YORK®

LIQUID COOLED OPTISPEED™ COMPRESSOR SPEED DRIVE		
OPERATION MANUAL	NEW RELEASE	Form 160.00-O10 (217)

MODELS HYP1100A, HYP1300A

1100 HP – 50/60 HZ, 380-415 VAC (371-06172-XXX)
1300 HP – 60 HZ, 460 VAC (371-06172-XXX)

Issue Date:
February 28, 2017

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

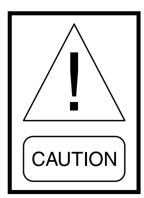
This equipment is a relatively complicated apparatus. During rigging, installation, operation, maintenance, or service, individuals may be exposed to certain components or conditions including, but not limited to: heavy objects, refrigerants, materials under pressure, rotating components, and both high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

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

SAFETY SYMBOLS

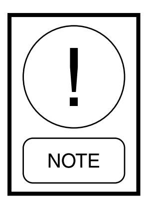
The following symbols are used in this document to alert the reader to specific situations:

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



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

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



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

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

CHANGEABILITY OF THIS DOCUMENT

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

It is the responsibility of rigging, lifting, and operating/service personnel to verify the applicability of these documents to the equipment. If there is any question regarding the applicability of these documents, rigging, lifting, and operating/service personnel should verify whether the equipment has been modified and if current literature is available from the owner of the equipment prior to performing any work on the chiller.

CHANGE BARS

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

ASSOCIATED LITERATURE

MANUAL DESCRIPTION	FORM NUMBER
Operation Manual (Unit) Model YK, (Centrifugal)	160.76-O1
Operation Manual (Control Panel) Model YK, (Centrifugal)	160.76-O2
Wiring Diagram (Control Panel) Model YK, (Centrifugal)	160.76-PW6
Wiring Field Connections (Variable Speed Drive) Model YK, (Centrifugal)	160.76-PW7
Renewal Parts (Variable Speed Drive)	160.00-RP8

NOMENCLATURE

W HYP 1300 X K C 30 B -40 A

DESIGN LEVEL (W)
W = Asia Design
_ = Global Design

DESIGN TYPE (HYP)

HORSEPOWER RATING (1300)

DESIGN PACKAGE (X)
X = Factory Mount
R = Retrofit Model

CHILLER APPLICATION (K)
K = (YK)

COOLING SYSTEM SOURCE (C)
C = Condenser Cooled
E = Evaporator Cooled

COOLING SYSTEM PRESSURE RATING (30)
30 = 300 PSIG
15 = 150 PSIG

INPUT TYPE (B)
B = Circuit Breaker
D = Disconnect Switch

VOLTAGE RANGE (-40)
40 = 380V 60Hz
42 = 400V 60Hz
50 = 400V 50Hz
46 = 460V 60Hz
68 = 415V 50Hz

SUFFIX MOD LEVEL (A)

TABLE 1 - VSD PART NUMBERS AND DESCRIPTIONS

MODEL		PART NUMBER		DESCRIPTION
		60 HZ	50 HZ	
1100 HP 380 VAC	HYP1100XKC30B-40A	371-06172-163		Factory Package, YK Filter Model
	HYP1100XKC30B-50A		371-06172-165	Factory Package, YK Filter Model
1100 HP 400 VAC	HYP1100XKC30B-42A	371-06172-181		Factory Package, YK Filter Model
	HYP1100XKC30B-50A		371-06172-183	Factory Package, YK Filter Model
1100 HP 415 VAC	HYP1100XKC30B-68A		371-06172-167	Factory Package, YK Filter Model
1300 HP 460 VAC	HYP1300XKC30B-46A	371-06172-161		Factory Package, YK Filter Model
1100 HP 380 VAC	HYP1100RKC30B-40A	371-06172-173		Retrofit Package, YK Filter Model
	HYP1100RKC30B-50A		371-06172-175	Retrofit Package, YK Filter Model
1100 HP 400 VAC	HYP1100RKC30B-42A	371-06172-185		Retrofit Package, YK Filter Model
	HYP1100RKC30B-50A		371-06172-187	Retrofit Package, YK Filter Model
1100 HP 415 VAC	HYP1100RKC30B-68A		371-06172-177	Retrofit Package, YK Filter Model
1300 HP 460 VAC	HYP1300RKC30B-46A	371-06172-171		Retrofit Package, YK Filter Model

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SECTION 1 - GENERAL INFORMATION

This instruction is to be used in conjunction with the Operation Instructions for YORK Centrifugal chillers furnished with an optional OptiSpeed™ Compressor Drive (OSCD) see associated literature.

OPTISPEED COMPRESSOR DRIVE OVERVIEW

OptiSpeed Compressor Drive 1100/1300 HP

The YORK® OptiSpeed Compressor Drive (OSCD) is specifically designed for the application of controlling an induction motor used on the YORK Model YK Centrifugal Liquid Chiller. This type of design allows the chiller to be design as a complete system, and take full advantage of the strengths of each major component within the system.

This new OSCD design builds on the successes of previous designs by being chiller mounted, provide for high levels of energy savings, improved integration with the chiller control center, liquid cooled, shell and tube heat exchanger, use of fast switching power modules, high reliability, and greater ease of service.

New features include:

- Circuit breaker with ground fault detection.
- Lower current levels are now require for ground fault detection from the drive logic board.
- Direct liquid cooling of power modules.
- A more accessible cooling system.
- Variable voltage input.
- Variable voltage output to support a wider voltage range of motors.
- The harmonic filter is standard on all models.
- Modular lighter weight power units that can be repaired in the field without complete replacement.
- Ease of maintenance and setup.

OPTISPEED COMPRESSOR DRIVE FEATURES

The new drive design is currently available in an 1100/1300 HP model. There are 3 power units used in this model. Each power unit contains all of the power devices required for one phase of input and output. In other words, the rectifier and inverter are integrated into one power unit.

This design has 2 methods of detecting a ground fault. The circuit breaker has the ability to detect a ground fault, as well as the drive logic board using data from the input current sensors

Direct liquid cooling is a much more efficient way of removing heat from the OSCD. This method also reduces the cooling load on the internal cooling coil. In the past, YORK developed direct liquid cooling for the inverter power modules, but today YORK is direct liquid cooling the rectifier, inverter, input inductor, and the output inductor.

The cooling system for the OSCD is greatly modified to improve serviceability of the power electronics. Repair of the power electronics no longer requires access to the back of the drive except to drain the cooling system. Also, the use of a shell and tube heat exchanger is standard on all models.

The OSCD can now be configured for many different input voltage levels. Lower input voltages may de-rate the input power rating of the OSCD, but the OSCD will produce the same output voltage and will use the same motor.

The harmonic filter is no longer an option, and the function of the harmonic filter is included in a new rectifier module. This type of arrangement for the rectifier no longer requires a separate power unit for the harmonic filter. Also this rectifier is part of the power unit for the inverter, thus reducing the number of parts required and increasing reliability.

The new OSCD control system allows for different motor voltages to be used. In a new production chiller the OSCD will support a 575 VAC motor. In retrofit applications the drive will support a 575 VAC motor or a 460 VAC, motor regardless on the input voltage provided to the OSCD.

The new power unit consists of a newly designed bus capacitor, new light weight plastic cooling blocks, new power module gate driver design, new rectifier module, and the cooling system is connected to the front of the power unit for reduce down time and service cost.

The new bus capacitor is the core of the power unit. The new capacitor is made of a material that is much more robust and has a longer lifetime than bus capacitors commonly used in the past. Also, this capacitor contains all of the hardware required to mount all of the other parts of the power unit.

The harmonic filtering is now part of the input to the OSCD. This feature is no longer an option when this OSCD is used.

