

 BY JOHNSON CONTROLS	COMPOUND YK CENTRIFUGAL LIQUID CHILLER	
OPERATION AND MAINTENANCE	NEW RELEASE	Form 160.82-OM1 (611)

MODEL CYK CENTRIFUGAL CHILLER / HEAT PUMP SYSTEM WITH QUANTUM™ LX CONTROLS



LD15345

R-134a

Issue Date:
June 8, 2011

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

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

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

This document is intended for use by owner-authorized operating/service personnel. It is expected that these individual 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:



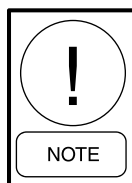
Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.



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 Quantum™ LX 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.

ASSOCIATED LITERATURE

MANUAL DESCRIPTION	FORM NUMBER
Renewal Parts	160.82-RP1
Startup Checklist	160.82-CL1

NOMENCLATURE

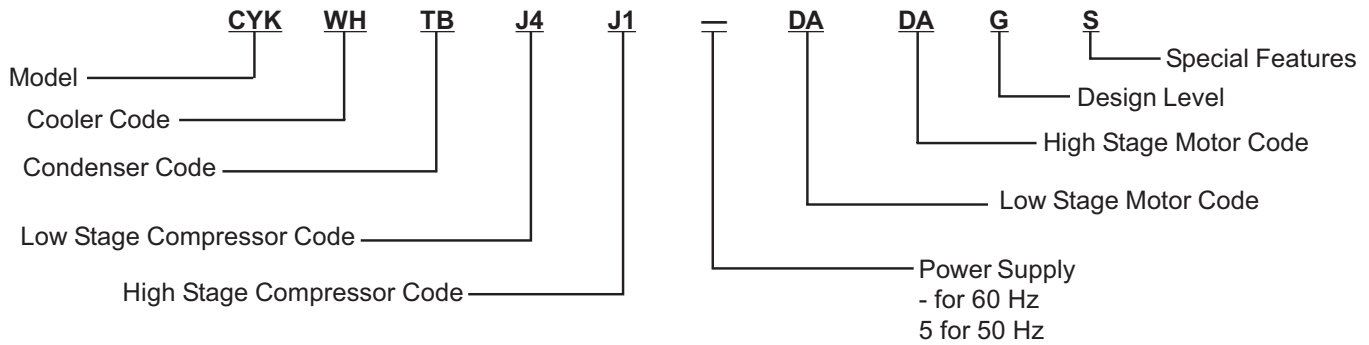


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SECTION 1 - DESCRIPTION OF SYSTEM

1

The Quantum™ LX system is a fully integrated control system for Compound YK chillers. The versatility of the CYK product allows it to be used as either a chiller or a heat pump application as a standard option. The advanced CYK control system manages all aspects of chiller operation, monitoring vital parameters and making real-time adjustments as necessary to ensure safe and efficient operation of primary system components.

A full-color, animated graphic operator interface provides the operator access to all real-time sensor data, and is equipped with both sensor history logging and complete alarm/system trip history features. Manual adjustments to operational parameters may be made by a qualified service technician. Among the monitored operating parameters are:

- Chilled liquid temperatures
- Refrigerant pressures and temperatures
- Cooling liquid temperatures
- Compressor data
- Pre-rotation vane positions
- Evaporator data
- Condenser data
- Subcooler data
- Oil pump pressures
- Motor Load
- General system data and data trending

The system setpoints are operator entered and include:

- Local Chilled liquid temperature setpoint
- Remote setpoint temperature
- Percent load limit
- Clock

Additional modifications may be made to system PID tuning. All data and control features are accessible from the operator interface display. The system is also accessible across an Ethernet LAN through a standard web browser.

SYSTEM ARCHITECTURE

The Quantum™ LX control panel contains all of the necessary control hardware and software within one self contained enclosure, and is mounted to the chiller package. The front of this control enclosure contains a graphic display and keypad, to allow the operator to access various system information and to make necessary adjustments to setpoints, calibrations and features.

Operator access to this system is through various screens. A screen is the physical representation of data on the display. Each screen has a title area. The title is descriptive of the screen. The current date and time is shown as well as the day of the week, Sunday (Sun.) through Saturday (Sat.) is displayed in the title area. The month of the year from January (Jan.) to December (Dec.) is displayed. The day of the month from 1 to 31 and the year from 0001 to 9999 is displayed. Time is displayed in military 24 hours format. The hours, minutes and seconds.

Some screens are for informational purposes only, and cannot be modified. These screens typically show analog values such as temperature and pressure, which are strictly functions of an associated sensor, and as such, cannot be modified. Other screens show setpoint values which can be changed, in order modify the units operating characteristics. For easier viewing, related information is separated into boxes. Sometimes selections are hidden when that the feature is unavailable.

Quantum™ LX control system consists of five major areas:

- **Quantum™ LX Controller** – The Quantum™ LX runs a software program that communicates with all of the digital and analog boards. This communication allows the Quantum™ LX to read the status of all the I/O boards, and display the data on the interface screen. The Quantum™ LX acts on this data, and provides the necessary control information to the I/O boards to provide the appropriate control of all input and output signals, based upon the configuration of installed features and options of the compressor package.
- Operator interaction is provided through the keypad, as well as informational status to the display. Interaction to the outside world is provided

through industry-standard communications protocols. Additional information about the Quantum™ LX can be found under the QUANTUM™ LX CONTROLLER section in this manual.

- **Power Supply** – Provides the necessary operating voltages for the proper operation of all control components. Additional information about the power supply can be found under the POWER SUPPLY section in this manual.

The DC power/communications harness in this panel is color-coded to make wire identification easier. The color coding is as follows:

- +5VDC - Red
- +12VDC - Yellow
- +24VDC – Dark Blue
- -12VDC - Violet
- Common/Ground - Black
- +RX/TX – White with Red
- -RX/TX – White w/ Black stripe
- **Digital Input / Output Boards** – Digital (on/off) signals are sent and received by these boards. The output signals are used for energizing solenoids, valves, contactors, relays, etc., and the input signals are used to sense the condition of switches, relay contacts, auxiliary contacts, etc. This board runs an independent software program from the Quantum™ LX to control devices, and communicates the status of all devices back to the Quantum™ LX. Additional information about the Digital Boards can be found under the DIGITAL BOARD section in this manual.
- **Analog Input / Output Boards** – Analog (variable) signals are sent and received by these boards. The output signals are used for controlling damper motors, modulated valves, etc., and the input signals are used to read the values being sent from pressure transducers, temperature sensors, etc. This board runs an independent software program from the Quantum™ LX to control devices, and communicates the status of all devices back to the Quantum™ LX. The analog board has 24 analog inputs and 8 analog outputs.
- **Operator Interface** – This section actually consists of two major components; the display and the keypad. The display is used to show the operator, via a graphical interface, the actual status of all

compressor values. Warnings and shutdowns (and history/trending), pressure and temperature values, digital I/O status, setpoints, etc. are viewed from this display. The Keypad is used by the operator to enter data such as setpoint values, calibration data, etc. into the Quantum™ LX controller. Additional information about the display can be found under the DISPLAY section in this manual.

Quantum™ LX Controller Board

Troubleshooting the Quantum™ LX Control Panel

This section contains information on troubleshooting and making corrections to the boards and control circuits of the Quantum™ LX.

General Information

The components within the control panel are sensitive and can be damaged by static electricity or mishandling. Only qualified technicians should directly handle these components.

- DO NOT attempt to make corrections to the power supply without shutting off the power to the control panel. Accidental shorts can irreparably damage the processor boards or the display screen.
- DO NOT handle the panel boards when the cables are disconnected without first attaching a properly grounded wrist ground strap to your body that will prevent static electrical discharge. Most problems encountered with the microprocessor and control circuits will be the result of a wiring fault, a blown fuse, faulty I/O module or failure of a peripheral control such as a solenoid coil or a pressure transducer.

Faults in the computer, while possible, are unlikely. If a fault develops in the computer, the probability is that all functions will cease and the display screen will go blank.

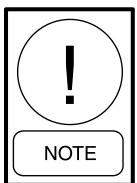
The control system of the compressor consists of an AC (high voltage) side, which is 120 volts, and a DC (low voltage) side. The AC side actuates solenoids, relays, alarms, and other electromechanical functions. The DC side operates the computer and its various sensors.



When working within the panel, the AC high voltage side, which is nominal 120 VAC and CAN CAUSE INJURY OR DEATH.

To troubleshoot the low-voltage side of the control circuits, it is necessary to have the following tools:

1. Accurate digital multimeter (capable of reading to DC/AC, mA to the hundreds place).
2. Small wire stripper.
3. Small screwdriver (with insulated shaft).
4. Small snip nose pliers.
5. Wrist Grounding strap.
6. Static free grounded work surface.



Proper panel voltage refers to the AC (high voltage) that has been supplied to the panel, which could be either nominal 120 VAC (Reference the Control Panel Power Specifications).

Some problems that are encountered involve troubleshooting the digital inputs and outputs. The Digital I/O (Input/Output) boards have six Digital I/O (DIO) board connectors labeled P1 through P6. The input and output modules are wired into a DIO connector plug. Position 3 provides power and position 4 is a neutral on the DIO connectors.

What To Do Before Calling for Service

Before calling for service, review the information on the following pages and try to discover and resolve the Quantum™ LX problem. The actual cause of most problems is usually not with the Quantum™ LX itself, but with something external to the panel. However, on the rare occasion that the problem has been identified as being the Quantum™ LX controller, use the following section as a guideline for servicing the panel. A blank screen could be the result of many different problems. Following is a list of possible reasons for no display:

- No power
- Loose or Faulty Display Cable or Inverter Cable
- Bad Display
- Bad Backlight Inverter

- Bad Backlight Fluorescent Tube
- Wrong Combination of Display, Cable, Inverter, or Software
- Faulty CPU Board

Replacing the Quantum™ LX Controller Board

Flash Card memory load is done prior to the board being shipped. The customer needs to have their settings manually recorded, or saved to a Flash Card, so that the new board can be setup the same as the old one. It is suggested that the operator first record all control setpoints prior to board replacement. Factory Setup settings will also be lost. The Setpoint Data sheets later in this manual are useful for recording this information. A Maintenance Flashcard may also be purchased that will allow these setpoints to be saved electronically, and may be downloaded at a later time (Refer to the Renewal Parts Manual).

The procedure to replace the Quantum™ LX is outlined below:

1. Shut off control power.
2. Remove the old board from the machine and the new board from its packing and place both on an anti-static surface.
3. Ensure that the jumpers on the new board are set the same as those on the old board.
4. Install the flash card from the old board to the replacement board.
5. Install the modified replacement board into the panel.
6. If program changes are necessary through the USB port download, then follow the directions in the Software Maintenance section of this manual for the procedure to reload a program.
7. Power the panel up, and set the date and time.

What Should Occur When Applying Power

When powering up the Quantum™ LX, the following sequence of events are indicative of a properly working main processor board:

- There are LED's on the main Quantum™ LX for CYK controller board.
- PWR (Power) LED will turn on solid on the Keypad Interface Board. This should be an indication that the board has received power.

- The ACT (Active) LED will blink on the Keypad Interface Board.
- The boot sequence will show the CMOS boot information briefly on the display.
- Once the board begins to boot the operating system “TUX” penguin icons will appear briefly in the top left corner.
- The HOME screen will appear on the display once the control application has started.
- The RX/TX lights of the Analog and Digital boards will also flash.

After the Quantum™ LX has properly powered up, the following sequence of events is indicative of proper communication to the analog and digital boards:

- The TX/RX LED's near the white connector will begin to blink.
- The Analog and Digital I/O boards TX/RX lights should be blinking.
- Each I/O board should have the power LED (next to the white connector) lighted and the active LED (next to the blue Dipswitch) should be blinking.

What If The CYK “Home” Status Screen Is Not Shown

If the Operating Status screen is not shown, check the following items:

1. If no LED's on the Keypad Interface board are lit, then check AC and DC power with a Multimeter.
2. Check if the lighting of the LED's is occurring as described in the What Should Occur When Applying Powering section. If the powering up sequence continues to repeat without displaying the HOME status screen, then there is a booting problem.
3. Check if an error message is displayed when booting. Be sure to write down any error messages exactly as they appear.
4. Check that the software is OK:
 - Is the correct software installed?
 - Did you just install new software?
 - If you need to clear the numerical setpoint and calibration areas of memory for any reason, clear the memory as described in the Software Maintenance section of this manual.

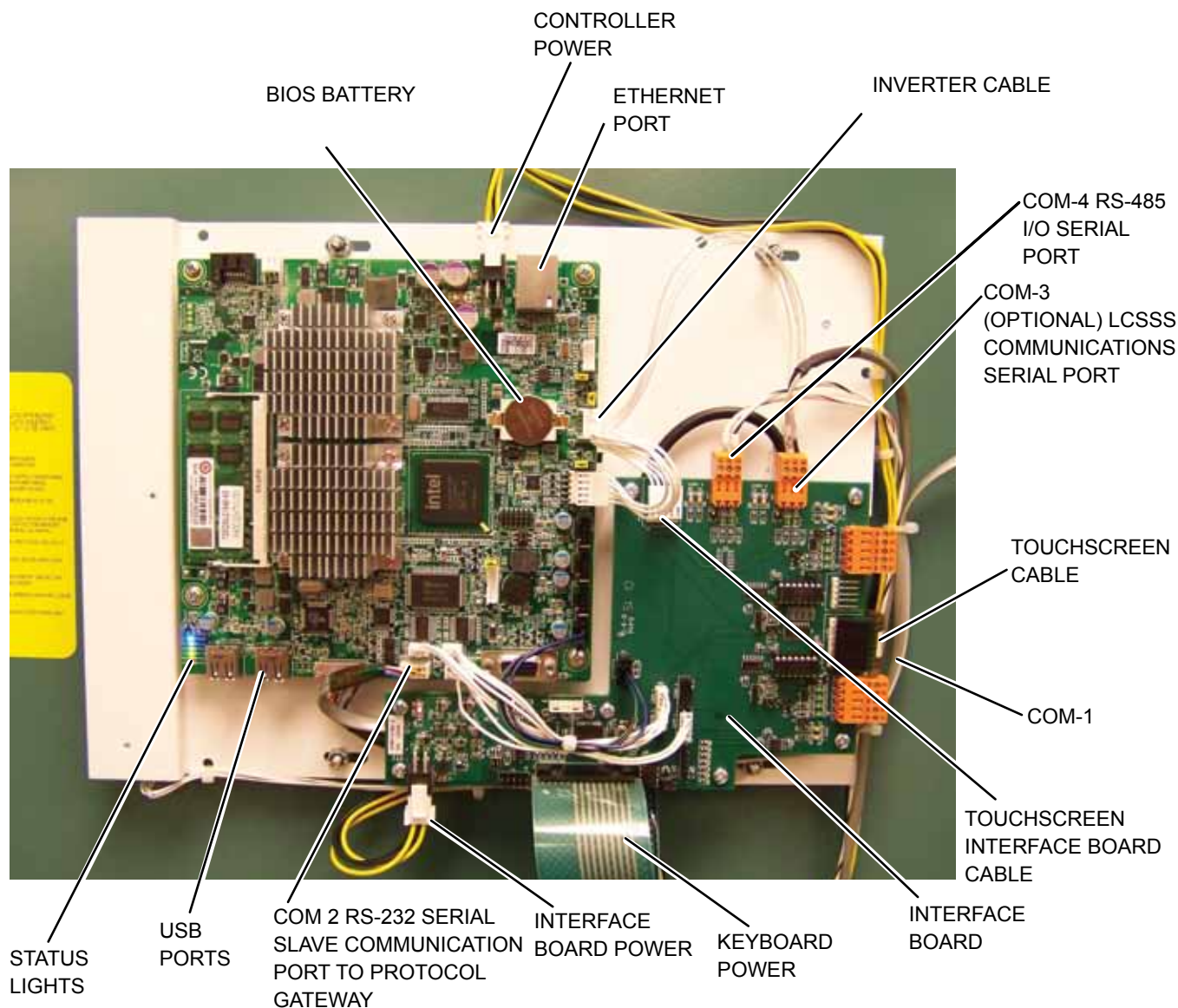
- NOTE: This information will be replaced by factory default values, so any setpoint and calibration data values that need to be customized must be reentered.

5. Check for bad connections.

6. Check the display. If the CPU board is booting but you have no display, check the following:

- Check the LCD backlight tube. Look very closely at the display to see if anything is visible in the dark screen. Using a beam type source of good lighting, such as a flashlight, look for any ghost type image. If it appears that there is something on the screen but very dark, the problem maybe with the LCD backlight tube. On the LG Philips, NEC and Sharp displays this tube is field replaceable. On the Samsung LCD display it is not available and the display will have to be replaced. There may be a sticker on the display mounting plate. If there is, it will have a part number that describes the type of display. If there is no sticker, you must take the display apart to identify the display manufacturer.
- Verify that both the display cable and the inverter cable are firmly seated.
- These cables both originate from the same connector on the Quantum™ LX. It may be necessary to remove the video cable from the back of the LCD display and reseal it to be sure it is connected properly.
- NOTE: This is a small connector and caution should be observed so that it is not damaged due to excessive force.

Refer to the Display Assembly Component Replacement Guide at the end of this section, and check that the LCD, LCD cable, and software versions are matched correctly.



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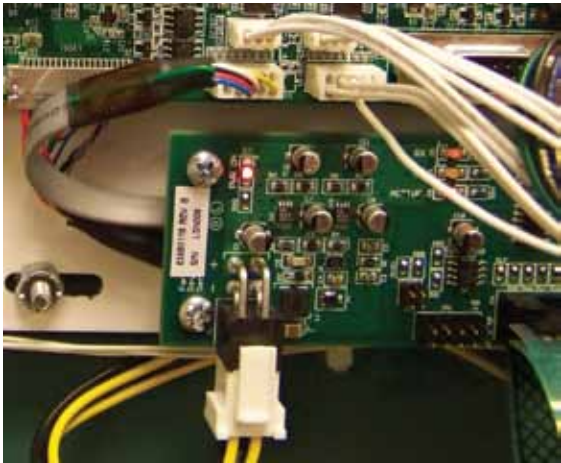
FIGURE 1 - MAIN CONTROLLER BOARD AND PERIPHERALS

Set the Quantum™ LX 5 board jumpers as follows



FIGURE 2 - QUANTUM™ LX JUMPER SETTINGS

LD15321



LD15322

FIGURE 3 - QUANTUM™ LX 5 MOTHERBOARD POWER CONNECTOR PINOUT

Power Supply

The power supply used in the Quantum™ LX control panel is shown in Figure 4. This power supply provides the following DC voltages:

Voltage #1 = +5 VDC (adjustable)

Voltage #2 = +24 VDC (adjustable)

Voltage #3 = +12 VDC (adjustable)

Voltage #4 = -12 VDC (not adjustable)

Of these four voltages, only the +5, +24, +12 VDC may be adjusted. Refer to the following page for the location of this potentiometer adjustment.

CONDOR MODEL GLD140D PINOUT

INPUT: J1

MOLEX P.C.B. HEADER P/N 39-30-2056

PIN 1) AC GROUND

PIN 2) N/C

PIN 3) AC NEUTRAL

PIN 4) N/C

PIN 5) AC LINE

MATING CONNECTOR MOLEX P/N:

HOUSING 39-01-4051, CONTACT 39-00-0164

SIGNALS: J2

AMP P.C.B. HEADER P/N: 641215-6

PIN 1) +SENSE

PIN 2) -SENSE

PIN 3) POWER FAIL

PIN 4) POWER GOOD

PIN 5) COMMON

PIN 6) INHIBIT

MATING CONNECTOR AMP P/N:

HOUSING 770602-6, CONTACT 770666-2

Voltage Adjustment Potentiometers:

V1 = + 5 Volts

V2 = + 24 Volts

V3 = + 12 Volts

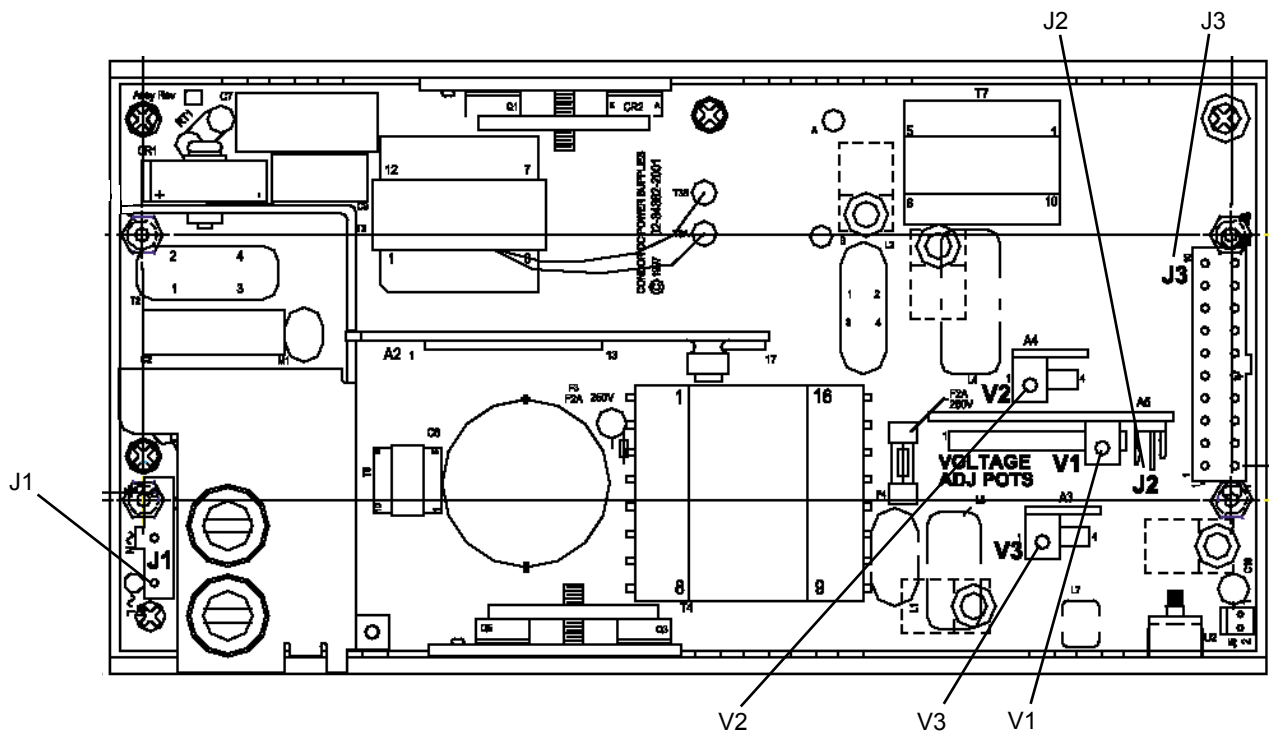


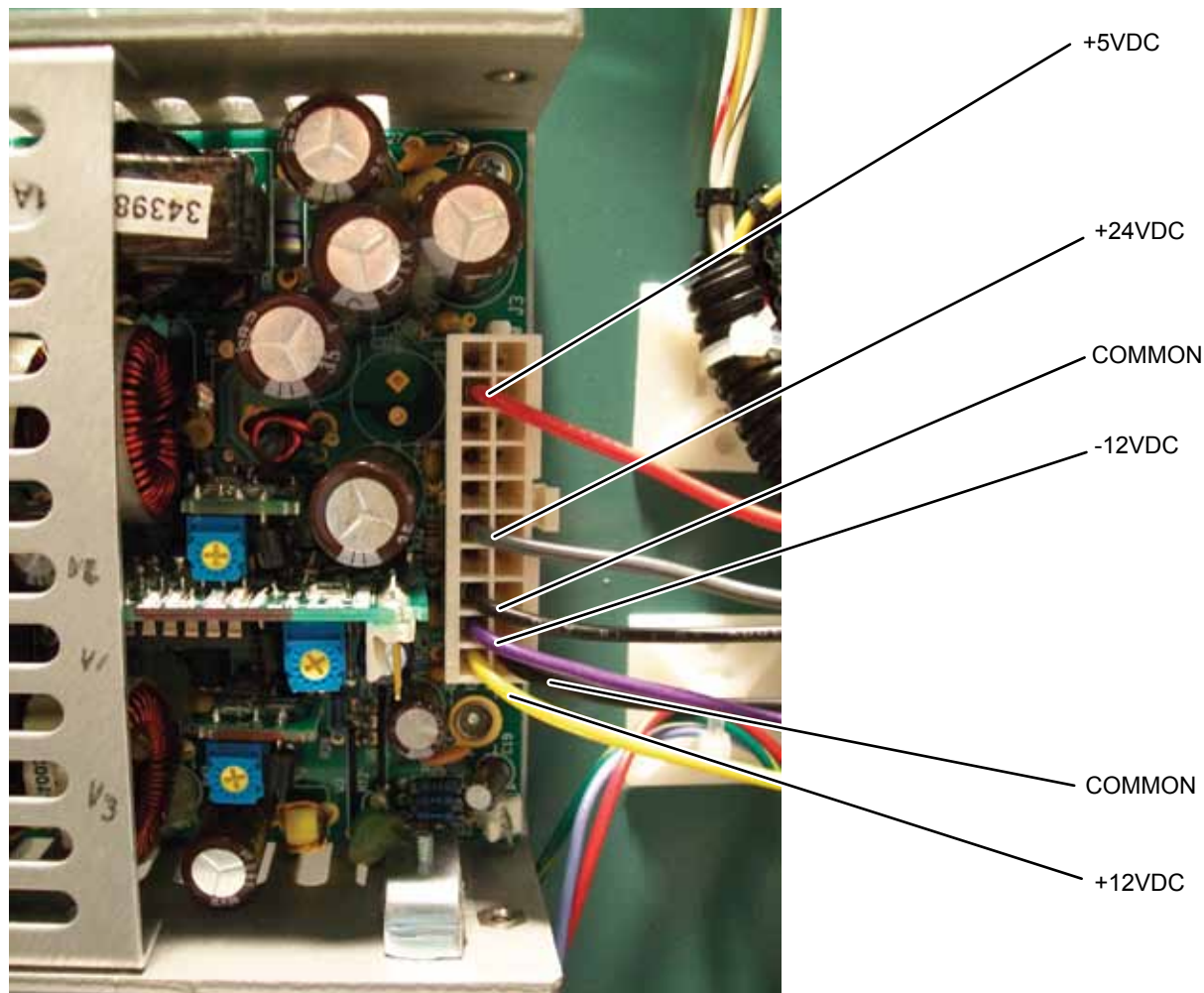
FIGURE 4 - POWER SUPPLY PINOUT

Power Supply Verification

All circuit boards within the Quantum™ LX control panel require accurately adjusted DC voltages in order to function properly. These voltages consist of +5 VDC, -12 VDC, +12 VDC and +24 VDC. Periodic measurement and adjustment of the DC power system is highly recommended for optimum system operation. Over time, it is possible for temperature, humidity, vibration and component age, to decrease the accuracy of these voltages. If any of the DC voltage levels are too far from their optimum range (especially +5 VDC), problems can occur.

All four DC voltages originate from the power supply. They are then daisy chained to the Quantum™ LX controller, and then on to all connected Digital and Analog boards. Refer to the Wiring Diagrams for the Quantum™ LX. Even with a perfectly adjusted supply, it is possible for a potential drop in voltage at each connection point within the daisychain. This drop normally is in the mill-volt range, but under some conditions, the drop can be much greater (as high as tenths of a volt). By the time the voltage reaches the last board in the daisy chain, and all of these potential voltages drops are considered, the combined drop can be such that serious problems can be apparent. Some examples of serious problems could be:

OUTPUT: J3
MOLEX P.C.B. HEADER P/N: 39-29-9206



MATING CONNECTOR MOLEX P/N:
HOUSING 39-01-2200, CONTACT 39-00-0164

LD15225

FIGURE 5 - OUTPUT: J3

Loss of or intermittent communications failures.

- A shutdown message stating Digital Board x Reset (where “x” is replaced by the number of the Digital Board that failed)
- An shutdown message stating Digital Board x Comm. Fail - Shutdown (where “x” is replaced by the number of the Digital Board that failed)
- An shutdown message stating Analog Board x Comm. Fail - Shutdown (where “x” is replaced by the number of the Analog Board that failed)
- Numerous sensor fault shutdown messages.
- Quantum™ LX reboots for no apparent reason.
- Improper readings of analog pressures and temperatures.
- LED's on the Quantum™ LX are lit, but nothing appears on the display.

In order to properly measure the DC power, it must be checked at the 1001 Terminal Block, and verified for acceptable total voltage drop at the end of the daisy chain (last I/O board). For the +5 VDC, if the voltage at the 1001 terminal block is in the range of +5.15 to +5.20), and the voltage being read at the last I/O board is greater than +5.0 V, it can be assumed that the +5 V power is correctly adjusted. For the +12 VDC, if the range at the last I/O board is between +11.8 and +12.2 VDC (+12.00 is ideal), it can be assumed that the +12 V power is correct. The range for this voltage is not critical at the Quantum™ LX, and the reading does not need to be taken there.



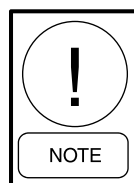
Measuring and adjusting the power supply voltages require the control power switch to be energized. Extreme care must be observed when taking any readings, as 120 volts is present within the power supply. Adjusting the supply requires the use of a small screwdriver with an insulated shaft inserted into the supply to access an adjusting potentiometer. It is possible for the screwdriver (and the person making the adjustment) to come into contact with potentially lethal voltages, so care must be taken.

Adjustment

To perform measurements and adjustments on the power supply voltages, use a reliable, calibrated Digital Volt Meter (DVM). The DVM should be accurate to 1/100 of a volt DC. With the control power switch

turned ON, wait until the Home Screen appears. This is because the graphics required to create this screen will draw more current than when the screen is showing the normal POST style messages during a boot up. If the screen never appears however (possibly due to a voltage problem), you will need to proceed regardless of what is or is not displayed.

Ensure that the meter is set to the proper range (DC, 0-50 V or equivalent), as well as observing proper wire polarity. Measure the +5 VDC first. Place the negative lead on the common (return) pin, and the positive lead on the +5 VDC pin as shown. Verify that the DVM is displaying in the range of +5.15 to +5.20. If the reading is outside of this range, then using a thin, flat bladed, insulated screwdriver, insert the tip into the access hole for the appropriate voltage potentiometer V1 (refer to the Condor model GLD140D pinout).



Extreme care must be used when adjusting the +5 VDC potentiometer. Adjustment should only be performed by qualified personnel, using an insulated screwdriver.

While watching the DVM, slowly rotate the screwdriver blade clockwise to increase the voltage or counter-clockwise to decrease. Once the voltage has been adjusted, remove the DVM probes from the Quantum™ LX, and install them into the white connector on the last I/O board in the daisy chain. Check the reading on the DVM at this last connector. If the reading at the Quantum™ LX has been adjusted properly, then this reading can be no lower than +5.0 DC. If the voltage is less, check all of the daisy chain connections on the DC-I/O harness. Ensure that all of its connectors are tight. If all connections are good, then go back and start measuring over again, this time beginning at the first board in the daisy chain. Continue checking the voltage at each connection, until you locate the point at which the voltage drop is excessive. This will usually indicate a connection that is not being made properly, or the sockets within the connector are weak. In either case, the DC-I/O wire harness may need replacing.

Next, you will want to measure the +12 VDC. Perform the same steps as with the +5 VDC measurement, with the exception that you will not need to measure at the Quantum™ LX. Measure directly at the last connection. If the voltage is low, ensure that there is not an excessive voltage drop in the daisy chain. If the voltage is out of range, then the supply itself may need replaced.

The -12 VDC may be measured the same as the other voltages, however, this voltage is not adjustable on any supply, so if the harness is not the culprit, the supply may need to be replaced.

Replacement

If the power supply is found to be bad, or not capable of acceptable adjustment, it will need replacing. Refer to the Renewal Parts manual document for the part number.

Digital Board

The information that follows in this section can help locate problems that may occur with Digital Input and Output circuit boards, and their interaction with the Quantum™ LX controller.

Digital Board Description

The Digital Board is actually a small microprocessor board and programmed to control discrete outputs, or accept discrete inputs, from external electrical devices. Each Digital Board has the capability of 24 independent channels or I/O (Input/Output). These I/O channels are dedicated as to their function, through the operating system (software), enabled options and external wiring. Each channel that is used by the software will have a module plugged into it. A yellow module indicates that it is used for Inputs. A black module is used for Outputs. A white module is for 24VDC inputs channels. The standard Quantum™ LX for CYK will have two Digital Boards.

Communications LED's

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

Reference the JUMPER AND DIPSWITCH SETTINGS section later in this manual. This section contains the dipswitch settings for addressing the Digital I/O Boards. When these switches are properly set, the

Quantum™ LX is able to serially communicate with each I/O board and provide control signals and data exchange. If these switches are not properly set, the result will be lost or failed communications, the wrong outputs being energized, or the wrong inputs being received.

Connections to the Quantum™ LX

As stated earlier, the Quantum™ LX for CYK control system utilizes two Digital, and two Analog Boards. (A third Analog board is optional for motor temperature or vibration monitoring.) To connect all of these boards together so that the Quantum™ LX can control them, they must be interconnected with a wiring harness that provides all of the necessary D.C. voltage requirements, as well as the communications capabilities. Two different harnesses have been used and a diagram of each of these wiring harnesses can be found later in this manual (see the Power I/O Wiring Harness drawings). Depending on the type of panel, the following harness will be used:

The wires that are inserted into the positions of one row are internally daisy chained on each I/O board, to continue the voltages and signals to the adjacent row. Therefore, any time that a connector is unplugged from the daisy chain, these voltages and signals cannot continue through the daisy chain to the next board. Whenever a plug is not to be inserted into a board, either for service or if not all boards are present, then a shunting plug (refer to Recommended Spare Parts list) must be installed onto the open connector. The four wires that feed from the power supply to the Quantum™ LX provide all of the necessary D.C. voltage that is required (+5 VDC, -12 VDC, +12 VDC, and Return or Common). The voltages are passed through the connector on the Quantum™ LX, and two new signals are generated by the Quantum™ LX to be passed on through the daisy chain to the I/O boards. These two signals are the RX (receive) and TX (transmit). These signals are the means by which the Quantum™ LX communicates to the I/O.

The Digital Boards only require the +5 VDC voltage and the Return (or common) for logic power. The communications signals (RX and TX) are required by all boards.

Logic Voltage (Power) LED

Located on the Digital Board is a Power LED. This LED will be illuminated as long as the Control Power switch is ON, and the proper voltage is present at the Quantum™ LX power supply. The power supply generates the +5 VDC voltage and passes it on through the Power-I/O harness. This LED does not indicate however that the proper voltage is necessarily present at the board, only that the voltage is enough to energize the voltage sensing circuitry. If a voltage related problem is suspected with regard to a Digital Board, the only way to actually determine this is to read the voltage on a Digital Voltage Meter (DVM). This may be accomplished by locating the white power / communications connector on the board. Notice that the Digital Board has one of these connectors on both ends of the board. The associated power/communications harness will only be plugged into one of these connectors. Take the red (positive) probe of the DVM and carefully insert the end into the “+5V” lead, and the black (negative) probe end into the “RET” (Return or Common) lead, as shown in the previous section.

Set the DVM to read DC, and set the proper range. The voltage reading must read a minimum of +5.0 VDC. The Power-I/O harness will have an associated voltage drop at each board connection. As an example, if you are reading the voltage at the first I/O board in the daisy chain, and it reads 4.98 VDC, you can be assured that the voltage at the subsequent connections for the remaining boards will be lower yet. The voltage will need to be corrected for proper operation of the system. The cause for a low voltage reading could be:

- The Quantum™ LX power supply may need adjustment (see the section on power supplies).
- The Power-I/O communications harness has a problem (a new harness may be needed).
- A problem may exist with one of the I/O boards (Digital or Analog).
- If the power LED is not lighted, check the cable for proper connectivity. Note: Each board provides the necessary connections to feed all signals to the following connectors. If the auxiliary Analog board is not installed, then a jumper plug (see Renewal Parts List) must be installed to daisy chain the signals.

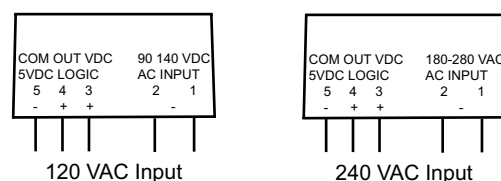
The most common problem that is due to a low +5 VDC voltage to the Digital Boards is an alarm message that reads Digital Board Reset Shutdown.

Active LED

The Digital Boards have an Active LED indicator on the board that blinks when the board's software is running. The activity LED indicators are labeled TX and RX. If the Active LED's are not blinking, check to ensure that the EPROM is installed properly. The EPROM is located in chip slot U8, next to the power connector.

Digital Inputs

A Digital Input is the portion of the hardware that allows devices such as limit switches, relay contacts, and level switches, to interface with the Quantum™ LX. The software program within the Quantum™ LX is constantly looking at these Input channels, via communications, and based upon whether a control voltage is present or not, will provide the necessary control for an associated Output channel. For instance, if a control voltage is present on the Oil Level Sensor input, the software will determine that the Separator has sufficient oil level for the oil heaters to be energized (if the temperature of the oil is also sensed to be low. Temperature sensing will be discussed in the Analog Input section). There are two possible varieties of Digital Input modules used on Frick standard control packages, however the CYK system only uses 120 VAC modules. Both of these module styles for 240 VAC and 120 VAC are yellow in color. Be certain that you have the correct module for 120 VAC. A side profile of these modules is shown below:



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FIGURE 6 - DIGITAL INPUT MODULES

These Input modules, can be identified as to their operating voltage by looking at either the side, as shown above, or from the top. You will notice the module operating voltage printed on the top, and the voltage range printed on the side.

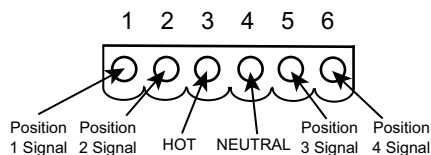
Never plug a 120 Volt Input module into a 240 Volt system, and vice-versa. Never plug an Output module into a position designated for an Input module. You will notice that when a module is plugged into the Digital board, there is a fuse located directly adjacent to the module. This fuse is of the pluggable variety, and must be plugged into the IN position for an Input module.

Digital Outputs

A Digital Output is the portion of the hardware that the Quantum™ LX is to control (energize). These devices include solenoids, relay coils, and heaters to be energized, based upon the logic within the Quantum™ LX software program. There is one variety of Digital Output modules used on standard compressor control packages. This module is black in color. A side profile of this module is shown below: Although this Output module is labeled as 280 VAC on the top, and on the side, it can be used on both 120 and 240 volt applications. Never plug an Input module into a position designated for an Output module. You will notice that when a module is plugged into the Digital Board, there is a fuse located directly adjacent to the module. This fuse is of the pluggable variety, and must be plugged into the OUT position for an Output module.

Checking The Digital Inputs and Outputs

Some problems that may be encountered involve troubleshooting the digital inputs and outputs. The Digital I/O (Input / Output) Boards have six Digital I/O (DIO) board connectors labeled P1 through P6. The Input and Output modules are wired to a DIO connector plug. Position 3 provides power and position 4 is a neutral on the DIO connectors. Positions 1, 2, 5, and 6 are signal connections, as shown below:



LD15227

FIGURE 7 - DIO CONNECTOR PLUG

The Digital I/O board's I/O modules are configured by proper module selection, AC or DC, operating voltage, input or output, and moving the fuse to the in or out position. The CYK I/O boards will be configured properly, refer to the Renewal Parts manual for details. An LED is associated with each module and displays the state of each module. A lit LED represents an Input that is High, receiving a signal or an Output that is On. Each of the sixteen modules has a corresponding display value shown on the I/O diagnostics screen. If a properly configured Digital I/O is not responding correctly, first look at the Digital Board on the "Setup Screen >> Digital I/O" and check if the module is on. If it is not on, check if the LED on the Digital Board is also not lit. If the LED is not lit, then check the fuse. If the fuse is OK, then check the module.

Fuse Testing and Replacement

1. Power off the panel.
2. Open the panel door.
3. Remove the questionable fuse.
4. Place the questionable fuse into the fuse tester at the one end of each Digital I/O Board refer to the Digital Board drawings at the end of this section for exact fuse tester location).
5. Power on the panel.
6. Check the LED on the tester. If the LED is lit, the fuse is OK.
7. Power off the panel.
8. If the fuse is faulty, check for external shorts on the corresponding circuit, the replace the fuse with a new plug-type fuse (refer to Recommended Spare Parts list).

Input and Output Module Testing and Replacement

1. Power off the panel.
2. Open the panel door.
3. Replace the questionable module.
4. Power on the panel.
5. If it is an Output module, check for proper panel voltage on the DIO connector plug. Check the voltage between position 4 (neutral) and the associated position to the Output module.
6. If it is an Input module, check if the associated LED is on when power is applied to the module.

Troubleshooting an Output

1. Make sure the LED associated with the Output is on when power is applied to the module.
2. If the LED is on when it should be, check for proper panel voltage on the DIO connector plug. Check the voltage between the position 4 (neutral) and the associated position to the
3. Output module.
4. If the voltage is OK, check for proper panel voltage between the associated position to the
5. Output module on the DIO connector and the associated position on the terminal strip.

6. If the voltage is OK, check the wiring external to the panel.
7. If voltage is not OK, check the fuse.
8. If the fuse is OK then check the module.
9. If the module is OK, check for proper panel voltage on the DIO connector plug between position 3 (Hot) and position 4 (neutral).
10. If the LED is not on when it should be and there is no operating condition preventing it, contact the Service Department.

Troubleshooting an Input

1. Make sure the LED associated with the Input is on when power is applied to the module.
2. If the LED is on then the fuse and Input module are good.
3. If the LED is on and there is no input voltage, replace the Input module.
4. If the LED is not on when power is applied, check the fuse.

