YORK®

LIQUID COOLED OPTISPEED™ COMPRESSOR DRIVE

OPERATION

Supersedes: 160.00-O4 (204)

Form 160.00-O4 (1007)

MODELS:
VSD292
VSD351
VSD419
VSD424
VSD503
VSD608

00633VIP

292 HP – 50 Hz, 400VAC (P/N 371-03700-XXX)
351 HP – 60 Hz, 460VAC (P/N 371-02767-XXX)
419 HP – 50 Hz, 400VAC (P/N 371-03789-XXX)
424 HP – 60 Hz, 575VAC (P/N 371-04881-XXX)
503 HP – 60 Hz, 460VAC (P/N 371-03789-XXX)
608 HP – 60 Hz, 575VAC (P/N 371-04563-XXX)

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OPTISPEED™ COMPRESSOR DRIVE GENERAL INFORMATION

This instruction is to be used in conjunction with the Operation Instructions for YORK Model YT & YK chillers furnished with an optional OptiSpeed™ Compressor Drive (OSCD).

Reference Instructions

Operation (Unit)	
Model YT, (Centrifugal)	Form 160.55-O1
Model YK, (Centrifugal)	Form 160.54-O1
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Model YK, (Centrifugal)	Form 160.54-O1
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Model YK, (Centrifugal)	Form 160.54-M1
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Model YK, (Centrifugal)	Form 160.54-PW8
Service (Variable Speed Drive)	Form 160.00-M4
Wiring Field Connections (Variable Speed Drive)	
Model YT, (Centrifugal)	Form 160.55-PW5
Model YK, (Centrifugal)	Form 160.54-PW5
Replacement Parts List (Variable Speed Drive)	Form 160.00-RP4

OPTISPEED™ MODEL NUMBER DEFINITIONS

V S D 3 5 1 _ R K F T - 4 6

- 46 — Voltage Rating: 46= 460VAC, 60Hz; 50= 400VAC, 50Hz; 58= 575VAC, 60Hz
- FT — Optional 519: Filter-Installed (FT) or Not (_)
- K — Chiller Type: YK (K), YT (T)
- R — Retrofit Package (R), Factory Package (_)
- 351 — Horsepower Rating: 292, 351, 419, 424, 503, 608
- VSD — Type of Drive

OPTISPEED™ MODEL PART NUMBER

MODEL NUMBER		PART NUMBER	
		60Hz	50Hz
292 HP	VSD292_T__-50	-	371-03700-101
	VSD292_K__-50	-	371-03700-102
	VSD292_TFT-50	-	371-03700-105
	VSD292_KFT-50	-	371-03700-106
	VSD292RT__-50	-	371-03700-111
	VSD292RK__-50	-	371-03700-112
	VSD292RTFT-50	-	371-03700-115
	VSD292RKFT-50	-	371-03700-116
351 HP	VSD351_T__-46	371-02767-101	-
	VSD351_K__-46	371-02767-102	-
	VSD351_TFT-46	371-02767-105	-
	VSD351_KFT-46	371-02767-106	-
	VSD351RT__-46	371-02767-111	-
	VSD351RK__-46	371-02767-112	-
	VSD351RTFT-46	371-02767-115	-
	VSD351RKFT-46	371-02767-116	-
419 HP	VSD419_T__-50	-	371-03789-105
	VSD419_K__-50	-	371-03789-106
	VSD419_TFT-50	-	371-03789-107
	VSD419_KFT-50	-	371-03789-108
	VSD419RT__-50	-	371-03789-115
	VSD419RK__-50	-	371-03789-116
	VSD419RTFT-50	-	371-03789-117
	VSD419RKFT-50	-	371-03789-118

OPTISPEED™ MODEL PART NUMBER (CON'T)

