YORK BY JOHNSON CONTROLS	OPTISPEED™ VARIABLE SPEED DRIVE	
SERVICE	NEW RELEASE	Form 160.84-M3 (414)

MODELS
HYP0490
HYP0774

LD14681

490 AMPS – 50/60 HZ, 380-460 VAC (P/N 371-06569-XXX)
774 AMPS – 50/60 HZ, 380-460 VAC (P/N 371-05992-XXX)

Issue Date:
April 25, 2014

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

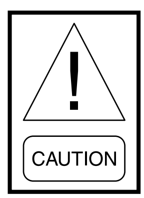
This equipment is a relatively complicated apparatus. During installation, operation maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, materials under pressure, rotating components, and both high and low voltage. Each of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

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

SAFETY SYMBOLS

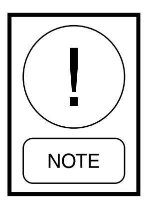
The following symbols are used in this document to alert the reader to specific situations:

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



Identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution if proper care is not taken or instructions 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 owner. Updated manuals, if applicable, can be obtained by contacting the nearest Johnson Controls Service office.

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

CHANGE BARS

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

ASSOCIATED LITERATURE

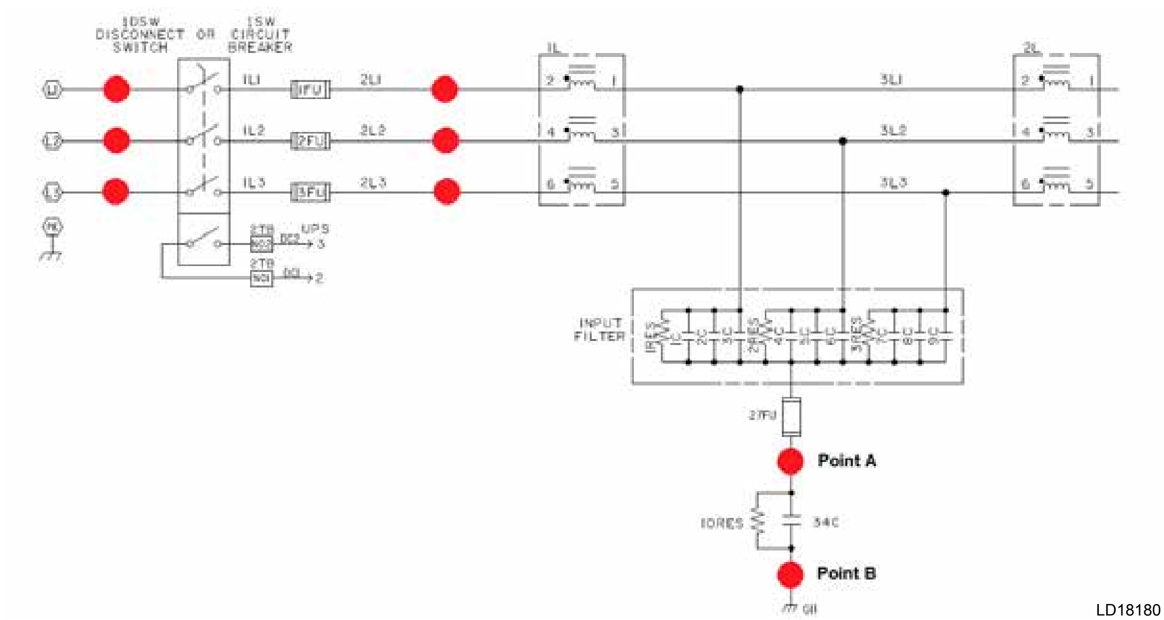
This instruction is to be used in conjunction with the Operation Instructions for YORK Model YMC^2 chiller.

MANUAL DESCRIPTION	FORM NUMBER
Installation Checklist and Request for Authorized Start-up Engineer	160.84-CL1
Start-up Checklist	160.84-CL2
Operation (Unit) Model YMC^2	160.84-O1
Service Instructions - Chiller, Motor and Compressor	160.84-M1
Service Instructions - OptiView Control Center	160.84-M2
Intallation and Reassembly	160.84-N1
Operation and Maintenance	160.84-OM1
Wiring Diagram Field Connections	160.84-PW1
Wiring Diagram (Control Panel)	160.84-PW2
Replacement Parts	160.84-RP1
Replacement Parts OptiSpeed Variable Speed Drive	160.84-RP3

WARNING

This product contains voltages that could cause injury or death. Follow all NFPA-70E safety rules. Before performing any troubleshooting procedures. Place the compressor switch in the stop position. Wait 5 minutes. Ensure that the DC BUS voltage is 50 VDC or less on the display of the chiller control panel. Ensure that all sources of power to the chiller are removed. These power sources would also include an externally connected 120 VAC supply provided as an option for the chiller. Remove all AC power sources upstream of the VSD and perform lockout / tagout procedures. Use a non-contact voltage sensor to ensure no AC power is present in the VSD enclosure. Use a DVM to measure AC and DC voltage at locations shown below. Measure the three phase connections phase to phase and phase to ground. All values should be zero. Measure voltage from Point A to Point B.

Measure the BUS voltage at J1 pins 1-2 on the VSD logic board using a DVM to ensure that BUS voltage is less than 50 VDC.



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MODEL NOMENCLATURE

HYP 0774 X H 30 D - 46

Voltage Rating
40 = 380VAC 60Hz
46 = 460VAC 60Hz
50 = 400VAC 50Hz
68 = 415VAC 50Hz

Input Type
D = Disconnect Switch
B = Circuit Breaker

Condenser Liquid Pressure PSIG
15 = 150
30 = 300

Chiller Application
H = YMC^2

X = Factory Package
R = Retrofit Package

Drive Current Rating (0490 or 0774)

Type of Drive

MODEL NUMBERS AND PART NUMBERS

0490 AMP MODEL 380/400 VAC 50HZ	
HYP0490XHC30D-50	371-06569-121
HYP0490XHC30B-50	371-06569-122
0490 AMP MODEL 415 VAC 50HZ	
HYP0490XHC30D-68	371-06569-125
HYP0490XHC30B-68	371-06569-126
0490 AMP MODEL 400 VAC 60HZ	
HYP0490XHC30D-40	371-06569-105
HYP0490XHC30B-40	371-06569-106
0490 AMP MODEL 460 VAC 60HZ	
HYP0490XHC30D-46	371-06569-101
HYP0490XHC30B-46	371-06569-102
0774 AMP MODEL 380/400 VAC 50HZ	
HYP0774XHC15D-50	371-05992-121
HYP0774XHC15B-50	371-05992-122
HYP0774XHC30D-50	371-05992-123
HYP0774XHC30B-50	371-05992-124

0774 AMP MODEL 415 VAC 50HZ	
HYP0774XHC15D-68	371-05992-125
HYP0774XHC15B-68	371-05992-126
HYP0774XHC30D-68	371-05992-127
HYP0774XHC30B-68	371-05992-128
0774 AMP MODEL 400 VAC 60HZ	
HYP0774XHC15D-40	371-05992-105
HYP0774XHC15B-40	371-05992-106
HYP0774XHC30D-40	371-05992-107
HYP0774XHC30B-40	371-05992-108
0774 AMP MODEL 460 VAC 60HZ	
HYP0774XHC15D-46	371-05992-101
HYP0774XHC15B-46	371-05992-102
HYP0774XHC30D-46	371-05992-103
HYP0774XHC30B-46	371-05992-104

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SECTION 1 - GENERAL OPERATON

This new drive design brings to market a product that uses new light weight materials, new power semi-conductors, new bus capacitor, compact power assembly design, liquid cooled inductors, and includes harmonic filtering on all models. The model number now describes the maximum output current of the 460 VAC model.

The copper chill plates used to cool the power semi-conductors are replaced with direct liquid cooled plastic cooling assemblies. The design is very similar to the design used on the VSD model drive. The liquid is sealed between the baseplate of the power semi-conductor and the plastic cooling assembly. The cooling is provided to the power semi-conductor by liquid flowing across the baseplate.

WHAT IS NEW?

This drive uses Insulated Gate Bipolar Transistors (IGBT). The IGBT has been used for many years in the design of the drive output and the harmonic filter. Typically, the IGBT modules used at this current rating contain 2 IGBT's. Johnson Controls worked closely with the IGBT manufacturer and had a third IGBT installed in the same module. This new module is used in the rectifier of the drive, and allows the drive to pre-charge without the use of an input contactor, or pre-charge resistors.

At the heart of the compact power unit is the new bus capacitor. The new bus capacitor contains all of the mounting hardware for the rectifier assembly, bus structure, and the inverter assembly. A separate heavy metal structure is not required in this assembly.

The bus capacitor is no longer an electrolytic design that required voltage balancing or the need of many capacitors in parallel due to low current ratings. The new bus capacitor uses a higher voltage rated material so that voltage balancing is not required. The current rating of this new capacitor is much higher, requiring only one bus capacitor to be used on smaller designs, and only one capacitor per phase on many other models.

This purpose built drive can take full advantage of condenser liquid always being available. Typically, condenser liquid is used as the cooling medium through a shell and tube heat exchanger for the drive. Other cooling mediums can be used, but special considerations must be made.

Air cooled inductors at these power levels get very hot, which could cause concern. Not any more. The input and output inductors in this drive is liquid cooled. The inductor is now no hotter than the inside of the drive. Most of the heat from the inductors is rejected directly into the liquid cooling system. The liquid cooled inductors greatly improves the cooling system, and reduces the need for air cooling in the drive.

HARMONIC FILTERING

Harmonic filtering is no longer a question with this new design. The controls for the rectifier IGBT's now provide harmonic filtering standard. A separate heavy power assembly, contactors, fuses, and harmonic filter logic board are no longer required for harmonic filtering. Today all of the controls for the drive and harmonic filtering are contained in the drive logic board. This new board is about the same size as the VSD model drive logic board.

COMPONENT OVERVIEW

HYP Compressor Drive

See Figure 1 on page 13 and Figure 2 on page 13.

The new HYP compressor drive is a liquid cooled, transistorized, PWM (Pulse Width Modulated) inverter in a highly integrated package. The harmonic filtering is now integrated into the standard HYP model drive. This package is small enough to mount directly onto the chiller motor. The power section of the drive is composed of four major blocks:

- a three phase AC to DC rectifier section with an integrated pre-charge circuit,
- a DC bus filter section,
- a three phase DC to AC inverter section,
- an input and output harmonic filters.

The following component overview is general to all models of HYP unless otherwise noted.

Disconnect Method

An electronic circuit breaker or disconnect switch connects the three phase power to input fuses and then onto the AC line inductor, input filter, load inductor, and then to the DC rectifier section. After the rectifier, power is stored in the bus capacitor until needed by the inverter. The inverter changes the DC into the proper AC voltage and frequency. The output harmonic filter will smooth out the PWM voltage waveform to improve the operation of the motor.

Harmonic Filter

The input harmonic filter in the HYP model is much like the harmonic filter used in earlier designs, except the IGBT's used in the harmonic filter are now part of the rectifier. The upper and lower IGBT's in the rectifier are used to command the wave shape of the input current. The input current waveform is commanded to be a sine wave that provides a very low total demand distortion (TDD) value as well as a power factor value of nearly unity.

The AC to DC rectifier uses several IGBT's in parallel. Each phase has one or more modules arranged in a parallel connection depending on the amount of input current required for that model. Each rectifier module contains 3 IGBT's that are called the Upper, Lower, and Auxilliary IGBT. All three IGBT's are required to rectify the 3 phase input AC voltage into DC voltage in a new three-phase bridge configuration. (*Figure 13 on page 36*). The use of the Auxilliary IGBT in the new three-phase bridge configuration in the rectifier permits pre-charge of the DC bus filter capacitors without the use of an additional components, and they also provide a fast disconnect from the AC line when the chiller enters the stopped mode.

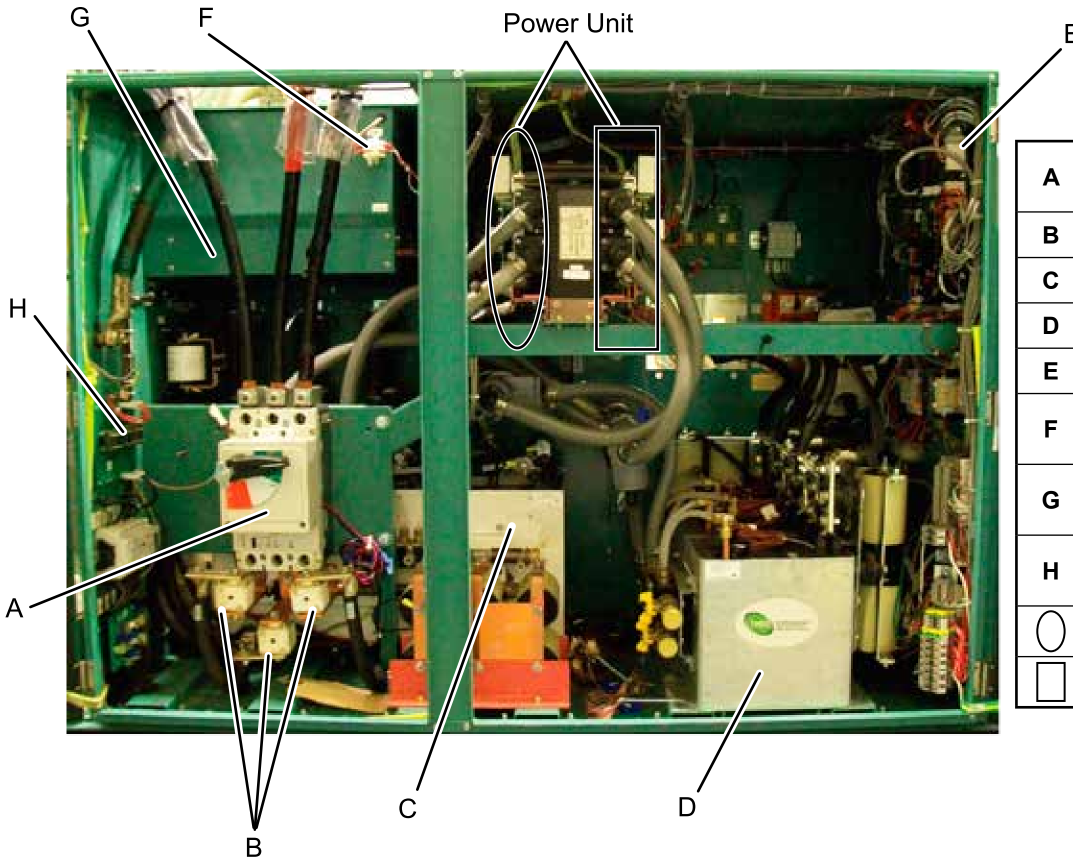
DC Bus

The DC Bus section of the drive consists of one basic component, a large capacitor or capacitors depending on the current requirement of the HYP model. These capacitors provide a large energy reservoir for use by the DC to AC inverter section of the HYP. These capacitors provide the physical foundation for the HYP power unit. All of the other components in the power unit are connected to the foundation of the bus capacitor.

Drive Output

The output of the drive also uses IGBT's to control the voltage and frequency to the motor. The controls within the drive logic board are different in how the output IGBT's are turned on and off, but the configuration of the IGBTs' is the same.

The output harmonic filter is new to the JCI design. The reason for the output harmonic filter is that the permanent magnet motor used on this chiller design has very little inductance, and does not provide much filtering of the output current from the drive. Without the output harmonic filter the compressor motor would overheat, and reduce the power available to the chiller.



A	Circuit Breaker (Disconnect)
B	Input Power Fuses
C	Input Line Inductor
D	Output Harmonic Filter
E	Drive Logic Board
F	Cooling Fan (Behind Panel)
G	Cooling Coil (Behind Panel)
H	Line Voltage Isolation Board
○	Rectifiers
□	Inverter

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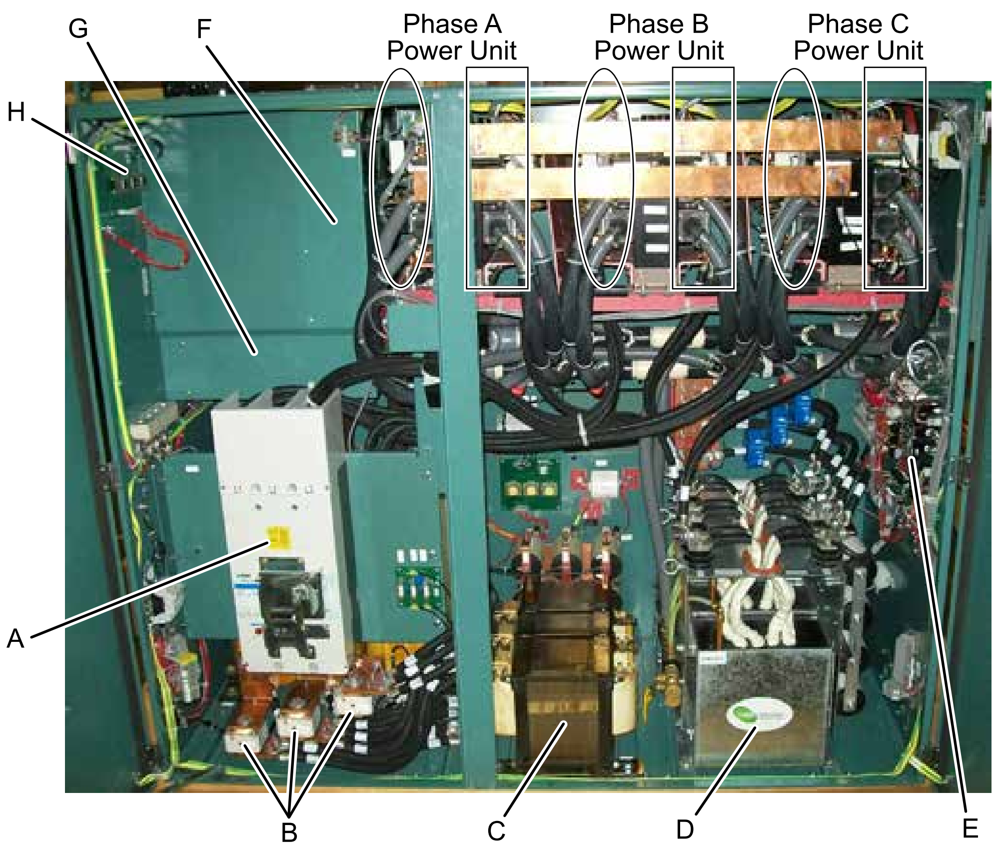
FIGURE 1 - DRIVE CABINET MODEL HYP0490



A	Circuit Breaker (Disconnect)
B	Input Power Fuses
C	Input Line Inductor
D	Output Harmonic Filter
E	Drive Logic Board
F	Cooling Fans (Behind Panel)
G	Cooling Coil (Behind Panel)
H	Line Voltage Isolation Board
○	Rectifiers
□	Inverter

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FIGURE 2 - DRIVE CABINET MODEL HYP0774

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SECTION 2 - DRIVE WIRING DIAGRAMS

Elementary Wiring Diagram 0490 AMP Notes

1. Field wiring to be in accordance with the National Electrical Code as well as all other applicable codes and specifications.
2. Terminal block connection points are indicated by numbers within a square, i.e. [1] 1TB. Main power connection points are indicated by numbers within a hexagon, i.e. ⟨L1⟩ . Component terminal markings are indicated by numbers within a circle. i.e. (2) . Numbers adjacent to circuit lines are the circuit identification numbers.
3. Terminals L1. L2, L3 and ground are the main power input terminals and are field connected. (See note 6). Terminals T1, T2 and T3 are the compressor motor lead power terminals and are factory connected on factory packaged units.
4. The three phase solid state motor overload protection system provide motor overcurrent protection at 105% full load amps.
5. See YORK Control Center wiring diagram product drawing Form 160.84-PW2.
6. Field Wiring Connections per Product Drawing Form 160.84-PW1.

LEGEND for 035-23951-001, 002, and 003

1C-6C	Capacitor, Film, Input Power Filter, 40µF, 31AMPS, 5%, 400VAC
7C	Capacitor, Film, 20µF, 400VAC
9C-20C	Capacitor, Film, Snubber, 1.0µF, 1200VDC
21C	Capacitor, Film, DC Link, 1500µF, 530AMPS, 1000VDC
22C-33C	Capacitor, Film, 50µF, 530VAC
1DSW	Switch Disconnect, 450AMPS, 600VAC, 100KA, Withstand
1SW	Circuit Breaker, 450AMPS, 600VAC, 100KA Withstand
1DCCT-6DCCT	DC Current Transformer, 1000AMPS
1FU-3FU	Fuse, Input Power, 550A, 700VAC, 200KA, Interrupting Semiconductor
4FU-6FU	Fuse, Input Voltage Sense, 1A, 600VAC, 200KA Interrupting
7FU-8FU	Fuse, Control Transformer Primary, 15A, 600VAC, 200KA Interrupting
14FU	Fuse, To Ups, 20A, 600VAC, 200KA Interrupting
15FU	Fuse, To Panel Non Critical, 6A, 600VAC, 200KA Interrupting
16FU-18FU	Fuse,Hransient Suppressor PCB, 5A, 600VAC, 200KA Interrupting
19FU	Fuse, To VSD Circuits Non Critical, 5A, 600VAC, 200Ka Interrupting
21FU	Fuse, Input Voltage Common Mode, 20A, 600VAC, 200Ka Interrupting
22FU-24FU	Fuse, Output Voltage Sense, 1A, 600VAC, 200Ka Interrupting
1L	Inductor, Line, 55µH, 447AMPS, 635VAC
2L	Inductor, Drive, 165µH, 447AMPS, 635VAC
3L	Inductor, Output, 28µH. 525AMPS, 600VAC
1MOD-6MOD	Module, Power Dual, Active Converter, 300AMPS 1200VDC
7MOD-12MOD	Module, Power Dual, Inverter, 450A, 1200VDC
1R	Relay, Cooling Fans and Pump
1RES-4RES	Resistor, Bleeder, 20K, 16W, 5%
5RES-10RES	Power Resistor, 0.5Ω, 240W, 10%
17RES	Resistor, 50K, 50W, 5%
1RT-2RT	Thermistor, Ambient, 10K At 25°C
1T	Transformer, Control, 3KVA, 480VAC:120VAC
2T-3T	Transformer, Class 2, 75VA, 120VAC:24VAC
1TB	Terminal Block
2TB	Terminal Block
3TB	Terminal Block
5TB	Terminal Block, Fan