New special plastic cooling blocks were designed for this OSCD. These plastic cooling blocks provide a light weight solution by replacing heavy copper or aluminum cooling blocks, while providing direct liquid cooling for the rectifier and inverter power modules. They also provide a method for mounting the power module assemblies to the bus capacitor within the power unit.

The power unit contains all of the items needed for the output of the OSCD in a highly integrated, but modular design. On top of the bus capacitor is the laminated bus structure and the gate driver board. One gate board per power assembly controls the rectifier and inverter power devices. The gate driver board isolates the turn-on and turn off commands from the drive logic board. The gate driver board also conditions the commands so that the power devices are properly turn on and off. The rectifier and inverter assemblies are attached to each side of the bus capacitor. The rectifier or inverter assemblies can be replaced in the field. A bus bleeder resistor is mounted on top of each power unit to discharge the energy store in the bus capacitor when the chiller is placed into the stop condition.

Ease of maintenance is provided by using the communications link between the OptiView™ panel and the OSCD. The cooling pumps and fans can be turned on from the OptiView™ panel. This provides for a safer annual coolant change. The programmed chiller full load amps is now programmed from the OptiView panel.

OPTISPEED COMPRESSOR DRIVE DETAILS

The 1300 HP drive contains 3 power assemblies. Each power assembly contains 2 capacitors with the rectifier of the left side of the power assembly, and the inverter on the right side of the power assembly. Due to the size of the power assemblies, the enclosure has 3 doors. See *Figure 1 on page 10*. The center and right doors cannot be opened unless the circuit breaker is placed in the off position, and the left door is open.

An electronic circuit breaker connects the three phase input power to input fuses and then onto the AC line inductor, and input filter. See *Figure 2 on page 11*. Three phase power continues onto the rectifier power modules to the bus capacitor to the inverter, then onto the output filter and to the compressor motor.

The AC line inductor provides isolation between the 3 phase power source and the input to the drive. The AC line inductor improves the input current waveform so that it appears more like a sine wave. The input filter reduces the effects of the high frequency switching of the rectifier and provides the inductance for boosting the bus voltage above the peak of the line voltage.

The higher bus voltage is required for harmonic current correction at the input of the OSCD, and to provide the correct output voltage to the motor when the line voltage is less than the voltage required for the compressor motor.

As with all drives, the bus capacitors need to be precharged. This is a process that limits the amount of current flowing into the bus capacitors. If this limit was not provided, then the input fuses and or the circuit breaker may open.

The precharge operation functions in the following manner. A precharge contactor and resistors limit the inrush current during the precharge time. The precharge contactor is directly controlled by the drive logic board. During the precharge period the drive logic board will command the precharge contactor to close for 12 seconds. During this time, the voltage will increase across the bus capacitors, and the current will be limited by the precharge resistors. This 12 second period is called the precharge time. After 12 seconds has passed, a small pilot relay directly controlled by the drive logic board will close, and cause the supply contactor to close. Shortly, after this time the precharge contactor will open. The drive is now precharged and is ready to run. The supply contactor will remain closed until the chiller is placed into the stop condition.

The AC to DC rectifier uses several power devices. Each phase power assembly contains several power modules arranged in a parallel connection. Each rectifier module contains 2 power devices that are called the Upper, and Lower device. These 2 power devices perform the function of rectification from AC to DC and boost the bus voltage. The power modules used in the rectifier are also used to provide the harmonic current filtering. See *Figure 5 on page 13*.

The 6 DC bus capacitors store energy to be used by the inverter. The rectifier supplies energy into the bus capacitors when the inverter does not require energy, but energy is pulled from the bus capacitors when the inverter is turned on.

The DC to AC inverter also uses several power devices arranged in a parallel connection. Each inverter module contains an Upper and Lower device. The switching pattern for these devices determine the output voltage and frequency provided to the compressor motor.

Typically, drives provide a pulse of voltage at the amplitude of the bus voltage for a varying period of time. This waveform is typically known as a square wave. This OSCD contains a resistor and capacitor network that slows down the rate at which the voltage on the output of the OSCD will change. This network protects the motor windings from very high peak voltage that could cause damage to the motor winding.

A new drive logic board was designed to provide all of the logic required to turn on and turn off all of the power devices, turn on and off the cooling fans and pumps, evaluate data from the input and output current sensors, evaluate data about the input voltage, and communicated to the OptiView™ panel.

Other sensors and boards are used to convey information back to the OSCD Logic board (See *Figure 4 on page 13*), and provide safe operation of the OSCD. Each power module contains a temperature sensor that provides temperature information back to the OSCD logic board. Two ambient temperature sensors ensure that the internal temperature of the OSCD does not exceed a safe operation level. Three current sensors monitor the output currents from the OSCD power unit and are used to protect the drive and motor from overcurrent conditions. Another 3 current sensors monitor the input current to the OSCD to provide input current limit, ground fault detection, and information for the harmonic current filtering. The bus voltage is monitored to verify that bus voltage is present. The line voltage is monitored to determine the line frequency, phase rotation, phase loss, and amplitude.

Harmonic Filter Benefits

The OptiSpeed Compressor Drive (OSCD) system now includes an input harmonic filter and high frequency filter trap designed to meet the IEEE Std 519, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems". The harmonic filter provides a means to improve the input current waveform drawn by the OSCD from the AC line, thus reducing the possibility of causing electrical interference with other sensitive electronic equipment connected to the same power source, and reduce power loss in the customer's switch gear and source transformer.

In addition, the power factor of the chiller system with this harmonic filter corrects the OSCD's input power factor to nearly unity over the full load range of the product. Some passive filters may over correct the power factor at lighter loads. Over correcting the power factor may cause voltage ringing on the power source that may affect other equipment, or could cause the VSD to fault on high bus voltage.

Harmonic Filter General Information

The Harmonic Filter is no longer an option for the HYP model of OSCD. The function of the Harmonic Filter is now integrated into the input of the OSCD. The input rectifier has fast switching power devices instead of SCR's and diodes. The OSCD can now control the input current waveform to a near sine wave shape by controlling how the rectifiers are turned on and off. The Harmonic Filter of the past injected harmonic current into the input of the OSCD to correct the current waveform.

Since the Harmonic Filter is basically the input to the OSCD there is no need for the additional pre- charge, power unit, Harmonic Filter logic board, and contactors for the harmonic filter of yesterday. The Harmonic Filter does not require its own pre-charge time, thus allowing the chiller to start or restart in a shorter period of time. This is an important benefit to many customers. The reductions in parts counts will improve the reliability of the OSCD, and ease of repair. See *Figure 5 on page 13*.

A line inductor is included on all models of HYP OSCD's. It is needed to limit the rate of change in the input current. Without the line inductor the input current cannot be properly controlled and harmonic currents would be generated.