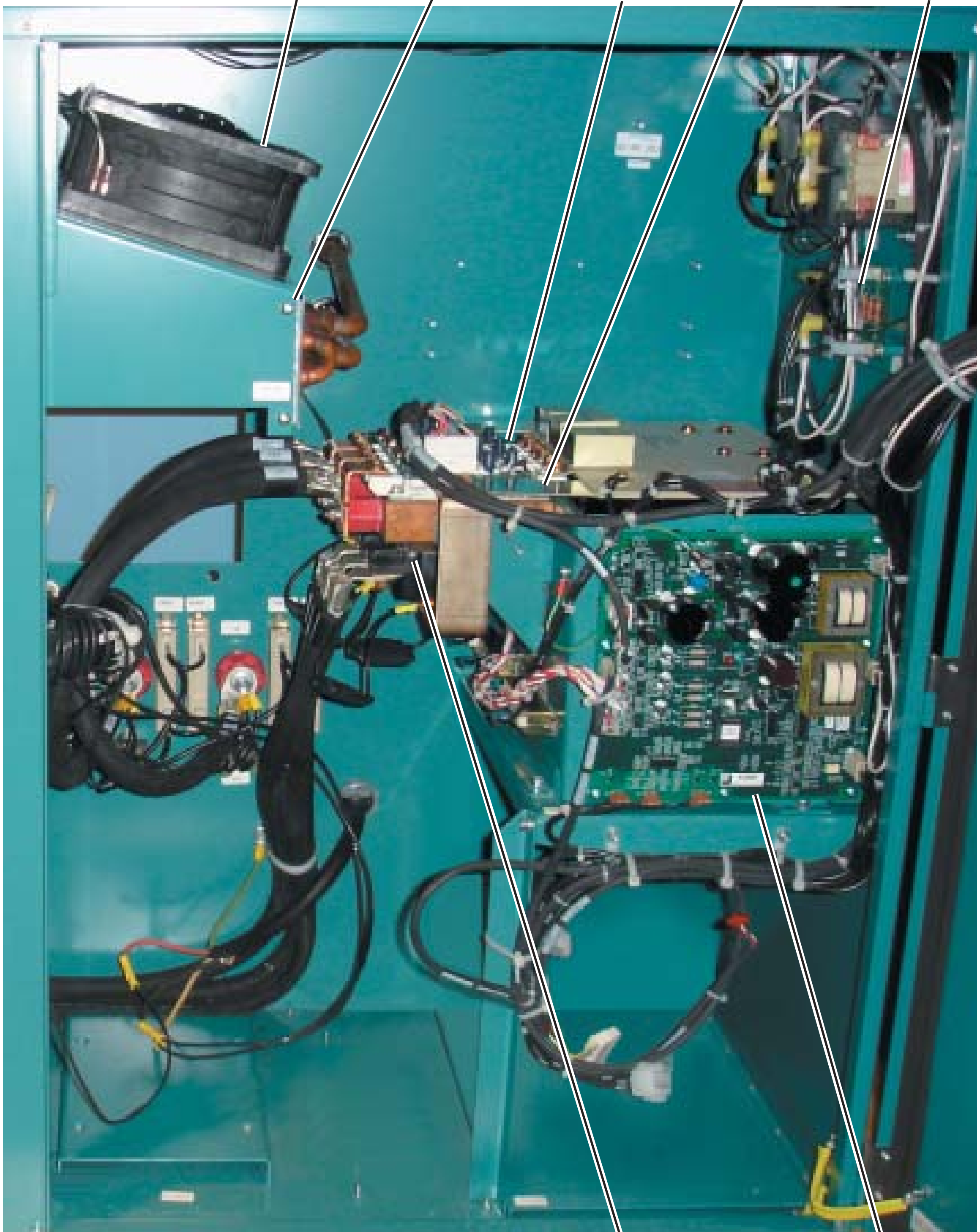
MODEL NUMBER		PART NUMBER	
		60Hz	50Hz
424 HP	VSD424_T__-58	371-04881-101	-
	VSD424_K__-58	371-04881-102	-
	VSD424_TFT-58	371-04881-103	-
	VSD424_KFT-58	371-04881-104	-
	VSD424RT__-58	371-04881-111	-
	VSD424RK__-58	371-04881-112	-
	VSD424RTFT-58	371-04881-113	-
	VSD424RKFT-58	371-04881-114	-
503 HP	VSD503_T__-46	371-03789-101	-
	VSD503_K__-46	371-03789-102	-
	VSD503_TFT-46	371-03789-103	-
	VSD503_KFT-46	371-03789-104	-
	VSD503RT__-46	371-03789-111	-
	VSD503RK__-46	371-03789-112	-
	VSD503RTFT-46	371-03789-113	-
	VSD503RKFT-46	371-03789-114	-
608 HP	VSD608_T__-58	371-04563-101	-
	VSD608_K__-58	371-04563-102	-
	VSD608_TFT-58	371-04563-103	-
	VSD608_KFT-58	371-04563-104	-
	VSD608RT__-58	371-04563-111	-
	VSD608RK__-58	371-04563-112	-
	VSD608RTFT-58	371-04563-113	-
	VSD608RKFT-58	371-04563-114	-

OPTISPEED™ SYSTEM ARCHITECTURE

NOTE: Variable Speed Drive Model VSD351 Shown

FIG. 1 - OPTISPEED™ SYSTEM ARCHITECTURE

OPTISPEED™ SYSTEM ARCHITECTURE (CON'T)



NOTE: Variable Speed Drive Model VSD351 Shown

FIG. 1 (CON'T) - OPTISPEED™ SYSTEM ARCHITECTURE

OPTISPEED™ SYSTEM ARCHITECTURE (CON'T)

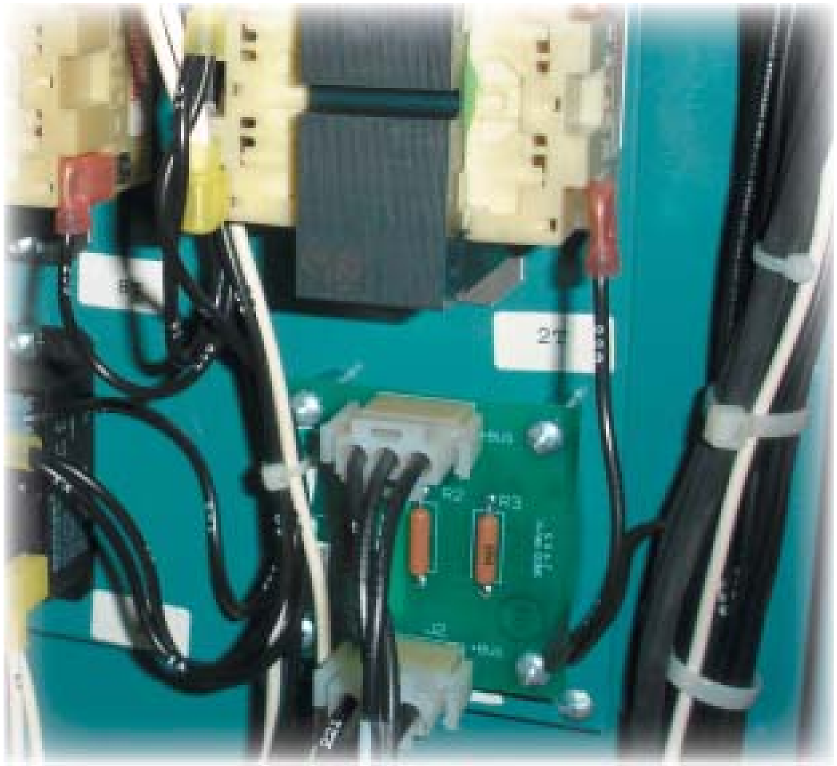
LD13165

FIG. 2 - VSD LOGIC BOARD (LOCATED ON PANEL DOOR)

LD13166

FIG. 3 - SCR TRIGGER BOARD

OPTISPEED™ SYSTEM ARCHITECTURE (CON'T)



LD13167

FIG. 4 - DC ISOLATOR BOARD

LD13168

FIG. 5 - GATE DRIVER BOARD

OPTISPEED/HARMONIC FILTER COMPONENT OVERVIEW

OptiSpeed Compressor Drive 292, 351 & 424 Hp

The YORK® OptiSpeed Compressor Drive (OSCD) is a liquid cooled, transistorized, PWM inverter in a highly integrated package. This package is small enough to mount directly onto the chiller motor, and small enough to be applied in many retrofit chiller applications. The power section of the drive is composed of four major blocks: an AC to DC rectifier section with an integrated pre-charge circuit, a DC link filter section, a three phase DC to AC inverter section and an output suppression network.