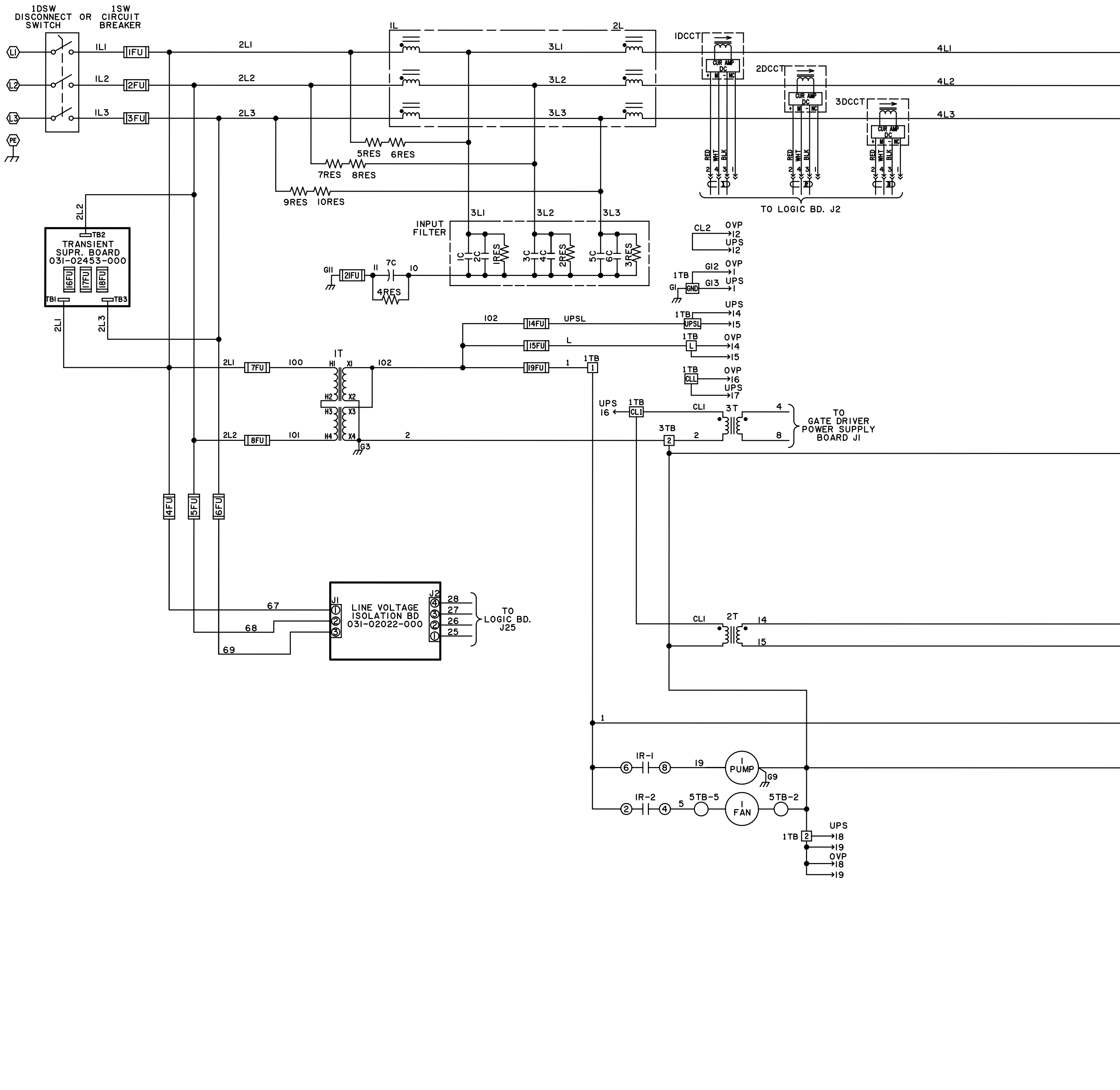

FIGURE 3 - ELEMENTARY WIRING DIAGRAM 0490 AMP

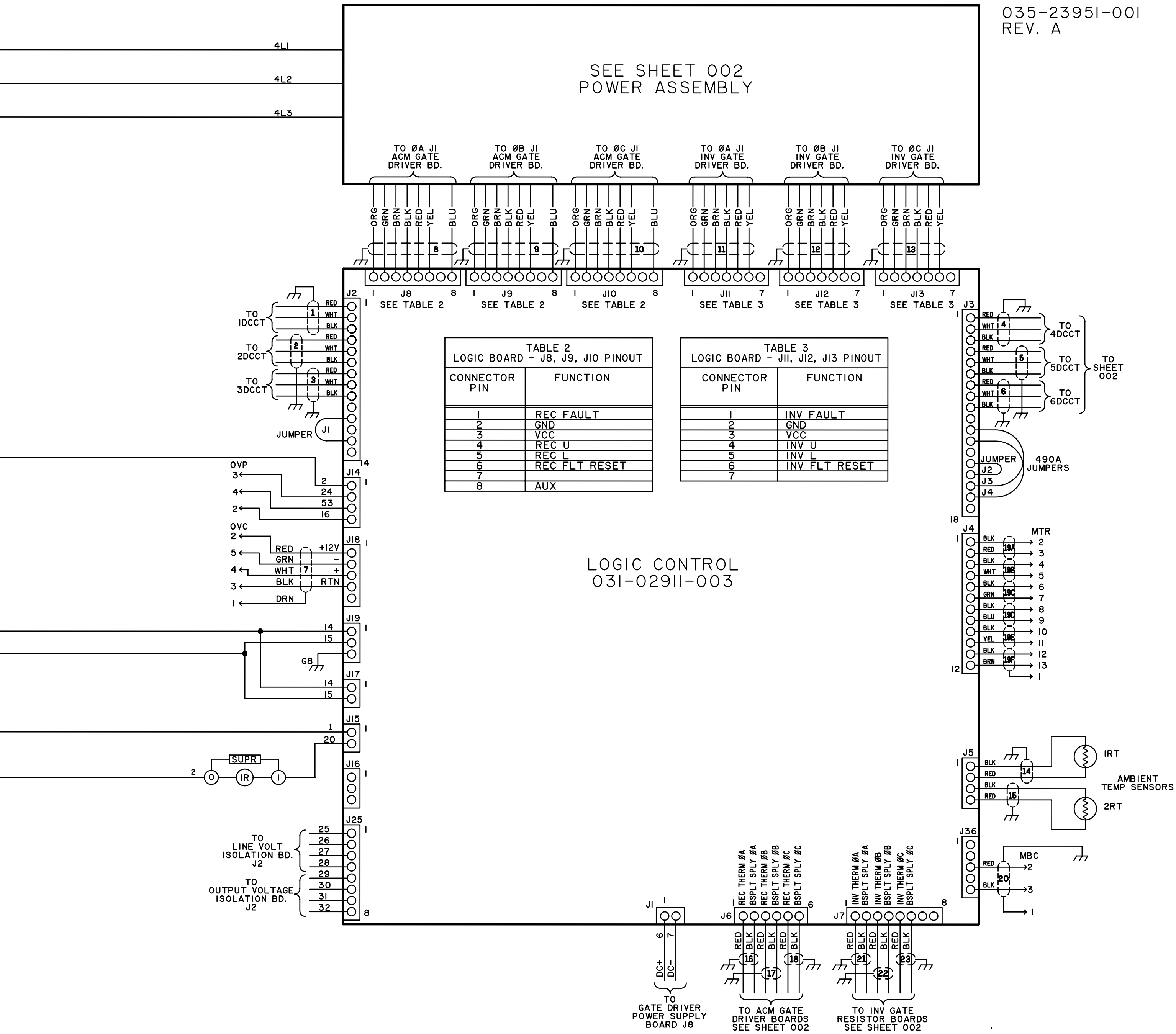

TABLE 2
LOGIC BOARD - J8, J9, J10 PINOUT

CONNECTOR PIN	FUNCTION
1	REC FAULT
2	GND
3	VCC
4	REC U
5	REC L
6	REC FLT RESET
7	
8	AUX

TABLE 3
LOGIC BOARD - J11, J12, J13 PINOUT

CONNECTOR PIN	FUNCTION
1	INV FAULT
2	GND
3	VCC
4	INV U
5	INV L
6	INV FLT RESET
7	

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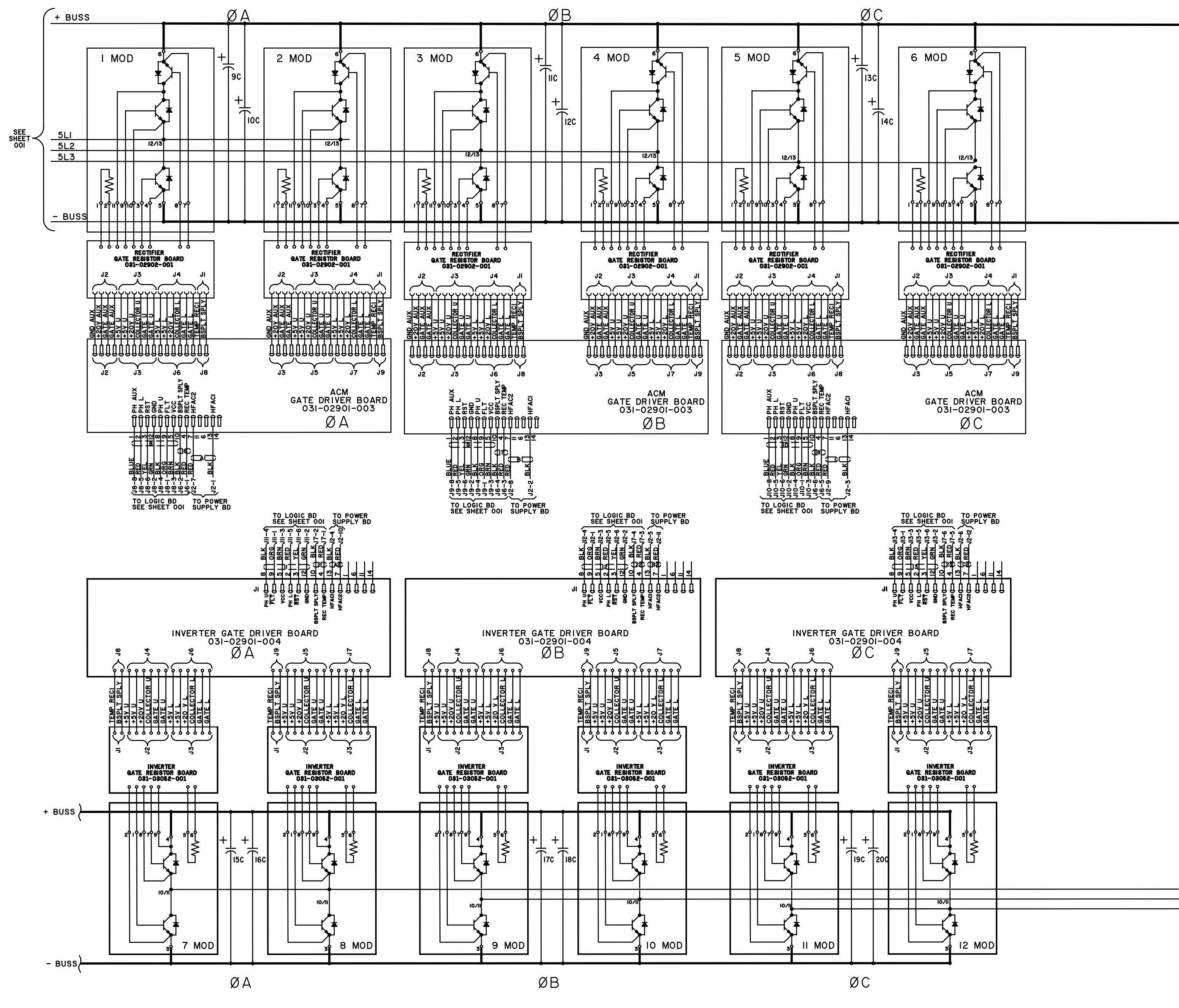
FIGURE 3 - ELEMENTARY WIRING DIAGRAM 0490 AMP (CONT'D)



* The 0490AMP unit consists of all 3 phases in one power unit.

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FIGURE 4 - POWER UNIT - ELEMENTARY WIRING DIAGRAM 0490 AMP

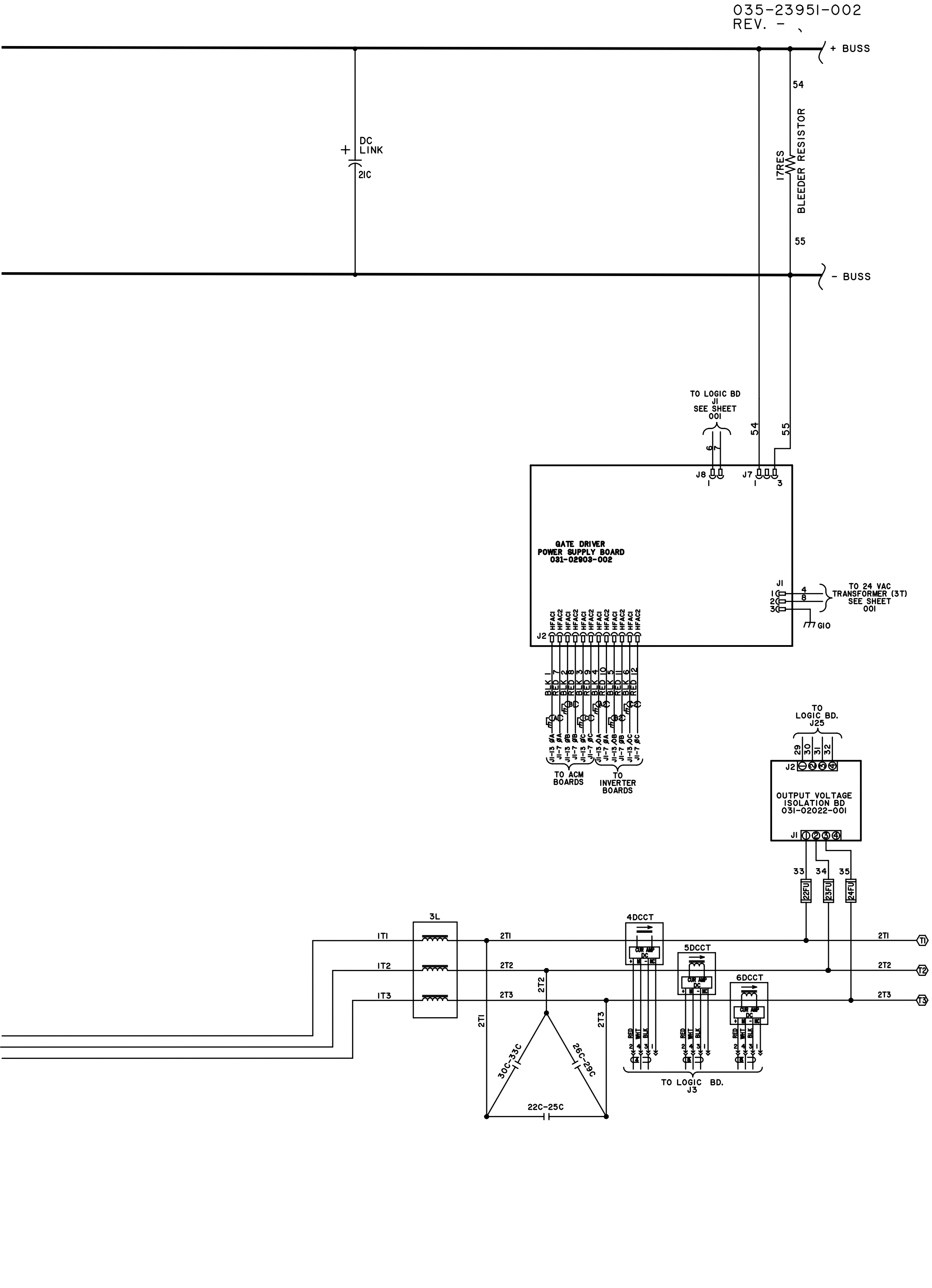

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FIGURE 5 - DRIVE OUTPUT - ELEMENTARY WIRING DIAGRAM 0490 AMP

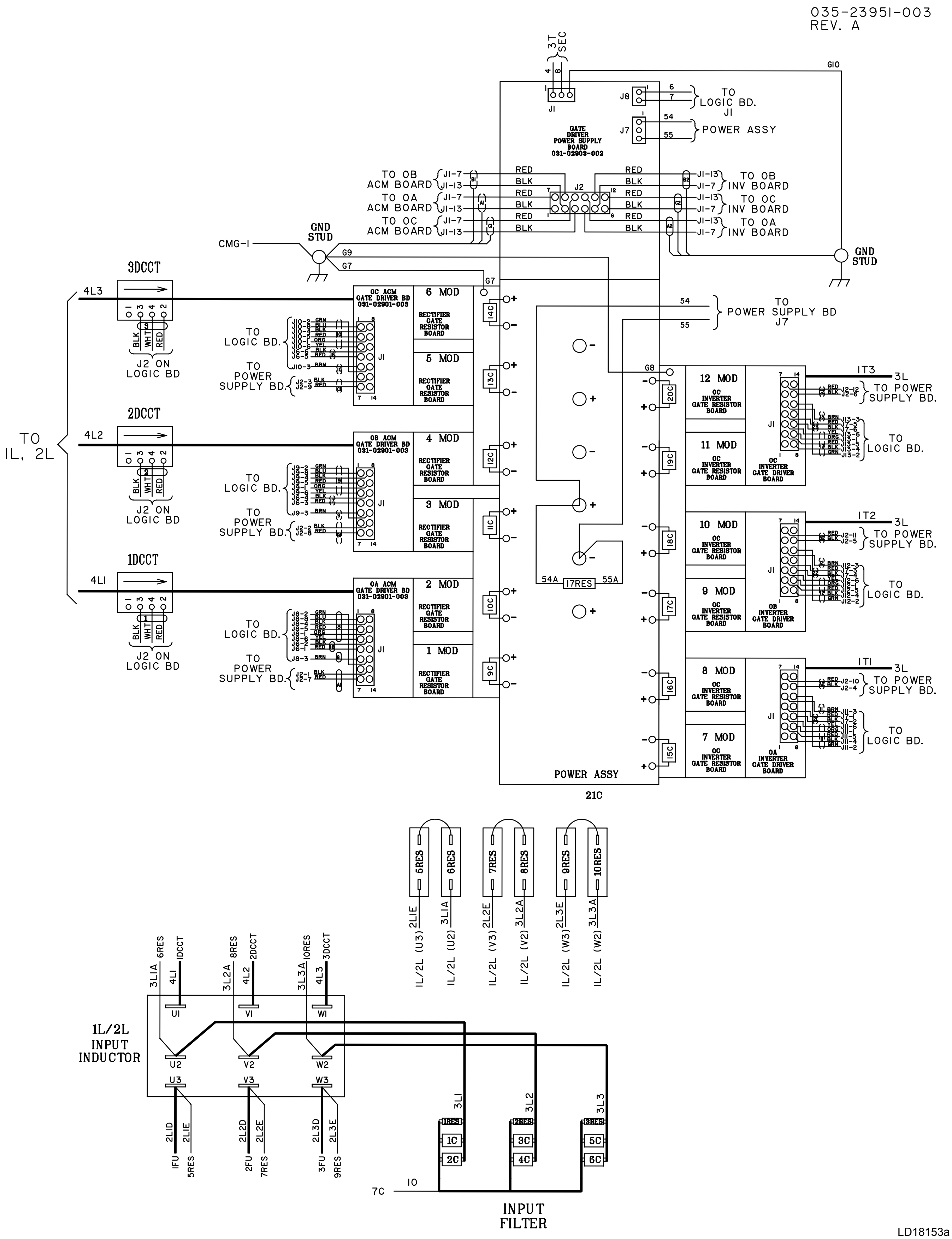

FIGURE 6 - CONNECTION DIAGRAM 0490

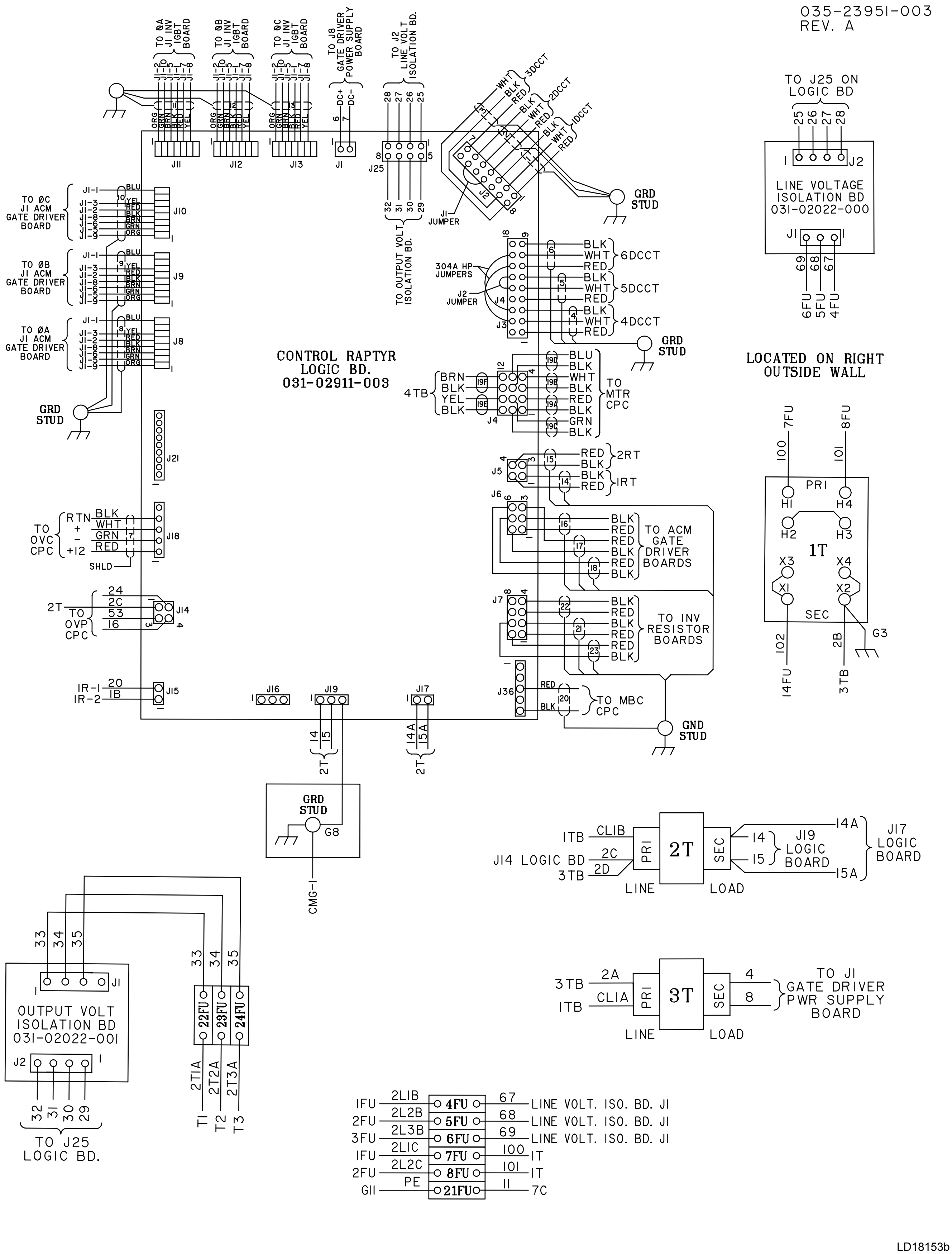

FIGURE 6 - CONNECTION DIAGRAM 0490 (CONT'D)

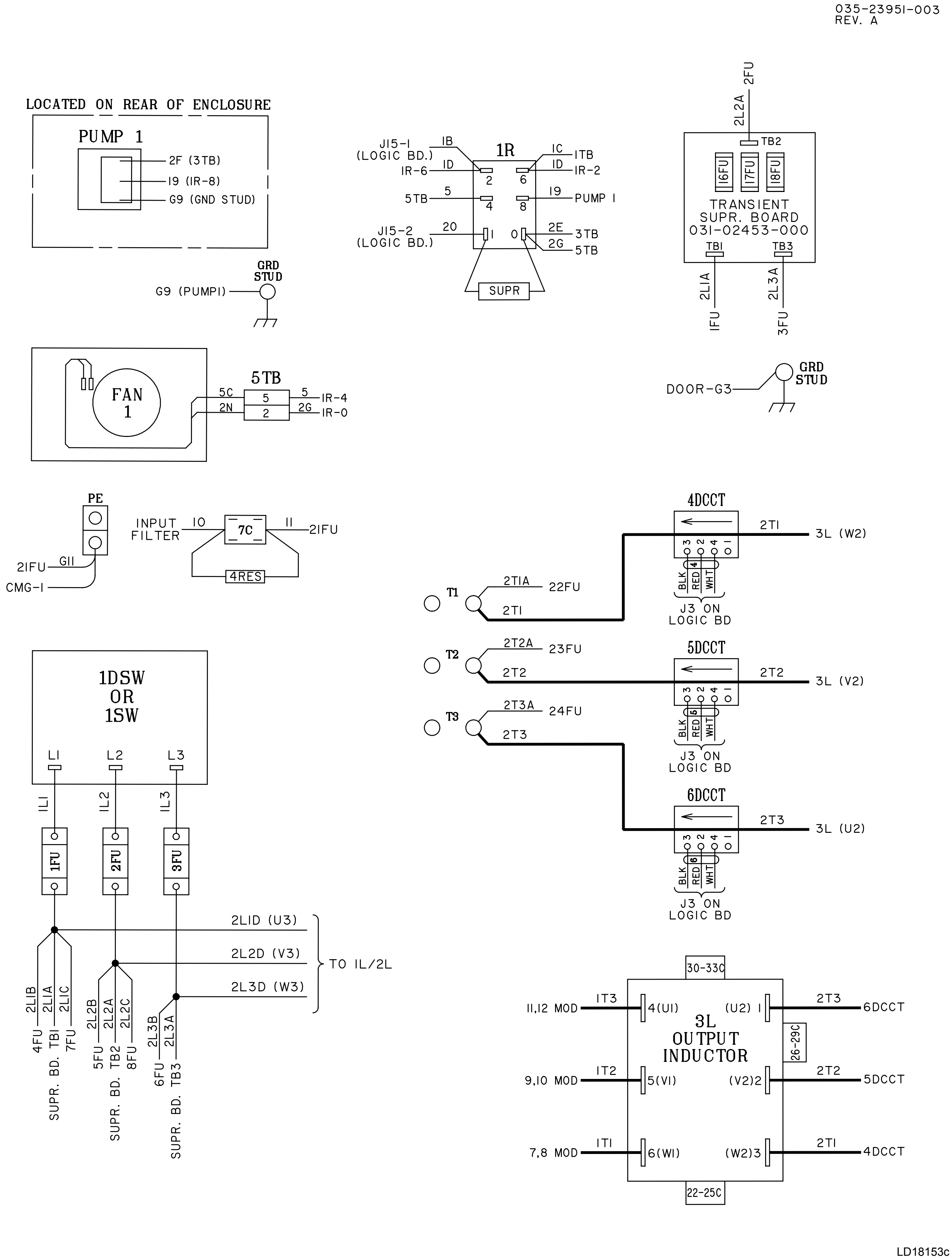

FIGURE 6 - CONNECTION DIAGRAM 0490 (CONT'D)

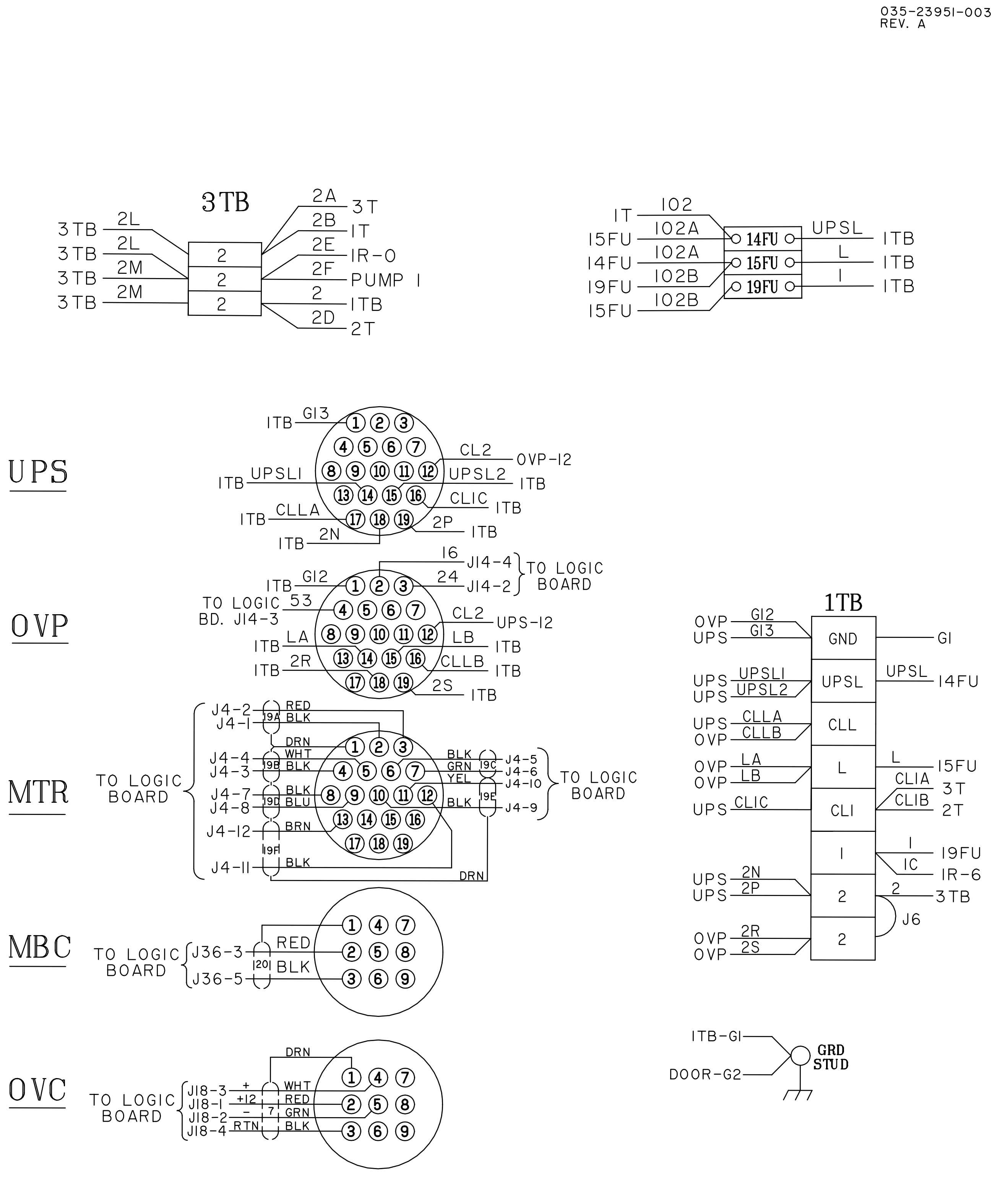

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FIGURE 6 - CONNECTION DIAGRAM 0490 (CONT'D)

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Elementary Wiring Diagram 0774 AMP Notes

1. Field wiring to be in accordance with the National Electrical Code as well as all other applicable codes and specifications.
2. Terminal block connection points are indicated by numbers within a source, i.e. [1] 2TB. Main power connection points are indicated by numbers within a hexagon, i.e.⟨L1⟩. Component terminal markings are indicated by numbers within a circle, i.e. (2). Numbers adjacent to circuit lines are the circuit identification numbers.
3. Terminals L1, L2, L3 and ground are the main power input terminals and are field connected (see note 6). Terminals T1, T2 and T3 are the compressor motor lead power terminals and are factory connected on factory packaged units.
4. The three phase solid state motor overload protection system provides motor overcurrent protection at 105% full load amps.
5. See YORK Control Center wiring diagram product drawing Form 160.84-PW2.
6. Field Wiring Connections per Product Drawing Form 160.84-PW1.

