OFF
(if control enabled)
HOT GAS BYPASS                   OFF
(if control enabled)
OIL PUMP                          ON
(if control enabled)
OIL LEVEL SWITCH                 ON
(if control enabled)
RUN PERMISSIVE                   ON
VSD RUN RELAY                    OFF
VSD SOFTWARE RUN SIGNAL          OFF
EDUCTOR TEMPERATURE              68.8 DEGF

```

UNIT OPERATING SCHEDULE

```

S M T W T F S      *=HOLIDAY
MON START=00:00AM   STOP=00:00AM
TUE START=00:00AM   STOP=00:00AM
WED START=00:00AM   STOP=00:00AM
THU START=00:00AM   STOP=00:00AM
FRI START=00:00AM   STOP=00:00AM
SAT START=00:00AM   STOP=00:00AM
HOL START=00:00AM   STOP=00:00AM

```

History Data Printout

History printouts provide stored data relating to all specific system and chiller operating conditions at the time of the fault, regardless if a lockout occurred. Whenever any fault occurs, all system operating data is stored in battery-backed memory on the control board at the instant of the fault, and is not affected by power failures or resetting of the faults. The history printout is the same as the operating data printout except for the header information shown below:

```

      Johnson Controls
      YVWA SCREW CHILLER
      HISTORY NUMBER 1
      2:04:14 PM 30 APR 12

SYS 1 YYYYYYYY
      HIGH DSCH PRESS SHUTDOWN
      STATUS AT TIME OF SHUTDOWN
SYS 1 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
SYS 2 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

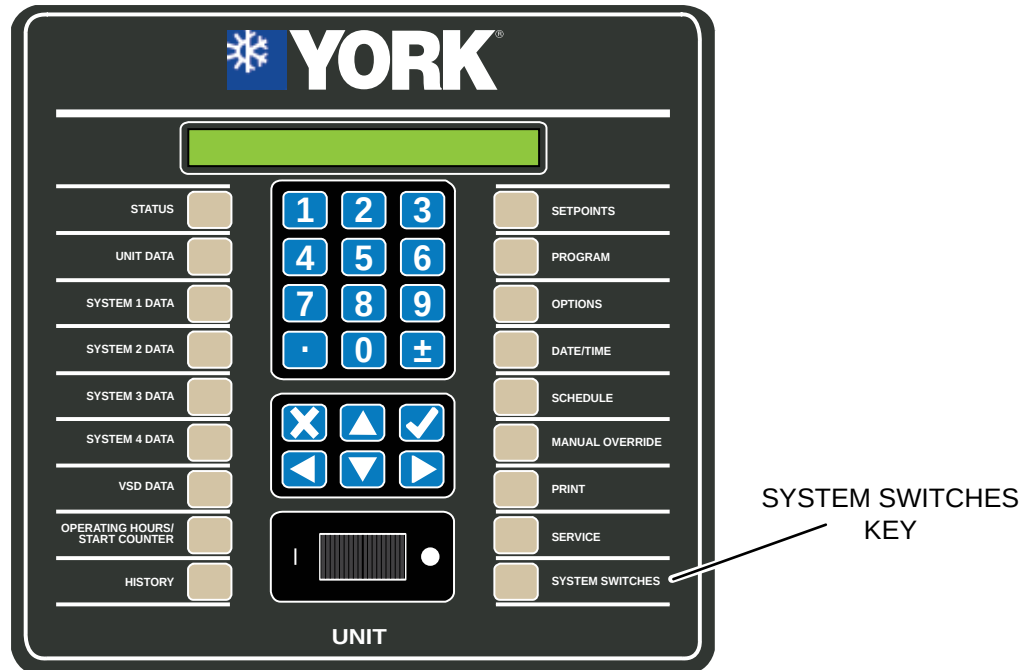
      ALL FAULTS
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

```

The most recent fault will always be stored as HISTORY BUFFER #1.