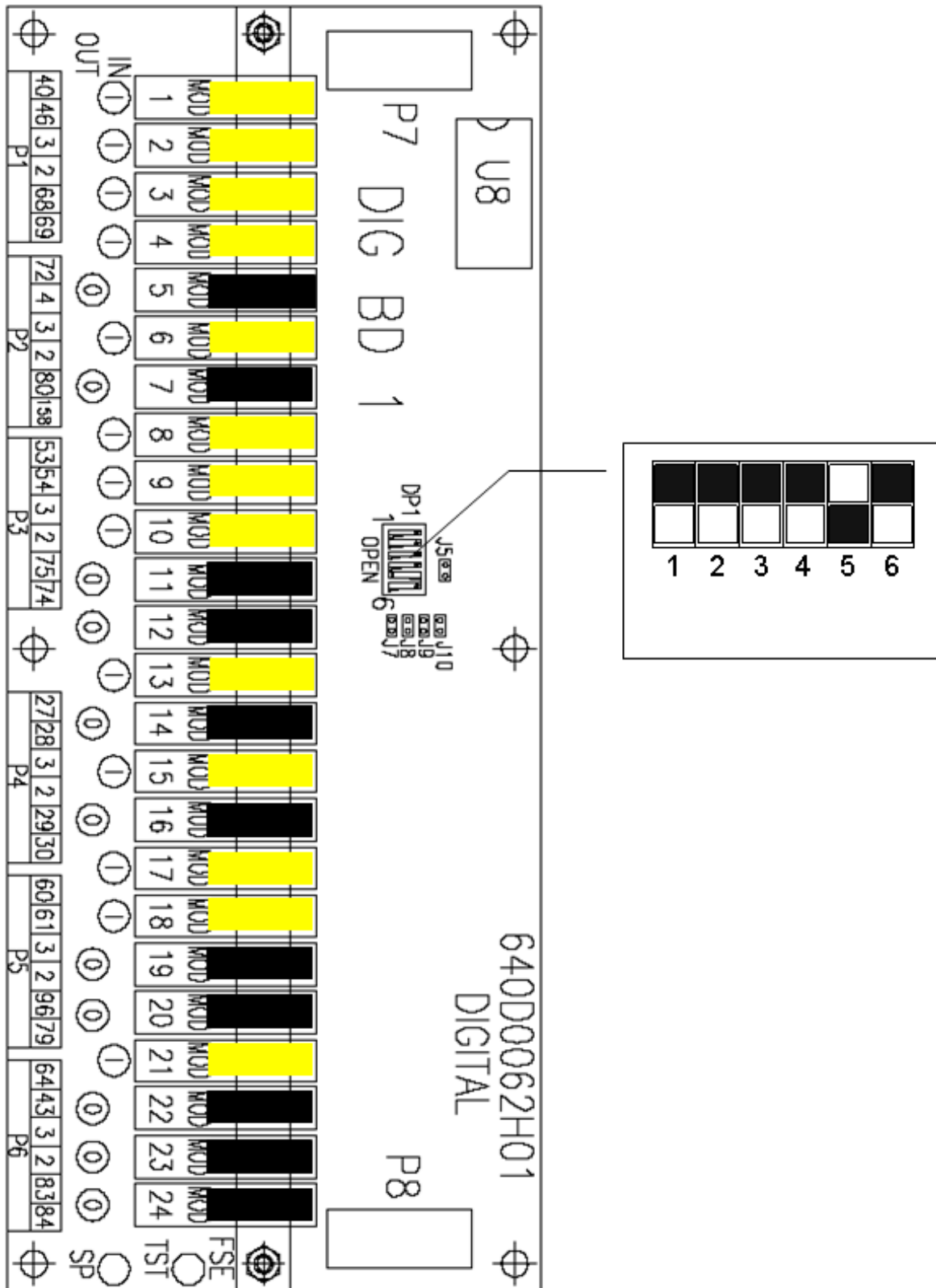
5. If the fuse is good, replace the Input module.
6. If you are receiving an Alarm or Shutdown from a digital input in which the adjacent LED indicator light is on, check the Service Screen to see if that channel is turning on and off. If so, replace the input module.

Replacing a Defective Digital Board

The procedure to replace a Digital board is outlined below:

1. Shut off control power.
2. Remove the old board from the machine and the new board from its packing and place both on an anti-static surface.
3. Check that all jumpers, dipswitches and components are properly setup on the new board as it was on the old board (refer to the Digital Settings tables near the end of this section).
4. Install the modified replacement board in the panel.

DIGITAL BOARD #1
INSTALL FUSES AND MODULES AS SHOWN
 Black = Output, Yellow=Input 120v, White=Input 24VDC



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FIGURE 8 - DIGITAL BOARD #1

DIGITAL BOARD #2
INSTALL FUSES AND MODULES AS SHOWN
Black = Output, Yellow=Input 120v, White=Input 24VDC

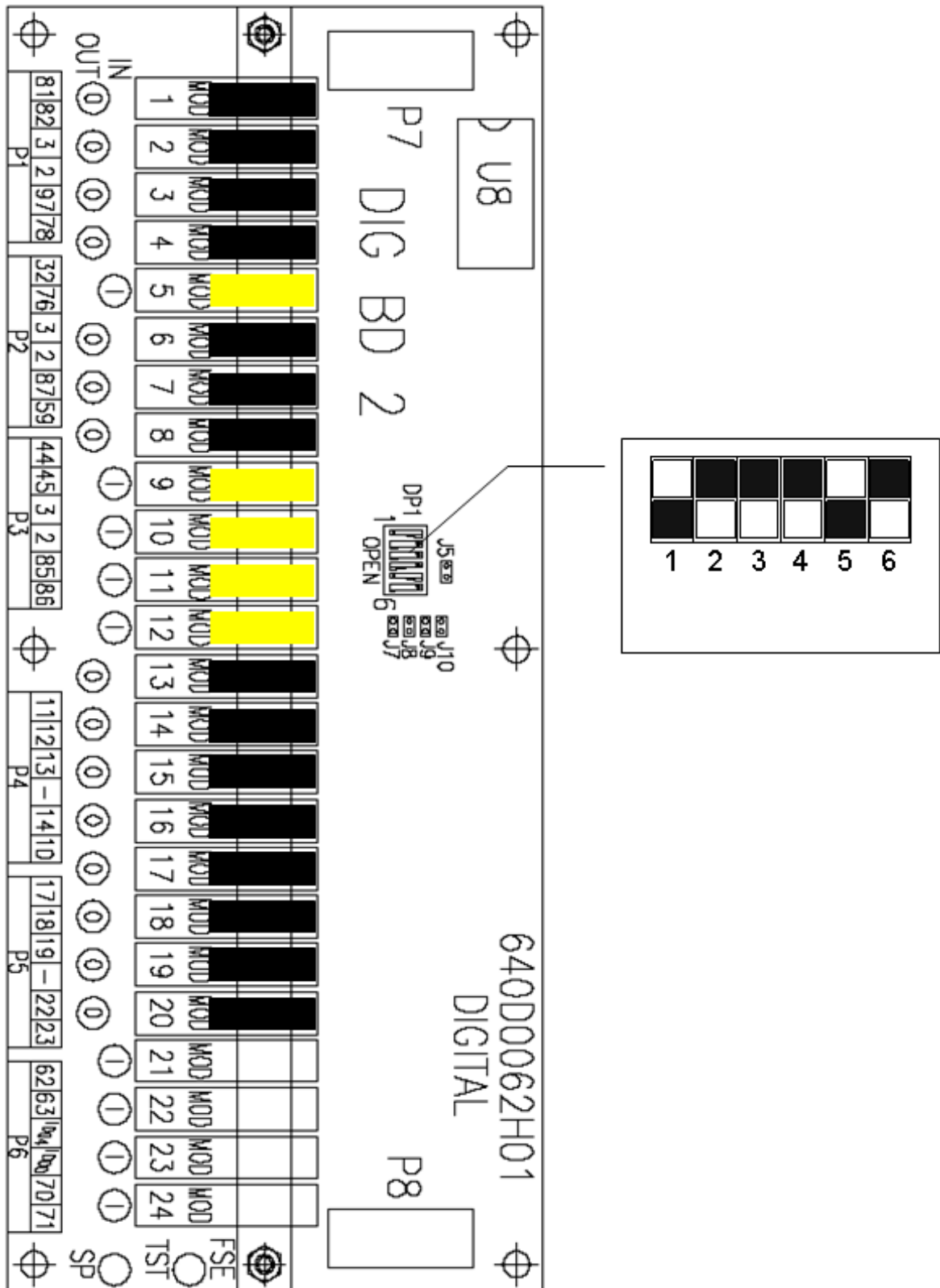


FIGURE 9 - DIGITAL BOARD #2

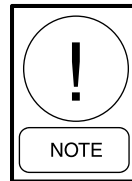
Analog Board

Overview

The Frick Quantum™ LX control panel is capable of reading external analog devices, such as temperature probes and pressure sensors. It uses these input signals for the purpose of monitoring and control. As an example, if an external temperature sensor began to read a higher than expected temperature in some area, the controller would sense this change, and provide the necessary output control signal to remedy the situation. Unlike a digital signal, which is typically either an on or off state, an analog signal can assume a wide variety of states, such as a temperatures probe reading a wide range of temperatures. The method used for receiving (and sending) these signals, is the analog board. The analog devices are wired directly to the board, and the on-board software/hardware converts the electrical signals received from these devices into data, which is then sent on to the Quantum™ LX control board via communications, and is monitored by the Operating system.

Analog Board Description (32 Channel)

The Analog Board is actually a small microprocessor board and is programmed to control analog outputs, or accept analog inputs, from external electrical devices. Each enhanced board has the capability of 24 independent input channels. With the Quantum™ LX CYK Control panel, these I/O channels are dedicated through the software and external wiring, as to the function of each channel. The Quantum™ LX controller can utilize up to three separate analog boards (Analog board #1, #2, and optionally #3), depending on the selected options.



The CYK application requires a specific level of firmware in the Analog I/O board. Only use the approved part number for Analog Board #2, which controls the PWM output control of the VS Oil Pump Drives. Only replace an Analog Board #2 that has a Firmware Version 2.52 or higher, refer to the Renewal Parts manual.

DIGITAL BOARD SETTINGS

TABLE 1 - COMMUNICATIONS SETTINGS

The following table is to be used when configuring the Quantum™ LX for external communications.

J5	in	120 ohm long communications line termination.
	out*	No termination.
J7	in	RS-422/485 transmit pull-up for long communications lines.
	out*	No pull-up.
J8	in	RS-422 transmit pull-up for long communications lines.
	out*	No pull-up.
J9	in	RS-422/485 receive pull-down for long communications lines.
	out*	No pull-down.
J10	in	RS-422 receive pull-down for long communications lines.
	out*	No pull-down.

* standard setting

TABLE 2 - DIPSWITCH SETTINGS

The following table is to be used to set the digital board addresses. If there is only one board installed, it should be set as board #1, if there are two boards they each need to be set according to the wiring diagrams.

	SW1	SW2	SW3	SW4	SW5	SW6
Board #1	on	on	on	on	off	on
Board #2	off	on	on	on	off	on

Communications LED's

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

Refer to the Analog I/O board setup later in this section. This section contains the dipswitch settings for addressing the Analog I/O Boards. When these switches are properly set, the Quantum™ LX is able to serially communicate with each I/O board and provide control signals and data exchange. If these switches are not properly set, the result can be one of the following:

- Lost or failed communications (displayed in the Communications Status box on the Home screen)
- The wrong analog input signals being received
- The wrong analog output signals being sent from the board.

Connections to the Quantum™ LX

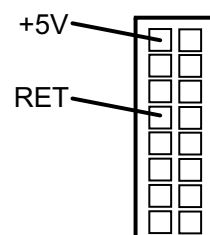
A copy of the chiller elementary wiring schematic is shipped with the CYK in a document pocket in the control panel (see the Chiller Elementary Schematic drawing). This harness has a 6-pin connector at one end that plugs into the Quantum™ LX. Another connector plugs into the power supply. The remaining four connectors (16 pin) will plug into each of the Digital and Analog Boards in the system (up to four total).

Upon close examination of this harness, you will notice that each of the connectors for both the Quantum™ LX and the four I/O boards, have two rows of connections. The wires that are inserted into the positions of one row are internally daisy chained on each I/O board, to continue the voltages and signals to the adjacent row. Therefore, any time that a connector is unplugged from the daisy chain, these voltages and signals cannot continue through to the next board. Whenever a plug is not to be inserted onto a board, either for servicing, or if not all boards are present because of the options that are present, then a shunting plug (refer to the Recommended Spare Parts list) must be installed onto the open connector. The four wires that feed from the power supply to the Quantum™ LX provide all of the necessary D.C. voltage that is required (+5 VDC, -12 VDC, +12 VDC, and Return or Common). The voltages are passed through the con-

nector on the Quantum™ LX, and two new signals are generated by the Quantum™ LX to be passed on through the daisy chain to the I/O boards. These two signals are the RX (receive) and TX (transmit). These signals are the means by which the Quantum™ LX communicates to the I/O. The Analog Board requires the +5 VDC for logic, the -12 VDC for internal voltage reference, and +12 VDC for external sensors (plus or +) and the Return (common or -). The communications signals (RX and TX) are required by all boards.

Logic Voltage (Power) LEDs

Located on the enhanced Analog Board are two power LEDs. The first of these is D1 LED (+5VDC), and will be illuminated as long as the Control Power switch is ON, and the proper voltage is present at Analog Board connector P3. The power supply generates the +5 VDC voltage, and passes it on through the Power-I/O harness. This LED does not indicate however that the proper voltage is necessarily present at the board, only that the voltage is enough to energize the voltage sensing circuitry. If a voltage related problem is suspected with regard to an Analog Board, the best way to actually determine this is to read the voltage on a DVM (Digital Volt Meter). This may be accomplished by locating the white power / communications connector on the board. Notice that the Analog Board has only one of these connectors. The associated power/communications harness plugs in to it. Take the red (positive) probe of the DVM and carefully insert the end into the +5V lead, and the black (negative) probe end into the RET (Return or Common) lead, as shown below:



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FIGURE 10 - LOGIC VOLTAGE LEDS

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

The cause for a low voltage reading could be:

- The Quantum™ LX power supply may need adjustment (see the section on power supplies).
- The Power-I/O communications harness has a problem (a new harness may be needed).
- A problem may exist with one of the I/O boards (Digital or Analog). If the power LED is not lighted, check the cable for proper connectivity. Note: Each board provides the necessary connections to feed all signals to the following connectors as in a “daisy-chain” network.

Active LED

The Analog Boards have an Active LED indicator that blinks when the board's software is running. If the Active LED is not blinking, it could be an indication that the internal program is not running. Try powering the Quantum™ LX controller off, then back on to see if the Active light starts blinking. If not, a new board may be required.

Analog Inputs

An Analog Input is the portion of the hardware that allows devices such as temperature sensors and pressure transducers to interface with the Quantum™ LX.

TABLE 3 - ENHANCED ANALOG BOARD INPUT CONFIGURATION TABLE

CHANNEL	ICTD	0-5VDC	0-10VDC	0-20MA	POT (POTENTIOMETER)	CT (MOTOR CURRENT)	ACCELEROMETER (VIBRATION MONITORING)	RTD (MOTOR PROTECTION ONLY)
1	*	*	*	*				*
2	*	*	*	*				*
3	*	*	*	*				*
4	*	*	*	*				*
5	*	*	*	*				*
6	*	*	*	*				*
7	*	*	*	*				*
8	*	*	*	*				*
9	*	*	*	*				*
10	*	*	*	*				*
11	*	*	*	*				*
12	*	*	*	*				*
13	*	*	*	*				*
14	*	*	*	*	*			
15	*	*	*	*	*			
16		*	*	*		*		
17	*	*	*	*			*	*
18	*	*	*	*			*	*
19	*	*	*	*			*	*
20	*	*	*	*			*	*
21	*	*	*	*			*	*
22	*	*	*	*			*	*
23	*	*	*	*			*	*
24	*	*	*	*			*	*

NOTE: Enhanced Analog Board 2 can utilize channels 17 through 24 for PhD if Analog Board 1 is of the old style. Refer to the section on Software Configuration for specific information on the procedure to set these channels.

The software program within the Quantum™ LX is constantly looking at these Input channels, via communications, and based upon what the voltage or current level of the channel is, will provide the necessary control for an associated action. (Digital Inputs are discussed in the Digital Input section).

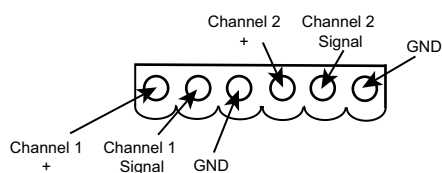
Analog inputs arrive at the board on connectors P4 through P10. Each of these connectors can receive two channels (for a total of twenty-four). Each of the twenty-four analog input channels is board software configurable to select for the following type of input signals:

Analog Outputs

An Analog Output is the portion of the hardware that the Quantum™ LX uses to provide control. With the Quantum™ LX, this output is dedicated for a 4-20 mA signal that is outputted to an external device, and cannot be changed through the software configuration.

Troubleshooting the Analog Inputs and Outputs

Some problems that are encountered involve troubleshooting the Analog inputs and outputs. The Analog Board has twelve Analog I/O board connectors labeled P4 through P10. The external Analog devices are wired to a connector plug. Position 1 connects to the plus (+) of the external device for channel 1, position 2 connects to the signal (SIG) of the external device for channel 1 and position 3 connects to ground (GND) of the external device for channel 1. Position 4 connects to the plus (+) of the external device for channel 2, position 5 connects to the signal (SIG) of the external device for channel 2 and position 6 connects to ground (GND) of the external device for channel 2, as shown below:



LD15229

FIGURE 11 - ANALOG OUTPUTS

Each input channel is configurable through the operating software. There are twenty-four analog input channels that can be selected for 4-20 mA, 0-5 VDC, 0-10 VDC, 0.5-4.5 VDC Ratiometric, ICTD, or RTD. Channel #16 will also take the 0-1 Amp motor CT as an input. Besides properly setting the software configuration, each channel is setup through software calibration for the proper transducer type and range, and each transducer must be calibrated through the appropriate

sensor calibration screen. These settings are all pre-programmed at the factory for the CYK Quantum™ LX control center. Improper setup of either the hardware or software will result in improper operation or range. The most common fault associated with the improper reading of the analog channels other than hardware or software setup problems fall into one of the following categories:

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

An open wire, shorted wire, or faulty sensor will usually give a reading at either the minimum or maximum end of the range scale. An erratic reading or a reading that seems to float up and down is usually indicative of a grounding problem. When a single transducer or cable is shorted to earth (or system) ground, this can show up as a whole assortment of problem channels. The easiest way to find a short to earth problem is to disconnect all the sensor plugs and ohm out each plug screw terminal to earth for open (infinite) impedance. All sensors should read open to earth with the exception of the CT motor current channel. One side of the CT is grounded in the Motor Terminal Box. (The third pin on pressure sensors is ground.)

Replacing a Defective Analog Board

The procedure to replace an Analog board is outlined below:

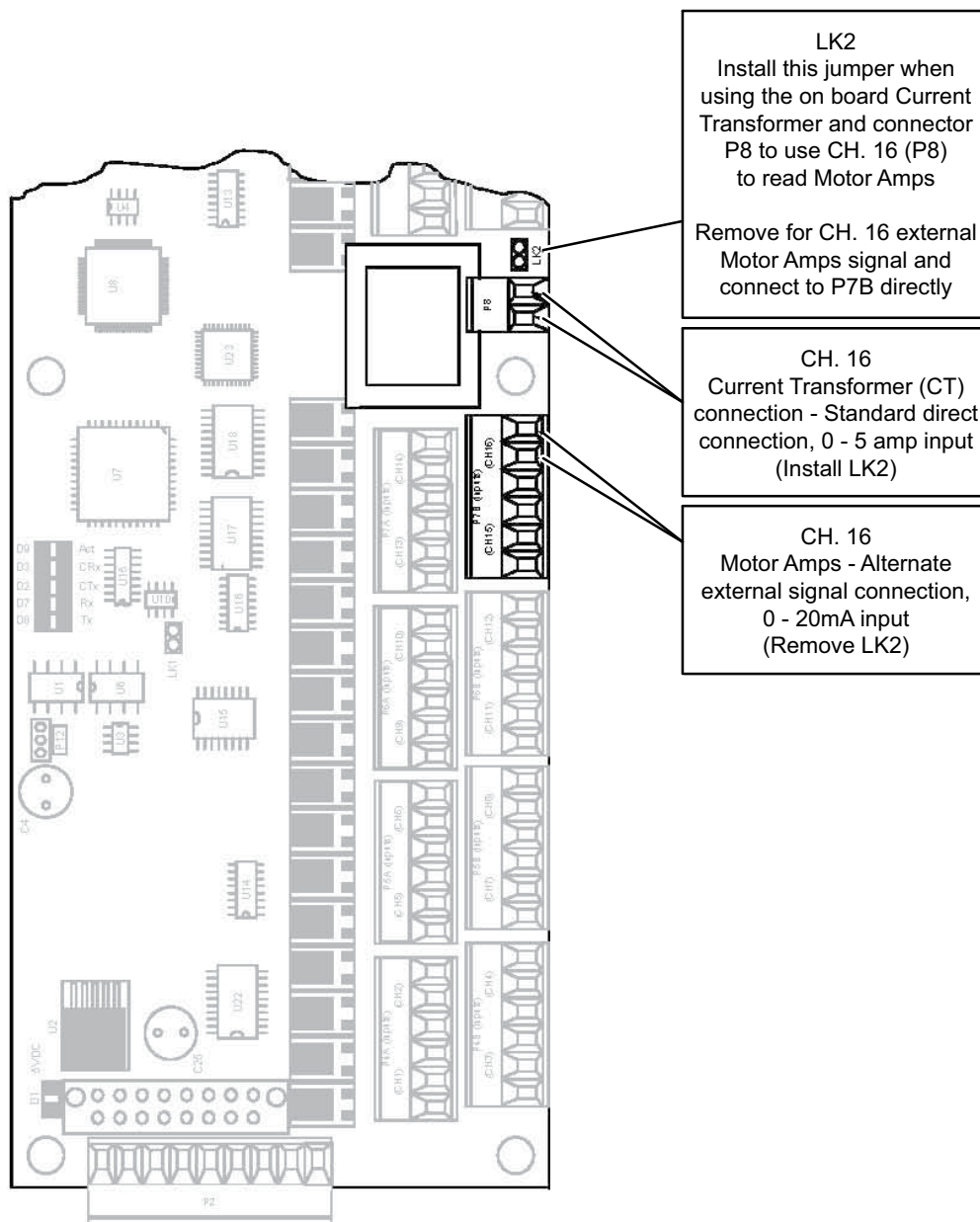
1. Shut off control power.
2. Unplug all connectors from the board. Remove the old board from the machine and remove the new board from its packing and place both on an anti-static surface.
3. Check that all jumpers and dipswitches are properly setup on the new board as it was on the old board.
4. Install the modified replacement board in the panel.
5. Plug all connectors back in.
6. Turn on control power.
7. After replacing or installing an Analog Board and powering on the control panel, select **[Redetect I/O Comms]** from the **Home >> Setup >> Serial Port Setup** screen (from Service User level 2). This selection provides a method to detect all connected Analog and Digital boards. If a board has

been removed, a communication error shutdown will be issued until this key is selected. The History screen will show what was detected. The **[Redetect I/O Comms]** key resets the memory of the processor as to which boards it requires communications from. Therefore, it is important to check the History screen to see which boards have been detected relative to the I/O boards actually in the panel.

Current Transformer (Motor Amps)

Channel 16 of Enhanced Analog Board 1 is dedicated to reading motor amps, either through the use of the on board current transformer when using a 0-1 amp CT,

or from an external source. When reading motor amps directly at the P8 terminal strip from a CT, the input signal cannot exceed 5 amps. TR1 and TR2 timers in the control panel will provide a short around the motor current detection circuitry to avoid any currents over 5 amps from reaching the detection circuitry during Locked Rotor Amp inrush. If you are using an external direct current mA or voltage device, remove the jumper at Link 2, and connect the wiring to connector P7B. If you intend on utilizing the on-board current transformer, then install Link 2, and connect the wiring to Channel 16, as shown in the diagram below:



LD15286

FIGURE 12 - MOTOR AMPS

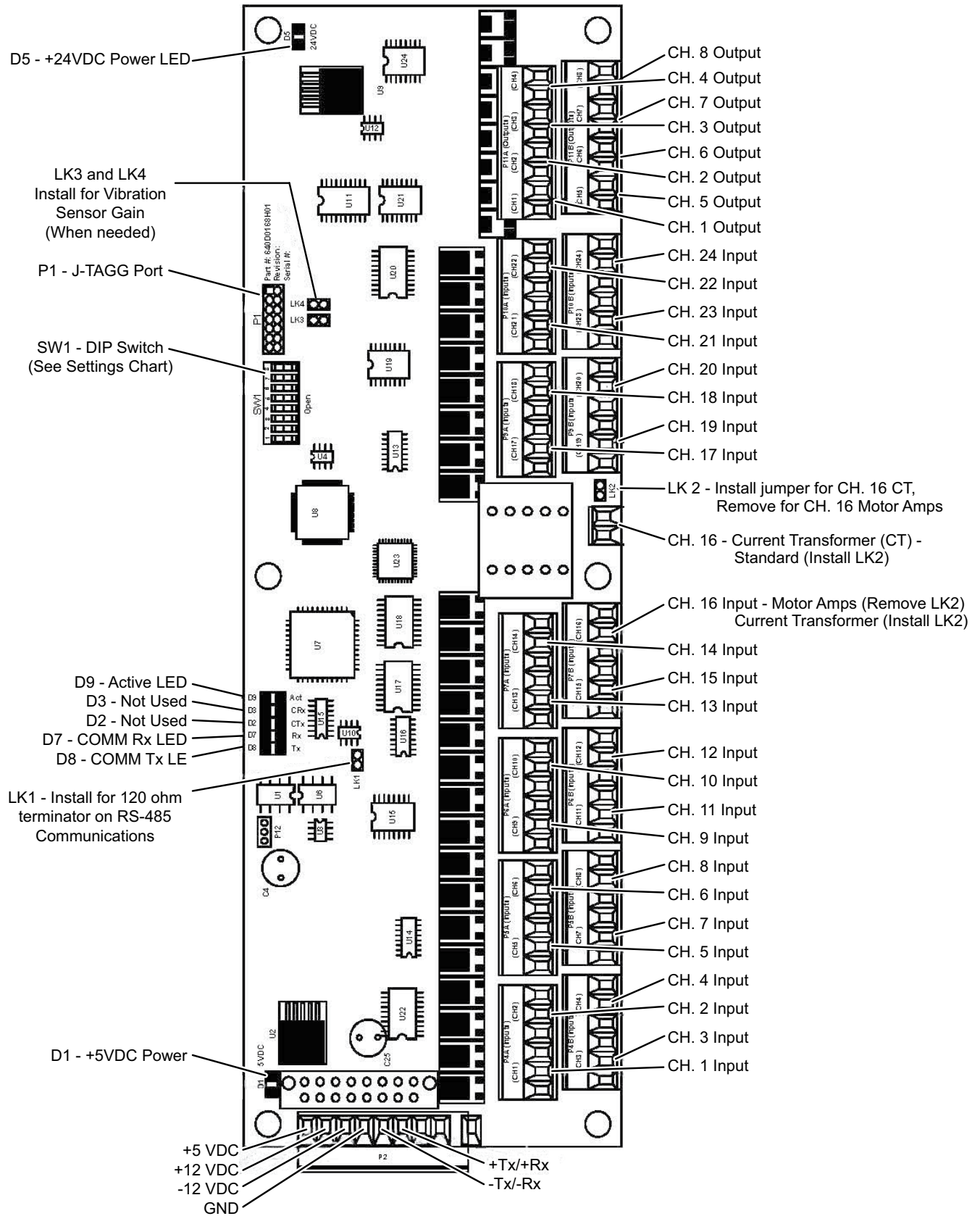


FIGURE 13 - ENHANCED ANALOG BOARD DIAGRAM

ENHANCED ANALOG BOARD SETTINGS**TABLE 4 - COMMUNICATIONS**

The following table is to be used when configuring the Quantum™ LX for external communications.

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

* default setting

TABLE 5 - CURRENT TRANSFORMER (CT)

ANALOG BOARD #1			ANALOG BOARD #2		
LK2	In*	Install for CT (Current Transformer).	LK2	In*	(Must be removed)
	Out	Remove to read Motor Amps on P8.		Out	Remove (Not Used)

* default setting

TABLE 6 - DIPSWITCH SETTINGS (USED TO SET THE BOARD ADDRESS)

The following table is to be used to set the analog board addresses. If there is only one board installed, it should be set as board #1, if there are two boards they each need to be set according to the wiring diagrams.

	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Board #1	off	off	off	off	off	off	off	off
Board #2	on	off	off	off	off	off	off	off

TABLE 7 - ANALOG BOARD

DESCRIPTION	ENHANCED ANALOG BOARD
Input Channels	24
Output Channels	8 (no driver chips required)
On Board CT (Current Transformer)	Yes (transformer incorporated on board)
On Board Vibration Circuit	Yes (no external modules required)
Channel Configuration	Software
Dimensions	4" x 11" (fits original board footprint)
Types of inputs:	
4 - 20mA	Yes
0 - 5 volt	Yes
1 - 5 volt	Yes
ICTD	Yes
RTD (1000 platinum)	Yes (currently for motor RTD inputs only)
Support Quantum™ LX Software Version	Resides in Flash Memory (Version 5.xx)
Service Dates	June 2003 - Present

REPLACEMENT PART NUMBERS	ANALOG BOARD 1	ANALOG BOARD 2	ANALOG BOARD 1	ANALOG BOARD 2
Baltimore Parts Replacement	640C0026G01	640C0026G02	640C0057G01	640C0057G02
Field Installation Kit	N/A	640C0057G11	N/A	640C0057G12

SECTION 2 - FUNDAMENTALS OF OPERATION



LD15323

FIGURE 14 - QUANTUM™ LX KEYPAD

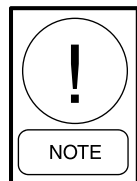
OPERATOR INTERFACE

Description

The Quantum™ LX Operator Interface actually consists of two components: A color 10-1/2" (diagonally measured) graphic display, and a membrane touch keypad. The display is used to view information coming from the Quantum™ LX controller, while the keypad and touch display allows the user to enter information into the controller.

Display Assembly

The Display assembly consists of a 640 x 480 resolution, LCD screen (which includes a fluorescent back-light tube, a backlight inverter circuit board, a wiring harness, and a touch sensitive layer. Refer to the Renewal Parts List manual for specific replacement part numbers.



Before replacing a display unit, ensure that the symptom is not actually being caused by a bad fluorescent tube, inverter or harness.

Display Replacement

1. Shut off control power.
2. Remove the defective display.
3. Install the new display.

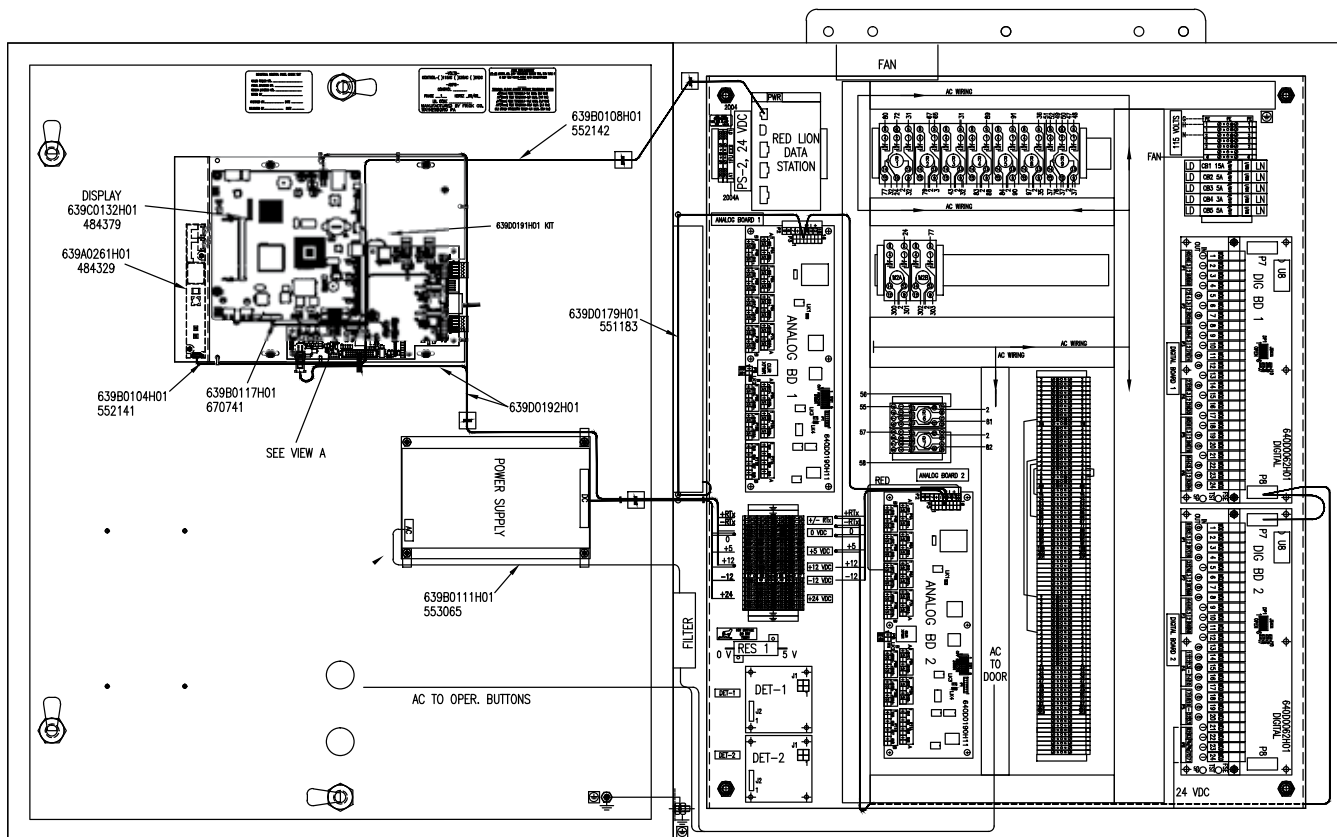
Keypad

The Keypad consists of two areas, the Display window and the Keypad itself. The Display window is simply a clear portion of the Keypad assembly which the Display is able to be viewed through. The Keypad area consists of a series of 27 membrane switches. Depressing each switch (key) should result in an audible tactile clicking sound. To ensure that each key is actually functioning, visually inspect the D8 LED located on the keypad interface board control board. This LED will normally flash on and off at a rate of about once per second. Pressing a key on the keypad will interrupt this flash rate, and repeatedly depressing a key will cause the LED to flash each time a key is pressed.

Keypad Replacement

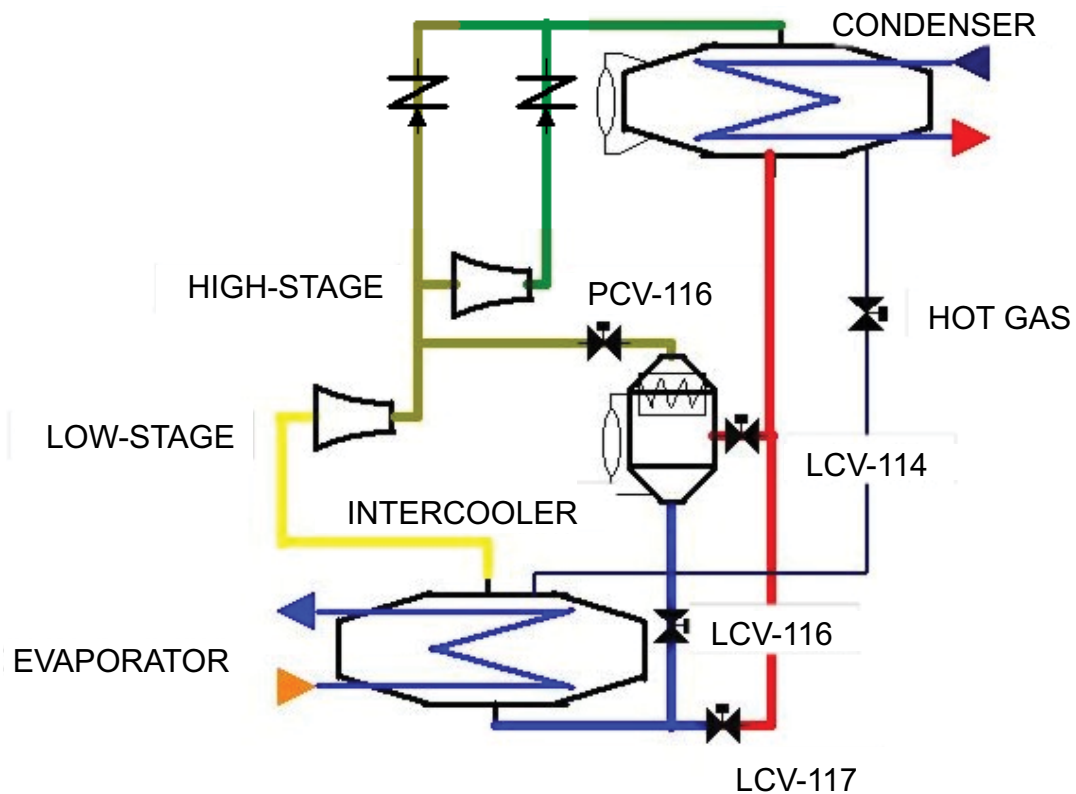
1. Shut off control power.
2. Unplug the defective keypad from the Quantum™ LX.

3. The keypad is affixed to the controller door with a double-sided tape film. Start by lifting the keypad at one of the corners. Once the keypad starts to break free from the underlying tape, continue pulling. A carefully used putty knife can help to separate the keypad from the adhesive.
4. Once the keypad has been entirely removed, you will notice that much of the double-backed tape is remaining on the panel door. Carefully using a window scraper style razor will remove most of this tape. Be careful not to scratch the paint outside of the keypad footprint.
5. Take the new keypad, and feed the flat cable through the slotted opening at the bottom of the display area.
6. Remove the paper backing of the keypad to expose the double-backed tape underneath.
7. Carefully align the keypad on the door, ensuring that the display is centered within the window of the keypad. Once you are satisfied with the position, firmly press the keypad into place.
8. Plug the keypad cable back into the Quantum™ LX.
9. Turn Control power back on.
10. Test the new keypad as described earlier.



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FIGURE 15 - QUANTUM™ LX BASIC PANEL LAYOUT



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LD15238

FIGURE 16 - GENERAL OPERATING SEQUENCE

Unit Not Operating

1. Control power is available to the control panel.
2. Compressor sump oil heaters are thermostatically controlled 53°F above saturation.



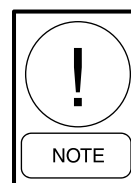
Only apply auxiliary control voltage to the chiller when the oil sumps have been filled with oil. Uncovered oil heater assemblies will produce high temperatures and destroy chiller oil sump components.

3. The capacity controls are disabled.
 - The compressor pre-rotation vanes are closed.
 - The hot gas bypass is closed when the evaporator pressure is below a freezing potential / open above freezing
 - The subcooler valve is closed above freezing potential, open below freezing potential.
 - The economizer valve is partially open.
 - The economizer bypass valve is partially open.

- The Variable Geometry Diffuser(s) are set to the "StartCV" command position.
- Oil Heaters are controlling the oil temperature to maintain 53°F above saturation.

System Startup

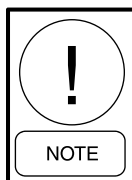
1. All chiller safety logic must be satisfied prior to starting, with the exception of the compressor oil pressure. The oil pressure safeties are bypassed initially, until the main oil pumps can establish pressures. The flow safeties are bypassed until the water pumps can establish flows. 5 seconds before the Pre-lubrication cycle completes the flows must be established, or the unit will trip on loss of water flow.



The hardwired safety relay MUST be clear of previous safety trips or power failures. The R1 hardwired safety relay must be physically reset. The R1 relay is hardwired in series with the high-pressure cutout and the emergency stop to shut down the main motors in the most extreme danger.



During the commissioning procedures, the Emergency Stop button should be pressed in, and R1 relay should be removed to prevent any undesired and inadvertent operation of the main motor starters. The Emergency Stop button is the “twist to reset” type.

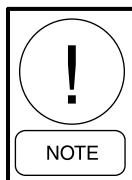


The System Status indicator box in the upper left corner of the DISPLAY screen will display the GREEN text “READY TO START.” This display will change at various times during the start-up and shutdown of the chiller.

See Graphic Displays for further details on the operator interface.

If the chiller has been recently started and shut down, the motor must remain off for sufficient time to cool down. See “Anti-recycle operation” at the further details.

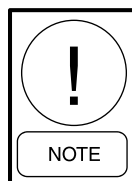
2. The chiller start may be initiated at this time by pushing the **START** key .



Local vs. Remote control of the start is established by the condition of the “LOCAL-REMOTE START” buttons on the “Evaporator” Screen. A start mode change may only be made with the unit stopped.

When in LOCAL, the start sequence begins as soon as the operator pushes the **START** key  on the front of the chiller control panel.

When in REMOTE, the “DCS CHILLER REMOTE START CONTACT” at (Across the network interface) must momentarily close to energize and initiate the chiller start sequence. Alternately, the chiller can be started by a remote run contact. The option for remote hardwired start must be configured on the Evaporator Screen. This will be covered in this section.



The chilled and condenser water flows must be established by the customer's pump control system or manually by the operator within 45 seconds after a start is initiated in order to close the chilled and condenser water low flow cutout contacts and continue with the start sequence.

3. With the above “**START INITIATED**” signal, the chiller controls start the low stage VSD oil pump and their respective representations on the display indicate a running oil pump. The oil heater shuts down during oil pump operation. A Pre-lube of 50 seconds will be started on the low stage compressor. The VSD Oil Pumps will produce 45 psid (3.10 BarD) pressure for the first 15 seconds of runtime. After 15 seconds, then they will maintain the setpoint of 36 psid (2.48 BarD).
4. If the pumps fail to start within 2 seconds after the PLC output is energized, an alarm signal will be transmitted to the DISPLAY for indication and recording.

5. Low Head Start

If the lift requirements of the chiller are less than the Immediate Two Stage threshold, sensed by entering Condenser Water Temperature minus Entering Chilled Water Temperature, the system will start in single stage mode. The low stage motor contactor will engage only after pre-lube is completed. When the starter has completed and the transition to full voltage operation, an auxiliary contact from the starter run (full voltage) contractor is input to the chiller control panel to operate the following:

- a. The capacity control system will be put into a hold condition in order to establish a level within the economizer vessel. The Economizer Level control valve LCV-116 will start ramping closed to maintain a level in the economizer. The LCV-116 will maintain the economizer level until shutdown. This refrigerant inventory management procedure insures that vast quantities of refrigerant



LD15240

FIGURE 17 - SYSTEM STATUS

aren't accumulated in the evaporator, which can cause liquid carryover.

- b. Once the economizer level has been established, the capacity controls enable. Compressor pre-rotation vanes and hot gas bypass valve will now begin to ramp open / closed respectively at a predetermined rate. See "Capacity Control Operation" for further details on the ramp-up of the controls.

After the interlock is established, the compressor pre-rotation vanes are opened to their minimum position necessary to prevent "surging" during the initial acceleration at start-up.

- c. After the low stage compressor interlock is closed and the minimum vane position is reached, the capacity controls try to maintain the chilled water out temperature. The system status display will display "**LOWSTAGE RUN**" with only the Low Stage compressor running in Single compressor mode.
- d. If the system head exceeds a predetermined Head pressure threshold, the high stage will be prelubed and started. This mode is 2-stage operating mode and will allow the chiller to operate over a wider range of head conditions. The booster stage allows the chiller to produce a greater lift, than a single stage could possibly produce.
- e. As the High Stage Compressor vanes open, the refrigerant path is re-directed from the bypass check valve, into the High Stage compressor. The check valve seals off the bypass path around the High Stage compressor, producing two stages of compression.