LEGEND for 035-23348-001, 002, 003, and 004

1C-9C	Capacitor, Film, Input Power Filter, 50uF, 55AMPS, 5%, 400VAC
10C-12C	Capacitor, Film, DC Link, 1500µF, 530AMPS, 1000VDC
13C-33C	Capacitor, Film, Snubber, 1.0µF, 1200VDC
34C	Capacitor, Film, 20uF, 400VAC
32C-49C	Capacitor, Film, 50µF, 585VAC
1DSW	Switch Disconnect, 1200AMPS, 600VAC, 100KA Withstand
1SW	Circuit Breaker, 1200AMPS, 600VAC, 100KA Withstand
1DCCT-3DCCT	DC Current Transformer, Input, 5000 AMPS to 1 AMPS
4DCCT-6DCCT	DC Current Transformer, Output, 5000 AMPS to 1 AMPS
1FU-3FU	Fuse, Input Power, 1250A, 700VAC, 200KA, Interrupting Semiconductor
4FU-6FU	Fuse, Input Voltage Sense, 1A, 600 VAC, 200KA Interrupting
7FU-10FU	Fuse, Control Supply XFMR Primary, 10A, 600VAC, 200KA Interrupting
11FU	Fuse, External Control Supply XFMR Secondary, 20A, 600VAC, 200KA Interrupting
12FU	Fuse, Internal Control Supply XFMR Secondary, 20A, 600VAC, 200KA Interrupting
13FU	Fuse, Internal Control Supply XFMR Secondary, 7A, 600VAC, 200KA Interrupting
14FU	Fuse, Gate Driver Control Supply XFMR Primary, 7A, 600VAC, 200KA Interrupting
15FU	Fuse, Gate Driver Control Supply XFMR Secondary, 7A, 600VAC, 200KA Interrupting
16FU-18FU	Fuse, Transient Suppressor PCB. 5A, 600VAC, 200KA Interrupting
19FU-21FU	Fuse, Output Voltage Sense, 1A, 600VAC, 200KA Interrupting
27FU	Fuse, Input Voltage Common Mode, 20A, 600VAC, 200KA Interrupting
1L	Inductor, Line, 27.5µH, 914 AMPS, 600VAC
2L	Inductor, Drive, 82µH, 914 AMPS, 600VAC
3L	Inductor, Output, 20µH, 730A, 600VAC
1M	Contactor, 3P 130A, 575V, Coil 120VAC 50/60 HZ
1MOD-12MOD	Module, Power Dual, Active Converter, 300AMPS 1200VDC
13MOD-21MOD	Module, Power Dual, Inverter, 450A, 1200VDC
1R	Relay, Cooling Fans and Pump
1RES-3RES	Resistor Bleeder, Input Power Filter, 20K, 16W, 5%
4RES-6RES	Resistor Bleeder, 27KΩ. 45W, 5%
10RES	Resistor Bleeder, Common Mode Cap, 20K, 16W, 5%
11RES-22RES	Resistor Damping, Input Filter, 25Ω, 240W
1RT-2RT	Thermistor, Ambient, 10K AT 25°C
1T-2T	Transformer, Control, 2KVA, 480VAC:120VAC
3T-4T	Transformer, Class 2, 75VA, 120VAC:24VAC
5T	Transformer, Control 175VA, 120VAC:32VAC
1TB	Terminal Block, Control Power
2TB	Terminal Block, Aux Contact
3TB	Terminal Block
5TB	Terminal Block, Fans

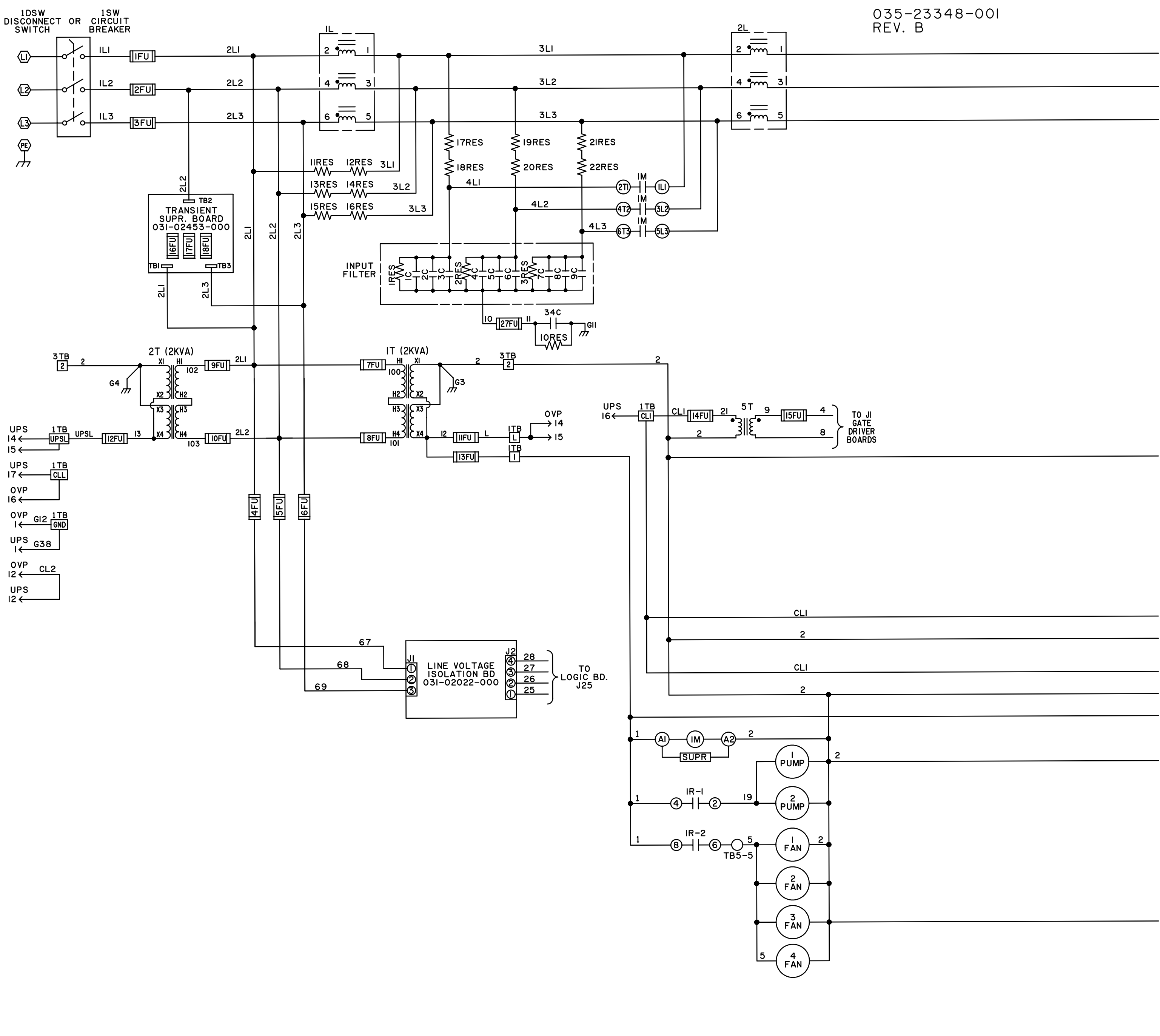

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FIGURE 7 - ELEMENTARY WIRING DIAGRAM 0774 AMP

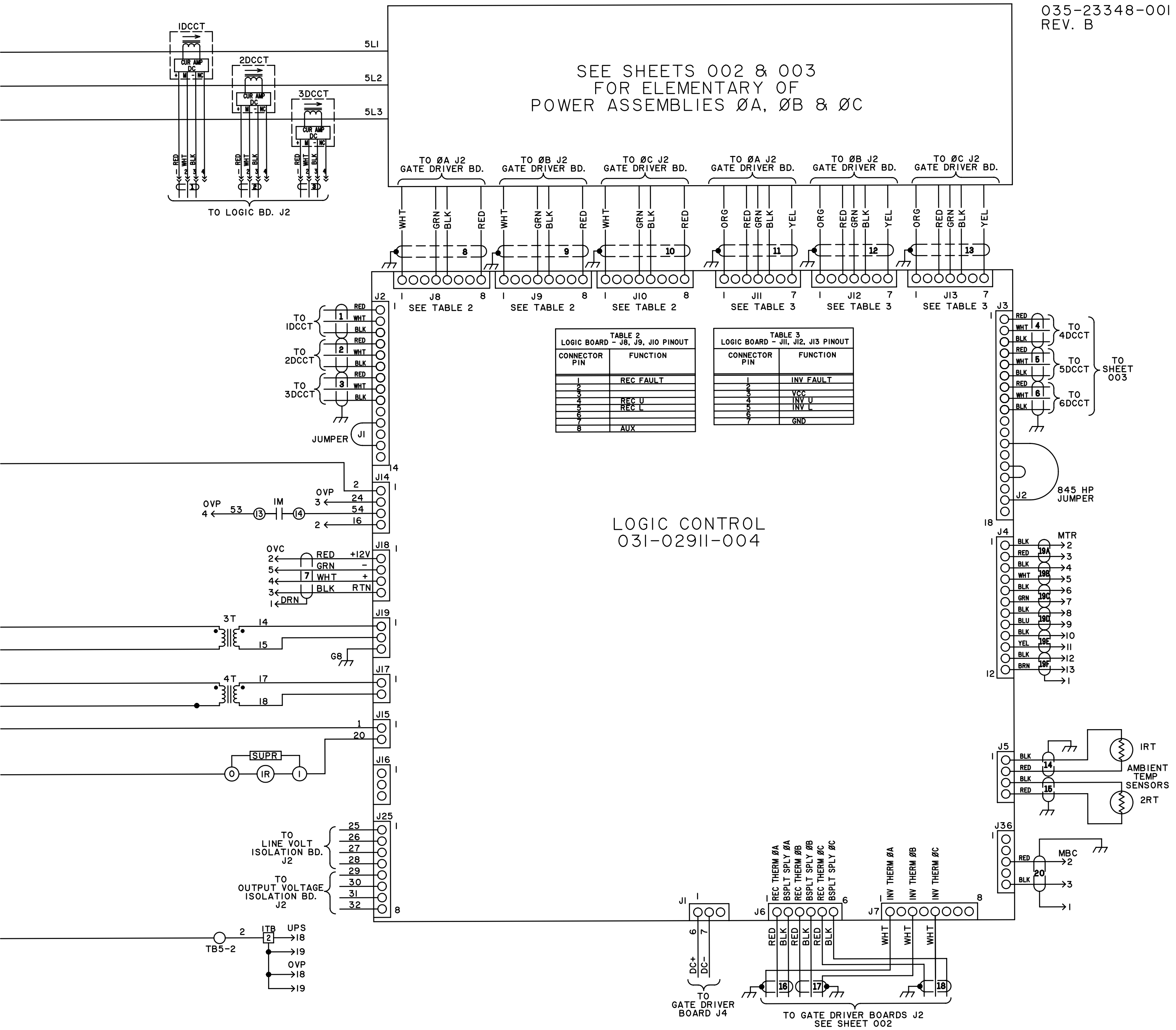

TABLE 2
LOGIC BOARD – J8, J9, J10 PINOUT

CONNECTOR PIN	FUNCTION
1	REC FAULT
2	
3	
4	REC U
5	REC L
6	
7	
8	AUX

TABLE 3
LOGIC BOARD – J11, J12, J13 PINOUT

CONNECTOR PIN	FUNCTION
1	INV FAULT
2	
3	VCC
4	INV U
5	INV L
6	
7	GND

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FIGURE 7 - ELEMENTARY WIRING DIAGRAM 0774 AMP (CONT'D)

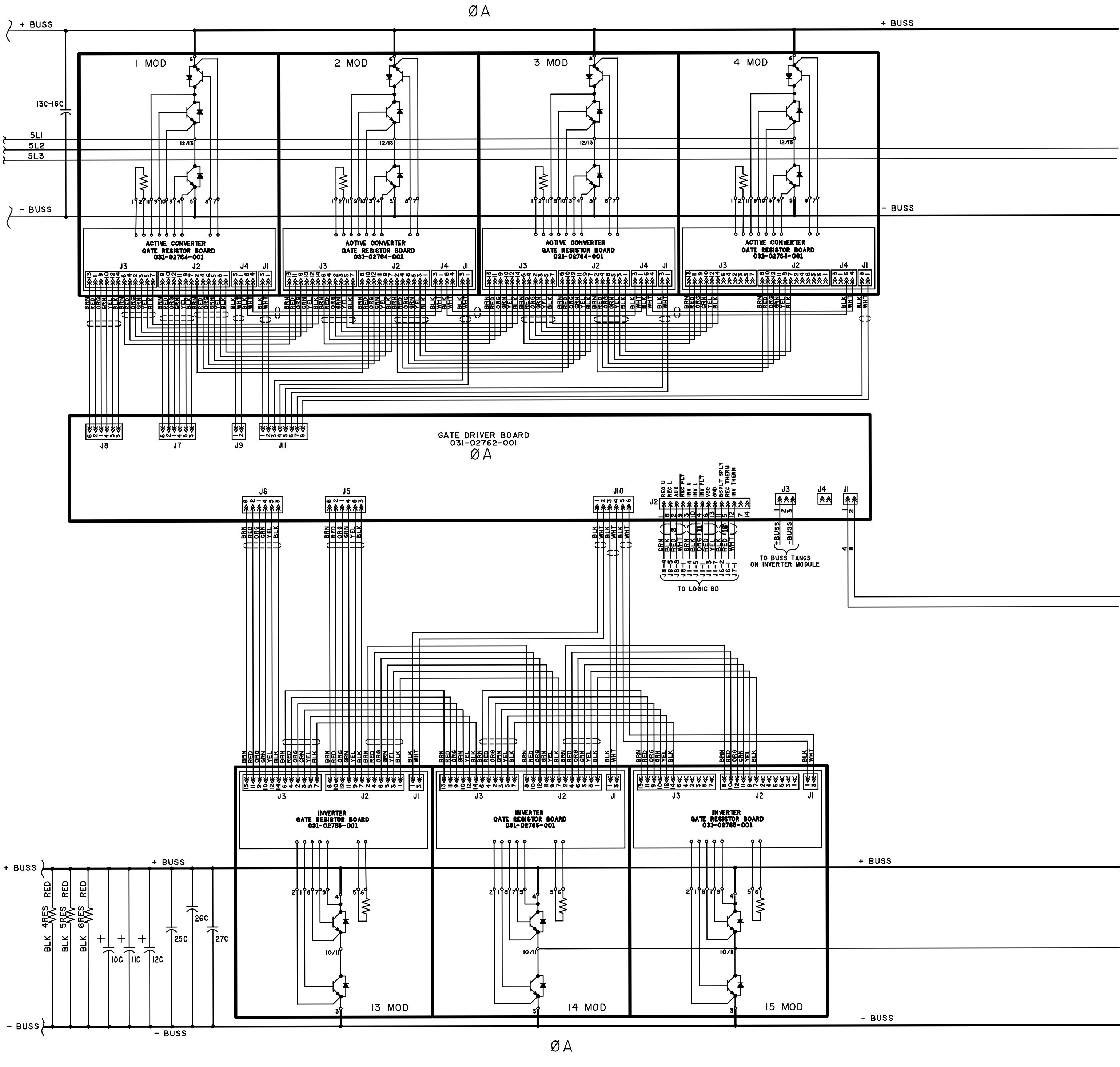
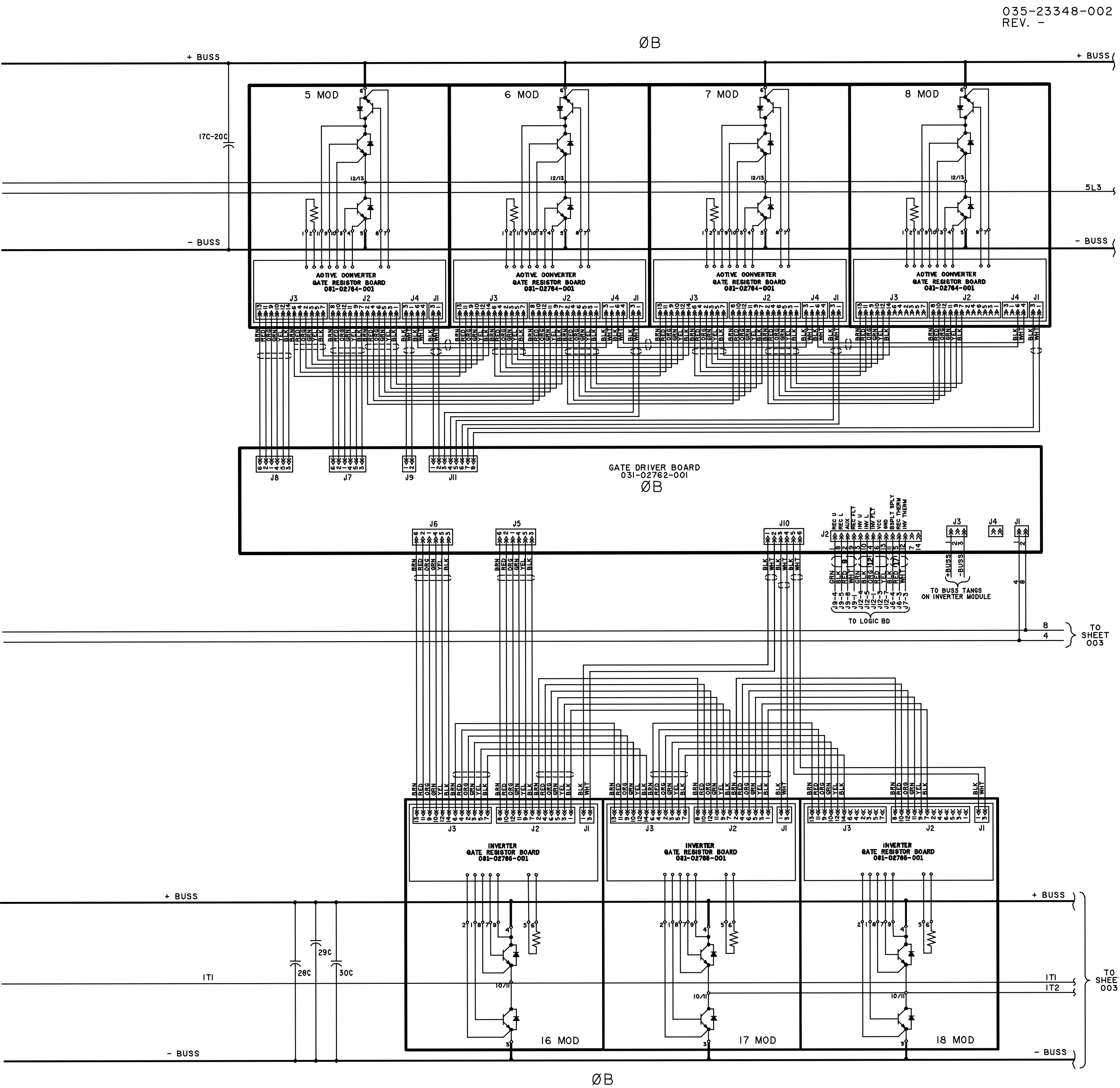
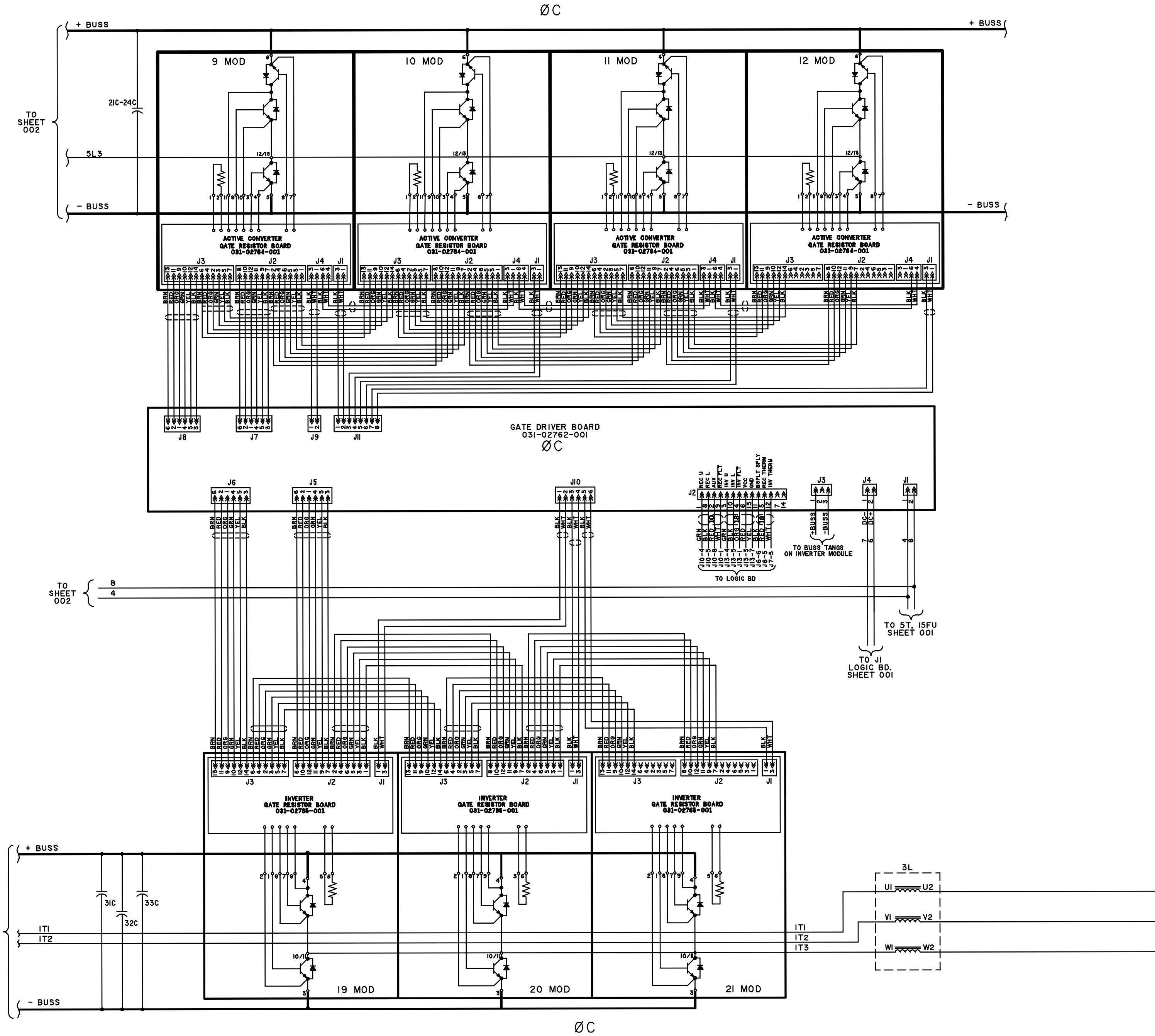


FIGURE 8 - POWER UNIT A - ELEMENTARY WIRING DIAGRAM 0774 AMP



LD18155b

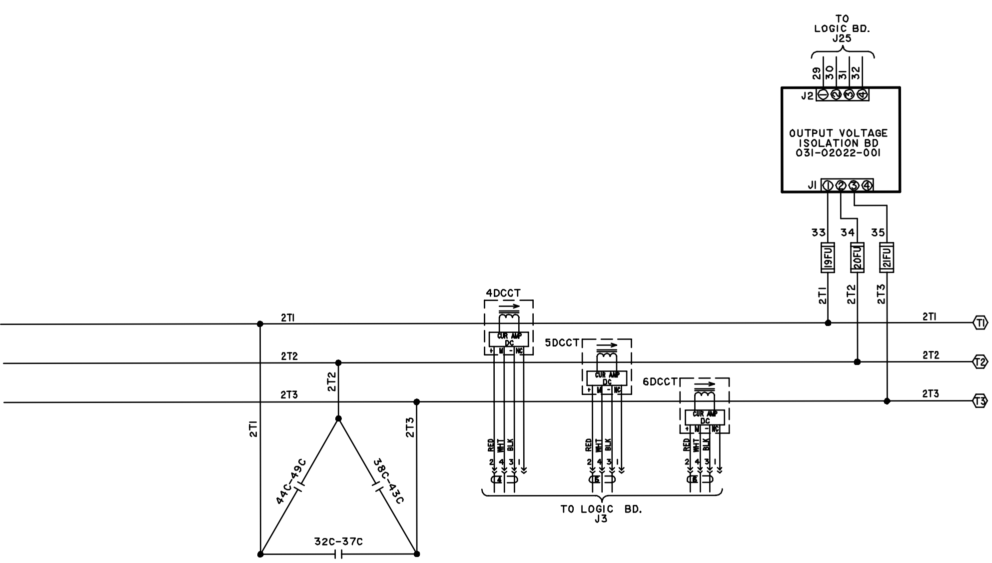
FIGURE 9 - POWER UNIT B - ELEMENTARY WIRING DIAGRAM 0774 AMP



LD18156a

FIGURE 10 - POWER UNIT C - ELEMENTARY WIRING DIAGRAM 0774 AMP

035-23348-003
REV. -



LD18156b

FIGURE 11 - DRIVE OUTPUT - ELEMENTARY WIRING DIAGRAM 0774 AMP

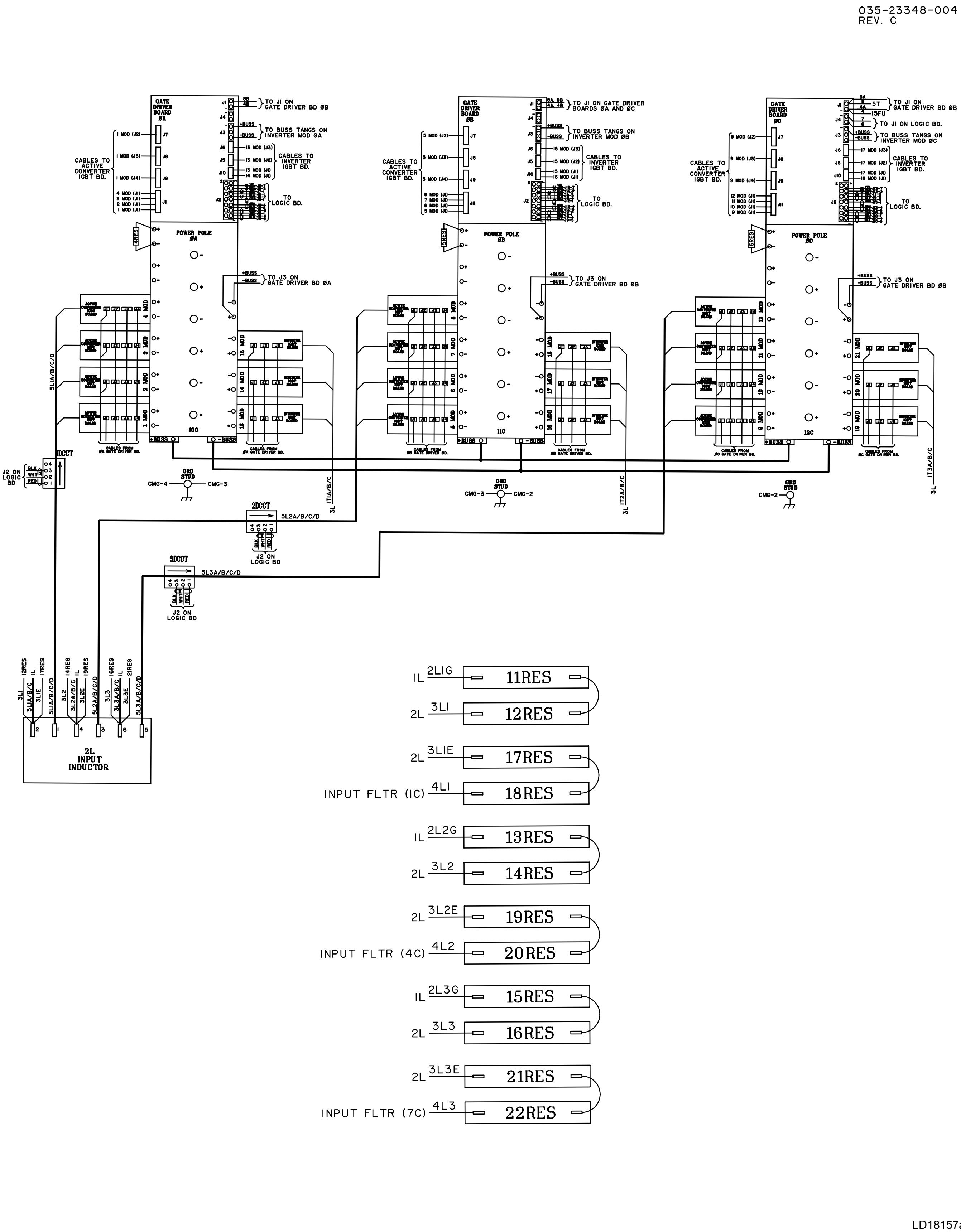


FIGURE 12 - CONNECTION DIAGRAM 0774

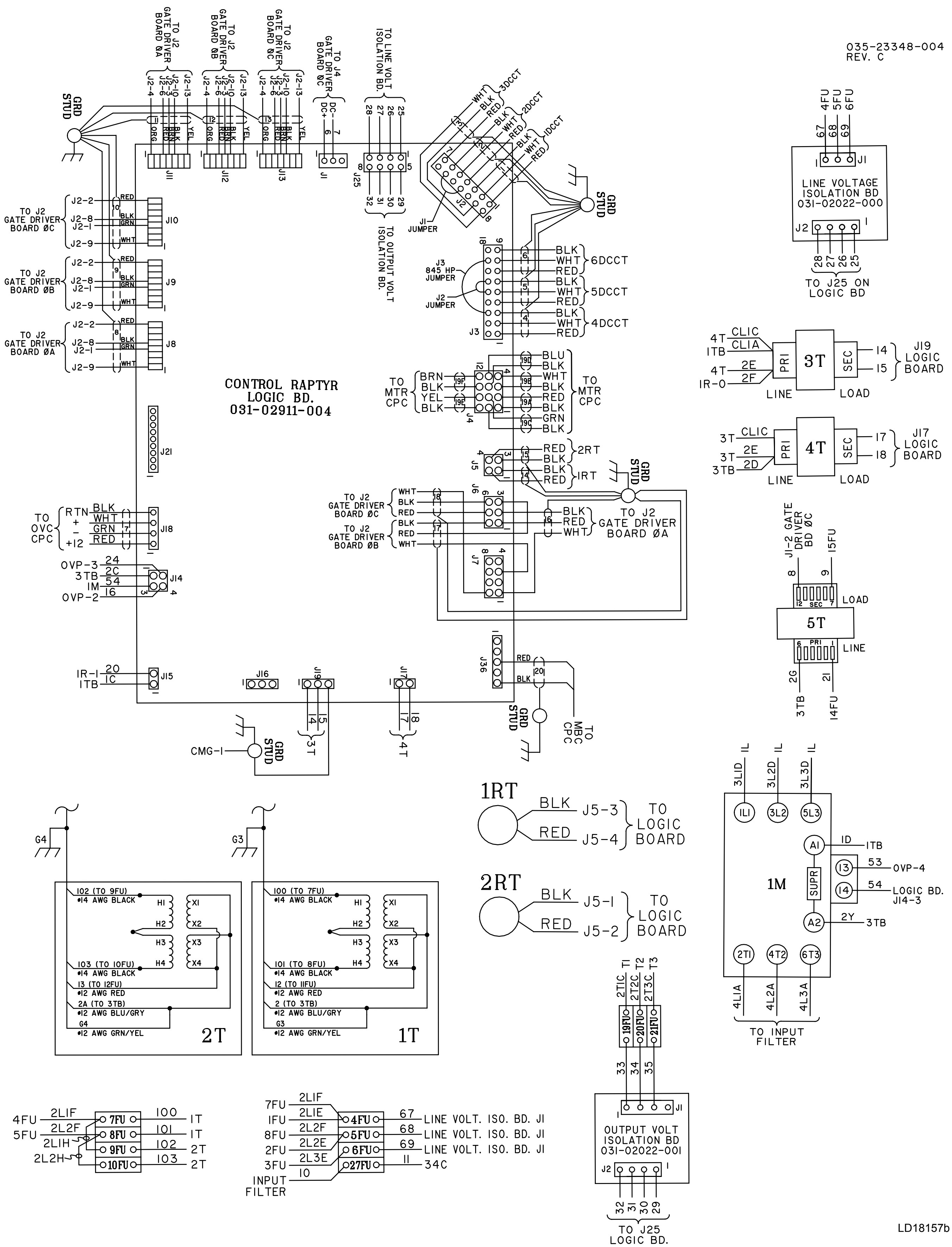


FIGURE 12 - CONNECTION DIAGRAM 0774 (CONT'D)