An electronic circuit breaker with ground fault sensing connects the AC line to an AC line inductor and then to the DC converter. The line inductor will limit the amount of fault current so that the electronic circuit breaker is sufficient for protecting the OSCD. Input fuses to the OSCD are no longer needed. The following description of operation is specific for the 351 Hp OSCD unless otherwise noted.

The AC to DC converter uses 3 Silicon Controlled Rectifiers (SCR's) and 3 diodes. One SCR and one diode are contained in each module. Three modules are required to converter the 3 phase input AC voltage into DC voltage. The modules are mounted on a liquid cooled heatsink. The use of the SCR's in the converter permits pre-charge of the DC link filter capacitors when the chiller enters the prelube cycle, and it also provides a fast disconnect from the AC line when the chiller enters the coastdown cycle. At this time, the OSCD is turned off, the SCR's in the converter are no longer turned on and remain in a turned off condition until the next pre-charge cycle. The DC link filter capacitors will start to discharge through the bleeder resistors. When the chiller enters the prelube cycle, the OSCD is commanded to pre-charge and the SCR's are gradually turned on to slowly charge the DC link filter capacitors. This is called the pre-charge period, which last for 20-seconds. At this time the SCR's are fully turned on. The SCR Trigger board provides the turn on and turn off commands for the SCR's. The OSCD Logic board provides the command to the SCR trigger board when to precharge.

WARNING

Although many of these parts are similar to the parts used in previous Variable Speed Drive (VSD) designs, these parts are only compatible with drives having the base part numbers included on the cover of this form. Failure to use the correct parts may cause major damage to these and other components in the drive. For example, the VSD logic board 031-02077-000 used in this drive is not compatible with 031-01433-000 logic board used in previous designs.

The DC Link filter section of the drive consists of one basic component, a series of electrolytic filter capacitors. The capacitors provide a large energy reservoir for use by the DC to AC inverter section of the OSCD. The capacitors are contained in the OSCD Power Unit. "Bleeder" resistors are mounted on the side of the Power Unit to provide a discharge path for the stored energy in the capacitors.

The DC to AC inverter section of the OSCD serves to convert the DC voltage to AC voltage at the proper magnitude and frequency as commanded by the OSCD Logic board. The inverter section is actually composed of one power unit. This power unit is composed of very fast switching transistors mounted on the same liquid cooled heatsink as the converter modules, the DC Link filter capacitors, and an OSCD Gate Driver board. This board provides the turn on and turn off commands to the output transistors. The OptiSpeed Compressor Drive Logic board determines when the turn on and turn off commands should occur. The gate driver board is mounted directly on top of the transistor module, and it is held in place with mounting screws and soldered to the transistor module.

The OSCD output suppression network is composed of a series of capacitors and resistors. The job of the suppressor network is to reduce the time it takes for the output voltage to switch as seen by the motor, and the peak voltage applied to the motor windings. This network protects the compressor motor from problems commonly associated with PWM motor drives.

Other sensors and boards are used to provide safe operation of the OptiSpeed Compressor Drive. The transistor module and heatsink have thermistors mounted on them to provide temperature information to the OSCD logic board. These sensors protect the OSCD from over temperature conditions. A Bus Isolator board is used to ensure that the DC link filter capacitors are properly charged. Three output current transformers protect the drive and motor from over current conditions.

OptiSpeed Compressor Drive 419, 503 & 608 HP

The 419, 503, and 608 Hp OSCD's function in the same manner as the 292, 351 & 424 Hp and have the same basic components. The power requirements of these higher horse power drives require more capacitors in the DC Link and 3 output transistor modules are needed. One module is used for each output phase. Each transistor module contains a thermistor, which is connected to the OSCD logic board. The transistor gate driver board is mounted on top of the transistor module as in the 292, 351 & 424 Hp, but it only contains 2 drivers. The modules and the boards are not interchangeable between the 292, 351 & 424 and 419, 503 & 608 Hp drives.

Harmonic Filter Option

The OptiSpeed Compressor Drive (OSCD) system may also include an optional harmonic filter and high frequency trap designed to meet the IEEE Std 519 -1992, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems". The harmonic filter is offered as a means to "clean up" 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. An additional benefit to the optional harmonic filter is that it will correct the system power factor to nearly unity.

The power section of the Harmonic Filter is composed of three major blocks: a pre-charge section, a three phase inductor and a Filter Power Unit.

The pre-charge section contains pre-charge resistors, a pre-charge contactor and a supply contactor. The pre-charge network serves two purposes, to slowly charge the DC link filter capacitors associated with the Filter Power Unit, and to provide a means of disconnecting the filter power unit from the AC line. When the chiller is turned off, both contactors are de-energized and the filter power unit is disconnected from the AC line. When the chiller starts to run, the pre-charge resistors are switched into the circuit via the precharge contactor for a fixed time period of 5 seconds. This permits the filter capacitors in the filter power unit to slowly charge. After the 5-second time period, the supply contactor is energized and the pre-charge contactor is de-energized thus permitting the filter power unit to completely charge. Three power fuses connect the filter power components to the AC line. Very fast semiconductor power fuses are utilized to ensure that the transistor module does not rupture if a catastrophic failure were to occur on the DC link of the filter power unit.

The three phase inductor provides some impedance for the filter to "work against". It effectively limits the rate of change in current at the input to the filter to a reasonable level.

The Filter Power Unit is the most complicated power component in the optional filter. Its purpose is to generate the harmonic currents required by the OSCD's AC-to-DC converter so that these harmonic currents are not drawn from the AC line. The Filter Power Unit is identical to the OSCD's Power Unit in the 351 Hp drive, except for 2 less capacitors in the filter capacitor "bank", and a smaller transistor module and modified gate driver board. The Harmonic Filter Gate Driver board provides turn on and turn off commands as determined by the Harmonic Filter Logic board. "Bleeder" resistors are mounted on the side of the Filter Power Unit to provide a discharge path for the DC Link filter capacitors.

Other sensors and boards are used to provide safe operation of the harmonic filter. The transistor module contains a thermistor temperature sensor that provides temperature information back to the Filter Logic Board. This sensor protects the Filter Power Unit from over temperature conditions. A Bus Isolator board is used to ensure that the DC link filter capacitors are properly charged and that the voltage is balanced. Two output current sensors are used to protect the filter against an over current or an overload condition. Input current transformers sense the input current drawn by the OSCD's AC to DC converter. The Line Voltage Isolation board provides AC line voltage information to the Harmonic Filter Logic board. This information is used to determine the proper bus voltage value.

