

Optispeed VSD

7049DV001



Agenda



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Agenda

- Day 1
- Day 2
- Day 3
- Resources



Vyper VSD Architecture



Harmonic Filter



The ACC Board



Checking for Catastrophic Faults

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Agenda

Day 1

Day 2

Day 3

Resources



The Cooling System



VSD Start-up



Calibrating the PRV Potentiometer



Power Distribution



Input Rectifier Module Replacement



Optispeed 7049 Operational Lab



Output Pole Replacement



Troubleshooting



Course Introduction



Welcome to the OptispeedCourse!

Let's introduce ourselves...

- Participant introduction
 - Name, location, years with the company
 - Experience working on VSD's
- Your Expectations
 - What do you want to learn this week?
- Instructor introduction



Housekeeping Issues

- Tent Name Cards
- Security Policies
- Bathrooms
- Smoking
- Class/Lunch (map)
- Break areas
- Fill out paperwork
- Class Roster
- Binder material
- Tour lab facility
- Lab safety requirements
- Cell Phones
- Evacuation

Learning Objectives:

At the conclusion of this course, you will be able to:

- Comprehend the **theory**, **operation**, and **application** of Variable Speed Drives.
- **Locate** and **identify** the components associated with the Style “D” and Vyper Variable Speed Drives.
- Explain the **functionality** of components associated with Variable Speed Drives.
- Demonstrate a basic understanding of how to **identify** and **analyze** Variable Speed Drive problems and **apply** troubleshooting techniques

Optispeed

The Basics

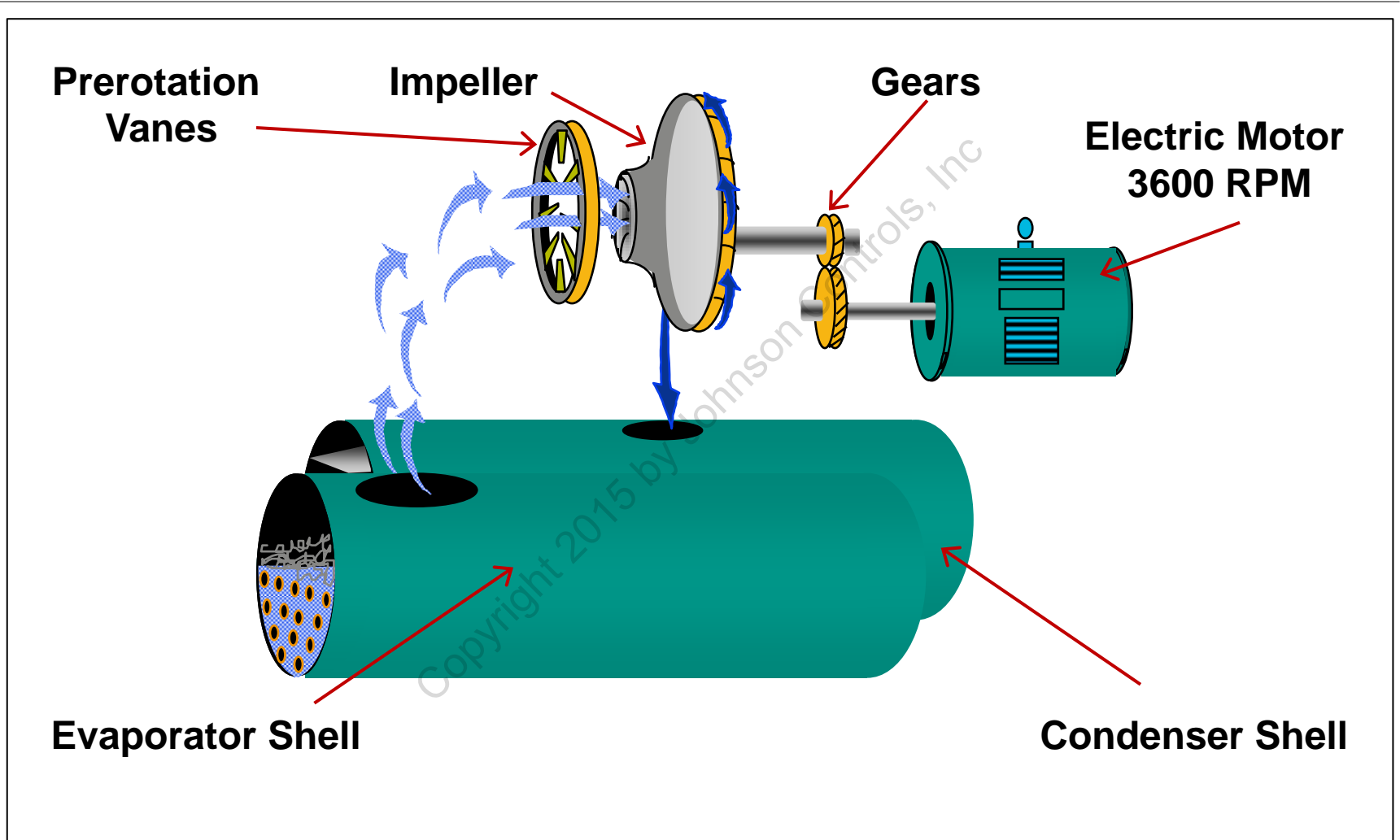


The Basics

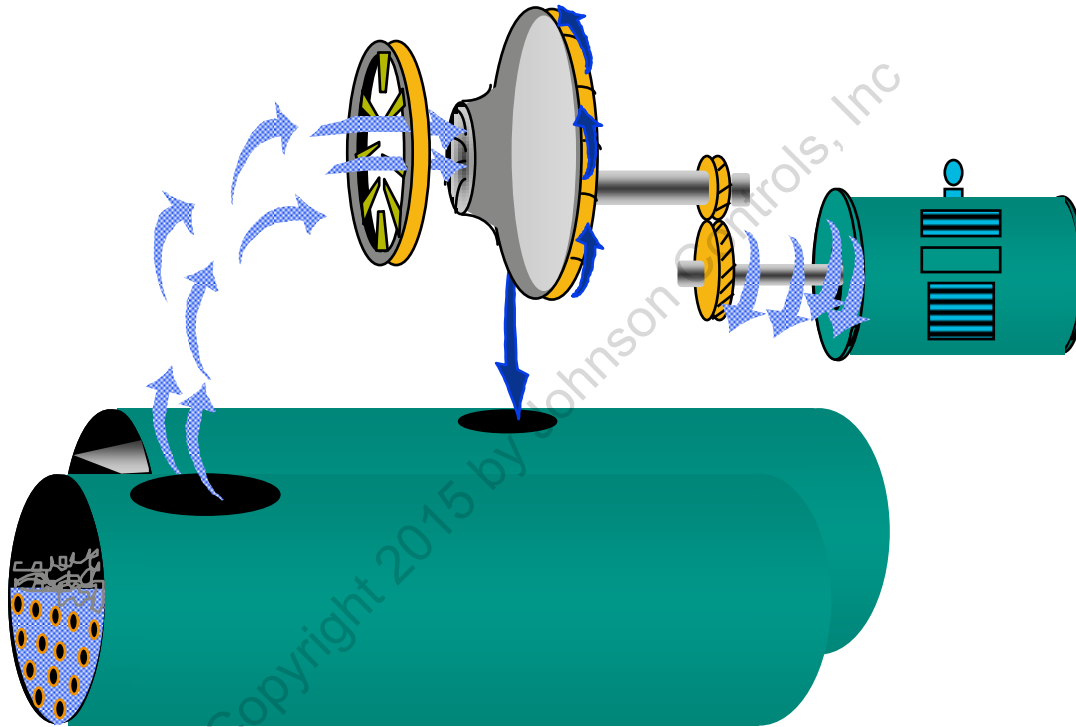
This section will cover basic:

- Centrifugal Compressor Operation
- AC Induction Motor Design
- Voltage to Frequency Ratio
- PWM Output Waveform
- Diode Operation
- SCR Operation
- Half-Wave Rectification
- Full-Wave Rectification
- Three-Phase Full-Wave Rectification

Centrifugal Compressor



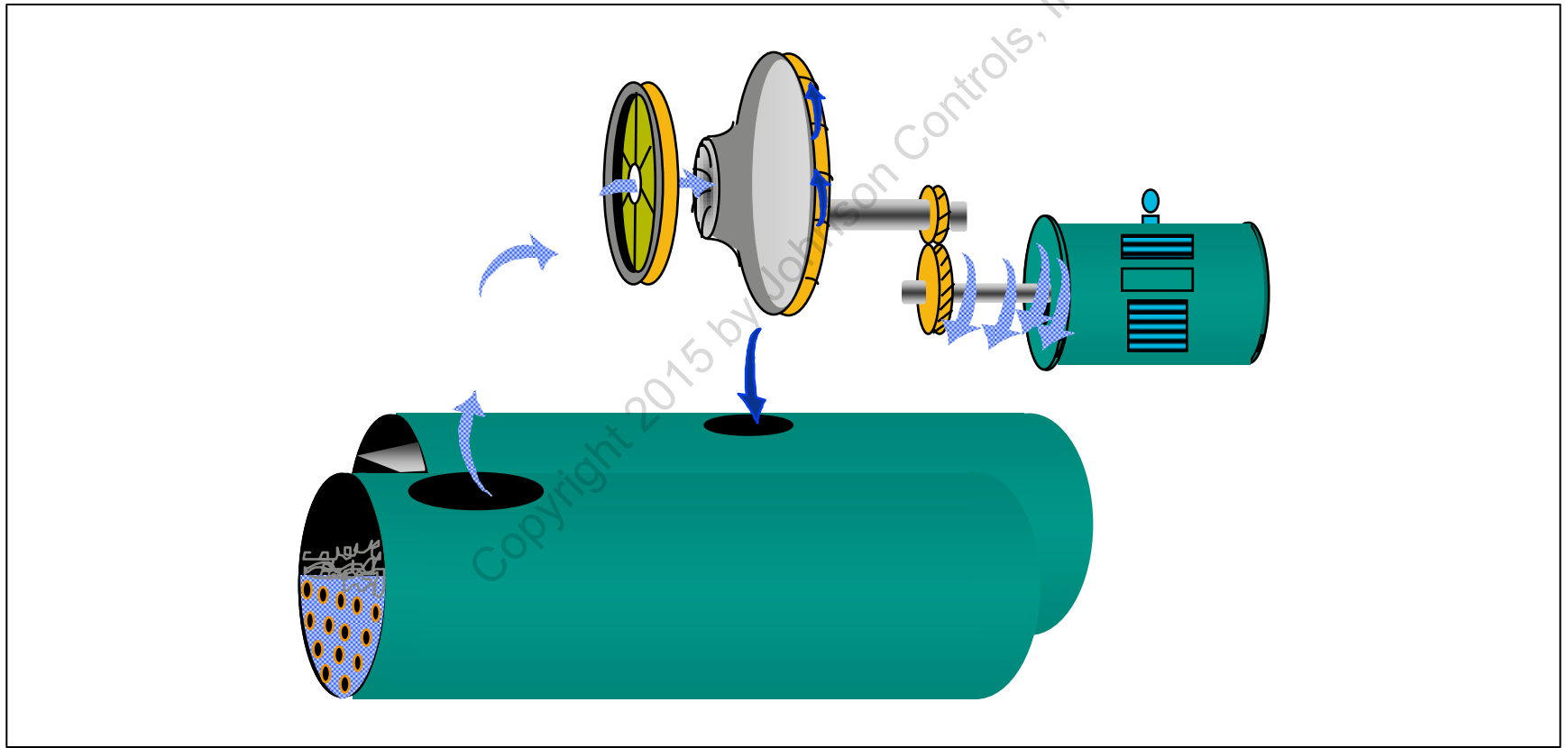
Constant Speed



Full Load Speed is 3600 RPM

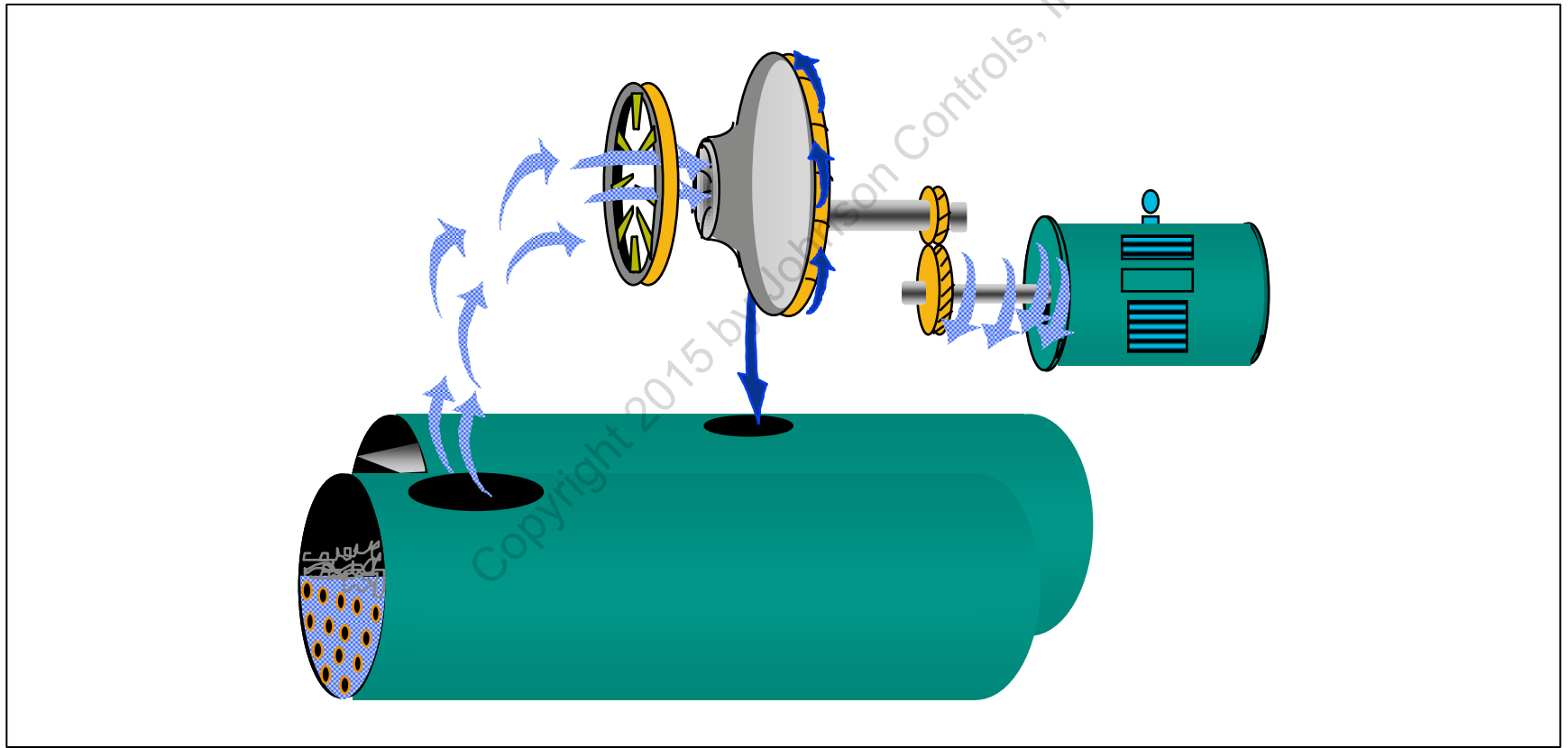
Constant Speed

As the load on the chiller decreases, the pre-rotation vanes begin to close. Speed remains 3600 RPM