FIGURE 115 - SAMPLE PRINTOUT (CONT'D)

SYSTEM SWITCHES



LD16388

FIGURE 116 - SYSTEM SWITCHES

SYSTEM SWITCHES **SYS 1 ON / OFF / RESET**
◀ ▶ = ON OR OFF OR RESET

Use the SYSTEM SWITCHES key to enable/disable System 1 or 2 on the chiller. In addition, safety lockouts can be cleared under this key. Pressing this key returns to the first SYSTEM SWITCHES screen. The ▼ and ▲ keys will scroll to the next or previous item. Use the ◀ or ▶ keys to scroll through the choices for each item and the ✓ key to accept the new item setting.

If RESET (LOCKOUT) is selected, a lockout fault on that system will be cleared, but the state of that system's switch will remain unchanged (ON or OFF).

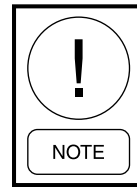
SYSTEM SWITCHES **SYS 2 ON / OFF / RESET**
◀ ▶ = ON OR OFF OR RESET

Use the ◀ or ▶ key to scroll through the message:

- SYSTEM OFF (default)
- SYSTEM ON
- RESET (LOCKOUT)

Press the ✓ key to enter the switch selection into memory.

If RESET (LOCKOUT) is selected and accepted, it will not change the position of the switch (ON or OFF).



Except in emergencies, always use the SYSTEM 1 or 2 SYSTEM SWITCH to turn off the compressor, which allows the compressor to go through a controlled shutdown. Avoid using the UNIT SWITCH to turn off the compressors.

Service Mode

To enter Service Mode, press the SERVICE key. The following message is the initial screen and is displayed when the SERVICE key is pressed. If a password is entered it will display **** where the XXXX is shown.

SERVICE MODE XXXX

PRESS ENTER KEY TO CONTINUE

From this display, press the ✓ key to enter “view only” Service Mode. All control board I/O will be viewable from this mode. No outputs can be changed from this mode.

The Control Board and some VSD Logic Board digital outputs can be toggled on or off in change mode. Some analog outputs can be changed with the numeric keypad in change mode. Enter change mode by turning OFF the UNIT SWITCH and entering 9675 (YORK) and pressing the ✓ key from the initial Service Mode display. If the UNIT SWITCH is turned back on or you leave Service Mode, outputs will revert to normal control and will not be able to be changed from Service Mode.

The DOWN arrow key can be used to scroll forward through the displays.

The UP arrow key can be used to scroll backwards through the displays.

Note: This will not be limited to only the inputs and outputs that are used but will apply to all available spare inputs and outputs on the control board.

The RIGHT arrow key can be used to jump to the beginning of the next section of displays.

The LEFT arrow key can be used to jump to the beginning of the previous section of displays.

The sections of displays are as follows:

- Software Versions
- Analog Inputs
- Digital Inputs
- Digital Outputs
- Analog Outputs
- VSD Logic Digital Outputs

Software Version

The software version of the control board and the VSD logic board can be viewed under Service Mode. They are located on the first screen under Service Mode after the initial screen.

SERVICE SOFTWARE VERSIONS

CONTROL = C.WCS.30.YY VSD = C.V5D.04.YY

The software version number will be in one of the following formats:

C.WCS.ZZ.YY (control board released version)

C.VSD.ZZ.YY (VSD logic board released version)

where C is the Product Classification and stands for Commercial unit

WCS is the Family Code and stands for Water Cooled Screw

VSD is the Family Code and stands for Variable Speed Drive

ZZ = The Product Code

30 = Optimized IPLV YVWS 2 Compressor Chiller

04 = VSD for YVWA 2 Compressor Chiller

YY = The Version Number

Unit Serial Number

The second key press under Service Mode is the Unit Serial Number. The following is the display message.

SERVICE UNIT S/N = YYYY XXXZZZ

Analog inputs

Following are the Analog Input displays that can be viewed from Service Mode. These messages will only display in English. Note: If the I/O is not implemented the message may indicate “SPARE”

SERVICE AI J17-11 REMOTE TEMP RESET
X.X VDC = XXX.X %

SERVICE AI J17-12 REMOTE CURRENT LIMIT
X.X VDC = XXX.X %

SERVICE AI J17-13 SPARE ANALOG INPUT
X.X VDC = XXX.X %

The Remote Temp Reset, Remote Current Limit, inputs have voltage dividers on the board if the jumper is set for a voltage input. The optional Remote Hot Water Reset has a voltage divider formed with a resistor on the board and one in a terminal block. The voltage read by the ADC is less than the voltage at the header for these inputs. To correct for this, the following calculation will be used for the voltage at the board header for the Service Mode displays for these 3 items if they are programmed for either of the voltage input modes under OPTIONS.