6. High Head Start

If the lift requirements of the chiller are greater than the Immediate Two Stage threshold, sensed by entering Condenser Water Temperature minus Entering Chilled Water Temperature, the system will start in two stage mode. The low stage motor contactor will engage only after pre-lube is completed. When the starter has completed and the transition to full voltage operation, an auxiliary contact from the starter run (full voltage) contractor is input to the chiller control panel to engage the High Stage starter, which started its pre-lube process only seconds after the Low stage pre-lube process had started.

- A. The capacity control system will be put into a hold condition in order to establish a level within the economizer vessel. The Economizer Level control valve LCV-116 will start ramping closed to maintain a level in the economizer. The LCV-116 will maintain the economizer level until shutdown. This refrigerant inventory management procedure insures that vast quantities of refrigerant aren't accumulated in the evaporator, which can cause liquid carryover.

- B. Once the economizer level has been established, the capacity controls enable. Compressor pre-rotation vanes and hot gas bypass valve will now begin to ramp open / closed respectively at a predetermined rate. See "Capacity Control Operation" for further details on the ramp-up of the controls.

After the motor starter interlock is established, the compressor pre-rotation vanes are opened to their minimum position necessary to prevent "surging" during the initial acceleration at start-up.

The capacity controls operate to control chiller capacity in response to process water outlet temperature. The hot gas will ramp closed first while maintaining a minimum vane anti-surge position on the vanes. If programmed for Load Matching, the High Stage vanes are reacting to the motor current of the Low Stage compressor. The capacity controls are further described by flowchart in a later section. The system status display will display "**SYSTEM RUN**" with both stages of compression running.

If the Head on the chiller reduces to below a programmable threshold, the High Stage compressor will be dropped offline. Under this condition, the low stage compressor will continue to run and attempt to make capacity with a reduced requirement for lift.

Ramp-Up of Capacity Controls

The ramp-up feature is used to provide a gradual increase in chiller capacity during start-up.

Refer to the "Capacity Control Diagrams" in *Figure 23 on page 49* along with the following to best understand the operation.

The DISPLAY will indicate when the "CHILLED WATER OUT TEMPERATURE CONTROL" is in the manual mode.

This occurs when the unit is shut down, during ramp-up and when the "DEMAND LIMITER" or the "EVAP LOW PRESS. OVERRIDE" control signal is being used to control the capacity of the chiller.

With the unit stopped, the “CHILLED WATER OUT TEMPERATURE CONTROL” is in manual, its setpoint is equal to the chilled water out temperature and its output is equal to the PRV signal. (When in manual, the controller drives its output to the same as the tieback valve, which would be 0% with unit off.)

When start is initiated, the PRV signal goes to the “PRV START-UP SIGNAL” value. This value determines the position of the compressor pre-rotation vanes at the instant the main motor starts. It is adjusted to keep the starting load on the motor low but also allow enough gas flow through the compressor to prevent surging at start-up.

After the compressor motor starts, the “START-UP SIGNAL” value increases at a rate determined by the “PRV Ramp Rate” setpoint until it reaches PROGRAMMED CAPACITY CONTROL FUNCTIONS, the “MIN PRV SIGNAL” value (minimum PRV signal allowed with the compressor running), and then holds at this value.

The “HGV RAMP CONTROL” output begins to decrease at this time to start closing the hot gas bypass valve.

After the motor power drops below the “DEMAND LIMITER” setpoint, its output signal increases rapidly to 100%. LSR-3 and LSR-4 will then select the lower output signal.

The hot gas valve will continue closing during the ramp-up period at a rate determined by the “HGV RAMP TIME” setpoint as long as the “HOT GAS CONTROL” output remains below the HGV ramp output signal.

During the ramp-up period, the “CHILLED WATER OUT TEMP. CONTROL” setpoint will track the chilled water out temperature and its output will be driven to equal the PRV signal. The vanes will continue to open at a rate determined by the “PRV RAMP RATE” setpoint as long as the “CHILLED WATER OUT TEMP. CONTROL” remains in “MANUAL.”

If during ramp-up the capacity increases sufficiently to lower the chilled water outlet temperature to less than 2° above the desired setpoint, the “CHILLED WATER OUT TEMP. CONTROL” is changed to the automatic mode and its output now changes in response to load changes.

If the chilled water temperature continues to fall, the “CHILLED WATER OUT TEMP. CONTROL” output will decrease causing the hot gas valve and PRV to move to whatever positions are required to maintain the chilled water at setpoint and provide stable compressor operation.

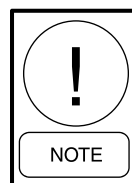
When the ramp-up is completed (PRV signal at 100%) and/or the “CHILLED WATER OUT TEMP. CONTROL” is changed to automatic, its setpoint will return to whatever setpoint is stored in the PLC memory at that time (if in “LOCAL SETPOINT” mode), or will change to the PROGRAMMED remote setpoint (if in “REMOTE SETPOINT” mode). The setpoint will change slowly at a rate determined by the “SETPOINT RAMP” rate value to the desired value.

The above tracking and reset tieback controls disable the “CHILLED WATER OUT TEMP. CONTROL” during shutdown and ramp-up when other logic is in control and provide for a smooth transition to automatic control as required.

The “CAPACITY CONTROLS DIAGRAM” Screen will indicate which signals are currently in control of the pre-rotation vanes and valves during start-up.

System Shutdown

1. The chiller may be shutdown normally by momentarily closing the DCS REMOTE STOP CONTACT to energize Input across the network (refer to the protocol listing manual), or by depressing the local **STOP** key . Also, the chiller may be stopped via a safety control, in which event the Quantum™ LX displays and records the cause of shutdown.
2. Avoid shutting down the chiller while still under high head conditions. Backspin can be violent and damaging to the compressor. Discharge check valves are installed to prevent damage on unplanned stops of the chiller; however it is best practice to unload the chiller before shutting down. During a controlled stop unload procedure, the vanes are brought closed, the and Hot Gas Valve is opened to drop the head across the vessels. Process Chiller controlled stops are generally shorter than Comfort Cooling Controlled stops.



The following safeties are “Hardwired” to stop the chiller regardless of the condition of the Output controlling the motor starter:

Emergency Stop (Pull to Stop Pushbutton) Compressor Discharge High Pressure Cutout

- a. The compressor pre-rotation vanes are closed to minimize back flow of gas through the compressor. The hot gas valve is opened

(above freezing conditions) to equalize the condenser pressure with the evaporator. The sideload valve is ramped closed. These actions are taken to reduce backspin of the compressor on shutdown.

- b. The compressor motor start relays are de-energized to open their contacts and de-energize the motor starter control circuits.
- c. The subcooler level control valve is opened fully to drain the refrigerant out of the subcooler.
- d. The water flow, and low oil pressure safety logic is inactivated to prevent nuisance alarms.
- e. The anti-recycle timer is activated at this time. The anti-recycle (cool down) time depends on the description under "Anti-recycle operation" at the end of this section.

During this time, further restarts of the motor are prevented.

- f. The compressor post-lube timing logic is enabled and the VSD pumps will run for 3 minutes to cool the oil system with the auxiliary water solenoid valve opened.

3. The condenser water flow may be shut off after the postlube cycle is complete.



If the shutdown is caused by Low Refrigerant Pressure, this could be an indication of a major refrigerant leak. In this event, the chilled water flow must be maintained to prevent freeze-up and damage to the tubes.

4. Five seconds after the oil pumps shut down, the compressor oil heaters are energized if the temperature of the oil requires it.

Anti-Recycle

1. Cold Starts

If the motor has been shutdown for 8 hours, the cool down (anti-recycle) time will be 2 minutes for the first and second cold start.

To start a third time, the chiller must be off for 30 minutes.

Any additional starts would be considered hot starts.

2. Hot Starts

If the chiller has been running less than 20 minutes, the cool down time will be the difference between 45 minutes and the hot motor running time since last start. For example, if chiller has run 5 minutes since last start, cool down time = 45-5 = 40 minutes.

If the chiller has been running 20 minutes or longer, the cool down time will be 2 minutes.

Excessive Starts

When the motor is started, a 24-hour counter is enabled. During the next 24-hour period, a total of 7 additional starts are allowed. If 8 starts are attempted in any 24-hour period, the chiller start logic is locked out for a minimum of 3 hours.

CAPACITY CONTROL OPERATION

Chiller Applications

Much of the function of the Control System is dedicated to chiller capacity control. Sensors register system conditions that are used to infer the total cooling load and make necessary adjustments to the system components.

There are two primary mechanisms by which cooling capacity is controlled: pre-rotation vanes, and the hot gas bypass valve. The primary directive of the Control System is first to maintain safe operating conditions, then to keep the system online, and finally to efficiently maintain setpoints.

The interaction of capacity control subsystems is complex, and can be better understood by referring to the capacity control diagram in the accompanying figures.

The capacity control philosophy of the YORK CYK chiller control system allows efficient, fully automated control, without need for operator intervention. The CYK control system is designed for industrial process applications. This control system also monitors and displays all safety aspects of the chiller and provides alarms and a shutdown if safety limits are exceeded. If operator intervention is required, manual controls are provided on the Electronic Operator interface, for all electric actuators.

The Capacity Controls algorithm automatically seeks out the most efficient operation of the CYK chiller. The pre-rotation vanes are automated to obey the temperature controller to maintain process water production.

In cases of low load, the pre-rotation vanes automatically throttle and are limited to a minimum anti-surge position, which is calculated from a head curve. To provide light duty operation, the hot gas recycle valve is seamlessly throttled open according to temperature demands. This keeps the centrifugal compressor out of surge and maintains process water production.

In cases of high load, which exceeds the motor current usage, the capacity controls algorithm automatically unloads the system to maintain a restriction on power consumption. In the same way, conditions of high discharge pressure or low suction pressure override the production of process water in the interests of keeping the chiller system online.

In cases of light load and low head, the Booster compressor is dropped offline, the intercooler bypassed, and the unit will be run with the Low-Stage compressor like a single-stage YK chiller.

In cases of high load and high head (ice building duty), the Booster compressor is brought back online to perform the additional gas compression. The unit runs in compound mode with the flash economizer in the cycle.

Basic Control Model

The analog model in *FIGURE 18* is derived from the pneumatic control systems that predated modern digital controllers. In pneumatics the lines connecting the controllers and select relays contained air at between 3 and 15 psi, representing the analog control values. In digital implementations of this model the connection points are variables which represent the loading and unloading values of the controllers in terms of 0% to 100%. The controller generates an output of 100% at a fully loaded state, and 0% at a fully unloaded state. Controllers may be direct or reverse acting depending on the relationship between the process variable and setpoint.

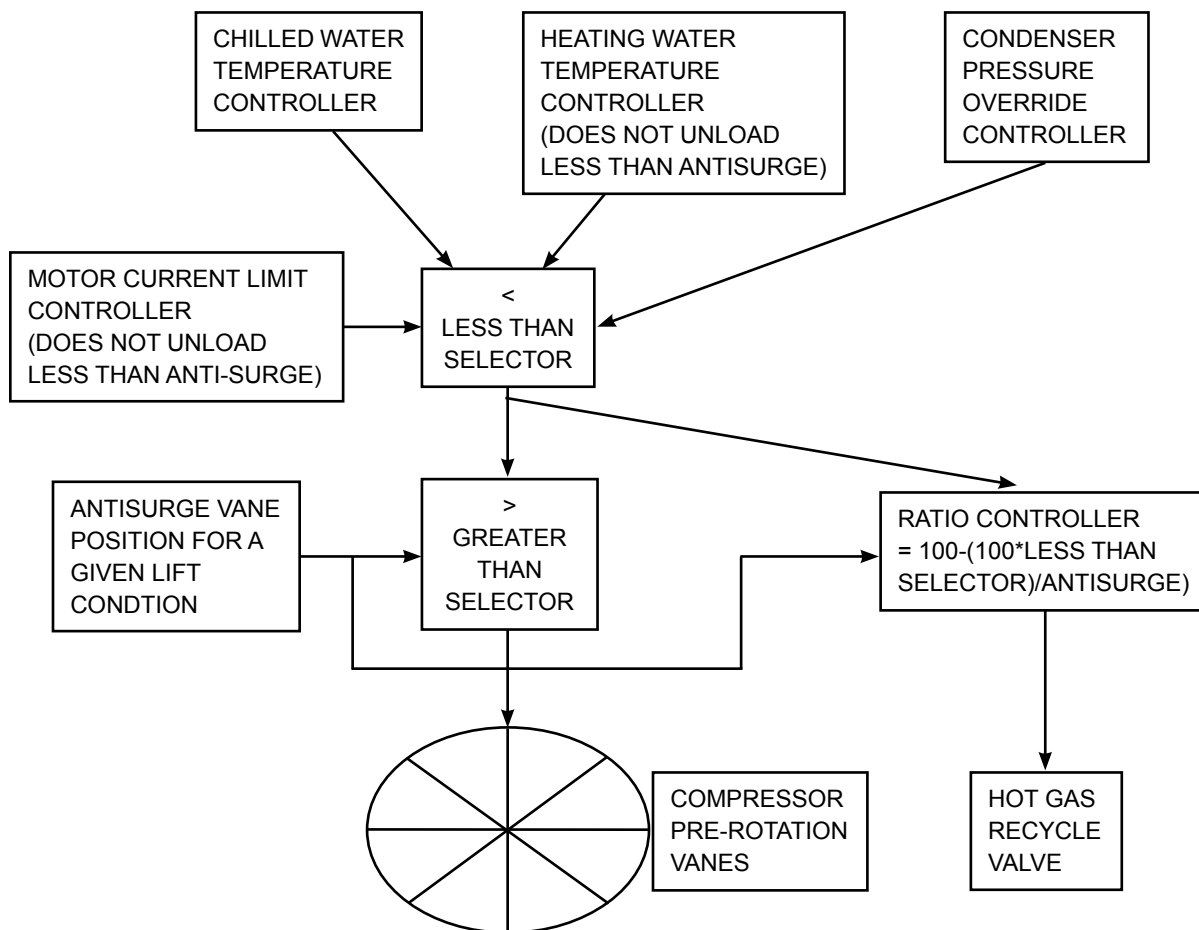


FIGURE 18 - CONTROL MODEL

In this figure, the vanes do not unload past the Anti-Surge map. As the Low Selector result value decreases past the value of the Anti-Surge map, the hot gas valve begins to open ratio metrically. At a fully unloaded command out of the Low Selector, the hot gas will be fully open.

Gain scheduling is important for this implementation to separate the dynamic reaction that the pre-rotation vanes have on the system, from the reaction response of the hot gas valve on the system. The tuning parameters of the controllers are changed to accommodate the change in output device when the result of the ratio controller becomes greater than zero. The control theory is discussed in greater detail later in this section.

Heat Pump Applications

The CYK chiller also becomes a heat pump when the capacity controls system is switched mode to control hot leaving water out of the condenser vessel. Leaving condenser water is the process variable of the heat pump. The leaving chilled water controller becomes a low temperature override in this mode. However there are considerations that must be made to create an effective control system around the “Water to Water Heat Pump”. In a typical chiller refrigerant cycle, it is assumed that the evaporator conditions remain relatively constant, and the condenser conditions are allowed to be adjusted to maintain the most efficient operating conditions.

The Heat Pump is limited to produce heat on the available heat extracted from the chilled water loop. If there is insufficient load on the chilled water loop, then hot gas will generate as much heat as it can to make up the lack of source heat from the chilled loop. More importantly the Heat Pump must have sufficient load on the condenser (heating) side to carry away the heat of compression of the system. The Design working pressure of the condenser vessel is the limiting factor of the hot water production. On the condenser side of the heat pump, if the load is less than the heat of compression load plus the refrigeration effect, the system will not be able to stay online as the total heat generated in the heat pump is not removed from the heating water loop and will accumulate causing a high pressure shutdown.

Heat Pump mode and Chiller/Heat Recovery capacity controls operation are mutually exclusive operational modes. The Chiller mode produces cold water at setpoint, and any hot water recovered simply a benefit. The inverse is also true. Whichever limitation is reached first becomes the limiting factor and the Heat Pump will unload based on low water temperature or high discharge pressure.

In practice for chillers this means the condenser temperature is kept as low as economically possible, and still maintaining a minimum lift requirement that produces the required differential pressure required for the sizing of the expansion valve. What we find in a chiller when running fully loaded at a low head the inlet guide vanes can be very closed, and the chiller still maintains a full load chilling output. As the lift requirements increase as the condenser temperature raises, the inlet guide vanes must open more to maintain a fully loaded condition. More work must be done to overcome the lift requirements.

In a WTWHP application the head alleviation found on an ARI chiller profile is not present. At light loads the chiller can run at a lower head. When a WTWHP must unload the lift requirements actually increase. In a chiller the difference between inlet and outlet cold water temperature goes down, and the difference between hot water inlet and outlet temperatures goes down. But the temperature difference between the Hot and Cold water sides goes up, increasing the lift requirements on the compressor. At a satisfied or unloaded state, the Hot Water leaving the WTWHP will be hot as possible, and the Cold Water will be as cold as possibly allowed.

A centrifugal compressor must move a minimum amount of refrigerant gas flow with relation to the lift requirements to keep out of surge. As the lift requirements go up, as the load goes down, the minimum mass flow requirements of the compressor increase. This presents a problem, in that the Centrifugal WTWHP cannot effectively unload as much as a chiller application. Experience tells us that this value is about 40% of rated heating capacity.

Recall that a chiller can actually run with no load on the evaporator, and that the temperature difference can be nearly zero. However if our useful heat is measured at the condenser side we quickly realize that due to the heat of compression, and inherent inefficiencies of the refrigeration effect, the heating capacity must always be non-zero. This minimum capacity of the heat pump must always be satisfied, or the unit must be switched off.

Role of Hot Gas Bypass

The natural solution on a centrifugal chiller application is that when the surge line is approached with a decrease in load, the mass flow cannot be decreased without aerodynamic instability; therefore the hot gas bypass is used to supplement mass flow. This supplemental mass flow creates a source of inefficiency in

the refrigeration cycle and allows the chiller to run at lower evaporator loads than it could without hot gas. This isn't particularly helpful in a WTWHP from a standpoint of unloading the hot water capacity. The shift of importance is placed on the heating water side. In order to reduce capacity on the heating water side, the chiller must remain efficient as possible. Adding a source of inefficiency, such as Hot Gas Bypass, creates more heat than without. This will actually increase the energy being deposited in the heating water system.

Conversely, the Hot Gas Valve has an important role, in that when the heat source of the evaporator water side is insufficient, the WTWHP can simply become inefficient by opening the hot gas valve to generate heat. There may be an economic breakpoint at which running the WTWHP with Hot Gas is less efficient than using fossil fuels for heat.

The Importance of Heat Balance

It becomes apparent that having a heat sink outside to WTWHP to use as much energy as possible is important. A Heat Balance must be maintained at all times. If the external system does not reject the energy from the heating water side, the energy is returned to the entering condenser water of the WTWHP. This increases the temperature of the loop. As the chiller unloads, it reaches that point at which the minimum mass flow through the compressor is reached. If this trend were left to continue, the hot water loop would increase in temperature, until it reached the equivalent design working pressure of the condenser vessel. The WTWHP must be switched off before the high pressure safety threshold is reached.

It becomes apparent that a WTWHP should never be oversized for an application. The Heat Pump is limited to produce heat on the available heat extracted from the chilled water loop. If there is insufficient load on the chilled water loop, then hot gas recycle will generate as much heat as it can to make up the lack of source heat from the chilled loop. More importantly the Heat Pump must have sufficient load on the condenser (heating) side to carry away the heat of compression of the system. The Design working pressure of the condenser vessel is the limiting factor of the hot water production. On the condenser side of the heat pump, if the load is less than the heat of compression load plus the refrigeration effect, the system will not be able to stay online as the total heat generated in the heat pump is not removed from the heating water loop and will accumulate causing a high pressure shutdown.

Therefore, if the minimum heat energy produced by the heat pump is not removed into the heating load, the discharge pressure will start to rise. Once the discharge pressure rises above the PC-113 discharge pressure override limit, the system will open the hot gas valve in an attempt to alleviate the pressure. When this occurs the "Death Spiral" of the heat pump has begun. If the process heating load does not begin to absorb the energy produced by the heat pump, then the centrifugal heat pump will shut down on high pressure safety.

If the heating load establishes equilibrium with the heat pump while its hot gas valve is open, then the hot gas recycle effect will false load the heat pump keeping the temperature satisfied possibly at an elevated discharge pressure. This is not a desirable condition, and therefore the excursion into such a situation should be avoided by rejecting all the available energy provided by the heat pump before a high pressure override occurs. This can be likened to orbiting the event horizon of a black hole. The discharge pressure must be made to be less than the Discharge Override Setpoint, in order for the hot gas valve to close. To break away from this condition, an increase in heating requirement must be placed on the heat pump to shut the hot gas so that the false loading of the recycle gas can be eliminated and the "Death Spiral" avoided.

Major Capacity Control Devices

Compressor Pre-rotation Vanes

The compressor pre-rotation vanes (PRV's) are internal guide vanes in the suction flow path to the impeller wheel. The PRV's are used to throttle the refrigerant flow through the system as a means of controlling capacity in response to the leaving chilled water temperature. If the leaving chilled water temperature falls below the setpoint, the PRV's are partially closed until the net cooling is reduced and the leaving chilled water returns to setpoint.

In the event of high motor power, the capacity control signal is over-ridden and the compressor PRV's are closed to keep the motor power down. On start-up, the PRV's are closed to reduce the starting load torque of the compressor.

The compressor pre-rotation vanes are closed on shutdown to reduce backflow of high-pressure gas from the condenser, which might otherwise cause the compressor to spin backwards at a high rate of speed.

A shaded pole motor operates the mechanical pre-rotation vane linkage, at the compressor. The shaded pole motor is operated by a contact closure to either open or close the vanes. A pre-rotation vane position potentiometer senses the position of the vanes and reports it to the controller as a percentage open value.

On Startup the low stage PRV's are opened to minimum vane. As the high stage compressor is started; the vanes are locked to together so that the high stage tracks ahead of the low stage at a predetermined offset percentage.

There is also an operational mode to balance motor current usage by controlling the high-stage vanes on the basis of motor current sharing. This algorithm allows the compressors to share compression ratios, while the low stage is controlled by the leaving process Water Temperature Controller. Vane opening is limited by pressure overrides and independently by motor current overrides.

Hot Gas Bypass Valve

The hot gas bypass valve is used primarily at low loads to maintain a minimum suction gas flow required by the compressor for stability. When the compressor has reduced capacity to its minimum flow (via pre-rotation vane throttling), further capacity reductions are accomplished by opening the hot gas bypass valve. This maintains the flow to the compressor by bypassing the discharge gas back to the compressor suction.

However, the hot gas flow replaces the useful evaporation in the cooler since the compressor flow is at minimum. Thus, the net chilling capacity is reduced (albeit not efficiently).

The minimum suction flow or minimum compressor PRV position will vary. As the differential "head" pressure is lowered (due to colder condenser water) the compressor is capable of stable operation at lower loads. The programming in the chiller panel thus uses the differential "HEAD" pressure to establish when the hot gas may be needed.

- On a water chilling application, this valve goes open on shutdown.
- On a brine application this valve is closed at shutdown to allow the pressures to drop slowly. Allowing low-pressure cold refrigerant from the evaporator to migrate into the condenser would create a freezing hazard for the condenser water.

The hot gas valve is a rotary ball type control valve with an electric actuator. The control signal is a modulating direct current signal, which is converted to a position by an electric actuator. The valve will be fully closed at low signal and open at high signal. Refer to the Wiring Diagram to see the 4-20mA Control Signal wiring. The Output Scaling screen allows factory selection of the proper output signal.

Subcooler Liquid Level Valve LCV-114

The subcooler liquid level valve controls the refrigerant liquid level in the subcooler located in the bottom of the condenser to maintain the proper amount of subcooling and provide the most efficient operation at all loads.

This valve is opened after shutdown to allow a slow change in pressure between evaporator and condenser. The pressure in the condenser forces the liquid out of the condenser into the economizer and the evaporator. Allowing low-pressure cold refrigerant from the evaporator to migrate into the condenser would create a freezing hazard for the condenser water. It opens at start-up and then slowly closes until it reaches the position dictated by the liquid level control PID instruction in the Quantum LX logic.

The liquid level valve is a rotary ball type control valve with an electric actuator. The control signal from the Quantum LX is modulated direct current, which is converted to a position by an electric actuator. The valve will be fully closed at low signal and open at high signal.

Economizer Liquid Level Valve LCV-116

The Economizer liquid level valve controls the refrigerant liquid level in the economizer to maintain a good liquid seal between the flash gas in the top of the economizer and the liquid to the evaporator, this provides the most efficient operation at all loads.

The liquid level valve is a rotary ball type control valve with an electric actuator. The control signal from the Quantum LX is modulating direct current, which is converted to a position by an electric actuator. The valve will be fully closed at low signal and open at high signal.

Economizer Bypass Valve LCV-117

The Economizer Bypass Valve is normally closed. It is used as a subcooler level control valve in system conditions when flow thru the economizer is reduced. This is manifested by the LCV-114 subcooler control valve controlling at 100% open and the subcooler level is rising. The LCV-117 and LCV-114 are essentially split ranged, with the LCV-117 valve at the high end of the controller. The Bypass control valve generally comes into operation when there is high refrigerant volume flow, or in single stage operation.

The liquid level valve is a rotary ball type control valve with an electric actuator. The control signal from the Quantum LX is modulating direct current, which is converted to a position by an electric actuator. The valve will be fully closed at low signal and open at high signal.

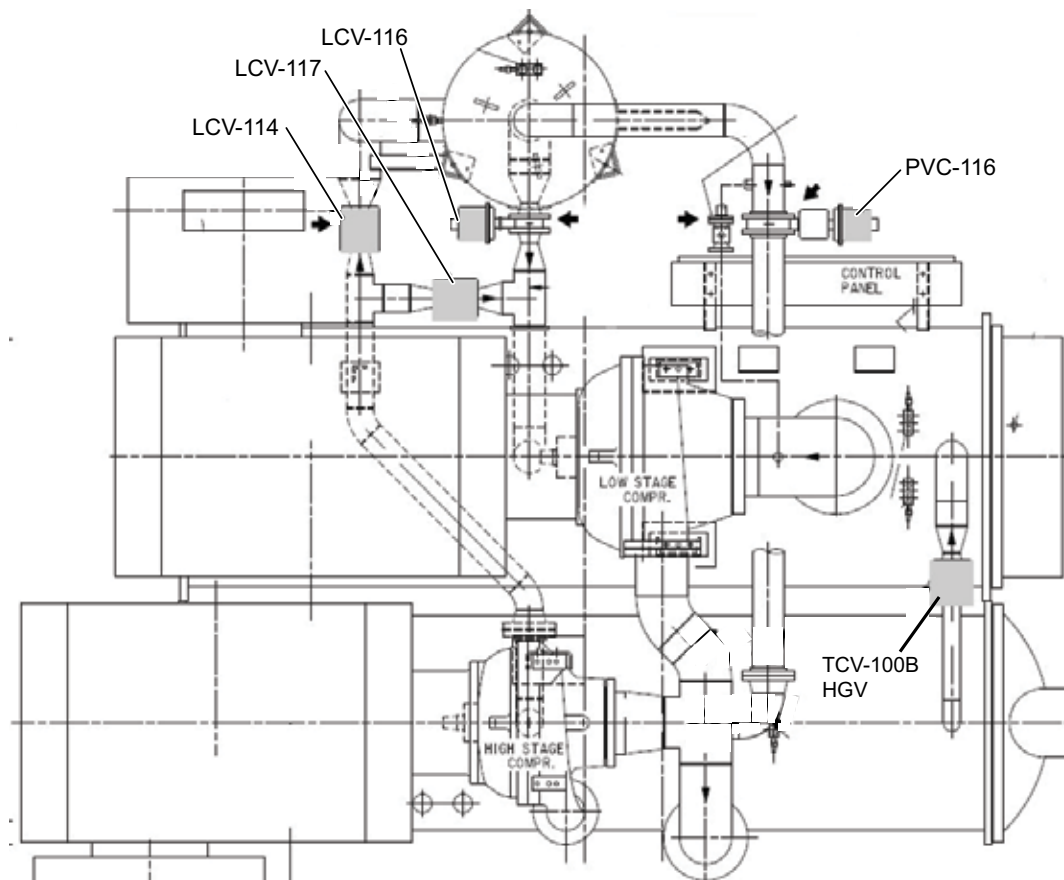
Interstage Gas Sideload Valve PCV-116

The interstage sideload valve controls refrigerant flash gas, from the economizer to the second stage compressor impeller wheel when required to maintain a minimum pressure differential between the economizer and the evaporator.

At normal conditions, the interstage valve will remain fully open during compressor operation and close on shutdown to reduce compressor backspin.

This valve remains closed for after start-up to allow the subcooler level controller to establish a liquid level in the subcooler and then slowly opens when the High Stage Compressor comes online.

The interstage valve is a rotary butterfly type control valve with an electric actuator. The control signal from the Quantum LX is a digital output through a double pole relay. The valve will be fully closed at low signal and open at high signal.



LD15239

FIGURE 19 - VALVE LOCATIONS

Programmed Capacity Control Functions

Chilled Temperature Control

Using the input signal from a temperature sensor in the leaving chilled water line, this control provides an output signal, which decreases as water temperature drops below set point to reduce the capacity of the chiller. When override and anti-surge conditions are satisfied, the temperature control subsystem may dominate. Since temperature control is the highest function associated with capacity control, its task must be concurrent and compliant with all other subsystems and subsystem directives. It indirectly controls the hot gas valve, and pre-rotation vanes in its attempt to maintain the chilled water temperature setpoint while keeping the compressor out of surge.

Heat Pump Temperature Control

Using the input signal from a temperature sensor in the leaving condenser water line, this control provides an output signal, which increases as water temperature drops below set point to increase the capacity of the chiller. When override and anti-surge conditions are satisfied, the temperature control subsystem may dominate. Since temperature control is the highest function associated with capacity control, its task must be concurrent and compliant with all other subsystems and subsystem directives. It indirectly controls the hot gas valve, and pre-rotation vanes in its attempt to maintain the condenser water temperature setpoint while keeping the compressor out of surge. The Chilled Temperature Control automatically acts as an override in Heat Pump mode, by providing a control loop to keep the water leaving the evaporator from becoming dangerously cold. The two temperature controls act thru LSR-1 selector.

Dynamic Override Controls

There are four operating parameters that are primarily concerned with the safe operation of the system: evaporator pressure, condenser pressure, economizer pressure, and motor load. If any of these parameters were to exceed the limits defined by the setpoints, it could lead to a shutdown of the chiller by the safety setpoints. Maintaining chiller operation is the function of the Dynamic Override subsystem.

This power override control function uses the motor power input signals to limit capacity. When one of the motor powers exceeds the setpoint, the control puts out a decreasing signal. The LSR-2, LSR-3 and LSR-4 will

then pass this lower signal on to close the compressor pre-rotation vanes, thus reducing the demand on the motor and returning the motor demand limit to below the maximum threshold.

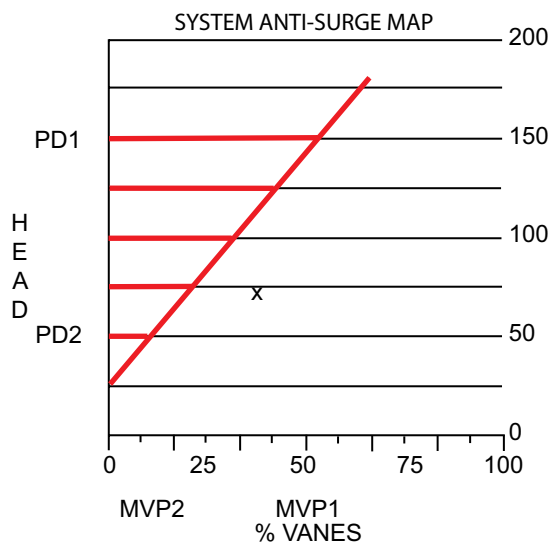
The pressure override systems prevent a system operation condition from shutting down a chiller prematurely. The pressure override loop controllers maintain the chiller operation just within the safe operational limits of the vessels, until system conditions return to design.

The discharge pressure override produces an unloading effect on the chiller if the cooling water to the chiller goes above design. If the chiller were not unloaded in this condition, the high-pressure cutout would shut the chiller down, and no cooling would be done. The economizer pressure override operates the same way, to protect the pressure limitations of the economizer vessel.

The low evaporator pressure override is a key override in preventing the unit from either freezing or going down on low evaporator conditions. A system overshoot, or a low temperature transition in process water can result in a low suction pressure condition. During startup, the condensing pressure may initially be low. This can cause the refrigerant to back up. If this occurs, the low level of evaporator liquid uncovers a portion of the tube bundle, thereby reducing the heat exchanger performance, and lowering the evaporator pressure. The low evaporator pressure override unloads the chiller rapidly, and often opens the hot gas valve to try to maintain a suction pressure in the chiller. As the fault condition subsides, the override backs off and returns the chiller to normal temperature controlled operation.

Anti-surge

Compressor surge is an undesirable condition occurring at low partial loading in which the system head pressure exceeds the dynamic pressure developed at the compressor discharge volute, causing localized reverse fluid flow through the impeller accompanied with loud noise and mechanical stresses. Opening the hot gas bypass valve, and keeping the vanes at a calculated position according to head mitigates surge. Keeping the compressor out of surge is the function of the anti-surge subsystem. The anti-surge system is based on a straight-line approximation of the compressor surge curve.



LD15231

FIGURE 20 - SYSTEM ANTI-SURGE

The anti-surge line is biased to the right of the actual surge line. When the compressor needs to move left on the map, and move less mass flow, the vanes can only be reduced so far, before a lack of mass flow causes a surge condition. The anti-surge system supplements

mass flow to the compressor by using the Hot Gas Bypass valve. This allows the chiller to be unloaded without danger of surge. Once the anti-surge system has been set for the maximum head condition, and the minimum head condition, the compressor is protected from surge. The point represented by the intersection of PD1 and MVP1 is the worst case operating condition of the compressor, with high head and low load. The other condition that defines the anti-surge line is at low head and low load, represented by the intersection of PD2 and MVP2. The shaded area of the left side of the map is the surge area. The vanes cannot close more than a given percentage for a given head condition, defined by this line. As the capacity control system unloads the chiller, the Hot Gas Bypass valve is opened proportionally to maintain stable operation and control the process.

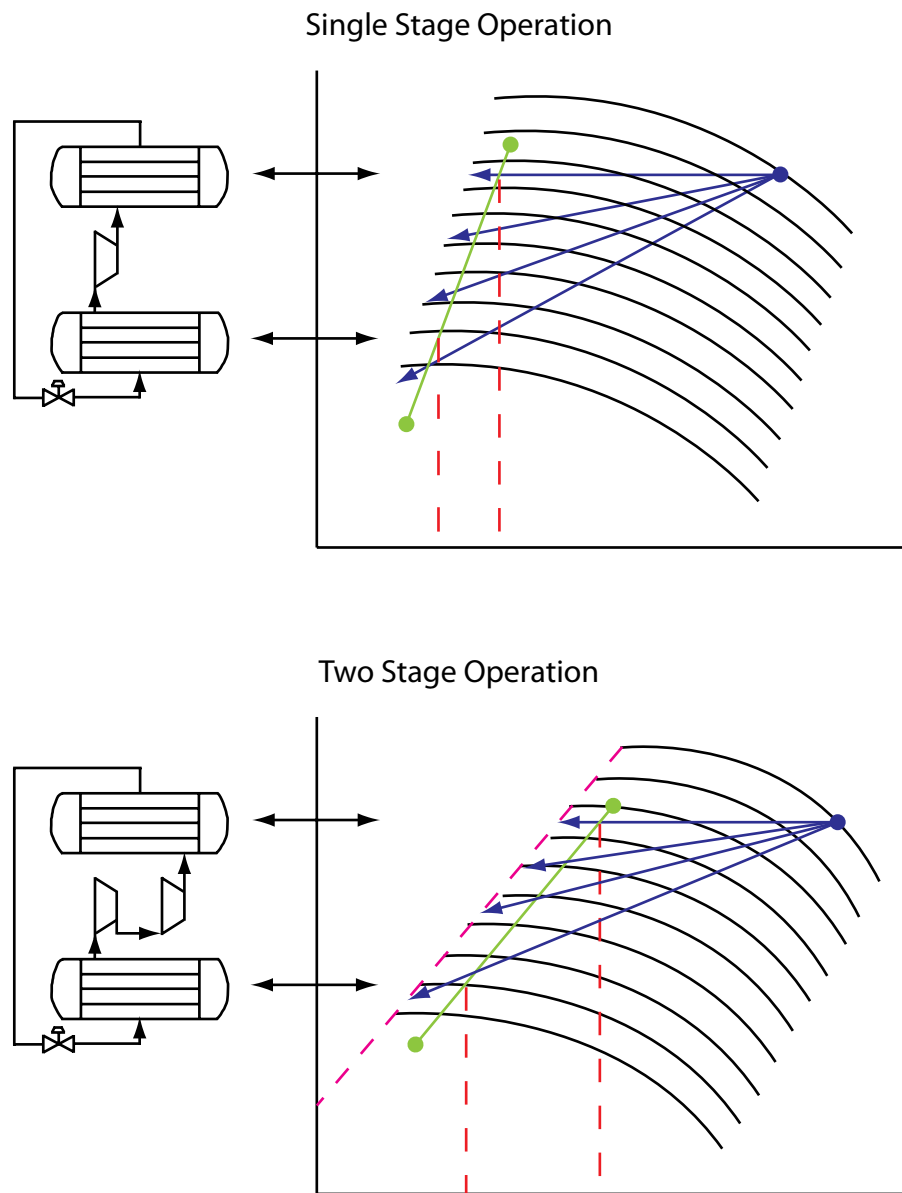
There are two sets of parameters for anti-surge. One set defines the map of the single stage compressor system, another set defines the 2-stage operating mode with both compressors running.

Anti-surge override acts at HSR-1 on the capacity controls diagram.



LD15298

FIGURE 21 - PARAMETERS FOR ANTI-SURGE



LD15278

FIGURE 22 - STAGE OPERATIONS

Anti-Surge Calculation

The anti-surge tuning values are based on estimated part load conditions and minimum vane signals required at these conditions to prevent unstable operation (surging):

	Compressor Differential (Head) Pressure	Minimum PRV Signal Setpoint for Stable Operation
High Head (PD1)	185 psid	MVP1 = 35% Open
Low Head (PD2)	120 psid	MVP2 = 12% Open



It is very important that this control be adjusted to suit chiller operating conditions to achieve maximum efficiency of operation.

ANTI-SURGE TUNING

Repeat this procedure for both LS ANTI-SURGE CALC and 2-STAGE SYSTEM ANTI-SURGE CALC, sets of parameters.

- With the chiller running in automatic, take the condensing conditions to the highest inlet temperature attainable in the system (without tripping on high discharge pressure). Increase tower inlet temperature or reduce tower flow.
- At the highest condensing temperature, start reducing the load on the chiller, by reducing the flow, or decreasing the inlet temperature. This will cause the capacity control system to back the vanes in an unload sequence.
- If the chiller surges before the Hot Gas valve begins to open, then the anti-surge line must move right on the map.
- If the chiller never surges down to minimum load, then the anti-surge parameters are adequate for protection, but may not be most efficient.
- During the unload sequence, record the operating head as PD1.
- Increasing and decreasing the parameter MVP1 will move the anti-surge line right and left on the map. Listen for a surge, and move the anti-surge line right several percent, to increase refrigerant flow, by supplementing hot gas.

- Repeat the procedure for low head operation.
- At the lowest condensing temperature, start reducing the load on the chiller, by reducing the flow, or decreasing the inlet temperature. This will cause the capacity control system to back the vanes in an unload sequence.
- If the chiller surges before the Hot Gas valve begins to open, then the anti-surge line must move right on the map.
- If the chiller never surges down to minimum load, then the anti-surge parameters are adequate for protection, but may not be most efficient.
- During the unload sequence, record the operating head as PD2.
- Increasing and decreasing the parameter MVP2 will move the anti-surge line right and left on the map. Listen for a surge, and move the anti-surge line right several percent, to increase refrigerant flow, by supplementing hot gas.

The plant condenser water control system will determine the actual high and low head conditions depending on the range of condenser water temperature allowed.

If actual operating conditions are different than those shown above, you must enter the new values for the anti-surge parameter calculation to produce the required output signals as shown in the following example:

	Compressor Differential (Head) Pressure	Minimum PRV Signal Setpoint for Stable Operation
High Head (PD1)	?? psid / ?? bar	MVP1 = ??% Open
Low Head (PD2)	?? psid / ?? bar	MVP2 = ??% Open

The “ANTI-SURGE MIN PRV POS” output (Y%) is calculated based on the actual calculated differential pressure (head) as follows:

$$PD \text{ (Head)} = (\text{Compressor Discharge Pressure}) - (\text{Evaporator Pressure})$$

$$Y\% = (PD - PD2) \times (MVP1 - MVP2) / (PD1 - PD2) + MVP2$$

$$\text{at High Head (92 psid), } Y\% = (92 - 40) \times (38 - 12) / (92 - 40) + 12 = 38\%$$

$$\text{at Medium Head (66 psid), } Y\% = (66 - 40) \times (38 - 12) / (92 - 40) + 12 = 25\%$$

$$\text{at Low Head (40 psid), } Y\% = (40 - 40) \times (38 - 12) / (92 - 40) + 12 = 12\%$$

Hot Gas Control Tuning

The “HOT GAS CONTROL” is automatically adjusted to achieve full hot gas (100% output change) as a decreasing load causes the “CHILLED WATER OUT TEMP. CONTROL” output to drop below the “ANTI-SURGE (MIN. PRV POSITION)” output to 0%.

The “HOT GAS CONTROL” output is calculated based on the “ANTI-SURGE (MIN PRV POSITION)” output signal and the actual capacity control signal (input %) as follows:

$$\text{Output \%} = 100 \times \text{LSR-3 \%} / \text{HSR-2 \%}$$

If the chiller was operating at the above low head condition (HSR-2 = 12%), the outputs would be as follows as the load decreases causing the capacity control signal to drop to 0%.

Capacity Control Signal at 12%

$$\text{Output \%} = 100 \times 12 / 12 = 100\% \text{ (Valve Fully Closed)}$$

Capacity Control Signal at 5%

$$\text{Output \%} = 100 \times 5 / 12 = 41.7\% \text{ (Valve Partially Open)}$$

Capacity Control Signal at 0%

$$\text{Output \%} = 100 \times 0 / 12 = 0\% \text{ (Valve Fully Open)}$$

Load Matching Control

Load matching is the control system that controls the vane operation of the High Stage compressor. This programmed control function uses the Low Stage motor load as a Setpoint signal. The process variable is the High Stage motor load. It uses proportional plus reset control to provide an output signal which increases as the current goes above the setpoint to open the High Stage Vanes and maintain a balance of compression ratios. Conversely, this option can be deactivated in favor of a fixed offset vane control, which is sometimes better with variable loads. The load matching control can be trimmed with a bias to attain an optimum interstage operating condition, for the economization cycle of the economizer.