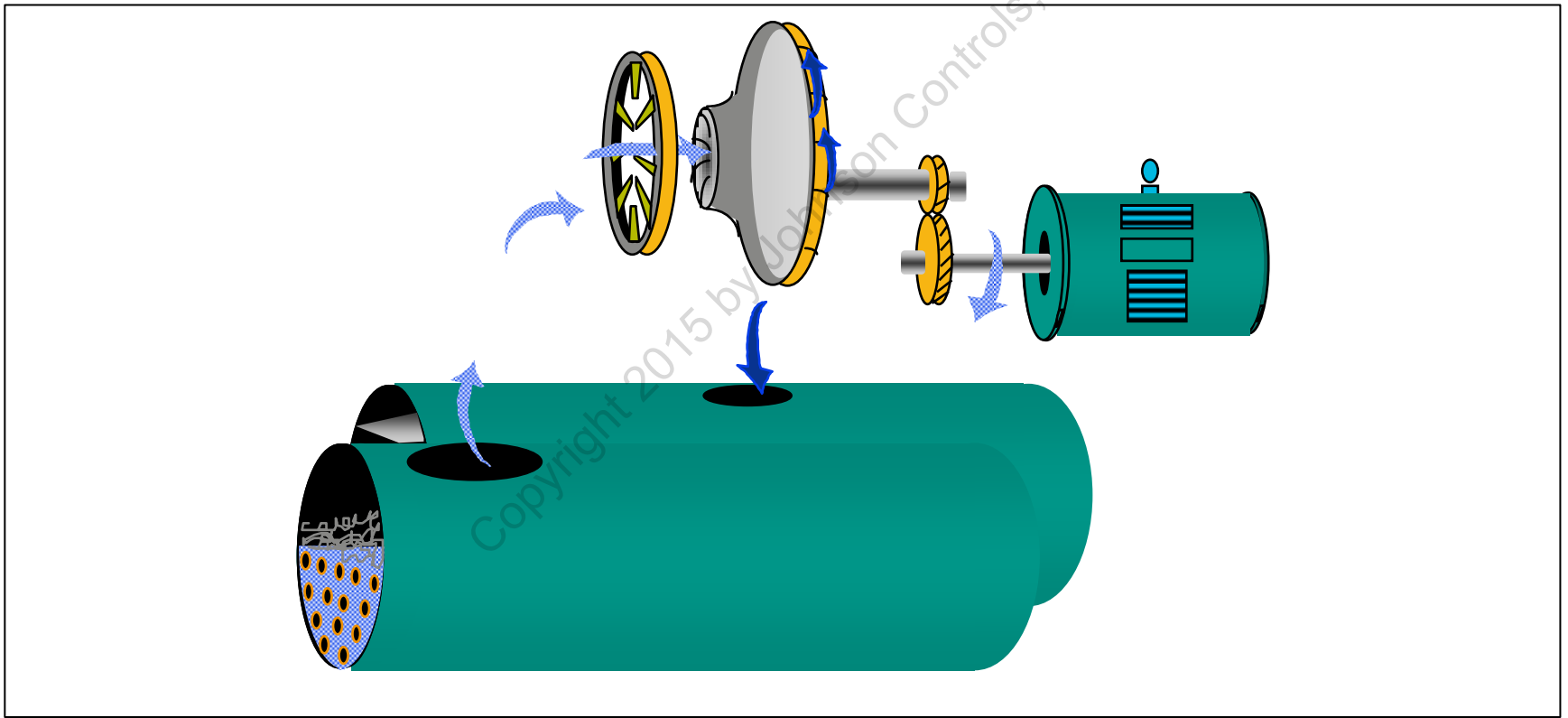
Variable Speed

The Adaptive Capacity Control logic senses various operating conditions and optimizes both the pre-rotation vane position and the motor speed.



Variable Speed

At off-design conditions the motor actually slows down and the pre-rotation vanes will remain open as long as possible. Optimizing both the motor and PRV will minimize energy consumption.



AC Induction Motor

$$\text{Synchronous RPM} = \frac{\text{Hz} \times 120}{\text{Poles}}$$

$$\text{Synchronous RPM} = \frac{\text{Hz} \times 60}{\# \text{ of Pole Sets}}$$

$$\text{Percent Slip} = \frac{\text{Synchronous RPM} - \text{Full Load RPM}}{\text{Synchronous RPM}} \times 100$$

(Typically 3 to 5%)

Voltage to Frequency Ratio

For every change in Hz, voltage must change by 7.6 volts for this application. Other applications ratios may be different.

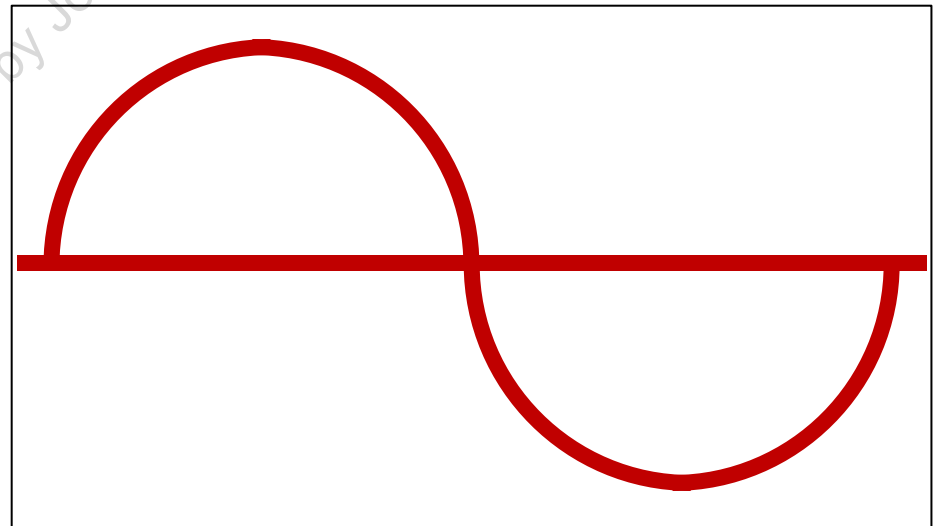
$$C = \frac{V}{f}$$

$$7.6 = \frac{460 \text{ volts}}{60 \text{ Hz.}}$$

The PWM waveform

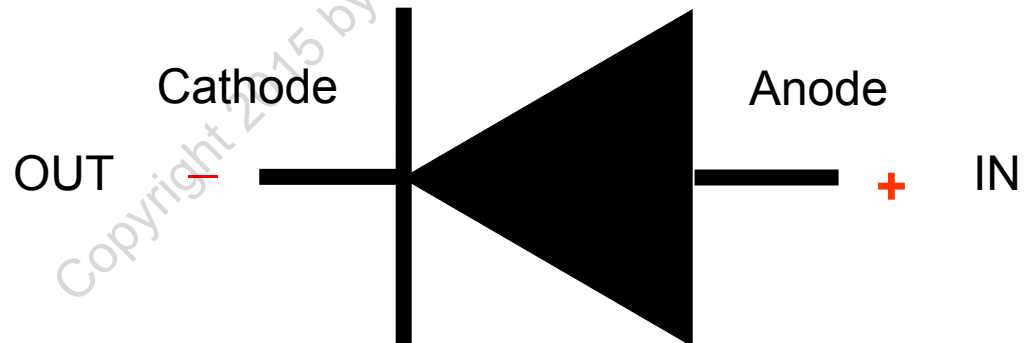
The PWM waveform:

- is achieved by applying full power for a defined time period.
- The longer the power device remains on, the higher the output voltage.
- The less time the power device remains on, the lower the output voltage.
- Equally, the longer the power device is off, the lower the output frequency.

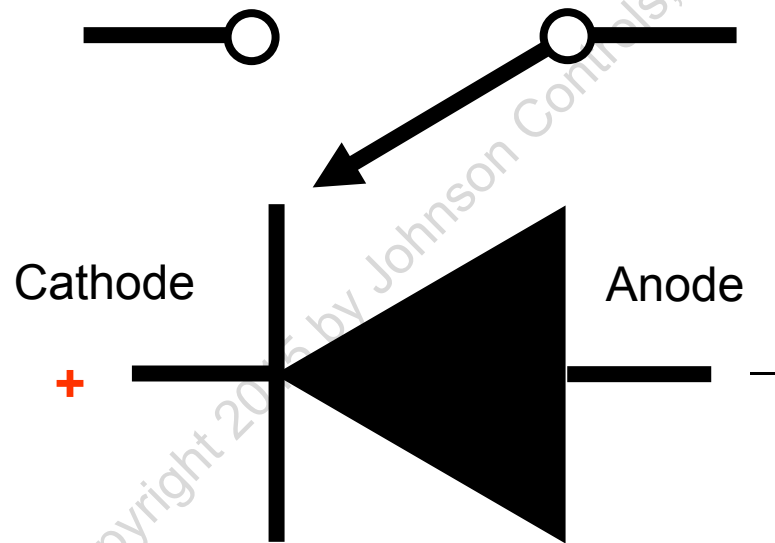


Forward Biased

+ = IN
+ IN to Anode
- = OUT
- OUT from Cathode

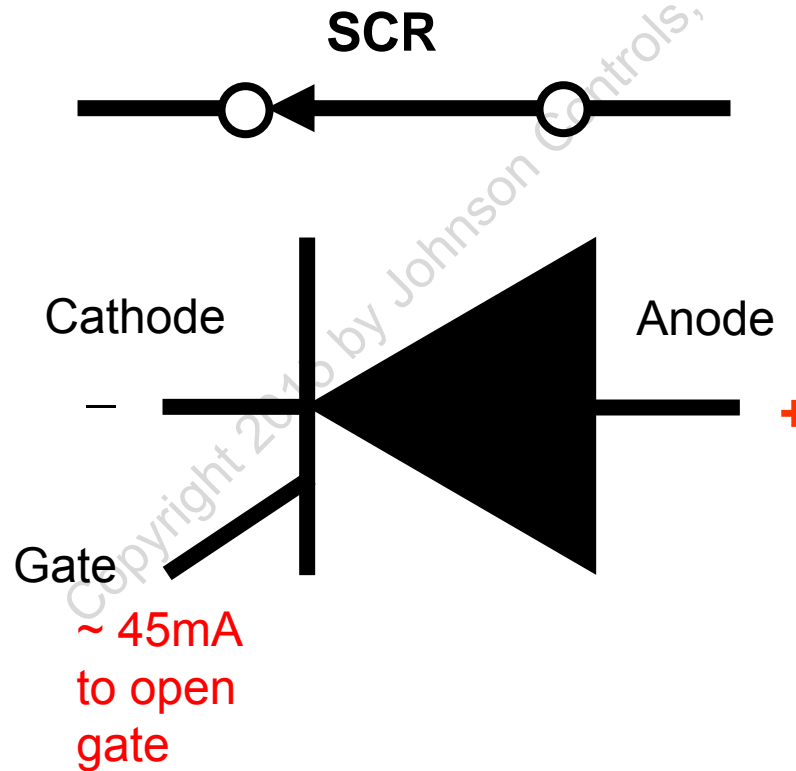


Reverse Biased



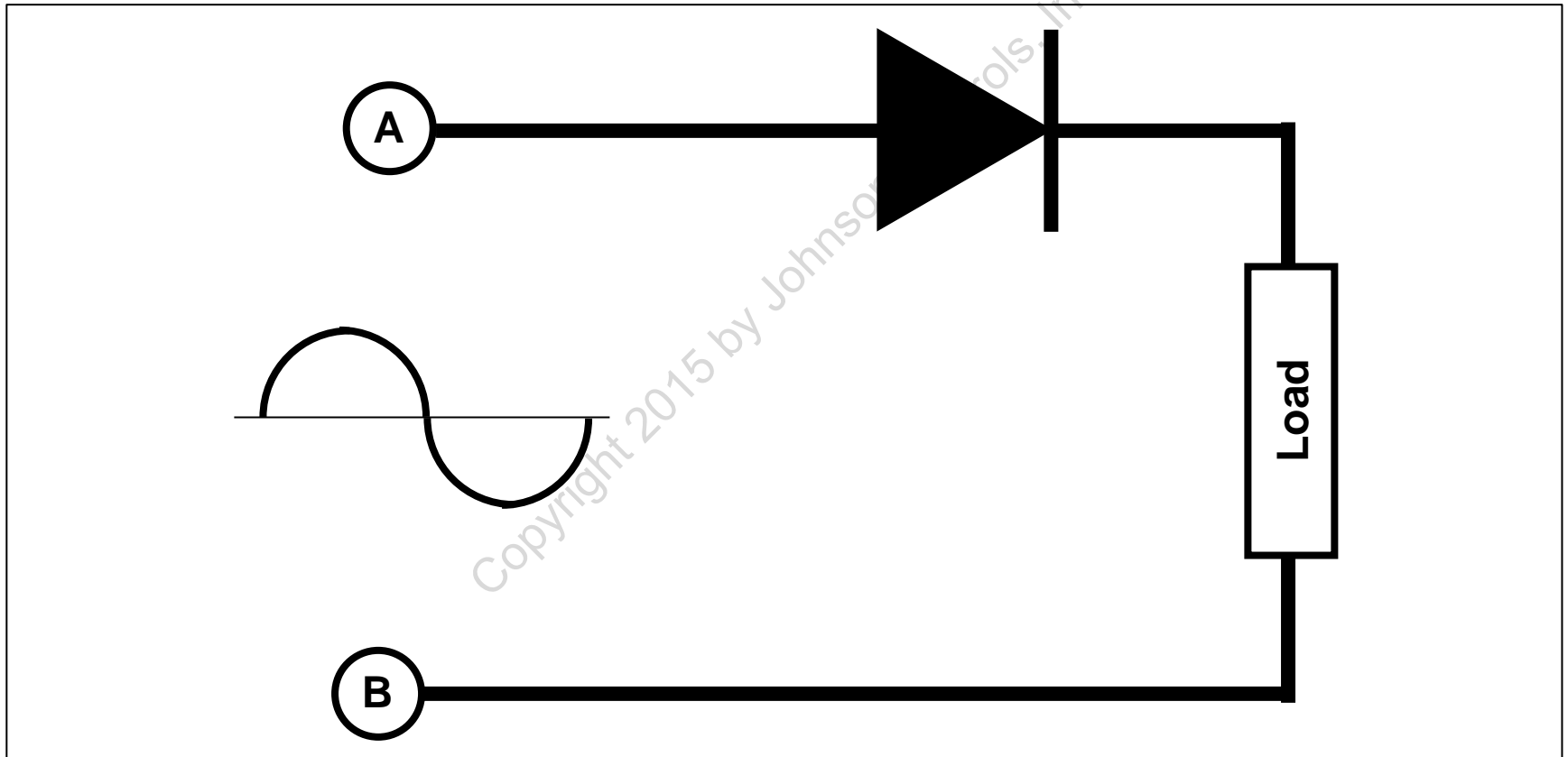
Forward Biased

- Removing the gate signal will not open the switch
- The SCR must also be reversed biased