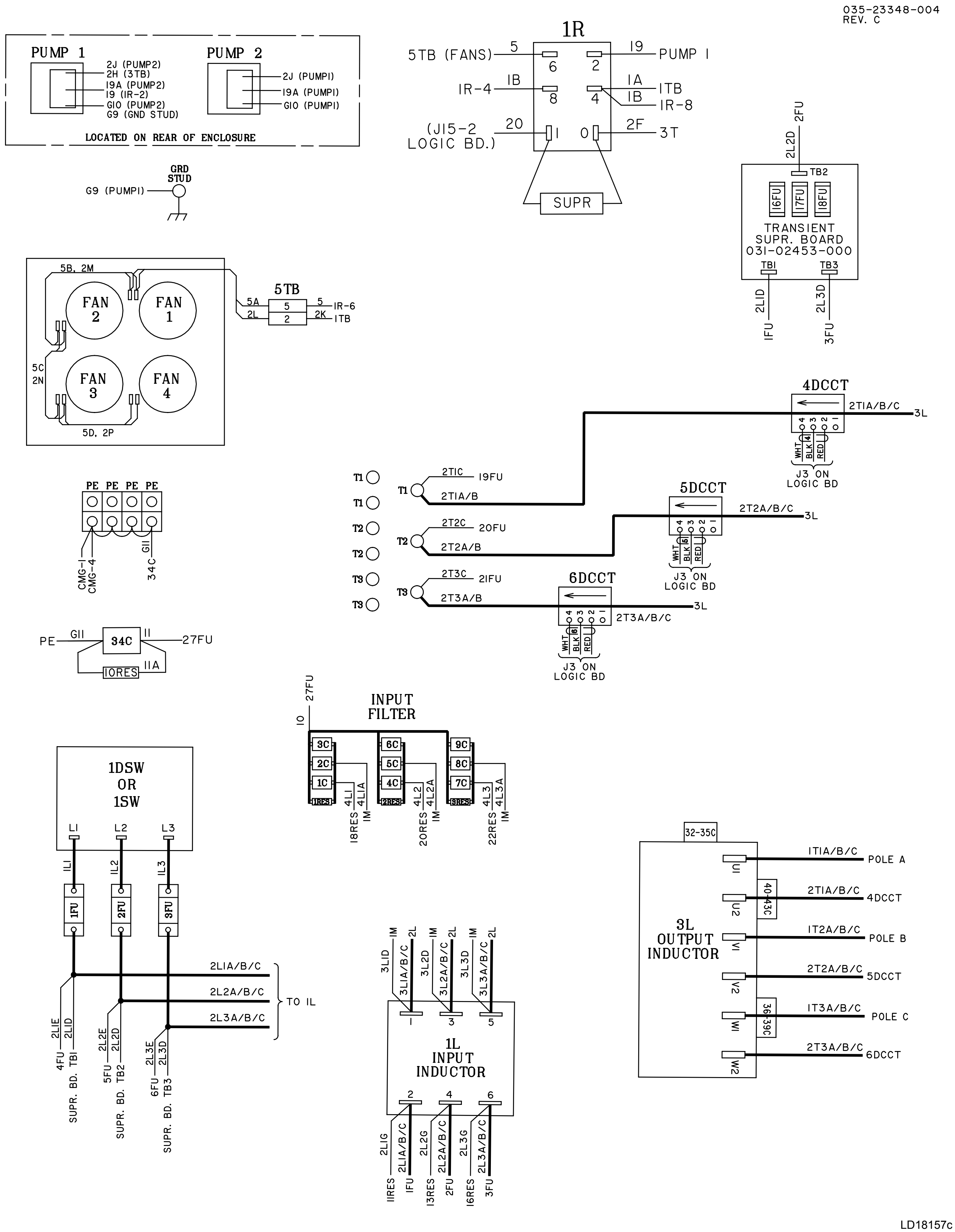


FIGURE 12 - CONNECTION DIAGRAM 0774 (CONT'D)

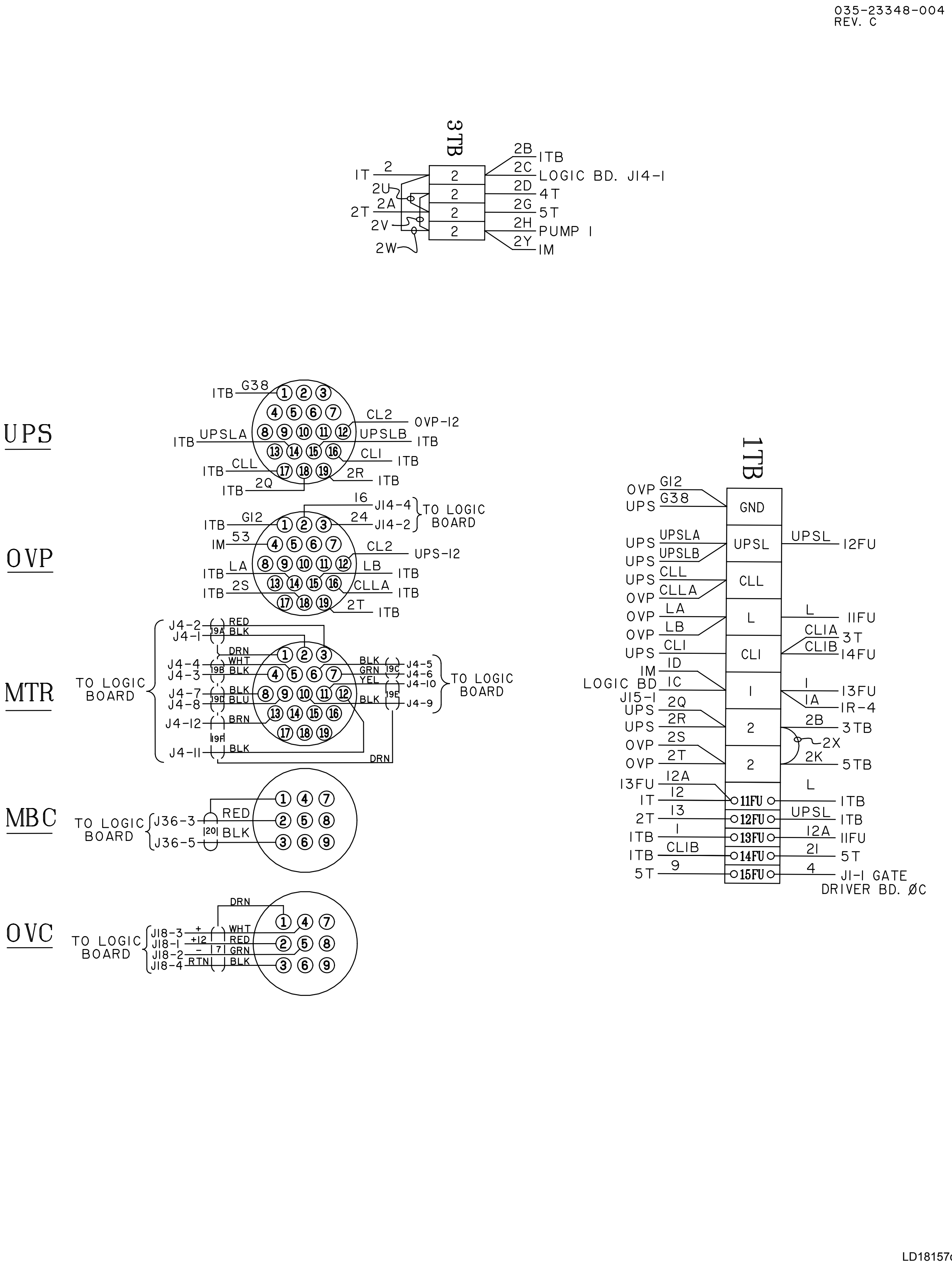


FIGURE 12 - CONNECTION DIAGRAM 0774 (CONT'D)

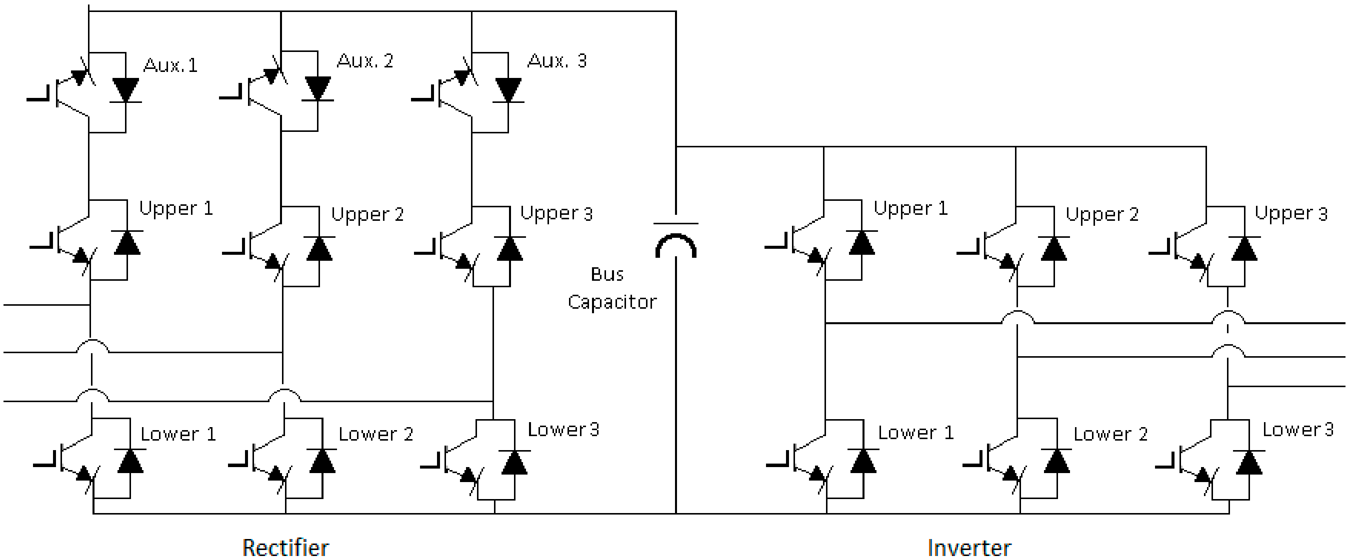


FIGURE 13 - HYP MODEL POWER CIRCUIT

SECTION 3 - COMPRESSOR DRIVE OPERATION DETAILS

NOTE

The following description of operation is general of all models of HYP drives unless otherwise noted.

The description of operation will be divided into sections, power, control, and protection. Some components will be discussed in one or all of the sections since they may provide a function in each section.

POWER SECTION DETAILS

When power is applied to the drive, the control circuitry receives power, but the power section is maintained in an off state. The drive will only activate the power section when commanded by the control panel to enter the start mode. When start mode is requested, the drive will enter the pre-charge state. This design does not have a dedicated pre-charge circuit. This function is integrated into the rectifier module.

When the chiller enters the start mode, the drive is commanded to pre-charge by the OptiView panel. The drive is pre-charged by gradually turned on the Auxilliary IGBT's so the current required to charge the DC bus capacitors is limited. When the pre-charge is complete the Auxilliary IGBT's remain turned on until the drive enters the stop mode, or a drive fault is generated.

The diagram in *Figure 14 on page 37* shows the three phase input rectifier for the drive. All HYP model drives have the same rectifier configuration. Depending on the input current rating of the drive, more or less modules will be connected in parallel to provide the required current.

During pre-charge, if the A phase voltage is positive relative to the C phase voltage and the Auxilliary 1 IGBT is turned on, then current will flow through the Upper 1 diode, through the Auxilliary 1 IGBT, charge up the bus capacitor, and return to the C phase through the Lower 3 diode. All three of the Auxilliary IGBT's are used during the pre-charge event. The voltage on the Bus capacitor at the end of the pre-charge event will be approximately 1.414 times the RMS value of the line voltage. For example, if the line voltage is 460 VAC, then 1.414 x 460 will provide a bus voltage of 650 VDC.

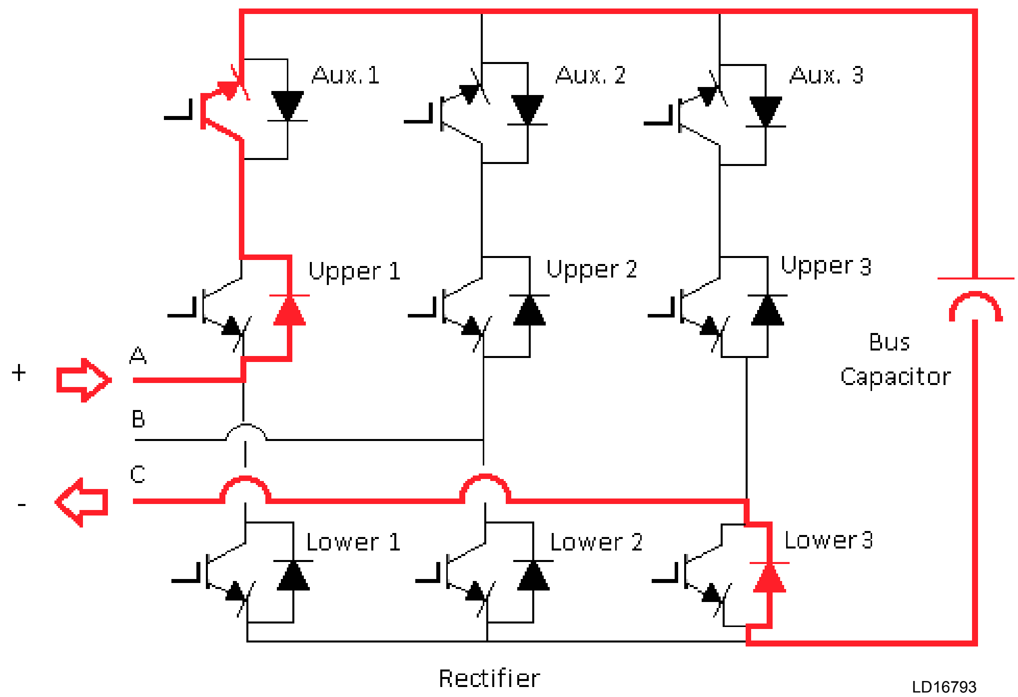


FIGURE 14 - INPUT RECTIFIER ELECTRICAL DIAGRAM

After pre-charge is complete the drive will enter the pre-regulation state. The pre-regulation state is a time where the upper and lower rectifier IGBT's are turn on and off in a specific pattern to boost the bus voltage up to 750 VDC. The boost voltage occurs when current is pulsed through the L2 inductor. When current is pulled through the L2 inductor a magnetic field is developed. When the current is stopped, the magnetic field collapses and provides a voltage that is added to the peak line voltage. The higher bus voltage allows the drive to provide the input current correction required to meet certain IEEE standards for input current harmonics.

The bus capacitor is needed because the rectifier does not provided current into the bus capacitor at the same time the current is needed by the inverter. In other words, the bus capacitor is like a big barrel. The rectifier dumps a bucket of power into the barrel every so often. The inverter dips out tablespoons of power to the motor. (Refer to *Figure 15 on page 39* and *Figure 16 on page 39*)

The DC to AC inverter section serves to convert the DC voltage back to AC voltage at the proper magnitude and frequency as commanded by the Drive Logic board. The inverter section is actually composed of one or three power units, depending on the current requirements of the HYP model. Three power units are used in the 0774 amp model. A single power unit is used on the 0490 amp model. (Refer to *Figure 1 on page 13* and *Figure 2 on page 13*) Three phases of the rectifier and the inverter are connected to one bus capacitor. This power unit is composed of rectifier and inverter power assemblies the DC bus capacitor, and a gate driver board. Each IGBT module has a resistor board soldered to it. This board determines how quickly the IGBT is turn on. Both the rectifier and inverter power modules are direct liquid cooled. The heat sinks for the power modules are mounted to the sides of the DC Bus capacitor. A bus structure connects the rectifier modules, DC Bus capacitor, and the inverter modules together. The bus structure is mounted on top of the DC Bus capacitor. A gate driver board is mounted on top of the bus structure, and held in place with mounting screws into the bus structure. This board conditions the gate command signals from the drive logic board so that the IGBT's can be turn on and off properly. Only one gate driver board is required to control the gate command for a single phase. This method provides a highly integrated and lighter weight power unit. (Refer to *Figure 18 on page 41*)

On drives that contain a single power assembly all of the IGBT's for the rectifier and inverter are contained in one assembly. This design requires the power supply for the gate driver, and the gate driver itself to have their own boards. Each IGBT module has a board soldered to it. This board is called the resistor board. Typically, two or three IGBT modules are used in parallel to satisfy the current requirements for that drive model. The gate driver board is mounted on top of each parallel set of IGBT's. This board conditions the gate command signals from the drive logic board so that the IGBT's can be properly turn on and turned off. The gate driver board is held in place with plastic clips, and the signals are transferred to the resistor board by pass through connectors. (Refer to *Figure 15 on page 39*, and *Figure 17 on page 40*) The pass through connectors work well since no wires are used, but care should be taken when installing this board since the pins can be bent while installing the board. A power supply board is mounted on the top of the bus structure. A single power supply on the power supply board provides power to all of the gate driver boards. (Refer to *Figure 17 on page 40*)

In *Figure 19 on page 42,* is the three phase output inverter for the drive. All of the HYP model drives have the same inverter configuration. Depending on the output current rating of the drive, more or less modules will be connected in parallel to provide the required current.

For the following description refer to *Figure 19 on page 42*. Typically, three power devices are turned on at the same time. Current is flowing in the 'B' and 'C' phase motor windings. Most of the current required for the inverter is provided by the bus capacitor as explained earlier. Current will flow from the bus capacitor through the turned on Upper 2 and 3 IGBT's. Energizing the 'B' and 'C' phase motor windings. The current will then return to the drive through the turned on Lower 1 IGBT and back to the bus capacitor. This sequence continues with all of the switches being used. At no time will an Upper and Lower of the same number IGBT ever be turned on at the same time. If this were to happen, a drive failure would occur.

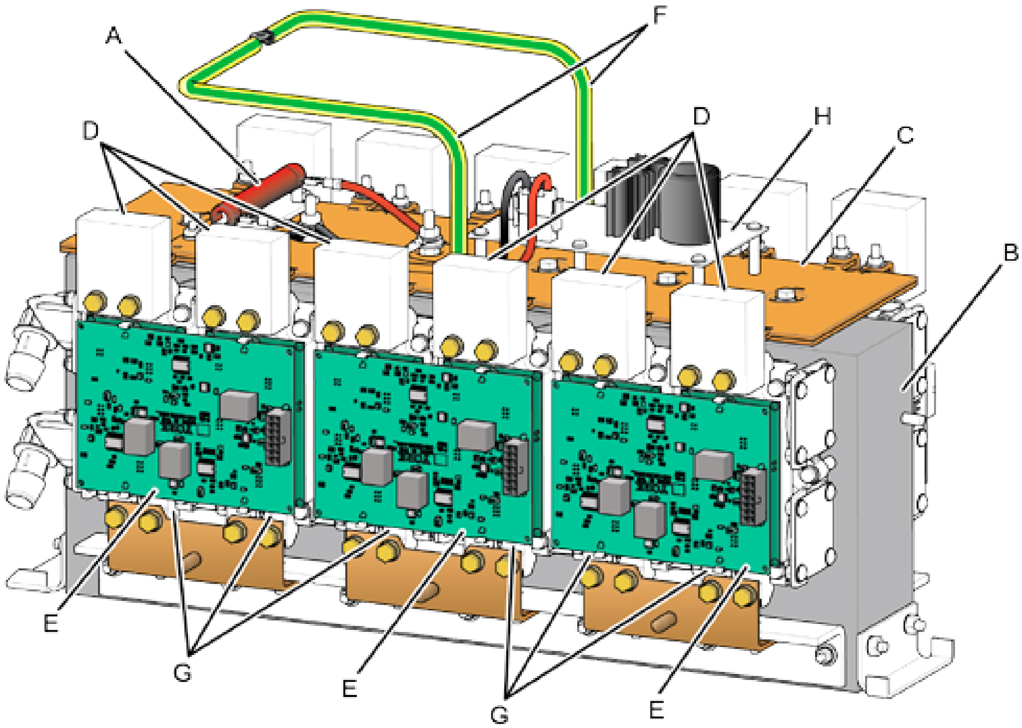
LD18042

FIGURE 15 - RECTIFIER SIDE OF THE POWER UNIT (MODEL 0490 SHOWN).

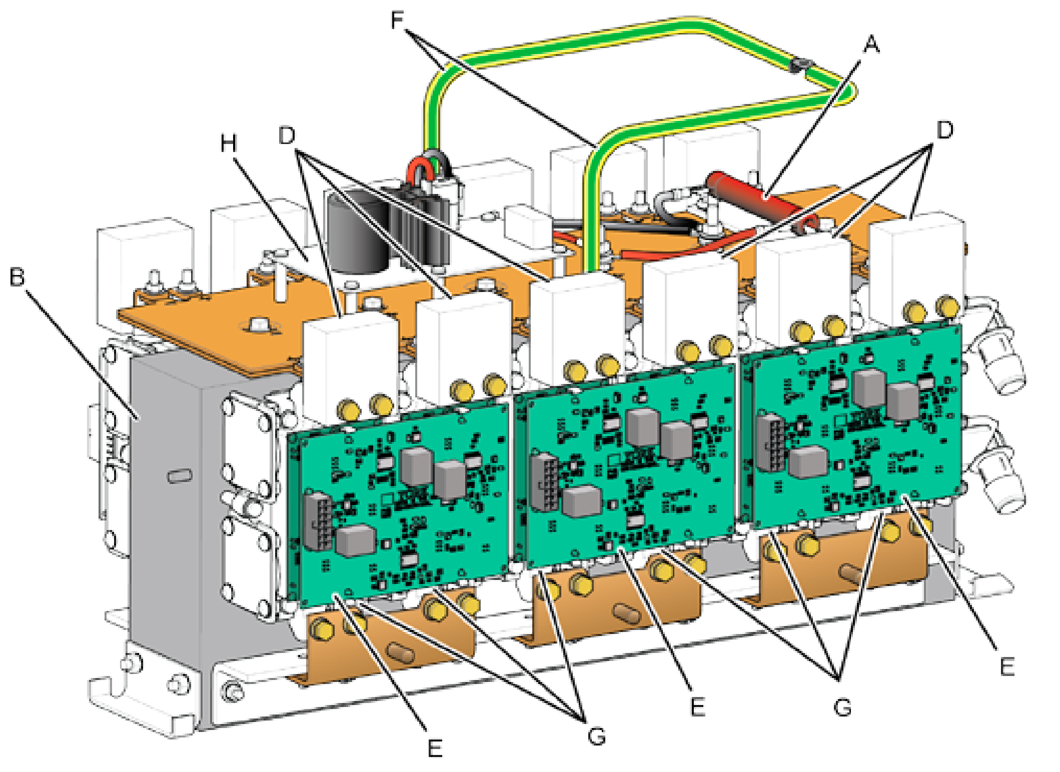
LD16292

FIGURE 16 - RECTIFIER SIDE OF THE POWER UNIT (MODEL 0774 SHOWN).

ITEM	DESCRIPTION
A	Bleeder Resistor
B	Bus Capacitor
C	Bus Plate
D	Bus Snubber Capacitors
E	Gate Driver Board
F	Ground Strap
G	IGBT Modules
H	Gate Driver Power Supply Board



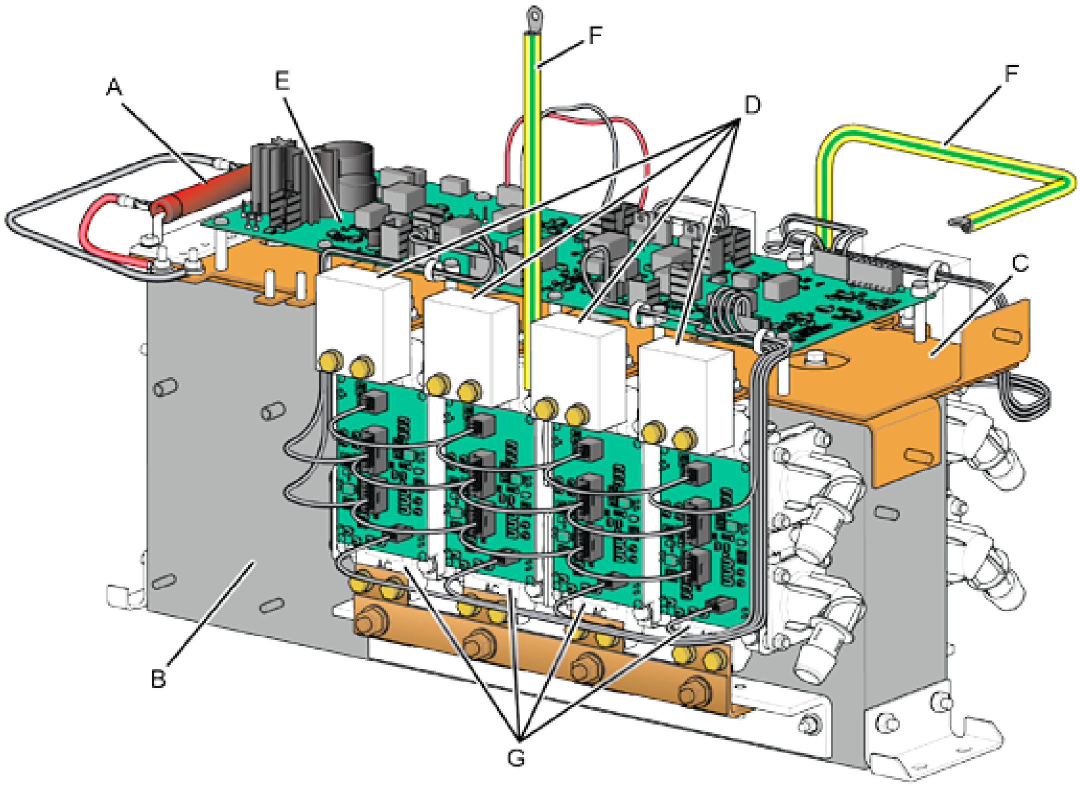
Rectifier Side



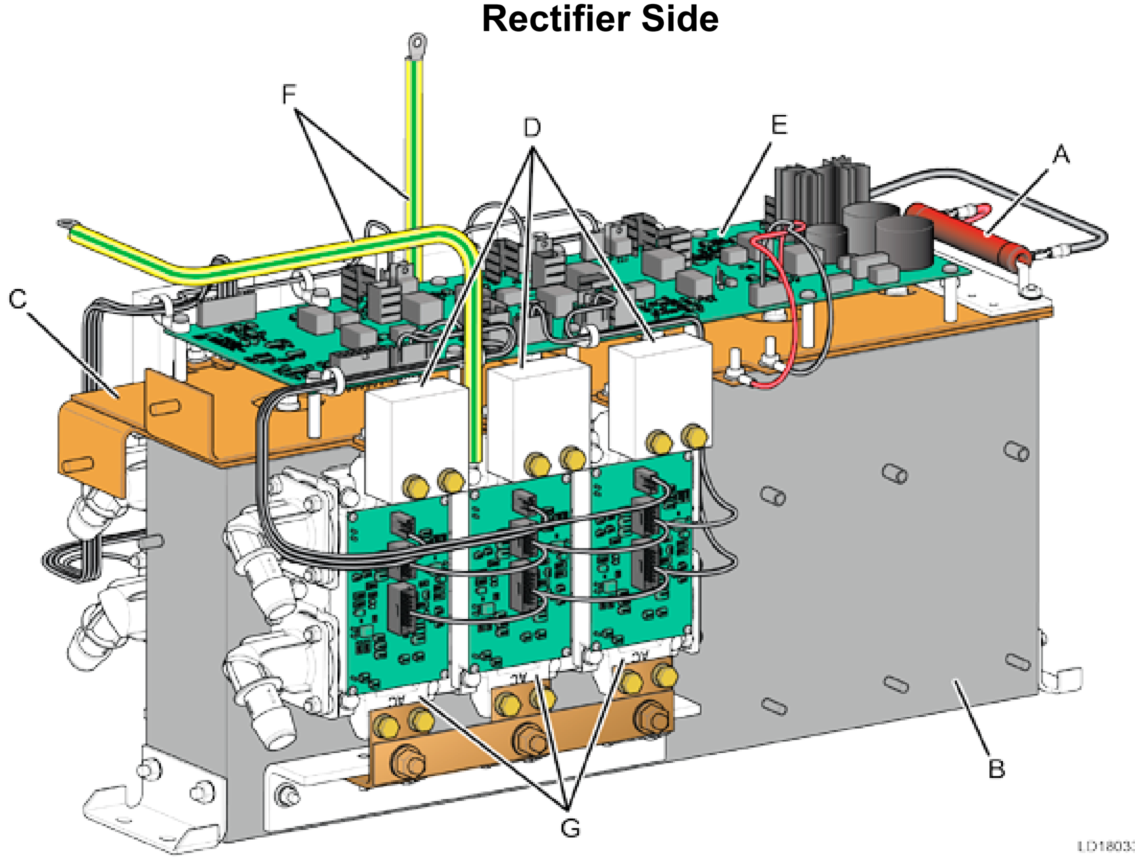
Inverter Side

FIGURE 17 - POWER UNIT (MODEL 0490)

ITEM	DESCRIPTION
A	Bleeder Resistor
B	Bus Capacitor
C	Bus Plate
D	Bus Snubber Capacitors
E	Gate Driver Board
F	Ground Strap
G	IGBT Modules



Rectifier Side



Inverter Side

FIGURE 18 - POWER UNIT (MODEL 0774)

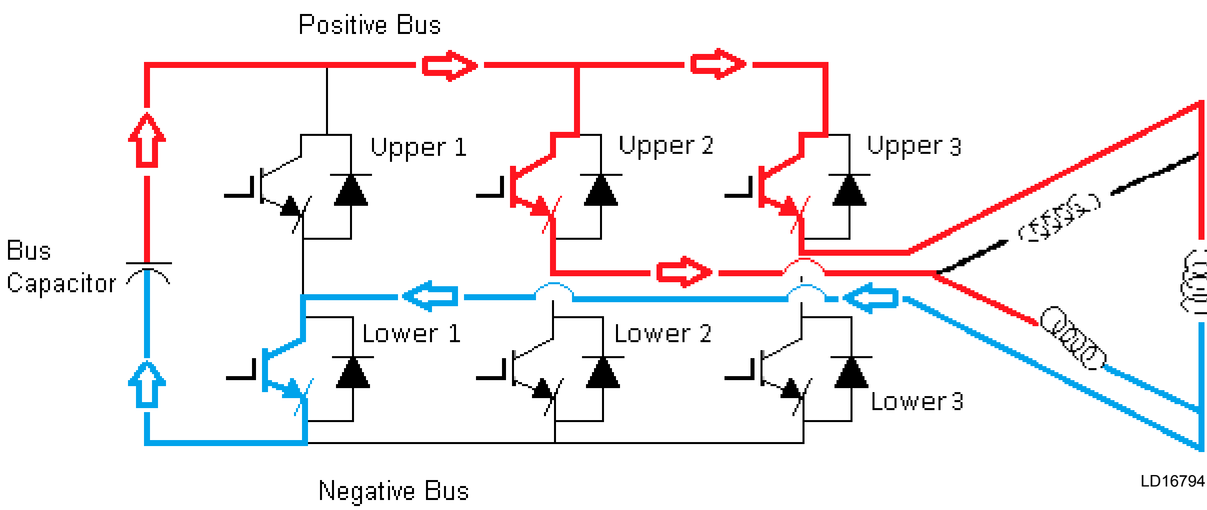


FIGURE 19 - OUTPUT INVERTER ELECTRICAL DIAGRAM

CONTROLS SECTION DETAILS

The Control Center

The Control Center used with today's HYP model drive provides all of the commands to the drive from the Microboard within the Control Center. A shielded cable is used to provide the communication link between the Control Center and the drive. This drive can only be connected to an OptiView Control Center that has MODBUS communications. The new features of the HYP model drive are not supported through the YORK Protocol style of communications. The HYP model drive is built to only function within a chiller system. The drive cannot pre-charge, start, or run without communications from the Chiller Control Center.