Capacity Controls Tuning

The PID controls are configured using the following tuning parameters:

SP = Setpoint

P = Proportional

I = Integral Gain / Reset Time (Minutes/Repeat)

D = Derivative Gain / Rate (Minutes)

The tuning values are estimated only and may require adjustment depending on actual chiller operating conditions. See “Graphic Display Description” for details on entering new tuning values on the “CAPACITY CONTROLS TUNING” screen.

Tuning Parameters

The PID controller calculation (algorithm) involves three separate parameters; the proportional, the integral and derivative values. The *proportional* value determines the reaction to the current error, the *integral* value determines the reaction based on the sum of recent errors, and the *derivative* value determines the reaction based on the rate at which the error has been changing. The weighted sum of these three actions is used to adjust the process via a control element such as the position of a control valve or the power supply of a heating element.

By tuning the three constants in the PID controller algorithm, the controller can provide control action designed for specific process requirements. The response of the controller can be described in terms of the responsiveness of the controller to an error, the degree to which the controller overshoots the setpoint and the degree of system oscillation.

Some applications may require using only one or two modes to provide the appropriate system control. This is achieved by setting the gain of undesired control outputs to zero. A PID controller will be called a PI, PD, P or I controller in the absence of the respective control actions. PI controllers are particularly common, since derivative action is very sensitive to measurement noise, and the absence of an integral value may prevent the system from reaching its target value due to the control action.

PID Controller Theory

This section describes the parallel or non-interacting form of the PID controller.

The PID control scheme is named after its three correcting terms, whose sum constitutes the Control Variable (CV). Hence:

$$\text{CV}(t) = P \text{ out} + I \text{ out} + D \text{ out}$$

where

P_{out} , I_{out} , and D_{out} are the contributions to the output from the PID controller from each of the three terms, as defined below.

Proportional Term

The proportional term (sometimes called *gain*) makes a change to the output that is proportional to the current error value. The proportional response can be adjusted by multiplying the error by a constant K_p , called the proportional gain.

The proportional term is given by:

$$P_{\text{out}} = K_p e(t)$$

where

P_{out} : Proportional term of output

K_p : Proportional gain, a tuning parameter

e : Error = $SP - PV$

t : Time or instantaneous time (the present)

A high proportional gain results in a large change in the output for a given change in the error. If the proportional gain is too high, the system can become unstable. In contrast, a small gain results in a small output response to a large input error, and a less responsive (or sensitive) controller. If the proportional gain is too low, the control action may be too small when responding to system disturbances.

In the absence of disturbances, pure proportional control will not settle at its target value, but will retain a steady state error that is a function of the proportional gain and the process gain. Despite the steady-state offset, both tuning theory and industrial practice indicate that it is the proportional term that should contribute the bulk of the output change.

Integral Term

The contribution from the integral term (sometimes called *reset*) is proportional to both the magnitude of the error and the duration of the error. Summing the instantaneous error over time (integrating the error) gives the accumulated offset that should have been corrected previously. The accumulated error is then multiplied by the integral gain and added to the controller output. The magnitude of the contribution of the integral term to the overall control action is determined by the integral gain, K_i .

The integral term is given by:

$$I_{\text{out}} = K_i \int_0^t e(\tau) d\tau$$

where

I_{out} : Integral term of output

K_i : Integral gain, a tuning parameter

e : Error = $SP - PV$

t : Time or instantaneous time (the present)

τ : a dummy integration variable

The integral term (when added to the proportional term) accelerates the movement of the process towards setpoint and eliminates the residual steady-state error that occurs with a proportional only controller. However, since the integral term is responding to accumulated errors from the past, it can cause the present value to overshoot the setpoint value (cross over the setpoint and then create a deviation in the other direction).

Derivative Term

The rate of change of the process error is calculated by determining the slope of the error over time (i.e., its first derivative with respect to time) and multiplying this rate of change by the derivative gain K_d . The magnitude of the contribution of the derivative term (sometimes called *rate*) to the overall control action is termed the derivative gain, K_d .

The derivative term is given by:

$$D_{\text{out}} = K_d \frac{d}{dt} e(t)$$

where

D_{out} : Derivative term of output

K_d : Derivative gain, a tuning parameter

e : Error = $SP - PV$

t : Time or instantaneous time (the present)

The derivative term slows the rate of change of the controller output and this effect is most noticeable close to the controller setpoint. Hence, derivative control is used to reduce the magnitude of the overshoot produced by the integral component and improve the combined controller-process stability. However, differentiation of a signal amplifies noise and thus this term in the controller is highly sensitive to noise in the error term, and can cause a process to become unstable if the noise and the derivative gain are sufficiently large.

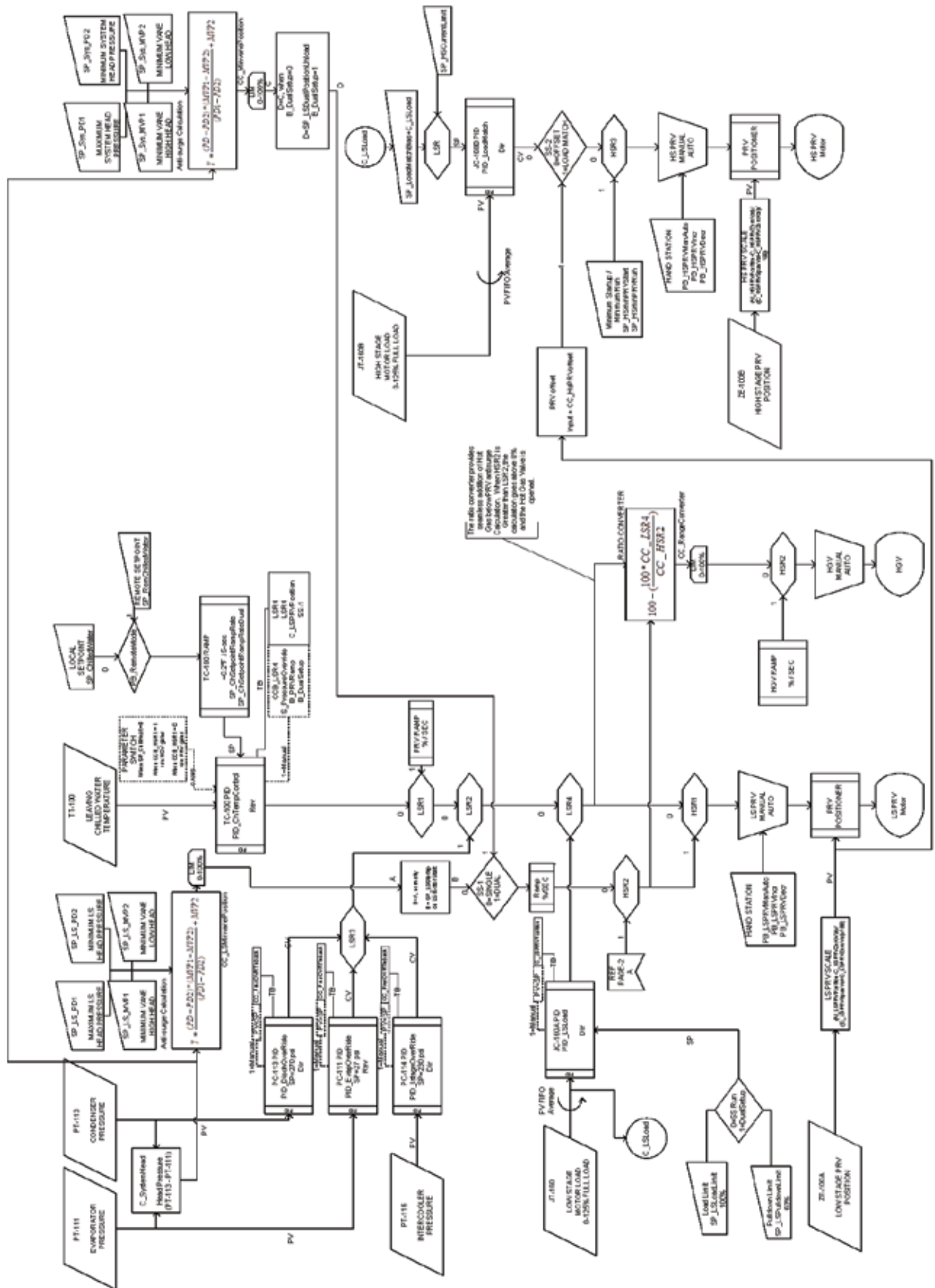


FIGURE 23 - CAPACITY CONTROL DIAGRAMS

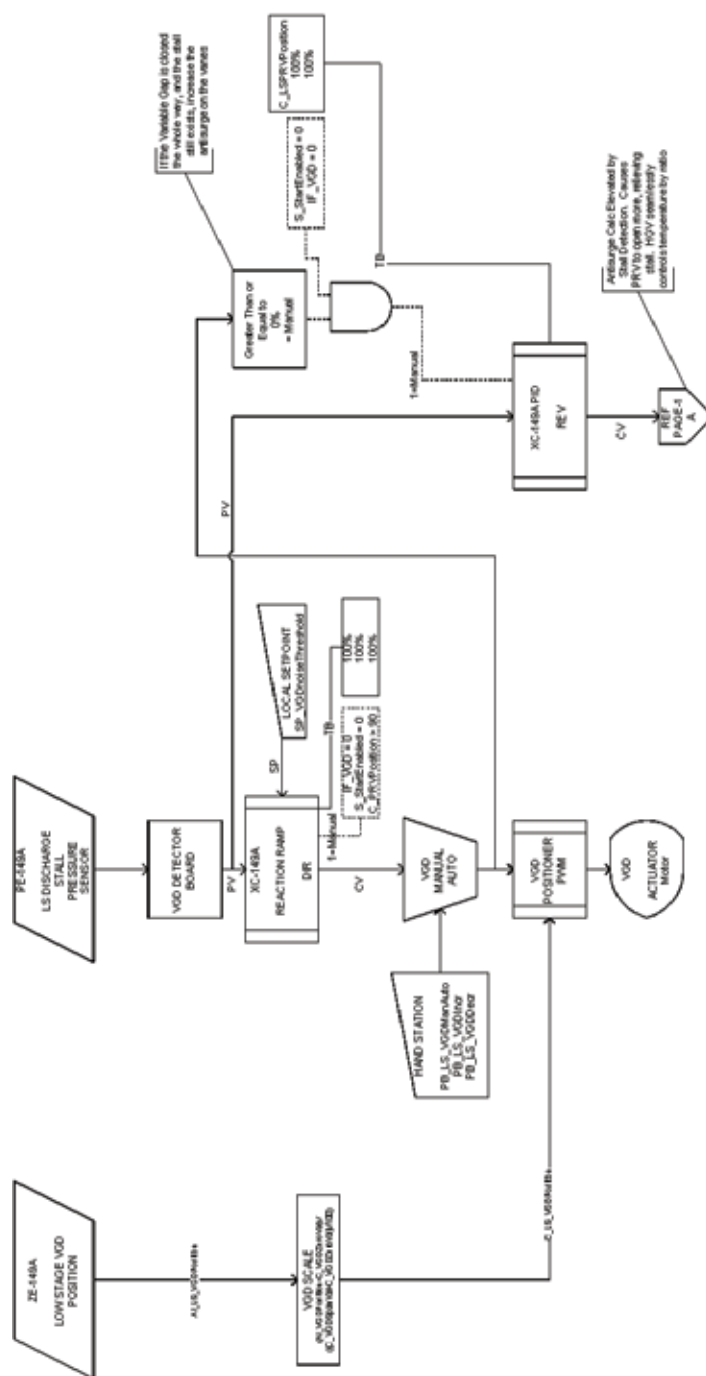


FIGURE 23 - CAPACITY CONTROL DIAGRAMS (CONT'D)

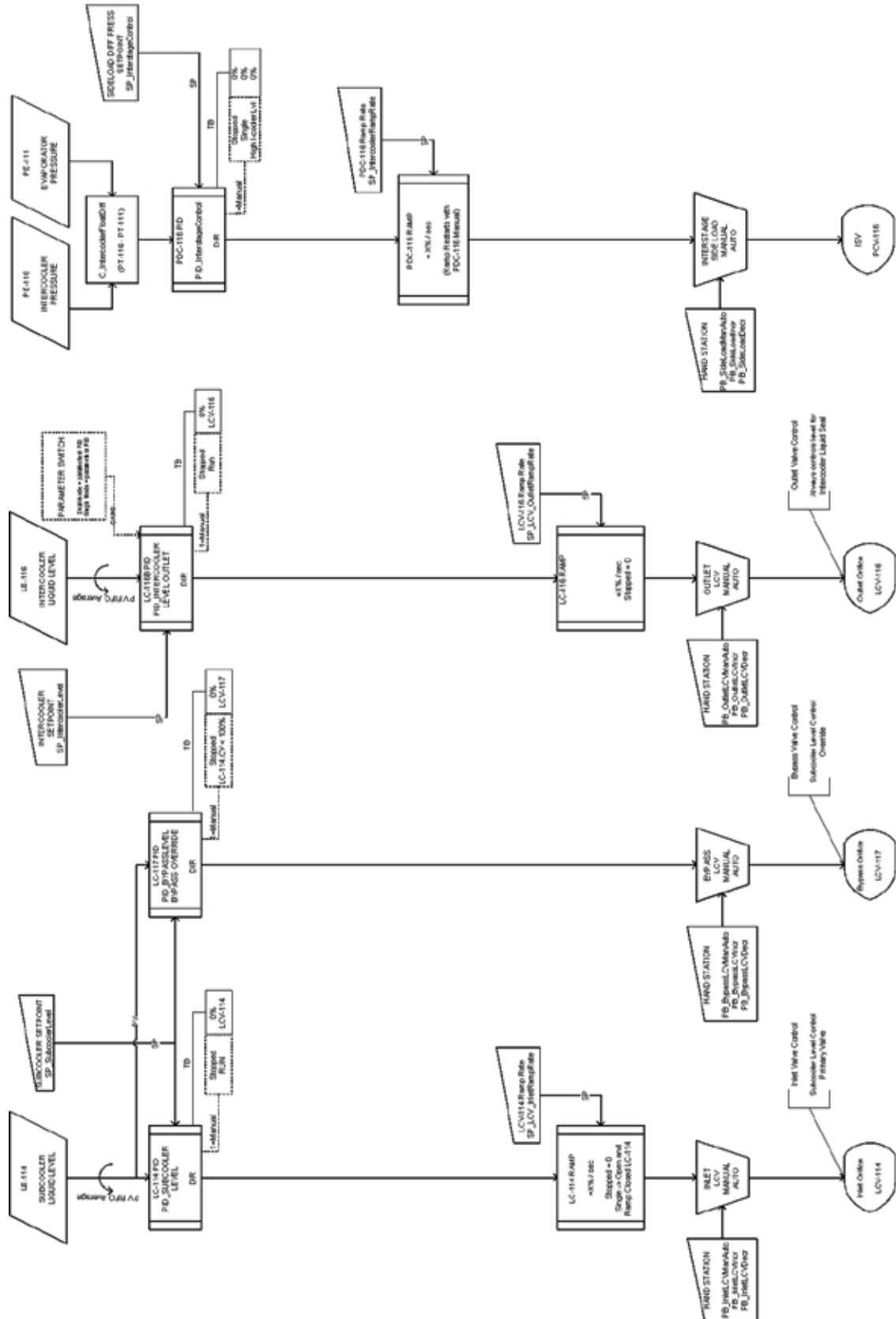


FIGURE 23 - CAPACITY CONTROL DIAGRAMS (CONT'D)

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SECTION 3 - QUANTUM LX CONTROL PANEL



FIGURE 24 - QUANTUM™ LX GRAPHIC DISPLAY

The Quantum™ LX Control Center is a microprocessor based control system for R134a centrifugal chillers. It controls the leaving chilled liquid temperature via Pre-rotation Vane controls and has the ability to limit motor current via control of the Pre-rotation Vanes. It is compatible with YORK Solid State Starter (optional), Medium voltage solid state starters, and electromechanical starters.

The panel comes configured with a full touchscreen LCD Graphic Display mounted in the middle of a keypad interface. The graphic display allows the presentation of several operating parameters at once. In addition, the operator may view a graphical representation of the historical operation of the chiller as well as the present operation. For the novice user, the locations of various chiller parameters are clearly and intuitively marked. Instructions for specific operations are provided on many of the screens.

The graphic display also allows information to be represented in both English (temperatures in °F and pressures in PSIG) and Metric (temperatures in °C and pressures in kPa or Bar) mode. The advantages are most apparent, however, in the ability to display many languages.

The Control Center continually monitors the system operation and records the cause of any shutdowns. This information is recorded in memory and is preserved even through a power failure condition. The user may

recall it for viewing at any time. During operation, the user is continually advised of the operating conditions by various status and warning messages. In addition, it may be configured to notify the user of certain conditions via alarms. A complete listing of shutdown, status, and warning messages is detailed in the DISPLAY MESSAGES portion of this manual.

There are certain screens, displayed values, programmable setpoints and manual control shown in this manual that are for Service Technician use only. They are only displayed when logged in at SERVICE access level or higher. The setpoints and parameters displayed on these screens are explained in detail in this section. These parameters affect chiller operation and should never be modified by anyone other than a qualified Service Technician. They are shown in this manual for reference only.

Also included are detailed descriptions of chiller features, such as the Refrigerant Level Control, Variable Speed Drive Oil Pump, Hot Gas Bypass, High Speed Thrust Bearing Proximity Probe, Remote Setpoints, and Standby Lubrication.

The Control Center expands the capabilities of remote control and communications. By providing a common networking protocol through the Building Automation System (BAS), YORK Chillers not only work well individually, but also as a team. This new protocol allows increased remote control of the chiller, as well

as 24-hour performance monitoring via a remote site. In addition, compatibility is maintained with the present network of BAS communications. The chiller also maintains the standard digital remote capabilities as well. Both of these remote control capabilities allow for the standard Energy Management System (EMS) interface:

1. Remote Start
2. Remote Stop
3. Remote Leaving Chilled Liquid Temperature Setpoint adjustment (0 to 10VDC, to 4 to 20mA).
4. Remote Condenser Water Setpoint adjustment (0 to 10VDC, or 4 to 20mA).
5. Safety Shutdown Contacts

The chiller operating program resides in the Control Center Microboard. The Quantum™ LX Control Center could be equipped with either of the following boards:

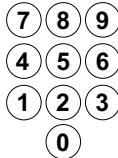
- Prior to 2011 the BCM motherboard 025-43703-000 was supplied.
- Chillers shipped after January of 2011 use an Avantech motherboard 025-44606-001. Any replacements in the field will use the upgrade kit 025-44606-000.

Navigating The Control Panel

Navigation through the various screens of the operator interface panel is highly intuitive. The touchscreen allows the user to select from the available screen displays and make setpoint adjustments.

The following is a list of the labeled keys on the keypad and the actions that occur when they are pressed.

KEY	FUNCTION
	STOP - When the compressor is running in <i>Manual Mode</i> , pressing this key immediately stops the compressor by placing it into Stop Mode. The compressor is stopped regardless of any other conditions.
	START - When in <i>Manual Mode</i> , this key places the compressor unit into the Start Mode for running.
	UNLOAD VALUE - Not Used

	LOAD VALUE - Not Used
	ALARM SILENCE - Immediately silences a sounding alarm and turns off the alarm annunciation device that is connected to this panel.
	MANUAL - Not Used
	NUMERALS [0 - 9] - The numerical keys are used to enter a value in a data field.
	DECIMAL [.] - This key is used when entering a decimal value in a data field.
	[+ /-] - When changing a value in a data field, this key toggles the value between negative and positive.
	BACKSPACE - Pressing this key will cause the current location of the cursor to backup one position per key depression. When changing a value in a data field, this key will delete the selected character.
	UP ARROW - Provides upward navigation within the <i>MAIN MENU</i> window.
	TAB - When in the mode of changing setpoints, pressing this key will cause the cursor to jump to the next data entry field.
	LEFT ARROW - When in the mode of changing setpoints, this key is used to go to the previous data entry field. When the <i>MAIN MENU</i> is shown, pressing this key will cancel the window.
	DOWN ARROW - Provides downward navigation within the <i>MAIN MENU</i> window.
	RIGHT ARROW - When in the mode of changing a data entry field, this key is used to go to the next character.
	ENTER - When changing data in a data entry field, this key will accept the change. This key is also used to select items on Menu Windows.
	SUBMIT - After changing a setpoint value, use this key to enter (submit) the change.
	MENU - Calibrate Touch Screen

SCREEN SELECTION

Graphical, animated screens display data and provide a means for accessing various system components. Screens indicate all aspects of operation and sensor data pertaining to the particular component depicted.

At the top of each main screen is displayed the system status, present date and time, local or remote control source and system access level. Sub-screens may also be available for some system components, providing additional data access. Screens are selected by selecting the touch cell with the screen name on it.

Display Features

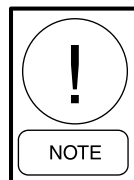
Display features are those that are available for viewing only, and include read-only parameters such as temperatures and pressures. Display features may be given as numerical values or graphics in the form of bar graphs, red indicator lights, or animated graphs.

Interactive Screen Features

Various aspects of chiller operation may be adjusted by the operator within the appropriate screen. Touch keys allow the operator to select a key appropriate to the adjustments required. Some interactive controls are depicted graphically while others, such as setpoints, appear as entry fields in which the operator may enter values directly.

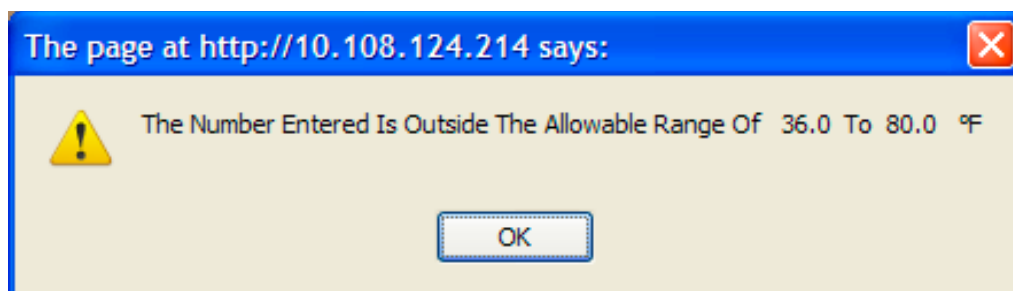
Programmable Features

The setpoints define the operation and limits of the chiller. These setpoints can be changed by operators in the field. These setpoints are stored on the compact Flash card.



Setpoints are not lost after power is interrupted. However, we suggest that a list of Setpoints be recorded and stored safely to facilitate reentry, in case there is a need to return to the original settings.

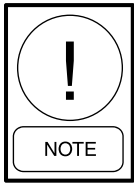
1. The data entry fields are identified by a black box with a white interior. The data is shown in black text. When on a screen that has adjustable setpoints, tab  to the setpoint box that you wish to modify (or select it on a web browser). Once the data field has been selected, the background turns blue, and the text turns white.
2. The current value of that setpoint is shown. Use the keypad to enter the new value. Typing a new value will completely erase the old value.
3. Press the keypad ENTER  key to input the new data in the data entry field and to move to the next data entry field.
4. Once all entries/changes have been made, pressing the SUBMIT  key will save the setpoint changes to memory.
5. If the value is out of bounds, an error message box displays the proper range of values. Press the OK touch key to acknowledge the error message. Re-enter a correct value.



LD15326

FIGURE 25 - ALLOWABLE RANGE

Programmable features are supplied as entry fields (Black Letters in a White Box) into which numeric values may be entered. These include setpoints and PID tuning parameters as well as setpoint values and anti-surge parameters.

The chiller Control System has four access levels: VIEW, OPERATOR, SERVICE and FACTORY. This instruction is intended only as a service manual. As such, screens depicted here are the system parameters available at the SERVICE and FACTORY levels of access, which require user login.

The system is provided with four levels of security access.

User Access Level 0: VIEW

The View mode allows non-setpoint screens to be viewed, but no setpoints to be changed. The View mode may not take manual control of the capacity devices.

User Access Level 1: OPERATOR

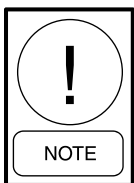
Operator is the privileged user. The operator may look at any status item, but may not access safety setpoint screens. The operator also may change the chilled water and demand limit setpoints. The operator may use the Manual / Auto stations. The Operator user's password is 9675

User Access Level 2: SERVICE

The service user is privileged to access any chiller screen. This user may also change setpoints. Service level may adjust tuning parameters, and perform general configuration and setup functions

User Access Level 3: FACTORY

This user is privileged above all other users. Factory level may adjust Scaling, Input / Output assignments, or Alarm and Shutdown settings.



System adjustments should be performed only by a qualified service person. Read all instructions carefully before making adjustments

User Login

In order to gain access to service authorized features, it is necessary to log into the system. On the home screen is the **LOGIN** key. Selecting this key brings up a display depicting the control panel keypad. Enter the user access level and then the password and press the return key on the keypad. The System Status display at the top of the screen shows the current login access level.

Pressing **LOGOUT** on the Home screen will log out the current user and return the access level to VIEW.

Manual Automatic Stations

Manual automatic stations allow analog control of valves and vanes. The analog process control system is based on a 0 – 100% range. The automatic control system drives the valve or vanes with a percentage of drive signal. The operator interface allows an experienced technician to take manual control of a device. Pressing the button marked AUTO toggles the device into a manual control state. The button turns red and the word MANUAL appears. Pressing MANUAL will toggle the device into an automatic state.

While in manual control, the OPEN (INCREASE) or CLOSE (DECREASE) buttons may be used to manipulate the valve or vane. The bar graph on the right shows the actual position of the valve or vane. The automatic bar graph shows where the automatic control system wants the device to be.

To provide a bumpless transfer of manual back to automatic operation, devices such as the Low Stage PRV's must be above antisurge to return to automatic operation. The Hot Gas Bypass valve shown in this example has an inhibit function. The Hot Gas Valve must be within 5 percent of its automatic value before it can be returned to automatic operation.

Screen Indicators

On (engaged) and Off (disengaged) signals are represented by "LED" symbols. A red LED symbol is ON , and a grey LED symbol is OFF .

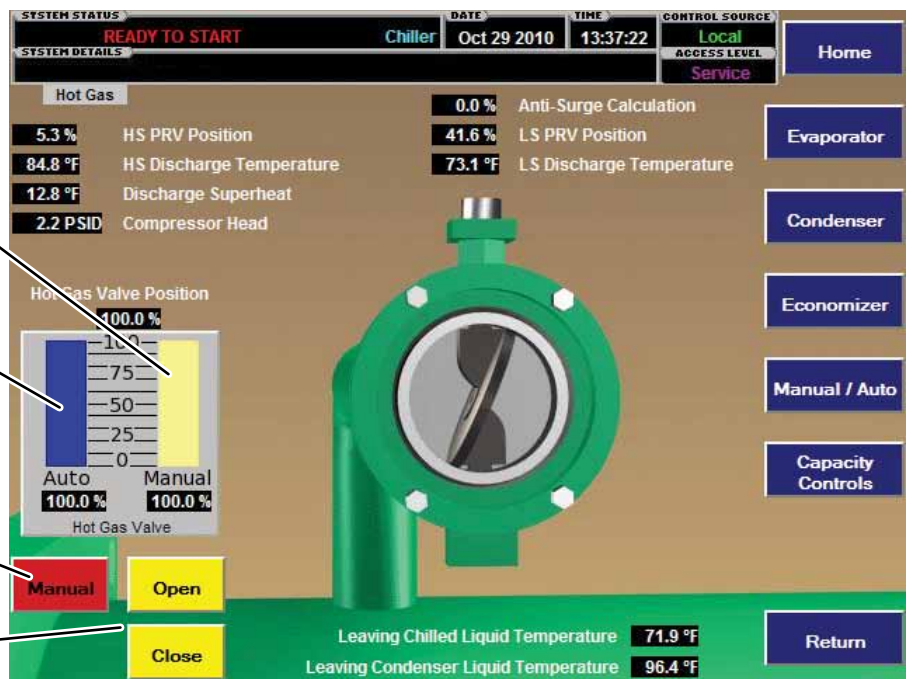
The Shutdown Trip indicator will remain in the alarm state until the RESET pushbutton is pressed after the conditions have returned to normal.

MANUAL control
value displayed
here

AUTOMATIC control
value displayed
here 0-100% open
of valve position

Pressing toggles
between AUTO
and MANUAL
mode

OPEN or CLOSE
valve by pressing



LD15283

FIGURE 26 - MANUAL AUTOMATIC STATIONS

Status Bar

The status bar will indicate the running condition of the unit. The leftmost top SYSTEM STATUS area describes the operational mode. The right portion of this block states whether the capacity controls are configured for CHILLER operation or HEAT PUMP operation.

The SYSTEM DETAILS block at the bottom shows alarm messages. Pressing **SYSTEM RESET** on the Home screen will attempt to reset any alarms or trips.

EXAMPLE 1



LD15327

EXAMPLE 2



LD15328

The main status indicator bar at the top of the screen will display the SYSTEM STATUS with the following messages:

TABLE 8 - SYSTEM DETAILS

SYSTEM STATUS	MESSAGE
READY TO START	Unit is ready to start in Local Mode
REMOTE START ENABLED	Unit is ready to start in Remote Mode
START / LS PRELUBE = XXX sec	Locally initiated start / Prelube cycle
REM START / LS PRELUBE = XXX sec	Remote initiated start / Prelube cycle
SYSTEM RUNNING 2-STAGE	System Running with two stages
SYSTEM COASTDOWN = XXX sec	System stopping / Postlube cycle
SYSTEM TRIPPED	System Tripped Offline
ANTIRECYCLE = XX:XX	Anti-recycle Countdown
LOW STAGE RUNNING	Unit running with One stage only
VANES CLOSING	Control Stop initiated
REMOTE LOCKOUT	Remote mode selected / not confirmed
HS START / PRELUBE = XX sec	High Stage booster is starting
RUNNING / DYNAMIC OVERRIDE	System Running but override in control
FAULT / ERROR	Processor is not responding

Web Browser

The web browser interface can be viewed from any desktop or laptop computer, which has access to the network that the compressor panel is attached to. To change screens, setpoints, etc., you simply use a mouse and the keyboard to view and change data. All screens that are shown will have a several buttons on the right hand side of the screen. Most screens will have four buttons, and one setpoint box. The three buttons are:

[Start Refresh] [Stop Refresh] – This button(s) appears immediately below the [Menu] button. This is actually a toggle button, as it changes function from Start Refresh to Stop Refresh each time it is clicked on. When the button shows as Start Refresh, a setpoint box will appear below it, with a time value displayed. The time value determines how often the display screen will refresh, or update its values. This time value is defaulted to 5 seconds, which means that the display will update all values shown every 5 seconds. Depending on the network connection speed, this updating may interfere

with your ability to change data setpoints, because the screen will refresh while you are entering the data. To solve this, simply increase the refresh time. The other alternative is to toggle the Refresh Button. By pressing [Stop Refresh], screen refreshing will terminate, and the time setpoint box will reappear. In this state, the particular screen that you are viewing will never update the displayed values. Changing to another screen will show the most recent values on the new screen, and then will not update again. So in the Stop Refresh state, screens will only be updated when new screens are accessed. This feature should not be used when monitoring for data. Try to find an acceptable refresh time for the Start Refresh state.

[Submit] – After having made changes to any information, the [Submit] button must be pressed for the controller to accept the new changes. This button performs the same function as the physical [Submit] button on the panel keypad.

CONTROL CENTER



29348A

FIGURE 27 - CONTROL CENTER

INTERFACE CONVENTIONS OVERVIEW

The new graphical display on each control panel allows a wide variety of information to be presented to the user. Each screen description in this document will begin with a section entitled OVERVIEW which will describe the graphical elements on the screen and give a short summary of the functions available. Each element on the screen will then be categorized into three distinct groups: Display Only, Programmable, and Navigation. Below is a short description of what types of information are included in these groups.

The Programmable values and Navigation commands are also subject to access level restrictions as described below. For each of these elements, an indication is given to show the minimum access level required to program the value or navigate to the subscreen.

DISPLAY ONLY

Values in this group are read-only parameters of information about the chiller operation. This type of information may be represented by a numerical value, a text string, or an LED image.

PROGRAMMABLE

Values in this group are available for change by the user. In order to program any setpoints on the system, the user must first be logged in with the appropriate access level. Each of the programmable values requires a specific access level which will be indicated beside the specified value. All of the programmable controls in the system fall into one of the categories described below:

Change Setpoints

On screens containing setpoints programmable at the OPERATOR access level, a key with this label will be visible if the present access level is VIEW. This key brings up the access level prompt described above. It allows the user to login at a higher access level without returning to the HOME Screen. After login, the user may then modify setpoints on that screen.

Setpoints

The Control Center uses the setpoint values to control the chiller and other devices connected to the chiller system. Setpoints can fall into several categories. They could be numeric values (such as 45.0°F for the Leaving Chilled Liquid Temperature), or they could enable or disable a feature or function.

Manual Controls

Some keys are used to perform manual control functions. These may involve manual control of items such as the Pre-rotation Vanes, variable orifice or oil pump speed. Other keys in this category are used to initiate/terminate processes such as calibrations or reports.

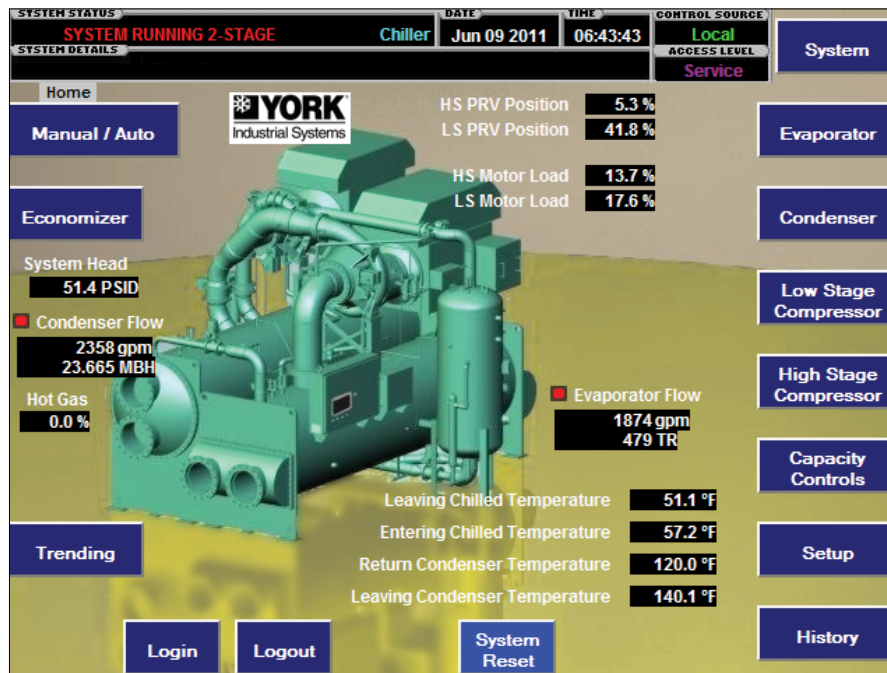
LANGUAGES

The Screens can be displayed in various languages. Language selection is done on the USER Screen. The desired language is selected from those available. Not all languages are available. English is the default language. If a language other than English is being displayed, an English-only speaking person should navigate to the USER Screen using the preceding navigation chart and select English per the USER Screen instructions in this manual.

Home Screen (*page 61*)

- System Screen (*page 63*)
- Evaporator Screen (*page 65*)
- Condenser Screen (*page 67*)
 - Subcooler Screen (*page 69*)
 - Hot Gas Screen (*page 71*)
 - Economizer Screen (*page 127*)
- Low Stage Compressor Screen (*page 73*)
 - LS Proximitor Calibration (Low And High Stages) Screen (*page 75*)
 - PRV Calibration Screen (*page 77*)
 - Oil Sump (Unified Sump Pressure) Screen (*page 79*)
 - Oil Sump (Ice Thermal Storage) Screen (*page 81*)
 - LS Variable Geometry Diffuser Screen (*page 85*)
- High Stage Compressor Screen (*page 87*)
 - HS Prox Calibration Screen (*page 89*)
 - Liquid Cooled Solid State Starter Screen (Optional) (*page 91*)
- Capacity Controls Screen (*page 95*)
 - Manual Auto Station (Capacity Control) Screen (*page 97*)
 - PID Capacity Controls Tuning Screen (*page 99*)
 - Overrides (Capacity Override Tuning Parameters) (*page 101*)
 - Anti-Surge Screen (*page 103*)
- Setup / Diagnostics Screen (*page 105*)
 - Test Outputs Screen (*page 107*)
 - Setpoints 1 Screen (*page 109*)
 - Setpoints 2 Screen (*page 111*)
 - Pressure Calibration Screen (*page 115*)
 - Temperature Calibration Screen (*page 117*)
 - Miscellaneous Calibration Screen (*page 119*)
 - Digital Input Configuration Screen (*135*)
 - Digital Output Configuration Screen (*137*)
 - Auxiliary Analog Configuration Screen (*139*)
- Economizer Screen (*page 127*)
- History Screen (*page 129*)
 - Freeze Screen (*page 131*)
- Trending Screen (*page 133*)
 - Trending Setup Screen (*page 135*)

HOME SCREEN



LD15240a

FIGURE 28 - HOME SCREEN

OVERVIEW

When the chiller system is powered on, the above default display appears. The primary values which must be monitored and controlled are shown on this screen. The HOME Screen display depicts a visual representation of the chiller itself.

DISPLAY

HS PRV Position

The High Stage PRV calibrated feedback from the PRV position potentiometer.

LS PRV Position

The Low Stage PRV calibrated feedback from the PRV position potentiometer.

HS Motor Load

Percent of High Stage rated motor load as transmitted from the motor protection relay.

LS Motor Load

Percent of Low Stage rated motor load as transmitted from the motor protection relay.

System Head

The head or lift as calculated from the condenser pressure minus the evaporator pressure.

Hot Gas

The percentage of Hot Gas Valve opening.

Liquid Temperatures

The cooling water and chilled water are measured at the waterboxes of the chiller using ICTD's.

Condenser Flow / Evaporator Flow

The red LED symbol will be on if there is water flow detected across the heat exchanger vessel.

INTERACTIVE

Blue function keys with white letters are screen navigation buttons. Screen access is limited by the security access level of the user.

Login

Pressing this button will bring up a numeric entry box. Press the number keys on the keypad to enter the access code. Press the Enter key after the code has been entered.

Logout

Pressing this button will log the user out of any advance access code, back to the VIEW level of access.

System Reset

This button will attempt to reset any alarms experienced by the control system. Alarms stay active until reset.

PROGRAMMABLE

Manual / Auto

Access Level Required: OPERATOR

Allows the operator to switch between automatic chiller control and temporary manual control of the system devices. In manual control, the device operation and position can be set as desired for troubleshooting or maintenance outside of the normal control routine.

Economizer

Access Level Required: OPERATOR

Returns the display to the Economizer Screen.

NAVIGATION

System

Used to provide additional system information.

Evaporator

A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

Low Stage Compressor

This screen displays data about the Low Stage Compressor.

High Stage Compressor

This screen Displays data about the High Stage Compressor.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

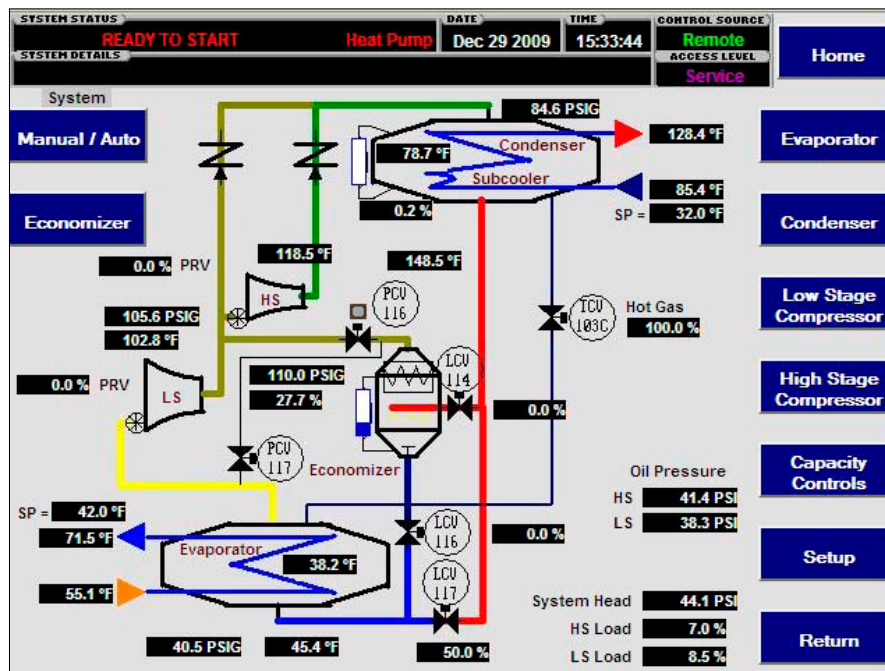
Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

History

This screen provides access to a Time stamped Record of shutdown conditions.

SYSTEM SCREEN



LD15241

FIGURE 29 - SYSTEM SCREEN

OVERVIEW

The system screen of the CYK chiller is a process flow representation of the refrigerant circuit. It shows key pressures, temperatures, levels, and actuator positions around the system at a glance.

DISPLAY

Hot Gas

Displays the percent open valve position of the Hot Gas Valve.

Oil Pressure

Displays the compressor oil pressure.

System Head

Displays the differential pressure across the system.

HS Load

Displays the motor percent amp load.

LS Load

Displays the motor percent amp load.

PROGRAMMABLE

Manual / Auto

Access Level Required: OPERATOR

Allows the operator to switch between automatic chiller control and temporary manual control of the system devices. In manual control, the device operation and position can be set as desired for troubleshooting or maintenance outside of the normal control routine.

Economizer

Access Level Required: OPERATOR

Returns the display to the Economizer Screen.

NAVIGATION

Home

Used to provide additional Home information.

Evaporator

A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

Low Stage Compressor

This screen displays data about the Low Stage Compressor.