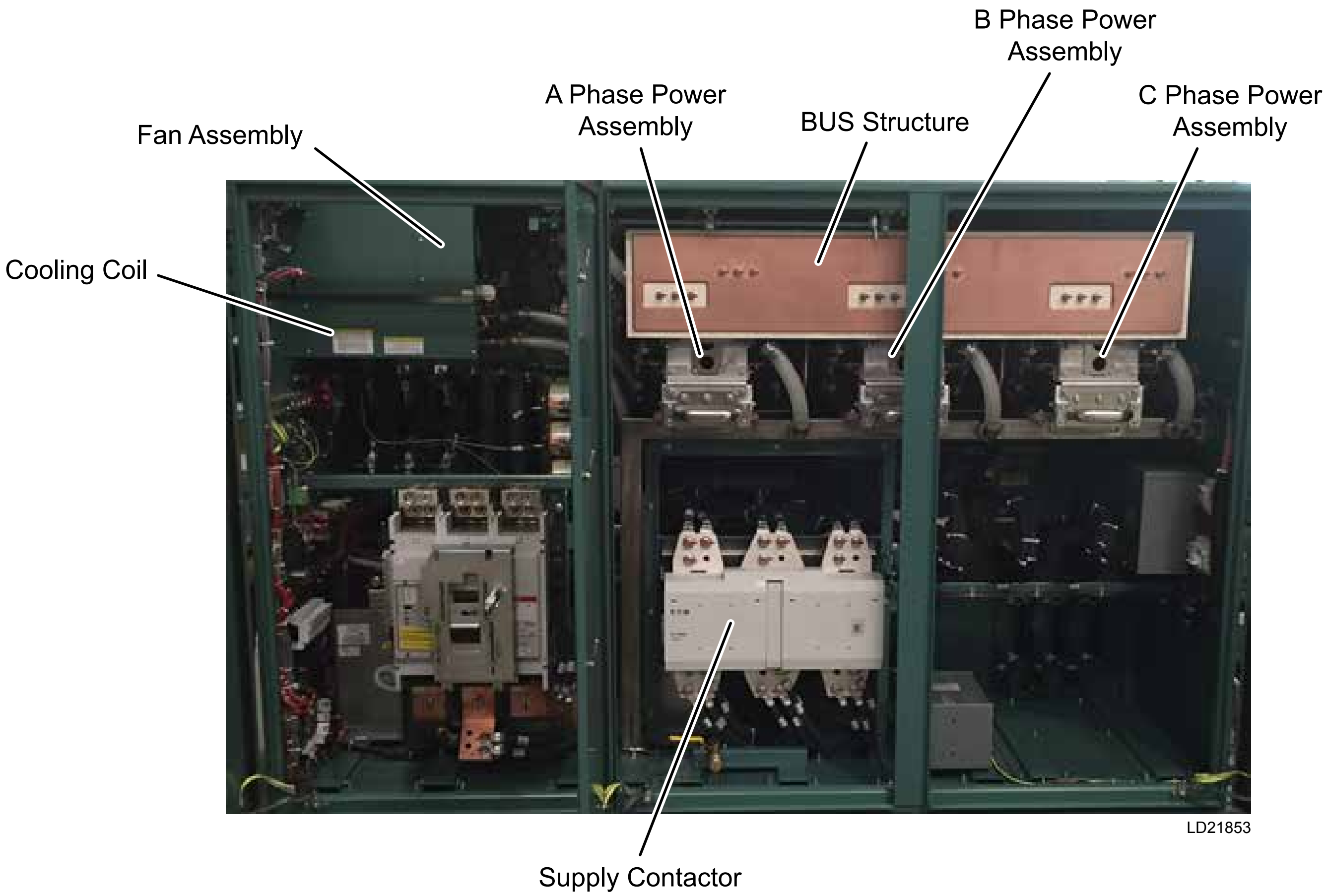

FIGURE 1 - HYP1100A / HYP1300A HP COMPLETE DRIVE CABINET

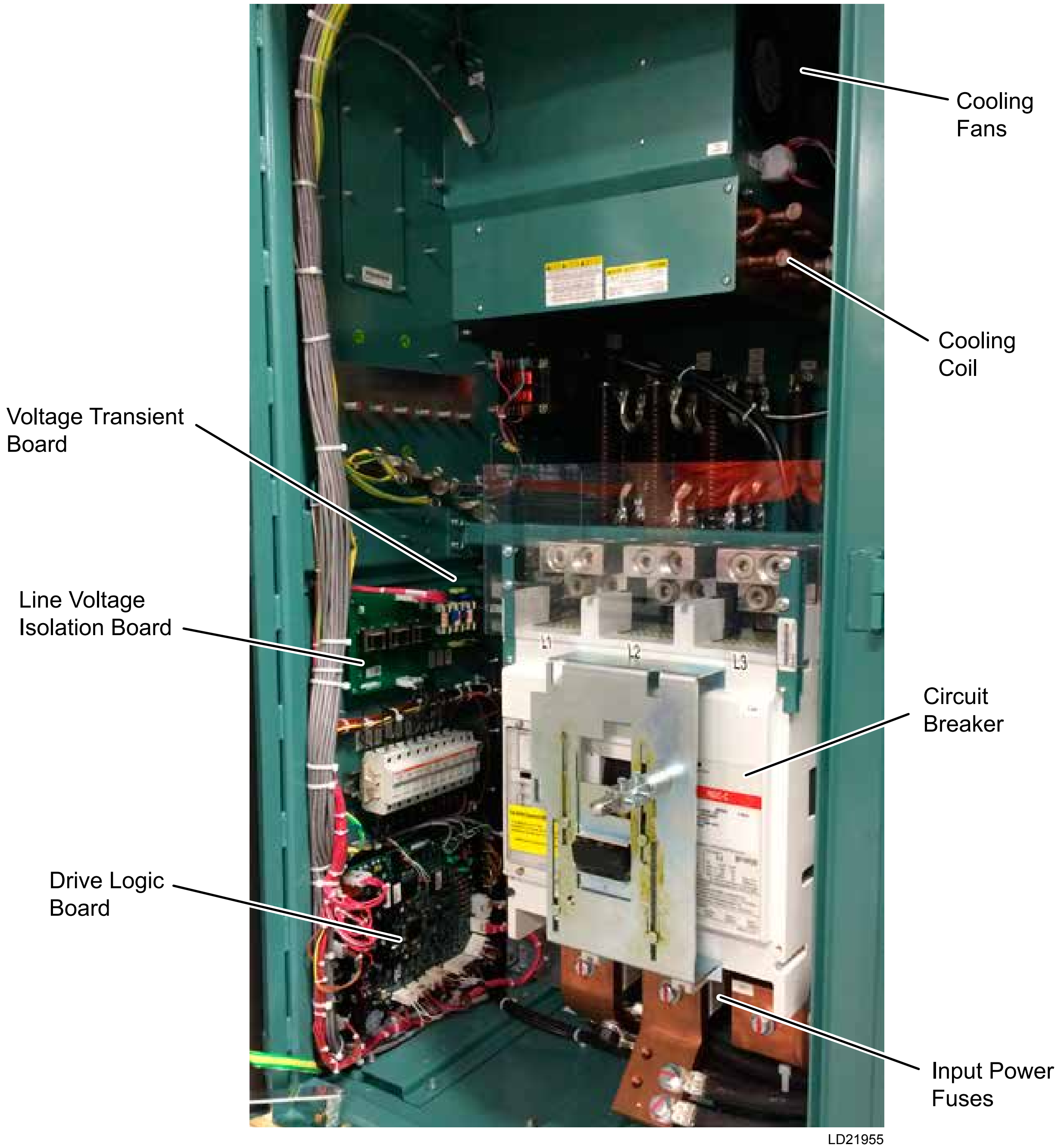

FIGURE 2 - LEFT SIDE OF HYP1100A / HYP1300A HP DRIVE CABINET

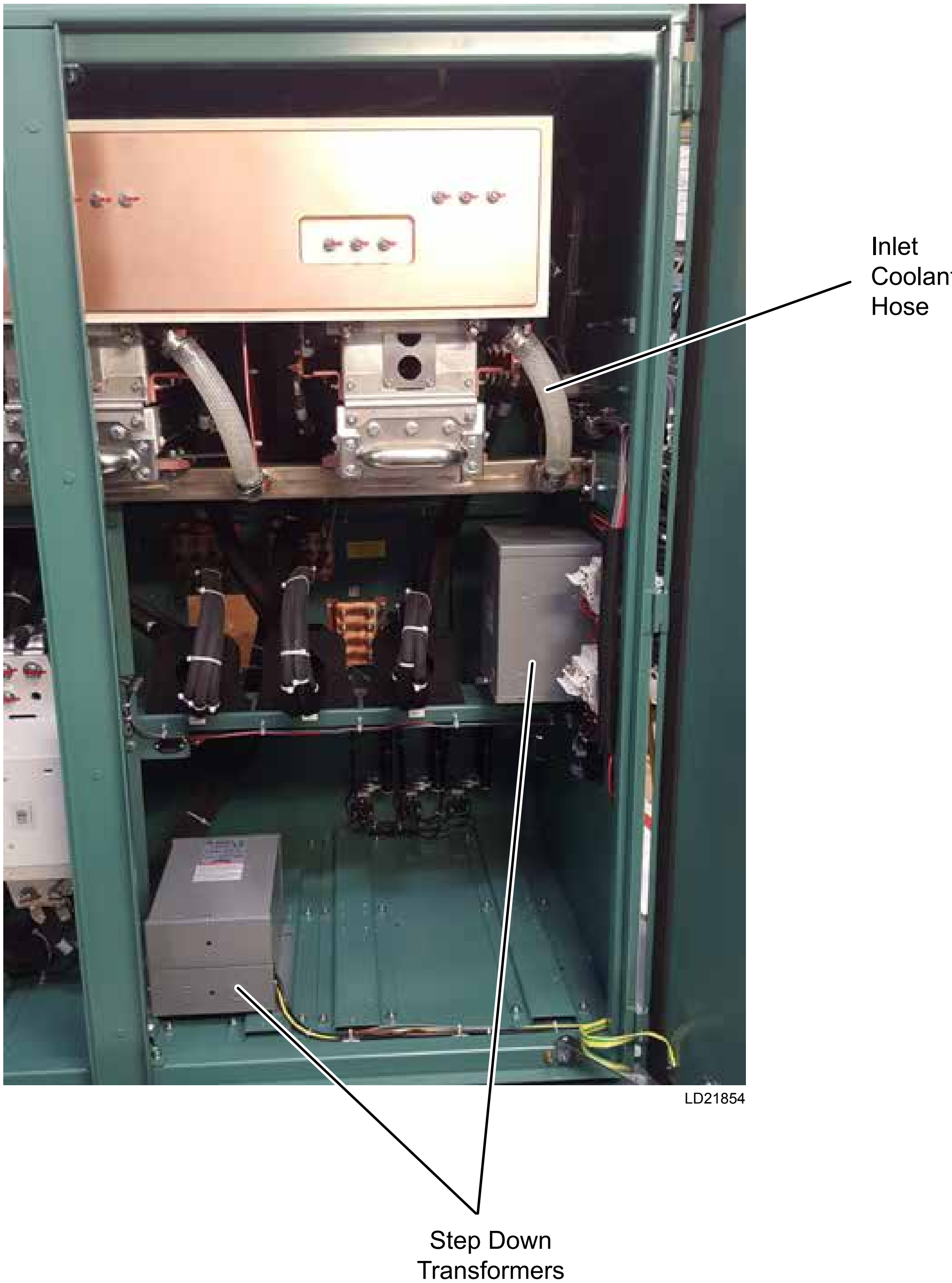

FIGURE 3 - RIGHT SIDE OF HYP1100A / HYP1300A HP DRIVE CABINET

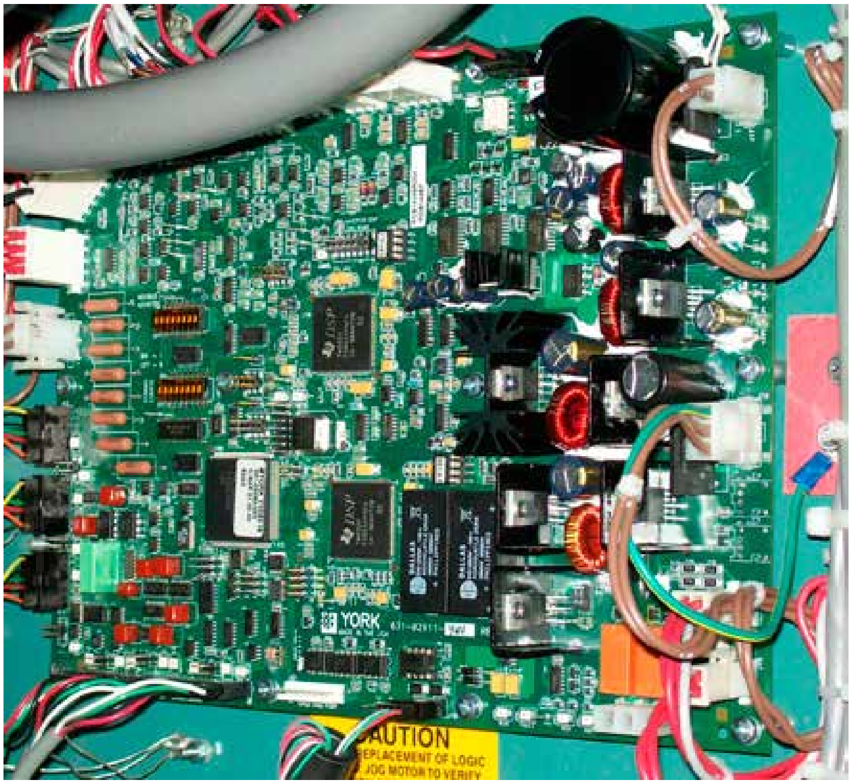

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FIGURE 4 - DRIVE LOGIC BOARD

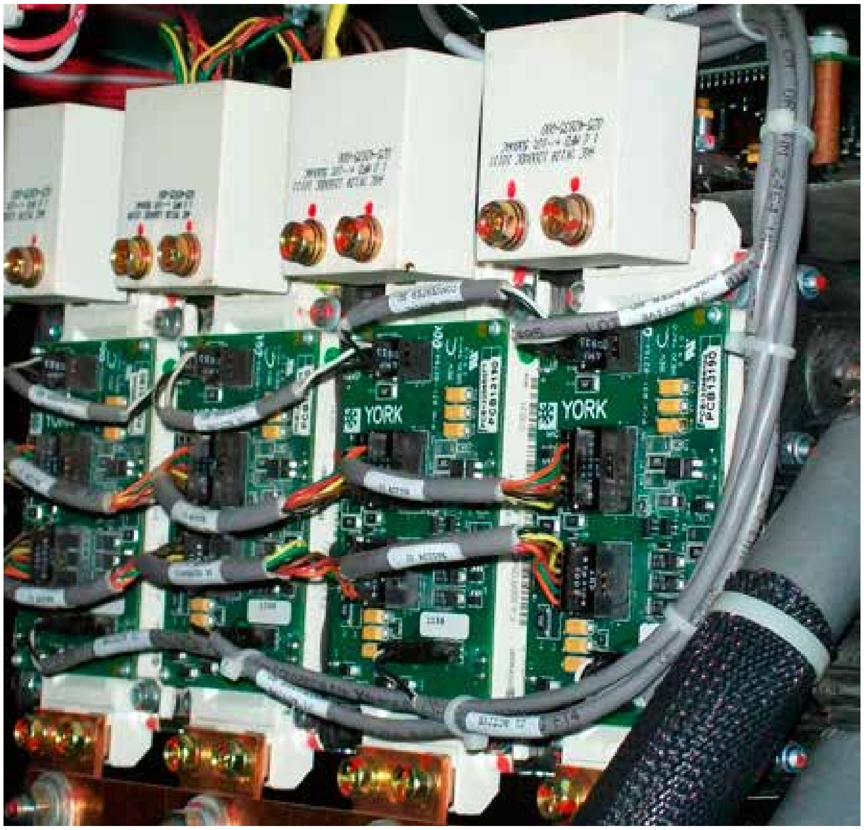

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FIGURE 5 - RECTIFIER SIDE OF THE POWER UNIT HYP1100A AND HYP1300A

DRIVE AND CHILLER OPERATION

When the chiller enters a start command, the OSCD is commanded to precharge, the pre-charge contactor will close and slowly charge the DC bus capacitors through the pre-charge resistors. This is called the precharge period, which will last for 12-seconds. After the 12-second time period has expired, the supply contactor will close and the pre-charge contactor will open. The supply and pre-charge contactors will remain in this state for the duration of the run cycle. The OSCD logic board directly provides the commands for the precharge contactor and a pilot relay to provide power to the supply contactor's coil. The coil power requirements for the supply contactor it too large to be directly driven by the drive logic board.