- Voltage = $10 * \text{ADC volts} / 4.5$
- If the input is programmed for a current input, the voltage read by the MUX is displayed. If the input is disabled under OPTIONS, the voltage display shows "DISABLED".

SERVICE AI J17-14 SYS 1 EDUCTOR TMP
X.X VDC = XXX.X °F

SERVICE AI J17-15 SYS 2 EDUCTOR TMP
X.X VDC = XXX.X °F

SERVICE AI J18-7 CHILLED LEV LIQUID TMP
X.X VDC = XXX.X °F

SERVICE AI J18-8 CHILLED ENT LIQUID TMP
X.X VDC = XXX.X °F

SERVICE AI J18-9 SPARE ANALOG INPUT
X.X VDC = XXX.X °F

SERVICE AI J19-1 SYS 1 MOTOR TEMP T1
X.X VDC = XXX.X °F

SERVICE AI J19-2 SYS 1 MOTOR TEMP T2
X.X VDC = XXX.X °F

SERVICE AI J19-3 SYS 1 MOTOR TEMP T3
X.X VDC = XXX.X °F

SERVICE AI J19-6 SYS 2 MOTOR TEMP T1
X.X VDC = XXX.X °F

SERVICE AI J19-7 SYS 2 MOTOR TEMP T2
X.X VDC = XXX.X °F

SERVICE AI J19-8 SYS 2 MOTOR TEMP T3
X.X VDC = XXX.X °F

SERVICE AI J20-1 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J20-2 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J20-3 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J20-6 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J20-7 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J20-8 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J21-3 SYS 1 EVAP TEMP
X.X VDC = XXX.X °F

SERVICE AI J21-6 SYS 1 COND LIQ REF LVL
X.X VDC = XXXX

SERVICE AI J21-13 COND LEAVE LIQUID TMP
X.X VDC = XXX.X °F

SERVICE AI J21-16 SYS 1 DISCHARGE TEMP
X.X VDC = XXX.X °F

SERVICE AI J21-20 SYS 1 EVAP PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J21-22 SYS 1 OIL PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J21-24 SYS 1 DISCHARGE PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J22-3 SYS 2 EVAP TEMP
X.X VDC = XXX.X °F

SERVICE AI J22-6 SYS 2 COND LIQ REF LVL
X.X VDC = XXXX

SERVICE AI J22-13 COND ENTER WATER TEMP
X.X VDC = XXX.X °F

SERVICE AI J22-16 SYS 2 DISCHARGE TEMP
X.X VDC = XXX.X °F

SERVICE AI J22-20 SYS 2 EVAP PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J22-22 SYS 2 OIL PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J22-24 SYS 2 DISCHARGE PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J23-3 SYS 1 ECONO TEMP
X.X VDC = XXX.X °F

SERVICE AI J23-6 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J23-13 SYS 1 SUBCOOL TEMP
X.X VDC = XXX.X °F

SERVICE AI J23-16 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J23-20 SYS 1 ECONO PRESS
X.X VDC = XXX.X °F

SERVICE AI J23-22 SYS 1 COND PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J23-24 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J24-3 SYS 2 ECONO TEMP
X.X VDC = XXX.X °F

SERVICE AI J24-6 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J24-13 SYS 2 SUBCOOL TEMP
X.X VDC = XXX.X °F

SERVICE AI J24-16 SPARE ANALOG INPUT
X.X VDC

SERVICE AI J24-20 SYS 2 ECONO PRESS
X.X VDC = XXX.X °F

SERVICE AI J24-22 SYS 2 COND PRESS
X.X VDC = XXX.X PSIG

SERVICE AI J24-24 SPARE ANALOG INPUT
X.X VDC

Digital inputs

Following are the Digital Input displays that can be viewed from Service Mode. The XXX is replaced with OFF or ON in this section. These messages will only display in English.