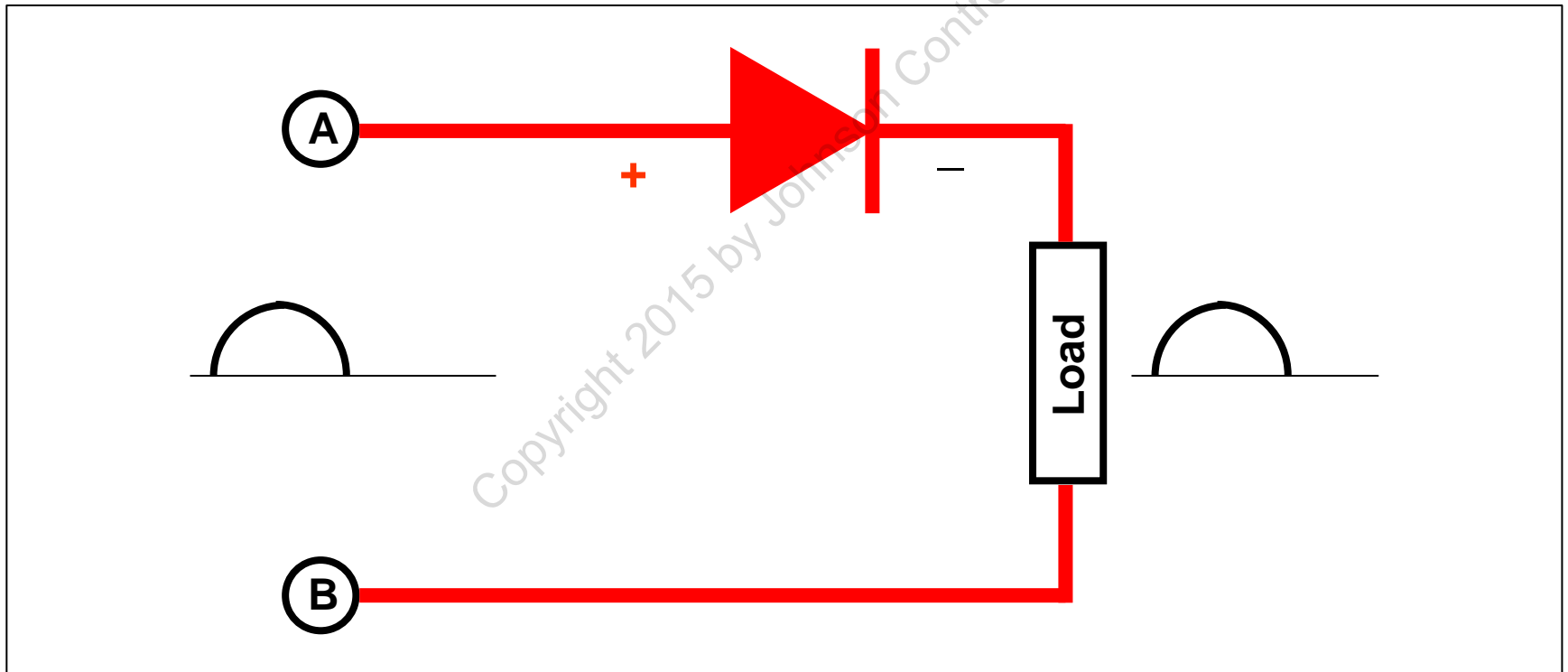
Half-Wave Rectification

- The voltages at point A and B are changing in opposite directions.
- When A is increasing in a positive direction, B is increasing negatively.



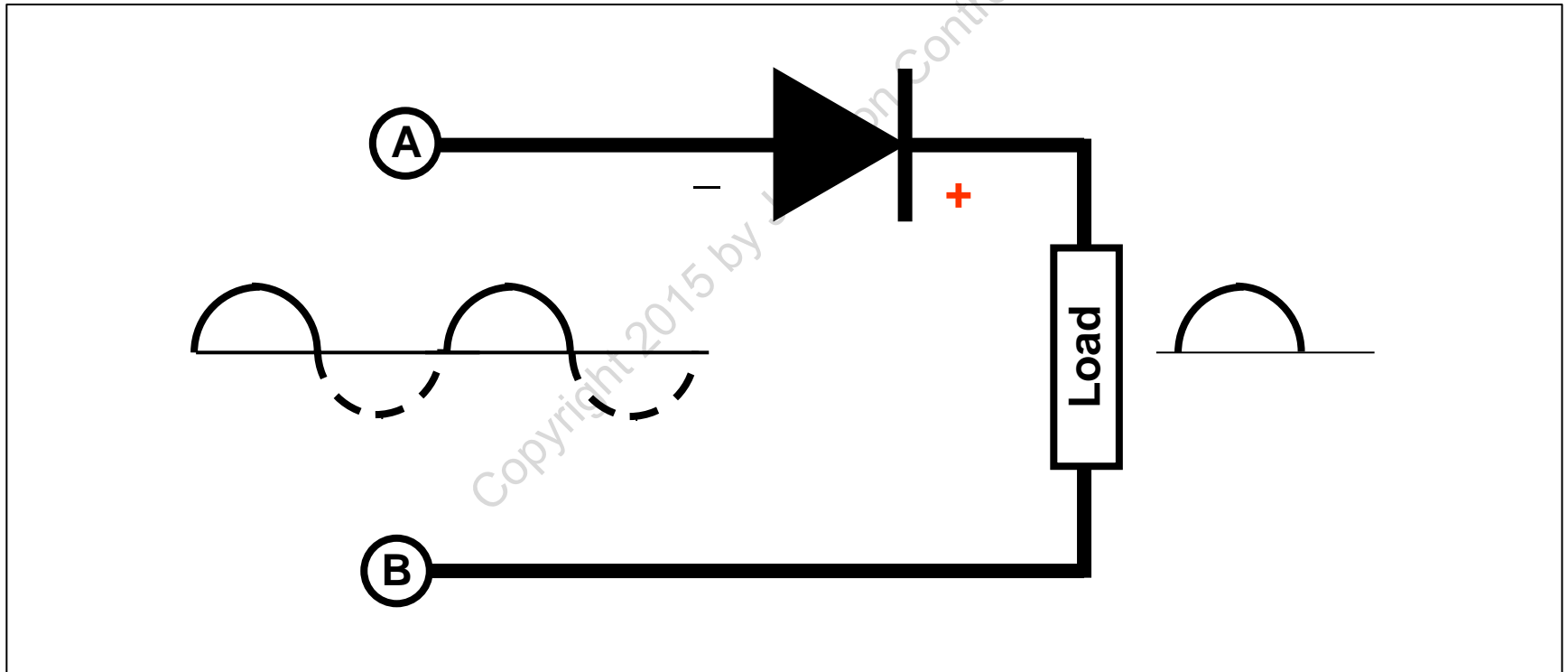
Half-Wave Rectification

- During the first half cycle, A is positive and B is negative.
- The diode has positive on its anode and negative on its cathode.
- The diode is forward biased, the load sees current

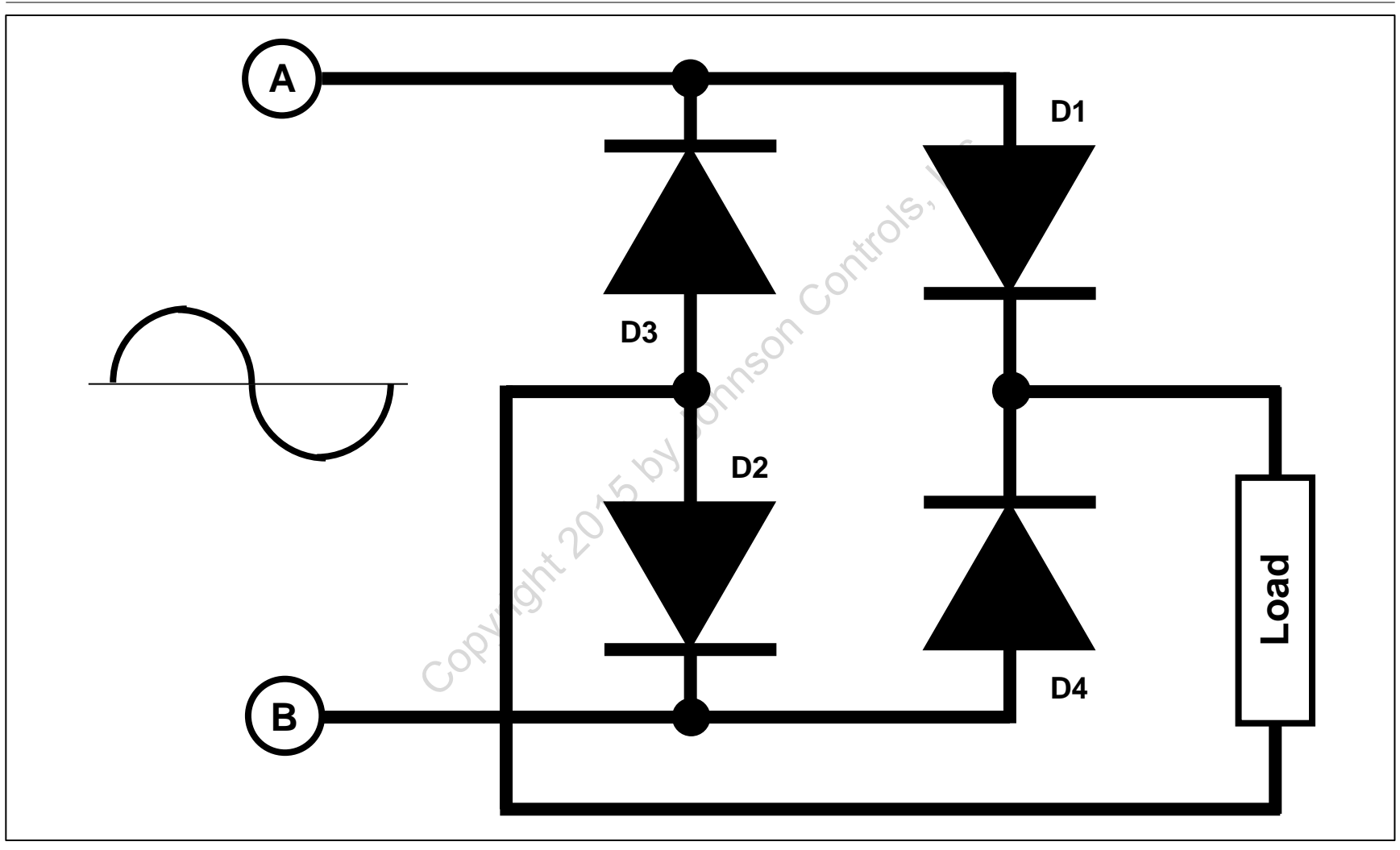


Half-Wave Rectification

- During the next half cycle, A is negative and B is positive.
- The diode has negative on its anode and positive on its cathode.
- The diode is reverse biased. The load sees no current

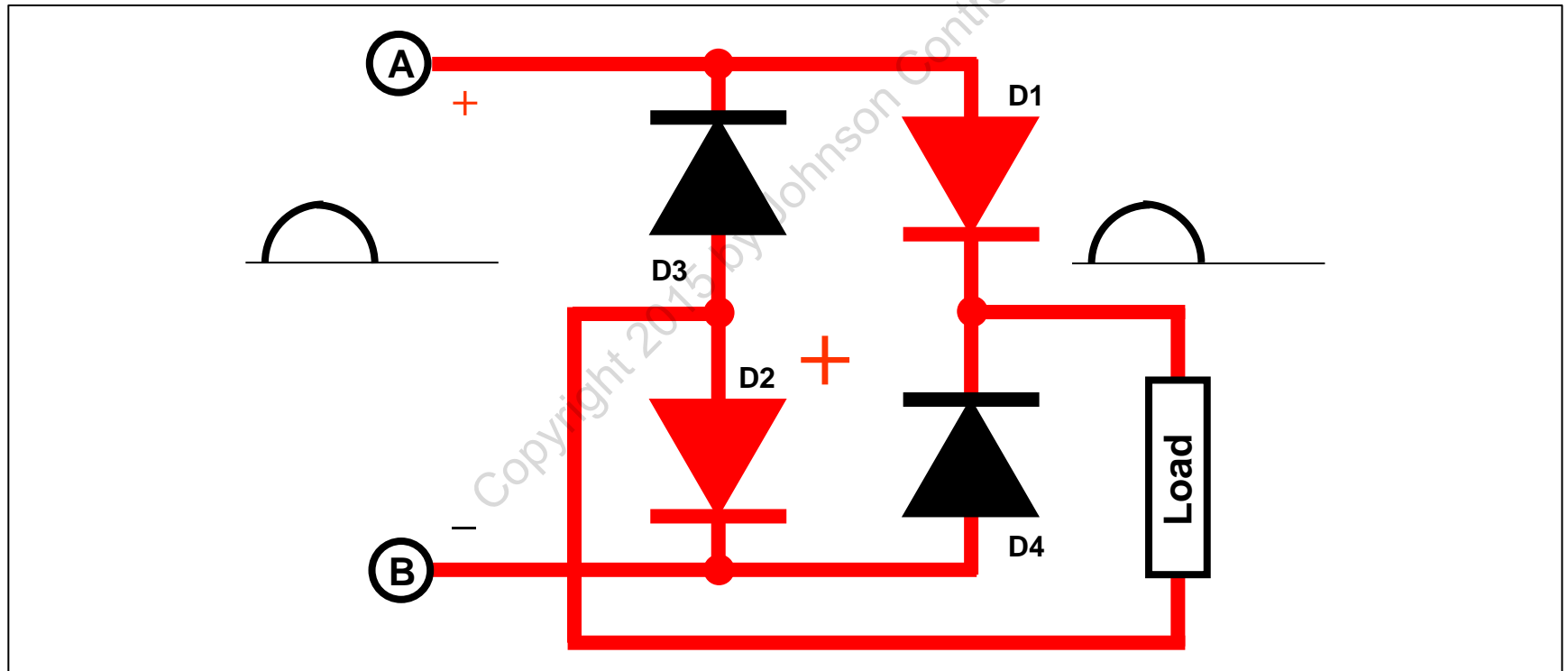


Full-Wave Rectification



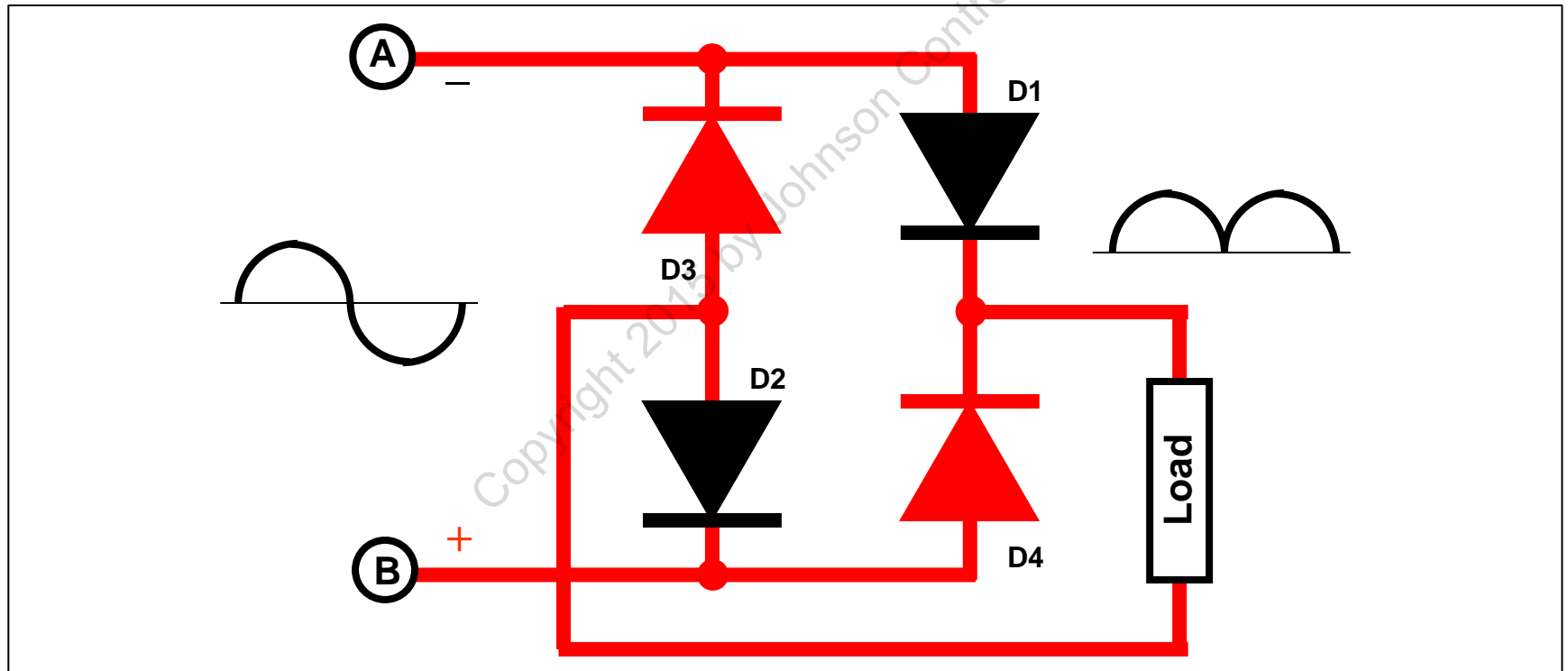
Full-Wave Rectification

- During the first half cycle, A is positive and B is negative.
- D1 has positive on its anode, D2 has negative on its cathode.
- Both diodes are forward biased. Load sees current.