The "trap" filter is standard on all OSCD's that contain an optional Harmonic Filter. The "trap" filter is composed of a series of capacitors, inductors, and resistors. The "trap" filter is used to reduce the effects of the PWM switching frequency of the filter.

OPTISPEED COMPRESSOR DRIVE CONTROL SYSTEM OVERVIEW

The OSCD control system can be connected to a Microcomputer Control Center or to an OptiView Control Center. Regardless of which control center is used each component performs the same function.

The OSCD control system is composed of various components located within both the Control Center and the OSCD. Thus integrating the Control Center with the OSCD. The OSCD system utilizes various microprocessors, which are linked together through a network of communications links.

The Control Center

The Control Center contains two boards that act upon OSCD related information, the Microboard and the Adaptive Capacity Control board (ACC). The ACC board performs two major functions in the OSCD control system - (1) to act as a gateway for information flow between the Control Center and the OSCD. (2) To determine the optimum operating speed for maximum chiller system efficiency.

The ACC board acts as an information gateway for all data flowing between the OSCD and the Control Center. The ACC board has a communication link to the OSCD logic board, and one communication link from the optional Harmonic Filter logic board. Once the ACC board receives the information, the information is then passed onto the Control Center via a software communication link. The OptiView™ Control Center communicates through communications port via a bi-directional serial port via a three wire cable connecting the ACC board to the Microboard.

In order to achieve the most efficient operation of a centrifugal compressor, the speed of the compressor must be reduced to match the “lift” or “head” of the load. This “lift” or “head” is determined by the evaporator and condenser refrigerant pressures. However, if the compressor speed is reduced too much, the refrigerant gas will flow backwards through the compressor wheel causing the compressor to “surge”, an undesirable and extremely inefficient operating condition. Thus there exists one particular optimum operating speed (on the “edge” of surge) for a given head, which provides the optimum system efficiency. The compressor’s inlet guide vanes, which are used in fixed speed applications to control the amount of refrigerant gas flowing through the compressor, are controlled together with the compressor speed on an OSCD chiller system to obtain the required chilled water temperature while simultaneously requiring minimum power from the AC line.

The ACC board automatically generates its own “Adaptive” three-dimensional surge surface map while the chiller system is in operation. This “Adaptive” operation is accomplished through the use of a patented surge detection algorithm. The novel surge detection system utilizes pressure information obtained from the chiller’s two pressure transducers or the OSCD’s instantaneous power output to determine if the system is in “surge”. Thus the adaptive system permits construction of a customized compressor map for each individual chiller system. Benefits of this new adaptive system include: (1) a customized compressor map for each chiller which eliminates inefficient operation due to the safety margin built into the previous designs to compensate for compressor manufacturing tolerances (2) the ability to update the system’s surge surface as the unit ages and (3) automatic updating of the compressor map if changes in refrigerant are implemented at a later date.

OptiSpeed and Optional Harmonic Filter Logic Control Boards

Within the OSCD enclosure, the OSCD logic board and optional Harmonic Filter logic board are interconnected via a 16-position ribbon cable. This cable provides power for the Filter logic board and a method of communications between the two boards.

The OSCD Logic board performs numerous functions, control of the OSCD’s cooling fans and pumps, when to pre-charge the bus capacitors, and generates the PWM.

The OSCD Logic board also determines shutdown conditions by monitoring the three phases of motor current, heatsink temperature, baseplate temperature, internal ambient temperature, and the DC Link voltage.

The optional Harmonic Filter logic board determines when to precharge the harmonic filter power unit, when to switch the transistors in the harmonic filter power unit, and collects data to determine power calculations. This board also uses this data to determine shutdown conditions.

Microcomputer Control Panel VSD Related Keypad Functions

Refer to 160.00-M4 for related keypad functions. Some of the displayed data in this form is different from the 160.00-M1.Under the Options Key – the following changes will be displayed:

VSD PHASE A INVERTER HEATSINK TEMP = ___°F.

VSD PHASE B INVERTER HEATSINK TEMP = ___°F.

VSD PHASE C INVERTER HEATSINK TEMP = ___°F.

These three temperature values are replaced with

VSD BASEPLATE TEMP = ___°F

for the 292, 351 and 424 Hp drives. The 491, 503 and 608 Hp drive will still display 3 phases of Baseplate temperature. When the Filter is Present the following data will be changed.

FILTER HEATSINK TEMP = ___°F.

This temperature data will now be called.

FILTER BASEPLATE TEMP = ___°F.

The names for the above data were changed because the temperature sensor is now inside the transistor module instead on the chill plate where the transistor module is mounted. This new sensor gives a better indication of true temperature of the power electronics.

OptiView Control Panel VSD Functions

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

VSD ADAPTIVE CAPACITY CONTROL

The YORK® OptiSpeed™ Compressor Drive utilizes a different approach to speed reduction compared to earlier variable speed products. There is no longer a pre-programmed surge map – the YORK® adaptive system experiments with the speed and vanes to find the optimum speed for any given condition. It does not always encounter a "Surge" in the process, but when it does, the Adaptive Capacity Control (ACC) stores into memory, the conditions surrounding the Surge, and therefore remembers to avoid the stored operating point anytime in the future.

Early versions of the ACC software required that the drive always start and run up to full speed. ACC software starting with version C.ACC.01.04 applies a new slow ramp up of the drive speed. This new software lowers the peak current demand from the drive during start up, saves additional energy, and reduces the possibility of the chiller running in a stall condition. With the OSCD, the chiller will always run at fixed speed until two conditions are met. These two conditions are:

Setpoint Requirements

The leaving chilled liquid temperature must be within +0.5 °F or lower from the leaving chilled liquid temperature setpoint. Speed reduction will not occur until the leaving chilled liquid temperature reaches this range.