SERVICE DI J4-2 UNIT SWITCH 1
STATUS = XXX

SERVICE DI J4-3 UNIT SWITCH 2
STATUS = XXX

SERVICE DI J4-4 SYS 1 HPCO
STATUS = XXX

SERVICE DI J4-5 SYS 2 HPCO
STATUS = XXX

SERVICE DI J4-6 VSD FAULT RELAY
STATUS = XXX

SERVICE DI J5-1 SYS 1 OIL LEVEL SW
STATUS = XXX

SERVICE DI J5-2 SYS 2 OIL LEVEL SW
STATUS = XXX

SERVICE DI J5-3 REMOTE MODE SELECT
STATUS = XXX

SERVICE DI J6-2 CHILLED LIQUID FLOW SW
STATUS = XXX

SERVICE DI J6-3 PRINT
STATUS = XXX

SERVICE DI J6-4 SYS 1 RUN PERM
STATUS = XXX

SERVICE DI J6-5 SYS 2 RUN PERM
STATUS = XXX

SERVICE DI J6-6 COND LIQUID FLOW SW
STATUS = XXX

SERVICE DI J7-1,2 HP OPT CAPABILITY
STATUS = XXX

SERVICE DI J7-3,4 SPARE DIGITAL INPUT
STATUS = XXX

SERVICE DI J7-5,6 SPARE DIGITAL INPUT
STATUS = XXX

SERVICE DI J7-7,8 SPARE DIGITAL INPUT
STATUS = XXX

SERVICE DI J7-19,0 SPARE DIGITAL INPUT
STATUS = XXX

Digital Outputs

Following are the Digital Output status displays that can be viewed from Service Mode. The XXX is replaced with OFF or ON in this section. The state of these outputs is only viewable unless the password 9675 (YORK) was entered from the initial Service Mode display with the UNIT SWITCH in the OFF position. If the password was entered followed by the ✓ key, all outputs can be toggled on and off via the ✓ key. These messages will only display in English.

SERVICE DO J9-1 SPARE DIGITAL OUTPUT
RB1 TB1-20 STATUS = XXX

SERVICE DO J9-2 SYS 1 VSD RUN
RB1 TB1-18 STATUS = XXX

SERVICE DO J9-3 SYS 1 ALARM
RB1 TB1-16 STATUS = XXX

SERVICE DO J9-4 SPARE DIGITAL OUTPUT
RB1 TB1-14 STATUS = XXX

SERVICE DO J9-5 SYS 1 VI STEP 1
RB1 TB1-12 STATUS = XXX

SERVICE DO J9-6 SYS 1 VI STEP 2
RB1 TB1-10 STATUS = XXX

SERVICE DO J9-7 VSD AUX COOLANT PUMP
RB1 TB1-8 STATUS = XXX

SERVICE DO J9-8 SYS 1 LIQUID REF INJ
RB1 TB1-6 STATUS = XXX

SERVICE DO J9-9 SYS 1 HOT GAS BYPASS
RB1 TB1-5 STATUS = XXX

SERVICE DO J9-10 SPARE DIGITAL OUTPUT
RB1 TB1-4 STATUS = XXX

SERVICE DO J9-11 SYS 1 COMP HEATER
RB1 TB1-3 STATUS = XXX

SERVICE DO J9-12 SYS 1 OIL PUMP
RB1 TB1-2 STATUS = XXX

SERVICE DO J10-1 EVAP / COND PUMP RUN
RB2 TB1-20 STATUS = XXX

SERVICE DO J10-2 SYS 2 VSD RUN
RB2 TB1-18 STATUS = XXX

SERVICE DO J10-3 SYS 2 ALARM
RB2 TB1-16 STATUS = XXX

SERVICE DO J10-4 CHILLER RUN
RB2 TB1-14 STATUS = XXX

SERVICE DO J10-5 SPARE DIGITAL OUTPUT
RB2 TB1-12 STATUS = XXX

SERVICE DO J10-6 SYS 2 VI STEP 1
RB2 TB1-10 STATUS = XXX

SERVICE DO J10-7 SYS 2 VI STEP 2
RB2 TB1-8 STATUS = XXX

SERVICE DO J10-8 SYS 2 LIQUID REF INJ
RB2 TB1-6 STATUS = XXX

SERVICE DO J10-9 SYS 2 HOT GAS BYPASS
RB2 TB1-5 STATUS = XXX

SERVICE DO J10-10 SPARE DIGITAL OUTPUT
RB2 TB1-4 STATUS = XXX

SERVICE DO J10-11 SYS 2 COMP HEATER
RB2 TB1-3 STATUS = XXX

SERVICE DO J10-12 SYS 2 OIL PUMP
RB2 TB1-2 STATUS = XXX

SERVICE DO J11-1 SPARE DIGITAL OUTPUT
RB3 TB1-20 STATUS = XXX

SERVICE DO J11-1 SPARE DIGITAL OUTPUT
RB3 TB1-20 STATUS = XXX

SERVICE DO J11-2 SPARE DIGITAL OUTPUT
RB3 TB1-18 STATUS = XXX