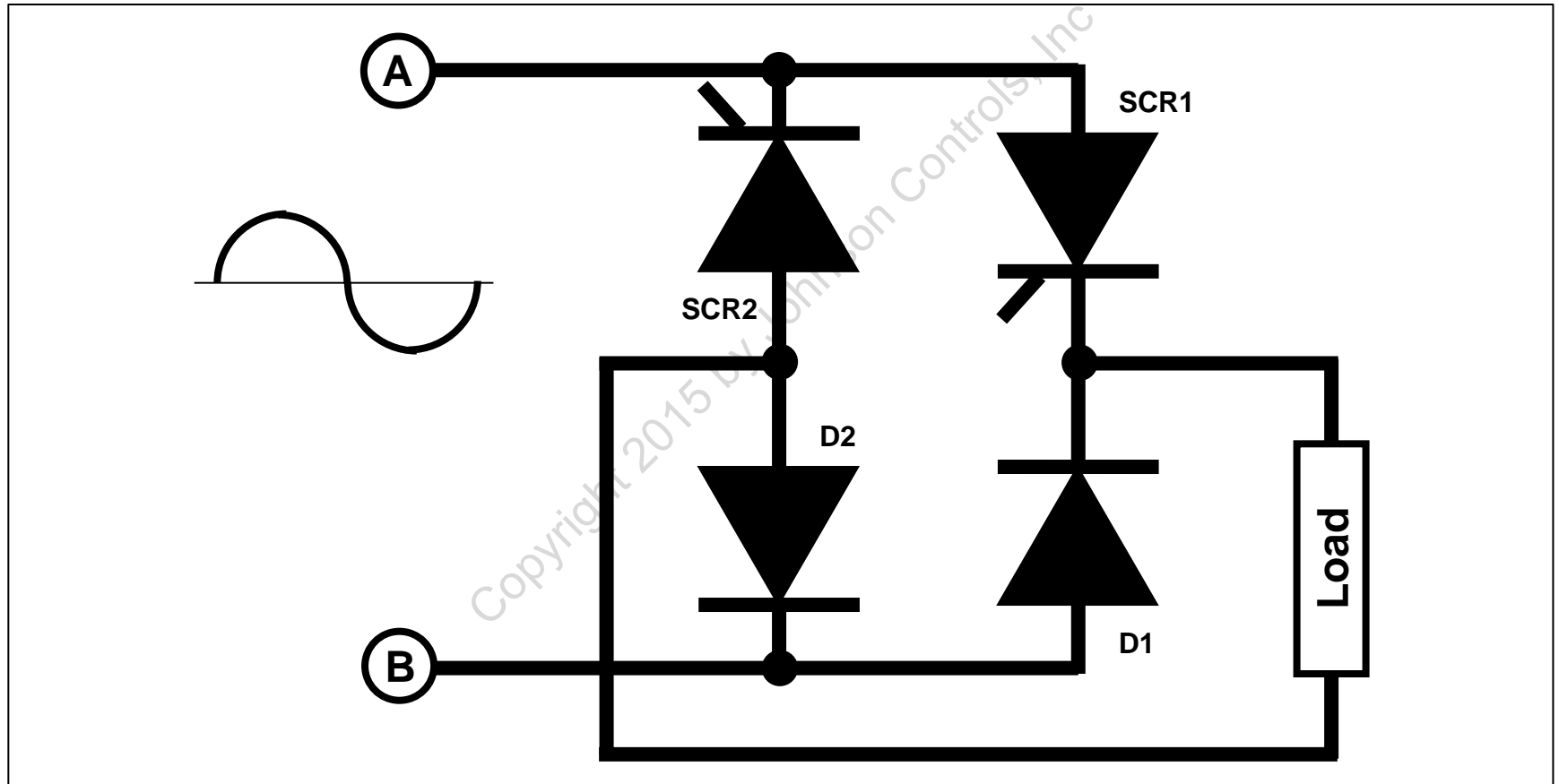
Full-Wave Rectification

- During the next half cycle, A is negative and B is positive.
- D4 has positive on its anode, D3 has negative on its cathode.
- Both are forward biased. Load sees current IN THE SAME DIRECTION



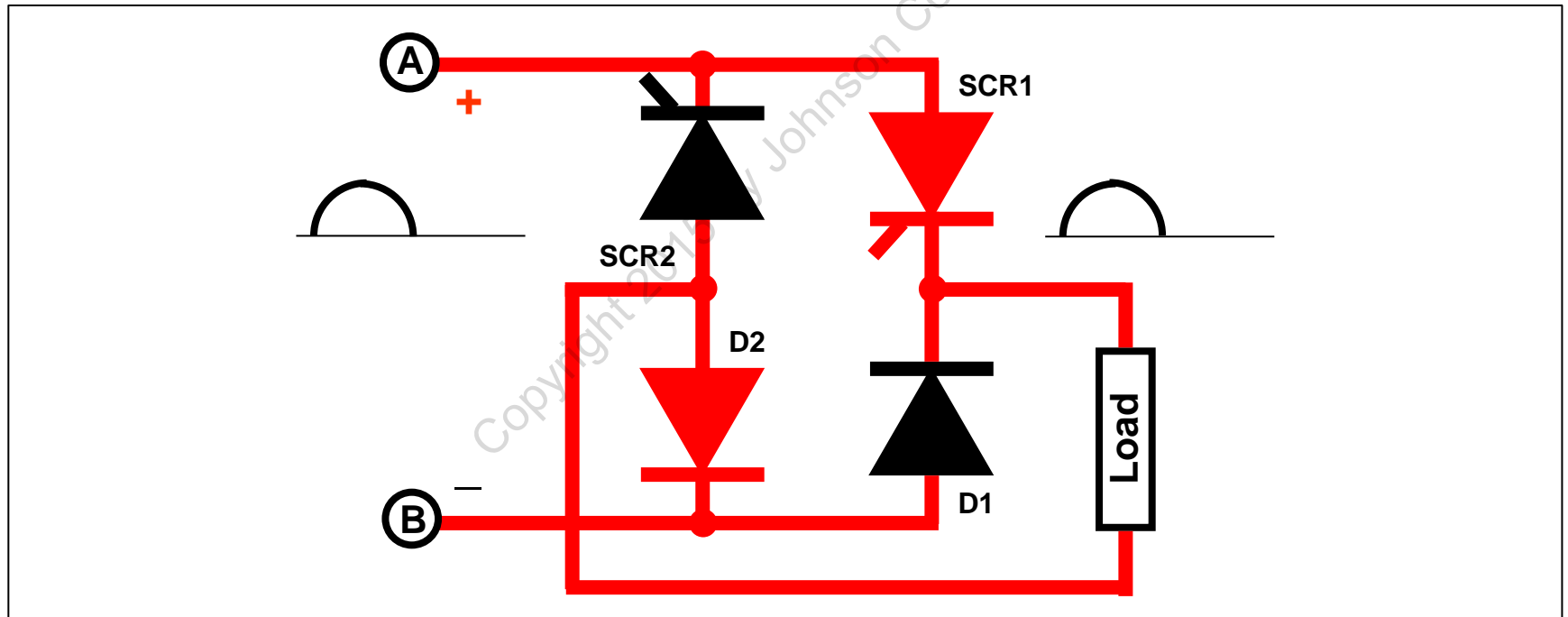
Full-Wave Rectification-SCR

- By removing the gate signal, the gate will close when the ac sine wave goes to zero volts



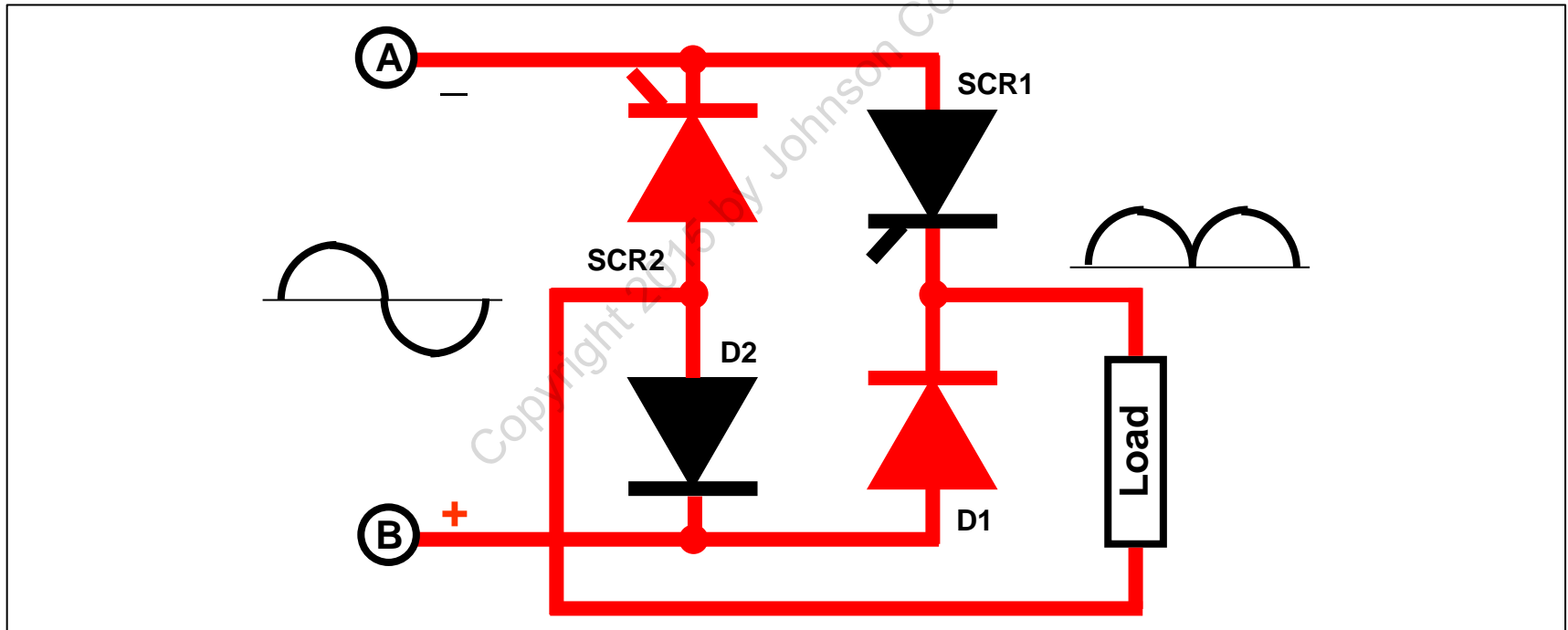
Full-Wave Rectification

- With the SCR's gated on, during the first half cycle, A is positive and B is negative.
- SCR1 has positive on its anode, D2 has negative on its cathode.
- Diode 2 and SCR 1 are forward biased.



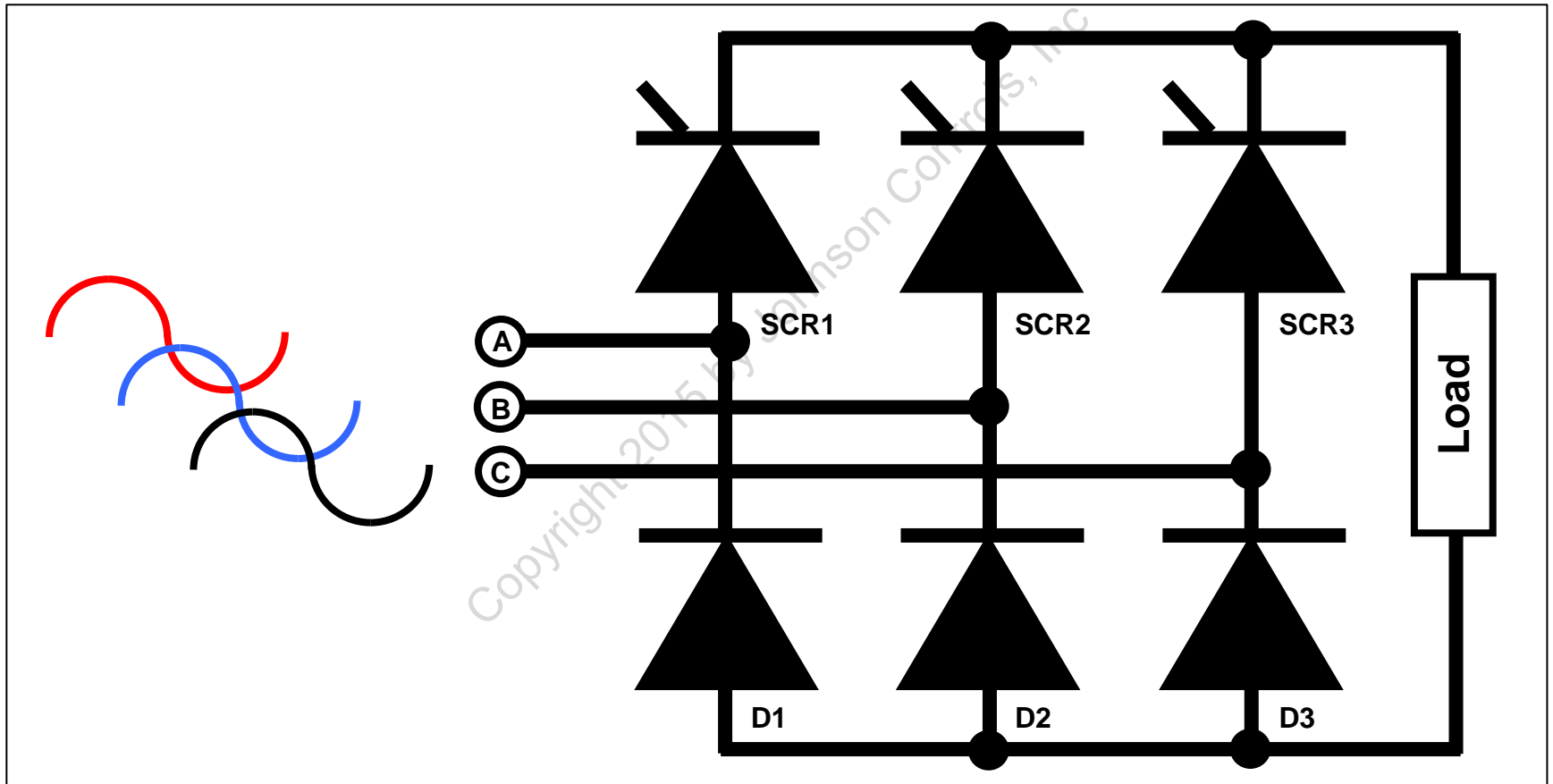
Full-Wave Rectification

- With the SCR's gated on, during the next half cycle, A is negative and B is positive.
- D1 has positive on its anode, SCR 2 has negative on its cathode.
- Diode 1 and SCR 2 are forward biased.