Various sensors located on the chiller provide data to the Control Center. The software within the Control Center determines the optimum operating speed for maximum chiller system efficiency.

The OptiView Control Center utilizes a different approach to speed reduction compared to earlier variable speed products. The capacity control is completely different from anything used in the past. Capacity control is now determined by a combination of compressor RPM, hot gas bypass, and variable geometry diffuser. Refer to the specific OptiView Control Panel operation and service book for detailed information. A list of this information can be found in the front of this book.

The Drive Operation

As described earlier, when the chiller enters the start mode, the drive is commanded by the OptiView panel to pre-charge. The drive is pre-charged by turning on the Auxilliary IGBT's for a longer period of time in each line cycle so that the DC bus capacitors are slowly charged. This is called the pre-charge period, which last for 12-seconds. The Auxilliary IGBT's will remain turned on until the drive enters the stop mode or a drive fault is generated.

After the 12-second time period has expired, the drive will enter the pre-regulation mode. In this mode, the rectifier IGBT's will start turning on and off and cause the bus voltage to increase to a regulated value of 785 VDC. The rectifier will continue to function until the chiller control enters the stop mode or a drive fault is generated.

During the run state the drive is constantly monitoring the input voltage, input current, bus voltage, output voltage and output current. There are many devices and boards that are used to provide these functions, and they are described below.

Control Boards

The input line voltage isolator board is used to step down the input line voltage to the proper level that the drive logic board can read. The input line voltage information is compared to the bus voltage value to determine when and for how long the input IGBT's should be turn on or off to maintain the correct bus voltage. This board is also the source for the input line voltage peak, RMS, voltage total harmonic distortion, total power factor, total supply KVA, input power, and input KW hours calculations data displayed on the OptiView panel.

Input current value and wave shape is determined by a device called a direct current current transducer (DCCT). This device is much faster at detecting changes in current than a current transformer. Most current transformers are designed to measure 50/60 Hz currents. The DCCT must be able to measure pulses of current very accurately. Since accuracy of the input current wave form is very important, one DCCT is needed for each phase. Power for this device is supplied from the drive logic board. The input current information is used by the drive logic board to determine when to draw current from the utility so that the input current waveform meets the IEEE 519-1992 standard for input current harmonics. These sensors are the source for the input current RMS, supply current total demand distortion, input % full load amps, input power, total power factor, total supply KVA, and the input KW hours calculations data displayed on the OptiView panel.

! NOTE

If a DCCT needs to be replaced that it is installed in the correct polarity. The DCCT has an arrow on top to indicated polarity. The replacement DCCT must have the arrow pointed in the same direction.

Bus voltage information is collected by the IGBT gate driver board on the C phase power assembly on drives that have 3 power assemblies. On drives that have a single power assembly the bus voltage is connected on the gate driver power supply board. In both cases, the bus voltage is current limited back to the drive logic board. This information is used by the drive logic board to ensure that the bus voltage is properly regulated during pre-regulation and running states. This board is also the source for the DC bus voltage data displayed on the OptiView panel.

The output voltage of the drive is measured by the output voltage isolation board. The design of this board is very similar to the input voltage isolation board. It has 3 transformers on the board to step down the output voltage of the drive to the proper level so that the drive logic board can read the output voltage. The input and output voltage isolation boards are NOT inter-changeable. The output voltage isolation board contains an additional connector location so that it cannot be used on the input of the drive. The drive logic board will use this information to determine the rotational speed of the motor rotor, the total harmonic distortion supplied to the motor, and determine how and when to turn on and off the inverter section of the drive. The data from the output voltage isolation board is also used to provide the OptiView panel with the output motor voltage values.

! NOTE

The output voltage isolation board can be mounted upside down and cause a drive failure. Ensure that the connector installed in the J1 connector contains only 3 wires.

The output current of the drive is measured by the same type of device used to measure the input current, but with a different current range. The drive logic board uses this information to protect the output from instantaneous over current, shorted output, overload on the drive and motor. The data from the motor current transducer is also used to provide the OptiView panel with the motor current values.

The gate driver board conditions the turn on and turn off commands from the drive logic board to the rectifier and inverter IGBT's , monitor it's own power supplies, determine gate driver faults, and provide feedback for the IGBT temperatures. It also isolates the drive logic board from the bus voltage.

This drive contains just one logic board. The functions of controlling the motor and the harmonic filtering are combined into this board. The logic board also performs other numerous functions such as control the cooling fans and pumps, evaluate all fault conditions, when and how to pre-charge the bus capacitor or bus capacitors, maintain the correct bus voltage amplitude, generate the on and off commands for the rectifier and the inverter, and provide communications to the OptiView panel.

When the chiller enters a normal stop command the drive will continue to follow the speed command from the OptiView panel. The OptiView panel will begin to unload the chiller. As the load and pressure across the compressor starts to go down, the output speed of the drive will go down. When the variable geometry diffuser reaches minimum load position, the drive will start to decelerate the motor to the programmed soft shutdown frequency. When the programmed soft shutdown frequency is reached all input and output power devices will be turned off except for the Auxilliary IG-

BT's. The OSCD will remain in a pre-charged state for 60 seconds, and then the Auxilliary IGBT's are turned off. The Auxilliary IGBT's remain turn on for 60 seconds to allow for a quick restart of the chiller. After the Auxilliary IGBT's are turn off the DC bus capacitors will start to discharge through the bleeder resistors.

The output harmonic filter is composed of a network of capacitors and a 3 phase inductor. The function of the output harmonic filter is to improve the output voltage and current waveforms to a wave shape that is very close to a sine wave. This reduces the temperature in the motor stator and rotor.

The Harmonic Filter Operation

The HYP model drive can now control the input current waveform to a near sine wave shape by controlling how the rectifier is turned on and off. The Harmonic Filter of the past injected harmonic current into the input of the drive so that the utility did not need to supply the harmonics.

Since the Harmonic Filter is now basically the input to the drive there is no need for the additional, precharge, 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 sooner. This is an important benefit to many customers. The reductions in parts counts will improve the reliability of the drive. The reduced parts count will also improve the ease of repair if a failure were to occur.

A line inductor is still 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.

The rectifier now will provide two functions, allow current to flow into the DC bus capacitor during precharge, and control the input current waveform. A separate gate driver board is not needed for each function. One gate driver board is used to control the rectifier and inverter power devices for each phase on those drive models that required 3 power assemblies. The drive model that uses only 1 power assembly requires 6 smaller gate driver boards. One for each phase of the rectifier and inverter.

The control for the harmonic filter works in such a manner that when current first flows into the drive a magnet field builds around the boost inductor. Since the current is flowing into the drive, the amplitude of the current is rising at the same time that the input voltage is rising. When the amplitude of current exceeds the desired value, the rectifier IGBT's switch state will chance. The change in switch state will cause the magnet field in the boost inductor to fall, and it will supply current into the drive. Although, current will continue to flow into the drive the current needed from the input of the drive will go down, since the boost inductor is providing some of the current. Depending on how much of the magnet field of the boost inductor is used, determines if the current is rising or if the current is falling. In the case of the rising current, the switch state will require the current to flow so that the magnet field is building for a longer period of time then it is falling. In the case of the falling current, the switch state will require the current to flow so that the magnet field is falling for a longer period of time then it is building.

The "trap" filter is integrated into all OSCD of this type. 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 from affecting other devices on the same power system.

Other Controls

Running the coolant pump no longer requires removing a plug from the drive logic board. The cooling system fans and pumps are now turned on by the press of a button on the OptiView panel. Refer to the OptiView panel operations form in the front of this form for the location of this button.

PROTECTION SECTION DETAILS

Many of the boards and sensors in the drive provide protection to the drive or the compressor motor.

The drive logic board is at the heart of the drive protection system. In all cases, the drive logic board makes the determination if there is a condition for a fault to occur. Other boards and sensors provide the information to the drive logic board to make the determination. It is important to understand that the device providing the information about the fault could be causing the fault, or the connection between the device and the logic board could cause the problem as well. Many times the problem can be a bad, loose, or dirty connector. Remove the connector and reinstall the connector to clean the connection.

The line voltage isolator board is used to step down the input line voltage to the proper level so that the drive logic board can read the input voltage. The input line voltage information is compared to the bus voltage value to determine when and for how long the input

IGBT's should be turn on or off to maintain the correct bus voltage. Input phase rotation and phase loss information is also collected with this board.

Input current value and wave shape is determined by a device called a direct current current transducer (DCCT). This device is needed to provide input current limit, and protect the rectifier from instantaneous over current events.

The gate driver board provides the bus voltage data to the drive logic board when the drive model contains 3 power assemblies. On drive models that contain one power assembly the bus voltage is connected to the gate driver power supply board.. This information is used to protect the drive from high and low bus voltages.

The output voltage of the drive is measured by the output voltage isolation board when the drive model contains 3 power assemblies. On drive models that contain one power assembly the bus voltage is connected to the gate driver power supply board. This data is used to protect the motor from high level of voltage harmonics also known as THD.

The output current of the drive is measured by 3 DCCT's. The data from these devices are used to protect the motor and the output of the drive from overload conditions and from instantaneous over current events.

The gate driver board provides protection to the Auxilliary, the rectifier, and the inverter IGBT's. When one of the IGBT's are not working properly, such as not turning on when the drive logic board is expecting a device to be in the "on" state. The gate driver board will indicate a fault. This board also provides over temperature protection for the IGBT's. The gate driver board also protects itself. If one of the low voltage isolated power supplies on the gate driver board were not working properly, then this board would generate a fault.

The OSCD Logic board also determines shutdown conditions by monitoring the three phases of input and output current, baseplate temperatures, internal ambient temperatures, input and output voltage as well as the DC Bus voltage.

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SECTION 4 - SAFETY SHUTDOWNS

GENERAL INFORMATION

Safety shutdown messages are organized in alphabetical order based on the OptiView Control Center messages.

Whenever a safety shutdown is generated by the Drive Logic Board, a series of events will occur. These events are:

- If the chiller is not running at the time of the shutdown, the Drive Logic Board will not turn on the power device gate drivers for the Auxilliary, rectifier or inverter.
- The K1 relay on the drive logic board will de-energize to indicate to the Control Center that the drive 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 a drive generated shutdown the gate driver for the power devices used in the Auxilliary, rectifier, and inverter will be turned off.
- The message “VSD Shutdown - Requesting Fault Data” will be displayed while the Control Center is requesting the fault data from the drive.
- The drive logic board will send a shutdown code via the serial 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.

TABLE 1 - SAFETY SHUTDOWNS

MESSAGE	DESCRIPTION
VSD – 105 % Motor Current Overload	This shutdown is generated when the VSD logic board has detected that the highest of the three output phase currents has exceeded 105% of the programmed full load current for 40 continuous seconds. **Possible Problems:** • Ensure that the full load amp rating is properly set for the application. • Verify that the condenser liquid temperature is within the design specification for the application. • Ensure that the programmed output frequency is not greater than the design specification for the application. • Ensure that the refrigerant level sensor system is working properly. • Measure the output current to ensure that the drive is measuring the current properly.
VSD – DC Bus Pre-Regulation Lockout	If the drive were to fail under the conditions of VSD – DC Bus Pre-Regulation 3 times in a row then this message will appear. Refer to VSD – DC Bus Pre-Regulation for detailed information.
VSD – DC Bus Lockout – Do Not Cycle Power	This shutdown is generated anytime when the bus voltage should be zero, but it is greater than 50 VDC. This shutdown is an indication that an Auxilliary IGBT is shorted. The bus cannot discharge when an Auxilliary IGBT is shorted. **If power is removed, and then reapplied without correcting this problem more damage will occur to the drive, and the repair will be more costly.** **Possible Problems:** • If the bus voltage value is approximately 600 VDC, then the auxiliary IGBT maybe shorted. Refer to the Troubleshooting section near the back of this form. Perform test for Verify a Rectifier Failure. • If the bus voltage value is approximately 350 VDC, then the output of the drive maybe shorted to earth. The problem is typically in the output inductor or the compressor motor. • Look for any evidence of a coolant leak around the output inductor. If there is evidence of a leak, then disconnect the wires between the inverter and the output inductor, and the wires between the output inductor and the motor. Perform a meg ohm test between the output of the inductor and the drive enclosure. The resistance should be 5 meg ohms or higher. Disconnect the output of the drive from the motor, then meg the compressor motor as per Form 160.84-M1.

TABLE 1 - SAFETY SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Ground Fault</td><td>
The 3 phases of input current to the drive are continuously monitored by the 3 input current DCCT's. In a pure power system with perfectly balanced line voltage, and insulation between conductors that has infinite resistance the ground current is zero. A normally functioning drive will have a ground current of 8-15 amps. Most of this current is caused by the switching of the power devices. Ground currents higher than these typical values means there is a problem. This shutdown occurs when the sum of the 3 input currents exceeds the value listed below for 1 second. These values are based on the drive model.
<table>
<tr><th>DRIVE MODEL</th><th>GROUND FAULT CURRENT</th></tr>
<tr><td>0490</td><td>40</td></tr>
<tr><td>0774</td><td>120</td></tr>
</table>
This ground fault shutdown will protect for ground faults that occur from the wiring of the input DCCT to the power assembly/assemblies. A ground fault that occurs before the DCCT will not be detected. This is why the circuit breaker also has a ground fault detection system. Ground faults that occur between the output of the drive and the motor will be detected as an over current fault.
Possible Problems:

Phase shorted to ground at the rectifier. Disconnect the wiring from the L2 inductor. Measure the resistance from each phase of the rectifier to ground. A good resistance reading is 5 meg ohms or higher. A low resistance reading indicates a problem. Remove the power wire from the rectifier with the low resistance reading. Measure the resistance at the rectifier with the low resistance reading. If the resistance reading is now high, then inspect the power wiring on that phase for any torn or cut insulation. There may be a burn mark as well. If the resistance reading is still low, then inspect the rectifier assembly for any burn marks or loose hardware. There may be a voltage spacing issue i.e. bent bus bar or lug, any conductor that could have fallen into the normal voltage spacing.
Validate the control wiring between the input DCCT and the VSD logic board.

</td></tr>
<tr><td>VSD – High Phase A Input Baseplate Temperature</td><td>
The input/rectifier IGBT module temperatures are continuously monitored by the gate driver board where the highest temperature for each phase is read. The highest temperature is sent to the VSD logic board where the temperature is compared against a threshold value. If any IGBT module on the input/rectifier exceeds this threshold then this shutdown will occur. This shutdown cannot be reset, and the cooling fans and pumps for the VSD will continue to run until the temperature of all the IGBT modules fall below 165°F (73.8°C). The temperature shutdown threshold value is drive model dependent.
<table>
<tr><th>DRIVE MODEL</th><th>HIGH PHASE INPUT BASEPLATE TEMPERATURE SHUTDOWN VALUE</th></tr>
<tr><td>0490</td><td>190°F (87.8°C)</td></tr>
<tr><td>0774</td><td>170°F (76.6°C)</td></tr>
</table>
Possible Problems:

Improper coolant venting, or air in the cooling system.
Improper coolant level for the drive.
Shipping coolant not drained at startup.
Clogged chill plate.
Low condenser liquid flow. This might occur with the head pressure control system.
Dirty shell and tube heat exchanger. Cleaning the heat exchanger is part of the annual maintenance.
Failure of the coolant pump.

</td></tr>
<tr><td>VSD – High Phase B Input Baseplate Temperature</td><td>For details see "VSD – High Phase A Input Baseplate Temperature" message preceding</td></tr>
<tr><td>VSD – High Phase C Input Baseplate Temperature</td><td>For details see "VSD – High Phase A Input Baseplate Temperature" message preceding</td></tr>
</table>

TABLE 1 - SAFETY SHUTDOWNS (CONT'D)

MESSAGE	DESCRIPTION
VSD – High Phase A Motor Baseplate Temperature	The motor/inverter IGBT module temperatures are continuously monitored by the gate driver board where the highest temperature for each phase is read. The highest temperature is sent to the VSD logic board where the temperature is compared against a shutdown value of 190°F (87.8°C). If any IGBT module on the motor/inverter exceeds this shutdown value then this shutdown will occur. This shutdown cannot be reset, and the cooling fans and pumps for the VSD will continue to run until the temperature of all the IGBT modules fall below 165°F (73.8°C). **Possible Problems:** • Improper coolant venting, or air in the cooling system. • Improper coolant level for the drive. • Shipping coolant not drained at startup. • Clogged chill plate. • Low condenser liquid flow. This might occur with the head pressure control system. • Dirty shell and tube heat exchanger. Cleaning the heat exchanger is part of the annual maintenance. • Failure of the coolant pump.
VSD – High Phase B Motor Baseplate Temperature	For details see "VSD – High Phase A Motor Baseplate Temperature" message preceding
VSD – High Phase C Motor Baseplate Temperature	For details see "VSD – High Phase A Motor Baseplate Temperature" message preceding
VSD – Input Current Overload	This shutdown is generated when the VSD logic board has detected that the highest of the three input phase currents has exceeded 116% of the programmed input full load current for 10 continuous seconds. **Possible Problems:** • Verify in the fault history that the input voltage is balanced. A sag in one phase can cause this problem. • Verify in the fault history that the input voltage did not sag on all three phases. • Ensure that the input current is balanced in the fault history. Run the IGBT rectifier test function to ensure that the input/rectifier IGBT are turning on and off. (This test function can be found under Section 8) • Ensure that the Variable Geometry Diffuser (VGD) is working properly. • Verify if there was a quick change in condenser liquid flow or condenser liquid temperature.
VSD – Input DCCT Offset Lockout	The drive contains 3 DCCT's to measure the input current. If the Input DCCT Offset cycling shutdown occurs 3 times in a row on the same phase, then this shutdown will occur. See Input DCCT Offset Cycling shutdown for more details.
VSD – Inverter Program Fault	This drive will be used on 2 different motor designs. It is necessary to validate that the inverter software is correct for the motor designed used in the application. To ensure that the correct software is installed in the VSD logic board, three pieces of data must state that the correct inverter software is installed in the VSD logic board for this shutdown not to occur. The software in the VSD logic board U38, must match the condition on J2 pin 14, and the programmed motor selection from the chiller control center. **Possible Problems:** • For this application a wire should not be connected to J2 pin 14 on the VSD logic board. • Verify that the chiller model number is correct on the Contract Screen of the control panel. • Verify that the correct chip is installed in U38.

TABLE 1 - SAFETY SHUTDOWNS (CONT'D)

MESSAGE	DESCRIPTION
VSD – Line Voltage Phase Lock Loop	The drive will automatically determine the input voltage frequency. The information about the input voltage frequency is provided to the drive logic board by the line voltage isolation board. If the drive logic board cannot determine that the input voltage frequency is 50 or 60 Hz then this shutdown will occur. **Possible Problems:** • Verify that line voltage is balanced on the control panel. If the line voltages are balanced, then there may be a wiring problem at the line voltage isolation board, or the VSD logic board. Input wire L1, must be connected to J1 pin #1 on the line voltage isolation board, and J2 pin #1 on the line voltage isolation board must be connected to J25 pin #1 on the drive logic board.. The wiring cannot be in any other order. The phases cannot be rotated or reversed within the drive wiring. Use the wiring diagrams found in this form to determine if all wiring between the input of the drive, through the line voltage isolation board, and to the drive logic board is correct. • Verify that the fuses that supply power to the line voltage isolation board are good. If a fuse is bad, then determine the reason for the fuse failure, and then replace the fuse.
VSD – Line Voltage Phase Rotation	The input of the drive is not sensitive to the phase rotation of the input voltage, but internally to the drive the rotation must remain the same. The output of the line voltage isolation board cannot show CBA rotation when the input voltage to the drive is really ABC rotation. There are 2 methods within the VSD logic board to determine the line voltage phase rotation. If these 2 methods do not report the same phase rotation then this shutdown will occur. **Possible Problem:** • Replace the VSD logic board.
VSD – Logic Board Plug	For this drive to work properly input and output current waveforms are required by the drive logic board. To ensure that the drive logic board receives this information, a jumper is connected across the connector where the input and output currents are connected to the drive logic board. This way the drive logic board can prove that the connector is installed. **Possible Problem:** • Ensure that J2 is installed on the drive logic board. • Ensure that J3 is installed on the drive logic board. • Validate that a jumper is installed on J2 pin 11 to 13. • Validate that a jumper is installed on J3 pin 13 to 18. • Ensure that the pins and sockets for J2 and J3 are in good condition. • Replace the drive logic board.
VSD – Logic Board Hardware	This shutdown is generated when the state of the auxiliary IGBT gate driver is not correct after power is applied to the drive. The drive logic board will determine that the logic states of the auxiliary IGBT gate drivers are correct before the drive is started. **Possible Solution:** Replace the drive logic board.

TABLE 1 - SAFETY SHUTDOWNS (CONT'D)

MESSAGE	DESCRIPTION
VSD – Motor Current THD Fault	This shutdown is designed to protect the compressor motor from overheating due to the effects of current harmonics produced by the VSD. Information from the output voltage isolation board is used to determine the output frequency of the drive. Then information from the output DCCT's is used within the drive logic board to determine the current harmonics presented to the motor. If the current harmonics are above a preset value determined by the drive logic board, then this shutdown will occur. **Possible Problems:** • The software on the drive logic board was improved to reduce the amount of harmonics produced by the drive output. In the fault history, ensure that software version C.HYP.04.03.01, and C.HYP.03.03.01 or later is installed. If older software is installed, then replace it with new software. The part number of the new software will remain the same as the existing software. • In the shutdown history is the output voltage balanced? If the output voltage is not balanced, then ensure that the fuses that provide power to the output voltage isolation board are good, and verify the wiring between the output of the drive to the output voltage isolation board, and then to the VSD logic board. Check for rotation of phase voltage in the wiring and for good electrical connections on all connectors. • In the shutdown history is the output current balanced? If the output current is not balanced, then verify the wiring between the output of the DCCT's to the VSD logic board. Check for rotation of phase current in the wiring and for good electrical connections on all connectors. • Ensure that the upper and lower gate drives are working properly. Inverter Test Mode will test the motor/inverter gate drivers. • Ensure that the DCCT's are installed so that the direction arrow is pointing toward the motor terminal connection.
VSD – Motor Current Imbalance	This shutdown will compare the average of the 3 output phase currents to the individual output phase currents. If the difference between these too values is greater than the shutdown value listed below for 45 seconds then this shutdown will occur. This value is based on the compressor motor. Refer to the sales order screen on the control center for the compressor motor model number. For example, the output currents are 200, 230, and 250 amps. The average current is 227 amps. The greatest difference is 200 – 227 = 27. This value is less than the shutdown value, and the chiller will continue to run. **Possible Problems:** • Measure the output current of the drive to ensure that the output current is imbalanced. If current measurement is balanced, then remove the output DCCT that is reading imbalanced and place it in a phase that has balanced current. If the same output phase still reads imbalanced on the control center, then replace the drive logic board. If the output current imbalance follows the DCCT, then replace the DCCT. • Inspect the output harmonic filter for any damaged parts. • Failure on the input/rectifier of the drive. Ensure that the input current is balanced.

MOTOR MODEL NUMBER	AMP VALUE
M2	37

TABLE 1 - SAFETY SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Phase A Input DCCT</td><td>This shutdown determines if the cable at the input DCCT is connected. During the pre-charge state the drive logic board must detect a minimum value of current. These values are based on the drive amp rating.

<table>
<tr><th>DRIVE AMP RATING</th><th>MINIMUM CURRENT</th></tr>
<tr><td>0490</td><td>5</td></tr>
<tr><td>0774</td><td>15</td></tr>
</table>
Possible Problems:
• Measure the input current to ensure that the drive is entering pre-charge.
• Cable is not properly installed on the input/rectifier DCCT for the phase reported in the message.
• Ensure that the pins and sockets are not damaged inside the housing on the DCCT.
• The DCCT is provided with a +20 VDC supply, it is connected to pin #2 on the DCCT. Validate that the power supply is present at the input DCCT on pin 2. If the power supply is not present, then ensure that the power supply is present at the drive logic board on J2 pins 1, 4, and 7. If the power supply is not present, the replace the drive logic board.
• The DCCT is provided with a -20 VDC supply, it is connected to pin #3 on the DCCT. Validate that the power supply is present at the input DCCT on pin 3. Validate that the power supply is present at the input DCCT. If the power supply is not present, then ensure that the power supply is present at the drive logic board on J2 pins 3, 6, and 9. If the power supply is not present, the replace the drive logic board.
• Perform a resistance test on the sensor wire of the input DCCT. This wire is connected to pin 4 on the DCCT housing. The input at the drive logic board depends on which phase this shutdown is occurring on. See the chart below for the appropriate connection on the logic board. Replace the harness if this test fails.