High Stage Compressor

This screen Displays data about the High Stage Compressor.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

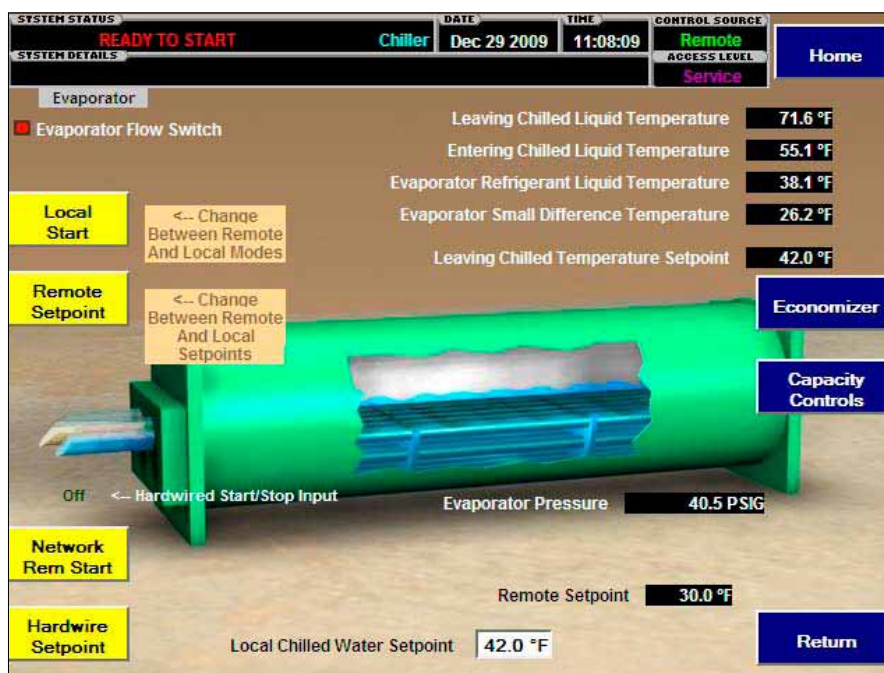
Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

Return

Returns the display to the previous screen.

EVAPORATOR SCREEN



LD15242

FIGURE 30 - EVAPORATOR SCREEN

OVERVIEW

The Evaporator screen shows the parameters associated with the cooler heat exchanger. Flow is indicated by the red LED symbol. Leaving and Entering water temperatures are shown, along with evaporator refrigerant temperature and pressure. The small difference temperature is calculated from the difference between the leaving process liquid and the evaporator refrigerant temperature. A high small difference temperature could indicate fouled tubes or improper charge. The remote chilled water setpoint is also shown for reference.

The ACTIVE leaving chilled water setpoint is shown for reference in the center of the screen.

DISPLAY

Leaving Chilled Liquid Temperature

Displays the temperature of the liquid as it leaves the evaporator.

Leaving Chilled Temperature Setpoint

Displays the present setpoint to which the chiller is operating, whether controlled locally or remotely.

Evaporator Pressure

Displays the present refrigerant pressure in the evaporator.

PROGRAMMABLE

Local Chilled Water Setpoint = XX.X

Access Level Required: OPERATOR

Pressing this button will allow the user to change the leaving chilled water setpoint. Water duty machines are limited to a minimum of 36°F leaving to prevent freezing. Brine duty machines are limited to the specific temperature of the brine concentration. Press Submit to confirm the new setpoint.

INTERACTIVE

Local Start / Remote Start

Access Level Required: SERVICE

This button toggles between a Locally initiated start from the chiller control panel START button, and a remote start from an external source.

Local Setpoint / Remote Setpoint*Access Level Required: SERVICE*

This button toggles between the local setpoint as defined by this screen, or a remotely defined setpoint from another source.

Network Remote Start / Hardwired Remote Start*Access Level Required: SERVICE*

This button toggles between the sources of the remote start signals. They can either come from the START command from across the network, or from Channel 8 input on the second digital input module. The remote status of the signal is shown above this button.

- The remote START word is: A-B **N119:10** or **Modbus 00001** (write a 1 to start)
- The remote STOP word is: A-B **N119:11** or **Modbus 00002** (write a 1 to stop)

When in Hardwired start mode, opening the Hardwired contact initiates a controlled stop.

- Remember remote Start / Stop / System Reset across the communications network must be set to Logic **HIGH** momentarily to initiate the command. The bit must be returned to Logic **LOW** after the command has been received.

Network Remote Setpoint / Hardwired Setpoint*Access Level Required: SERVICE*

This button toggles between the source of the remote setpoint. It can either be sourced from A-B **N102:98** or **Modbus 47299** across the network, or from a remote analog signal shown on the wiring diagram. Remember that analog values are times 10.

When the system is configured for remote starts, a message will appear “Please Press LOCAL START button to enable Remote Starts”. Pressing the local start button on the panel after remote starts has been enabled insures the safety of the operator, so that no remote user can start the chiller without a local operator’s knowledge. The message will then change to “Remote Starts Permitted until Mode is changed to LOCAL or chiller trips offline”.

During a start sequence the economizer level will establish before the chiller/heat pump loads, to keep from slugging the low stage compressor. The message will appear “PRV RAMP HOLD – BUILDING ECONOMIZER LEVEL”. This will stay illuminated until the level is established.

NAVIGATION**Home**

Used to provide additional Home information.

Economizer

Returns the display to the Economizer Screen.

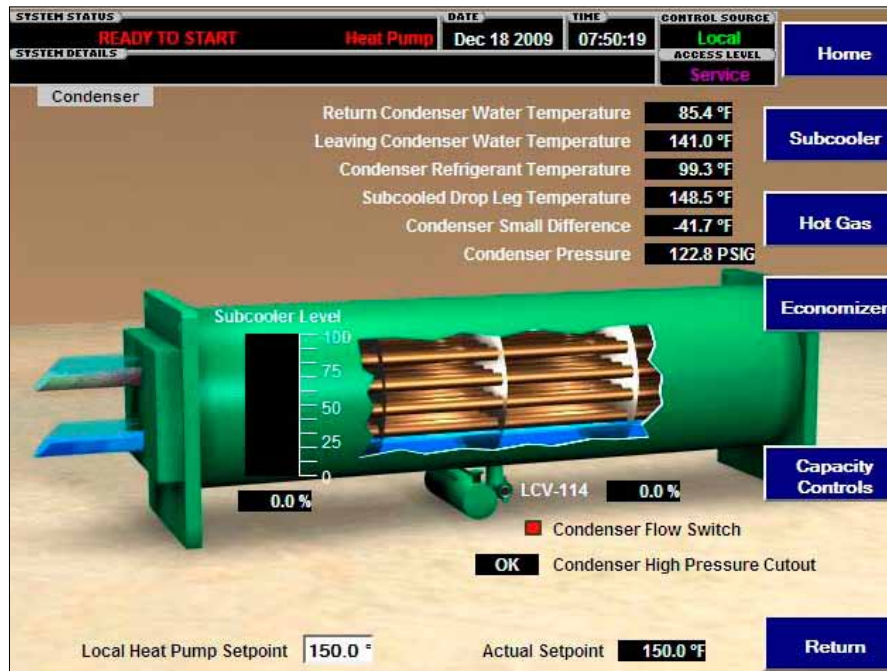
Capacity Controls

Returns the display to view the Capacity Controls Screen.

Return

Returns the display to the previous screen.

CONDENSER SCREEN



LD15243

FIGURE 31 - CONDENSER SCREEN

OVERVIEW

The condenser screen shows the operational nature of the condensing heat exchanger. The temperatures of the water entering and leaving the condenser are shown. The Condensing pressure and saturation temperature are also shown on this screen. The temperature of the subcooled liquid coming out of the drop leg of the condenser is displayed here. The conditions of the High Pressure Cutout will always be OK under normal operation. If the High Pressure Cutout switch ever shows TRIP, investigate the pressure of the condenser vessel and evaluate the integrity of the switch. This switch is installed per code with no intervening stop valve.

DISPLAY

Return Condenser Water Temperature

Displays the water temperature as it enters the condenser.

Leaving Condenser Water Temperature

Displays the water temperature as it leaves the condenser.

Condenser Pressure

Displays the refrigerant pressure in the condenser.

Condenser Flow Switch

Indicates whether flow is present in the condenser.

PROGRAMMABLE (HEAT PUMP ONLY)

Local Heating Water Setpoint = XX.X

Access Level Required: OPERATOR

Pressing this button will allow the user to change the leaving condenser water setpoint. Press Submit to confirm the new setpoint.

During a start sequence the economizer level will establish before the chiller/heat pump loads, to keep from slugging the low stage compressor. The message will appear "PRV RAMP HOLD – BUILDING ECONOMIZER LEVEL". This will stay illuminated until the level is established.

NAVIGATION

Home

Used to provide additional Home information.

Subcooler

Returns the display to the Subcooler Screen.

Hot Gas

Returns the display to the Hot Gas Screen.

Economizer

Returns the display to the Economizer Screen.

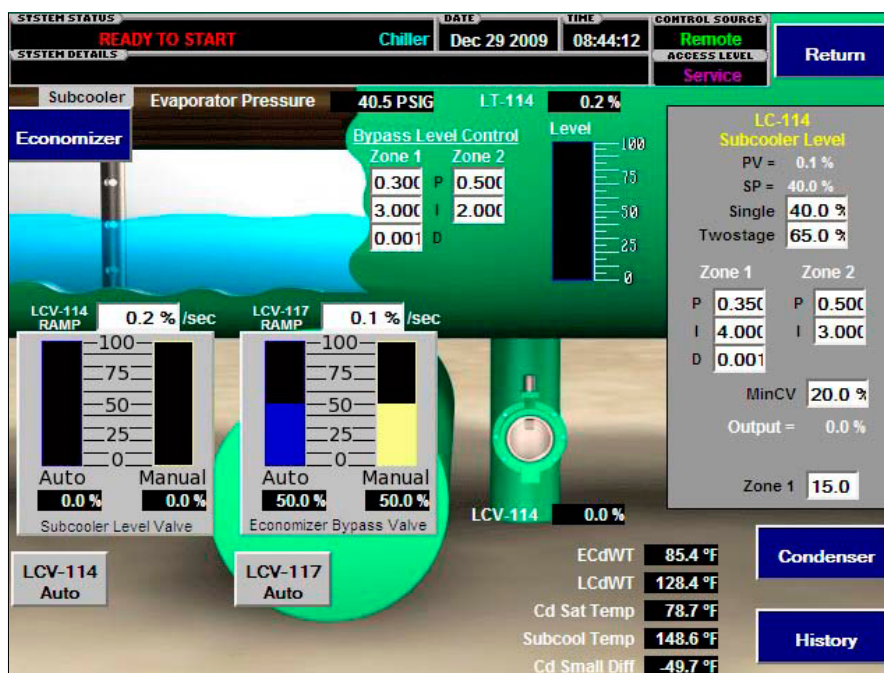
Capacity Controls

Returns the display to view the Capacity Controls Screen.

Return

Returns the display to the previous screen.

SUBCOOLER SCREEN



LD15265

FIGURE 32 - SUBCOOLER SCREEN

OVERVIEW

The Subcooler provides a cycle efficiency to the chiller by cooling the high pressure refrigerant before it passes through the high pressure expansion valve.

DISPLAY

Return Condenser Water Temperature

Displays the temperature of the condenser water returning to the condenser.

Leaving Condenser Water Temperature

Displays the temperature of the condenser water returning to the condenser.

Condenser Refrigerant Temperature

Displays the current temperature of the condenser refrigerant.

Subcooler Temperature

Displays the temperature of the refrigerant in the subcooler.

Condenser Small Temperature Difference

Displays the temperature expressed as a differential between the water leaving and the water entering the condenser.

Evaporator Refrigerant Level

(Graphical) Displays the evaporator refrigerant level in percent.

INTERACTIVE

Subcooler Valve Manual / Auto Station

Allows the operator to manually adjust the subcooler valve to the desired setting. Pressing the Auto key allows the operator to adjust the subcooler level valve from 0 – 100% open using the Increase and Decrease keys on the bottom of the display. Pressing the AUTO button when in manual adjustment mode toggles back to automatic control.

PROGRAMMABLE

LC-114 is the subcooler level control box. Parameters include:

(PV) Process Variable – Indicates the process variable value.

(SP single) Subcooler Level Setpoint – Operator uses this entry field to adjust the subcooler level setpoint when running a single stage.

(SP twostage) Subcooler Level Setpoint – Operator uses this entry field to adjust the subcooler level setpoint while running compounded in two-stage mode.

PID – Proportional variable (P), integral variable (I), and derivative variable (D).

- ZONE 1 – Is the steady state control loop gains.
- ZONE 2 – Is the transient and more aggressive control loop gains.
- DB – Deadband that defines Zone 1 and Zone 2. The DB value is the Percentage of the total range that Zone 1 tuning values are used. For example, entering 10% will define a 10% band around the setpoint where the steady state Zone 1 gains will be used.
- SUBCOOLER RAMP RATE in %/sec – When the chiller is powered on, the subcooler valve attempts to fill the subcooler at the designated rate.

- FIFO SAMPLES – Because the refrigerant represents a large fluid mass, constant wave and ripple motion pervades the fluid level measurements. The processor samples the refrigerant level once every 10 milliseconds, then takes the average of this number of readings.
- MIN CV – The subcooler level control valve cannot be allowed to close. The control variable signal is limited to this percentage, to keep the valve from completely closing and the unit from going down on low suction pressure.

NAVIGATION**Return**

Returns the display to the previous screen.

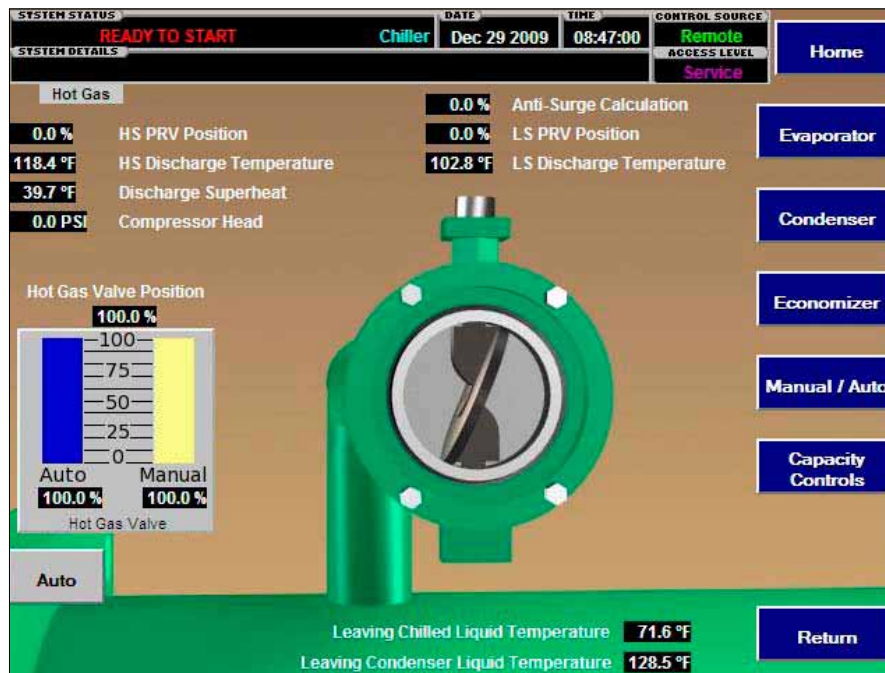
Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

History

This screen provides access to a Time stamped Record of shutdown conditions.

HOT GAS SCREEN



LD15246

FIGURE 33 - HOT GAS SCREEN

OVERVIEW

This screen displays a cutaway view of the Hot Gas Bypass Valve. The setpoints relating to the Hot Gas Bypass Control are maintained on this screen. Related Hot Gas control parameters are displayed for reference. The Hot Gas Valve can be manually controlled from this screen. Through animation, the relative valve position is displayed.

DISPLAY

HS PRV Position

Displays the position of the pre-rotation vanes in percent.

HS Discharge Temperature

Displays the compressor discharge temperature.

Discharge Superheat

Displays the temperature expressed as a differential between the discharge temperature and the condenser saturation temperature.

Compressor Head

Displays the pressure expressed as a differential between the compressor suction and compressor discharge pressures.

Hot Gas Valve Position

Displays the position of the valve in terms of percentage open.

Antisurge Calculation

Is the present minimum Low Stage vane position for the current running conditions.

LS PRV Position

Displays the position of the pre-rotation vanes in percent.

LS Discharge Temperature

Displays the compressor discharge temperature.

Leaving Condenser Liquid Temperature

Displays the temperature of the condenser liquid as the liquid exits the condenser.

Leaving Chilled Liquid Temperature

Displays the temperature of the chilled liquid as the liquid exits the evaporator.

INTERACTIVE**Hot Gas Valve Manual Auto Station**

Allows the operator to manually adjust the position of the hot gas bypass valve.

Pressing the Auto key allows the operator to adjust the hot gas valve position from 0 – 100% open using the Open and Close keys on the bottom of the display.

Pressing the AUTO button while in manual adjustment mode to toggle back to automatic control will only be accepted if the manual setting is within 5% of the automatic setting.

NAVIGATION**Home**

Used to provide additional Home information.

Evaporator

A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

Economizer

Returns the display to the Economizer Screen.

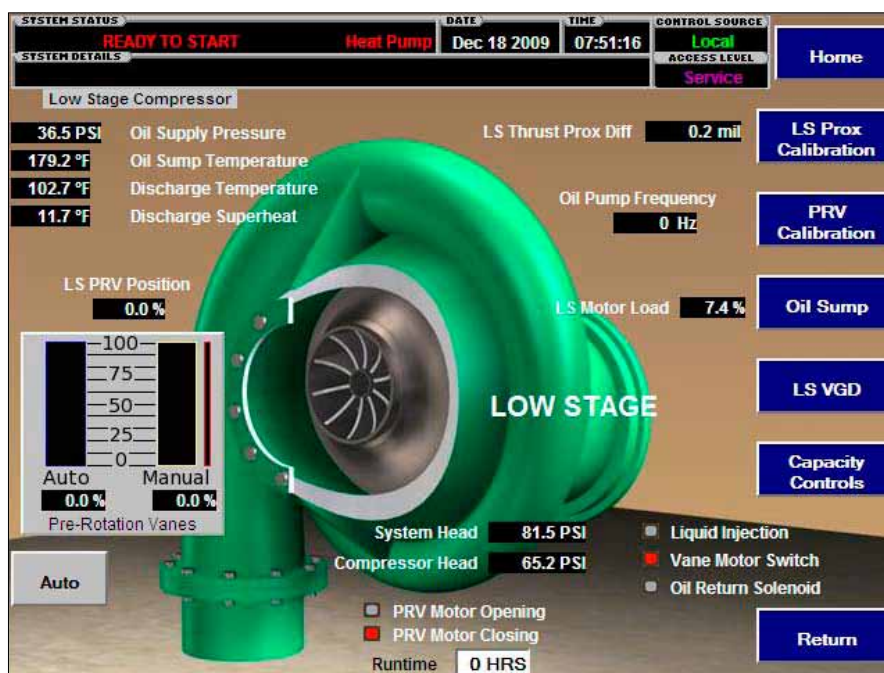
Capacity Controls

Returns the display to view the Capacity Controls Screen.

Return

Returns the display to the previous screen.

LOW STAGE COMPRESSOR SCREEN



LD15244

FIGURE 34 - LOW STAGE COMPRESSOR SCREEN

OVERVIEW

Displays data about the Low Stage Compressor.

DISPLAY

Oil Supply Pressure

Displays the pressure differential between the high side oil pressure transducer (HOP, located between oil filter output and compressor bearing input) and the low side oil pressure transducer (LOP, located between oil sump and compressor housing). The displayed value includes offset pressure derived from auto-zeroing during the system prelube. The display field will show _ _ _ when either of the transducers used to calculate oil pressure are out of range. The zero function occurs when the RESET button is pressed, the oil pumps are not running, and there are no system faults or alarms. The offset pressure is the pressure difference between the high oil pressure (HOP) transducer and the low oil pressure (LOP) transducer outputs. During this time, the transducers should be sensing the same pressure. However, due to accuracy tolerances in transducer design, differences may exist in these pressure readings.

To compensate for these differences between transducers and assure differential pressure sensing accuracy, the offset pressure is subtracted algebraically from the oil (differential) pressure value. The offset pressure calculation will not be performed if either transducer is out of range and the offset value will be 0 PSI in this instance.

Oil Sump Temperature

Displays the temperature of the oil in the sump.

Discharge Temperature

Displays the temperature of the refrigerant (vapor) at discharge of the compressor before the refrigerant enters the condenser.

Discharge Superheat

Displays the discharge superheat. This value is calculated by subtracting the condenser saturation temperature (PE-113) from the compressor discharge temperature (TE-112).

LS PRV Position

Displays the Compressors PRV open position percentage.

LS Thrust Prox Diff

Displays the distance between the high-speed thrust collar and the tip of the proximity probe. This measurement takes into account the reference position established at the time of compressor manufacture.

Oil Pump Frequency

Displays operating frequency at which Oil Pump is commanded to run.

LS Motor Load

Displays the motor current as a percentage of the Full Load Amps (FLA) value.

System Head

Displays the chiller head pressure calculated as (condenser pressure – evaporator pressure).

Compressor Head

Displays the Compressors head pressure calculated as condenser pressure minus economizer pressure.

NAVIGATION**Home**

Used to provide additional Home information.

LS Prox Calibration

Returns the display to view the LS Prox Calibration Screen.

PRV Calibration

Access Level Required: OPERATOR

Only available if the chiller is stopped, advances to the PRV Calibration Screen.

Oil Sump

Returns the display to view the Oil Sump Screen.

LS VGD

Returns the display to view the LS VGD Screen.

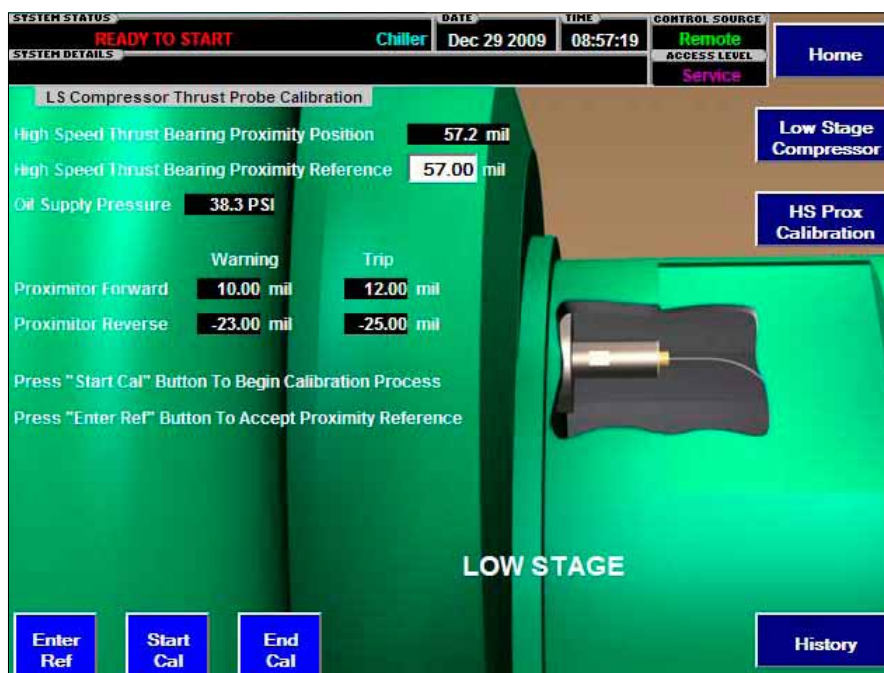
Capacity Controls

Returns the display to view the Capacity Controls Screen.

Return

Returns the display to the previous screen.

LS PROXIMITOR CALIBRATION (LOW AND HIGH STAGES) SCREEN

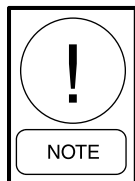


LD15244

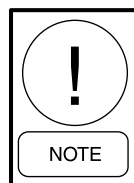
FIGURE 35 - LS PROXIMITOR CALIBRATION (LOW AND HIGH STAGES) SCREEN

OVERVIEW

At the factory, or when a compressor is replaced on a chiller, the proximity probes must be calibrated. Insure that there is oil in the oil sumps during this procedure. Navigate to this screen, and press [START CAL] to start the calibration procedure. The oil pump will produce rated pressure, and the proximity reading will be taken. This will be the reference point. Press [ENTER REF] to ACCEPT the calibration data. Press [END CAL] to end the calibration procedure.



If the difference between the actual reading and this reference exceed the alarm and trip values, and a proximitors TRIP is produced, the compressor should be evaluated for thrust bearing damage.



Any time the Quantum™ LX controller application program is updated, the axial proximitors reference values, recorded on the panel door from commissioning, must be entered into these screens.



If a compressor proximity shutdown is generated, it will be necessary to contact the YORK factory Technical Support to reset the panel to insure there is not damage to the compressor thrust bearing.

DISPLAY

High Speed Thrust Bearing Proximity Position
N/A

High Speed Thrust Bearing Proximity Reference
N/A

Oil Supply Pressure

Displays available oil pressure to the compressor.

Proximitors Forward

Warning and Shutdown limits.

Proximitors Reverse

Warning and Shutdown limits.

NAVIGATION**Home**

Used to provide additional Home information.

Low Stage Compressor

This screen displays data about the Low Stage Compressor.

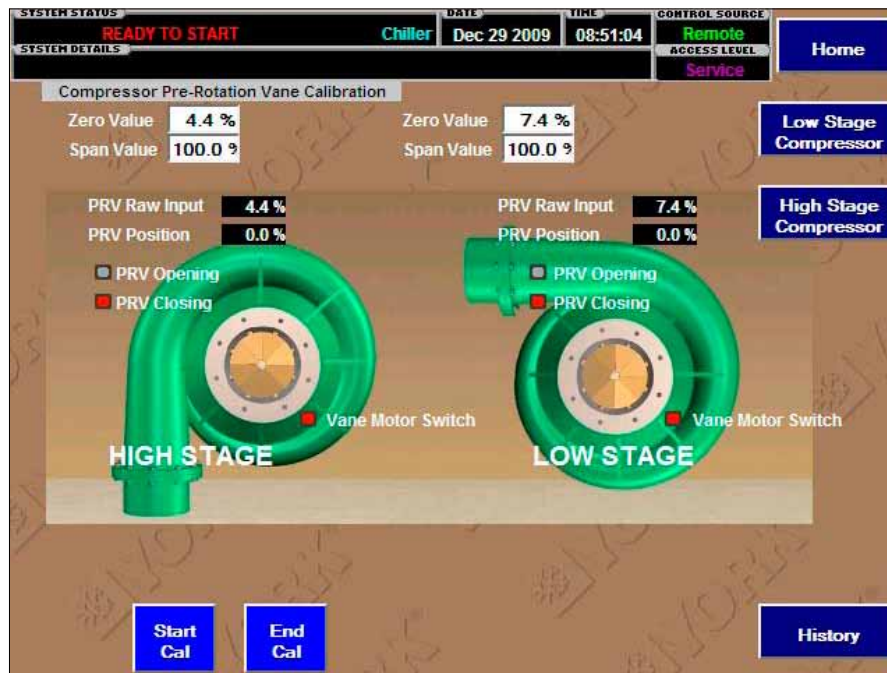
HS Prox Calibration

This screen Displays data about the HS Prox Calibration.

History

This screen provides access to a Time stamped Record of shutdown conditions.

PRV CALIBRATION SCREEN



LD15266

FIGURE 36 - PRV CALIBRATION SCREEN

OVERVIEW

If a PRV position potentiometer must be replaced in the field, the position of the potentiometer relative to the actual vane position is critical.

1. The PRV POT assembly, shown below, should first be assembled to the compressor. Next navigate to the PRV Calibration screen on the panel.
2. Loosen the Allen Set Screw on the PRV POT coupling connected to the COMPRESSOR side of the coupling. This will allow you to turn the coupling and move the potentiometer position.
3. Adjust the PRV POT position until the PRV RAW INPUT percentage reads between 10% and 20%.
4. After this reading is obtained, tighten the Allen Set Screw on the coupling, and the proceed to the calibration procedure as described below.

DISPLAY

PRV Raw Input

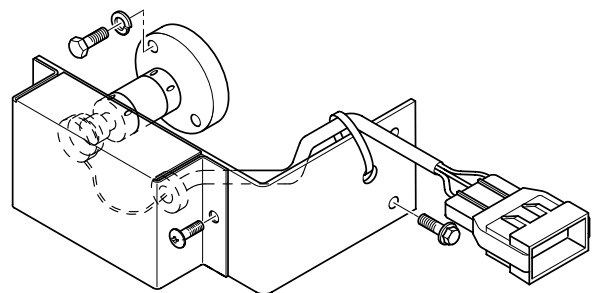
Displays the vane position signal read directly off the potentiometer.

PRV Position

Displays the real-time position of the vanes.

PRV Opening / Closing

Displays the status of the vane actuator.



LD14879a

FIGURE 37 - PRV POSITION SENSOR

Vane Motor Switch (LED)

Illuminates when the Vane Motor Switch contacts are closed (provided by PRV Closed Limit Switch ZS-100A).

Zero Value Setpoint

Access Level Required: OPERATOR

For manual calibration of the PRV; corresponds to the raw PRV potentiometer input with the vanes fully closed.

Span Value

Access Level Required: OPERATOR

For manual calibration of the PRV; corresponds to the raw PRV potentiometer input with the vanes fully open.

INTERACTIVE**[START CAL]**

Selecting this button initiates a vane position calibration algorithm.

[END CAL]

Selecting this button accepts the automated vane calibration or cancels the calibration procedure.

When START CALIBRATION is selected, a message “Vane motor stroking please wait” appears.

Press [END CAL] to accept calibration.

NAVIGATION**Home**

Used to provide additional Home information.

Low Stage Compressor

This screen displays data about the Low Stage Compressor.

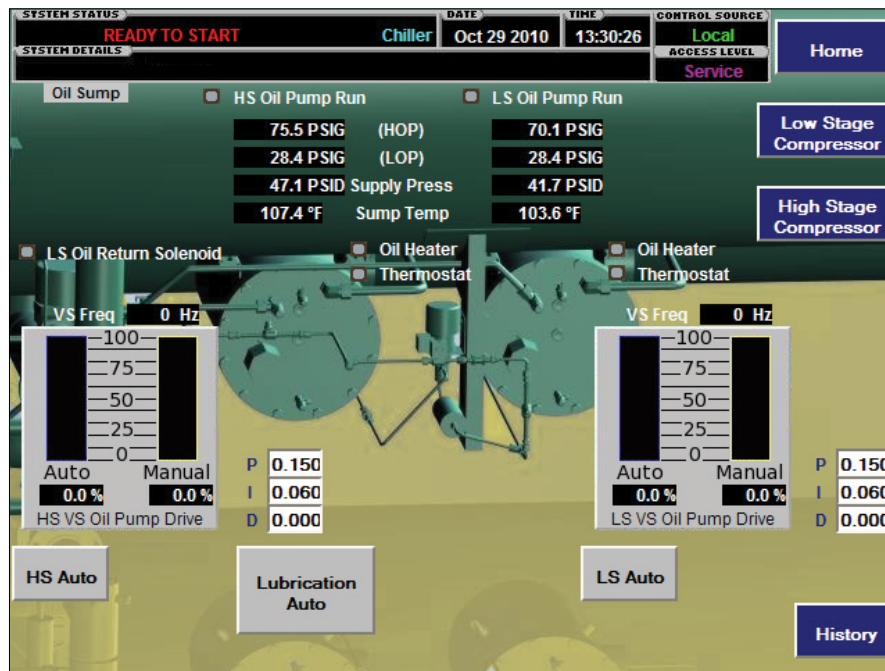
High Stage Compressor

This screen Displays data about the High Stage Compressor.

History

This screen provides access to a Time stamped Record of shutdown conditions.

OIL SUMP (UNIFIED SUMP PRESSURE) SCREEN



LD15281

FIGURE 38 - OIL SUMP (UNIFIED SUMP PRESSURE) SCREEN

OVERVIEW

This screen displays a close-up of the chiller oil sump and provides all the necessary setpoints for maintaining the Variable Speed Oil Pump (VSOP). In addition, this screen allows manual control of the frequency command sent to the VSOP.

DISPLAY

HS Oil Pump Run

Indicates the run status of the Oil Pump.

LS Oil Pump Run

Indicates the run status of the Oil Pump.

Oil Heater

Indicates the operational status of the oil heater.

LS Oil Return Solenoid

N/A

PROGRAMMABLE

HS Auto/LS Auto

Access Level Required: SERVICE

Manual automatic stations allow analog control of valves and vanes. The analog process control system is based on a 0 – 100% range. The automatic control system drives the valve or vanes with a percentage of drive signal. The operator interface allows an experienced technician to take manual control of a device. Pressing the button marked AUTO toggles the device into a manual control state. The button turns red and the word MANUAL appears. Pressing MANUAL will toggle the device into an automatic state. While in manual control, the OPEN (INCREASE) or CLOSE (DECREASE) buttons may be used to manipulate the valve or vane. The bar graph on the right shows the actual position of the valve or vane. The automatic bar graph shows where the automatic control system wants the device to be.

P

This key allows the service technician to set the proportional gain of the primary and economizer oil pumps.

I

This key allows the allows the service technician to set the integral gain of the primary and economizer oil pumps.

D

This key allows the service technician to set the derivative gain of the primary and economizer oil pumps.

NAVIGATION**Home**

Used to provide additional Home information.

Low Stage Compressor

This screen displays data about the Low Stage Compressor.

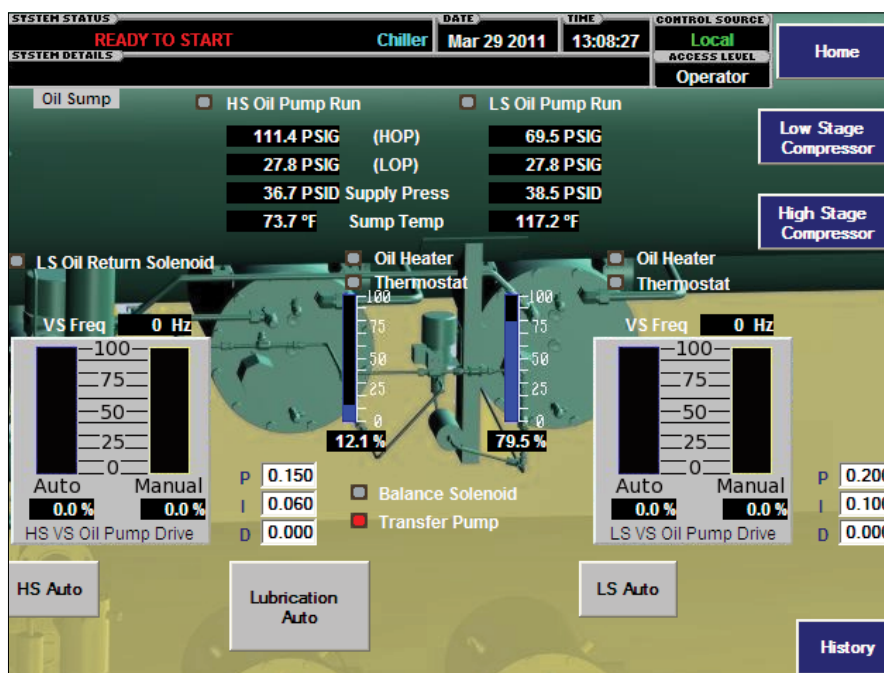
High Stage Compressor

This screen Displays data about the High Stage Compressor.

History

This screen provides access to a Time stamped Record of shutdown conditions.

OIL SUMP (ICE THERMAL STORAGE) SCREEN



LD15267

FIGURE 39 - OIL SUMP (ICE THERMAL STORAGE) SCREEN

OVERVIEW

This screen displays a close-up of the chiller oil sump and provides all the necessary setpoints for maintaining the Variable Speed Oil Pump (VSOP). In addition, this screen allows manual control of the frequency command sent to the VSOP.

DISPLAY

Oil Sump Temperature

Displays the oil sump temperature.

Oil Sump Pressure (Hop)/(Lop)

Displays the pressure at the high and low pressure sides of the oil sump.

Oil Supply Pressure

Displays the oil supply differential pressure (pump – sump).

Oil Pump Frequency

Displays the variable-speed oil pump drive frequency.

Oil Pump Run

Indicates the operational status of the oil pump.

Oil Return Solenoid

Indicates the status of the oil return solenoid.

Oil Heater

Indicates the operational status of the oil heater.

INTERACTIVE

Auto / Manual

Allows *SERVICE MODE* to manually adjust the oil pump drive speed.

Selecting Auto causes two additional screen tabs to appear. Increases the drive frequency and Decreases the drive frequency. Pressing the MANUAL while in manual control mode toggles back to automatic control.

This Manual / Auto station is not available below Service Level access.

Lubrication Auto/Lubrication Lock On

Toggles the oil pumps off/on in standby mode, producing rated oil pressure with the drives in automatic. This can be used for testing the oil lubrication circuit. This button can also be used when jogging the motors for direction.

PROGRAMMABLE**Access Level Required: SERVICE****Oil Supply Pressure Controller**

Includes proportional gain (P), integral gain (I), and differential gain (D) accessible by SERVICE level.

On Non-Unified Oil Sumps the oil transfer settings are available to the SERVICE level.

Oil Sump levels are indicated in the center of the screen. If the oil levels associated with each level alarm shown in the bottom center of the screen and alarm will be logged in the alarm history.

The purposed of the oil transfer system is to maintain equal levels of oil in each sump. If the oil levels are more than 15% different, then a transfer is initiated automatically. If the oil in the high stage sump is higher then the balance transfer solenoid is opened until the levels are equal or the LS High oil level STOP setpoint is reached. If the oil in the Low Stage is higher then the oil transfer pump is started until the levels are equal, or until the LS Low oil level setpoint is reached, or the HS High oil level setpoint is reached.

Oil Return System Operation

Centrifugal chillers will lose a small amount of oil into the refrigeration system. Over time, this oil will accu-

mulate in the evaporator refrigerant charge. This oil can have a negative impact on heat transfer for modern tube surfaces. It is necessary to have an oil return system in place to return the lost oil back to the compressor oil reservoir.

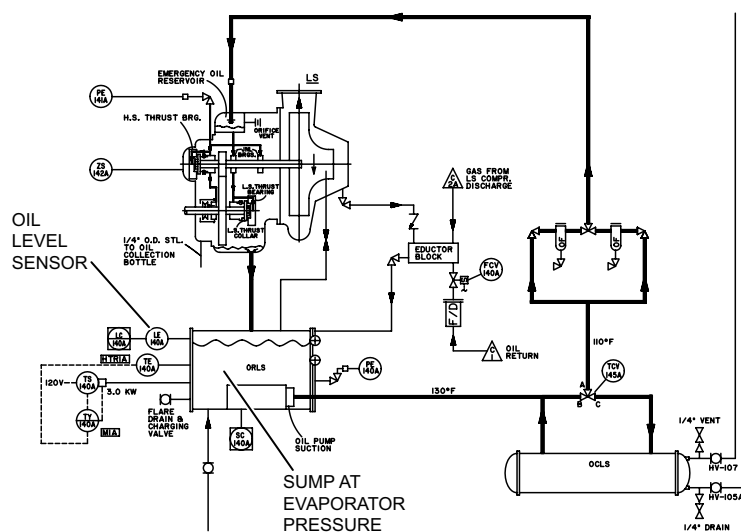
Eductor Block Low Stage Oil Return

The compound YK oil return system uses an eductor block to return oil to the low stage compressor oil reservoir. The eductor block uses high-pressure refrigerant gas through a venturi nozzle eductor as motive force to pull oil rich refrigerant liquid from the evaporator and into to the low stage oil reservoir. Over time, oil lost from both compressors would accumulate in the low stage compressor reservoir.

The Oil Return Eductor draws oil from the evaporator and returns it to the Low Stage Sump Pressure. Oil could also have been lost from the High Stage Oil Sump.

High Stage Oil Return

A means to return oil to the High Stage Oil Sump is provided by a small pump. The pump activates when the High Stage Oil Sump is 15% below the Low Stage, with the provision that the Low stage must not be near empty alarm.

**FIGURE 40 - LOW STAGE OIL RETURN EDUCTOR**

LD15293

An oil level control system is provided to return oil to the higher-pressure high stage oil reservoir. This system consists of a small oil pump piped between the two oil reservoirs and individual level transmitters on each reservoir. The control system monitors the level in each reservoir, and turns the oil transfer pump on when the level in the high stage drops approximately an inch below that of the low stage. If the oil level in the low stage oil reservoir drops 1 inch below the level in the high stage, oil is bled from the supply line to the high stage compressor to the low stage reservoir. A solenoid valve controls this. Low and high oil level alarms are programmed for each reservoir, when the levels extend beyond the sight ports. After servicing the compressor oil, each reservoir should be filled to the sight glass. When adding oil during operation, the oil may be added into the low stage reservoir. The transfer pump will move the oil to the high stage reservoir as needed.

Compressor PRV/suction plenum oil drain: A small connection in the PRV area of each compressor drains a small amount of oil that may collect there. Each compressor is vented to its respective oil reservoir. The low stage compressor drains this oil through the main educator block. The high stage compressor has a separate oil

educator block to return the oil to the high stage reservoir. Refer to the oil flow diagrams.

CAUTION: Use only the approved York “K” type polyolester oil with R-134a. Do not use mineral oils.

Condensate Management System

The Low Stage Primary CYK chiller with separate oil sump pressures requires additional valves and controls to manage refrigerant condensate. When the Low Stage Compressor runs alone, the High Stage Compressor is at discharge pressure. The tendency is that a large heat sink body like the High Stage Compressor is a natural place for refrigerant to condense. Often times the plant room is cooler than the tower water and increases the proclivity for refrigerant to gather in the High Stage Compressor.

This situation is mitigated by additional valves not found on a CYK Heat Pump or Radiator cooled unit, since their oil sumps operate both at suction pressure. These additional valves isolate the High Stage Oil Sump from the rest of the system and prevent refrigerant condensate from the High Stage Compressor from migrating down to the sump.