SERVICE DO J11-3 SPARE DIGITAL OUTPUT
RB3 TB1-16 STATUS = XXX

SERVICE DO J11-4 SPARE DIGITAL OUTPUT
RB3 TB1-14 STATUS = XXX

SERVICE DO J11-5 SPARE DIGITAL OUTPUT
RB3 TB1-12 STATUS = XXX

SERVICE DO J11-6 SPARE DIGITAL OUTPUT
RB3 TB1-10 STATUS = XXX

SERVICE DO J11-7 SPARE DIGITAL OUTPUT
RB3 TB1-8 STATUS = XXX

SERVICE DO J11-8 SPARE DIGITAL OUTPUT
RB3 TB1-6 STATUS = XXX

SERVICE DO J11-9 SPARE DIGITAL OUTPUT
RB3 TB1-5 STATUS = XXX

SERVICE DO J11-10 SPARE DIGITAL OUTPUT
RB3 TB1-4 STATUS = XXX

SERVICE DO J11-11 SPARE DIGITAL OUTPUT
RB3 TB1-3 STATUS = XXX

SERVICE DO J11-12 SPARE DIGITAL OUTPUT
RB3 TB1-2 STATUS = XXX

Analog Outputs

Following are the Analog Output status displays that can be viewed from Service Mode. The states of these outputs are only viewable unless the password 9675 (YORK) was entered from the initial Service Mode display with the UNIT SWITCH in the OFF position. If the password was entered followed by the ✓ key,

all outputs can be programmed via the numeric keypad and ✓ key as a percentage of full scale output. These messages will only display in English.

The following equation is used to calculate the nominal output voltage based on the entered percent of full scale output (x10 format) programmed.

$$V_{out} = 10.28 \text{ V} * \% \text{ Full Scale} / 1000$$

SERVICE AO J15-1 SYS 1 COND VALVE OUT
XXX.X % = XX.X VDC

SERVICE AO J15-3 SYS 1 ECON VALVE OUT
XXX.X % = XX.X VDC

SERVICE AO J15-5 SYS 2 COND VALVE OUT
XXX.X % = XX.X VDC

SERVICE AO J15-7 SYS 2 ECON VALVE OUT
XXX.X % = XX.X VDC

SERVICE AO J14-1 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J14-2 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J14-3 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J14-4 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J25-1 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J25-2 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J25-3 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

SERVICE AO J25-4 SPARE ANALOG OUTPUT
XXX.X % = XX.X VDC

VSD Digital Outputs

The VSD Digital Output status that can be viewed from Service Mode is below. It is only viewable unless the password 9675 (YORK) was entered from the initial Service Mode display with the UNIT SWITCH in the OFF position. If the password was entered followed by the ENTER key, this can be changed. The message will only display in English.

SERVICE DO J10-2 VSD COOLING FAN/PUMP
VSD LOGIC STATUS = XXX

Unit Serial Number Entry Mode

Unit serial number entry mode will allow the programming of all the fields that make up the unit's serial number. These will either be programmed at the factory or by service personnel on the job. This mode may be entered by pressing the SERVICE key, entering the unit serial number entry mode roving password (calculated by a stand alone program – contact York Service for password), and pressing ✓. The password will only be good for one day.