The cooling fans and pumps will turn on after the precharge time is complete, and continue to run for 2 minutes after the stop command is provided from the OptiView panel.

During normal chiller run conditions the OptiView panel provides a speed command to the OSCD. The speed command is converted into the proper turn-on and turn-off commands for the inverter by the drive logic board.

OPTISPEED COMPRESSOR DRIVE CONTROL SYSTEM OVERVIEW

The HYP model of OSCD can only be controlled by the OptiView Control Panel with a 031-03630 microboard installed.

The OSCD control system is composed of various components located within both the OptiView Control Panel and the OSCD. Thus integrating the Control Center with the OSCD. The OSCD system utilizes various microprocessors, which are linked together through a ModBus communication link.

Data such as output currents, baseplate temperatures, and input voltage are communicated from the OSCD to the microboard for display through the ModBus communications link. The OptiView panel collects data from the many chiller sensors to determine the optimum speed for the compressor. This information is communicated to the drive logic board. The drive logic board then determines the output voltage and frequency to control the compressor motor.

OptiView Control Panel VSD Functions

Refer to the specific OptiView™ Control Panel service and operation manual for detailed information. All of the OSCD related information is contained under the Motor and Compressor Screens.

Drive Not Reducing Speed

The ACC may begin the process of reducing speed, but may stop speed reduction if instability in the leaving liquid temperature is encountered. Once the system again becomes unstable, no additional speed reduction can occur. The most common causes for instability are:

- High Condenser liquid temperature.
- Dirty Condenser tubes.
- Chillers with very light loads.
- Rapid changes to chilled or condenser liquid flow.
- Valves on air-handler coils closing rapidly causing changes in heat-load.
- Extremely short chilled liquid loop.
- Parallel chiller with poor control is causing temperature variations.
- Parallel Chiller with poor control of chilled or condenser water flows.
- Improper evaporator refrigerant level.

If you experience a problem with an OSCD not reducing speed at all, make certain the system is not in manual speed control, or locked into fixed speed. Either situation will cause the chiller to maintain full speed. If the OSCD is reducing speed, but not running as slow as you expect it should, it is likely because it is either in an unstable condition, or running just above a mapped surge point.

SECTION 2 - SAFETY SHUTDOWNS

General Information

The Shutdowns are organized in alphabetical order based on the OptiView™ Control Center messages.

Whenever a Safety Shutdown is generated by the OSCD, a series of events will occur.

- If the chiller is not running at the time of the shutdown, the OSCD Logic Board will not turn on the gate drivers.
- The K3 relay on the OSCD logic board will de-energize to indicate to the Control Center that the OSCD has shutdown. The K3 relay will remain de-energized until the cause of the shutdown has been corrected.
- If the chiller is running at the time of the shutdown, the Control Center will start a coastdown period (150 seconds for centrifugal chillers or shorter for those chillers that contain the optional "Quick Start" feature).
- The message "VSD Shutdown - Requesting Fault Data"...will be displayed when the Control Center is requesting the fault data from the OSCD.
- The OSCD Logic Board will send a shutdown code via the communications link to the Control Center. The Micro Board will interpret the shutdown code and display a shutdown message on the display of the Control Center.

After the coastdown period has timed out, the chiller may be restarted if the shutdown is no longer active, and the CLEAR FAULT key is pressed

TABLE 2 - SAFETY SHUTDOWNS MESSAGE

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – DC BUS LOCKOUT – DO NOT CYCLE POWER</td><td>When the unit is stopped in a mode where no command exists to energize the DC bus, the DC bus voltage is monitored and checked against a threshold level of 100 VDC every five minutes. If the DC bus voltage is higher than the threshold value, this shutdown is generated. When the condition clears and the VSD input modules are tested and determined acceptable the chiller can be started.</td></tr>
<tr><td>VSD – DC BUS PRE-REGULATION LOCKOUT</td><td>If the unit fails to complete pre-regulation (due to VSD – DC BUS PRE-REGULATION fault), it shall have to repeat pre-charge in order to attempt another pre-regulation. The VSD shall wait 10 seconds before clearing the DC bus voltage pre-regulation fault and allowing another pre- charge to start. The unit's fan(s) and water pump(s) shall remain energized during this wait time. The VSD shall allow up to three consecutive pre-regulation-related faults (i.e. VSD-DC BUS PRE-REGULATION) to occur. After the third consecutive fault, this shutdown is generated.</td></tr>
<tr><td>VSD – GROUND FAULT</td><td>This message is generated when the sum of the 3 phases of instantaneous input current values are greater than the shutdown value for a period of 1 second for the given model of drive listed below.<table><tr><th>DRIVE MODEL</th><th>GROUND CURRENT SHUTDOWN VALUE</th></tr><tr><td>1100/1300</td><td>200 Amps</td></tr></table></td></tr>
<tr><td>VSD – HIGH PHASE A INPUT BASEPLATE TEMPERATURE</td><td>This shutdown occurred because the Input Baseplate Temperature exceeded the shutdown value for the given model of drive listed below. After the unit trips, the VSD fan(s) and water pump(s) shall remain energized for 2 minutes after the fault occurred.<table><tr><th>DRIVE MODEL</th><th>HIGH PHASE A INPUT BASEPLATE TEMPERATURE SHUTDOWN VALUE</th></tr><tr><td>1100</td><td>170°F (76.6°C)</td></tr><tr><td>1300</td><td>150°F (65.5°C)</td></tr></table></td></tr>
<tr><td>VSD – HIGH PHASE B INPUT BASEPLATE TEMPERATURE</td><td>See "VSD – HIGH PHASE A INPUT BASEPLATE TEMPERATURE" message preceding.</td></tr>
</table>