Stability Requirements

The leaving chilled liquid temperature must be stable. Lack of stability will be indicative of the vanes hunting, the leaving chilled liquid temperature varying, and the green LED on the ACC board will be on. Once the above conditions are met, the ACC board may begin to lower the speed of the compressor motor 1/10 of a hertz at a time. As the ACC board lowers the speed, the leaving chilled liquid temperature will begin to creep up. As this occurs, the control center will begin to open the vanes slightly, just enough to maintain the leaving chilled liquid temperature within +/- 0.5°F of the leaving chilled liquid temperature setpoint. The ACC board will continue to lower speed, with the leaving chilled liquid temperature control in turn driving the vanes to a more open position. This process will continue until one of three following situations occur:

Full Open Vane Operation

Once the vanes reach the full open position, the ACC board knows it can no longer reduce speed and maintain the leaving chilled liquid temperature setpoint. The ACC board will maintain operation at this point, with the vanes full open, and the speed at the last point reached when the vanes hit 100%. If there is an increase in load while at this point, the ACC board will increase speed until the vanes are closed to 95% of open. The ACC board will then be allowed to continue to reduce speed again.

Effects of Surge

If in the process of reducing speed and opening vanes the compressor should surge, the ACC board will boost the speed up by 0.8 Hz. The ACC board will store in memory a value that represents the ratio of condenser pressure to evaporator pressure, the vane position, and the speed of the drive. The ratio of condenser pressure to evaporator pressure is displayed as Delta P/P on the Control Panel. The ACC board will then know not to reduce speed this low again, if the same delta pressure, and the vane position conditions are encounter again in the future. As the chiller encounters various conditions, which result in surge, it will store more points, and eventually this storing of points creates a "Surge Map". Surge may be detected in two ways, by monitoring the pressure differential across the compressor, or by monitoring the compressor motor current. Either detection will light the Red LED on the ACC board, indicating a surge was detected. The chiller may surge 6 to 8 times before the ACC board can raise the speed enough to get the chiller back out of surge. Each surge is counted on the surge counter, which may be called up on the control center. This surge counter will always display the total number of surges encountered by the chiller as determined by the ACC board. Surging which occurs at fixed speed will increment the surge counter as well, but only surges that occur when speed reduction is possible are recorded in the surge map.

Drive NOT Reducing Speed

The ACC board may begin the process of reducing speed, but may stop speed reduction if instability is encountered. This is the same instability discussed as one of the two conditions which must be met to begin reducing speed initially (See "Stability Requirements"). 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.
- Inproper 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. As described above, the chiller must achieve stability, which is evidenced by the Green LED being extinguished, before speed reduction will commence. Instability will cause the Green LED to be illuminated.

Stability Limit Adjustment

Stability Limit Adjustment allows the system to properly function with larger amounts of temperature instability. Consult YORK Service to make this adjustment.

Surge Margin Adjustment

Surge Margin Adjustment allows the Service Technician to increase the speed of the drive for all mapped surge points. This parameter is rarely used, and it decreases the efficiency of the OSCD chiller system.

SAFETY SHUTDOWNS

General Information

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

Whenever a Safety Shutdown is generated by the OSCD or Harmonic Filter Logic Board, 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 K1 relay on the OSCD logic board will de-energize to 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 via the communications link to the ACC board and then 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. Place the Compressor Switch in the Stop/Reset position, and then into the Start position and release. The chiller will start if no faults are active.

Motor or Starter – Current Imbalance

MESSAGE: MOTOR OR STARTER – CURRENT IMBALANCE

The OSCD logic board generates this shutdown. This shutdown will become active when the highest of the three motor currents exceeds 80% of the programmed FLA. After these conditions are met, if any one phase of motor current exceeds 30% of the average current for 45 seconds, a Safety shutdown will be activated.

VSD - 105 % MOTOR CURRENT OVERLOAD

MESSAGE: 105% MOTOR CURRENT OVERLOAD

The OSCD logic board generates this shutdown by reading the current from the 3 output current transformers. The shutdown is generated when the OSCD logic board has detected that the highest of the three output phase currents has exceeded 105% of the programmed 100% full load amps (FLA) value for more than 40 seconds. This shutdown requires a manual reset via the Reset push-button on the OSCD logic board.

VSD - High Converter Heatsink Temperature

MESSAGE: HIGH CONVERTER HEATSINK TEMP

A thermistor sensor is located of the copper chill plate of the OSCD Power Unit. If at anytime this thermistor detects a temperature of 170°F (76°C) or higher a shutdown will occur. The cooling fans and coolant pump on the OSCD will continue to run after the shutdown until the thermistor temperature has dropped below 160°F (71°C). This shutdown requires a manual reset via the Reset push-button on the OSCD logic board.

VSD - High Inverter Baseplate Temperature (292, 351 & 424 Hp drives)

MESSAGE: HIGH INVERTER BASEPLATE TEMPERATURE FLT

A thermistor sensor is located inside the transistor module on the OSCD power unit. If at anytime this thermistor detects a temperature of 175°F (79°C) or higher a shutdown will occur. The cooling fans and coolant pump on the OSCD will continue to run after the shutdown until the thermistor temperature has dropped below 165°F (74°C). This shutdown requires a manual reset via the Reset push-button on the OSCD logic board.

VSD - High Phase (X) Inverter Baseplate Temperature (419, 503 & 608 Hp drives)

MESSAGE: HIGH PHASE (X) BASEPLATE TEMPERATURE FAULT

NOTE

The X will indicate the phase that the high temperature has occurred.

A thermistor sensor is located inside the transistor module on the OSCD power unit. If at anytime this thermistor detects a temperature of 175°F (79°C) or higher a shutdown will occur. The cooling fans and coolant pump on the OSCD will continue to run after the shutdown until the thermistor temperature has dropped below 165°F (74°C). This shutdown requires a manual reset via the Reset push-button on the OSCD logic board.

VSD - Precharge Lockout

MESSAGE PRE-CHARGE FAULT LOCKOUT

If the OSCD fails to meet the pre-charge criteria (refer to pre-charge faults), the pre-charge circuit will wait for a period of 10 seconds before another pre-charge attempt. The unit's cooling fans and coolant pump shall remain energized during this time period. Following this 10-second period, the pre-charge shall again be initiated. The unit shall attempt to meet the pre-charge criteria three consecutive times before the OCSD will shutdown, lockout, and display this message.

Harmonic Filter - High Baseplate Temperature

MESSAGE HIGH FILTER BASEPLATE TEMPERATURE FAULT

A thermistor sensor is located inside the transistor module on the harmonic filter power unit. If at anytime this thermistor detects a temperature higher then the threshold value a shutdown will occur. Refer to the chart below for the shutdown threshold values. A manual reset is required by pressing the "Overtemp Reset" pushbutton located on the Filter Logic board.