The following table lists the serial number fields that can be programmed in this mode.

TABLE 70 - UNIT SERIAL NUMBER ENTRY MODE PROGRAMMABLE FIELDS

UNIT SERIAL NUMBER FIELD	LOW LIMIT	HIGH LIMIT	DE-FAULT
Unit Serial Number Position 1	0	Z	R
Unit Serial Number Position 2	A	N	A
Unit Serial Number Position 3	A	Z	N
Unit Serial Number Position 4	A	Z	X
Unit Serial Number Position 5-7	0	999	0
Unit Serial Number Position 8-10	0	999	0

Following are the messages for the Setup Mode values in the order they appear.

S/N ENTRY UNIT SERIAL NUMBER POS 1
◀ ▶ X

The choices for this option are as follows:

0 through 9 and Letters 'A' through 'Z'.

S/N ENTRY UNIT SERIAL NUMBER POS 2
◀ ▶ X

The choices for this option are as follows:

Letters 'A' through 'N'.

S/N ENTRY UNIT SERIAL NUMBER POS 3
◀ ▶ X

The choices for this option are as follows:

Letters 'A' through 'Z'.

S/N ENTRY UNIT SERIAL NUMBER POS 4
◀ ▶ X

The choices for this option are as follows:

Letters 'A' through 'Z'.

S/N ENTRY UNIT S/N = YYYY XXXZZZ
UNIT SERIAL NUMBER POS 5-7 = XXX

S/N ENTRY UNIT S/N = YYYY XXXZZZ
UNIT SERIAL NUMBER POS 8-10 = ZZZ

If any serial number position contains an invalid letter/number, a priority status unit warning message will be displayed until a valid serial number has been entered.

EEV Override

(Access code 1616) - Provides the ability to override the Danfoss controller output with a manually entered valve percent open (0 - 100%). A value of 101 will allow the Danfoss controller to control the valves. The entered value will be reset to the default value on power up.

TABLE 71 - EEV OVERRIDES

EEV MODE VALUE	LOW LIMIT	HIGH LIMIT	RESET TO DEFAULT ON POWER UP	DEFAULT
Manual J15-1,2	0	101 (auto)	YES	101
Manual J15-3,4	0	101 (auto)	YES	101
Manual J15-5,6	0	101 (auto)	YES	101
Manual J15-7,8	0	101 (auto)	YES	101
Manual J14-1,2	0	101 (auto)	YES	101

System 1 Condenser Level Control Valve

EEV MODE ◀DEF XXXXX LO XXXXX HI XXXXX
J15-1,2 % OPEN(101=AUTO) = XXX %

System 1 Economizer Feed Valve

EEV MODE ◀DEF XXXXX LO XXXXX HI XXXXX
J15-3,4 % OPEN(101=AUTO) = XXX %

System 2 Condenser Level Control Valve

EEV MODE ◀DEF XXXXX LO XXXXX HI XXXXX
J15-5,6 % OPEN(101=AUTO) = XXX %

System 2 Economizer Feed Valve

EEV MODE ◀DEF XXXXX LO XXXXX HI XXXXX
J15-7,8 % OPEN(101=AUTO) = XXX %

Data Logging Mode

Data Logging Mode will allow the configuration and initiation of data logging. This mode may be entered by pressing the SERVICE key, entering the Data Logging password (1234), and pressing ✓.

Following are the messages for Data Logging Mode values in the order they appear. These messages will only display in English.

DATA LOG DATA LOGGING
◀▶ XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXX = ENABLED or DISABLED, selectable via the LEFT/RIGHT arrow keys.

DATA LOG ◀DEF XXXXX LO XXXXX HI XXXXX
DATA LOGGING TIMER = XX SEC

When Data logging is enabled the computer acquiring the data's Serial communications port will need to be configured for 19.2Kbaud, 1 Stop bit, 1 Start bit and no Parity. When Data Logging is disabled configure the serial port back to default.