TABLE 2 - SAFETY SHUTDOWNS MESSAGE (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – HIGH PHASE C INPUT BASEPLATE TEMPERATURE</td><td>See “VSD – HIGH PHASE A INPUT BASEPLATE TEMPERATURE” message preceding.</td></tr>
<tr><td>VSD – HIGH PHASE A MOTOR BASEPLATE TEMPERATURE</td><td>The chiller has shutdown because the motor baseplate temperature exceeded the shutdown value for the given model of drive listed below. After the unit trips, the VSD fan(s) and water pump(s) shall remain energized for 2 minutes after the fault occurred.
<table>
<tr><th>DRIVE MODEL</th><th>HIGH PHASE A MOTOR BASEPLATE TEMPERATURE SHUTDOWN VALUE</th></tr>
<tr><td>1100</td><td>160°F (71.1°C)</td></tr>
<tr><td>1300</td><td>150°F (65.5°C)</td></tr>
</table></td></tr>
<tr><td>VSD – HIGH PHASE B MOTOR BASEPLATE TEMPERATURE</td><td>See “VSD – HIGH PHASE A MOTOR BASEPLATE TEMPERATURE” message preceding.</td></tr>
<tr><td>VSD – HIGH PHASE C MOTOR BASEPLATE TEMPERATURE</td><td>See “VSD – HIGH PHASE A MOTOR BASEPLATE TEMPERATURE” message preceding.</td></tr>
<tr><td>VSD – HIGH TOTAL DEMAND DISTORTION</td><td>This shutdown indicates the input current to the VSD is not sinusoidal. This shutdown will occur if the Total Demand Distortion (TDD) exceeds 25% continuously for 45 seconds. The displayed TDD is the sum of the harmonic currents up to the 50th harmonic supplied by the main power to the VSD divided by the Full Load Amps.</td></tr>
<tr><td>VSD – INPUT CURRENT OVERLOAD</td><td>The input current overload value is variable based on the Input Job Full Load Amps value programmed at the Control Panel. The input current overload value is 1.16 times the Input Job Full Load Amps value, but not to exceed the value for the given model of drive listed below. This calculation takes into account installations where the input line voltage could be up to 10% below the nominal value. An additional 5% of current is added to reduce nuisance shutdowns due to power fluctuations. To provide addition time for the chiller too unload, the input current overload value must be greater than the shutdown value for 10 continuous seconds for this shutdown to occur.
<table>
<tr><th>DRIVE MODEL</th><th>INPUT CURRENT OVERLOAD MAXIMUM SHUTDOWN VALUE</th></tr>
<tr><td>1100/1300</td><td>1305 Amps</td></tr>
</table></td></tr>
<tr><td>VSD – INPUT DCCT OFFSET LOCKOUT</td><td>If three consecutive VSD – Phase A, B or C Input DCCT Offset cycling faults occur, this safety shutdown is generated to require investigation and manual reset.</td></tr>
<tr><td>VSD – INVERTER PROGRAM FAULT</td><td>The VSD software contains a verification process to ensure that the correct set of software is installed in the VSD logic board for the application.</td></tr>
<tr><td>VSD – LINE VOLTAGE PHASE ROTATION</td><td>The input voltage to the VSD is not phase rotation sensitive, but the VSD must be able to determine the correct input phase rotation. If the VSD logic board cannot determine the correct phase rotation, then this shutdown is generated.</td></tr>
<tr><td>VSD – LOGIC BOARD HARDWARE</td><td>After power is applied to the chiller, the VSD logic board performs several internal tests to ensure proper operation of the input power device. If the tests fail, then this shutdown is generated.</td></tr>
<tr><td>VSD – LOGIC BOARD PLUG</td><td>A jumper is located in the rectifier and inverter current transformers connectors that indicate the connector is properly installed. If either connector is not installed, then this shutdown is generated.</td></tr>
<tr><td>VSD – MOTOR CURRENT IMBALANCE</td><td>Each phase of motor current is compared against the average of the three phases of motor current to determine the current imbalance value. If the current imbalance value is greater than 32 amps for a period of 45 seconds, then this shutdown is generated. For example: The three motor current RMS values are 200, 225, and 240 amps. This would calculated to an average current of (200 + 260 + 240)/3 = 233 amps. Subtract the real current value from the average value. 200 – 233 = 33, 260 – 233 = 33, 240 – 233 = 7. If this condition or worse were maintained for 45 seconds, then this shutdown is generated, because the motor current imbalance is 33 amps.</td></tr>
</table>

TABLE 2 - SAFETY SHUTDOWNS MESSAGE (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – 105% MOTOR CURRENT OVERLOAD</td><td>The 105% motor current overload value is based on the highest output current compared to the programmed Motor Current value displayed on the Control panel. The 105% motor current over-load value is 1.05 times the programmed Motor Current value displayed on the Control panel.
The motor current overload value must be greater than the shutdown value for 40 continuous seconds for this shutdown to occur.
<table>
<tr><th>DRIVE MODEL</th><th>MAXIMUM MOTOR CURRENT OVERLOAD SHUTDOWN VALUE</th></tr>
<tr><td>1100</td><td>1024 Amps</td></tr>
<tr><td>1300</td><td>1209 Amps</td></tr>
</table></td></tr>
<tr><td>VSD – MOTOR CURRENT THD FAULT</td><td>This shutdown provides protection to the compressor motor. High levels of current total harmonic distortion (THD) can cause the motor to overheat. Verify that all wiring is properly connected between the inverter and the output harmonic filter.</td></tr>
<tr><td>VSD – PHASE A INPUT DCCT</td><td>The input current in each phase to the VSD is measured during the precharge time. If the input current does not exceed the shutdown value for the given model of drive listed below, then this shutdown is generated.
<table>
<tr><th>DRIVE MODEL</th><th>MINIMUM INPUT CURRENT SHUTDOWN VALUE</th></tr>
<tr><td>1100/1300</td><td>5.0 Amps</td></tr>
</table></td></tr>
<tr><td>VSD – PHASE B INPUT DCCT</td><td>See “VSD –PHASE A INPUT DCCT” message preceding.</td></tr>
<tr><td>VSD – PHASE C INPUT DCCT</td><td>See “VSD –PHASE A INPUT DCCT” message preceding.</td></tr>
<tr><td>VSD – PHASE A MOTOR DCCT</td><td>The motor current in each phase of the VSD is measured at the beginning of the run command. The motor current at this time should measure very low. This low value will be used as the zero current value for the rest of this run time. The motor current is then monitored for the next 1.5 seconds to ensure that a minimum amount of current is flowing to the motor. If at the end of the 1.5 second time a minimum of 25 amps peak is not detected, then this shutdown is generated.</td></tr>
<tr><td>VSD – PHASE B MOTOR DCCT</td><td>See “VSD –PHASE A MOTOR DCCT” message preceding.</td></tr>
<tr><td>VSD – PHASE C MOTOR DCCT</td><td>See “VSD –PHASE A MOTOR DCCT” message preceding.</td></tr>
<tr><td>VSD – PHASE LOCKED LOOP</td><td>The VSD must be able to determine the input voltage frequency from the input voltage measurement. If the input voltage frequency is not stable enough for the VSD to make this determination, then this shutdown is generated.</td></tr>
<tr><td>VSD – PRECHARGE LOCKOUT</td><td>If the unit fails to complete pre-charge (due to VSD – PRECHARGE – LOW DC BUS VOLTAGE or VSD – PRECHARGE – HIGH DC BUS VOLTAGE), the VSD shall time 10 seconds before clearing the fault and allowing another pre-charge to start. The unit’s fan(s) and water pump(s) shall remain energized during this time. The VSD shall allow up to three consecutive pre-charge- related faults to occur. After the third consecutive pre-charge-related fault, this shutdown is generated.</td></tr>
<tr><td>VSD – RECTIFIER PROGRAM FAULT</td><td>The VSD software contains a verification process to ensure that the correct set of software is installed in the VSD logic board for the application.</td></tr>
<tr><td>VSD SHUTDOWN – REQUESTING FAULT DATA</td><td>The VSD has shut down the chiller and the control center has not yet received the cause of the fault from the VSD, via the serial communications link. The VSD shuts down the chiller by opening the Motor Controller “VSD Stop Contacts” (located on the VSD Logic Board and connected between TB6-16 and TB6-53 in the control center). The Microboard in the control center then sends a request for the cause of the fault to the VSD Logic Board over the serial link. Since serial communications are initiated every 2 seconds, this message is typically displayed for a few seconds and then replaced with one of the other VSD fault messages.</td></tr>
</table>

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SECTION 3 - CYCLING SHUTDOWNS

General Information

The Shutdowns are organized in alphabetical order based on the OptiView Control Center Panel messages. The Microcomputer Control Panel messages are also included under these headings.

Whenever the OSCD or Harmonic Filter Logic Board generates a Cycling Shutdown a series of events will occur.

- If the chiller is not running at the time of the shutdown, the OSCD Logic Board will not turn on the output transistors.
- The K1 relay on the OSCD logic board will de-energize. This action will indicate to the Control Center that the OSCD has shutdown. The K1 relay will remain de-energized until the cause of the shutdown has been corrected.
- If the chiller is running at the time of the shutdown, the Control Center will start a coastdown period (150 seconds for centrifugal chillers).
- The message "VSD Shutdown - Requesting Fault Data"...will be displayed when the Control Center is requesting the fault data from the OSCD.
- The OSCD or Harmonic Filter Logic Board will send a shutdown code to the Control Center. The Micro Board will interpret the shutdown code, and display a shutdown message on the display of the Control Center.