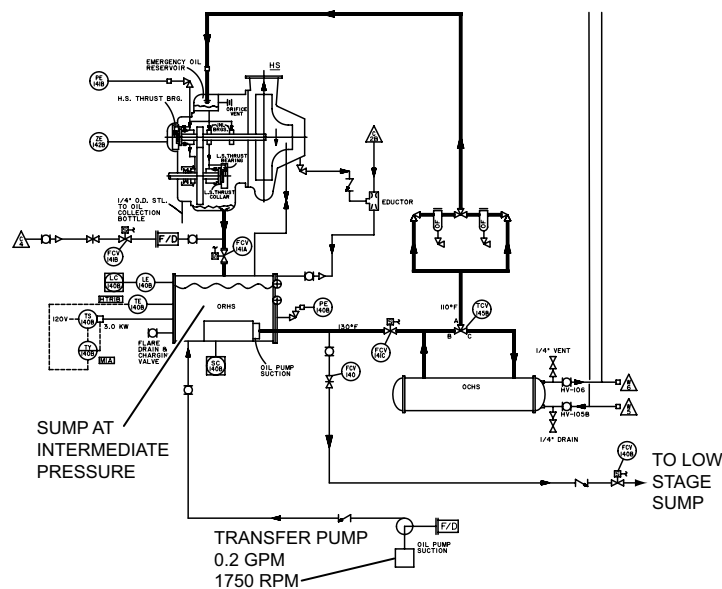
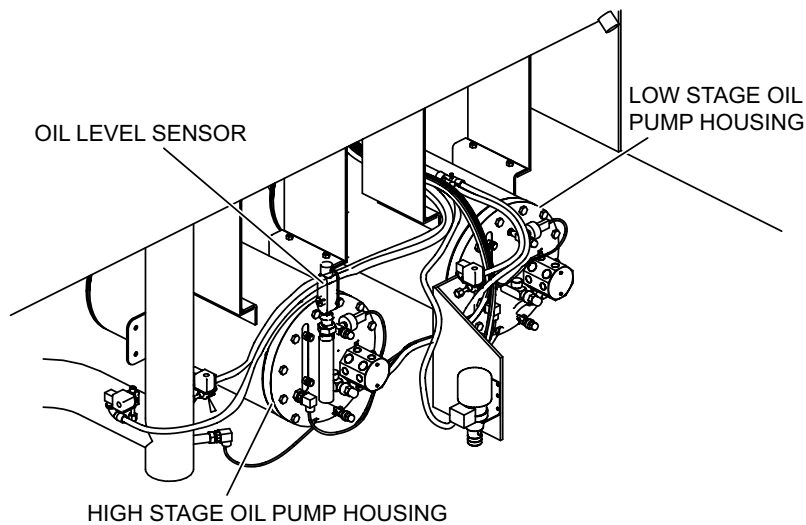


FIGURE 41 - HIGH STAGE OIL RETURN EDUCATOR

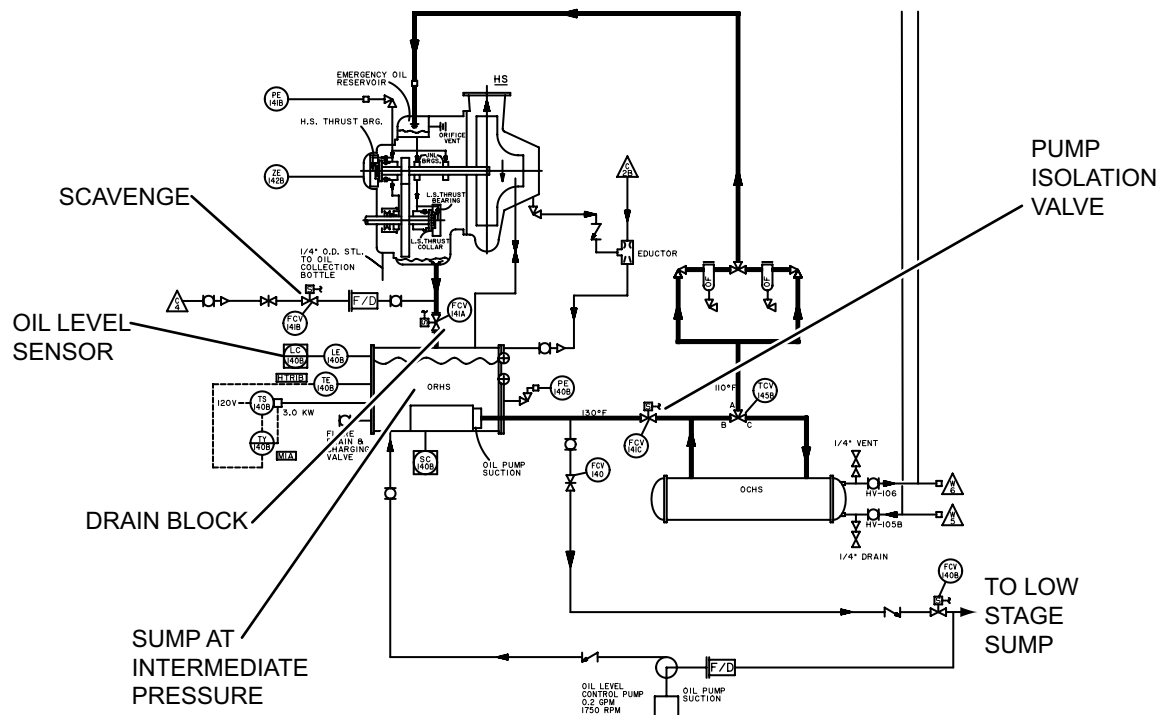
LD15294a

**FIGURE 42 - OIL LEVEL SENSOR**

LD15295

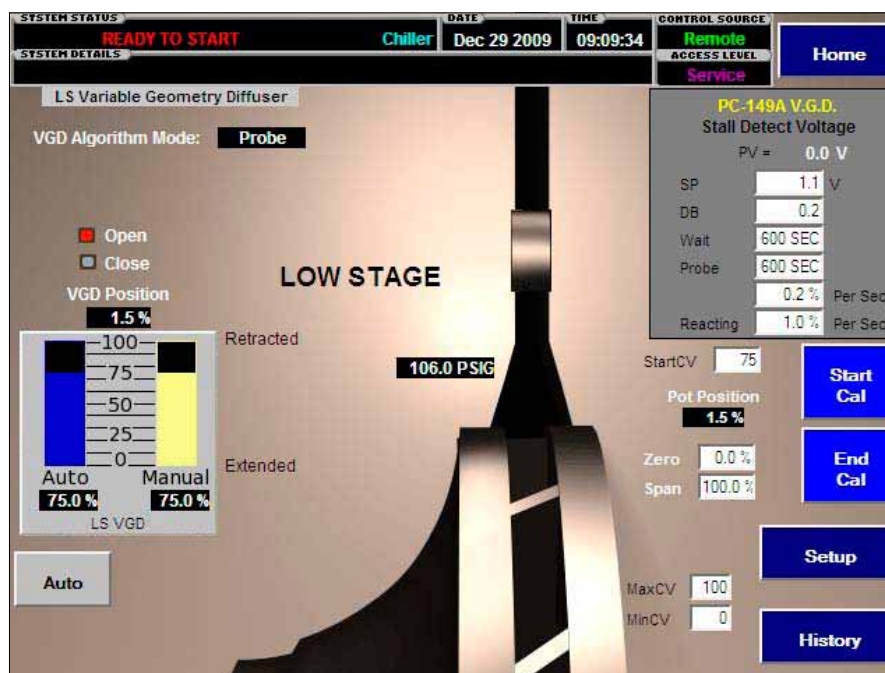
When the CYK chiller runs in single-stage operation, valve FCV-141A (Drain Block) stops refrigerant gathering in the gearbox cavity from going down the oil drain line. Valve FCV-141B (Scavenge) allows this condensed liquid to be returned to the evaporator. Valve FCV-141C (Pump Isolation Valve) closes and prevents oil from siphoning out of the sump and filling the gearbox with oil.

When the chiller runs in two-stage operation, the valve FCV-141A (Drain Block) opens to allow oil to return to the sump. Valve FCV-141B (Scavenge) closes. Valve FCV-141C (Pump Isolation Valve) opens to allow oil to circulate through the lube system.

**FIGURE 43 - HIGH STAGE OIL SUMP**

LD15294a

LS VARIABLE GEOMETRY DIFFUSER SCREEN



LD15256

FIGURE 44 - LS VARIABLE GEOMETRY DIFFUSER SCREEN

OVERVIEW

The variable geometry diffuser (VGD), provides acoustic attenuation to the compressor noise. The VGD ring extends into the discharge to attenuate stall noise by straightening the gas flow, and retracts when attenuation is not required.

A standard manual-auto station is provided to take control of the VGD. The reaction ramp will be set to Manual when transferring to Automatic operation.

The Variable Geometry Diffuser operates when the chiller is running. It has three states of operation with a manual override feature:

1. PROBE
2. WAIT
3. REACT

The voltage setpoint from the Stall Detector board, provides the limitation of noise from the compressor. The deadband setpoint will allow some area where the VGD won't move constantly. The wait period is a soak time when the VGD stops probing for noise. The Probing time and rate control how much the VGD retracts while it looks for noise. The Reaction ramp extends the VGD when the noise level threshold is exceeded.

The VGD must be calibrated before it is used. Pressing START CAL while the machine is off, starts extending the VGD to its full limit. The Zero and Span are captured so that the VGD can be controlled linearly throughout its range of travel. Pressing END CAL will end the calibration procedure.

The feedback potentiometer is calibrated such that 100.0% open is when the VGD actuator is fully retracted, and 0.0% open is when the VGD actuator is fully extended. The calibration procedure first holds the OPEN VGD output ON constantly until the percent of potentiometer input stops moving indicating end of travel. This value in percent from the potentiometer raw input is captured as the SPAN value. The CLOSE VGD output is then held in the ON state until the percent of potentiometer input stops changing in the other direction indicating end of travel. This value in percent from the potentiometer raw input is captured as the ZERO value. The scaled position of the VGD is calculated as follows:

$$\text{VGDPotition} = (\text{Pot_Value} - \text{VGDZeroValue}) / ((\text{VGDSpanValue} - \text{VGDZeroValue}) / 100)$$

At the end of the calibration procedure the VGD should return to normal operation. If the potentiometer should go out of range, an alarm should be set indicating that the potentiometer is out of range, or out of adjustment.

The VGD positioner algorithm takes its target setting from the VGD reaction ramp (discussed later in this section). The target is compared with the actual value of VGD position in percent as calculated above. The algorithm then sends an open or close pulse to the VGD actuator to make the error between target and actual equal zero.

The positioner acts on a 5 second timebase where the pulse length is controlled by the percent error multiplied by a gain factor of typically 4.8 seconds. The resultant is overridden to be not less than a 1000 millisecond pulse. This produces a bidirectional pulse width modulation controller, when the error is positive the VGD is pulsed open, when the error is negative the VGD is pulsed closed.

To insure uniform operation on startup a pre-set startup setting is given to the VGD position controller. This value is loaded into the VGD reaction ramp when the chiller shuts down. The pre-set startup point is determined empirically in commissioning but is typically within the 70 to 90% range.

When in manual override the manual-automatic station takes control of the reaction ramp and overrides the VGD target position. The positioner then follows the manual controlled value. This is useful for testing the hardware.

The VGD filter board sends a 0 to 5 volt signal to the VGD control algorithm. This voltage is compared with a noise threshold setting. (typically 1.1 volts) When the stall voltage is higher than the threshold setting, stall is considered to be present. The stall is attenuated by reducing the VGD reaction ramp at the user-entered ramp rate in % per second. (typically 1.0 % per second) This is the REACT mode of the controller and operates until the stall noise voltage falls below the stall threshold setting.

Once the stall voltage goes below the threshold, the algorithm goes into a WAIT cycle. The wait cycle can be interrupted at any time by a REACT condition. Otherwise the WAIT cycle continues for the user-specified time. (typically 600 seconds)

The PROBE state occurs after the WAIT cycle is completed. The PROBE cycle continues only for the user-specified time. (typically 600 seconds) During the probe time the VGD reaction ramp is increased to retract the VGD ring at a user-specified rate. (typically 0.2 % per second). At any time during the PROBE mode if the VGD stall noise voltage reaches but does not exceed the stall threshold within the deadband area, the PROBE cycle is stopped and a WAIT cycle is started. If during the

PROBE cycle the stall voltage exceeds the stall threshold setting, a REACT condition occurs. At the completion of the PROBE cycle time without exceeding or meeting a stall condition, a WAIT cycle is started.

This algorithm runs until the chiller is shut down, at which point the reaction ramp is reset to the pre-set starting point.

The travel of the VGD ring is limited by the MaxCV and MinCV limit settings.

DISPLAY ONLY

VGD Algorithm Mode

Displays the state of operation for the VGD.

VGD Motor Opening (LED)

Illuminates when the Primary Compressors VGD is in the process of opening (retracting).

VGD Motor Closing (LED)

Illuminates when the Primary Compressors VGD is in the process of closing (extending).

VGD Position

Displays the Primary Compressor VGD position (provided by VGD Position Potentiometer ZE-149A).

PROGRAMMABLE

Auto

Access Level Required: OPERATOR

Refer to *Figure 26 on page 57* for operational description.

NAVIGATION

Home

Used to provide additional Home information.

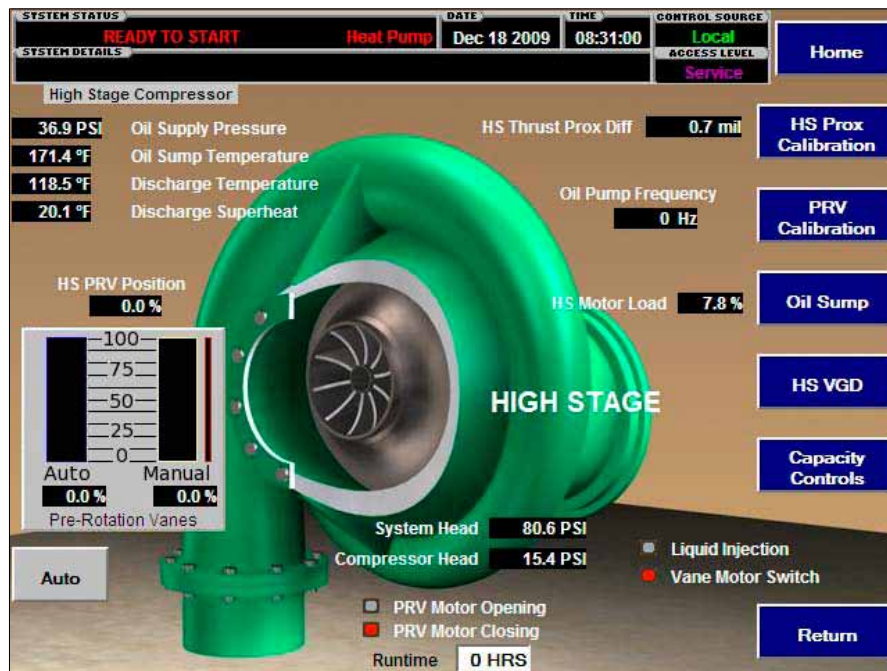
Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

History

This screen provides access to a Time stamped Record of shutdown conditions.

HIGH STAGE COMPRESSOR SCREEN



LD15245

FIGURE 45 - HIGH STAGE COMPRESSOR SCREEN

OVERVIEW

Displays data about the High Stage Compressor.

DISPLAY

Oil Supply Pressure

Displays the oil supply pressure.

Oil Sump Temperature

Displays the oil sump temperature.

Discharge Temperature

Displays the temperature of the refrigerant gas at the compressor outlet.

Discharge Superheat

Displays the temperature expressed as the differential between the discharge temperature and the condenser saturation temperature.

System Head

Displays the chiller head pressure calculated as (condenser pressure – evaporator pressure).

Compressor Head

Displays the head pressure expressed as a differential between the compressor suction and discharge.

HS Thrust Prox Diff

Displays the distance between the high-speed thrust collar and the tip of the proximity probe. This measurement takes into account the reference position established at the time of compressor manufacture.

Oil Pump Frequency

Displays the operating frequency of the variable-speed oil pump drive.

HS Motor Load

Displays the position.

HS PRV Position

Displays the position of the pre-rotation vanes in percent.

Vane Motor Switch

Indicates the status of the vane motor switch.

Oil Return Solenoid

Displays the status of the oil return solenoid to the Low Stage Compressor.

INTERACTIVE**Pre-Rotation Vane Manual / Auto Station**

Access Level Required: OPERATOR

Operator may manually adjust the position of the pre-rotation vanes.

Pressing the Auto button allows the operator to adjust the pre-rotation vane setting from.

0 – 100% open using the OPEN and CLOSE keys on the bottom of the display.

Pressing the MANUAL button while in manual control mode toggles back to automatic control.

NAVIGATION**Home**

Used to provide additional Home information.

HS Prox Calibration

Returns the display to view the HS Prox Calibration Screen.

PRV Calibration

Access Level Required: OPERATOR

Only available if the chiller is stopped, advances to the PRV Calibration Screen.

Oil Sump

Returns the display to view the Oil Sump Screen.

HS VGD

Returns the display to view the HS VGD Screen.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

Return

Returns the display to the previous screen.

HS PROXIMITOR CALIBRATION SCREEN



LD15252

FIGURE 46 - HS PROXIMITY CALIBRATION SCREEN

OVERVIEW

This screen displays a cutaway view of the chiller compressor, revealing the proximity probe sensor and provides the capability of calibrating the proximity probe sensor.

DISPLAY ONLY

Thrust Prox Probe Position

Displays the distance between the high-speed thrust collar and the proximitor probe that is used to measure the position. A positive number is in the forward direction, a negative number is in the reverse direction.

Thrust Prox Differential

Displays the difference between the proximitor probe position and the proximitor reference position.

Compressor Oil Pressure

Displays the primary compressor oil pressure.

Calibration Active (LED)

Illuminates when the primary compressor is currently performing a proximitor calibration.

PROGRAMMABLE

Thrust Prox Reference

Access Level Required: SERVICE

This key allows the technician to define the primary compressor proximitor probe offset reference position.

Primary Prox Calibration

Access Level Required: SERVICE

Start

This button activates a primary compressor proximitor probe calibration procedure to begin, which starts the compressor oil pump.

Accept

This button allows the technician to accept the position of the primary compressor proximitor probe.

End

This button cancels the request for a primary compressor proximitor calibration procedure.

Reset Tripped Prox

Access Level Required: FACTORY

This button allows the technician to reset a tripped primary compressor proximitor probe under the direction from the Factory Technical Support Team.

NAVIGATION

Home

Used to provide additional Home information.

Low Stage Compressor

This screen displays data about the Low Stage Compressor.

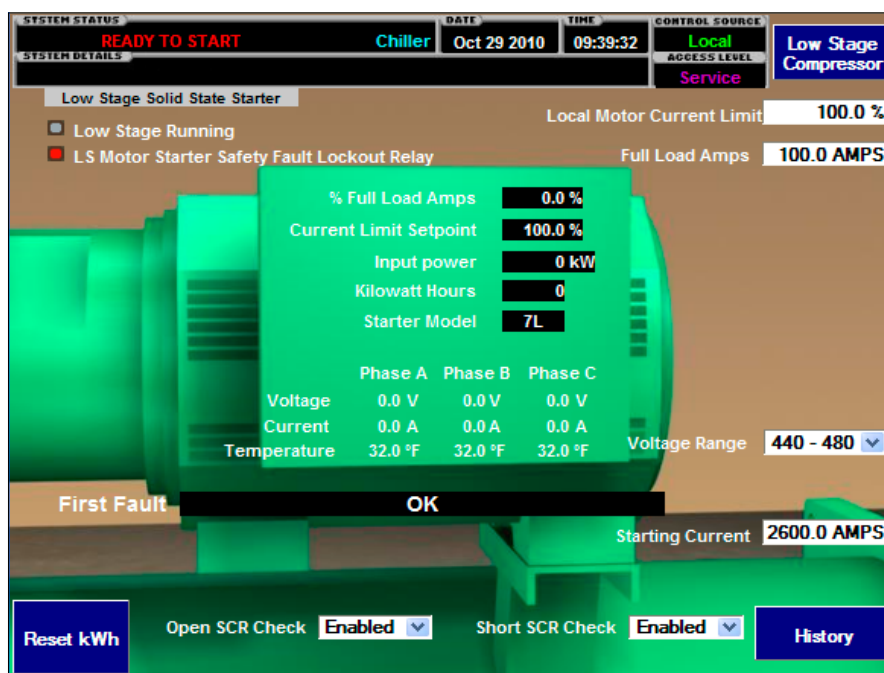
HS Prox Calibration

This screen Displays data about the HS Prox Calibration.

History

This screen provides access to a Time stamped Record of shutdown conditions.

LIQUID COOLED SOLID STATE STARTER (OPTIONAL)



LD15325

FIGURE 47 - LIQUID COOLED SOLID STATE STARTER (OPTIONAL)

OVERVIEW

The YORK model LCSSS is an option for the CYK in low voltage applications. The LCSSS is factory mounted and integrated onto the Quantum™ LX industrial control center. The starter is configured at the factory. The LCSSS data is viewable from this screen. Refer to the LCSSS literature FORM 160.00-O2 for operation of this equipment. Please recall that the CYK does not support cycling shutdowns.

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

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

The Logic/Trigger Board is powered by +24VDC from the Quantum™ LX industrial control center Power Supply. The Quantum™ LX Motherboard COM 3 communicates with this board via a 19.2K baud Mod-

bus ASCII serial data communications link. The **STOP** relay contacts on the Logic/Trigger Board assure a positive shutdown on all LCSSS initiated shutdowns.

When the temperature sensors detect a heatsink temperature above 108°F, the circulation pump will run until the temperature drops below this threshold. The high heatsink temperature is handled as a temperature-based anti-recycle. When the temperature returns to normal, the LCSSS will be reset automatically by the Quantum™ LX, and the System Status “**READY TO START**” will be displayed.

DISPLAY ONLY

Motor Run (LED)

Indicates when the CYK Control Center is commanding the motor to run.

Motor Full Voltage Run Interlock (LED)

Indicates when the LCSSS has confirmed motor operation.

Starter OK (LED)

Indicates when the LCSSS has confirmed a no fault condition.

Motor Current % Full Load Amps

Displays the motor current as a percentage of Job Full Load Amps setpoint.

Input Power

Displays the kilowatts measured by and transmitted from the starter.

Voltage – Phase A, B, C

Displays the 3-phase input line voltage as measured by and transmitted from the starter.

Current – Phase A, B, C

Displays the 3-phase motor current as measured by and transmitted from the starter.

Starter Model

Displays the starter model number as transmitted from the starter.

INTERACTIVE

When the Logic Board detects an **Overload** condition, Relay K1 contacts open and the **Overload** LED illuminates. A Motor Starter Fault is displayed in the System Details. The contacts remain open and the LED remains illuminated until manually reset at the Quantum™ LX.

The Low Stage SSS is configured as Modbus node 1, and the High Stage SSS is configured as Modbus node 2. The Quantum™ LX Com 3 port is used as the Modbus Master to communicate with the starters.

PROGRAMMABLE**Local Motor Current Limit**

Access Level Required: OPERATOR

Allows the user to specify the maximum allowed motor current (as percentage of FLA). When the motor current reaches this value, the Capacity Controls will not be permitted to load further. If the motor rises above this value, the Capacity Controls will reduce the current to this value.

Full Load Amps

Access Level Required: SERVICE

Defines the maximum amps at which the motor can operate. This value is viewable when logged in at Operator or View access level.

TABLE 9 - FULL LOAD AMPS

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

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

TABLE 10 - START CURRENT

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

Voltage Range

Access Level Required: SERVICE

Allows the user to select specific line voltage range for voltage checking. When not disabled, this line voltage range is used to determine a low line and high line voltage threshold for initiating a shutdown.

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

Open SCR (Enabled/Disabled)

Access Level Required: SERVICE

Allows the user to enable or disable the Solid State Starter Open SCR safety detection. This must never be disabled unless under advisement of the YORK Factory.

Open SCR (Enabled/Disabled)

Access Level Required: SERVICE

Allows the user to enable or disable the Solid State Starter Open SCR safety detection. This must never be disabled unless under advisement of the YORK Factory.

kWH Reset

Access Level Required: SERVICE

Allows the user to reset the cumulative Kilowatt Hours.

NAVIGATION

Low Stage Compressor

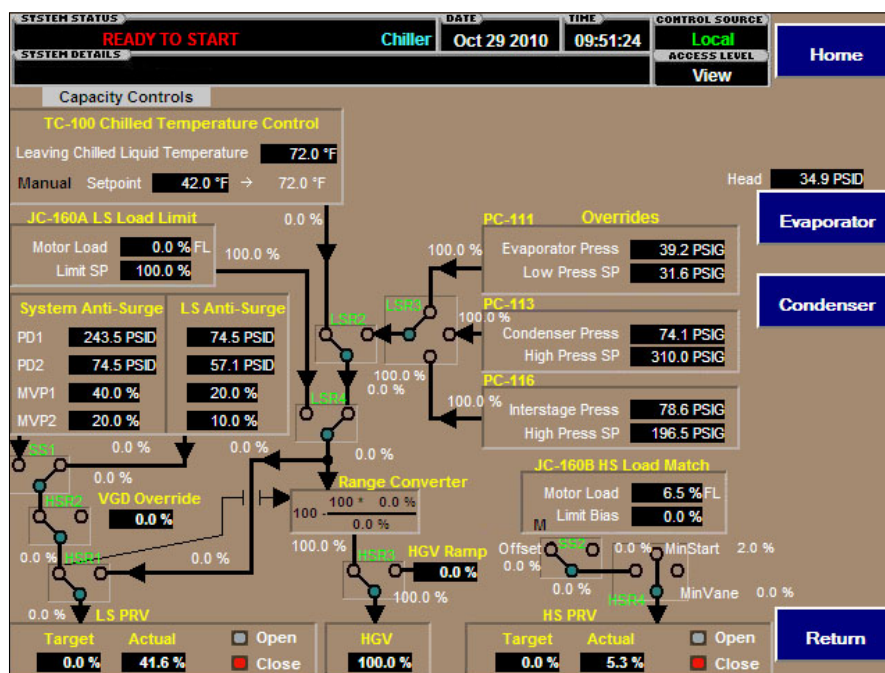
This screen displays data about the Low Stage Compressor.

History

This screen provides access to a Time stamped Record of shutdown conditions.

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CAPACITY CONTROLS SCREEN



LD15257

FIGURE 48 - CHILLER MODE

CHILLER MODE

The Capacity Controls Screen schematically illustrates the logical operations of chiller capacity control. Sensor readings are linked with setpoint values and compared. PID loops, depicted in each box, pass signals through high or low-pass relay (HSR/LSR) junctions. The relay makes a simple comparison of two signals and passes the higher or lower of the two depending on whether the relay is high or low pass.

HEAT PUMP MODE

The CYK machine has the ability to control itself as a CHILLER or a HEAT PUMP. In Chiller mode, the Leaving Water temperature from the evaporator heat exchanger is the process signal. In Heat Pump mode, the Leaving Water temperature from the condenser heat exchanger is the process signal. The CYK control system will adjust the vanes and hot gas valve to attempt to generate the desired process temperature.

OVERRIDES

Evaporator Pressure

Displays the current evaporator pressure.

Low Pressure Setpoint

Displays the system low evaporator pressure setpoint, at which the chiller will be unloaded if the evaporator pressure goes below this threshold.

Condenser Pressure

Displays the current condenser pressure.

High Pressure Setpoint

Displays the system high condenser pressure setpoint, at which the chiller will be unloaded if the condenser pressure goes above this threshold.

Interstage Pressure

Displays the current interstage pressure.

Interstage High Pressure Setpoint

Displays the system high condenser pressure setpoint, at which the chiller will be unloaded if the condenser pressure goes above this threshold.

Motor Load

Displays the current motor load in percentage.

Load Limit

Displays the motor load limit setpoint.

HGV Ramp

Displays the hot gas valve ramp rate in percent.

HGV

Displays the current hot gas valve position from opened to closed in percent.

PRV Actual

Displays the actual current position of the pre-rotation vanes from opened to closed in percent.

PRV Target

Displays the control system intended position of the pre-rotation vanes.

Refer to the table of contents for the explanation of the operation of the Capacity Controls System.

NAVIGATION**Home**

Used to provide additional Home information.

Evaporator

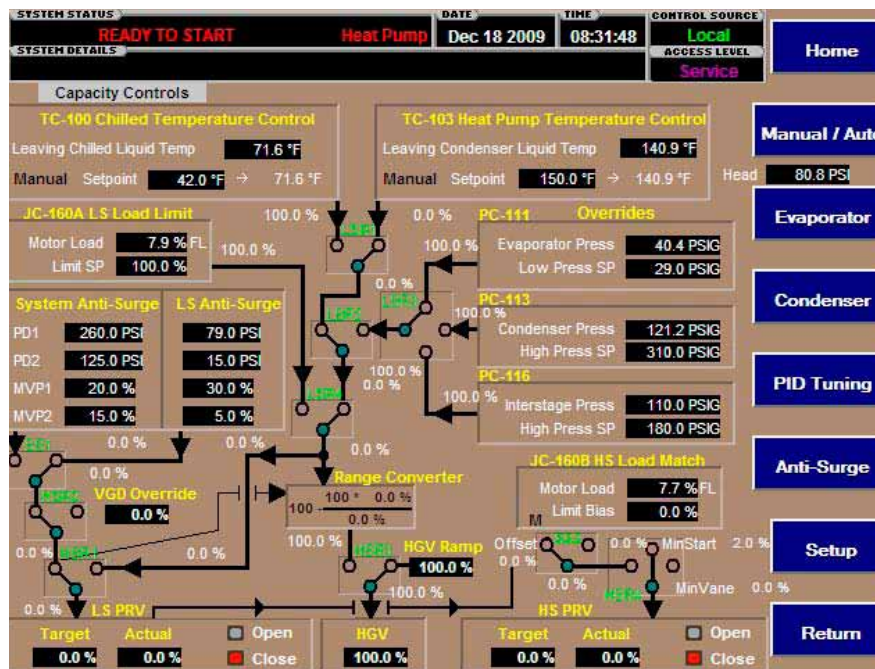
A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

Return

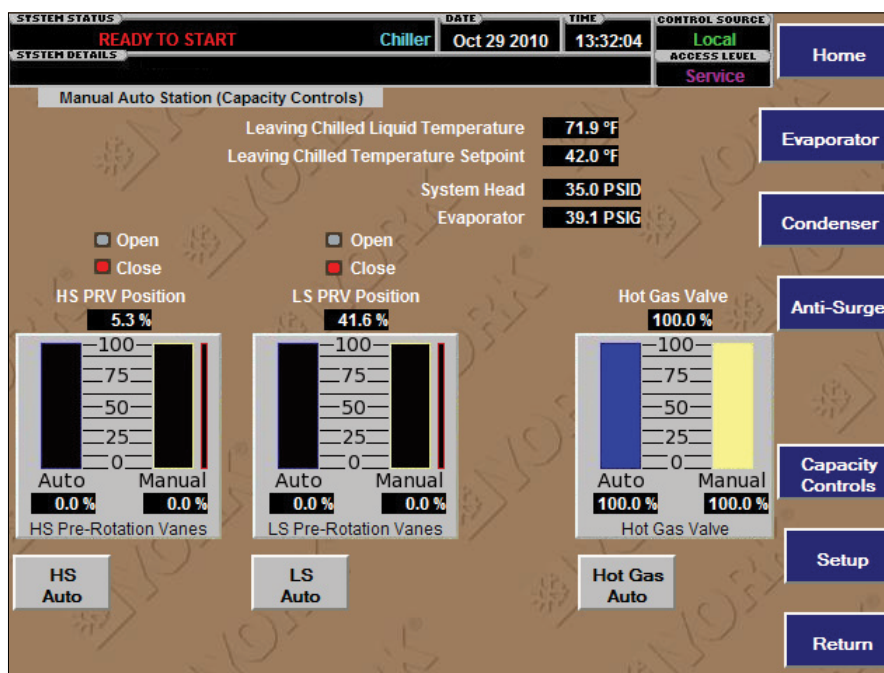
Returns the display to the previous screen.



LD15247

FIGURE 49 - HEAT PUMP MODE

MANUAL AUTO STATION (CAPACITY CONTROLS) SCREEN



LD15280

FIGURE 50 - MANUAL AUTO STATION (CAPACITY CONTROLS) SCREEN

OVERVIEW

The capacity controls manual-auto station screen can be used to take manual control of all three capacity controls devices. (Putting both sets of vanes in manual control brings up an option on synchronous open and closed keys to synchronously open and close both sets of vanes)

LED symbol indicators are shown for observing pulses fed to each PRV shaded pole actuator motor. The actual PRV position feedback is listed at the TOP of each manual-auto station.

Anti-surge values for both sets of vanes are depicted as a RED bar graph to the right of each station.

If the Low or High Stage vanes are put back into automatic control, above the calculated anti-surge value, the Capacity Controls algorithm will adjust to the manual value and calculate from that point. If released below anti-surge calculation, the station will go into an inhibit condition. The manual value must be increased above anti-surge to transition back to automatic operation.

DISPLAY ONLY

Leaving Chilled Liquid Temperature

Displays the temperature of the chilled liquid as it leaves the evaporator.

Leaving Chilled Temperature Setpoint

Displays the present setpoint to which the chiller is operating, whether controlled locally or remotely.

System Head

Displays the system head differential pressure.

PROGRAMMABLE

HS Auto

Access Level Required: OPERATOR

Refer to *Figure 26 on page 57* for operational use.

LS Auto

Access Level Required: OPERATOR

Refer to *Figure 38 on page 79* for operational use.

Hot Gas Auto

Access Level Required: OPERATOR

Refer to Figure 26 for operational use.

NAVIGATION**Home**

Used to provide additional Home information.

Evaporator

A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

Anti-Surge

This screen displays data about the Anti-Surge.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

Return

Returns the display to the previous screen.

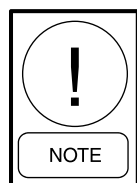
PID TUNING SCREEN

LD15261

FIGURE 51 - PID TUNING SCREEN

OVERVIEW

This screen would normally only be used on initial start-up by a York Service Technician to fine tune the capacity controls. The effects of changes to the PID tuning are observed by changing back to Screen #10 : CAPACITY CONTROLS.



Contact a YORK Service Agent if adjustments are required to the Capacity Controls tuning.

The present status of the adjustable tuning parameters are shown for each PID controller and other programmed control functions. The PID controllers are configured using ISA equations, with the following values:

- SP = Set Point
- P = Controller Gain
- I = Integral Gain (Reset)
- D = Derivative Gain

For the setpoint of TC-100 and TC-103, the “LOC SP=” text changes to “REM SP=” when being controlled remotely. See Evaporator Screen in Chiller Mode, or Condenser Screen for Heat Pump Mode, for details on changing the setpoint of these controls.

Changing Tuning Parameters

To change tuning parameters touch the numeric entry area, and a cursor will appear where a new value can be entered. Enter the new value and press the [SUBMIT] button.

The tuning values shown are estimated only and may require adjustment depending on actual chiller operating conditions.

Ramp Values

The Ramp Rates are used on chiller startup. The PID controls are put into manual, and ramped slowly to reach their setpoints without overshoot. The actual running conditions of the water system will determine whether faster or slower ramp rates are appropriate.

TC-100 has a setpoint ramp rate in Degrees Temperature per Second for both Single Stage and Two Stage operation respectively indicated by a 1 and 2.

The Hot Gas Valve has a startup ramp rate which can be defined here. The Hot Gas Valve starts at 100% open and ramps closed at this ramp rate until the ramp is complete, or a setpoint, or override is reached.

JC-160B

The HS motor load limiter controller has two functions, depending on the system configuration.

- If the system is configured for load matching between the stages, then the setpoint for this controller comes from the actual motor load of the Low Stage. LS LOAD is displayed next to the setpoint.

The BIAS setpoint controls the balance of the compressor load matching. A positive value will load the high stage this much more than the low stage. A negative value will keep the high stage unloaded this much less percent than the low stage.

- If the system is configured for an offset High Stage compressor operation, then this demand limiter PID takes its setpoint from the HS Limit setpoint block below the SP= value. HS LIMIT is displayed in this case.

NAVIGATION

Home

Used to provide additional Home information.

Overrides

Returns the display to view the Capacity Override Tuning Parameters.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

History

This screen provides access to a Time stamped Record of shutdown conditions.

OVERRIDES SCREEN

The screenshot displays the 'OVERRIDES SCREEN' for a chiller system. At the top, a status bar shows 'SYSTEM STATUS: READY TO START', 'Chiller', 'DATE: Dec 29 2009', 'TIME: 09:18:45', 'CONTROL SOURCE: Remote', and 'ACCESS LEVEL: Service'. A 'Home' button is in the top right. Below this is a 'Capacity Override Tuning Parameters' section with five main control loops: PC-111 (Low Press Override), PC-113 (High Press Override), JC-160A (LS Motor Limit), PC-116 (Interstage Override), and XC-149 (PRV Antistall). Each loop has fields for PV, SP, P, I, D, and Output. To the right of these loops are 'Demand Limit' and 'Pulldown Limit' settings, and a 'Demand Temp' field. At the bottom, there are 'System Head' (44.1 PSI), 'Single To 2-Stage' (50.0 PSI), '2-Stage To Single' (40.0 PSI), '85.4 °F ECdW - 55.1 °F EChW = 30.2 °F', and 'Immediate 2-Stage Threshold' (15.0 °F). On the far right, there are buttons for 'Manual / Auto', 'Anti-Surge', 'Capacity Controls', 'Setup', and 'History'.

LD15262

FIGURE 52 - OVERRIDES SCREEN

OVERVIEW

The Override Tuning Screen allows the operator to adjust capacity controls tuning parameters. The screen depicts four control loops:

(PC-111) Evaporator Pressure

(PC-113) Compressor Discharge Pressure

(PC-116) Interstage Pressure

(JC-160A) LS Motor Load Limiter

Refer to PID tuning procedures to adjust these loops.

JC-160A

The Low Stage demand limiter PID has a pulldown function associated with it. The pulldown is not time-based like conventional pulldown timers. This pulldown is temperature-based over a sliding scale of demand limitation. As the chiller attains the desired setpoint, from a standby state, the demand limit is slowly allowed to increase. This prevents a sudden change of demand limit and also keeps the system from overload during and ice-building start up.

Enter the higher of the two temperatures in the **Pulldown Temp** box. This is the starting entering chilled temperature. Enter the lower of the demand limit percentages in the **Pulldown Lim** box. This is the demand limit allowed during the pulldown of the system. As the system reaches setpoint, the lower of the two entering chilled temperatures in the **Demand Temp** box will result in a higher allowable Demand Limit in the **Demand Lim** box. The Demand Temp should be greater than the actual entering chilled liquid temperature setpoint, by several degrees.

XC-149

The PRV Anti-stall controller will become active when the VGD gap on the LS compressor is fully extended. This controller will open the PRV's on the LS compressor to maintain the stall setpoint given on the LS VGD screen. Refer to the LS VGD controller screen. As the stall noise decreases, the PRV's are allowed to return to normal as the XC-149 controller goes back to a zero output.

PROGRAMMABLE**Single To 2-Stage***Access Level Required: SERVICE*

This setpoint determines at what head pressure (condenser pressure – evaporator pressure) the High Stage booster compressor should be brought online. During operation with the single Low Stage compressor the head may increase above the ability for one stage of compression to handle (high duty head or brine duty). Therefore, the booster is brought online to increase the lift.

2-Stage To Single*Access Level Required: SERVICE*

This setpoint determines at what head pressure the High Stage booster compressor is not needed to accomplish the lift of the system. Running the High Stage compressor unnecessarily is a waste of energy (low head duty). Below this threshold a single stage of compression is enough to produce the system lift; therefore, the booster is dropped offline until it is needed again.

Immediate Two-Stage Threshold*Access Level Required: SERVICE*

The difference between the entering condenser water and entering chilled water predicts the head conditions when the CYK is started. If the difference in temperature is above this programmable setpoint, the CYK will

start both compressors as quickly as possible when it is started. If the difference is below this value, the head will not be great, and only the low stage is needed to start with.

NAVIGATION**Home**

Used to provide additional Home information.

Anti-Surge

This screen displays data about the Anti-Surge.

Capacity Controls

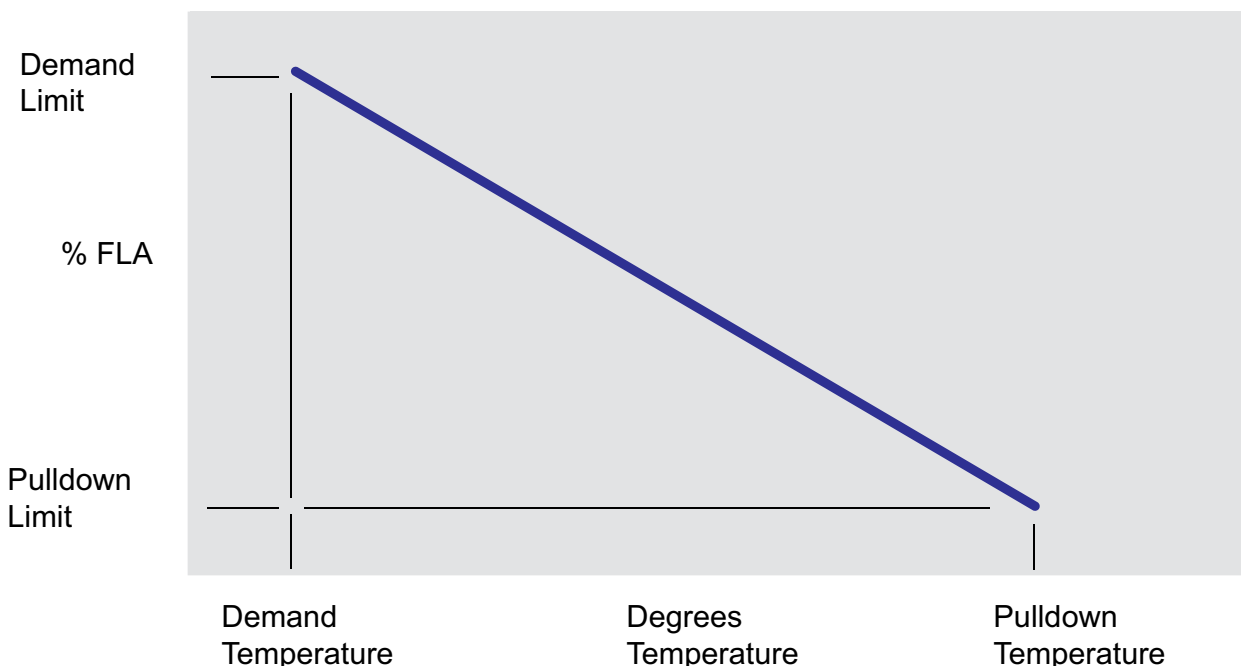
Returns the display to view the Capacity Controls Screen.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

History

This screen provides access to a Time stamped Record of shutdown conditions.



LD15234

FIGURE 53 - TEMPERATURE-BASED DEMAND LIMITER FUNCTION

ANTI-SURGE SCREEN



LD15263

FIGURE 54 - ANTI-SURGE SCREEN

OVERVIEW

Depicted on the Anti-surge tuning parameters screen is a plot showing the surge area as a function of compressor head versus PRV position. The area to the left the line, highlighted in red, are the conditions under which surge can be expected to occur.

ANTI-SURGE MAP

PD1 is the maximum system head pressure as defined by the entry fields.

PD2 is the minimum system head pressure as defined by the entry fields.

MVP1 is the minimum allowable vane position at the maximum system head pressure PD1.

MVP2 is the minimum allowable vane position at the minimum system head pressure PD2.

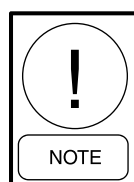
An "X" on the plot shows the current Low Stage Vane operating point.

There are entry fields for three separate surge curves.

- The LS ANTI-SURGE CALC is a surge curve for single stage CYK operation.
- The 2-STAGE SYSTEM ANTI-SURGE CALC is a surge curve for 2-stage CYK operation.
- The HS ANTI-SURGE CALC is a surge curve for just the high stage compressor alone. This can be used to keep the High Stage Vanes from adjusting below the percentage of the Low Stage vanes at low loads.