Data Logging resets to Disabled automatically on power up of the panel.

When Data Logging is **enabled**, The header text line shall be transmitted after which only data values will be serially transmitted to the RS-232 port at an interval defined by the Data Logging Interval. This can be from 5 to 30 seconds. The data will be comma separated with a carriage return and line feed transmitted at the end of each transmission interval. All data transmitted at each interval will be from the same snapshot in time.

Numeric data will never have a non-numeric character sent. (<, >, etc.) If a numeric value is out of range, it shall send the limit value.

While Data Logging is enabled, the automatic fault data print is disabled, so be careful to Disable data logging when finished.

Following is a list of all data values that are included in Data Logging and the heading.

TABLE 72 - YVWA 2 COMPRESSOR CHILLER DATA LOGGING DATA

NUMBER	DATA VALUE	HEADING TEXT
1	Date (DD/MM/YYYY)	DATE
2	Time (hh/mm)	TIME
3	Entering Chilled Liquid Temperature xxx.x	ECHLT
4	Leaving Chilled Liquid Temperature xxx.x	LCHLT
5	LCHLT / LCHWT Setpoint xxx.x	LCHLT_SETP
6	Entering Condenser Liquid Temperature xxx.x	ECLT
7	Leaving Condenser Liquid Temperature xxx.x	LCLT
8	Evaporator Flow Switch x	EVAP_FLOW
9	Condenser Flow Switch x	COND_FLOW
10	Sys 1 Run Time (ssssssss)	1_RUN_TIME
11	Sys 1 Evaporator Pressure xxx.x	1_EVP_PRS
12	Sys 1 Evaporator Refrigerant Temperature xxx.x	1_EVP_TMP
13	Sys 1 Compressor Discharge Pressure xxx.x	1_DIS_PRS
14	Sys 1 Compressor Discharge Temperature xxx.x	1_DIS_TMP
15	Sys 1 Compressor Discharge Super Heat xxx.x	1_DIS_SH
16	Sys 1 Oil Pressure xxx.x	1_OIL_PRS
17	Sys 1 Oil Differential Pressure xxx.x	1_OIL_DPRS
18	Sys 1 Subcooled Liquid Refrigerant Temperature xxx.x	1_SUB_TMP
19	Sys 1 Economizer Pressure xxx.x	1_ECN_PRS
20	Sys 1 Economizer Outlet Temperature xxx.x	1_ECN_TMP
21	Sys 1 Economizer Super Heat xxx.x	1_ECN_SH
22	Sys 1 Economizer Feed valve output xxx.x	1_ECN_VLV
23	Sys 1 Condenser Pressure xxx.x	1_COND_PRS
24	Sys 1 Condenser Liquid Refrigerant Level xxx.x	1_LQ_LVL
25	Sys 1 Condenser Liquid Refrigerant Level Setpoint xxx.x	1_LQ_LVLSP
26	Sys 1 Condenser Level control valve output xxx.x	1_LQ_VLV
27	Sys 1 Active Load Limit xxx	1_LD_LIM
28	Sys 1 Motor Current %FLA xxx.x	1_MTR_AMP
29	Sys 1 Motor Temperature 1 xxx.x	1_MTR_TMP1
30	Sys 1 Motor Temperature 2 xxx.x	1_MTR_TMP2
31	Sys 1 Motor Temperature 3 xxx.x	1_MTR_TMP3
32	Sys 1 Coolant Injection Valve Status x	1_INJ_VLV
33	Sys 1 Hot Gas Bypass Status x	1_HGBP
34	Sys 1 Oil Level Switch Status x	1_OIL_SW
35	Sys 1 Eductor Temperature xxx.x	1_EDU_TMP
36	Sys 1 Differential Oil Filter Pressure xxx.x	1_FLT_DPRS
37	Sys 2 Run Time (ssssssss)	2_RUN_TIME
38	Sys 2 Evaporator Pressure xxx.x	2_EVP_PRS