DRIVE HP RATING	THRESHOLD SHUTDOWN VALUE
292/351	175° F (79° C)
419/424/503/608	190° F (88° C)

Harmonic Filter - High Total Demand Distortion

MESSAGE: FLTR HIGH TDD FLT

The control center determines this shutdown by using data supplied from the harmonic filter logic board. This shutdown indicates that the filter is not operating correctly or the input current to the OSCD/filter system is not sinusoidal. This shutdown will occur if the Total Demand Distortion (TDD) in any one phase exceeds 25% continuously for 45 seconds. TDD is an acronym for Total Demand Distortion, a term defined by the IEEE Std 519-1992 standard as "the total root - sum - square harmonic current distortion, in percent of the maximum demand load current (15 or 30 min demand)". The harmonic filter option was designed to provide an input current TDD level of 8% or less for the OSCD system. A standard OSCD less the optional filter typically has an input current TDD level on the order of 28 - 30%.

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 gate drivers.

- 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 via the serial communications link to the Adaptive Capacity Control Board and then 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. Leave the Compressor Switch in the Run position. The chiller will start if no faults are active.

VSD - DC Bus Voltage Imbalance

MESSAGE: BUS VOLTAGE IMBALANCE FAULT

The DC link is filtered by many large electrolytic capacitors, which are rated for 450 VDC. These capacitors are wired in series to achieve a 900 VDC capability for the DC link. It is important that the voltage is shared equally from the junction of the center, or series capacitor connection, to the negative bus and to the positive bus. This center point should be approximately ½ of the total DC link voltage. If the voltage is greater than ± 88 VDC from the ½ of the total DC link voltage, then this shutdown will occur.

VSD - High DC Bus Voltage

MESSAGE: BUS OVER-VOLTAGE FAULT

The DC bus voltage is continuously monitored and a shutdown will occur if the DC bus voltage exceeds 745 VDC (for 400 VAC & 460 VAC units) or 909 VDC (for 575 VAC units). This shutdown will protect the capacitors from a voltage that exceeds their rating.

VSD - High Internal Ambient Temperature

MESSAGE: HIGH AMBIENT TEMPERATURE FLT

The ambient temperature of the OSCD is monitored by a temperature sensor mounted on the OSCD logic board. The high ambient trip threshold is 145°F (63°C) for all HP units except 424 HP which has a trip threshold of 153°F (67°C). If this fault occurs, the fans and coolant pump will remain on until the internal ambient temperature has fallen to 137°F (58°C) for all HP units except 424 HP which will run the fans and coolant pump until the internal ambient has fallen to 145°F (63°C).

VSD - High Phase A (or B, C) Instantaneous Current

MESSAGE PHASE A (OR B, C) OVERCURRENT FAULT

This shutdown is generated by the OSCD logic board. If any one phase of motor current as measured by the Output Current Transformers exceeds a threshold. Refer to the chart below for the shutdown threshold value.

DRIVE HP RATING	THRESHOLD SHUTDOWN VALUE
292/351/424	771 AMPS PEAK
419/503/608	1200 AMPS PEAK

If an Instantaneous Current Fault occurs but the chiller restarts and runs without a problem, the cause may be attributed to a voltage sag on the utility power feeding the OSCD that is in excess of the specified dip voltage rating for this product. This is especially true if the chiller was running at, or near, full load. If there is a sudden dip in line voltage, the current to the motor will increase. The chiller vanes cannot close quickly enough to correct for this sudden increase in current and the chiller will trip on this fault.

VSD - Initialization Failed

MESSAGE: VSD INITIALIZATION FAILED

At power-up, the OSCD logic board will go through a process called initialization. At this time, memory locations are cleared, jumper positions are checked, and communications links are established between the OSCD logic board, ACC board, and the Control Center.

VSD - Invalid Current Scale Selection

MESSAGE: INVALID CURRENT SCALE FAULT

The J1 connector on the OSCD logic board contains jumpers along with wires from the output CTs. The jumpers tell the logic board the size of the OSCD being employed in order to properly scale the output current. If the jumper configuration is found by the logic board to be invalid, the system will be shut down and the above message will be generated. The proper jumper configuration is shown on the wiring label for the OSCD.

VSD - Logic Board Power Supply

MESSAGE: MAIN BOARD POWER SUPPLY

This shutdown is generated by the OSCD logic board, and it indicates that one of the low voltage power supplies for the OSCD logic board has dropped below their allowable operating limits. The power supplies for the logic boards are derived from the secondary of the 120 to 24 VAC transformer which in turn is derived from the 480 to 120 VAC control transformer.

VSD - Logic Board Processor

MESSAGE: PWM COMMUNICATIONS FAULT

This shutdown is generated by the OSCD logic board. If a communications problem occurs between the two microprocessors on the OSCD logic board this shutdown will occur.

VSD - Low Converter Heatsink Temperature

MESSAGE: LOW CONV HEATSINK TEMP.

A thermistor sensor is located on the SCR/Diode block side of the copper chill plate on the OSCD Power Unit. Anytime this thermistor detects a temperature of 37°F (3°C) or lower a shutdown will occur.

VSD - Low DC Bus Voltage

MESSAGE LOW DC BUS VOLTAGE FLT

If the line voltage were to quickly drop the current seen by the motor could exceed it’s rating. The low bus voltage shutdown will prevent this from happening. The shutdown is generated when the DC link voltage drops below 500 VDC for 460 VAC input voltage, 414 VDC for 400 VAC input voltage or 600 VDC for 575 VAC input voltage.

VSD - Low Inverter Baseplate Temperature

MESSAGE: LOW INVERTER BASEPLATE TEMPERATURE FLT.

A thermistor sensor is located inside the transistor module(s) on the OSCD power unit. Anytime this thermistor detects a temperature of 37°F (3°C) or lower a shutdown will occur.

VSD - Phase A (B, C) Gate Driver

MESSAGE: PHASE A (B,C) GATE DRIVER FLT

A second level of overcurrent current protection exists on the OSCD gate driver board. The collector-to-emitter voltage of each transistor module is checked while the device is turned on. This is called the collector-to-emitter saturation voltage. If the voltage across the transistor module is greater than a set threshold, the transistor module is turned off. This fault can also be caused if the transistor is not being turned on when it should.