HS curve is not depicted in a graphic.

These MVP1 and MPV2 are typically zero for most applications.



The Anti-surge parameters must be determined experimentally during the commissioning procedure. Values shipped with the unit are only default.

Refer to *Anti-Surge Tuning on Page 46* for details on anti-surge control line operation and tuning.

NAVIGATION

Home

Used to provide additional Home information.

Evaporator

A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Condenser

A detailed view of all condenser parameters, including control of the liquid level functions.

PID Tuning

Returns the display to view the Capacity Controls Tuning Parameters.

Overrides

Returns the display to view the Capacity Override Tuning Parameters.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

SETUP SCREEN

LD15255

FIGURE 55 - SETUP SCREEN

OVERVIEW

Provides access to advanced functions and setup of the CYK.

DISPLAY

PLC Clock Present

Shows present date and time.

Last Start Date

Shows the date and time of the last motor start.

Runtime Last Start

Shows the days, hours and minutes of the last motor run interval.

INTERACTIVE

Reset Start Count

Access Level Required: FACTORY
Resets the start counter (restricted access).

Reset Run Timer

Access Level Required: FACTORY
Resets the run timer (restricted access).

Reset Anti-Recycle

Access Level Required: FACTORY
Resets the anti-recycle (restricted access).

Chiller Mode / Heat Pump Mode

Access Level Required: OPERATOR
Toggles between Chilling Operation and Heat Pump operation.

NAVIGATION

Home

Used to provide additional Home information.

Trending

Returns the display to view the Trending Screen.

Diagnostics

Returns the display to view the Diagnostics Screen.

Test Outputs

Returns the display to view the Test Outputs Screen.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

Serial Port Setup

Returns the display to view the Serial Port Setup Screen.

Ethernet

Returns the display to view the Ethernet Screen.

History

This screen provides access to a Time stamped Record of shutdown conditions.

TEST OUTPUTS SCREEN



LD16096

FIGURE 56 - TEST OUTPUTS SCREEN

OVERVIEW

The Test Output screen is used to test a solenoid or digital valve. Pressing the key corresponding to the device name, will cause it to turn ON momentarily for testing purposes.

INTERACTIVE

Each solenoid in the system, as well as the oil transfer pump has a test button associated with it on this screen.

Pressing the corresponding button will engage the output for two seconds for test purposes. For slow valves the output will be engaged for a longer time delay.

NAVIGATION

Home

Used to provide additional Home information.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

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SETPOINTS 1 SCREEN

SYSTEM STATUS		DATE		TIME		CONTROL SOURCE	
READY TO START		Dec 29 2009		15:52:48		Remote	
SYSTEM DETAILS						ACCESS LEVEL	
						Service	
Setpoints 1							
Symbol	Actual	Warning Setpoint	Trip Setpoint	Description			
PAL/LL-111	40.5 PSIG	28.0 PSIG	27.0 PSIG	Evaporator Pressure			
PAH/HH-113	84.5 PSIG	310.0 PSIG	314.0 PSIG	HS Compressor Discharge Pressure			
PAH/HH-114	105.6 PSIG	206.0 PSIG	206.0 PSIG	Interstage Pressure			
Low Stage Compressor							
PDSL/LL-140A	38.2 PSI	20.0 PSI	15.0 PSI	Low Compressor Supply Oil			
PDSH/HH-140A		85.0 PSI	90.0 PSI	High Compressor Supply Oil			
TAL/LL-140A	179.2 °F	70.0 °F	55.0 °F	Low Compressor Oil Temperature			
TAH/HH-140A		180.0 °F	185.0 °F	High Compressor Oil Temperature			
High Stage Compressor							
PDSL/LL-140B	41.4 PSI	20.0 PSI	15.0 PSI	Low Compressor Supply Oil			
PDSH/HH-140B		85.0 PSI	90.0 PSI	High Compressor Supply Oil			
TAL/LL-140B	171.4 °F	70.0 °F	55.0 °F	Low Compressor Oil Temperature			
TAH/HH-140B		180.0 °F	185.0 °F	High Compressor Oil Temperature			
LAH/HH-116	27.7 %	85.0 %		Economizer Level	95.0 %	Sideload Close	
TAH/HH-113	118.6 °F	210.0 °F	225.0 °F	Compressor Discharge Temperature			
TAL/LL-100	71.5 °F	35.6 °F	35.0 °F	Leaving Liquid Temperature			
PAH/HH-116	110.0 PSIG	200.0 PSIG	206.0 PSIG	Economizer Pressure			
Setpoints 2							
Saturation Calc							

LD15260

FIGURE 57 - SETPOINTS 1 SCREEN

OVERVIEW

This screen is only available under the highest access level.

The Safety setpoints are the thresholds of safe operation for the York CYK chiller. Each CYK is designed with unique applications in mind, therefore each will have unique safety setpoints.



Consult the York Factory before attempting to change any safety setpoints. These thresholds protect the CYK chiller from operations outside its design parameters. Safe operation of the chiller, and warranty claims, will be compromised by unauthorized changes.

NAVIGATION

Home

Used to provide additional Home information.

Setpoints 2

Returns the display to view the Setpoints 2 Screen.

Saturation Calc

Returns the display to view the Saturation Calc Screen.

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SETPOINTS 2 SCREEN

LD15249

FIGURE 58 - SETPOINTS 2 SCREEN

OVERVIEW

The miscellaneous setpoints screen allows access to programmable features that control the more high level parameters of the CYK control system. Care is to be taken when accessing these setpoints.

HS PRV Offset vs Load Matching Control

There are two modes of operation for the HS compressor capacity control.

Load Matching

The HS compressor can be selected to run equal compression ratio as the LS compressor, as in a radiator or heat pump application. This selection is convenient in that both compressor will use approximately the same percent work to accomplish the total head. If LOAD MATCHING operation is selected the HS compressor vanes will be operated on a demand limiter PID with the setpoint being slaved to the LS compressor motor current. In this way the compressors will track nicely together always sharing the lift.

This method is not ideal when the compressors are selected to operate more efficiently with disproportionate sharing of compression ratios.

HS PRV Offset

In the case of an ice building application with disproportionate expectations of lift between the HS and LS compressors, another control method is needed. This can also be used in other modes for an alternative mode of HS compressor operation.

The two percent values of LOW HEAD OFFSET and HIGH HEAD OFFSET, must be supplied to create a linear scale between the lift requirements defined by System Antisurge PD1 and PD2 in terms of differential pressure. So, at a relatively high lift across the entire system, the HS compressor operates its PRV's the HIGH HEAD OFFSET in percent above the LS compressor vane position. The offset is calculated from here down to the LOW HEAD OFFSET position at PD2 in differential pressure, over a calculated linear scale.

The Offset slope can be either Positive or Negative, meaning that the HIGH HEAD OFFSET can be (and often is) less than the LOW STAGE OFFSET.

During this mode of operation the HS compressor demand limit (current limit) controller is active and will override the offset function if the demand on the HS motor is too high.

This method of High Stage Compressor control should be used in situations where the best efficiency is obtained by an intermediate temperature that is not equal compression ratio sharing between stages.

Figure 61 illustrates the HS PRV offset function.

CONTROL STOP

Control Stop Chiller Temp Setpoint

This is the setpoint that the TC-100 temperature control will receive during a controlled stop procedure. The setpoint should be higher than the inlet chilled water temperature to unload the chiller quickly.

Control Stop Heat Pump Temp Setpoint

This is the setpoint that the TC-103 temperature control will receive during a control stop procedure in Heat Pump mode. The setpoint should be lower than the inlet condenser water temperature to insure a quick machine unload sequence.

CONTROL STOP MAX TIMEOUT

This time governs the maximum time that a control stop cycle should be allowed to take. If the chiller doesn't unload fast enough, this is the maximum time allowed of running after the STOP button is pressed.

RAMPS AND START POSITIONS

PRV Ramp

Ramp rate that the vanes will be limited to during a chiller start.

Start Unload

LS vane position limitation during two stage transition from single stage to two stage.

LS PRV Start

Open the vanes this small percentage before engaging the drive motor while in prelube.

HS PRV Start

Open the vanes this small percentage before engaging the drive motor while in prelube.

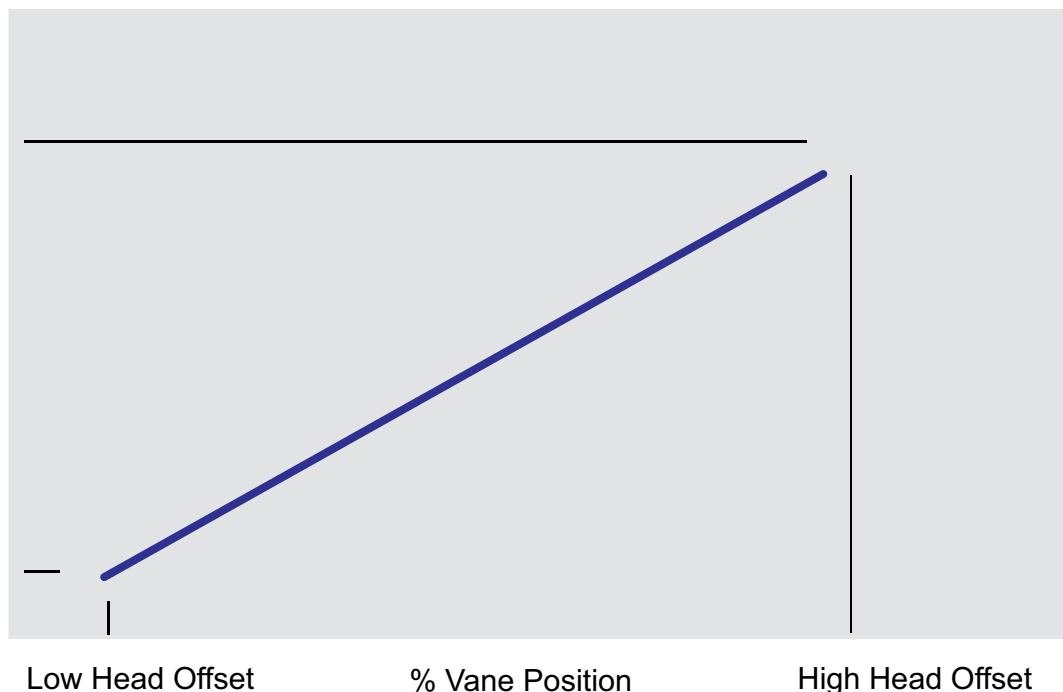
PRV Response Gain

The PRV's have a positioner algorithm that pulses them open or closed based on their target signal from the capacity controls. This gain is defaulted to 4800 for most compressors. Very small compressors have smaller faster PRV actuator motors, which may require the gain to be reduced to 4000.

PD1 from
System
Antisurge
Map

Chiller
Head

PD2 from
System
Antisurge
Map



LD15235

FIGURE 59 - HS PRV OFFSET CONTROL SCALE FUNCTION

SS1 Ramp Rate

Selector Switch 1 has a rate of change limiter associated with it, which limits the rate of change of the anti-surge calculated value to the number entered here. This prevents large transient changes caused by tower condition upsets from affecting stable chiller operation.

Minvane Low Limit

This value is the minimum calculated value allowed out of SS1. If SS1 were to go to zero, then the ratiometric hot gas calculation would not work. Therefore this value must be greater than zero.

HS Catchup Offset

This percentage value defines how far the HS vanes need to be above the LS vanes, before the LS vanes are allowed to resume Temperature Control, when a two-stage transition occurs.

Miscellaneous Settings

Motor Undercurrent Trip (LS and HS)

If the motor current does not exceed this value during run, then the load feedback is malfunctioning and must be investigated.

Standby Lube Cycle Interval

Hours of delay between shaft seal lubrication cycles. A shaft seal lubrication cycle is a 3 minute lubrication cycle.

PRV Ramp Release

This is the percentage of LS PRV position that the LS compressor is held at to establish an economizer level prior to initial start ramp up. This value is ignored after the economizer level setpoint is met.

LCV-114 Open On Start

On chiller start, the LCV-114 valve is forced to preset to this percentage.

LCV-117 % Open On Start

On chiller start, the LCV-117 valve is forced to preset to this percentage.

LCV-116 % Open On Start

On chiller start, the LCV-116 valve is forced to preset to this percentage.

Inlet Valve Level Control Setpoint Bias

The PRV Ramp Release is held until the economizer level setpoint plus this (negative) value is obtained in the economizer vessel.

Economizer Level Loss Bias

In two stage operation, if the level in the economizer goes below the setpoint minus this value, then restart the economizer level control ramp. Minimizes oscillations in regaining level control.

Economizer Gas Bleed Solenoid (On and Off)

ON – In single stage operation, if the economizer level goes below the setpoint minus this value, the gas bleed solenoid PCV-117 control becomes active.

OFF – In single stage operation, in order to turn off the Economizer Gas Bleed Solenoid the level must make an upward transition of this many percent.

NAVIGATION

Home

Used to provide additional Home information.

Setpoint 1

Returns the display to view the Setpoint 1 Screen.

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PRESSURE CALIBRATION SCREEN

10:05:58
Oct 29 2010

Pressure Calibration

Atmospheric Pressure: 14.7 PSID

Setup

Current Value	Low	Range	High	Sensor Signal	IO Board	IO Channel	Bit Count	Bit Count Calibration Zero	Bit Count Calibration Span
Evaporator 39.1 PSIG	0.0 PSIG	125.0 PSIG	0.5-4.5V	Analog Board2	1	1435	402	3689	
Condenser 74.3 PSIG	0.0 PSIG	400.0 PSIG	0.5-4.5V	Analog Board2	2	1015	402	3689	
Economizer 78.5 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	3	1265	402	3689	
LS Compressor Low Oil Pressure 28.5 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	4	716	402	3689	
HS Compressor Low Oil Pressure 28.5 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	4	716	402	3689	
LS Compressor High Oil Pressure 70.3 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	6	1175	402	3689	
HS Compressor High Oil Pressure 75.5 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	7	1232	402	3689	
LS VGD Pressure 71.9 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	17	1193	402	3689	
HS VGD Pressure 318.4 PSIG	0.0 PSIG	300.0 PSIG	0.5-4.5V	Analog Board2	19	3902	402	3689	

LD15268

FIGURE 60 - PRESSURE CALIBRATION SCREEN

OVERVIEW

This screen is only available under the highest access level.



Scaling values in the processor must agree with the marked scaling values on each instrument. If the scaling is not correct, the safe operation of the chiller is jeopardized. Only change scaling under the direction of the factory.

The pressure sensors can be configured for many types of inputs. Standard configuration uses YK Ratiometric pressure sensors. Signal type is 0.5 to 4.5 VDC. Each channel should be calibrated for zero and span bit counts for the highest accuracy.

DISPLAY

Displays and controls the instrument scaling of each Pressure transducer on the chiller.

PROGRAMMABLE

Atmospheric Pressure

Access Level Required: SERVICE

Atmospheric pressure is defined for Absolute Pressure reading references. (Typically 14.7PSI)

NAVIGATION

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

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TEMPERATURE CALIBRATION SCREEN

10:08:04
Oct 29 2010

Temperature Calibration

Setup

	Current Value	Offset	Range Low	Range High	Sensor Signal	IO Board	IO Channel
Chilled Water Out Temperature	71.8 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	1
Chilled Water In Temperature	60.7 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	2
Condenser Water Out Temperature	96.4 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	4
Condenser Water In Temperature	94.0 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	3
Evaporator Refrigerant Liquid Temperature	38.2 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	5
LS Comp Refrig Discharge Temperature	73.2 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	6
HS Comp Refrig Discharge Temperature	84.7 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	7
Subcooled Liquid Temperature	150.0 °F	0.0 °F	-0.0 °F	200.0 °F	0-5V	Analog Board1	8
LS Compressor Oil Temperature	103.5 °F	0.0 °F	-0.0 °F	250.0 °F	0-5V	Analog Board1	9
HS Compressor Oil Temperature	107.4 °F	0.0 °F	-0.0 °F	250.0 °F	0-5V	Analog Board1	10

LD15269

FIGURE 61 - TEMPERATURE CALIBRATION SCREEN

OVERVIEW

The Temperature inputs are set for ICTD (Integrated Circuit Temperature Detector) by default. These are calibrated to a known temperature by the offset column. The usable range of readings is adjustable.

DISPLAY

Displays and controls the instrument scaling of each temperature detector on the chiller.

PROGRAMMABLE

Temperature Probes

Access Level Required: SERVICE

Temperature probes can be calibrated in Service Mode by entering the actual temperature into the first column, or calculating an offset and entering it into the second column. Press the SUBMIT key on the keypad to confirm changes.

NAVIGATION

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

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MISCELLANEOUS CALIBRATION SCREEN

The screenshot shows the 'Miscellaneous Calibration' screen with a timestamp of 10:09:24 on Oct 29 2010. The screen is divided into two main sections: 'Page 2' and 'Setup'. The 'Page 2' section contains a table of calibration parameters for various sensors and actuators. The 'Setup' section contains two sub-sections: 'LOW STAGE' and 'HIGH STAGE', each with a 'FLA' (Full Load Amps) input field.

Current Value	Range Low	Range High	Sensor Signal	IO Board	IO Channel	Bit Count	Bit Count Calibration Zero	Bit Count Calibration Span
High Stage Motor Current 6.6 AMPS	200.0 AMPS		4-20mA	Analog Board2	16	905	819	3443
LS Oil Reservoir Level 66.6 %	0.0 %	100.0 %	0-5V	Analog Board2	9	2728	0	4095
HS Oil Reservoir Level 70.8 %	0.0 %	100.0 %	0-5V	Analog Board2	10	2898	0	4095
Subcooler Liquid Level 49.0 %	0.0 %	100.0 %	4-20mA	Analog Board1	17	2008	0	4095
Economizer Liquid Level 31.2 %	0.0 %	100.0 %	4-20mA	Analog Board1	18	1841	819	4095
LS PRV Position 41.6 %	0.0 %	100.0 %	0-10V	Analog Board1	14	1705	0	4095
HS PRV Position 5.3 %	0.0 %	100.0 %	0-10V	Analog Board1	15	215	0	4095

LOW STAGE
FLA: 100.0 AMPs

HIGH STAGE
FLA: 100.0 AMPs
20 mA Level: 200 Amps

LD15270

FIGURE 62 - MISCELLANEOUS CALIBRATION SCREEN

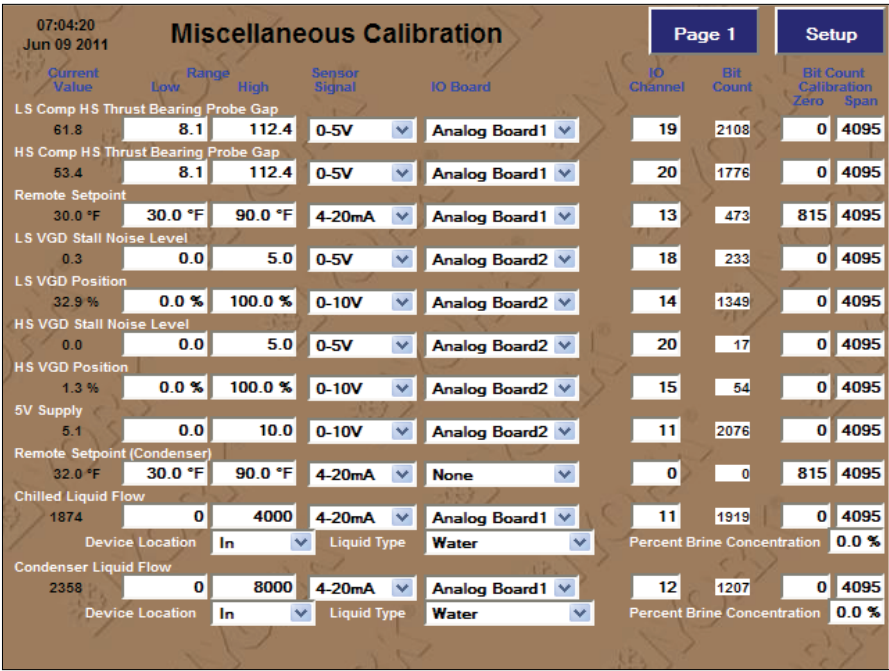
OVERVIEW

The Miscellaneous Calibration page configures any inputs that are not pressures or temperatures on the standard system. The motor CT's range should be entered with the CT ratio from the Sales Order. The FLA should be entered with the full load amps of the motors from the Sales Order.

NAVIGATION

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

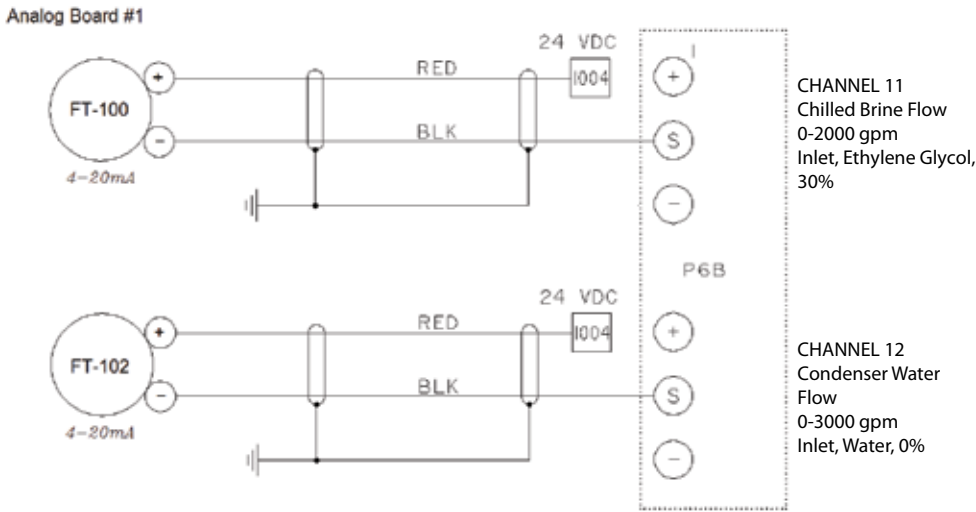


LD15270a

FIGURE 62 - SCALING – MISCELLANEOUS INPUTS SCREEN (CONT'D)

The technician must configure the engineering units of the flowmeter in GPM both Low and High. The sensor signal from the dropdown box (4-20mA is preferred). The IO Board analog board and the channel to which the instrument is attached. The technician must also determine the flowmeter device location, whether it is on the IN/OUT or an AVERAGE of the water box nozzle

temperatures. The liquid type must also be selected for the capacity calculation to work out correctly. The liquid can be *water/ethylene glycol/ or propylene glycol*. The concentration of the brine solution must also be entered in percent volume. If the liquid is water, then the concentration of brine is 0%.



LD16095

FIGURE 63 - FLOW INSTRUMENTS WIRING

DIGITAL INPUT CONFIGURATION SCREEN

10:12:16
Oct 29 2010

Auxiliary Calibration
Page 1

Calibration
Page 2

Aux Analog
Configuration

Name	Current Value	Offset	Low	Range	High
Intercooler Flux Voltage	0.0 V	0.0 V	0.0 V		4000.0 V
Room Temperature	32.0 °F	0.0 °F			
Auxiliary Analog 3	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 4	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 5	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 6	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 7	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 8	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 9	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 10	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 11	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 12	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 13	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 14	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 15	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 16	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 17	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 18	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 19	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG
Auxiliary Analog 20	30.0 Hg	0.0 PSID	30.0 Hg		485.3 PSIG

LD15272

FIGURE 64 - DIGITAL INPUT CONFIGURATION SCREEN - AUXILIARY CALIBRATION, PAGE 1

OVERVIEW

The addition of a third analog board to the CYK control center is an option. This third board can be configured for additional point monitoring, and additional safeties. Each channel is field programmable for label, range, and safety limits. If the CYK system is equipped with Analog Board #3, this board can be configured for motor temperature RTD monitoring, or Vibration probe monitoring. The channels can be dynamically labeled and configured for signal type.

On this page use a Personal Computer Keyboard plugged into any USB port on the Quantum™ LX Controller board to enter the name of the channel. Then define the signal type and device range.



Do not modify these values unless under the direction of the factory.

On this page, enter the safety limits if they are required for each channel. If a safety is not used, put the limit to a level that cannot be attained under normal operation.

The safety for each channel can be configured for any of the following:

- Disabled
- Enabled when the Low Stage Compressor is running.
- Enabled when the High Stage Compressor is running.
- Enabled Always

10:13:09
Oct 29 2010

Auxiliary Calibration Page 2

Calibration
Page 1
Aux Analog
Configuration

	IO Board	IO Channel	Sensor Signal	Sensor Type	Units If Type Is Other
Interocitor Flux Voltage	Analog Board3 ▾	1	4-20mA ▾	Other ▾	V
Room Temperature	Analog Board3 ▾	2	RTD ▾	Temperature ▾	
Auxiliary Analog 3	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 4	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 5	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 6	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 7	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 8	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 9	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 10	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 11	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 12	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 13	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 14	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 15	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 16	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 17	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 18	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 19	None ▾	0	1-5V ▾	Pressure ▾	
Auxiliary Analog 20	None ▾	0	1-5V ▾	Pressure ▾	

LD15273

FIGURE 65 - DIGITAL INPUT CONFIGURATION SCREEN - AUXILIARY CALIBRATION, PAGE 2

DIGITAL OUTPUT CONFIGURATION SCREEN

12:46:57
Jun 10 2011

Digital Output Configuration

Setup

Input / Output	IO Board	IO Channel
LS Liquid Line Solenoid Valve	Digital Board1	11
HS Liquid Line Solenoid Valve	Digital Board1	12
LS Oil Return Solenoid Valve	Digital Board1	19
Interstage Sideload Valve	Digital Board1	20
LS Compressor Oil Heater Contactor	Digital Board1	14
HS Compressor Oil Heater Contactor	Digital Board1	16
LS Compressor Motor Start/Stop Control Relay	Digital Board1	5
HS Compressor Motor Start/Stop Control Relay	Digital Board1	7
LS Compressor Oil Pump Start/Stop Relay	Digital Board1	1
HS Compressor Oil Pump Start/Stop Relay	Digital Board2	2
Oil Transfer Pump Relay	Digital Board2	3
HS Oil Transfer Solenoid	Digital Board2	4
Condensate Management Relay	Digital Board2	6
Economizer Gas Bleed Solenoid	Digital Board2	7
Open Low Stage PRV	Digital Board2	13
Open High Stage PRV	Digital Board2	17
Close Low Stage PRV	Digital Board2	14
Close High Stage PRV	Digital Board2	18
Open Low Stage VGD	Digital Board2	15
Open High Stage VGD	Digital Board2	19
Close Low Stage VGD	None	16
Close High Stage VGD	Digital Board2	20
Software System Reset R1 Safety Relay	Digital Board1	22
Chiller Running	Digital Board1	23
Chiller Common Alarm	Digital Board1	24

LD16102

FIGURE 66 - DIGITAL OUTPUT CONFIGURATION SCREEN

OVERVIEW

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

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AUXILIARY ANALOG CONFIGURATION SCREEN

LD16103

FIGURE 67 - AUXILIARY ANALOG CONFIGURATION SCREEN

		Low		High	
		Setpoint	Delay	Setpoint	Delay
Interocitor Flux Voltage Disabled	Warning	1000.0 V	1 SEC	5000.0 V	1 SEC
	Shutdown	2000.0 V	1 SEC	5000.0 V	1 SEC
Room Temperature Disabled	Warning	50.0 °F	0 SEC	50.0 °F	0 SEC
	Shutdown	50.0 °F	0 SEC	50.0 °F	0 SEC
Auxiliary Analog 3 Disabled	Warning	30.0 Hg	0 SEC	30.0 Hg	0 SEC
	Shutdown	30.0 Hg	0 SEC	30.0 Hg	0 SEC
Auxiliary Analog 4 Disabled	Warning	30.0 Hg	0 SEC	30.0 Hg	0 SEC
	Shutdown	30.0 Hg	0 SEC	30.0 Hg	0 SEC
Auxiliary Analog 5 Disabled	Warning	30.0 Hg	0 SEC	30.0 Hg	0 SEC
	Shutdown	30.0 Hg	0 SEC	30.0 Hg	0 SEC

LD15279

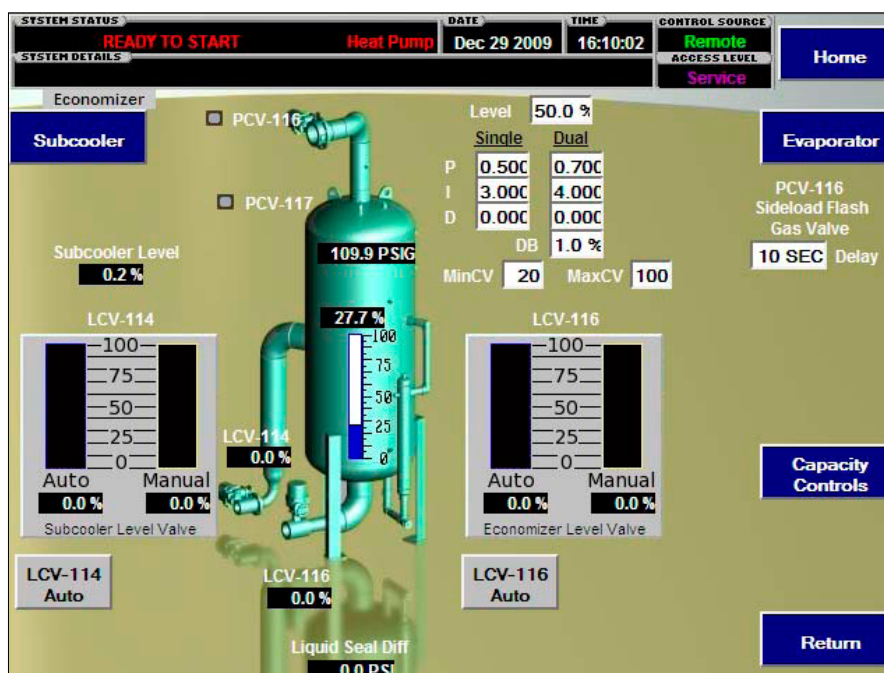
FIGURE 68 - AUXILIARY ANALOG INPUT SAFETIES SCREEN, PAGE 1

OVERVIEW

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

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ECONOMIZER SCREEN



LD15248

FIGURE 69 - ECONOMIZER SCREEN

OVERVIEW

The economizer screen depicts the operation of the economization vessel, which is mounted beside the main heat exchanger vessels. The economizer takes subcooled liquid into its side port from the subcooler level control valve LCV-114. This liquid is decelerated thru a spray-pipe and a vortex breaker. The decelerated liquid is exposed to intermediate interstage pressure. Some small amount of the liquid flashes into a gas, and travels thru the top port (thru an eliminator) and out into the interstage. The remaining liquid travels thru the bottom of the economizer, where its level is controlled by the outlet level control valve LCV-116. This action provides a cycle efficiency improvement by adding flash-gas to the suction of the booster compressor. The level control of the economizer provides a liquid seal between the intermediate gas pressure and the evaporator pressure on the other side of the LCV-116 level control valve. A 40 to 50% level is typical for the economizer vessel level. The level setpoint is not critical, just that the liquid seal is maintained. The LCV-116 level control is available with two sets of tuning parameters, since running in single stage mode and two-stage mode present different running characteristics.

On startup, the economizer level control will override loading the chiller until a sufficient level is attained. The refrigerant management aspect of the economizer must be maintained during normal operation. This prevents slugging liquid into the suction of the compressor.

In single Stage operation the PCV-116 sideload control valve is closed. The PCV-116 sideload control valve is used only during two-stage operation; its purpose is to prevent backspin at shutdown. When the unit goes into a controlled stop, the sideload is closed to prevent pressure from forcing the low stage compressor to spin backwards. The PCV-116 also protects the interstage from slugging liquid, by closing, if a high economizer level occurs.

On startup the PCV-116 valve opening can be delayed by a timer. This timer is programmable from this screen. The time delay in seconds should allow the HS compressor vanes to obtain a reasonably open position before the sideload gas valve is opened. This prevents reverse flow of gas through the sideload line.

PCV-117 is called the BLEED SOLENOID; it is used exclusively in single stage operation. As the gas pressure builds in the top of the economizer vessel, no more liquid can enter the vessel. To maintain a level setpoint during single stage operation, the gas that has expanded in the top of the economizer must be bled off. This valve will open when the LT-116 level sensor is 15% less than setpoint. It will remain open until the level signal raises by 1%, or until its timer times out after 1 minute. It is normal to have this valve open and close occasionally during a single stage run.

Standard Manual-auto stations are provided to take control of any individual valve. The PID controlling the valve will adjust to the manual position upon Manual to Automatic operation transfer.

PROGRAMMABLE

LCV-114 Auto

Access Level Required: OPERATOR

Refer to Figure 26 for operational use.

LCV-116 Auto

Access Level Required: OPERATOR

Refer to Figure 26 for operational use.

NAVIGATION

Home

Used to provide additional Home information.

Evaporator

A detailed view of all evaporator parameters, including the programmable Leaving Chilled Liquid Setpoints.

Capacity Controls

Returns the display to view the Capacity Controls Screen.

Return

Returns the display to the previous screen.

HISTORY SCREEN

SYSTEM STATUS		DATE	TIME	CONTROL SOURCE		Return
READY TO START		Heat Pump	Dec 29 2009	16:01:05	Remote	
SYSTEM DETAILS						
ACCESS LEVEL						
Service						
History						
Safety		Occurred		Cleared		
01	Alarm: HS Motor Current No Run	12-22-09 07:15:10		12-22-09 07:15:24		
02	Alarm: LS Motor Current No Run	12-22-09 07:15:10		12-22-09 07:15:24		
03	Alarm: LS Interlock With No Run	12-22-09 07:15:10		12-22-09 07:15:24		
04	Alarm: HS Interlock With No Run	12-22-09 07:15:10		12-22-09 07:15:24		
05	Trip: R1 Safety Relay Not Set	12-21-09 13:46:46		12-21-09 13:46:50		
06	Alarm: LS Interlock With No Run	12-21-09 11:44:43		12-21-09 13:13:31		
07	Alarm: HS Interlock With No Run	12-21-09 11:44:43		12-21-09 13:13:31		
08	Alarm: HS Motor Current No Run	12-21-09 11:44:41		12-21-09 13:13:31		
09	Alarm: LS Motor Current No Run	12-21-09 11:44:41		12-21-09 13:13:31		
10	Trip: LS Pump Did Not Make Setpoint	12-21-09 11:44:31		12-21-09 13:13:31		
11	Trip: LS Low Oil Pressure	12-21-09 10:21:25		12-21-09 10:43:30		
12	Alarm: LS Low Oil Pressure	12-21-09 10:21:25		12-21-09 10:43:30		
13	Trip: LS Motor Amps Low	12-16-09 09:59:51		12-16-09 14:16:59		
14	Alarm: HS Motor Current No Run	12-16-09 09:55:15		12-16-09 09:55:52		
15	Alarm: LS Motor Current No Run	12-16-09 09:55:15		12-16-09 09:55:52		
16	Alarm: HS Interlock With No Run	12-16-09 09:55:15		12-16-09 09:55:52		
17	Trip: LS Motor Interlock Lost	12-16-09 09:55:04		12-16-09 09:55:52		
18	Trip: LS Motor Starter Fault	12-16-09 09:53:31		12-16-09 09:53:36		
19	Trip: LS Motor Starter Fault	12-16-09 09:52:54		12-16-09 09:53:07		
20	Trip: Emergency Stop	12-16-09 09:51:27		12-16-09 09:51:34		
21	Trip: Emergency Stop	12-16-09 09:51:21		12-16-09 09:51:26		
22	Trip: R1 Safety Relay Not Set	12-16-09 09:50:43		12-16-09 09:51:26		
23	Alarm: HS Motor Current No Run	12-14-09 15:30:56		12-14-09 15:31:18		
24	Alarm: LS Motor Current No Run	12-14-09 15:30:56		12-14-09 15:31:18		

LD15253

FIGURE 70 - HISTORY SCREEN

OVERVIEW

The History Screen provides a comprehensive report of all system alarms and trips. Given are the date and time of the trip or alarm along with a description of each. When an alarm is acknowledged, the system stamps the alarm with the date and time that the particular alarm was acknowledged.

INTERACTIVE

Acknowledge

The acknowledge function key stamps the alarm with the date and time that the alarm occurred. Use the arrow keys to highlight and move between alarm messages. Press the ENTER key when an alarm is highlighted to view the frozen data capture at the time that this alarm occurred. This display as described in the next section is the "Freeze Screen".

NAVIGATION

Return

Returns the display to the previous screen.

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FREEZE SCREEN



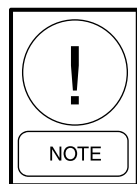
LD15254

FIGURE 71 - FREEZE SCREEN

OVERVIEW

Access a Freeze Screen by highlighting a warning or trip event on the HISTORY screen by using the up and down arrow keys and select the particular event by pressing the [ENTER] button.

These screens provide lists of various chiller parameters which were recorded at the instant the chiller event that produced a trip.



Record desired data prior to updating the Quantum™ LX software.

NAVIGATION

Home

Used to provide additional Home information.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.

History

This screen provides access to a Time stamped Record of shutdown conditions.

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TRENDING SCREEN



LD15250

FIGURE 72 - TRENDING SCREEN

OVERVIEW

The Trending Screen provides a setup utility to trend and log data points. The Realtime Trend feature stores data internally to view on a time basis live on the Quantum™ LX. The Historical Data Log feature stores the data points in a file that can be transferred off the Quantum™ LX and into a computer where the data can be stored or analyzed further.

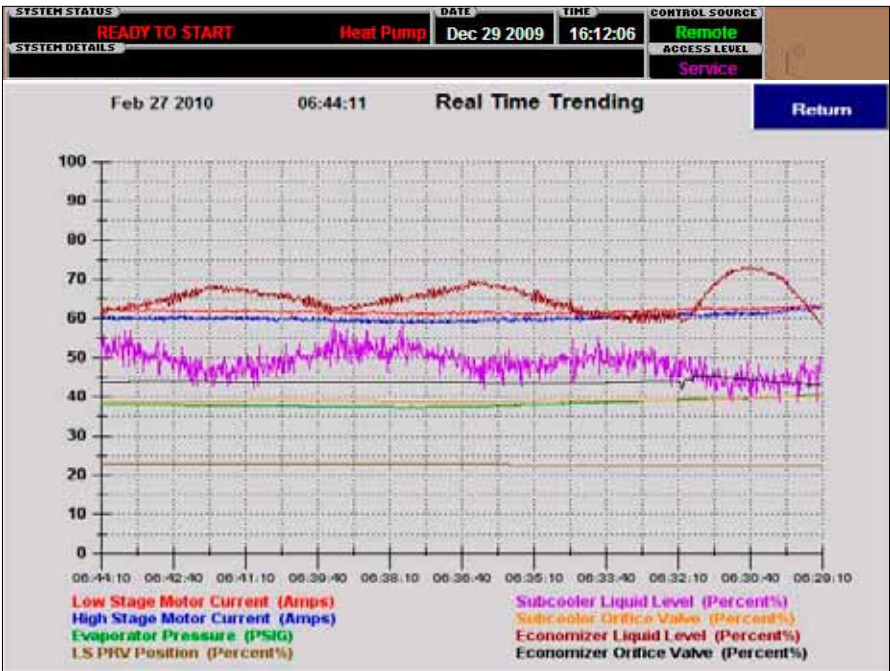
NAVIGATION

Home

Used to provide additional Home information.

Setup

This screen provides a single location to program the most common system setpoints. It is also the gateway to many of the general system setup parameters such as I/O configuration, Communications Setup, Software Maintenance, Trending, and diagnostics.



LD15250

FIGURE 73 - REAL TIME TRENDING SCREEN

TRENDING SETUP SCREEN

SYSTEM STATUS READY TO START Heat Pump DATE Dec 29 2009 TIME 16:16:06 CONTROL SOURCE Remote ACCESS LEVEL Service

SYSTEM DETAILS

Trending Setup

Real Time

Select Data To Trend

Low Stage Motor Current

LS Compressor Low Oil Pressure

Condenser Pressure

Economizer Pressure

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Recording Interval 10 SEC

Disable Real Time Trending When Chiller Is Off No

History

Select Data To Trend

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Low Stage Motor Current

Recording Interval 1 MIN

Disable History Trending When Chiller Is Off No

Download Trending Data Files

LD15251

FIGURE 74 - TRENDING SETUP SCREEN

OVERVIEW

There are 8 “pens” that can chart data. Touching the pens channel 1 through 8 will allow the user to assign a data point to the “pen”. Select the desired data by scrolling up and down through the list with the touch-screen or with the UP and DOWN arrow keys.

Return to the Trending Screen to select REAL TIME TRENDING to view the trend.

Graphical display of sensor values over the entire period of operation of the chiller. Use the tab key on the keypad to select between Pens 1 – 8. When a pen has been selected, use the UP and DOWN arrow keys on the keypad to assign the desired sensor to that Pen. Press ENTER to confirm the selection.

Trending Data Files can be downloaded to a USB flash drive for analysis or storage. Insert a USB Flash drive into any USB port on the Quantum™ LX Controller Board, and then press “DOWNLOAD TRENDING DATA FILES” on this screen. The files will be stored in a Comma Separated Variable format for analysis in a spreadsheet software package.

NAVIGATION

Return

Returns the display to the previous screen.

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SECTION 4 - SOFTWARE UPDATE PROCEDURE

Access to update the chiller SOFTWARE MAINTENANCE screen is only available on the SETUP screen when the unit is in a standby state. The standby state is defined as when the system is NOT running, and the oil pumps are NOT running. The system can be tripped, or ready to start, but not coasting down.

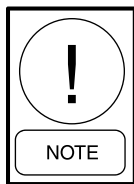
Receiving The Update Image

The update image can be transmitted by email or by use of an FTP service.

The update will consist of three files:

- *burnit.bat*
- *cf.zip*
- *dd.exe*

1. Place these files in the root C:\ folder on your Windows personal computer.
2. Use Winzip or Windows to extract the *cf.img* file from the *cf.zip* file. (To use Windows XP to extract the *cf.img* file, right click on it and select EXTRACT ALL. Then Type C:\)
3. Insure that the *cf.img* file resides in the C:\ folder on the harddrive
4. Remove any other removable flash media from your computer. There must only be one removable USB “thumb” drive attached when creating the update “thumb” flash drive.
5. Insert your USB flash drive (thumb drive) into your personal computer’s USB port.

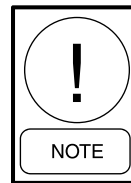


All data on the USB flash drive will be overwritten in this procedure, and it will become unusable to WINDOWS computers. See subsequent section to restore Windows usability of this flash drive.

6. Click on the *burnit.bat* file in Windows Explorer, and a DOS command prompt will open, and the contents of *cf.img* will be written to your USB flash drive (thumb drive). **Be patient as this process can take some time.**
7. When the message appears in the DOS box that you may “Press Any Key to Continue”, do so and then remove the USB flash drive safely from the computer.