3-Phase Full-Wave Rectification

- Phasing does not have to be ABC. The logic board needs to know if the phasing is ABC or CBA so it knows when to turn on the SCR's.



Basic Electrical Concepts



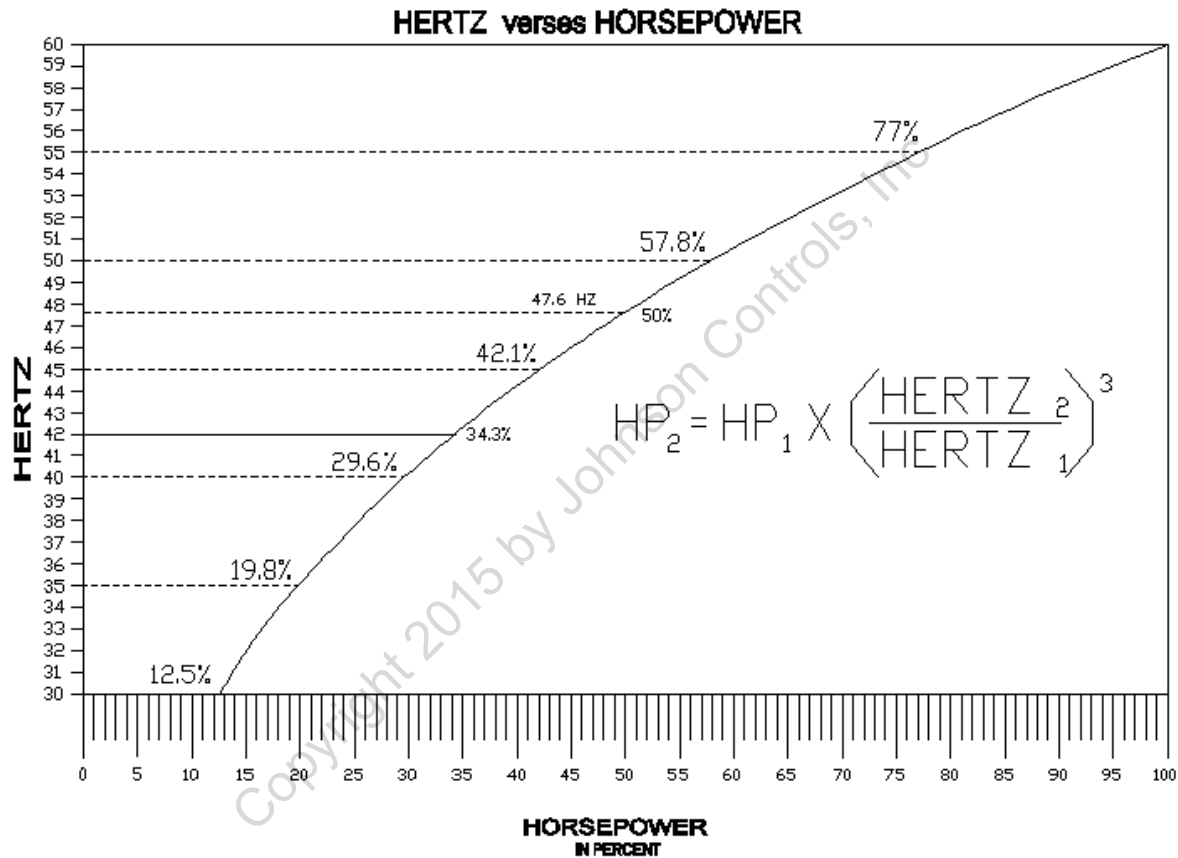
Variable-Speed Drive Basics

This section will cover:

- Motor Speed vs. Motor Horsepower
- AC Power Generation
- Types of VSD Waveforms
- Motor Design
- Voltage to Frequency Ratio
- Electronic Symbols
- Ohms Law

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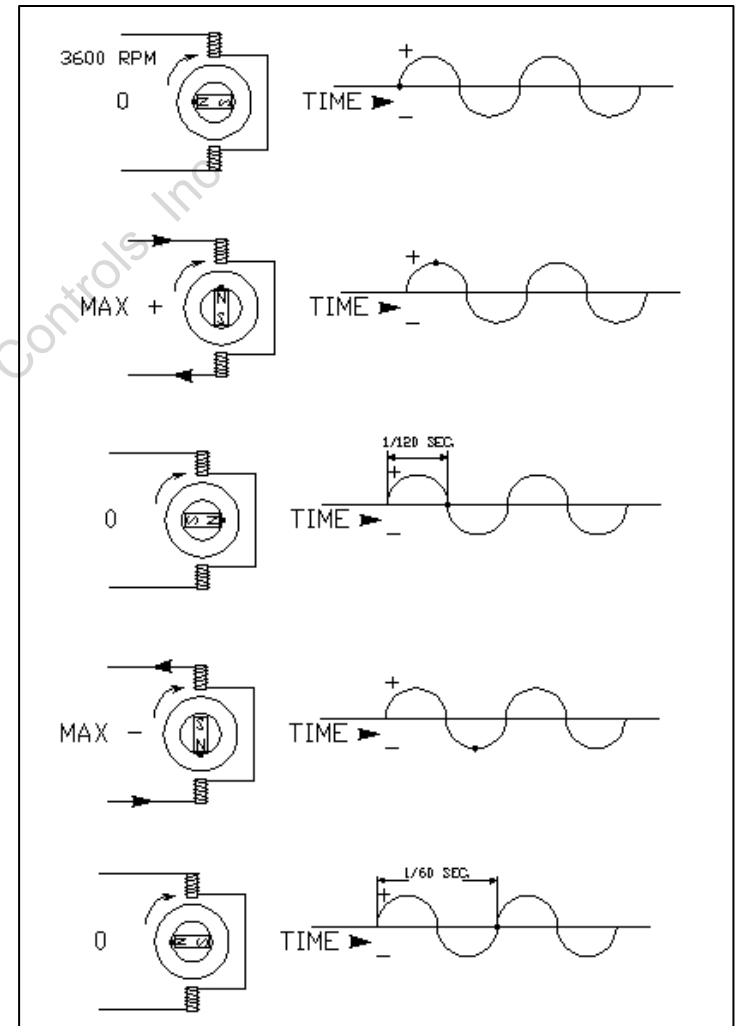
Hertz vs Horsepower Ratio



Horsepower vs. Motor Speed

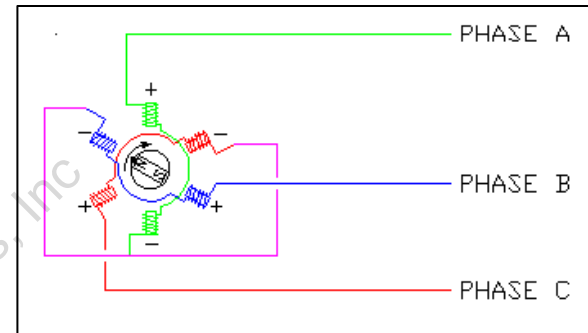
Single-Phase Generator Output

- AC Sine wave
 - 0 to Peak to 0
 - positive and negative
- VSD Output
 - Mimics a Generator
 - Simulated Sine wave
- RMS vs Peak

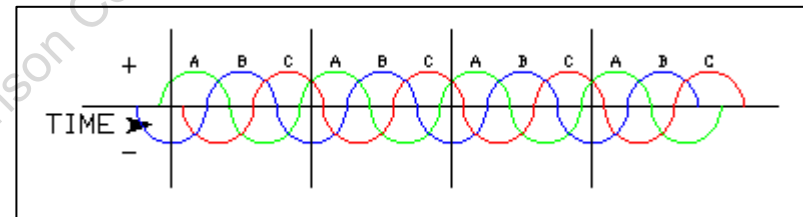


Three-Phase Generator

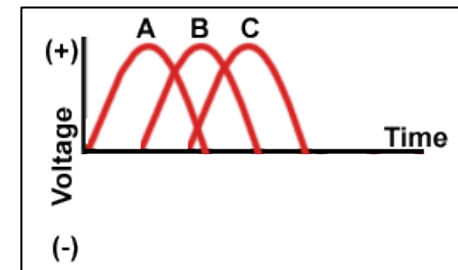
- 3 Single phases
 - 120 Degrees Apart



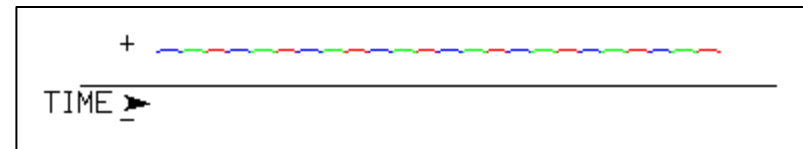
- VSD
 - 3 Phase Input



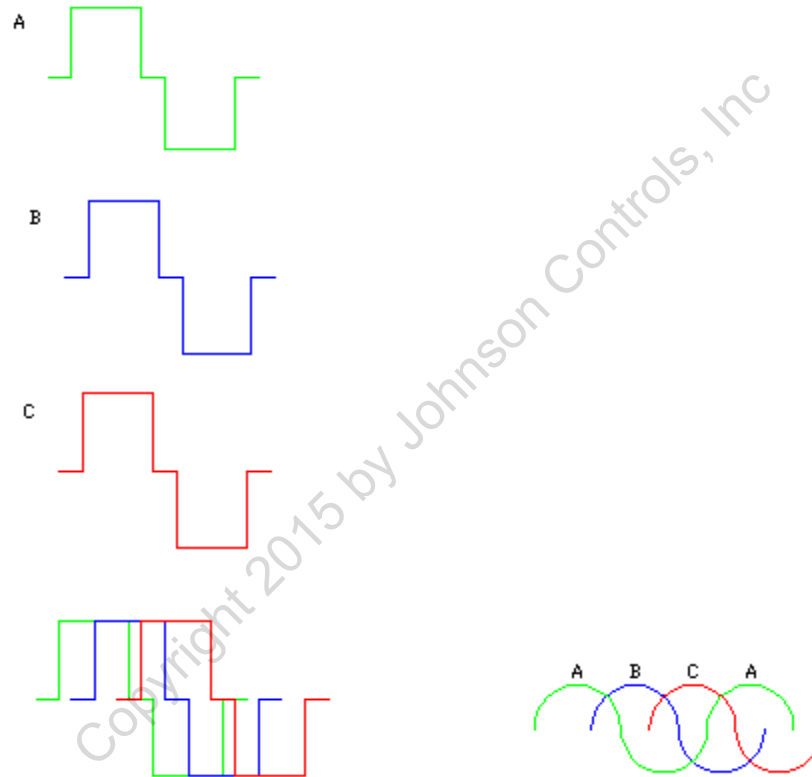
- Rectifies to DC
 - Ripple



- Filter Capacitors



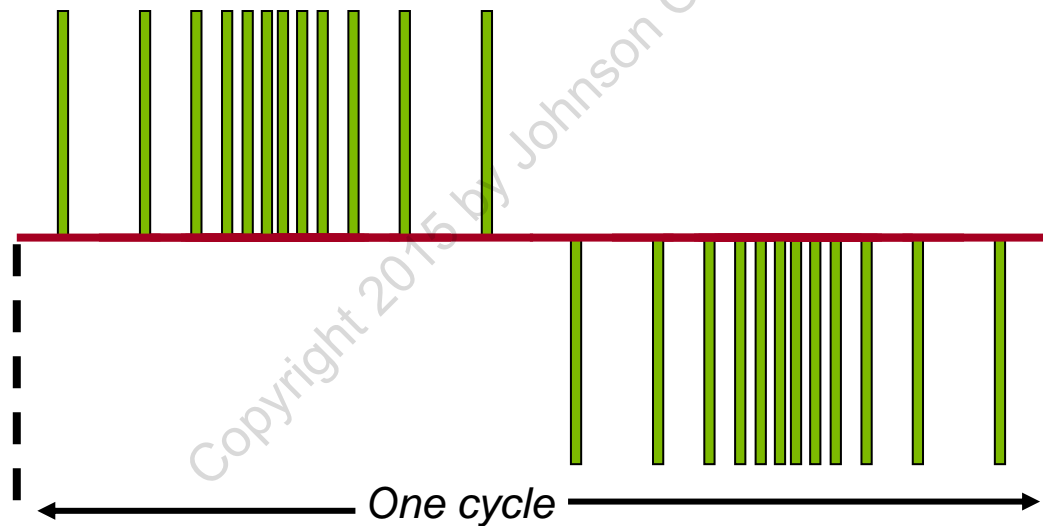
6 Step



The Old T-M I and T-M II 6-Step Output Wave Shape

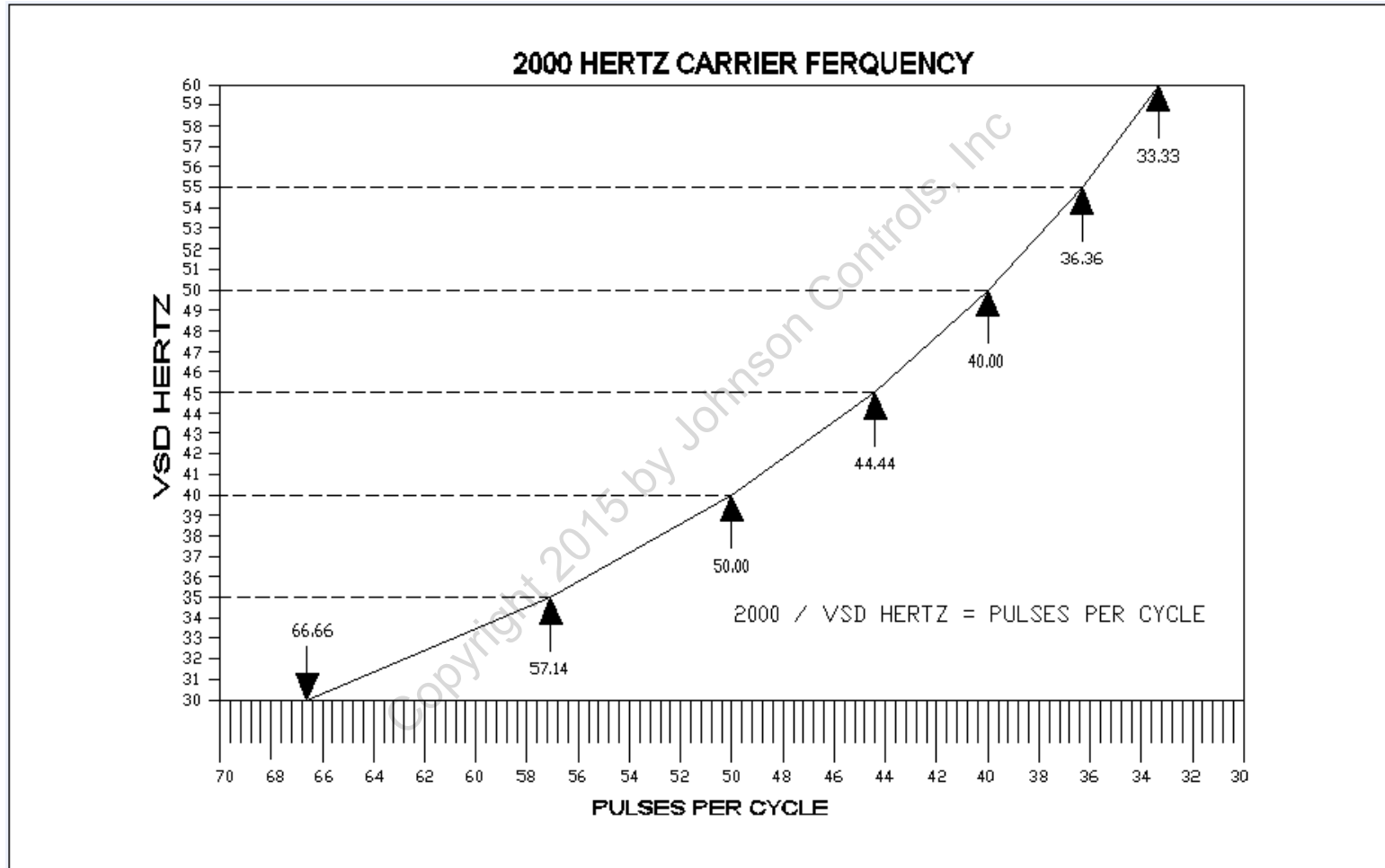
Output Voltage Control

This is a “simulated” voltage, because the output section produces about 2000 full-voltage pulses per second which are spaced so as to yield an instantaneous that’s the average of the duration of the pulse and the duration of its previous space. The instantaneous averages simulate the progression of voltage through a sine wave, with pulses farther apart at the ends and closer together toward the middle.