<table>
<tr><th>PHASE THAT SHUTDOWN OCCURS ON</th><th>DCCT ASSOCIATED WITH SHUTDOWN</th><th>INPUT TO DRIVE LOGIC BOARD</th></tr>
<tr><td>Phase A</td><td>1 DCCT</td><td>J2 – Pin 2</td></tr>
<tr><td>Phase B</td><td>2 DCCT</td><td>J2 – Pin 5</td></tr>
<tr><td>Phase C</td><td>3 DCCT</td><td>J2 – Pin 8</td></tr>
</table>
• Failure of the DCCT - Rotate the input DCCT that is always having the shutdown into one of the other phases. This will require the removal of the DCCT and the installation of this DCCT into one of the other phases. Just switching the control wiring to the DCCT will cause a failure in the input/rectifier. If this shutdown occurs on the same phase, then replace the drive logic board. If this shutdown follows the placement of the DCCT, then replace the DCCT.</td></tr>
<tr><td>VSD – Phase B Input DCCT</td><td>For details see “VSD – Phase A Input DCCT” message preceding</td></tr>
<tr><td>VSD – Phase C Input DCCT</td><td>For details see “VSD – Phase A Input DCCT” message preceding</td></tr>
</table>

TABLE 1 - SAFETY SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Phase A Motor DCCT</td><td>This shutdown determines if the cable at the motor DCCT is connected. This shutdown is generated 1.5 seconds after the motor run command if the motor current does not exceed 25 amps.

Possible Problems:
• Measure the output current to ensure that the drive is starting to run.
• Cable is not properly installed on the output/motor DCCT for the phase reported in the message.
• Ensure that the pins and sockets are not damaged inside the housing on the DCCT.
• The DCCT is provided with a +20 VDC supply, it is connected to pin #2 on the DCCT. Validate that the power supply is present at the input DCCT on pin 2. If the power supply is not present, then ensure that the power supply is present at the drive logic board on J3 pins 1, 4, and 7. If the power supply is not present, the replace the drive logic board.
• The DCCT is provided with a -20 VDC supply, it is connected to pin #3 on the DCCT. Validate that the power supply is present at the input DCCT on pin 3. Validate that the power supply is present at the input DCCT. If the power supply is not present, then ensure that the power supply is present at the drive logic board on J3 pins 3, 6, and 9. If the power supply is not present, the replace the drive logic board.
• Perform a resistance test on the sensor wire of the input DCCT. This wire is connected to pin 4 on the DCCT housing. The input at the drive logic board depends on which phase this shutdown is occurring on. See the chart below for the appropriate connection on the logic board. Replace the harness if this test fails.
<table>
<tr><th>PHASE THAT SHUTDOWN OCCURS ON</th><th>DCCT ASSOCIATED WITH SHUTDOWN</th><th>INPUT TO DRIVE LOGIC BOARD</th></tr>
<tr><td>Phase A</td><td>4 DCCT</td><td>J3 – Pin 2</td></tr>
<tr><td>Phase B</td><td>5 DCCT</td><td>J3 – Pin 5</td></tr>
<tr><td>Phase C</td><td>6 DCCT</td><td>J3 – Pin 8</td></tr>
</table>
• Failure of the DCCT - Rotate the input DCCT that is always having the shutdown into one of the other phases. This will require the removal of the DCCT and the installation of this DCCT into one of the other phases. Just switching the control wiring to the DCCT will cause a failure in the motor/inverter. If this shutdown occurs on the same phase, then replace the drive logic board. If this shutdown follows the placement of the DCCT, then replace the DCCT.</td></tr>
<tr><td>VSD – Phase B Motor DCCT</td><td>For details see “VSD – Phase A Motor DCCT” message preceding</td></tr>
<tr><td>VSD – Phase C Motor DCCT</td><td>For details see “VSD – Phase A Motor DCCT” message preceding</td></tr>
<tr><td>VSD – Precharge Lockout</td><td>This shutdown is generated when the Precharge cycling fault occurs 3 consecutive times. See the Precharge cycling shutdown message for details.</td></tr>
<tr><td>VSD – Rectifier Program Fault</td><td>After power is applied, the drive logic board will verify that the two software programs on the drive logic board are compatible with each other, and that the application of the software is the same as the application of the VSD. If these items are not compatible, then this shutdown will occur.

Possible Problems:
• Wrong software version is installed. Review the shutdown history for this shutdown. Under the VSD section of the history is the software version numbers for the inverter and rectifier software. The inverter software version must be in the following format, C.HYP.04.xx.xx. The rectifier software version must be in the following format, C.HYP.03.xx.xx. The values that replace the xx.xx in the software version must have the same numbers.
• The drive is used on the wrong application. This drive will be used to control a permanent magnet motor or an induction motor. The permanent magnet motor application does not require a jumper connected to J2 pin 14 on the drive logic board. If a wire is installed in J2 pin 14, then it should be removed.</td></tr>
</table>

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SECTION 5 - CYCLING SHUTDOWNS

General Information

Cycling shutdown messages are organized in alphabetical order based on the OptiView Control Center messages.

Whenever a cycling shutdown is generated by the Drive Logic Board, a series of events will occur. These events are:

- If the chiller is not running at the time of the shutdown, the drive logic board will not turn on the power device gate drivers for the Auxilliary, rectifier or inverter.
- The K1 relay on the drive logic board will de-energize to indicate to the Control Center that the drive 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 a drive generated shutdown the gate driver for the power devices used in the Auxilliary, rectifier, and inverter will be turned off.
- The message “VSD Shutdown - Requesting Fault Data” will be displayed when the Control Center is requesting the fault data from the drive.
- The drive logic board will send a shutdown code via the serial 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 will automatically restart if the shutdown is no longer active.

TABLE 2 - CYCLING SHUTDOWNS

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – DC Bus Pre-Regulation</td><td>This shutdown is generated 2 seconds after the VSD enters the pre-regulation state if the bus voltage is not within +/- 50 VDC of the DC Link voltage setpoint. The DC Link voltage setpoint is determined by the compressor motor. Refer to the sales order screen on the control center for the compressor motor model number.
<table>
<tr><th>MOTOR MODEL NUMBER</th><th>DC LINK VOLTAGE SETPOINT</th></tr>
<tr><td>M2</td><td>785</td></tr>
</table>
Possible Problems:
• Verify in manual Pre-Regulation that the bus voltage is increasing. If the bus voltage is not increasing verify that the rectifier IGBT gate driver LED's are flashing on the drive logic board. If the rectifier gate driver LED's are not flashing then replace the drive logic board.</td></tr>
<tr><td>VSD – High DC Bus Voltage</td><td>If the DC bus voltage exceeds the HIGH DC BUS VOLTAGE SHUTDOWN VALUE, then the drive will shutdown and display this shutdown message.
<table>
<tr><th>DRIVE MODEL</th><th>HIGH DC BUS VOLTAGE SHUTDOWN VALUE</th></tr>
<tr><td>0490</td><td>878 VDC</td></tr>
<tr><td>0774</td><td>985 VDC</td></tr>
</table>
Possible Problem:
• A rapid line voltage event has occurred. If the VSD restarts automatically and runs until the chiller is stopped, then the line voltage event is most likely the cause.
• The output of the VSD is shorted to earth. Disconnect the motor from the VSD, and try to start the chiller. If a different shutdown occurs, then the motor is shorted to earth. If the same shutdown occurs, then the output harmonic filter maybe shorted to earth.
• Inspect the harmonic filter for any coolant leaks. If leaks are found at the fittings, then replace the fittings.
• The output harmonic filter maybe shorted to earth. Disconnect the output harmonic filter. Measure resistance from all three phases on the output harmonic filter to ground. A resistance value of less than 5 Meg ohms is a bad reading. Inspect the inductor for any connections to earth, or a failed filter capacitor on the output harmonic filter. Replace any failed filter capacitor. If a filter capacitor is not the problem, and the output harmonic filter is shorted to earth, then replace the output harmonic filter.
• Motor/Inverter IGBT shorted to earth. Measure resistance from the output of the motor/inverter IGBT to earth. A measurement of 5 Meg ohms or higher is not a failure. A lower resistance value will require an inspection of this area of the VSD. A loose wire or washer may cause a ground connection. If an inspection does not reveal a problem, then replace the Motor/Inverter assembly that has the low resistance reading.</td></tr>
</table>

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – High Internal Ambient Temperature</td><td>This shutdown is generated when one of the two ambient temperature sensors exceeds a temperature of 158°F (70°C). The ambient temperature sensors are located near the circuit breaker/disconnect switch, and near the output harmonic filter. This shutdown cannot be reset until the temperature of both ambient temperature sensors falls below 148°F (64.4°C). The fans and pumps for the VSD will continue to run until the temperature drops below the reset level.

Possible Problems:
• Improper coolant level for the VSD.
• Failure to replace the shipping inhibitor with the running inhibitor.
• Failure of the internal fan.
• Failure of the fan/pump relay.
• Loose or improper wire connections on the circuit breaker/disconnect switch.
• Improper purging of air from the cooling system, causing the input inductor, or output harmonic filter to overheat.
• Dirty shell and tube heat exchanger. Regular maintenance of the shell and tube heat exchanger is required. It is recommended that the tubes of the heat exchanger be cleaned at least once a year.
• Low condenser water flow. The VSD requires 8 feet of head on the condenser to maintain adequate flow through the heat exchanger.
• Using higher then designed condenser liquid temperature.</td></tr>
<tr><td>VSD – High Phase A Input Current</td><td>The input current for each phase is measured by an input DCCT. The DCCT provides information to the drive logic board about the amplitude of the input current. If the input current is higher than the instantaneous current value listed below, then the drive will shutdown.

<table><tr><th>DRIVE AMP RATING</th><th>INSTANTANEOUS CURRENT VALUE</th></tr><tr><td>0490</td><td>886</td></tr><tr><td>0774</td><td>1446</td></tr></table>
Possible Problems: If the high current shutdown occurs on different phases.
• Large power consuming equipment connected to the same power source is causing a line voltage sag.
• Storm event can cause a surge in the line voltage.
• The switching of power factor correction capacitors at the customer site or at the utility.

Possible Problems: If the high current shutdown occurs on the same phase.
• There may be a problem in the measurement of the input current. Rotate the input DCCT that is always having the shutdown into one of the other phases. This will require the removal of the DCCT and the installation of this DCCT into one of the other phase. Just switching the control wiring to the DCCT will cause a failure in the input/rectifier. If the high current shutdown occurs on the same phase, then replace the drive logic board. If the high current shutdown follows the placement of the DCCT, then replace the DCCT.</td></tr>
<tr><td>VSD – High Phase B Input Current</td><td>For details see “VSD – High Phase A Input Current” message preceding</td></tr>
<tr><td>VSD – High Phase C Input Current</td><td>For details see “VSD – High Phase A Input Current” message preceding</td></tr>
</table>

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – High Phase A Motor Current</td><td>The output current for each phase is measured by an output DCCT. The DCCT provides information to the drive logic board about the amplitude of the output current. If the output current is higher than the instantaneous current value listed below, then the VSD will shutdown.

<table><tr><th>DRIVE AMP RATING</th><th>INSTANTANEOUS CURRENT VALUE</th></tr><tr><td>0490</td><td>776</td></tr><tr><td>0774</td><td>1317</td></tr></table>
Possible Problems: If the high current shutdown occurs on different phases.
• Large power consuming equipment connected to the same power source is causing a line voltage sag.
• Storm event can cause a surge in the line voltage.
• The switching of power factor correction capacitors at the customer site or at the utility.
• One phase on the output of the VSD is not turning on. This problem will cause the two phases that are working to have high current values. If the C phase is not turning on, then sometimes the A phase will cause the high current shutdown and other times the B phase will cause the high current shutdown. Ensure that the gate driver LED's are lit for all phases on the gate driver boards. Perform the Inverter Test found in section 8 of this form.
Possible Problems: If the high current shutdown occurs on the same phase.
• Verify that none of the capacitors in the output harmonic filter has failed or is burnt.
• Ensure that the inductor in the output harmonic filter does not have a shorted phase.
• Ensure that the motor is not shorted across a phase.</td></tr>
<tr><td>VSD – High Phase B Motor Current</td><td>For details see "VSD – High Phase A Motor Current" message preceding</td></tr>
<tr><td>VSD – High Phase C Motor Current</td><td>For details see "VSD – High Phase A Motor Current" message preceding</td></tr>
<tr><td>VSD – Initialization Failed</td><td>Upon the application of power, the Drive logic board will go through a process called initialization. At this time, memory locations are cleared, jumper positions are checked, and serial communications links are established between the Drive logic board, and the Control Center. If any one of these items are not completed this shutdown is generated.
Possible Problems:
• Configuration problem on the drive logic board. Verify that all of the switches for SW1 and SW2 are in the off position.
• Configuration problem on the control center. Verify that the communication setting are properly setup as per Form 160.84-M1.</td></tr>
<tr><td>VSD – Invalid Setpoint</td><td>The control center will provide data about the chiller application to the VSD, and the VSD will validate that the motor data, and the VSD model number matches between the control center and the VSD. If this data does not match, then this shutdown will occur.
Possible Problems:
• Validate that the chiller model number is correct on the chiller control center.
• Validate that the drive model number is correct on the chiller control center.
• For this application, ensure that no wire is installed on the drive logic board at J2 pin 14.
• Ensure that the correct wire jumper is installed at J3 pins 11-13 and pins 16-18. Ensure that the sockets are properly seated in the housing, and that the socket is not bent. The socket may need to be removed from the housing using the correct tool to ensure that the wire is properly crimped. The table below will show the correct wire jumper setting.

<table><tr><th>DRIVE MODEL</th><th>JUMPER POSITIONS</th></tr><tr><td>0490</td><td>J3-11 to J3-16, J3-12 to J3-17</td></tr><tr><td>0774</td><td>J3-12 to J3-17</td></tr></table></td></tr>
</table>

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Logic Board Processor</td><td>The drive logic board contains several microprocessors. This shutdown is generated when the communications between these microprocessors stop communicating for a period of 1.5 seconds.
Possible Problems:
• Failure of the drive logic board. Replace the drive logic board.</td></tr>
<tr><td>VSD – Logic Board Power Supply</td><td>The drive logic board determines if the low voltage power supplies on the drive logic board are maintained within specification. If any one of the low voltage power supplies is running outside the specification this shutdown will occur. This shutdown will be present in the shutdown history every time the power is applied to the VSD.
Possible Problems:
• Loss of power to the drive logic board. The drive logic board uses 2 separate power supply sections. Each section requires a 24 VAC source. The 24 VAC source is provided to the drive logic board on J17 and J19. Ensure that these connectors are properly connected to the drive logic board. Inspect the pins, sockets, and housings for these connectors to ensure that nothing is damaged.
• Loss of power to the drive logic board. The 0490 amp drive has one transformer that provides the 24 VAC supply. Ensure that the 24 VAC is present on J17 and J19. If the voltage is not present, then ensure that 120 VAC is provide to the primary of this transformer. If 120 VAC is present on the primary of the transformer, then replace the transformer.
• Loss of power to the drive logic board. The 0774 amp drive has 2 transformers that provides the 24 VAC supply. Transformer 3T provides power to J17, and 4T provides power to J19. Ensure that the 24 VAC is present on J17 and J19. If the voltage is not present, then ensure that 120 VAC is provide to the primary of this transformer. If 120 VAC is present on the primary of the transformer, then replace the transformer.
• Power supply failure. The drive logic board contains several test points for power supplies. These test points are located between J17 and J19 on the drive logic board. Each test point has the power supply voltage written by the pin. Measure each test point, if any of the voltages to do read properly then replace the drive logic board.</td></tr>
<tr><td>VSD – Low DC Bus Voltage</td><td>This shutdown is generated anytime after the pre-regulation state has generated the correct DC link voltage setpoint, and then the DC link voltage drops to a minimum value. This value is based on the motor model number.
<table><tr><th>MOTOR MODEL NUMBER</th><th>DC LINK VOLTAGE SETPOINT</th></tr><tr><td>M2</td><td>755</td></tr></table>Possible Problem:
• Low Line voltage event or sag caused by turning on a large power consuming device on the same power source.</td></tr>
<tr><td>VSD – Low Phase A Input Baseplate Temperature</td><td>This shutdown is generated anytime input/rectifier modules temperature drops below 37°F (2.7°C). This shutdown cannot be reset until the temperature of all modules exceeds 42°F (5.5°C). The fans and pumps for the VSD will continue to run until the temperature exceeds the reset level.
Possible Problem:
• Loose wire – Each IGBT module contains a temperature sensor. The highest of the temperatures for each phase is reported to the drive logic board. So, a loose wire on a single IGBT module cannot cause this problem.
• Loose or broke connector -
On model 0490 drive ensure that the J8 and J9 connectors are properly installed on the gate driver board. Ensure that the wires on J1 pin 10 or pin 4 are properly installed on the gate driver board. Verify that the J6 connector is properly connected on the drive logic board. Any loose or broken wire on the J6 connector can cause this shutdown.
On model 0774 drive ensure that the J11 connector is properly installed on the gate driver board. Ensure that the wires on J2 pin 5 or pin 11 are properly installed on the gate driver board. Verify that the J6 connector is properly connected on the drive logic board. Any loose or broken wire on the J6 connector can cause this shutdown.</td></tr>
</table>

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

MESSAGE	DESCRIPTION
VSD – Low Phase B Input Baseplate Temperature	For details see "VSD – Low Phase A Input Baseplate Temperature" message preceding
VSD – Low Phase C Input Baseplate Temperature	For details see "VSD – Low Phase A Input Baseplate Temperature" message preceding
VSD – Low Phase A Motor Baseplate Temperature	This shutdown is generated anytime motor / inverter modules temperature drops below 37°F (2.7°C). This shutdown cannot be reset until the temperature of all modules exceeds 42°F (5.5°C). The fans and pumps for the VSD will continue to run until the temperature exceeds the reset level. **Possible Problem:** • Loose wire – Each IGBT module contains a temperature sensor. The highest of the temperatures for each phase is reported to the drive logic board. So, a loose wire on a single IGBT module cannot cause this problem. • Loose or broke connector - On model 0490 drive ensure that the J8 and J9 connectors are properly installed on the gate driver board. Ensure that the wires on J1 pin 10 or pin 4 are properly installed on the gate driver board. Verify that the J6 connector is properly connected on the drive logic board. Any loose or broken wire on the J6 connector can cause this shutdown. On model 0774 drive ensure that the J10 connector is properly installed on the gate driver board. Ensure that the wires on J2 pin 11 or pin 12 are properly installed on the gate driver board. Verify that the J6 connector is properly connected on the drive logic board. Any loose or broken wire on the J6 connector can cause this shutdown.
VSD – Low Phase B Motor Baseplate Temperature	For details see "VSD – Low Phase A Motor Baseplate Temperature" message preceding
VSD – Low Phase C Motor Baseplate Temperature	For details see "VSD – Low Phase A Motor Baseplate Temperature" message preceding
VSD – Not Running	This shutdown is generated by the Control Panel when the VSD logic board does not report its run state for 10 continuous seconds.

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Phase A Input DCCT Offset</td><td>
Direct Current Current Transformers (DCCT) sometimes do not measure zero current properly. To determine if the DCCT is measuring current properly, the output of the DCCT is measured every time before the VSD enters the precharge state. If the output of the DCCT is close enough to zero current, then the operation of the DCCT is determined to be good. If the output of the DCCT is above a threshold determined by the drive logic board, then this fault will occur. This same test is performed on all 3 of the input/rectifier DCCT’s at the same time.
Possible Problems:

Cable is not properly installed on the input/rectifier DCCT for the phase reported in the message.
Ensure that the pins and sockets are not damaged inside the housing on the DCCT.
The DCCT is provided with a +20 VDC supply, it is connected to pin #2 on the DCCT. Validate that the power supply is present at the input DCCT on pin 2. If the power supply is not present, then ensure that the power supply is present at the drive logic board on J2 pins 1, 4, and 7. If the power supply is not present, then replace the drive logic board.
The DCCT is provided with a -20 VDC supply, it is connected to pin #3 on the DCCT. Validate that the power supply is present at the input DCCT on pin 3. Validate that the power supply is present at the input DCCT. If the power supply is not present, then ensure that the power supply is present at the drive logic board on J2 pins 3, 6, and 9. If the power supply is not present, then replace the drive logic board.
Perform a resistance test on the sensor wire of the input DCCT. This wire is connected to pin 4 on the DCCT housing. The test input at the drive logic board depends on which phase this shutdown is occurring on. See the chart below for the appropriate connection on the logic board. Replace the harness if this test fails.

<table>
<tr><th>PHASE THAT SHUTDOWN OCCURS ON</th><th>DCCT ASSOCIATED WITH SHUTDOWN</th><th>INPUT TO DRIVE LOGIC BOARD</th></tr>
<tr><td>Phase A</td><td>1 DCCT</td><td>J2 – Pin 2</td></tr>
<tr><td>Phase B</td><td>2 DCCT</td><td>J2 – Pin 5</td></tr>
<tr><td>Phase C</td><td>3 DCCT</td><td>J2 – Pin 8</td></tr>
</table>

Failure of the DCCT - Rotate the input DCCT that is always having the shutdown into one of the other phases. This will require the removal of the DCCT and the installation of this DCCT into one of the other phases. Just switching the control wiring to the DCCT will cause a failure in the input/rectifier. If this shutdown occurs on the same phase, then replace the drive logic board. If this shutdown follows the placement of the DCCT, then replace the DCCT.

</td></tr>
<tr><td>VSD – Phase B Input DCCT Offset</td><td>For details see “VSD – Phase A Input DCCT Offset” message preceding</td></tr>
<tr><td>VSD – Phase C Input DCCT Offset</td><td>For details see “VSD – Phase A Input DCCT Offset” message preceding</td></tr>
</table>

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

MESSAGE	DESCRIPTION
VSD – Phase A Input Gate Driver	This shutdown is generated when one of the input gate driver power supplies is operating outside of tolerance, or the voltage across the input / rectifier IGBT is too high. The gate driver board determines this shutdown, and provides feedback to the VSD logic board that this shutdown occurred. **Possible Problems:** • One of the gate driver LED's are not lit. Ensure that all of the gate driver LED's are lit on each phase for the input/rectifier. There are 3 LED's for each phase. If only one LED is not lit, then replace that gate driver board that does not have the lit LED. • Model 0490 drive - None of the gate driver LED's are lit on one phase. Measure 12 VDC from the J1 connecter pin 7 and pin 13 to earth on the gate driver board. If the voltage is present, then replace the gate driver board. • Model 0490 drive - None of the gate driver LED's are lit on any of the phases. Measure 12 VDC from the TP-F and TP-G to earth on the gate driver power supply board (031-02903). If voltage is present, then verify that the J2 connector on the gate driver power supply board is properly installed. If the measured voltage is 23 VDC on TP-F or TP-G, then replace the gate driver power supply board. If no voltage is present, then verify that 24 VAC is present between pin 1 and pin 2 on the J1 connector of the gate driver power supply board. If voltage is present, then replace the gate driver power supply board. If the voltage is not present, then replace the 3T transformer. • Model 0774 drive - None of the gate driver LED's are lit on one phase. Measure 24 VAC at the J1 connector of the gate driver board. If 24 VDC is present, then replace the gate driver board. Inspect the housing, pins and sockets for the J1 connector. Replace as needed. • Model 0774 drive - None of the gate driver LED's are lit on any of the phases. Verify that 14FU or 15FU are not open. Determine root cause of the fuse failure and then replace the fuse. If 14FU or 15FU are not open, then verify that 24 VAC is provided on the output of 5T. If 24 VAC is not present on the output of 5T, then replace 5T. • If the gate driver fault occurs on the same phase all of the time and is present when power is applied. Rotate the gate drive connectors on the drive logic board J8, J9, and J10. WARNING ***Only apply power for this test. Do not attempt to run the chiller. Failure of the input/rectifier will occur. If the shutdown remains on the same phase, then replace the drive logic board, If the shutdown follows the gate driver board, then verify the wiring between J8, J9, and J10 on the drive logic board to J2 on the gate driver board. J8, J9, J10 must be returned to their original positions before running the chiller.***
VSD – Phase B Input Gate Driver	For details see "VSD – Phase A Input Gate Driver" message preceding

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

MESSAGE	DESCRIPTION
VSD – Phase C Input Gate Driver	For details see "VSD – Phase A Input Gate Driver" message preceding
VSD – Phase A Motor Gate Driver	This shutdown is generated when one of the motor / inverter gate driver power supplies is operating outside of tolerance, or the voltage across the motor / inverter IGBT is too high. The gate driver board determines this shutdown, and provides feedback to the VSD logic board that this shutdown occurred. **Possible Problems:** • One of the gate driver LED's are not lit. Ensure that all of the gate driver LED's are lit on each phase for the motor/inverter. There are 3 LED's for each phase. If only one LED is not lit, then replace that gate driver board that does not have the lit LED. • Model 0490 drive - None of the gate driver LED's are lit on one phase. Measure 12 VDC from the J1 connecter pin 7 and pin 13 to earth on the gate driver board. If the voltage is present, then replace the gate driver board. • Model 0490 drive - None of the gate driver LED's are lit on any of the phases. Measure 12 VDC from the TP-F and TP-G to earth on the gate driver power supply board (031-02903). If voltage is present, then verify that the J2 connector on the gate driver power supply board is properly installed. If the measured voltage is 23 VDC on TP-F or TP-G, then replace the gate driver power supply board. If no voltage is present, then verify that 24 VAC is present between pin 1 and pin 2 on the J1 connector of the gate driver power supply board. If voltage is present, then replace the gate driver power supply board. If the voltage is not present, then replace the 3T transformer. • Model 0774 drive - None of the gate driver LED's are lit on one phase. Measure 24 VAC at the J1 connector of the gate driver board. If 24 VDC is present, then replace the gate driver board. Inspect the housing, pins and sockets for the J1 connector. Replace as needed. • Model 0774 drive - None of the gate driver LED's are lit on any of the phases. Verify that 14FU or 15FU are not open. Determine root cause of the fuse failure and then replace the fuse. If 14FU or 15FU are not open, then verify that 24 VAC is provided on the output of 5T. If 24 VAC is not present on the output of 5T, then replace 5T. • If the gate driver fault occurs on the same phase all of the time and is present when power is applied. Rotate the gate drive connectors on the drive logic board J11, J12, and J13. WARNING ***Only apply power for this test. Do not attempt to run the chiller. Failure of the motor/inverter will occur. If the shutdown remains on the same phase, then replace the drive logic board, If the shutdown follows the gate driver board, then verify the wiring between J11, J12, and J13 on the drive logic board to J2 on the gate driver board. J11, J12, J13 must be returned to their original positions before running the chiller.*** • Perform the Inverter Test found in Section 8. • Perform a compressor motor megger test as per Form 160.84-M1.
VSD – Phase B Motor Gate Driver	For details see "VSD – Phase A Motor Gate Driver" message preceding.
VSD – Phase C Motor Gate Driver	For details see "VSD – Phase A Motor Gate Driver" message preceding.

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Precharge – High DC Bus Voltage</td><td>This shutdown is generated when the bus voltage does not reach a minimum value 12 seconds after precharge was started. The minimum value is determined by the input voltage setpoint. If this shutdown repeats 3 times in a row a VSD – Precharge Lockout will occur.
<table>
<tr><th>INPUT VOLTAGE SETPOINT</th><th>MINIMUM VALUE</th></tr>
<tr><td>230</td><td>250</td></tr>
<tr><td>380 / 415</td><td>414</td></tr>
<tr><td>460</td><td>500</td></tr>
</table>
Possible Problems:
• One of the Aux. IGBT's are not turning on. Ensure that all of the gate driver LED’s are lit. A faulty gate driver for the Aux. IGBT will not cause a gate driver fault.
• One of the Aux. IGBT's are not turning on. Review the shutdown history. All three phase of input current should have about the same value. If one phase is consistently low, then determine why this phase is not turning on. Check wiring between gate driver board and drive logic board. Verify that pin 8 is properly installed on J8, J9, and J10 on the drive logic board.
• Failed bleeder resistor. Disconnect one side of the bleeder resistor, and measure the resistance. The resistance for the 0490 model is 50 K ohms. The resistance for the 0774 model is 27 K ohms.</td></tr>
<tr><td>VSD – Precharge – Low DC Bus Voltage</td><td>This shutdown is generated when the bus voltage does not reach a minimum value 4 seconds after precharge was started. The minimum value is determined by the input voltage setpoint. If this shutdown repeats 3 times in a row a VSD – Precharge Lockout will occur.
<table>
<tr><th>INPUT VOLTAGE SETPOINT</th><th>MINIMUM VALUE</th></tr>
<tr><td>230</td><td>25</td></tr>
<tr><td>380 / 415</td><td>41</td></tr>
<tr><td>460</td><td>50</td></tr>
</table>
Possible Problems:
• The bus voltage is always zero. Ensure that the bus voltage value is provided to the drive logic board.
• Model 0490 drive – Ensure that J7 on the gate driver power supply board is connected to both sides of the bus capacitor. J7 pin 1 is connect to the positive bus. J7 pin 3 is connected to the negative bus. Ensure that J8 on the gate driver power supply board is connected. Ensure that J1 on the drive logic board is connected and that pin 1 is positive, and pin 2 is negative.