VSD - Precharge - DC Bus Voltage Imbalance

MESSAGE: PRECHARGE BUS V IMBALANCE

The definition for this fault is identical to “ VSD - DC Bus Voltage Imbalance” except that the fault has occurred during the precharge period, which begins during pre-lube. Refer to “ VSD - DC Bus Voltage Imbalance” shutdown for possible problems.

VSD - Precharge - Low DC Bus Voltage

MESSAGE: PRECHARGE LOW VOLTAGE FAULT

This fault has two different timing events. First, the DC Bus voltage must be equal to or greater than 50 VDC for 460 VAC input voltage, 41 VDC for 400 VAC input voltage or 60 VDC for 575 VAC input voltage, 4 seconds after pre-charge has begun. Second, the DC Bus voltage must be equal to or greater than 500 VDC for 460 VAC input voltage, 414 VDC for 400 VAC input voltage or 600 VDC for 575 VAC input voltage, 20 seconds after pre-charge has begun.

VSD - Run Signal

MESSAGE: RUN RELAY FAULT

Two run signals are generated by the Control Center, one via hardware and the second via the communications link. Upon receipt of either of the two run signals by the OSCD logic board, a 5-second timer will begin. If the missing run signal is not received within the 5-second window the OSCD logic board will shut down and the Control Center will display the shutdown message.

VSD - Serial Communications

MESSAGE: SERIAL RECEIVE FAULT

This message is generated when communications between the micro board and the ACC board, or the ACC board and OSCD logic board is disrupted for a least 22 seconds. If the optional Harmonic Filter is installed then the fault can be generated when the communications between the OSCD logic board and the Harmonic Filter logic board, or the Harmonic Filter logic board and the ACC board is disrupted.

VSD - Single Phase Input Power

MESSAGE: SINGLE PHASE POWER SUPPLY

This shutdown is generated by the SCR Trigger board and relayed to the OSCD logic board to initiate a system shutdown. The single phase control uses circuitry to detect the loss of any one of the three input phases. The trigger board will detect the loss of a phase within one half line cycle of the phase loss. An LED on the SCR Trigger board will indicate that the board is detecting the fault, and not a wiring problem between the trigger board and the OSCD logic board. This message is also displayed every time power to the OSCD is restored, or if the input power dips to a very low level. Usually it indicates that someone has opened the disconnect switch.

VSD - Stop Contacts Open

MESSAGE: INVERTER INITIATED STOP FAULT

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 ACC board, detailing the cause of the fault. If this circuit ever opens without receiving an accompanying cause for the fault over the communication link (within 11 communication tries, approximately 22 seconds) this message will be displayed. This fault may be replaced with a Serial Communications fault if the serial link has failed.

Harmonic Filter - 110 % Input Current Overload

MESSAGE: FLTR OVERLOAD FLT

The three phases of RMS filter current are measured by the output DCCTs'. This information is sent to the harmonic filter logic board. If any one phase of filter current exceeds a threshold for 40 seconds a shutdown will occur. Refer to the chart below for the shutdown threshold value.

DRIVE HP RATING	THRESHOLD SHUTDOWN VALUE
292/351/424	128 AMPS RMS
419/503/608	176 AMPS RMS

Harmonic Filter - DC Bus Voltage Imbalance

MESSAGE: FLTR BUS V IMBALANCE FLT

The DC link is filtered by many large electrolytic capacitors. It is important that the voltage be shared equally across each capacitor so the maximum capacitor voltage rating is NOT exceeded. The DC isolation board is connected to the plus bus, minus bus, and where the series capacitors are connected to each other. The harmonic filter logic board then measures the voltage between the plus bus and the series connection, and the minus bus and the series connection of the bus capacitors. If at anytime while the harmonic filter is running these 2 measurements become unequal by 50 VDC (for 400 VAC and 460 VAC input voltage) or 65 VDC (for 575 VAC input voltage) then a shutdown will occur.

Harmonic Filter - DC Current Transformer 1(or 2)

MESSAGE: FILTER DCCT 1 (OR 2) ERROR

During initialization, with no current flowing through the Direct Current Current Transducers (DCCT's), the DCCT's output voltages are measured and compared with a preset limit in the harmonic filter logic board. If the measured values exceed the preset limits, the DCCT's are presumed to be bad and this shutdown will be generated.

Harmonic Filter - High DC Bus Voltage

MESSAGE: FLTR BUS OVER-VOLTAGE FLT

The harmonic filter logic board continuously monitors the harmonic filter DC link voltage if the level of the DC link voltage exceeds a range of 822 to 900 VDC (for 400 VAC and 460 VAC input voltage) or 999 to 1099 VDC (for 575 VAC input voltage) this shutdown is initiated. Keep in mind that the harmonic filter has its own DC bus as part of the harmonic filter power unit. The harmonic filter DC Link is not connected in any way with the drive's DC Link.

Harmonic Filter - High Phase A (B, C) Current

MESSAGE: FLTR PHASE A (B,C) OVERCURRENT

The output current of the harmonic filter is read by the Direct Current-Current Transducer (DCCT). This current information is sent to the harmonic filter logic board where it is compared against a threshold. If the output current of the harmonic filter power unit is greater than the threshold, then the harmonic filter will turn off for 5-6 line cycles. After that time the filter operation will resume. If the harmonic filter operation is stopped 3 times within a period of 60 line cycles, then the filter and VSD power units are shut down and this message is generated.

DRIVE HP RATING	THRESHOLD SHUTDOWN VALUE
292/351/424	378 ± 59 AMPS Pk
419/503/608	523 ± 84 AMPS Pk

Harmonic Filter - Logic Board Or Communications

MESSAGE: IEEE-519 FILTER FAULT

This shutdown states that the hardware on the harmonic filter logic board is indicating a fault, but the software on the harmonic filter logic board does not state why. The harmonic filter logic board signals a fault condition to the OSCD logic board but does not respond to a software request for fault information.

Harmonic Filter - Logic Board Power Supply

MESSAGE: FLTR POWER SUPPLY FLT

This shutdown indicates that one of the low voltage power supplies on the harmonic filter logic board have dropped below their permissible operating voltage range. The harmonic filter logic board receives its power from the OSCD logic board. The power supplies for the OSCD logic boards are in turn derived from the secondary of the 120 to 24 VAC transformer.