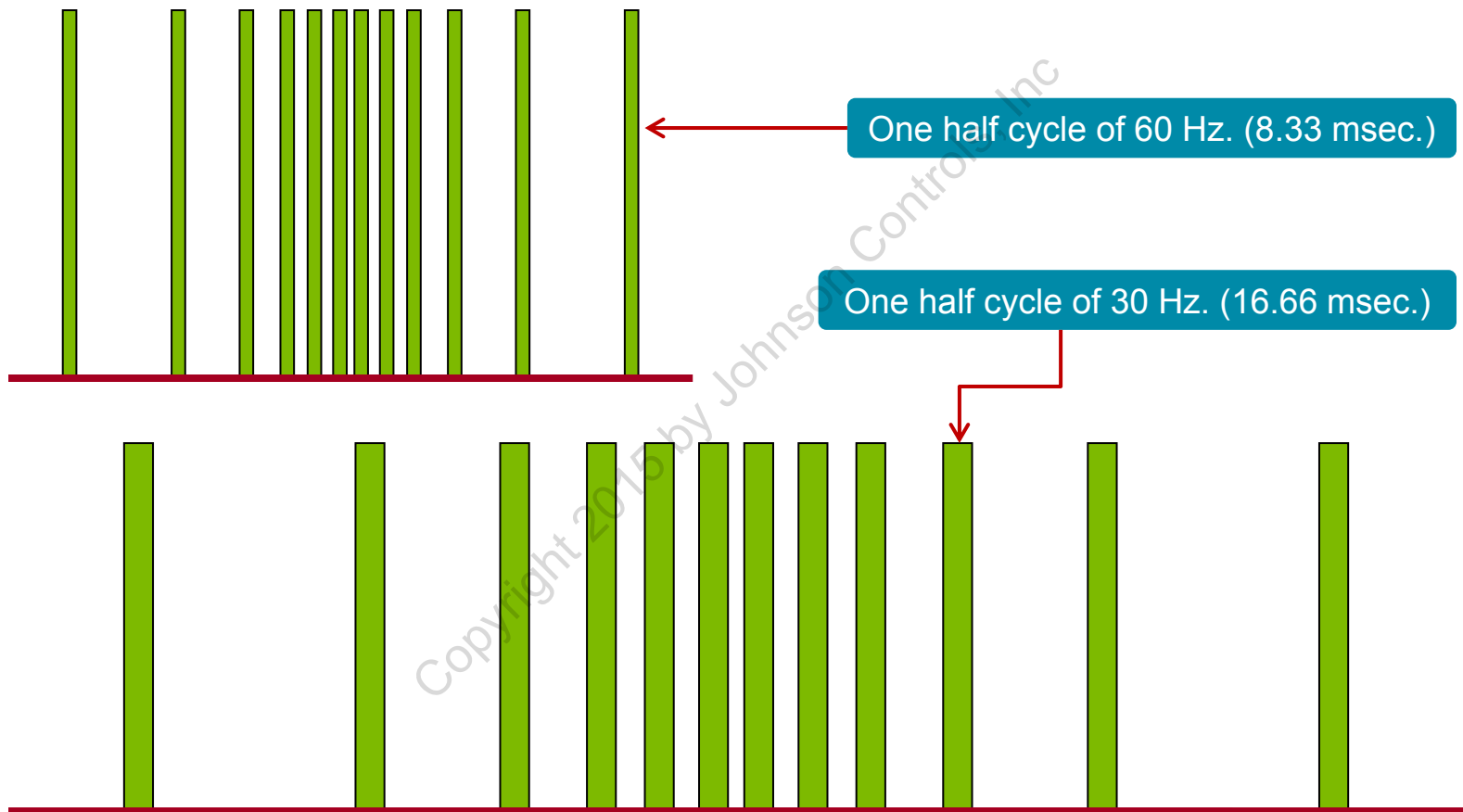
Carrier Frequency = 2000 Hz

Carrier Pulse Graph

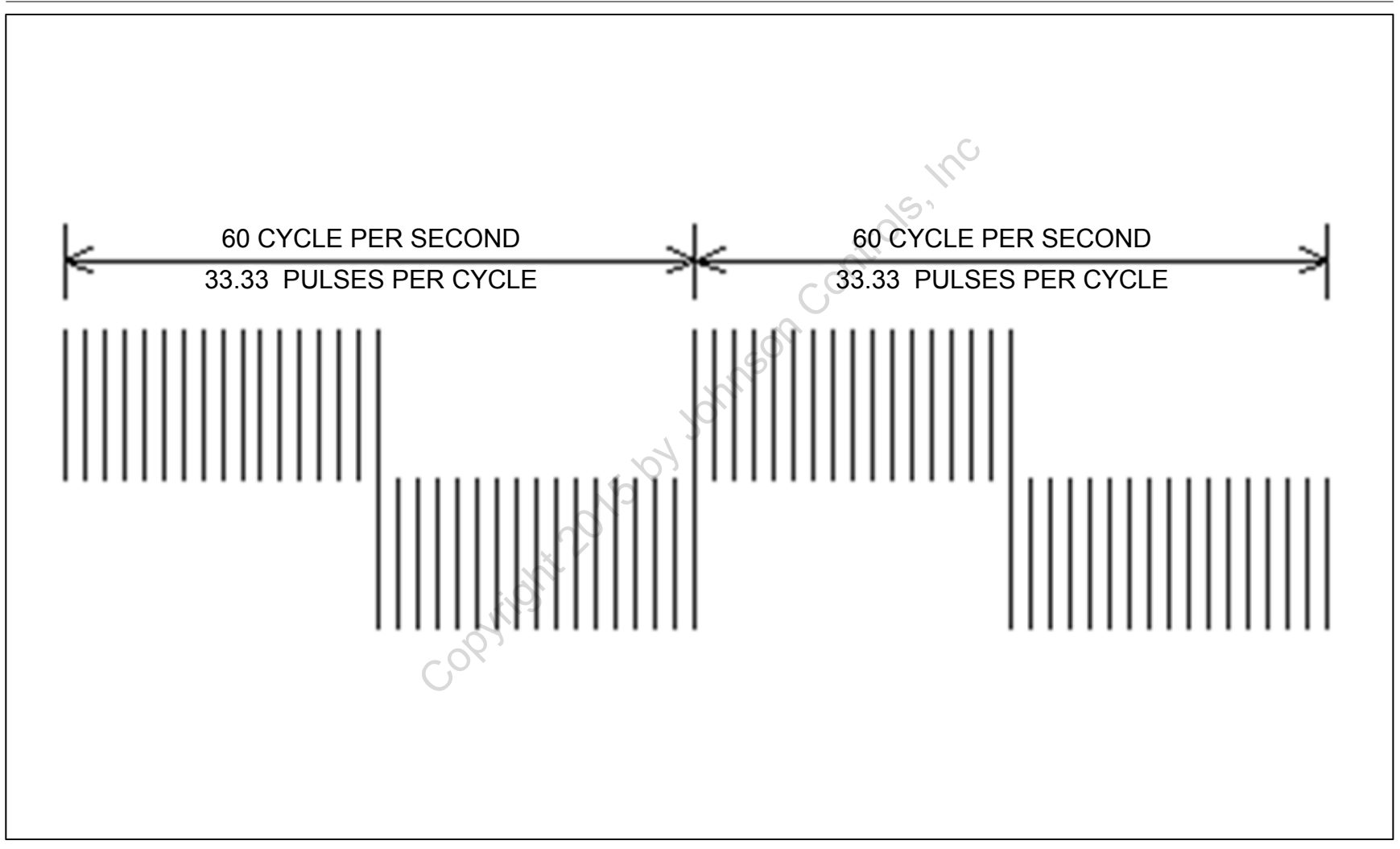


Output Frequency Control

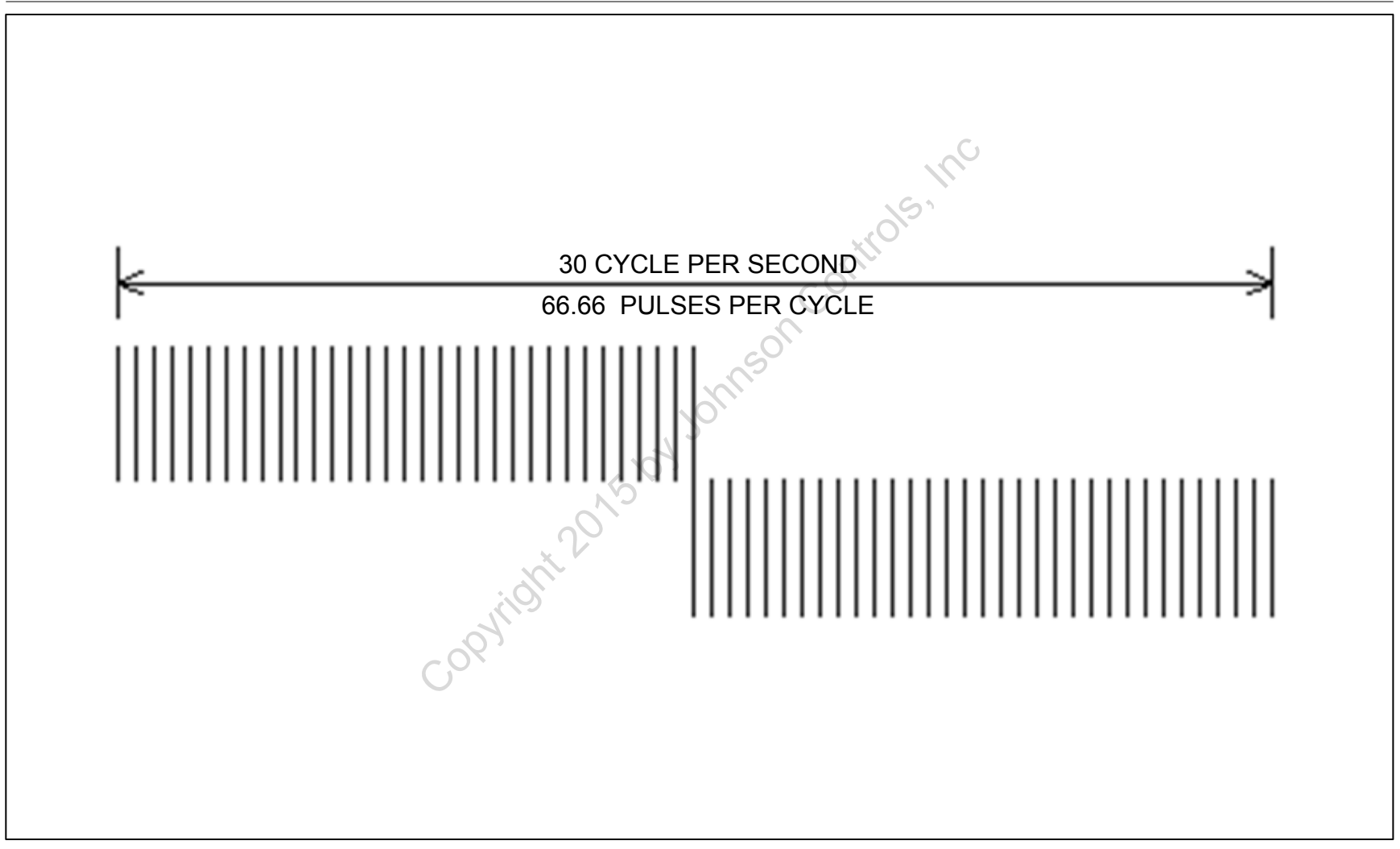
(2000/hz = pulses per cycle)



60 Hz Output



30 Hz Output



Basic Motor Speed Design Formula

$$\text{Motor speed} = \frac{120 \times \text{Frequency}}{\text{No. of Poles}}$$

$$\text{Motor speed} = \frac{120 \times 60}{2} = 3600 \text{ rpm}$$

Design Speed Motor Formula

Basic Voltage-vs.-Frequency Formula

$$C = \frac{V}{f}$$

If we plug in the values for 440-480 vac @ 60 Hz.

$$7.7 = \frac{460 \text{ volts}}{60 \text{ Hz.}}$$

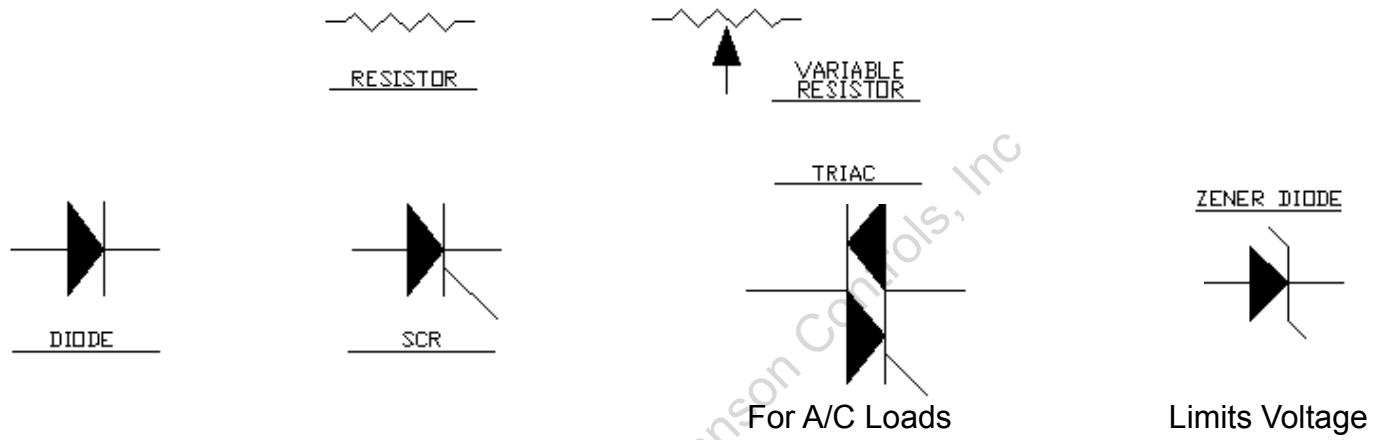
If we plug in the values for 380-400 vac @ 50 Hz.

$$7.8 = \frac{390 \text{ volts}}{50 \text{ Hz.}}$$

Where they use 50 Hz., the Voltage is usually 380-400 Vac, so they can still use all the same motors (running At 5/6 design speed for 60 Hz.)