• Model 0774 drive – Ensure that J3 on the gate driver board is connected to both sides of the bus capacitor. J3 pin 1 is connect to the positive bus. J3 pin 3 is connected to the negative bus. Ensure that J4 on the gate driver board is connected. This connection is only made on the C phase power assembly. Ensure that J1 on the drive logic board is connected, and that pin 1 is positive, and pin 2 is negative.
• The bus voltage is not rising high enough. Measure the resistance across the bus capacitor. The meter should charge and discharge the capacitor. If the resistance value remains low, then replace the bus capacitor.
• None of the Aux. IGBT's are turning on. Check wiring between gate driver board and drive logic board. Verify that pin 8 is properly installed on J8, J9, and J10.</td></tr>
</table>

TABLE 2 - CYCLING SHUTDOWNS (CONT'D)

<table>
<tr><th>MESSAGE</th><th>DESCRIPTION</th></tr>
<tr><td>VSD – Run Signal</td><td>The drive requires the receipt of a run command through the communication system, and a run command through hardware. Regardless of which command is received first, the second command must be received within 5 seconds. This shutdown will occur if the second command is not received with the 5 second time period.
Possible Problems.
• Typically this problem is not associated with the communications system. If the communications system was the problem, then no data would be communicated between the control center and the drive.
• Hardware run signal not getting to the drive logic board. Wire 24 is the hardware run signal. When the hardware run signal is received wire 24 will have 120 VAC applied to it. Ensure that wire 24 is connected to J14 pin 2 of the drive logic board. Also ensure that wire 24 is connected to both sides of terminal block 1TB. One side of 1TB should have wire 24 coming from the control center. The other side of 1TB should have wire 24 connected that runs to the drive logic board.
• Wire 24 does not change state to 120 VAC. In the control center find wire 24 on I/O board. Connect a voltage meter between the wire 24 connection and earth. Start the chiller. Does wire 24 change from 0 VAC to 120 VAC. If it does not, then verify that the wire 24 signal from the micro board is changing state. If the voltage does not change on the micro board, then replace the micro board. If the voltage does change, then validate the ribbon cable between the micro board and the I/O board. If the cable is bad, then replace the cable. If the cable is properly connected, and is in good condition, then replace the I/O board.</td></tr>
<tr><td>VSD – Serial Communications</td><td>This shutdown is generated when serial communications is missing or corrupt for 10 continuous seconds between the control center and the drive logic board.
Possible Problems.
• Communications is not working on the drive logic board. The drive logic contains 2 LED’s near the J18 connector. The LED’s are noted at RCV and XMT. Both of these LED’s should be flashing after the control center has booted up. If only the RCV is flashing, then ensure that the U66 chip is properly installed. Replace the U66 chip. If the U66 does not solve the problem, then replace the drive logic board.
• Communications not working on the control center. The micro board contains communication LED’s. Ensure that the send and receive LED’s are flashing. If the send LED is not flashing, then remove the communications cable. If the send LED is not flashing, then replace the micro board.
• Communications cable failure. Verify that the communications cable is properly connected from J18 on the drive logic board, to terminal block 2TB in the drive, and over to the control center.</td></tr>
<tr><td>VSD – Single Phase Input Power</td><td>This shutdown is generated when the RMS phase to phase voltage drops to a low limit based on the input line voltage for a period of one line cycle.
<table><tr><th>INPUT LINE VOLTAGE</th><th>LOW LIMIT VALUE</th></tr><tr><td>230</td><td>147</td></tr><tr><td>380 / 415</td><td>263</td></tr><tr><td>460</td><td>294</td></tr></table>
Possible Problems.
• Loose connection on the input wiring. Verify that the wire between the input of the drive up to the line voltage isolation board is tight and properly connected.
• Loose connection on the control wiring. Ensure that the wiring between the line voltage isolation board, and the drive logic board is properly connected.
• Loose or failed fuse holder. Fuses 4FU, 5FU, and 6FU protect the input to the line voltage isolation board. Ensure that the fuses are tight in the fuse holder, and that there are no problems with the fuses.
• Failure of the line voltage isolator board. Measure AC voltage on J25 of the drive logic board. The voltage should be around 5.3 VAC when measured phase to phase. Phase to phase measurement is from pin 1-2, 2-3 and 3-1. The value of 5.3 VAC is not absolute, but the 3 values should be balanced within a few tenth of a volt. Typically, a bad reading would be ½ the normal value on one phase. If the readings are not balanced, then disconnect the J2 connector on the line voltage isolator board and repeat these measurements at the line voltage isolator board. If the voltage is not balanced when measured at the line voltage isolation board, then replace the line voltage isolation board. If the voltage is balanced, then replace the drive logic board.</td></tr>
</table>

MESSAGE	DESCRIPTION
VSD – Stop (Fault) Contacts Open	When the drive indicates a shutdown, the fault relay on the drive logic board will open and the Fault LED will turn off. When the fault relay opens 120 VAC is no longer present on terminal block 1TB wire 53. The loss of the 120 VAC on wire 53 in the control center indicates that the drive has shutdown. If the drive does not respond with a reason why the fault relay is open, then this message will appear. **Possible Problems:** • Drive logic board failure. Is the fault LED lit? If the LED is lit, then verify if 120 VAC is present at terminal 16 and 53 on at J14 pin 4 and 3 of the drive logic board. If voltage is present on both pins, then the drive logic board is good. If voltage is present on J14 pin 4 and not on pin 3, then replace the drive logic board. If voltage is not present on J14 pin 4 or pin 3, then verify the wiring connections between J14, 1TB and the I/O board in the control center. • I/O board failure in the Control Center. • Failure of the ribbon cable between the I/O board and the microboard.

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SECTION 6 - WARNING MESSAGES

GENERAL INFORMATION

A WARNING message will indicate that the operation of the Drive is affected in some manner, but the Drive is still functioning.

TABLE 3 - WARNING MESSAGES

MESSAGE	DESCRIPTION
WARNING – VSD – DC Bus Active	This warning is displayed anytime the DC bus voltage is greater than 50 volts and the drive is not in the run state. If this warning is still active 10 minutes after the precharge command has been removed from the drive, then typically, this warning indicates that the Aux. IGBT has failed. When the Aux. IGBT is shorted power cannot be removed from the bus, and the bus capacitor will remained charged. As long as the drive remains power, no more of a failure will occur, and the chiller can still run in this condition. If power is removed from the drive, and reapplied precharge of the bus capacitor will occur as soon as power is applied. The precharge will not control the amount of current flowing into the bus capacitor, because of the shorted Aux. IGBT. THIS WILL CAUSE A FAILURE OF THE INPUT/RECTIFIER. Do not apply power to the drive until the cause of this warning is determined.

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SECTION 7 - START-UP PREPARATIONS

CIRCUIT BREAKER SETUP

The circuit breaker used on the HYP model drive has many settings for overload, short circuit, and ground fault protection. Generally, these setting are adjusted by the manufacture, but these setting should be verified before starting the chiller. The breaker settings for each drive are a little different. Details for the circuit breaker settings are listed below.

TABLE 4 - SETTINGS FOR CIRCUIT BREAKER

SETTINGS FOR THE 0490 AMP CIRCUIT BREAKER (P/N 224-37879-000)		
NAME OF ADJUSTMENT	**ABBREVIATION OF ADJUSTMENT**	**SETTING VALUE**
Long Time Pickup	“IR”	“F”
Long Time Delay	“TR”	“2”
Short Time Pickup	“ISD”	“2”
Short Time Delay	“TSD”	“J”
Ground Fault Pickup	“IG”	“0.2”
SETTINGS FOR THE 0774 AMP CIRCUIT BREAKER (P/N 224-37855-000)		
Long Time Delay	“TR”	“2”
Short Time Pickup	“ISD”	“2”
Ground Fault Pickup	“IG”	“0.2”
Ground Fault Delay	“TSD”	“J”

OPTIVIEW CONTROL CENTER

Make certain the correct EPROMs are all installed in the proper locations. Be sure the dimple in the end of the chip is oriented in the correct direction.

Perform a visual inspection of the drive. Ensure that all wiring and wiring connectors are tight and properly seated. Verify that no coolant leaks are present in the drive. Inspect the power assemblies, coolant headers, and liquid cooled inductors for any signs of a coolant leak.

Apply power to the chiller, and check the System Status Line on the Control Center. After a few seconds you should get the message, “System Ready to Start”.

If you do not see the message, “System Ready to Start”, then turn off power, wait five minutes for the voltage to discharge, verify voltage is no longer present, and then double check all wiring and connections.

1. If initial power-up is successful, verify that the programmed input current is the same as listed on the contract screen. The input current is now programmed from the control center. The drive logic board does not have a trimpot for this adjustment any more.
2. Next, drain the coolant from the drive. Follow the drain procedure found below. The drive is shipped with a 50/50 mix of Propylene Glycol and YORK Corrosion Inhibitor. This type of coolant is being used to protect the cooling loop from damage due to freezing conditions during the shipping process. This coolant mixture does not have the thermodynamic properties required by the drive, and may cause it to overheat. Thus, this 50/50 mixture must be drained and replaced with YORK Corrosion Inhibitor as currently used in the drive. **Propylene Glycol is the same material used to winterize recreational vehicles. Although, it is non-toxic we suggest permission should be obtained before discarding it into a sewer.**
3. Next, fill the coolant loop using YORK's Corrosion Inhibitor, part number 013-02987-000. Follow the fill procedure found in this form. The coolant pump/pumps can be turn on and off from a selection on the control panel.

SERVICE PROCEDURES

General

The following are detailed steps required to drain, fill and vent the cooling loop for the 0490 and 0774 HYP model of drive. All of these steps are to be followed completely to prevent the introduction of air into this system. There are individual components of this system that by their design may contribute to air entrainment and can cause the VSD to overheat some specific piping components that are not thermally protected.

VSD Cooling System Components

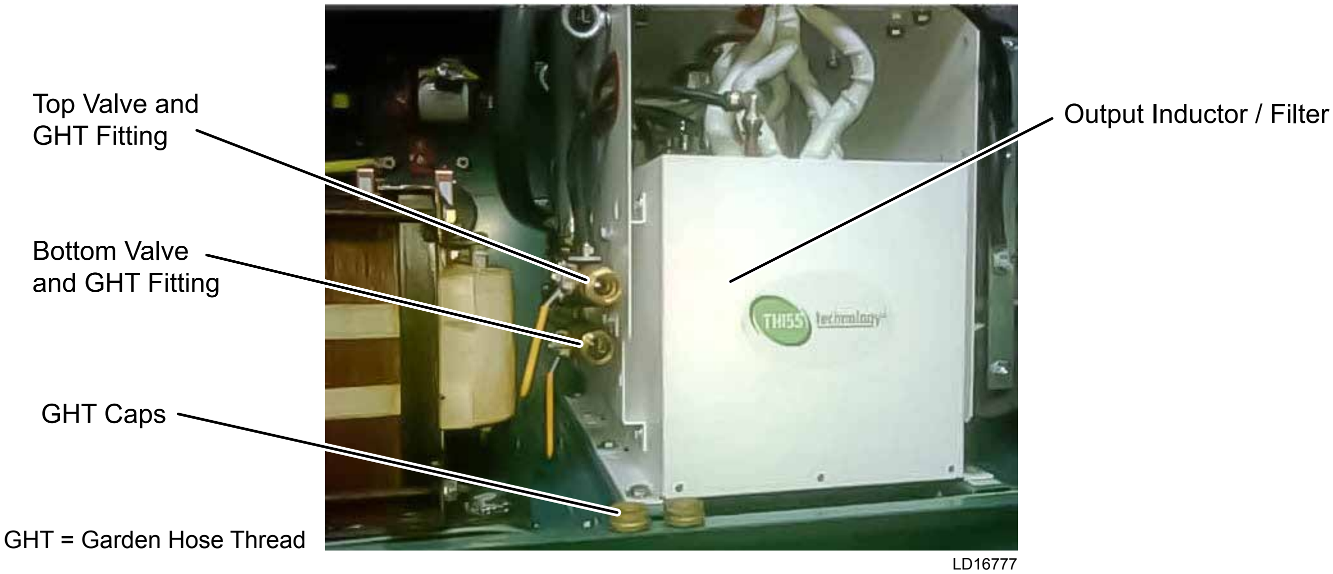


FIGURE 20 - COOLING SYSTEM INSIDE OF VSD

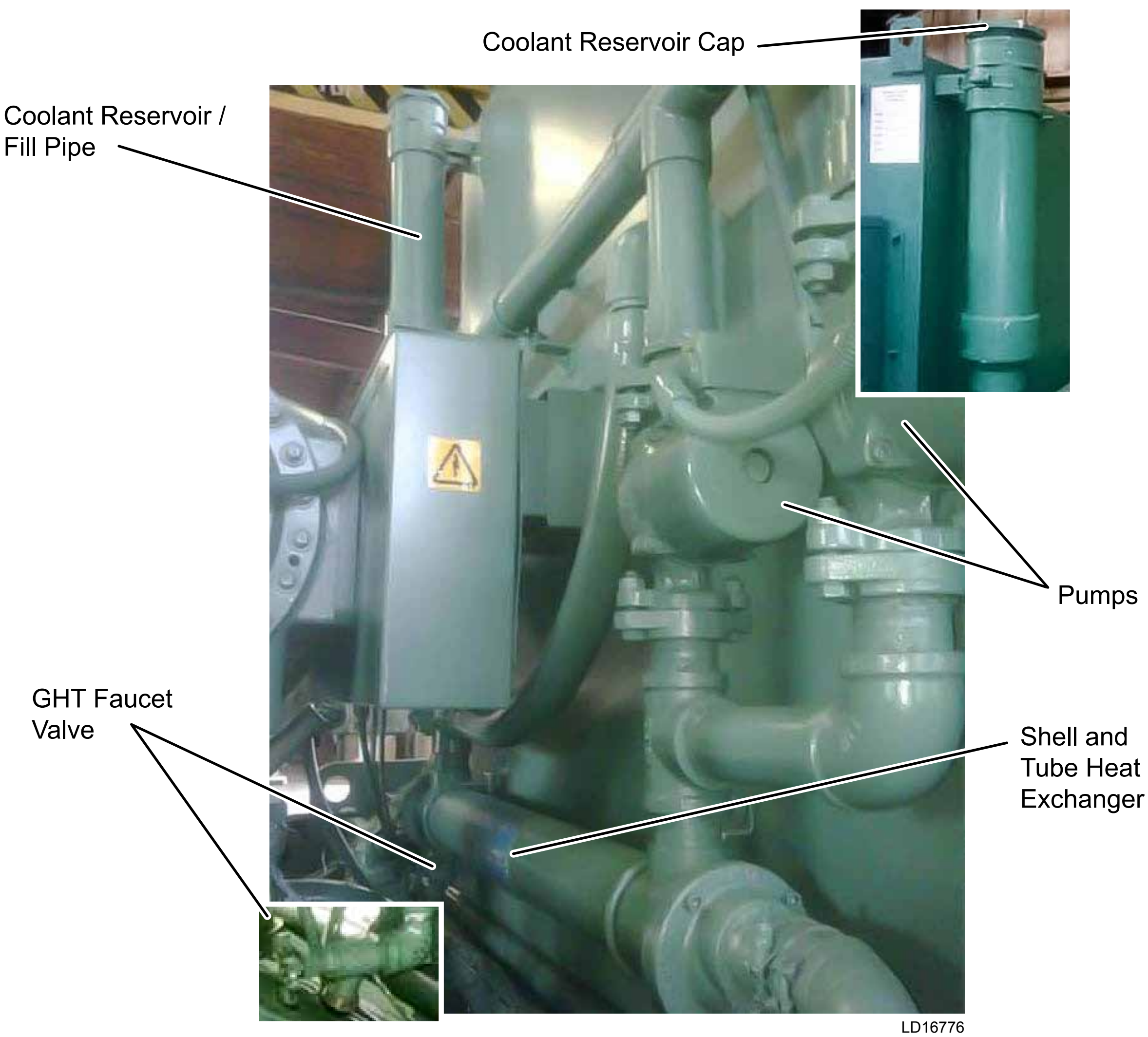


FIGURE 21 - COOLING SYSTEM ON THE BACK OF THE VSD

DRAINING THE SYSTEM

NOTE

All fluids drained containing Propylene Glycol or Inhibited Water should be collected and disposed of properly according to facility procedures.

If two hoses are available, the heat exchanger and the output filter can be drained at the same time. (Refer to *Figure 20 on page 70* and *Figure 21 on page 70*)

1. Remove coolant reservoir cap.
2. Attach drain hose to GHT faucet valve on the bottom of the shell and tube heat exchanger.
3. Ensure supply manifold valve(s) are open.
4. Open the heat exchanger drain valve to allow coolant to drain. Once coolant stops flowing close the valve, and remove drain hose.
5. Attach drain hose to the top fitting of the output inductor inside the VSD cabinet.
6. Open top valve of the output inductor to allow coolant to drain. Once coolant stops flowing close the valve, and remove drain hose.
7. Attach drain hose to the bottom fitting of the output inductor.
8. Open bottom valve of the output inductor to allow coolant to drain.
9. Install coolant reservoir cap to prevent too much air leaking out.
10. Apply 5 PSI compressed air in the top fitting on the output inductor to blow residual liquid out of the output inductor.

    Warning – Do NOT exceed the 5 PSI rating. Damage to the cooling system my result.

    Once coolant stops flowing turn off the air supply, close the valve, and remove drain hose.
11. Attach drain hose to the valve on the bottom of the shell and tube heat exchanger.
12. Open heat exchanger drain valve, repeat step #10 to allow remaining coolant to drain from the shell and tube heat exchanger.
13. Close all valves and replace all caps. System is now drained.

COOLANT FILL PROCEDURE

Part Numbers

Inhibited Water (Pink)

1 gal = 013-02987-000
55 gal = 013-03346-000

Propylene Glycol (Yellow)

5 gal = 013-03344-000
55 gal = 013-03345-000

WARNING

Coolants may foam up when cycled through the system or when the pumps are shut off and the coolants tend to rise. Do not fill reservoir to top while unit is running or it may overflow when pumps are shut off.

1. Confirm that the heat exchanger drain valve and both of the output inductor drain valves are closed.
2. Open supply manifold valve(s).
3. Remove the cap from the coolant reservoir.
4. Connect a low volume pump to the bottom fitting on the output inductor.
5. Use the low volume pump to fill the coolant loop. Open the valve for the bottom fitting on the output inductor. Slowly, fill the cooling system until coolant is within 1 inch from the top of the coolant reservoir.
6. Close the valve for the bottom fitting on the output inductor, and remove the low volume pump. Wipe up any inhibitor that may have dripped.
7. Apply power to the chiller.
8. Start pumps using the OptiView panel.

    Press: Home > VSD > VSD Details > Manual Cooling > Enable.
9. Allow pumps to run for 15 seconds.
10. Disable the pumps.

    Press: Home > VSD > VSD Details > Manual Cooling > Disable.
11. Check the fill pipe and add more inhibitor if needed to bring the level back to the within 1 inch from the top.

12. Start the pumps and run for 5 minutes.
13. Disable the pumps and check the fill pipe. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
14. Close the supply manifold valve(s).
15. Start the pumps and run for 5 minutes.
16. Disable the pumps and check the fill pipe. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
17. Open the supply manifold valve(s).
18. Start the pumps and run for 10 minutes.
19. Disable the pumps and check the fill pipe. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
20. Close the supply manifold valve(s).
21. Start the pumps and run for 10 minutes.
22. Disable the pumps and check the fill pipe. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
23. Open the supply manifold valve(s).
24. Start the pumps and run for 15 minutes.
25. Disable the pumps and check the fill pipe. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
26. Close the supply manifold valve(s).
27. Start the pumps and run for 15 minutes.
28. Disable the pumps and check the fill pipe. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
29. Open the supply manifold valve(s).
30. Start the pumps and run for 20 minutes.
31. Disable the pumps.
32. Check the fill pipe for inhibited water level. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.
33. Check the fill pipe again for inhibitor level at 1 hour and 24 hours of operation. Add more inhibitor if needed to bring the level back to the within 1 inch from the top.

SECTION 8 - TROUBLESHOOTING AND COMPONENT REPLACEMENT PROCEDURES

GENERAL INFORMATION

The following procedures are designed to guide the service technician along the path that leads to the identification of the cause for the problem. The service technician should understand the operation of the HYP model drive and function of each major component. It is recommended that the service technician read and understand the information contained in this instruction prior to troubleshooting this product. Also, the service technician must understand the system interface and be able to utilize system wiring diagrams to follow signal flow throughout the system. Due to the integration of the HYP model drive with the Graphic Control Center, a good working knowledge of the Control Center is also necessary (Refer to the Associated Literature listed at the beginning of this document).

Several levels of documentation are required for the troubleshooting process. The HYP model drive wiring diagram, (Form 160.84-PW4) supplied with every drive is the top level document. It provides the overall wiring and configuration. Sections of this instruction provide the required lower level understanding. Specifically, block diagrams provide signal flow and simplified representations of all board circuitry.

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

NOTE

Some of the protection circuitry for the drive is protected by fuses. If these fuses are open, then the protection circuit will not protect the drive. A failure of these fuses will not cause the drive to perform differently, and no faults will occur. It is best practice to verify that all fuses are still in working order every time the drive is entered.

NOTE

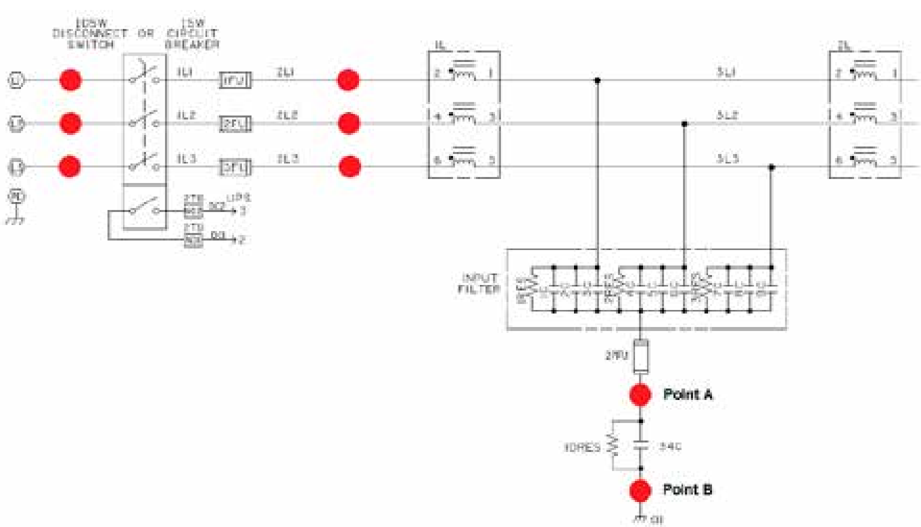
Due to the way the input fuses are manufactured, if any of the fuses are open, then all three fuses must be replaced.

SAFE ENTRY PROCEDURE

WARNING

This product contains voltages that could cause injury or death. Follow all NFPA-70E safety rules. Before performing any troubleshooting procedures. Place the compressor switch in the stop position. Wait 5 minutes. Ensure that the DC BUS voltage is 50 VDC or less on the display of the chiller control panel. Ensure that all sources of power to the chiller are removed. Remove all AC power sources upstream of the VSD and perform lockout / tagout procedures. Use a non-contact voltage sensor to ensure no AC power is present in the enclosure. Use a DVM to measure AC and DC voltage at locations shown below. Measure the three phase connections phase to phase and phase to ground. All values should be zero. Measure voltage from Point A to Point B.

Measure the BUS voltage at J1 pins 1-2 on the VSD logic board using a DVM to ensure that BUS voltage is less than 50 VDC.



LD18180

SIGNAL PHASE POWER PROCEDURE (MODEL 0490)

This procedure allows for the application of 120 VAC to the VSD and the Control Center so that fault history can be downloaded and various troubleshoot processes can be performed without the application of utility power.

Not following this procedure correctly may cause 120 VAC to back feed through the control transformer and cause utility power levels to be present in the VSD enclosure.

- Perform the “Safe Entry Procedure” found in this form before continuing.
- Refer to the *Figure 22 on page 74* for model 0490 below for reference.
- Remove fuses 7FU and 8FU from the circuit. They are located on the left wall of the enclosure.
- Remove fuses 14FU, 15FU, and 19FU from the circuit. They are located on the back wall of the enclosure.
- Connect a jumper between terminals 1, L, and UPSL on TB1.
- With power removed from the 120 VAC source. Connect one side of the 120 VAC source to terminal 1 on TB1.
- Connect the other side of the 120 VAC source to terminal 2 on TB3.
- Turn on the 120 VAC source. The control panel should begin to boot up, and the LED’s on the drive logic board will light up.

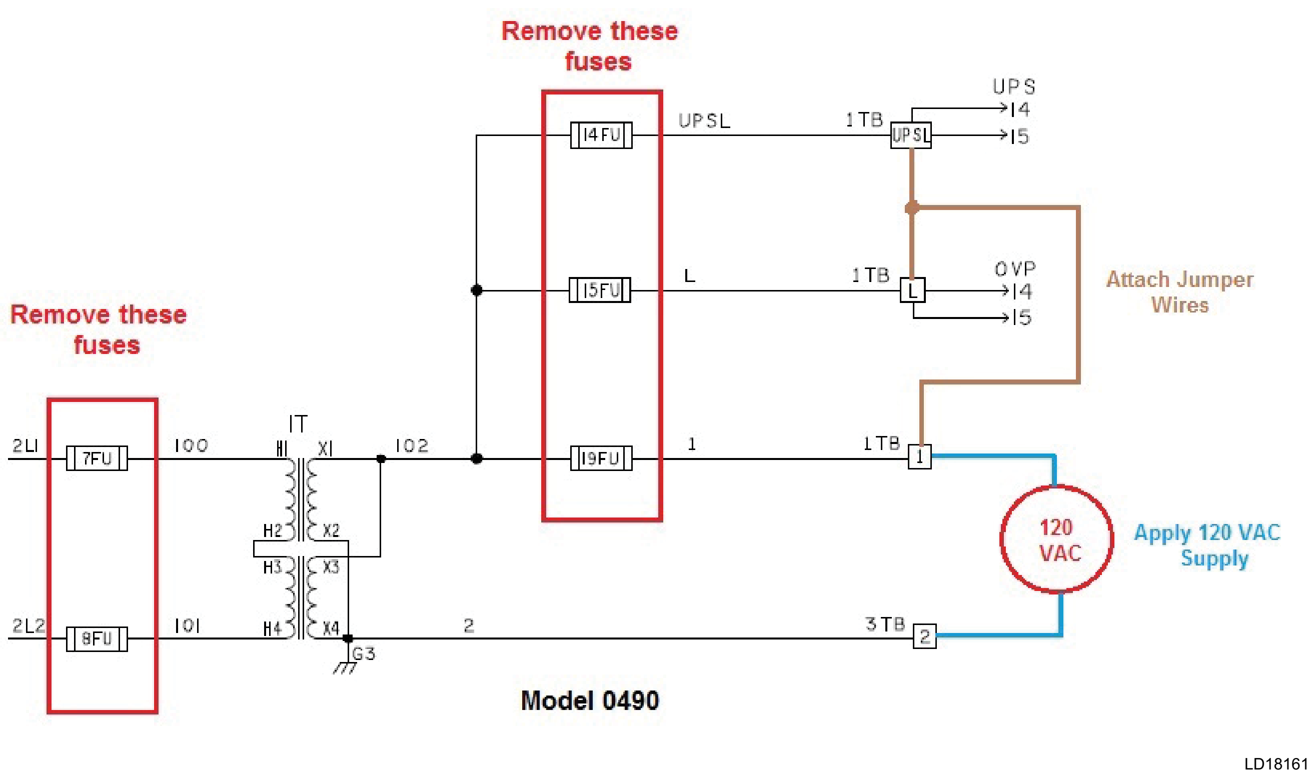
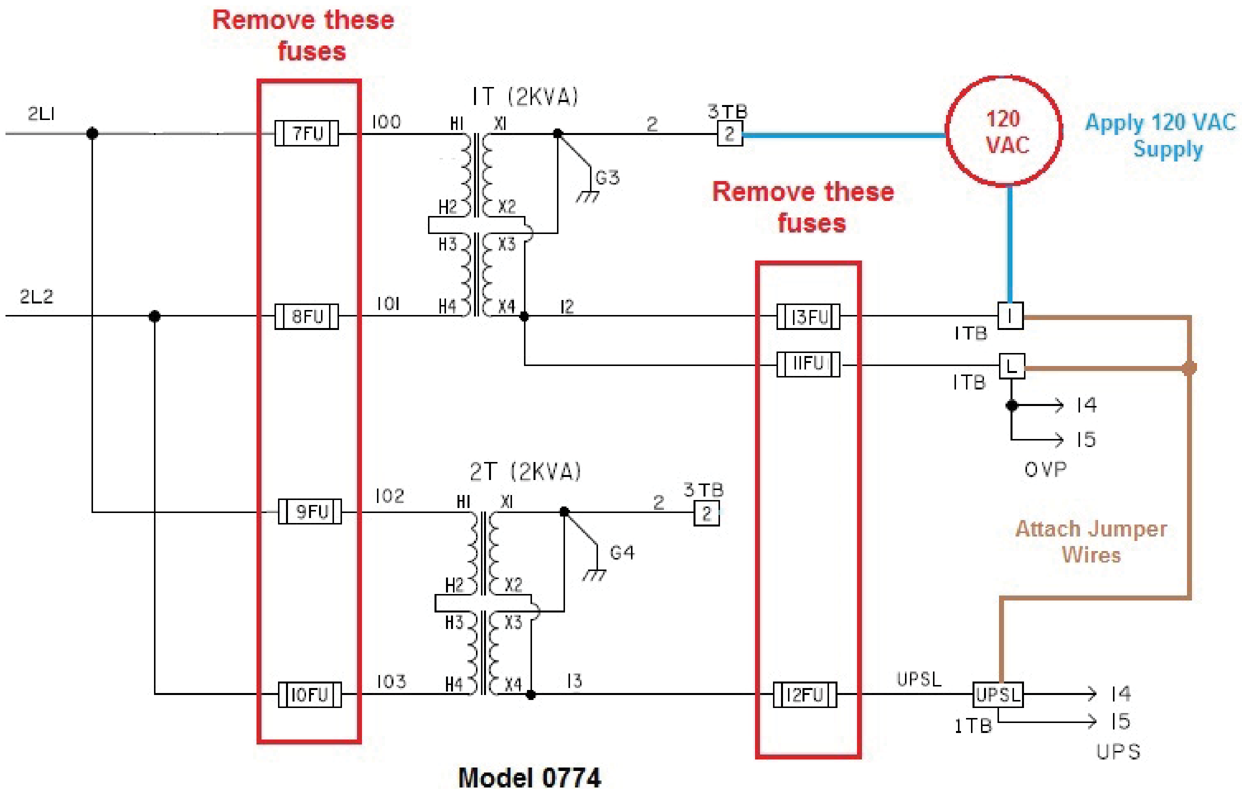


FIGURE 22 - SIGNAL PHASE POWER PROCEDURE (MODEL 0490)

SIGNAL PHASE POWER PROCEDURE (MODEL 0774)

Refer to the comments and WARNING in the model 0490 procedure.