Harmonic Filter - Low DC Bus Voltage

MESSAGE: FLTR LOW BUS VOLTAGE FLT

The harmonic filter dynamically generates its own filter DC link voltage by the interaction of the harmonic filter choke and switching its transistors. This DC level is actually higher than the level obtained by simply rectifying the input line voltage.

NOTE

The DC link voltage is always higher on the harmonic filter power unit then on the OSCD VSD power unit.

Thus the harmonic filter actually performs a voltage “boost” function. This is necessary in order to permit current to flow into the AC line from the harmonic filter when the AC line is at its peak level. This particular shutdown and its accompanying message are generated when the harmonic filter’s DC link voltage drops to a level less than 80 VDC (for 400 VAC and 460 VAC input voltage) and 100 VDC (for 575 VAC input voltage) below the harmonic filter DC link voltage setpoint.

Harmonic Filter - Phase Locked Loop

MESSAGE: FLTR PHASE LOCK LOOP FLT

This shutdown indicates that a circuit called a “phase locked loop” on the harmonic filter logic board has lost synchronization with the incoming power line for a period of time.

Harmonic Filter - Precharge - Low DC Bus Voltage

MESSAGE: FLTR PCHARGE LOW BUS V FLT

Two minimum voltage thresholds must be met in order to complete the precharge cycle. The first occurs 1/10th of a second after pre-charge is initiated and the other occurs 5 seconds after precharge is initited. See table below for specific values.

NOMINAL INPUT VOLTAGE VALUE	1st MINIMUM VOLTAGE VALUE	2nd MINIMUM VOLTAGE VALUE
400 VAC	41 VDC	425 VDC
460 VAC	50 VDC	525 VDC
575 VAC	60 VDC	630 VDC

Harmonic Filter - Run Signal

MESSAGE: FLTR RUN RELAY FLT

When a digital run command is received at the harmonic filter logic board from the OSCD logic board, a 1/10 second timer is started. A redundant run command must also occur on the communication link from the OSCD logic board before the timer expires or the OSCD will be shut down.

WARNING MESSAGES

General Information

A WARNING message will indicate that the operation of the OptiSpeed Compressor Drive or the Harmonic Filter is affected in some manner but the OptiSpeed Compressor Drive is still functioning.

Warning – Vanes Uncalibrated – Fixed Speed

MESSAGE:

This message is displayed when the Pre-Rotation Vanes are not calibrated or have failed to calibrate, and the OptiSpeed Compressor Drive is enabled. Under this condition the OSCD will run at a constant maximum speed. This message will no longer appear after a successful calibration.

Warning - Harmonic Filter - Operation Inhibited

MESSAGE: FILTER - OPERATION INHIBITED

This message is displayed when the function of the Harmonic Filter is inhibited at the Control Center. This message is no longer displayed when the function of the Harmonic Filter is enabled at the Control Center. The function of the harmonic filter can only be inhibited or turned on when the chiller is not running.

Warning - Harmonic Filter - Data Loss

MESSAGE: FILTER DATA LOSS

This message is displayed if the communications link between the OSCD logic, and the harmonic filter logic, or the ACC boards are interrupted for at least a period of 20 seconds. This message can also occur as a background message when the chiller is running. When this message is displayed all filter related values are replaced with X's. If communications is re-established, the message will disappear, and normal values will again be displayed.

VSD FREQUENTLY ASKED QUESTIONS

Why doesn't the measured input amps of the OSCD agree with the rated FLA?

The input current to the OSCD may be considerably lower, compared to the output current. This is due to the power factor at the input to the OSCD being greater than .95, and nearly unity when the Harmonic Filter option is included. Chiller FLA must be measured at the motor terminals, where the power factor is the normal motor power factor. Use a true RMS reading meter to make these measurements.

On a retrofit OptiSpeed Compressor Drive, what is the DV/DT Network for?

The combination of long runs of wire between the OSCD and the compressor motor, with the fast rise time of the output voltage of the OSCD can cause excessively high voltage potential at the motor terminals. Without the DV/DT Network, the insulation in the compressor motor may be overly stressed. The DV/DT Network reduces the high voltage potential to below the motor's voltage specification. The design of the DV/DT network currently in production has a requirement for installation on top of the motor terminal box. Do NOT add any additional wire between the motor terminal connections and the DV/DT Network. The additional wire will reduce the DV/DT Network's effectiveness, and potentially shorten the life of the motor.

On all OSCD's, this same circuit is located on the back wall of the OSCD enclosure near the motor connections. Since this filter is already present inside the cabinet on all OSCD, some installers have questioned whether the internal circuit must be disabled when using the terminal box mounted accessory. The answer is NO - you do not need to disconnect the filter inside the OSCD cabinet.

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, you get 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.

When is a Booster Pump required on a Retrofit OptiSpeed Compressor Drive?

Detailed information is supplied in Form 160.05-N4. In general, the OSCD requires 8 ft of head for proper water flow to the OSCD heat exchanger. If this amount of head is not available, then a booster pump is required.

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).

My chiller will not slow down, why?

The OSCD will not reduce the motor speed until the leaving chilled water temperature is below 0.5 degree from setpoint. Once in this window, the speed still cannot be reduced until the operation is deemed to be stable, based upon the vanes are not continually moving open and closed to maintain temperature. This hunting effect is normally due to one of the following:

- Chilled water and Condenser water flows are not at design GPMs.
- Return water temperature is varying due to 3-way valves or other system configuration, and the chiller is simply following changes in load.
- Vane stroke is too large. Remove the sensitivity jumper in the Micro Computer Control Center, or program a lower sensitivity on the OptiView Control Center. Also, check the vane motor to see that the fullest possible stroke is being utilized. Moving the vane motor arm pivot point closer to center, and extending the degrees of travel by adjusting the internal end stops, will reduce the amount of vane action for the same period of operation.
- Verify that the condenser is clean.
- Verify that the liquid level control is working properly, and maintaining a refrigerant level in the condenser.
- Ensure that the condenser water temperature is proper for the load on the chiller. In many cases, the condenser water temperature is still at 85°F.

Failure to reduce speed may also be due to the system having been placed in Manual Speed when in VSD Service Mode.

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.

NOTES

NOTES

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