After the coastdown period has timed out, the chiller will automatically restart if the shutdown is no longer active.

TABLE 3 - CYCLING SHUTDOWN MESSAGE

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – DC BUS PRE-REGULATION</td><td>The DC bus voltage has not increased to a value of +/- 50 volts of the DC bus voltage setpoint within 2 seconds after entering the pre-regulation state. The setpoint value is dependent on the rated input voltage of the VSD, and the rated motor voltage. If this condition does not pass, then this shutdown is generated.
The VSD will attempt another pre-charge and pre-regulation cycle after a delay of 10 seconds. If this shutdown occurs three consecutive times, then the chiller will lock out on a "VSD – DC BUS PRE-REGULATION LOCKOUT".
<table>
<tr><th>RATED INPUT VOLTAGE</th><th>RATED MOTOR VOLTAGE</th><th>DC BUS VOLTAGE SETPOINT</th></tr>
<tr><td>380-415</td><td>380-460</td><td>680</td></tr>
<tr><td>460</td><td>380-460</td><td>750</td></tr>
<tr><td>380-460</td><td>575</td><td>820</td></tr>
</table></td></tr>
<tr><td>VSD – HIGH DC BUS VOLTAGE</td><td>If the DC bus voltage exceeds the value for the given model of drive, then this shutdown will occur. Typically, this shutdown will occur when there is a sudden change in the input voltage due to storms, utility power problems, or site power problems.
<table>
<tr><th>DRIVE MODEL</th><th>HIGH DC BUS VOLTAGE SHUTDOWN VALUE</th></tr>
<tr><td>1100/1300</td><td>985 VDC</td></tr>
</table></td></tr>
<tr><td>VSD – HIGH INTERNAL AMBIENT TEMPERATURE</td><td>The variable speed drive contains two temperature sensors, which monitor the unit's internal ambient temperature. This shutdown is generated when the higher of the two ambient temperatures exceeds a high limit of 158°F (70°C). The unit's fan(s) and water pump(s) remain energized until the internal temperature drops below 148°F (64°C), after which they shall be de-energized and the fault can be cleared. Some potential causes for this shutdown are internal VSD fan failure, VSD coolant pump failure, entering condenser water temperature higher than design, condenser water flow lower than required, fouled VSD heat exchanger, or restriction of condenser water to the VSD.</td></tr>
</table>

TABLE 3 - CYCLING SHUTDOWN MESSAGE (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD - HIGH PHASE A INPUT CURRENT</td><td>If the A phase input current exceeds the value for the given model of drive, then a cycling shutdown will occur. If three high input current cycling shutdown faults occur on any phase within 90 minutes, the third fault in the 90 minute period will cause a Safety Shutdown. If the safety shutdown occurs, the chiller can be restarted after the CLEAR FAULTS key is pressed.
<table>
<tr><th>DRIVE MODEL</th><th>INPUT CURRENT FAULT VALUE</th></tr>
<tr><td>1100</td><td>3304 Amps</td></tr>
<tr><td>1300</td><td>2796 Amps</td></tr>
</table></td></tr>
<tr><td>VSD - HIGH PHASE B INPUT CURRENT</td><td>See “VSD – HIGH PHASE A INPUT CURRENT” message preceding.</td></tr>
<tr><td>VSD - HIGH PHASE C INPUT CURRENT</td><td>See “VSD – HIGH PHASE A INPUT CURRENT” message preceding.</td></tr>
<tr><td>VSD – HIGH PHASE A MOTOR CURRENT</td><td>If the A phase motor current exceeds the value for the given model of drive, then a cycling shutdown will occur. If three high motor current cycling shutdown faults occur on any phase within 90 minutes, the third fault in the 90 minute period will cause a Safety Shutdown. If the safety shutdown occurs, the chiller can be restarted after the CLEAR FAULTS key is pressed.
<table>
<tr><th>DRIVE MODEL</th><th>MOTOR CURRENT FAULT VALUE</th></tr>
<tr><td>1100/1300</td><td>2164 Amps</td></tr>
</table></td></tr>
<tr><td>VSD – HIGH PHASE B MOTOR CURRENT</td><td>See “VSD – HIGH PHASE A MOTOR CURRENT” message preceding.</td></tr>
<tr><td>VSD – HIGH PHASE C MOTOR CURRENT</td><td>See “VSD – HIGH PHASE A MOTOR CURRENT” message preceding.</td></tr>
<tr><td>VSD - INITIALIZATION FAILED</td><td>Upon application of power, all boards go through the initialization process. At this time, memory locations are cleared, program jumper positions are checked and serial communications links are established. If this process is not completed the OptiView panel will indicate this fault. There are several causes for an unsuccessful initialization as follows:
Serial data communications must be established. Refer to VSD – Serial Communications fault. If communications between the VSD Logic Board, and control center Microboard does not take place during initialization, this message will be generated. The Serial communications can be verified by selecting the VSD DETAILS screen from the MOTOR screen and observing the Full Load amps value. A zero displayed for this and other VSD parameters, indicates a serial communications link problem.</td></tr>
<tr><td>VSD – INVALID SETPOINTS</td><td>The VSD Logic Board is able to determine which model of drive can run which model of motor. If the Control Center provides a model of motor that is not compatible with this model of VSD, then this shutdown is generated. When this condition clears, the chiller can be started after the CLEAR FAULTS key is pressed.</td></tr>
<tr><td>VSD – LOGIC BOARD POWER SUPPLY</td><td>This shutdown is generated by the VSD logic board and it indicates that the low voltage power supplies for the logic boards have dropped below their allowable operating limits. This message usually means the power to the VSD has been removed.</td></tr>
<tr><td>VSD – LOGIC BOARD PROCESSOR</td><td>This shutdown is generated if a communications problem occurs between the two microprocessors on the VSD Logic Board.</td></tr>
<tr><td>VSD – LOW PHASE A INPUT BASEPLATE TEMPERATURE</td><td>The temperature of the input baseplate phase A has decreased below the low limit of 37°F (2.7°C). All phase temperatures have to increase above the fault-reset threshold of 42°F (5.5°C), for this fault to be cleared. The cooling fans and pumps will turn on while this shutdown is present. They will turn off when the temperature rises above the fault-reset threshold.</td></tr>
<tr><td>VSD – LOW PHASE B INPUT BASEPLATE TEMPERATURE</td><td>See “VSD – LOW PHASE A INPUT BASEPLATE TEMPERATURE” message preceding.</td></tr>
</table>

TABLE 3 - CYCLING SHUTDOWN MESSAGE (CONT'D)