Applying the Software update to the Quantum™ LX

1. Stop the chiller, and allow the postlube cycle to complete.
2. With power ON, insert the USB flash drive (thumb drive) device into any USB port.
3. Enter (at least) User Level 2 (Service) by Pressing LOGIN from the HOME screen.
4. Returns the user to the HOME screen.
5. Navigate to the SETUP screen.
6. Navigate to Software Maintenance.



The touch panel will stop working in the software Maintenance Screen, use the keypad.

7. Press [1] to Save Setpoints.
 - a. Enter any identification number (0 - 99) representing the file number to store your setpoints, in the popup box.
 - b. After entering the number, press the TAB  key and then press the ENTER  key.
8. Press [2] to do a Full System Install.
9. Press [3] to Restore Setpoints.
 - a. Enter the setpoint identification number that was entered in step 7.a)
10. At the conclusion of the Full System Install the Quantum™ LX may ask if you want to do a System Update.
 - a. Reply with YES
11. After the System Update remove the USB thumb drive as instructed and cycle the control panel power.
12. The control application will restart and return to the HOME screen.
13. Check the software version number on the LOGIN screen to see that the system has been updated.



Plug a USB Flash Memory Drive into any one of these USB ports on the bottom of the Main Controller board.

LD15274

FIGURE 75 - USB FLASH DRIVE

Reclaim USB Flash Drive From Linux Ext Partition

When a USB flash drive is used with the Quantum™ LX, it will be repartitioned to a Linux ext partition type, which is unreadable by Microsoft Windows. Follow the directions below to reclaim the drive to a FAT or FAT32 partition table. This will purge all information from the flash drive. You will need to be an administrator on your Windows PC.

1. Insert the USB flash drive into a port on your computer.
2. Open the *Disk Management* program by clicking START >> RUN... and typing the following command:
3. **mmc %systemroot%\system32\diskmgmt.msc**
4. Press *enter* on your keyboard.
5. A *Disk Management* window will appear.

6. There should be more than one disk shown. Select the drive letter of the USB flash drive [for example (E:)]. Highlight this drive letter.

DO NOT HIGHLIGHT (C:) or all data on your computer will be destroyed

7. From the menu select ACTION >> ALL TASKS >> DELETE PARTITION
8. A popup will appear saying that the selected partition was not created by Windows and might contain data recognized by other operating systems. Do you want to delete this partition. Respond **YES**
9. Re-highlight the removable disk in the bottom of the *Disk Management* window and notice that it is "Unallocated".
10. From the menu select ACTION >> ALL TASKS >> NEW PARTITION.

11. A popup wizard will appear, select NEXT, and then select NEXT again to confirm the PRIMARY PARTITION, then select again to confirm the default size.
12. Assign the drive letter (**E:**) [or other if desired] and select NEXT.
13. Format the partition with a FAT32 file system, default allocation, and type a volume label (or leave at default), then select NEXT.
14. Click Finish
15. Re-highlight the removable disk in the bottom of the *Disk Management* window and notice that it is "FAT23 and Healthy".
16. From the menu select ACTION >> ALL TASKS >> FORMAT
17. Type a Volume Label, select FAT32 and use the default allocation size.
18. Confirm the popup box that appears telling you that all data will be erased on the flash drive with an **OK**.
19. Close the *Disk Management* program.

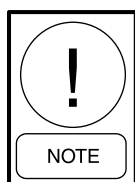
Your USB flash drive is now ready to use with Windows again.

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SECTION 5 - SYSTEM COMMUNICATION AND NETWORKING

ETHERNET AND NETWORKING

YORK Industrial Systems Controls uses Ethernet as the primary method of connecting one or multiple Quantum™ LX panels to a common computer network. In the past, this interconnection would have been done by serial protocol wiring, such as RS-232/422/485. But with the capabilities of today's technology, Ethernet is the quickest and most efficient way of providing this inter connectivity. Whereas the old serial communications methods (RS232, etc.) were slow by today's standards (kilobits per second transmission speed), Ethernet is available in two speeds: 10 Mbps and 100 Mbps.



*For connection examples, refer to the section of this manual entitled **Quantum™ LX Local Ethernet Configurations and Quantum™ LX Ethernet Network Configurations**.*

Ethernet is a data and information sharing system. To put it simply, it is a method of connecting one computer to many others on a common network. This network can consist of both hardwired connections, and wireless devices, hence the name ETHERNET. Any Windows or Linux based computer is capable of accessing this network. All that is needed is either a modem, USB port, or an Ethernet port. These devices provide the necessary point of connection for one end (branch) of the connection (a home computer for instance).

The other point that completes the connection is usually provided by an Internet Service Provider (or ISP). The Internet Service Provider usually has a very large network router, or means of bring in many individual connections. The router then assigns a discrete and individual address to each connection (much like a street address). This address is known as an Internet Protocol address (IP). The IP address consists of a series of 4 to 12 digits, and is normally transparent to the end user.

For those individuals familiar with using the internet, they are familiar that every time they activate their web browser (the software that allows your computer to connect), there is an address bar that appears near the top of the screen. This address bar is where you would enter the IP address of the computer or network that you would like to communicate with. To make this simpler, these numeric IP addresses are also coded to allow alpha-numeric names to be masked over them, so that rather than having to enter an address of 216.27.61.137, you can simply enter in www.jci.com, as an example. Although the actual process is more detailed and complicated than this basic explanation, the end result is that most of the work is being done invisibly. The following write up describes how to set up the Quantum™ LX to do this behind the scenes work, so that it can communicate both at the Internet level, and at a local Ethernet level.

CONNECT TO
LAN 1 FOR
ETHERNET
COMMUNICATIONS



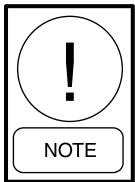
Bottom view of Quantum™ LX controller board

LD15274a

FIGURE 76 - ETHERNET CONNECTION

Cabling

Each Quantum™ LX Ethernet connection must be individually cabled (known as a homerun) direct from a switch or computer. Unlike RS422/485 communications which allowed for cable daisy chaining, Ethernet connections do not allow this. This type of cabling is designed to handle the 100- Mbps speed needed by Ethernet. Both ends of each cable must have an RJ-45 connector attached. The RJ-45 connector looks similar to the RJ-11 connector on the end of a telephone cord but is slightly larger (and not compatible). You can buy Cat 5 cables in predetermined lengths with the connectors already attached (for short runs), or you can buy the cable in rolls, cut it to length and install the RJ-45 connectors to the ends (up to 100 meters per each cable run). Although it is recommended to use shielded, twisted pair Cat 5 cable, if the cable is not properly constructed and tested, it can actually be more detrimental to the network than unshielded cable. As long as all of the cables that are used have been properly constructed AND tested, either shielded or unshielded are acceptable. This is mostly due to the excellent (electrical) noise immunity that is inherent with Ethernet components.



Follow standard networking procedures for the interconnections of all components. For individual cable runs in excess of 300 feet (~100 meters), a Switch/ Hub must be used for each additional run.

Cabling Do's and Don'ts –

It is recommended to follow these guidelines when installing and using CAT 5 Ethernet cable:

- Do run all cables in a star (homerun) configuration.
- Do keep all individual cable lengths under 300 feet. If greater distances are needed, use a switch/ hub every 300 feet.
- Do ensure that the twists of the wire pairs within the cable are maintained from end to end.
- Do make gradual bends in the cable. Keep each bend radius over one inch.
- Do keep all cables tie wrapped neatly.
- Do try to maintain parallel cable runs where possible.
- Do keep the cable as far away as possible from EMI sources (motors, transformers, solenoids, lighting, etc.)

- Do label the ends of each cable, to facility troubleshooting and identifying in the future.
- Do test each individual cable run with an approved CAT5 E cable tester. A TONING alone test is NOT acceptable.
- Do use rubber grommets anywhere that the cable enters through a hole in a metal panel.
- ALWAYS obey local, national and fire building codes.

The following are things that should NOT be done when installing and using CAT 5 Ethernet cable:

- Don't install cable taut, cables must always have some "play" or slack in them.
- Don't over-tighten cable ties.
- Don't splice a cable. If a break occurs, or the length is not long enough (under 300 feet), replace the entire run with an intact length.
- Don't tie cables to electrical conduits.
- Don't strip more than one inch from the end of each cable when installing end connectors.
- Don't sharply bend or kink the cable.
- Don't mix 568A and 568B wiring at the same installation. 568B is the most common wiring.
- Don't use excessive force when pulling cable.

RJ-45 Connectors

Ethernet network cables require the use of industry standard RJ-45 plugs as shown below, for the termination of all cables:



LD15276

FIGURE 77 - TYPICAL RJ-45 CONNECTOR

When looking at this connector, pin 1 is at the left, and pin 8 is at the right.

The Hub

A Hub is a common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN (Local Area Network). They also contain multiple ports. When a data packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

The Switch

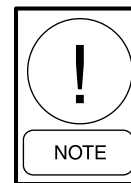
Network Switches look nearly identical to hubs, but a switch generally contains more intelligence than a hub. Unlike hubs, network switches are capable of inspecting the data packets as they are received, determining the source and destination device of a packet, and forwarding that packet appropriately. By delivering messages only to the connected device that it was intended for, network switches conserve network bandwidth and offer generally better performance than hubs.

The Switch takes the signal from each computer/Quantum™ LX and sends it to all of the other computers/LX panels in your plant or office. Switches come in several sizes, noted by the number of ports available -- a four-port Switch can connect four computers, an eight-port Switch can connect up to eight computers and so on.

So, if you start with a four-port Switch but eventually add more panels, you can buy another Switch and connect it to the one you already have, increasing the potential number of panels on your network.



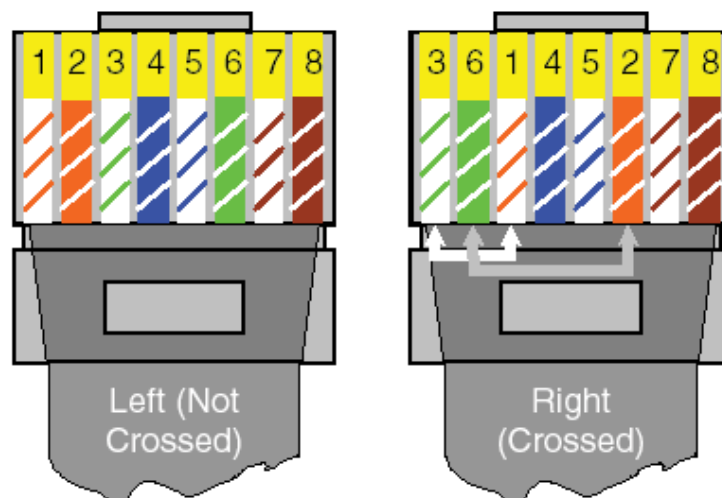
FIGURE 79 - TYPICAL SWITCH



If you want to connect one computer to one Quantum™ LX, you can avoid the switch and use a crossover Cat 5 cable. With a crossover cable, you directly connect one Ethernet device to the other without a Switch. To connect more than two you need a Switch.

5

Refer to the following pictorial to construct a crossover cable:



BOTH ENDS OF A CROSSOVER CABLE

FIGURE 78 - CROSSOVER CABLE

Cat-5 Ethernet Cable Color Codes

- 1 – White w/orange stripe 5 – White w/blue stripe
 2 – Orange w/white stripe 6 – Green w/white stripe
 3 – White w/green stripe 7 – White w/brown stripe
 4 – Blue w/white stripe 8 – Brown w/white stripe

Because of the large number of possible configurations in an Ethernet network, you most likely will not have any type of automated installation software. This means that you will need to manually configure all the options. To configure these options for the Quantum™ LX, please refer to Ethernet Setup on the next page.

TABLE 11 - ETHERNET COMPONENT RECOMMENDATIONS

COMPONENT	DESCRIPTION	PART NUMBER	MANUFACTURER
Cable	Shielded solid 4-pair* (1000 Ft)	BOXCAT5E-DSSO	Cablesforless.com
	Shielded solid 4- pair*	E-PLG-SOLID-SH	VPI
		CR45-100S	Cables Direct
		9504 CS	Alpha Wire Co.
	Un-shielded solid 4-pair**	9504 F	
		E-PLG-SOLID	VPI
	Un-shielded solid 4-pair** (1000 Ft)	345U5-1000BLK	Ram Electronics
		0-5EPCS-BK	Computercablestore.com
Crimp Tool	RJ-45 Crimp Tool	HT-210C	Cablesforless.com
		P-15027	Stonewall Cable, Inc.
		S2307692	Computers4sure.com
		10-RJ1145	Computercablestore.com
Connectors	RJ-45 For Shielded 4-pair solid wire cable	P-15007	Stonewall Cable, Inc.
	RJ-45 For Un-shielded 4-pair solid wire cable	5-554169-3	Tyco Electronics
		1-5E45-010	Computercablestore.com
		P-15029	Stonewall Cable, Inc.
Cable Tester	Ethernet Cable Tester - Continuity only	TST-5150	Cablesforless.com
		TS075A-R2	Black Box
	Complete Cable I/O Qualification Tester	N/A	Fluke
Switches	5 RJ-45 port	SFN-5TX	Phoenix
	7 RJ-45 Port and 1 ST Fiber Optic Port	SFN-7TX/FX ST	Phoenix
	8 RJ-45 port	SFN-8TX	Phoenix

*STP = Shielded Twisted Pair

**UTP = Unshielded Twisted Pair

Ethernet Setup

Once all of the cabling has been run and all connections have been made, it is now necessary to setup the Quantum™ LX software to recognize and handle the Ethernet connection.

The following section describes the suggested panel setup for connecting the Quantum™ LX panel to an existing Ethernet connection:

IP DATA

Address Type – The following drop-down menu is provided:

Fixed (Static) – A fixed address is usually assigned by the network (LAN) administrator, and is normally always the same.

DHCP (Dynamic) – Dynamic Host Configuration Protocol permits autoassignment of temporary IP addresses for new devices connecting to the network.

IP Address – (Internet Protocol) Four setpoint boxes are provided here. Every device on an Internet or Ethernet network must be assigned a unique identifying number, called an IP Address (this is similar in concept to the Quantum™ LX panel ID number). The IP address is how the network identifies each device that is attached. A typical IP address would look like this: 216.27.61.137

Gateway Address – Four setpoint boxes are provided here. This is the IP address for the computer or device onto which your local network is connected to. This gateway device is how all of the devices attached to your local network are routed to other gateways and networks. A router is a Gateway device that routes packets between different physical networks. A gateway is a network point that acts as an entrance to another network.

SYSTEM STATUS SYSTEM RUNNING 2-STAGE Heat Pump DATE Jun 09 2011 TIME 07:10:33 CONTROL SOURCE Local ACCESS LEVEL Service

Ethernet Setup

IP Data

Address Type: Fixed (Static) [v]

IP Address: 10 108 124 214

Gateway Address: 10 108 125 254

Subnet Mask: 255 255 254 0

Web Server Port: 80

Naming Data

Hostname: QLX-host

Workgroup: QLX Compressors

Comment: CYK QuantumLX

Email Data

Email Notification On Trip: Disabled [v]

Local Email Address: QLX@mailhost.eng.york.yo

Alias Name For Local Email Address: CYK Chiller #1

Subject: CYK QuantumLX Trip Notifi

SMTP Server Name OR IP Address: 10.110.15.32

SMTP Server Port Number: 25 Use TLS: No [v]

SMTP Authentication: User Name: 12JammyDodg Password: [v]

Comma-Delimited List Of Email Recipients: 12JammyDodgers@gmail.com

Protocols

ModBus TCP: Disabled [v]

Ethernet/IP: Disabled [v]

Return

HOME --> SETUP --> ETHERNET

LD15258a

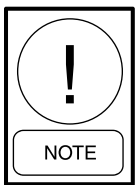
FIGURE 80 - ETHERNET SETUP

Subnet Mask – A TCP/IP number used to determine to which TCP/IP subnet a device belongs. Devices in the same subnet can be communicated with locally without going through a router (to the outside world). When a TCP/IP device tries to communicate with another device the bits of the TCP/IP destination address are "ANDed" with the subnet mask to determine whether the address is a local address (broadcastable) or must be reached through a router. A subnet mask of 255.255.255.0 used by a computer with a TCP/IP address of 10.10.10.1 would include the addresses 10.10.10.0 through 10.10.10.255 in the local network, basically telling the computer to try a router if it's transmitting to any other IP address. This is all part of the TCP/IP protocol.

Web Server Port – This is the port, or channel, that a web server uses to communicate through. Just as a computer sends data to a printer through a printer port, a web server sends and receives data through the Web Server Port. By default, the port number for a Web server is 80.

Naming Data

Host Name – Enter a distinct name that you wish to be able to identify this particular compressor by (for example; Unit1). The Host Name must be fifteen characters or less in length, use no spaces and use only upper and lower case letters. It is similar in concept to the function of the Panel ID, and basically allows the network router to interpret the actual IP address of a particular unit as this host name. When using a web browser within the system network, this name can be entered as the web location that you wish to visit (instead of having to type in the IP address). After modifying a Host Name, you will be required to cycle power. The network router could take up to fifteen minutes to recognize the change.



The IP Address Type must be set to DHCP (Dynamic) for this section to work.

Work Group – All of the Quantum™ LX units within a network may be grouped into different categories. These categories could be unit locations, or perhaps categorized by unit function. For instance, if you wanted to group the units by function, and had 10 units, and three of them were Evaporators (located on the roof), then Evap1 could be the name of a work group. Another three units may be Heat Pump Units, this work

group could be named Heat Pump 1, and the remaining four units could be standard chillers, and they could be named Chiller1. So name each unit by these functional Work Group names. The Work Group name must be fifteen characters or less in length, and can use numerals and upper and lower case letters. When using the network neighborhood feature of Windows® Explorer, by looking at your Network Neighborhood, you would see the name of the Work Group, and within that work group you would see the individual Host Names of each unit within that work group. After modifying a Work Group name, you will be required to cycle power. The network router could take up to fifteen minutes to recognize the change.

Server String – This is a comment area that can be used in conjunction with the Host Name. For example, if the Host Name is Plant1, you could set the Server String to print something like EastPlant, or some other additional information about the unit. The Server String has no control function; it is strictly an informational area.

E-Mail Data

The purpose of the E-Mail data feature is to allow the controller to send a Warning or Shutdown message to defined listing of recipients.

Email Notification On Warning Or Shutdown – For the E-mail notification feature to work, it must be enabled (it is disabled as a default). The following drop-down menu is provided:

- Disabled
- Enabled

Local Email Address – Use this setpoint box to enter a valid E-mail address that has been assigned to the internet account.

Alias Name For Local Email Address – Enter here a custom name to identify more clearly the local Email address. When a message is sent to all recipients, this is the name that will appear in the Email FROM column.

Subject – Enter a custom subject that you would like to appear when a message failure is sent. When a message is sent to all recipients, this is the wording that will appear in the Email SUBJECT column.

SMTP Server Name OR IP Address – SMTP stands for Simple Mail Transfer Protocol. SMTP servers handle outgoing email, and accept email from other domains. When you set up an email client, you must specify an outgoing server (sometimes called an SMTP server).

Often, this server is designated in the form of smtp.domain.com. But this can vary, so be sure to check with your email service provider or LAN administrator to find out their outgoing server.

SMTP Server Port Number – This value is in almost all cases going to be 25. This should be set by the network or LAN administrator. **Comma-Delimited List Of Email Recipients** - This is simply the list of the Email addresses that you would like to have any messages sent to. Separate each email address with a comma.

SMTP Authentication for Email Data – Emails can be sent when the Quantum sets an alarm.

Protocols

The purpose of this section is to enable or disable the Modbus TCP and Ethernet/IP parameters.

- Modbus TCP:
 - Disabled
 - Enabled
- Ethernet/IP:
 - Disabled
 - Enabled

SERIAL COMMUNICATIONS

General Description

Serial communications to and from the Quantum™ LX uses RS-232 or RS-485 hardware protocol depending on the specific Com port.

The Com-4 serial communications port is configured for RS-485 and is connected directly to the I/O boards. Com-1 is located at the bottom left of the controller board.

The Com-1 port is not used.

The Com-2 port is the programmable **Serial Slave Communication Port** on the Serial Setup screen. It is an RS-232 port and can be used to communicate to an external supervisory system or networking gateway device.

The Com-3 port is reserved for the optional Liquid Cooled Solid State Starter Modbus Master Communication Port.

RS-232 Description

RS-232 is by far the most common (and oldest) serial communications hardware protocol, as almost all laptop and desktop computers will have at least one RS-232

serial communications port available. It was initially developed for the emerging computer industry in the 1960's. Originally, it was a method of sending data from a mini or main frame computer, to devices such as printers, punch card readers, teletypes, magnetic tape units and modems. In those early days, the maximum speed at which RS-232 was capable of transmitting (about 9600 bits per second), was quite satisfactory, as most of the receiving devices were mechanical in nature (except for modems), and barely able to keep up with these speeds.

RS-232 uses single ended TX (transmit data) and RX (receive data). This means a common ground wire is shared between TX and RX, so only 3 wires are needed or a data only serial channel: TX, RX, and GND.

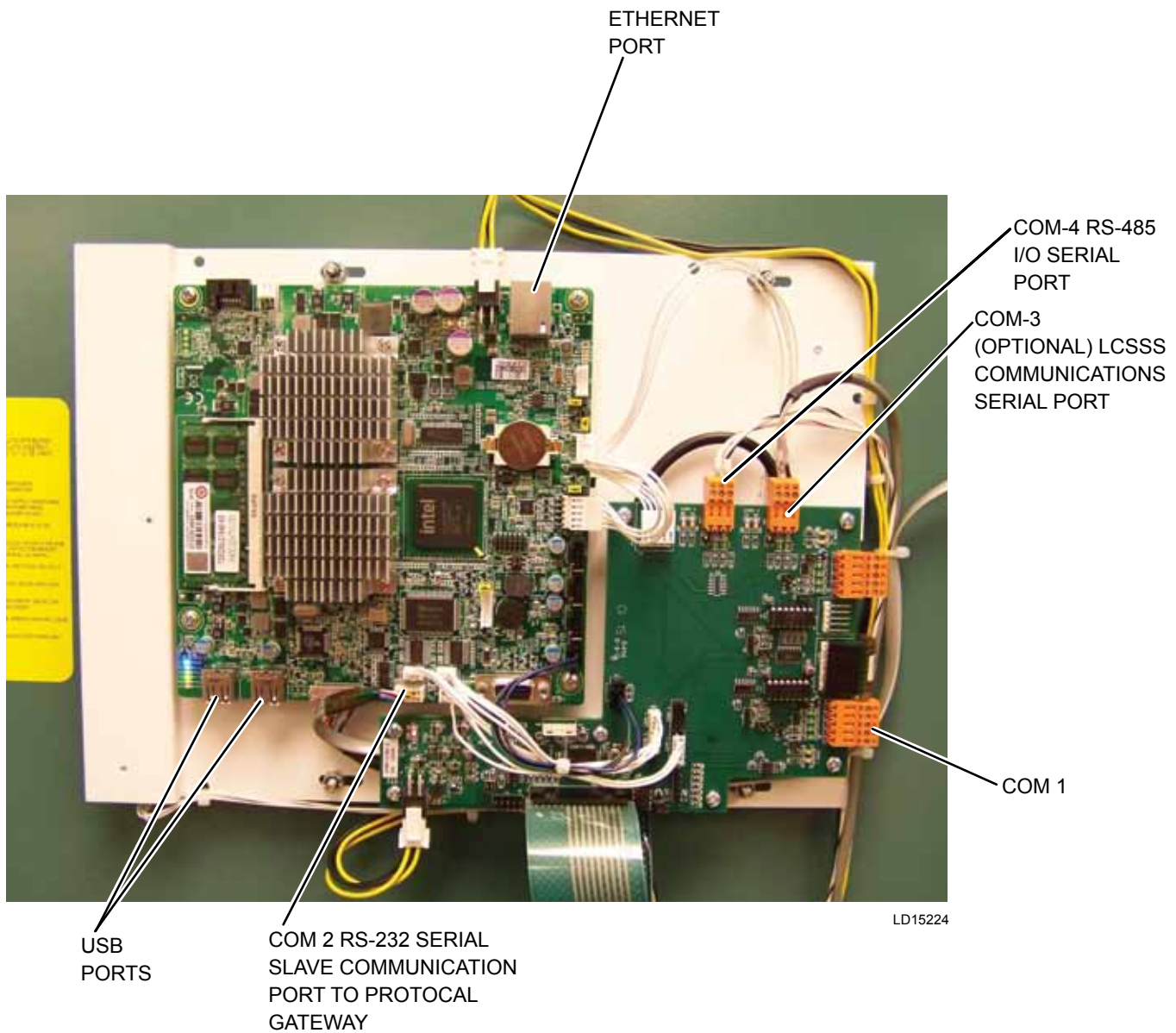
Disadvantages of single ended signaling is that it is more susceptible to noise than differential signaling (RS-422/485), effective cable distances are shorter (typically about 50 Ft. total, due to low noise immunity) and data rates are slower. Additionally, there is the limitation that only two devices can communicate together (master and slave).

The Quantum™ controller has one RS-232 port available. Com-3 attached to the RedLion Data Station provides the communication link to Building Automation System or DCS.

RS-485 Description

When serial communications started moving into the industrial environment, it was quickly noted that because of the high electrical noise potential from electric motors, valves, solenoids, fluorescent lighting, etc., that the noise immunity characteristics of RS-232 protocol was grossly lacking. Additionally, the distances between the communicating equipment on the factory floor was much greater than that within the typical office environment. For these reasons, RS-485 was developed.

RS-485 is a half duplex bus. This means that it can only send data, or receive data at any given time. It cannot do both at the same time. The Quantum™ LX uses a 2-wire system for RS-485 (one positive transmit/receive wire and one negative transmit/receive wire). Up to 30 Quantum™ LX controllers may be simultaneously connected up to a total distance of 2000 ft. using a daisychain wiring scheme (to be explained later). One advantage to using RS-485 as opposed to RS-422 is that only a single twisted pair cable need to be run to all devices (while RS-422 requires a double twisted pair cable), much greater noise immunity than RS-232. RS-422/RS-485 signals cannot be connected directly to an RS-232 device.

**FIGURE 81 - SERIAL PORT LOCATIONS**

Serial Communications Setup

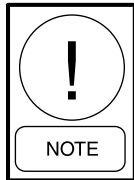
After the serial communications wiring has been connected, and jumpers correctly set, the LX software needs to be setup to match that of the device(s) that it is to communicate with. The following screen is where this information can be found:

The following setpoints are provided:

Compressor ID – A number that is used by an external communications application, to converse to individual compressors. On interconnected systems, this number must be unique. Valid values are from 1 – 99.

Status – Shows the current communications status of the port. The possible messages are:

Off – No communications are currently taking place.



A delay of 15 seconds or more of inactive communications (time between valid responses) will cause this message to display.

Active – Valid communications are actively occurring.

Failed – An invalid command was received by the port. This could be due to a bad checksum value, a wiring issue, or hardware problem at either the transmitting (host) or receiving (Quantum™ LX) end.

Baud Rate – The baud rate defines the speed at which external communications can occur. The higher the baud rate, the faster the communications. It is best to start out using a lower baud rate, and increasing the value only after verifying that communications errors do not occur. If errors start to occur, drop the baud rate back down. A pull down menu is provided to select from the following:

- 1200
- 2400
- 4800
- 9600
- 19200
- 38400
- 57600
- 115200

HOME >> SETUP >> SERIAL COMMUNICATIONS

LD15259

FIGURE 82 - COMMUNICATIONS SETUP

Data Bits – Determines the number of bits in a transmitted data package. A pull down menu is provided to select from the following:

- 7
- 8

Stop Bits – A bit(s) which signals the end of a unit of transmission on a serial line. A pull down menu is provided to select from the following:

- 1
- 2

Parity – In communications, parity checking refers to the use of parity bits to check that data has been transmitted accurately. The parity bit is added to every data unit (typically seven or eight data bits) that are transmitted. The parity bit for each unit is set so that all bytes have either an odd number or an even number of

set bits. Parity checking is the most basic form of error detection in communications. A pull down menu is provided to select from the following:

- None
- Even
- Odd

Protocol – A protocol is the special set of rules that each end of a communications connection use when they communicate. A pull down menu is provided to select from the following Quantum™ LX recognized protocols:

- None
- ModBus ASCII
- ModBus RTU
- AB DF1 Full Duplex
- AB DF1 Half Duplex

Use the following form to record all settings:

TABLE 12 - SERIAL COMMUNICATION SETUP

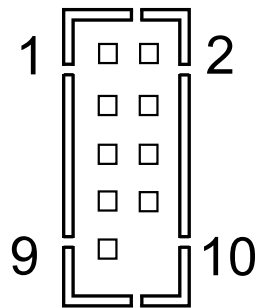
COMPRESSOR ID	(0 - 255)	
	Com 1	Com 3
	Baud Rate	☐ 1200 ☐ 2400 ☐ 4800 ☐ 9600 ☐ 19200 ☐ 38400 ☐ 57600 ☐ 115200
	Data Bits	☐ 7 ☐ 8
	Stop Bits	☐ 1 ☐ 2
	Parity	☐ None ☐ Even ☐ Odd
	Protocol	☐ None ☐ Modbus ASCII ☐ Modbus RTU ☐ AB DF1 Full Duplex ☐ AB DF1 Half Duplex

Serial Communications Port Wiring

COM-2

The following pictorial shows the communications board, as well as the jumpers, LED's and signal pinouts to allow the end user to communicate to Com-2 using RS-232 protocol.

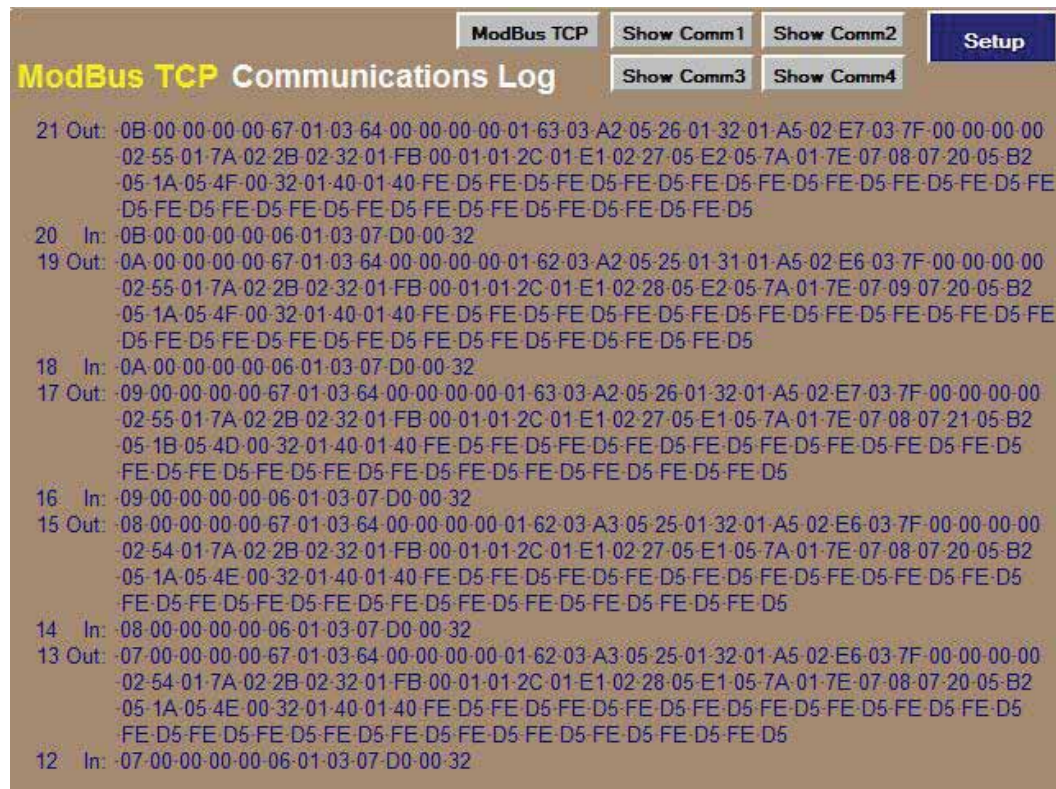
On the Communications Setup screen, verify that the proper Panel ID, Baud rate, data bits, and protocol has been setup at the Quantum™ LX, and matches that of the initiating device.



LD15236

TABLE 13 - COMMUNICATIONS BOARD

PIN	SIGNAL	DESCRIPTION
1	DCD	Data Carry Detect
2	SIN	Serial In or Receive Data
3	SOUT	Serial Out or Transmit Data
4	DTR	Data Terminal Ready
5	GND	Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	VCC_ COM	Power Source



LD15284

FIGURE 84 - MODBUS TCP COMMUNICATIONS LOG

This screen allows the technician to view the ModBus TCP data communications information that the Quantum™ LX is receiving and transmitting. Each time a new command is sent or received, the screen will need to be refreshed by selecting the [Refresh] button, as described earlier. The top line of data is the most recent activity. At the left of each line, you should see whether the data is IN or OUT (Response or Command), and

the actual data (in Hexadecimal format). This information can be used to compare against the data being sent and received at the other end of the communications link, to verify proper operation.

At the bottom of this page is an example for a breakdown of how the data packets are created, using the data that has been shown on the above screen

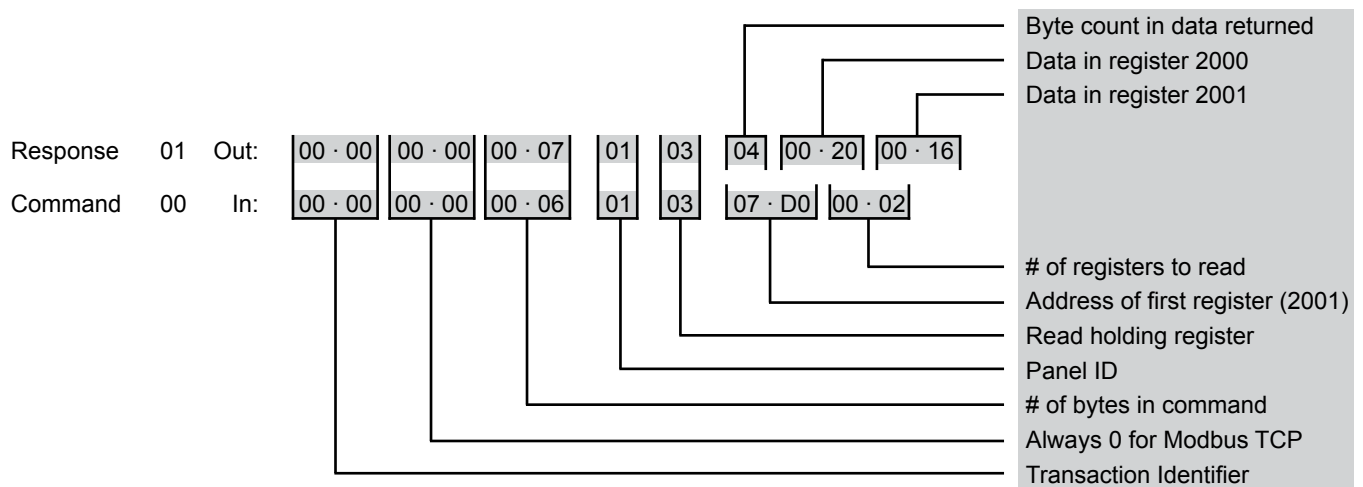


FIGURE 85 - HOW THE DATA PACKETS ARE CREATED

NETWORK INTERFACE PROTOCOLS

The Quantum™ LX for CYK supports the following protocols internally:

- ModBus ASCII
- ModBus RTU
- AB DF1 Full Duplex
- AB DF1 Half Duplex
- Modbus TCP over Ethernet
- Ethernet Industrial Protocol with Allen-Bradley data table structures

Additional protocols and media are supported by the RedLion Data Station Plus.

Please refer to Red Lion Controls publication 07036 DSPLE for configuring and interfacing to the RLC Data Station Plus.

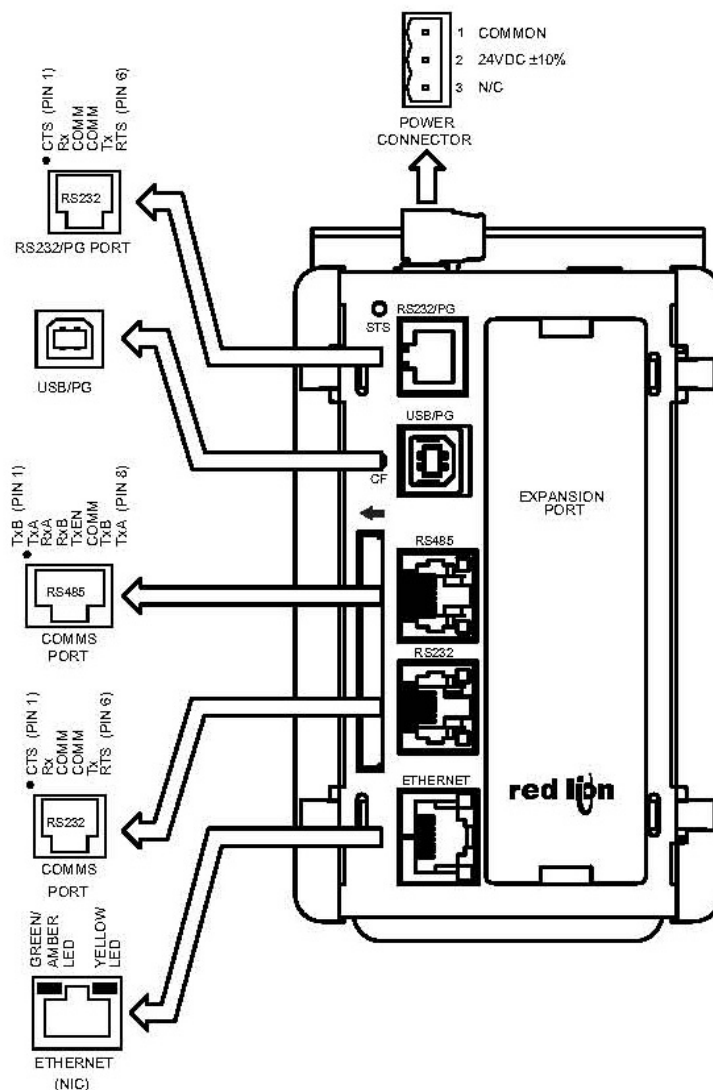
<http://www.redlion.net/Products/Groups/DataStationPlus/DataStationPlus/Docs/07038.pdf>

Data Station Pinout

RLC Crimson 2.0 configuration software can be downloaded here.

<http://www.redlion.net/Support/Downloads/SoftwareLibrary/Crimson2.html>

See the CYK protocol list document in the chiller IOM.



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FIGURE 86 - DATA STATION PINOUT

SECTION 6 - TROUBLESHOOTING

When there is a problem that makes no sense due to unexplainable things happening, check the following:

1. Is the panel powered by an isolating power source such as a control transformer in the starter panel?
2. Is the panel powered from a lighting or utility panel?
3. It is important to know if the unit ever worked properly.
4. If the unit used to work properly, try to determine when the problem first showed up.
5. It is important to know if the problem occurs randomly, frequently, or all the time.
6. Check what the temperature is in the engine room and at the panel. Is it very hot or very cold? Make sure that the motor is not blowing exhaust air on the control panel.
7. If it just started to act up, then check if there was recently a severe lightning storm, fire, flood, or a plant accident. If any of the following conditions are possible, then check for it:

Has any water, refrigerant, or oil leaked into the panel or conduit?
8. If it just started to act up, then check if anything was recently changed in the system (i.e. software or hardware.)
9. If it just started to act up, then check if any service was recently done to the chiller or its electrical system?
10. If there is communication wiring connecting the panel to another panel or device, then check the following:
 - If the Quantum™ LX is unexplainably shutting down, try disconnecting the communications cable to see if the problem goes away.
 - Check if the communications cable shields are tied to machine ground at only one location. For a PLC or Opto22 based system, the shield should normally be tied only at the PLC or Opto22 panel. For dual sequencing machines, the shield should only be tied to ground in one panel, typically the “Lead” machine.
 - Check that you are using the Frick recommended communications cable.
11. If this is an older plant, has the plant wiring been brought up to code?
12. Do you have power wiring mixed with control, sensor or communications wiring?
13. Check that the starter panel is grounded to the plant transformer. There are usually four wires: 3 for the 3 phases and 1 for plant ground.
14. Check that the motor is grounded to the starter panel. There are usually four wires: 3 for the phases and 1 for ground.
15. Ensure that one side of the motor current transformer is grounded in the motor starter panel. The wire to the control panel terminal #2 is usually the only one grounded.
16. Check that the temperature transducers are properly grounded. The temperature probes usually have two short wires coming out of the sensor, and are tied to a shielded cable at the thermal well head. The shield is insulated at the temperature probe and grounded at the panel end.
17. Check if one of the temperature probes has a signal wire shorted to machine ground. To do this, first pull the orange plug from the micro board and then use a DVM and check each white wire to machine ground and each black wire to machine ground.
18. Check that all inductive loads (i.e. coils, solenoids, or relays, etc.) connected to the I/O output modules have surge suppressors across them, preferably at the devices. Most of the larger factory installed inductive loads should have surge suppressors as well.
19. If the chiller control settings unexplainably change modes, it may be a noise problem affecting the keypad’s input circuit. Check if it works OK with the keypad cable disconnected. If it works OK, then check the grounding as described above. If the grounding is OK then replace the keypad.
20. Make sure that you have a continuous ground back to the power source. The ground connection must be copper. A conduit ground will not work. Do not drive a ground stake at the chiller since extraneous currents will be attracted to the chiller.

21. Make sure that there is no AC wiring lying next to the printed circuit board.
22. Unexplainable chiller auxiliary failures are usually indicative of noise due to wiring problems (i.e. incorrect earth grounds, mixed power and control wiring, unsuppressed coils, etc)
23. If the chiller is unexplainably shutting down, check if the machine shares control transformer power with something else. Make sure each chiller has its own isolation transformer in the motor control center off the three-phase bus with the secondary properly grounded.

The following factors can be used to convert from English to the most common SI Metric values.

TABLE 14 - 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)	304.8	Meters (m)
	Inches (in)	25.4	Millimeters (mm)
Weight	Pounds (lbs)	0.4538	Kilograms (kg)
Velocity	Feet / Second (fps)	0.3048	Meters / Second (m/s)
Pressure Drop	Feet of Water (ft)	2.989	Kilopascals (kPa)
	Pounds / Square Inch (psi)	6.895	Kilopascals (kPa)

TEMPERATURE

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), subtract 32° and multiply by 5/9 or 0.5556.

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: $10.0^{\circ}\text{F range} \times 0.5556 = 5.6^{\circ}\text{C range}$



P.O. Box 1592, York, Pennsylvania USA 17405-1592
Copyright © by Johnson Controls 2011
Form 160.82-OM1 (611)
Issue Date: June 8, 2011
NEW RELEASE

800-861-1001
www.johnsoncontrols.com

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