- Perform the "Safe Entry Procedure" found in this form before continuing.
- Refer to the *Figure 23 on page 75* for model 0774 below for reference.
- Remove fuses 7FU through 10FU from the circuit. They are located on the left wall of the enclosure.
- Remove fuses 11FU through 13FU from the circuit. They are located on the right wall of the enclosure.
- Connect a jumper between terminals 1, L, and UPSL on TB1.
- With power removed from the 120 VAC source. Connect one side of the 120 VAC source to terminal 1 on TB1.
- Connect the other side of the 120 VAC source to terminal 2 on TB3.
- Turn on the 120 VAC source. The control panel should begin to boot up, and the LED's on the drive logic board will light up.



LD18162

FIGURE 23 - SIGNAL PHASE POWER PROCEDURE (MODEL 0774)

INVERTER TEST MODE

The following requirements must be present before this test will function.

- The chiller system must be in the off state.
- The DC bus voltage must be below 50 VDC.
- No VSD faults can be present except for “Line Voltage Single-Phase”, “Line Voltage Phase Lock Loop”, or “Line Voltage Phase Rotation”. One or all of these faults maybe present if line voltage is removed, and single phase power is connected. Single phase power is not required for this test to function. If single phase power is used during this test the rectifier gate driver LED’s will flash during the test below.
- At least 4 minutes since the chiller was last stopped, or power was applied to the VSD logic board.

Once the above requires are met, then follow these steps below to use the “Inverter Test Mode”.

- Place the chiller control panel into “Service Mode”.
- Navigate to the “Variable Speed Drive Details Screen”.
- Press the “Test Mode” button. A drop down box will appear to select “Enable”. The LED on the Test Mode button will turn on when the VSD acknowledges test mode through communications. Test Mode will run until it is disabled or unless one of the above requirements is no longer valid.
- The motor/inverter gate driver LED’s on the drive logic board will turn on, but only 3 LED’s at a time. These LED’s are located near connectors J11, J12, and J13. These LED’s will remain lit for 1 second, and then turn off for 1 second. None of the inverter gate drive LED’s should be lit at this time. The other set of 3 LED’s will now turn on for 1 second and then turn off for 1 second. None of the inverter gate drive LED’s should be lit at this time. The LED’s on the gate driver board will respond in the same manner, except the off state for the gate driver will have the LED lit. So instead of there being a time when all 6 LED’s are off, there will be a time when all 6 LED’s are lit. Verify that the LED’s are flashing on the drive logic board and on the gate driver boards for the motor/inverter.
- If the LED’s do not function properly on the drive logic board, then replace the drive logic board.
- If the LED’s do not function properly one the gate driver boards, then rotate the non-functioning gate driver board onto a phase where the gate driver board is working. Repeat the above test. If the problem follows the non-functioning gate driver board, then replace the non-functioning gate driver board. If the problem appears on a gate driver board that was working, then replace the gate driver cable between the gate driver board and the drive logic board.
- Once this test is complete, press the “Test Mode” button. A drop down box will appear to select “Disable”. The LED on the Test Mode button will turn off.

Verify a Rectifier Failure

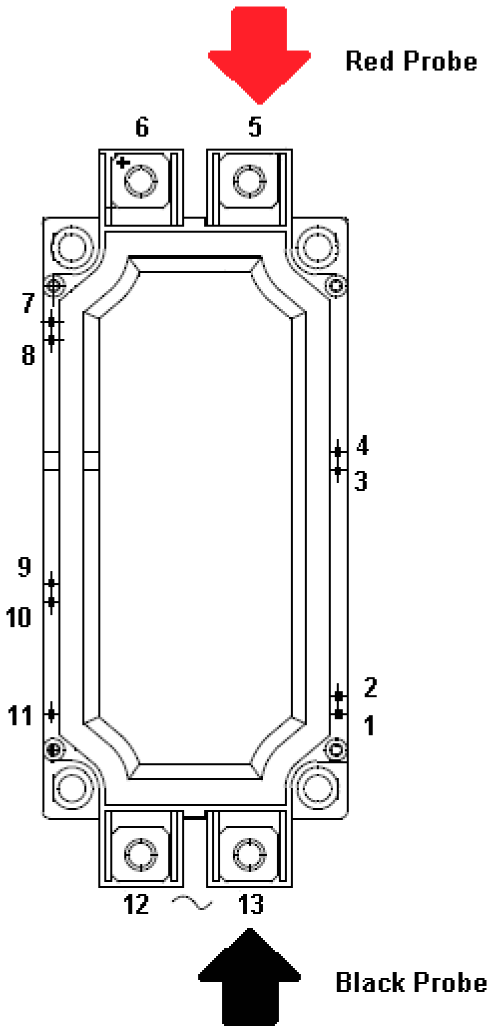
General Information

The procedure below should only be used after all Lockout and Tag out procedures are performed, and the proper verification performed to determine that the drive is safe to enter. The steps below provide information on where to connect a digital ohm meter or an analog ohm meter. The digital ohm meter will need to be set to the diode reading. The analog ohm meter will need to be set to read resistance on the Rx1 scale. The resistance readings for these tests will indicate that the diode in the device is turned on or turned off. The absolute resistance values are not that important. The digital meter will indicate a low voltage reading when the diode is turned on such as 0.3-0.4 volts. With the digital meter the voltage will be higher when the diode is turned off such as a reading of 2.0 to 3.0 volts or overload. The analog meter will read resistance of 5 – 15 ohms when the diode is on. The analog meter will read greater than 70 ohms when the diode is turned off. For reading the meter when the diode is off, it may take a few seconds for the meter to respond correctly because of the bus capacitors in the circuit.

Make a copy of the Diode Check Table found at the end of the Verify an Inverter Failure test in this form. Fill in the Diode Check Table while performing these tests. The table will be used for all drive models. Depending on the drive model under test there may be blank spaces in the table.

8

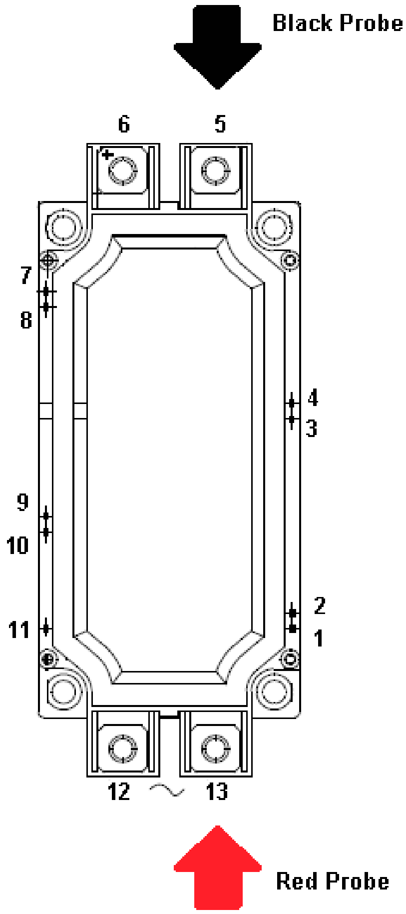
Step 1



LD16796

1. Place the Red or Positive probe of the meter on Pin 5 of the IGBT assembly.
2. Place the Black or Negative probe of the meter on Pin 13 of the IGBT assembly.
3. A normal reading will indicate that the switch is “ON”.

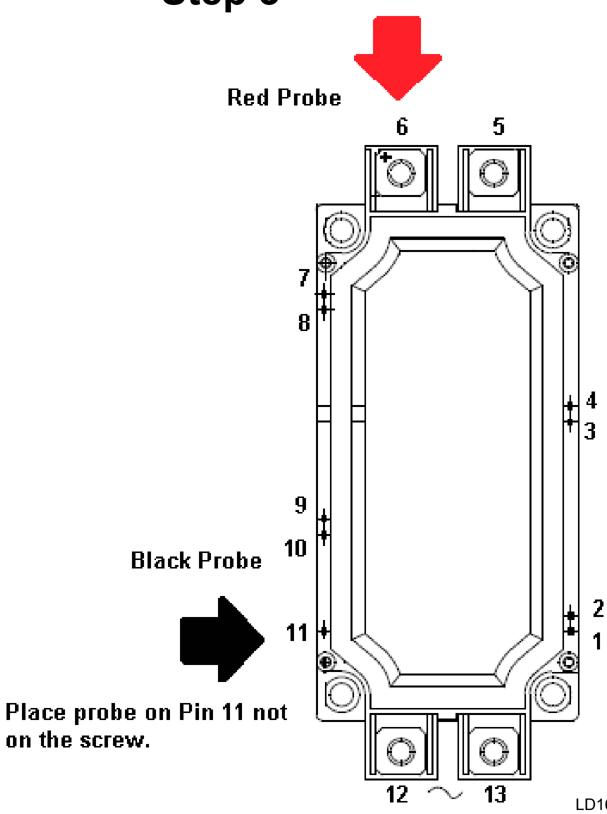
Step 2



LD16797

1. Place the Black or Negative probe of the meter on Pin 5 of the IGBT assembly.
2. Place the Red or Positive probe of the meter on Pin 13 of the IGBT assembly.
3. A normal reading will indicate that the switch is "OFF".

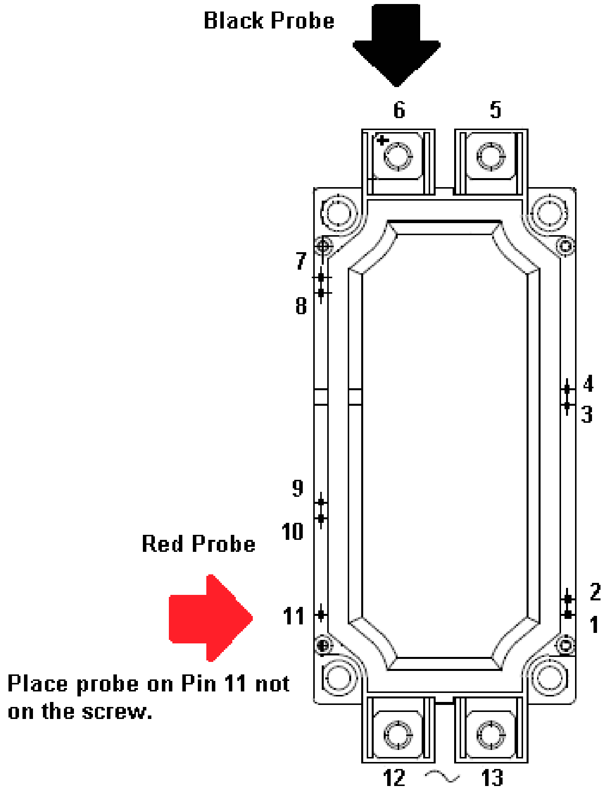
Step 3



LD16798

1. Place the Red or Positive probe of the meter on Pin 6 of the IGBT assembly.
2. Place the Black or Negative probe of the meter on Pin 11 of the IGBT assembly.
3. A normal reading will indicate that the switch is "ON".

Step 4

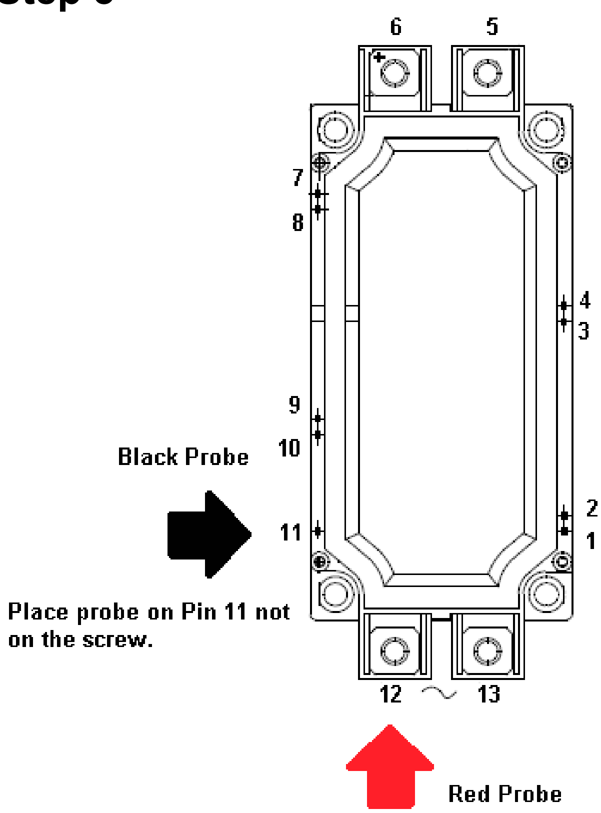


LD16799

1. Place the Black or Negative probe of the meter on Pin 6 of the IGBT assembly.
2. Place the Red or Positive probe of the meter on Pin 11 of the IGBT assembly.
3. A normal reading will indicate that the switch is "OFF".

8

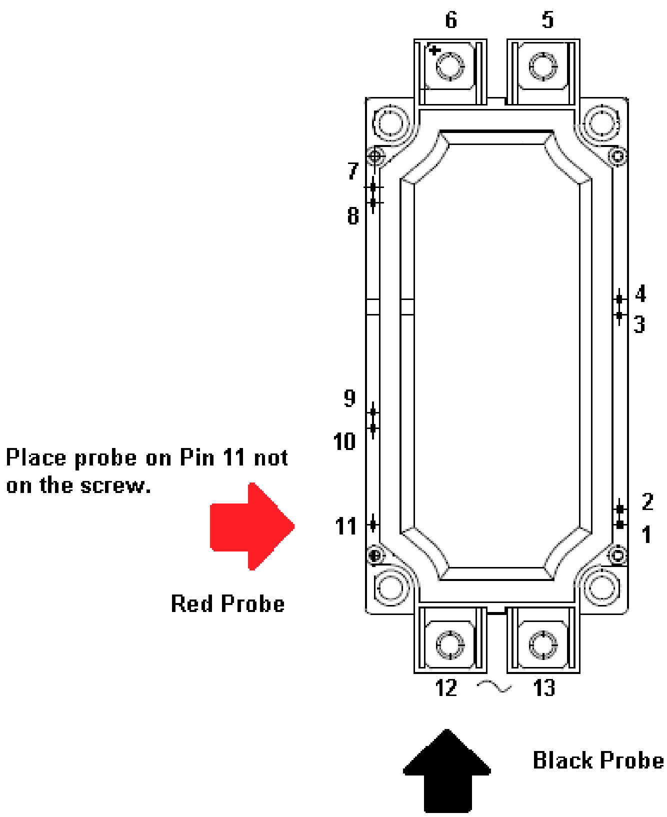
Step 5



LD16800

1. Place the Black or Negative probe of the meter on Pin 11 of the IGBT assembly.
2. Place the Red or Positive probe of the meter on Pin 12 of the IGBT assembly.
3. A normal reading will indicate that the switch is "ON".

Step 6



LD16801

1. Place the Red or Positive probe of the meter on Pin 11 of the IGBT assembly.
2. Place the Black or Negative probe of the meter on Pin 12 of the IGBT assembly.
3. A normal reading will indicate that the switch is “OFF”.

Repeat this test for each rectifier module in the suspected phase. If any of the modules failed this test then the complete rectifier assembly for that phase must be replaced.

NOTE

If any of the input power fuses failed, then all 3 of the input power fuses must be replaced.

NOTE

The rectifier assembly associated with an input power fuse failure must be replaced regardless of test results. For example, if the A and C phase input power fuses failed, and the C phase rectifier assembly failed the above test, but the A phase assembly passed the above test, then the A phase rectifier assembly must also be replaced.

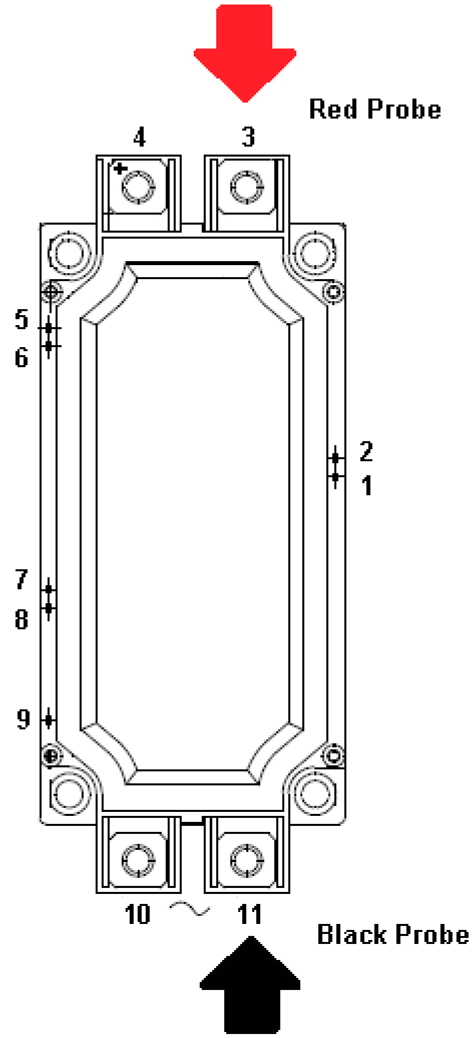
Verify an Inverter Failure

General Information

The procedure below should only be used after all Lockout and Tag out procedures are performed, and the proper verification performed to determine that the drive is safe to enter. The steps below provide information on where to connect a digital ohm meter or an analog ohm meter. The digital ohm meter will need to be set to the diode reading. The analog ohm meter will need to be set to read resistance on the Rx1 scale. The resistance readings for these tests will indicate that the diode in the device is turned on or turned off. The absolute resistance values are not that important. The digital meter will indicate a low voltage reading when the diode is turned on such as 0.3-0.4 volts. With the digital meter the voltage will be higher when the diode is turned off such as a reading of 2.0 to 3.0 volts or overload. The analog meter will read resistance of 5 – 15 ohms when the diode is on. The analog meter will read greater than 70 ohms when the diode is turned off. For reading the meter when the diode is off, it may take a few seconds for the meter to respond correctly because of the bus capacitors in the circuit.

Make a copy of the Diode Check Table found at the end of the Verify an Inverter Failure test in this form. Fill in the Diode Check Table while performing these tests. The table will be used for all drive models. Depending on the drive model under test there may be blank spaces in the table.

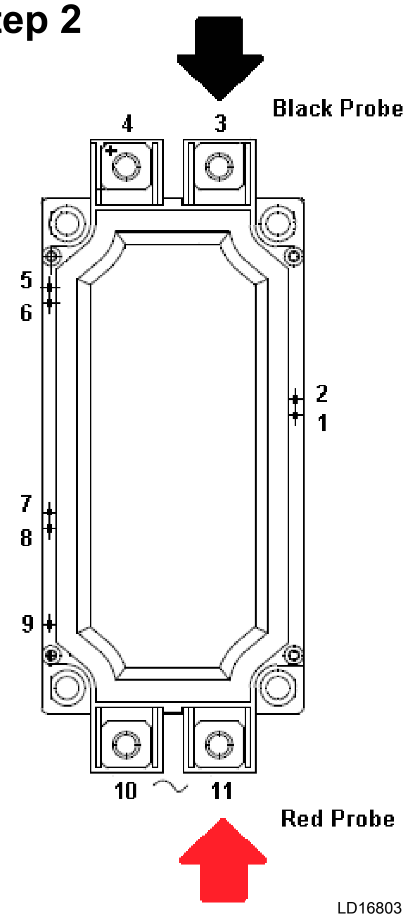
Step 1



1. Place the Red or Positive probe of the meter on Pin 3 of the IGBT assembly.
2. Place the Black or Negative probe of the meter on Pin 11 of the IGBT assembly.
3. A normal reading will indicate that the switch is “ON”.

LD16802

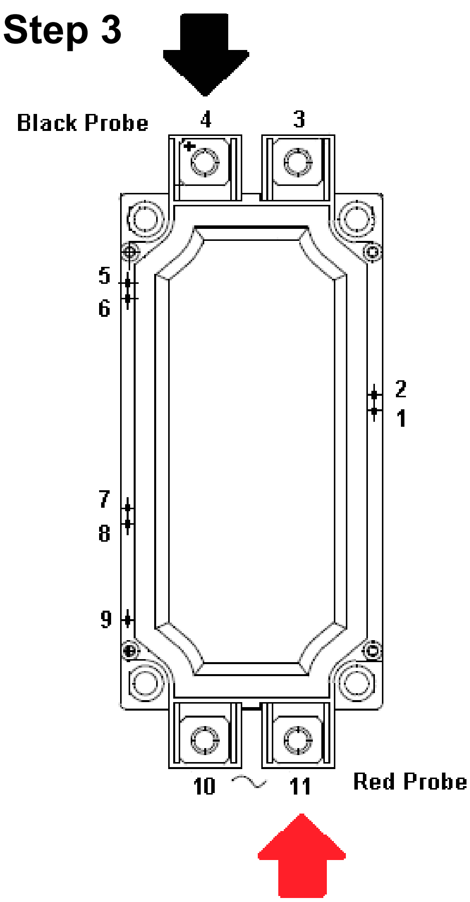
Step 2



LD16803

1. Place the Black or Negative probe of the meter on Pin 3 of the IGBT assembly.
2. Place the Red or Positive probe of the meter on Pin 11 of the IGBT assembly.
3. A normal reading will indicate that the switch is “OFF”.

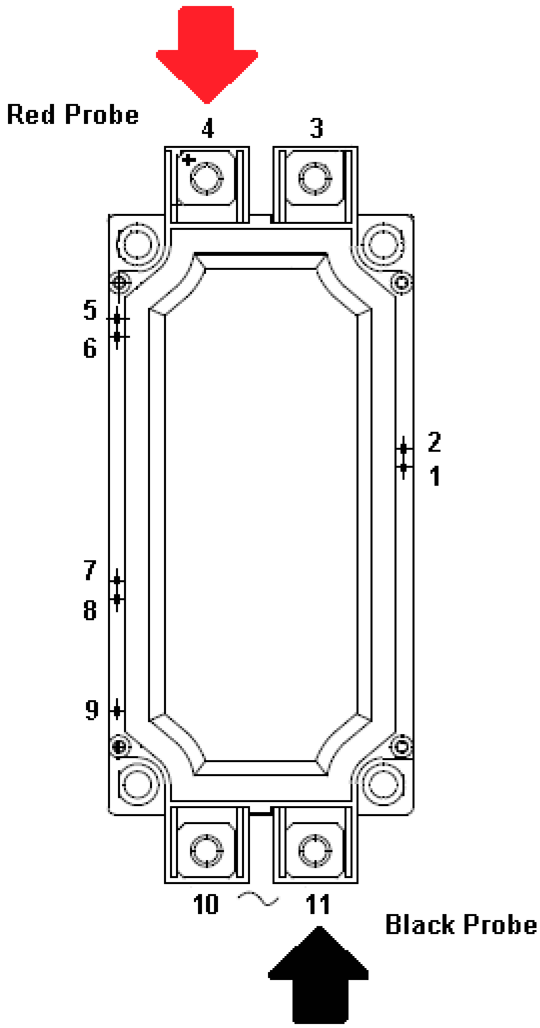
Step 3



LD16804

1. Place the Black or Negative probe of the meter on Pin 4 of the IGBT assembly.
2. Place the Red or Positive probe of the meter on Pin 11 of the IGBT assembly.
3. A normal reading will indicate that the switch is “ON”.

Step 4



LD16805

1. Place the Black or Negative probe of the meter on Pin 4 of the IGBT assembly.
2. Place the Red or Positive probe of the meter on Pin 11 of the IGBT assembly.
3. A normal reading will indicate that the switch is "OFF".

Repeat this test for each inverter module in the suspected phase. If any of the modules failed this test then the complete inverter assembly for that phase must be replaced.

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IGBT / DIODE CHECK SHEET

	Positive Probe Location	Negative Probe Position	Digital Meter Correct Answer	Analog Meter Correct Answer	Front					Rear
PHASE A	Rectifier									
	5	13	0.3-0.4 volts	5-15 ohms						
	13	5	2.0-3.0 volts	> 70 ohms						
	6	11	0.3-0.4 volts	5-15 ohms						
	11	6	2.0-3.0 volts	> 70 ohms						
	12	11	0.3-0.4 volts	5-15 ohms						
	11	12	2.0-3.0 volts	> 70 ohms						
	Inverter									
	3	11	0.3-0.4 volts	5-15 ohms						
	11	3	2.0-3.0 volts	> 70 ohms						
	11	4	0.3-0.4 volts	5-15 ohms						
	4	11	2.0-3.0 volts	> 70 ohms						
PHASE B	Rectifier									
	5	13	0.3-0.4 volts	5-15 ohms						
	13	5	2.0-3.0 volts	> 70 ohms						
	6	11	0.3-0.4 volts	5-15 ohms						
	11	6	2.0-3.0 volts	> 70 ohms						
	12	11	0.3-0.4 volts	5-15 ohms						
	11	12	2.0-3.0 volts	> 70 ohms						
	Inverter									
	3	11	0.3-0.4 volts	5-15 ohms						
	11	3	2.0-3.0 volts	> 70 ohms						
	11	4	0.3-0.4 volts	5-15 ohms						
	4	11	2.0-3.0 volts	> 70 ohms						
PHASE C	Rectifier									
	5	13	0.3-0.4 volts	5-15 ohms						
	13	5	2.0-3.0 volts	> 70 ohms						
	6	11	0.3-0.4 volts	5-15 ohms						
	11	6	2.0-3.0 volts	> 70 ohms						
	12	11	0.3-0.4 volts	5-15 ohms						
	11	12	2.0-3.0 volts	> 70 ohms						
	Inverter									
	3	11	0.3-0.4 volts	5-15 ohms						
	11	3	2.0-3.0 volts	> 70 ohms						
	11	4	0.3-0.4 volts	5-15 ohms						
	4	11	2.0-3.0 volts	> 70 ohms						

The following factors can be used to convert from English to the most common SI Metric values.

TABLE 5 - SI METRIC CONVERSION

MEASUREMENT	MULTIPLY ENGLISH UNIT	BY FACTOR	TO OBTAIN METRIC UNIT
Capacity	Tons Refrigerant Effect (ton)	3.516	Kilowatts (kW)
Power	Horsepower	0.7457	Kilowatts (kW)
Flow Rate	Gallons / Minute (gpm)	0.0631	Liters / Second (l/s)
Length	Feet (ft)	0.3048	Meters (m)
	Inches (in)	25.4	Millimeters (mm)
Weight	Pounds (lbs)	0.4538	Kilograms (kg)
Velocity	Feet / Second (fps)	0.3048	Meters / Second (m/s)
Pressure Drop	Feet of Water (ft)	2.989	Kilopascals (kPa)
	Pounds / Square Inch (psi)	6.895	Kilopascals (kPa)

TEMPERATURE

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), subtract 32° and multiply by 5/9 or 0.5556.

Example: (45.0°F - 32°) x 0.5556 = 27.2°C

To convert a temperature range (i.e., a range of 10°F) from Fahrenheit to Celsius, multiply by 5/9 or 0.5556.

Example: 10.0°F range x 0.5556 = 5.6 °C range

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