39	Sys 2 Evaporator Refrigerant Temperature xxx.x	2_EVP_TMP
40	Sys 2 Compressor Discharge Pressure xxx.x	2_DIS_PRS
41	Sys 2 Compressor Discharge Temperature xxx.x	2_DIS_TMP
42	Sys 2 Compressor Discharge Super Heat xxx.x	2_DIS_SH
43	Sys 2 Oil Pressure xxx.x	2_OIL_PRS
44	Sys 2 Oil Differential Pressure xxx.x	2_OIL_DPRS
45	Sys 2 Subcooled Liquid Refrigerant Temperature xxx.x	2_SUB_TMP

TABLE 72 - YVWA 2 COMPRESSOR CHILLER DATA LOGGING DATA (CONT'D)

NUMBER	DATA VALUE	HEADING TEXT
46	Sys 2 Economizer Pressure xxx.x	2_ECN_PRS
47	Sys 2 Economizer Outlet Temperature xxx.x	2_ECN_TMP
48	Sys 2 Economizer Super Heat xxx.x	2_ECN_SH
49	Sys 2 Economizer Feed valve output xxx.x	2_ECN_VLV
50	Sys 2 Condenser Pressure xxx.x	2_COND_PRS
51	Sys 2 Condenser Liquid Refrigerant Level xxx.x	2_LQ_LVL
52	Sys 2 Condenser Liquid Refrigerant Level Setpoint xxx.x	2_LQ_LVLSP
53	Sys 2 Condenser Level control valve output xxx.x	2_LQ_VLV
54	Sys 2 Active Load Limit xxx	2_LD_LIM
55	Sys 2 Motor Current %FLA xxx.x	2_MTR_AMP
56	Sys 2 Motor Temperature 1 xxx.x	2_MTR_TMP1
57	Sys 2 Motor Temperature 2 xxx.x	2_MTR_TMP2
58	Sys 2 Motor Temperature 3 xxx.x	2_MTR_TMP3
59	Sys 2 Coolant Injection Valve Status x	2_INJ_VLV
60	Sys 2 Hot Gas Bypass Status x	2_HGBP
61	Sys 2 Oil Level Switch Status x	2_OIL_SW
62	Sys 2 Eductor Temperature xxx.x	2_EDU_TMP
63	Sys 2 Differential Oil Filter Pressure xxx.x	2_FLT_DPRS
64	Remote Mode Select	REM_SEL
65	Heat Pump x	HEAT_PUMP
66	VSD Speed Command xxx.x	VSD_SPD
67	Sys 1 Operational Code xxx	1_OP_CODE
68	Sys 2 Operational Code xxx	2_OP_CODE
69	Sys 1 Fault Code xxx	1_FAULT
70	Sys 2 Fault Code xxx	2_FAULT
71	VSD DC Bus Voltage xxx	VDC_BUS
72	VSD Ambient Temp xxx.x	VSD_AMBTMP
73	VSD Aux Coolant Pump x	VSD_AUXPMP

NOTES

The following factors can be used to convert from English to the most common SI Metric values.

METRIC CONVERSION

TABLE 73 - SI METRIC CONVERSION

MEASUREMENT	MULTIPLY ENGLISH UNIT	BY FACTOR	TO OBTAIN METRIC UNIT
Capacity	Tons Refrigerant Effect (ton)	3.516	Kilowatts (kW)
Power	Horsepower	0.7457	Kilowatts (kW)
Flow Rate	Gallons / Minute (gpm)	0.0631	Liters / Second (l/s)
Length	Feet (ft)	0.3048	Meters (m)
	Inches (in)	25.4	Millimeters (mm)
Weight	Pounds (lbs)	0.4538	Kilograms (kg)
Velocity	Feet / Second (fps)	0.3048	Meters / Second (m/s)
Pressure Drop	Feet of Water (ft)	2.989	Kilopascals (kPa)
	Pounds / Square Inch (psi)	6.895	Kilopascals (kPa)

TEMPERATURE

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), subtract 32° and multiply by 5/9 or 0.5556.

Example: $(45.0^{\circ}\text{F} - 32^{\circ}) \times 0.5556 = 27.2^{\circ}\text{C}$

To convert a temperature range (i.e., a range of 10°F) from Fahrenheit to Celsius, multiply by 5/9 or 0.5556.

Example: $10.0^{\circ}\text{F range} \times 0.5556 = 5.6^{\circ}\text{C range}$



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