MESSAGE	DESCRIPTION
VSD – LOW PHASE C INPUT BASEPLATE TEMPERATURE	See “VSD – LOW PHASE A INPUT BASEPLATE TEMPERATURE” message preceding.
VSD – LOW PHASE A MOTOR BASEPLATE TEMPERATURE	The OptiView panel will determine this fault when the temperature of the motor base-plate phase A has decreased below the low limit of 37°F (2.7°C). All phase temperatures have to increase above the fault-reset threshold of 42°F (5.5°C), for this fault to be cleared. The cooling fans and pumps will turn on while this shutdown is present. They will turn off when the temperature rises above the fault-reset threshold.
VSD – LOW PHASE B MOTOR BASEPLATE TEMPERATURE	See “VSD – LOW PHASE A MOTOR BASEPLATE TEMPERATURE” message preceding.
VSD – LOW PHASE C MOTOR BASEPLATE TEMPERATURE	See “VSD – LOW PHASE A MOTOR BASEPLATE TEMPERATURE” message preceding.
VSD – NOT RUNNING	The OptiView panel will determine this fault when the VSD has not reported run state via serial communications for 8 seconds while the microboard issues a VSD run command. The fault is released when the microboard command is “Stopped State”.
VSD – PHASE A INPUT DCCT OFFSET	When the VSD begins precharge, the output of the input current Direct Current Cur- rent Transformers (DCCT) are evaluated to ensure that they are reading zero current when no current is flowing through the DCCT. If the zero current output value is above a threshold, then this shutdown is generated.
VSD – PHASE B INPUT DCCT OFFSET	See “VSD – PHASE A INPUT DCCT OFFSET” message preceding.
VSD – PHASE C INPUT DCCT OFFSET	See “VSD – PHASE A INPUT DCCT OFFSET” message preceding.
VSD – PHASE A INPUT GATE DRIVER	The gate driver board for the input rectifier monitors the power supplies within the gate driver circuit, and verifies that the input rectifier can be properly controlled. If the gate driver monitor determines that the input rectifier cannot be properly controlled, then the drive will shut down and display this message.
VSD – PHASE B INPUT GATE DRIVER	See “VSD – PHASE A INPUT GATE DRIVER” message preceding.
VSD – PHASE C INPUT GATE DRIVER	See “VSD – PHASE A INPUT GATE DRIVER” message preceding.
VSD – PHASE A MOTOR GATE DRIVER	The gate driver board for the motor inverter monitors the power supplies within the gate driver circuit, and verifies that the input rectifier can be properly controlled. If the gate driver monitor determines that the input rectifier cannot be properly controlled, then the drive will shut down and display this message.
VSD – PHASE B MOTOR GATE DRIVER	See “VSD – PHASE A MOTOR GATE DRIVER” message preceding.
VSD – PHASE C MOTOR GATE DRIVER	See “VSD – PHASE A MOTOR GATE DRIVER” message preceding.
VSD – PRECHARGE – LOW DC BUS VOLTAGE 1	During Pre-charge, the DC bus voltage must exceed the minimum threshold which is determined by Line Voltage Setpoint (see the table below) within 4 seconds after the pre-charge signal has been commanded. If this condition is not met, this shutdown is generated. The VSD logic board shall wait 10 seconds before clearing the fault and allowing another pre-charge to start. The VFD’s fan(s) and water pump(s) shall remain energized during this time. The VSD logic board shall allow up to three consecutive pre-charge-related faults to occur. After the third consecutive pre-charge-related fault, Safety Shutdown message “VSD – PRECHARGE LOCKOUT” is generated.

LINE VOLTAGE	MINIMUM THRESHOLD (VOLTS)
380/415	41
460	50

TABLE 3 - CYCLING SHUTDOWN MESSAGE (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – PRECHARGE – LOW DC BUS VOLTAGE 2</td><td>During Pre-charge, the DC bus voltage must exceed the minimum threshold which is determined by Line Voltage Setpoint (see the table below) within 12 seconds after the pre-charge signal has been commanded. If this condition is not met, this shutdown is generated. The VSD logic board shall wait 10 seconds before clearing the fault and allowing another pre-charge to start. The VFD’s fan(s) and water pump(s) shall remain energized during this time. The VSD logic board shall allow up to three consecutive pre-charge-related faults to occur. After the third consecutive pre-charge-related fault, Safety Shutdown message “VSD – PRECHARGE LOCKOUT” is generated.
<table>
<tr><th>LINE VOLTAGE</th><th>MINIMUM THRESHOLD (VOLTS)</th></tr>
<tr><td>380/415</td><td>414</td></tr>
<tr><td>460</td><td>500</td></tr>
</table></td></tr>
<tr><td>VSD – RUN SIGNAL</td><td>Redundant RUN signals are generated by the control center; one via TB6-24 and the second via the Serial Communications link. Upon receipt of either of the two RUN commands by the VSD, a 5 second timer shall commence timing. If the run signal on TB6-24 is not received by the VSD Logic Board within 5 seconds, a shutdown is performed and this message is displayed. This is generally indicative of a wiring problem between the control center and the VSD.</td></tr>
<tr><td>VSD – SERIAL RECEIVE</td><td>This shutdown is generated when the VSD logic board has not received a valid communications packet from the control center for 10 consecutive seconds.</td></tr>
<tr><td>VSD SHUTDOWN – REQUESTING FAULT DATA</td><td>The VSD has shut down the chiller and the control center has not yet received the cause of the fault from the VSD, via the serial communications link. The VSD shuts down the chiller by opening the Motor Controller VSD Stop Contacts. The control center then sends a request for the cause of the fault to the VSD over the serial link. Since serial communications are initiated every 2 seconds, this message is typically displayed for a few seconds and then replaced with one of the other VSD fault messages.</td></tr>
<tr><td>VSD – SINGLE PHASE INPUT POWER</td><td>The VSD monitors the input voltage of all three phases. If the input voltage of any one phase drops below the threshold value for the given input voltage range below, then this shutdown will occur.
<table>
<tr><th>INPUT VOLTAGE RANGE</th><th>INPUT VOLTAGE SINGLE PHASE SHUTDOWN VALUE (VOLTS)</th></tr>
<tr><td>380/415</td><td>264</td></tr>
<tr><td>460</td><td>295</td></tr>
</table></td></tr>
<tr><td>VSD - STOP CONTACTS OPEN</td><td>Whenever the OSCD initiates a fault, it first opens the fault relay on the OSCD logic board. When the relay opens a message is sent to the OptiView panel microboard, detailing the cause of the fault. If this circuit ever opens without receiving an accompanying cause for the fault over the communication link within 20 seconds then this message will be displayed. This fault may be replaced with a Serial Communications fault if the serial link has failed.</td></tr>
</table>

VSD FREQUENTLY ASKED QUESTIONS

Is a Condenser Water Strainer used with the shell and tube heat exchanger?

Since the shell and tube heat exchanger can be cleaned with a rifle brush, no extra precautions are needed to keep the heat exchanger cleaned. No strainer is provided with this OSCD. The intent is to have the heat exchanger cleaned annually. Gaskets are available (refer to the service parts list).

What is the timing of the Anti-Recycle when an OSCD is applied?

The anti-recycle time is much quicker with an OSCD than with a starter. The reason is the elimination of inrush current on start-up. The OptiSpeed compressor drive slowly accelerates the compressor motor so that the motor does not consume more than 100% of the motor's nameplate full load amps. The anti-recycle time is five (5) starts in succession, followed by a ten minute wait. After ten minutes, the OSCD can be started five more successive starts. This is permitted on OSCD units only, due to the low current draw and reduced motor heating during startup.

Should the customer install isolation between the Power Conduits and the OptiSpeed Compressor Drive?

We no longer require a section of non-metallic conduit at the entrance and exit of the OSCD as we did on previous products. If any customer or installer wishes to continue to follow this practice, we have no objections as long as the OSCD is properly grounded.

Can I apply an OptiSpeed Compressor Drive to a generator?

Yes, the OSCD can be applied to a generator. No modifications are required for a generator application. We have several OSCD installations running on generator power without difficulty. It is necessary that the generator's output voltage and frequency be maintained within the specified range for that particular OSCD. This is usually not a problem for most generators, since motor current at startup is limited to less than 1X the Full Load Amps (FLA). Although no changes are required for the generator, the generator will need to support a level of harmonic current. Also, a time delay is required between the switching of power supplies of 10 seconds. This delay applies to switch between utility power to generator power and generator power back to utility power.

Do I have a problem with my coolant? The pink color is no longer visible?

The coolant normally has a pink or rose color when new. After several months of operation, this color may dissipate, and the coolant may appear almost colorless. The lack of the color in the coolant does not necessarily indicate a problem. Most colorless samples test above 1000 PPM nitrite, which is normal. There is no need to flush the system unless you find the coolant becoming opaque or cloudy. In this case we suggest you obtain a sample for analysis, then flush the system with coolant and install fresh coolant. The coolant must be changed every year regardless of color or test results. The coolant is required to be changed every year.

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