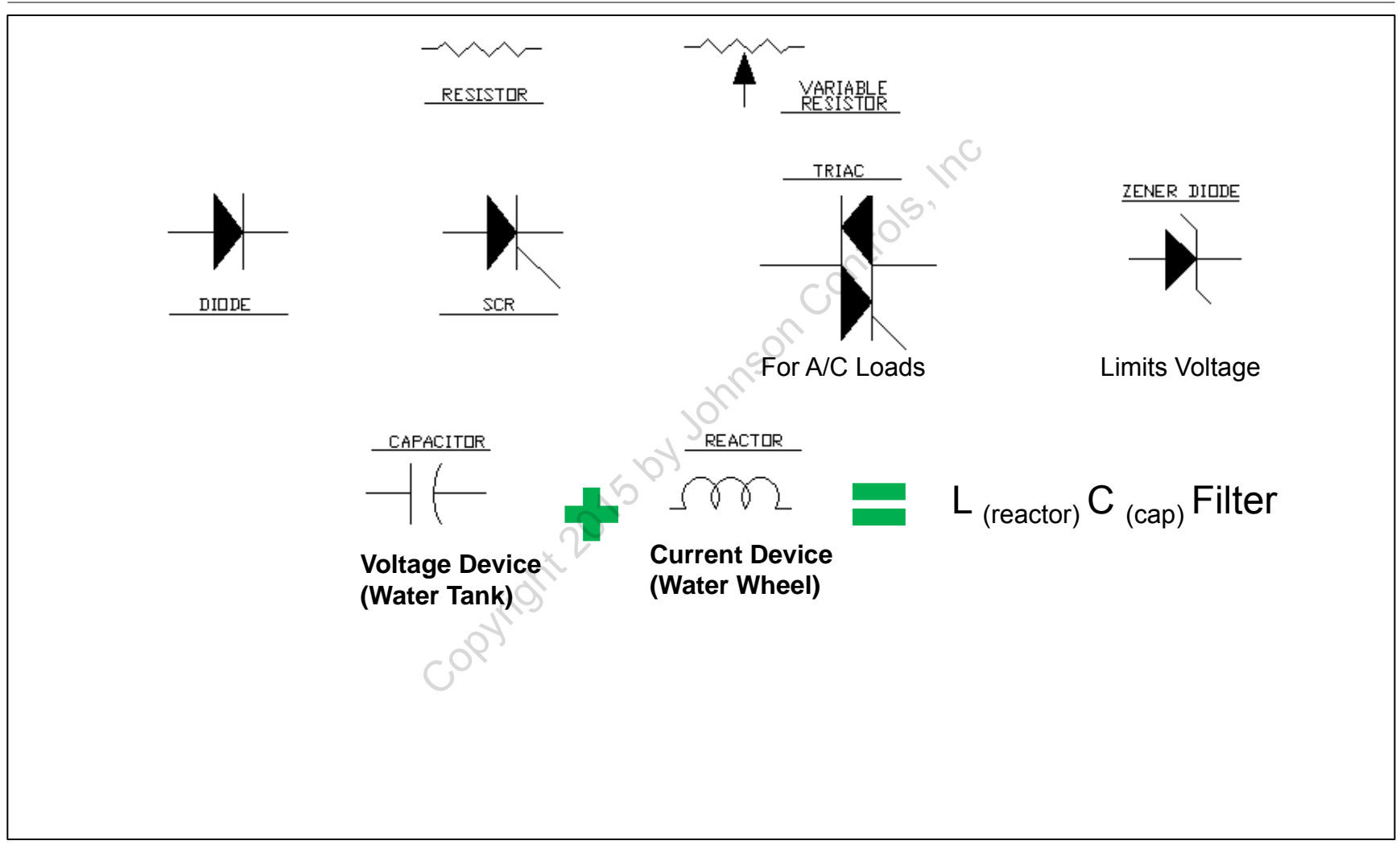


Electronic Components and Their Symbols

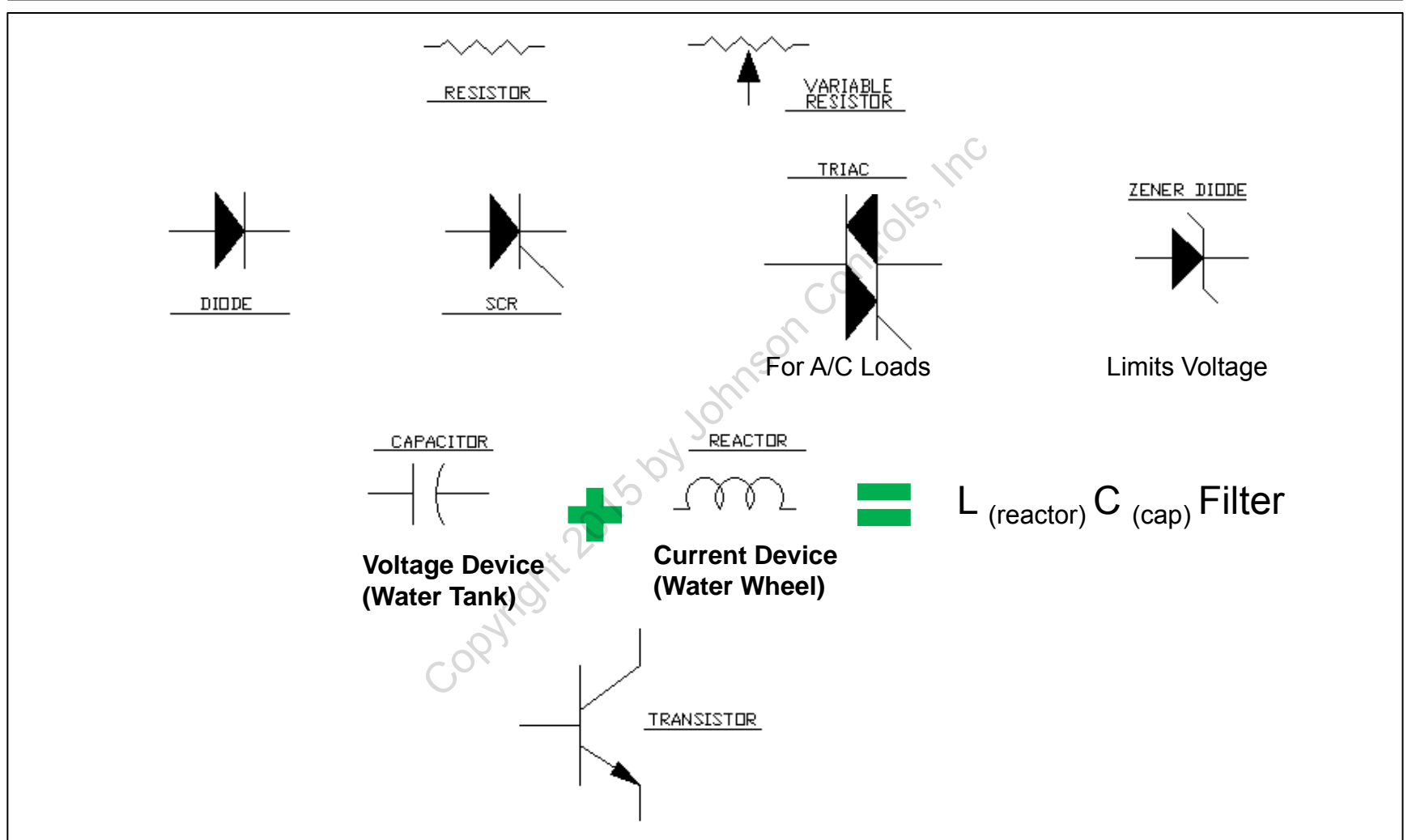


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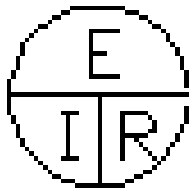
Electronic Components and Their Symbols (Cont'd)



Electronic Components and Their Symbols (Cont'd)



Ohm's Law



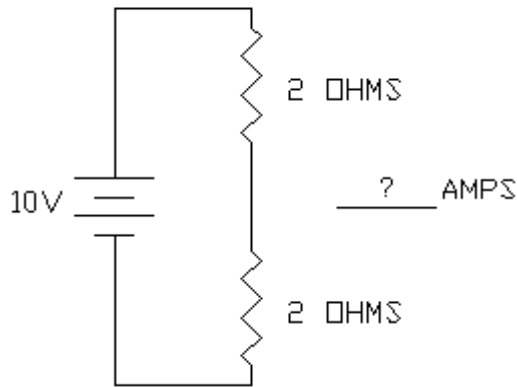
E=VOLTS

I=AMPS

R=RESISTANCE

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Ohm's Law: 2 Resistors in Series

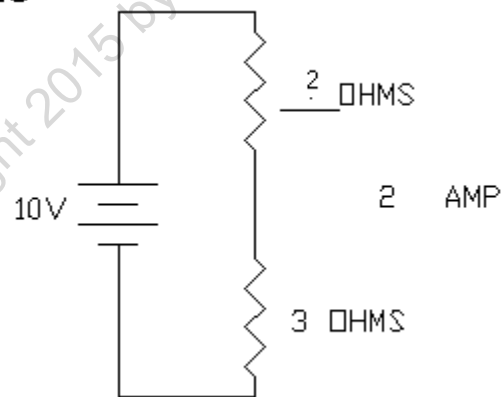


$$\frac{E}{R} = I \quad \frac{10}{4} = 2.5$$

$$R_t = R_1 + R_2$$

$$\frac{E}{I R}$$

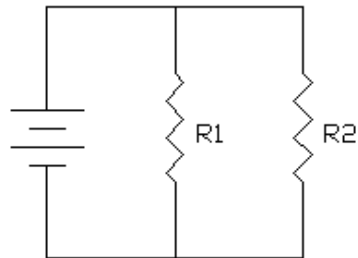
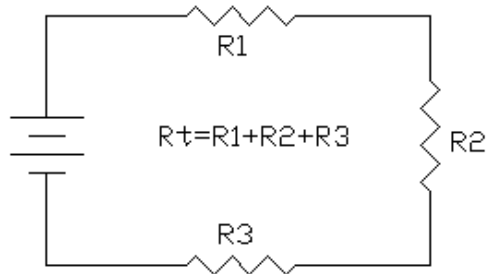
E=VOLTS
I=AMPS
R=RESISTANCE



$$\frac{E}{I} = R \quad \frac{10}{2} = 5$$

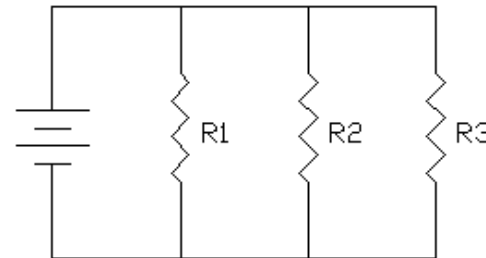
$$5 - 3 = 2$$

Ohm's Law: 3 Resistors in Series, Resistors in Parallel



Same Resistance Values

$$R_t = \frac{R1 \times R2}{R1 + R2}$$



Varying Resistance Values

$$R_t = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$

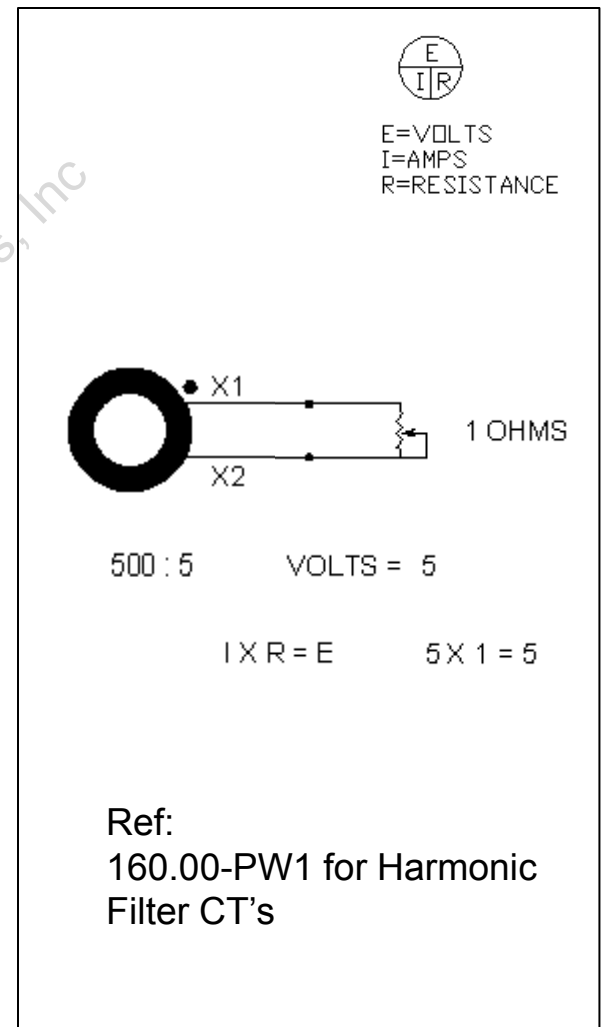


E=VOLTS
I=AMPS
R=RESISTANCE

Resistance Formulas

Ohm's Law: Current Transformers

- A CT is not really a transformer
 - It is the secondary of a transformer
 - The motor lead through it is the primary.
- With current
 - The CT generates a current which will conform to the ratio
 - The PCB burden resistor determines the voltage
 - No/Too Large resistor equals over voltage and CT failure
- Marked Terminal – X1
 - Ensure output sine wave is in sync with input sine wave



Style D VSD Architecture



Style “D” VSD Architecture

- Component Identification and Location
- Circuit Diagram Identification and Location
- Component Functions

Form 160.00-M1

Form 160.00-PW1

Form 160.00-RP2

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VSD

- 351 HP – Vyper & Style D
- 503 HP - Vyper & Style D
- 790 HP – Style D
- 1100 HP – Style D
- Development Line
 - TM1 → TM2 → Styles A, B, C, D → Vyper

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TM3 Styles

- Style “A” – This series applies to 503 HP only. Ground fault protection was incorporated into the circuit breaker rather than utilizing separate GFI modules.
- Style “B” – This series includes wire harness changes to address 50HZ, higher voltage scaling on the ‘519’ Filter Logic Board with matching software changes, and various other software modifications
- Style “C” – This series is identical to the Style B series, except that the circuit breaker and some fuses have been changed to permit a 65,000 A. Short-Circuit Rating.
- Style “D” – This series incorporates changes to the ‘519’ Filter Logic Board and Filter Gate Driver Board, resulting in improved Percent TDD values:

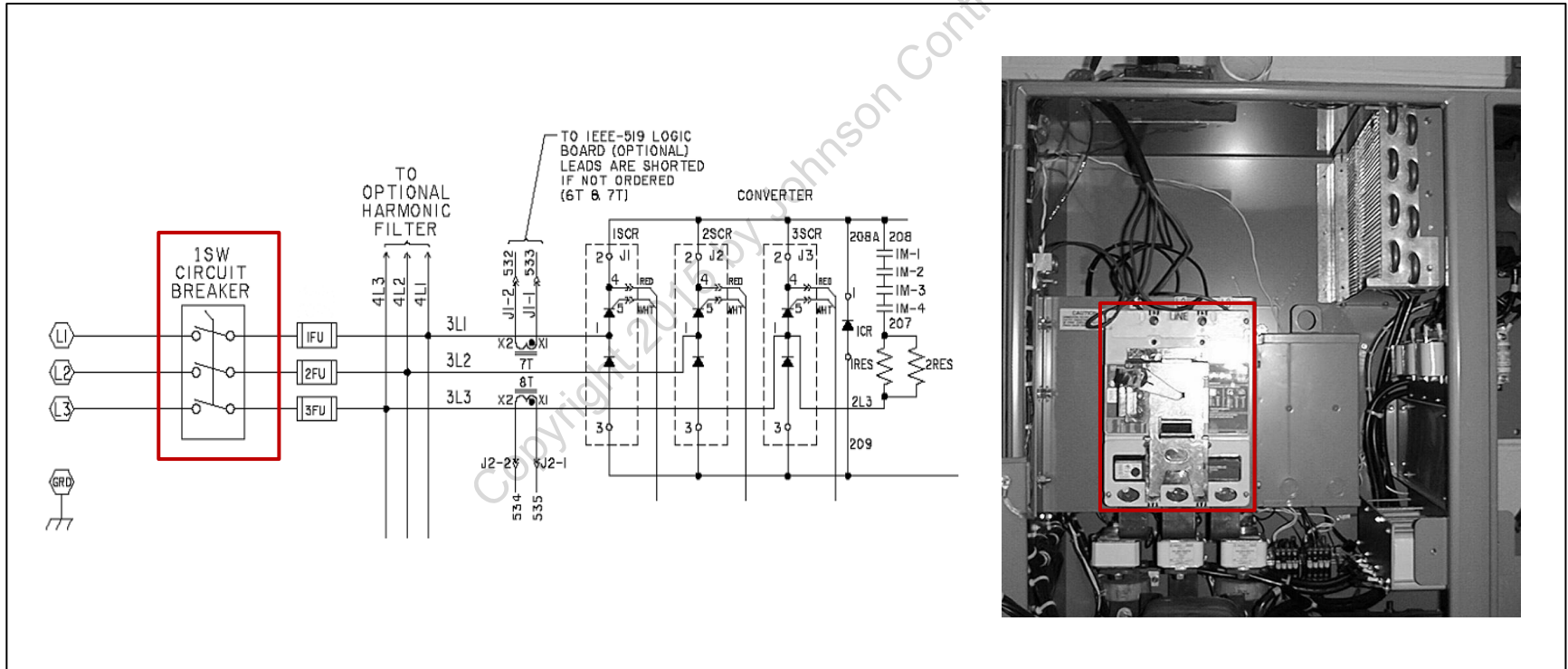
Style “D” VSD Major Components Exclusive of Harmonic Filter

- Electronic Disconnect / Circuit Breaker
- Bridge Rectifier Section (SCR's & Diodes)
- Filter Section (Reactor & Capacitors)
- Inverter Section (IGBT's)
- VSD Logic Board

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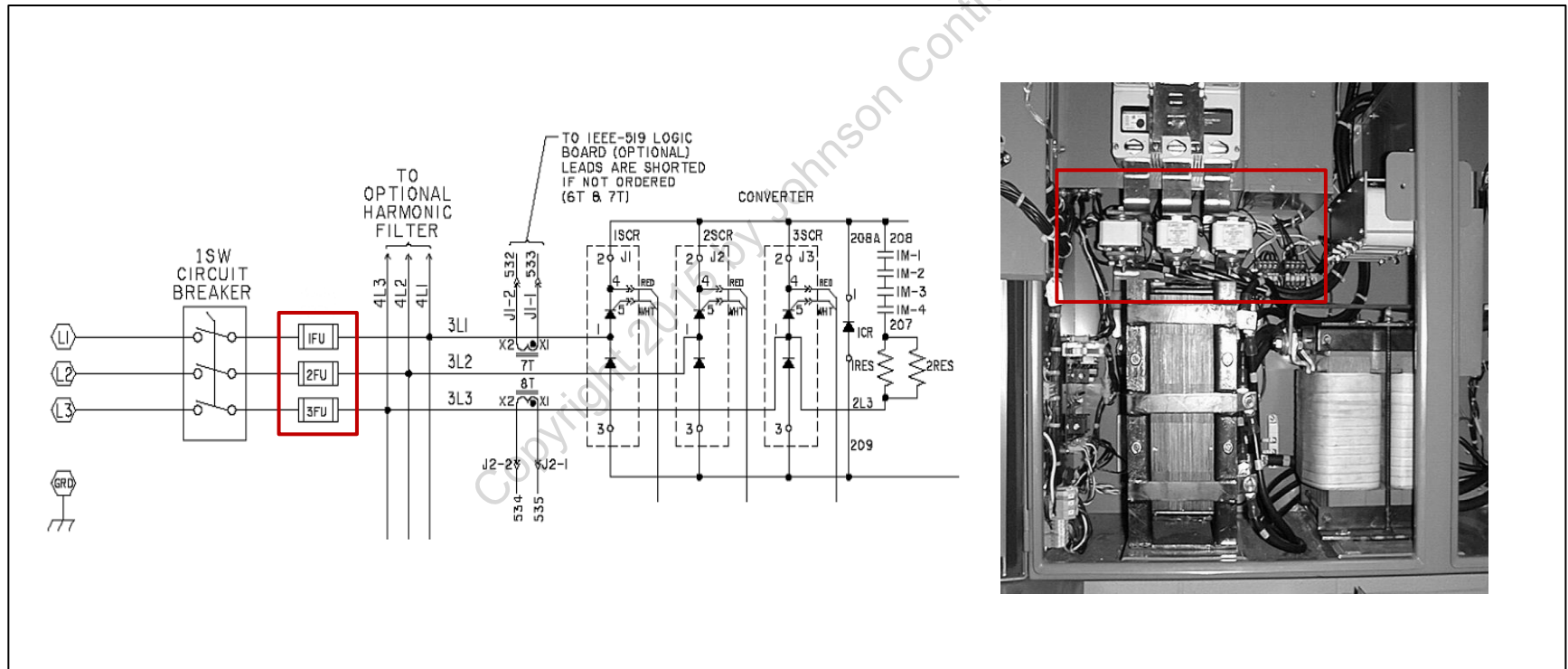
Electronic Circuit Breaker

- Protects against ground faults
- Provides a physical means of connecting and disconnecting the incoming power.



Electronic Circuit Breaker Components

- Line Fuses protect the Bridge SCR / Diode Modules from:
 - Physical damage due to component failure within the Bridge / Rectifier Section.
 - Failure due to incoming power line surges.



Bridge Rectifier Components

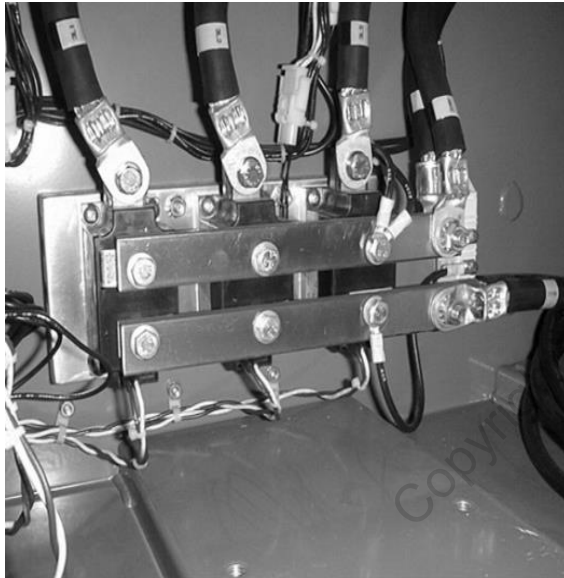
- Input Rectifier Modules
- SCR Trigger Board
- Pre-Charge Resistors
- Pre-Charge Contactor
- Free-Wheeling Diode

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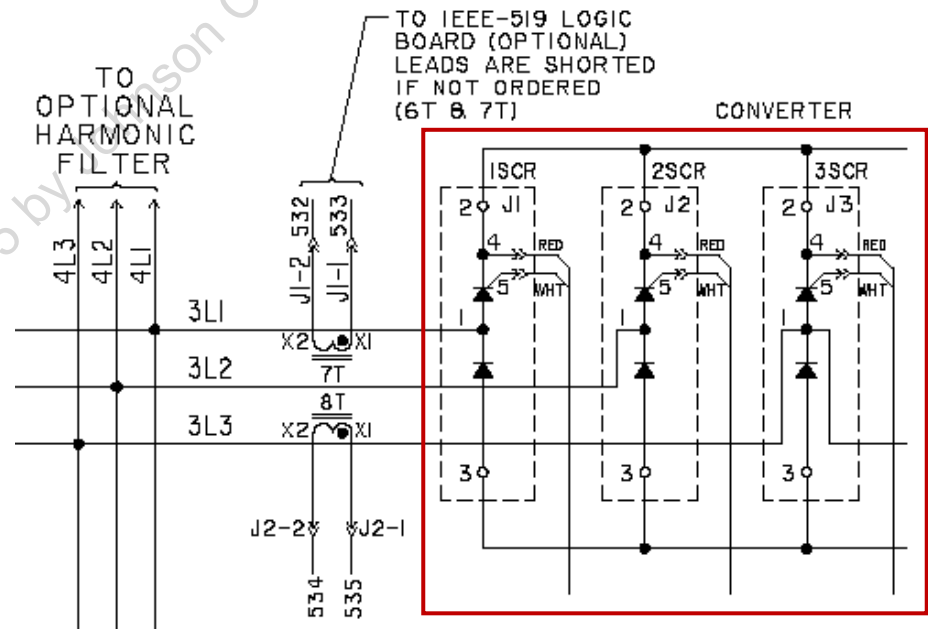
Bridge Rectifier Components

Input Rectifier Modules

- Converts 3-phase AC to DC.
- Provides a fast disconnect



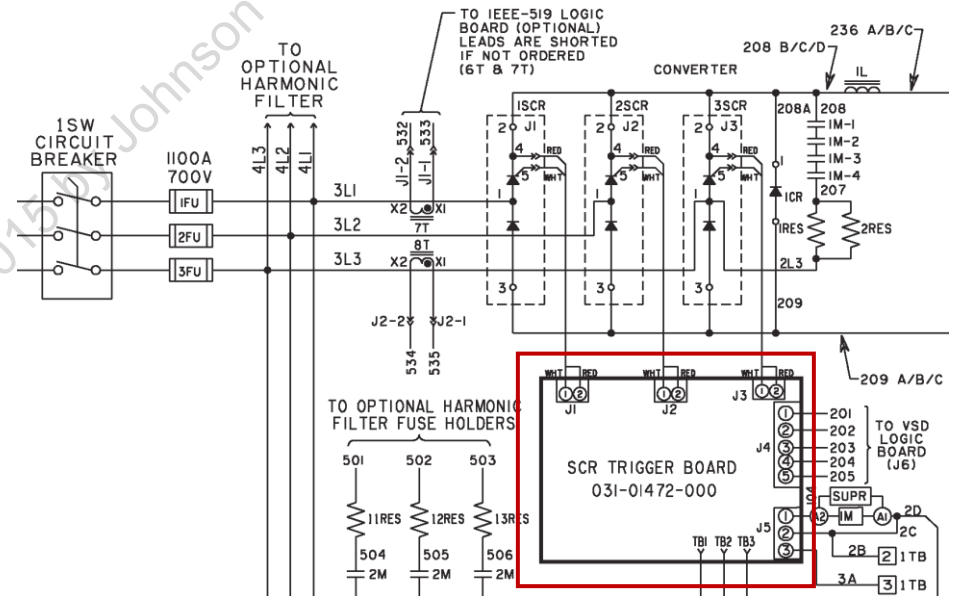
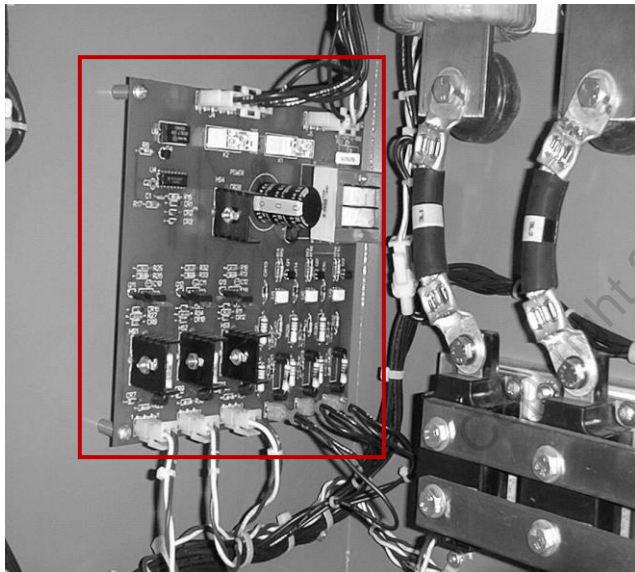
Wires must be shorted together



Bridge Rectifier Components

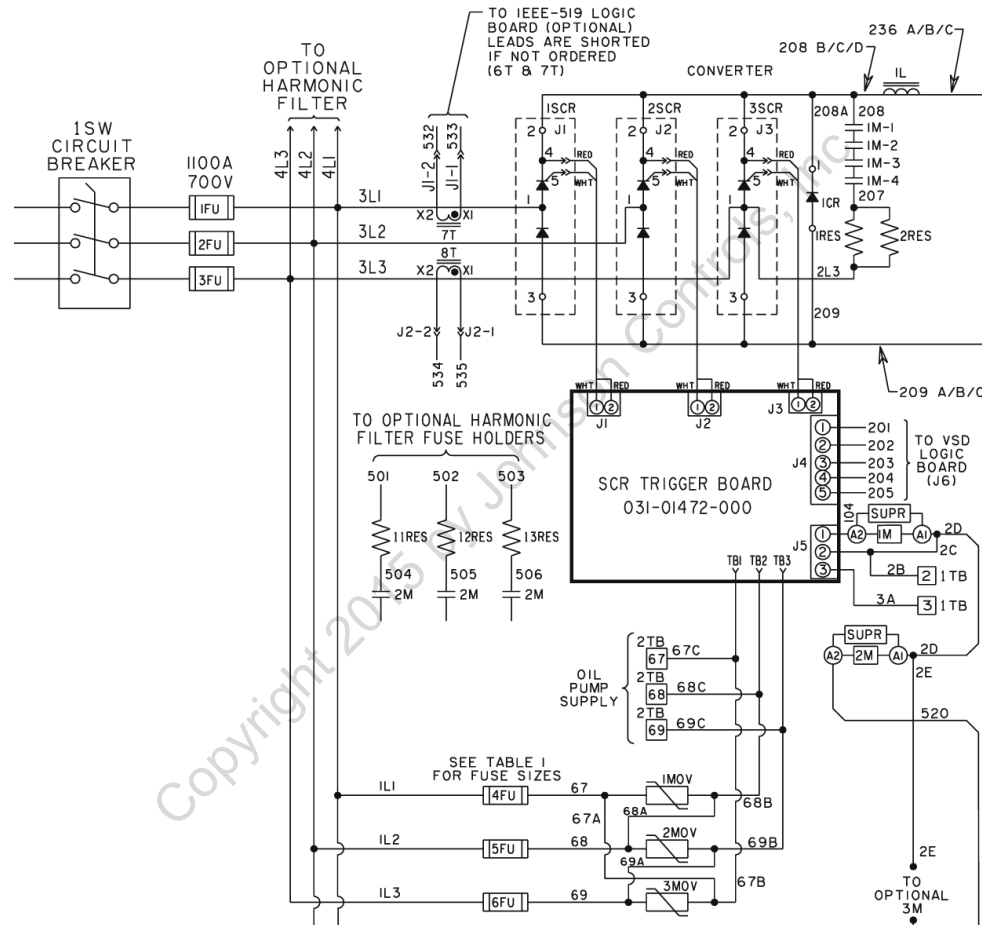
SCR Trigger Board

- Controls the Pre-Charge
- Monitors the incoming 3-phase power
- Gates on the SCR's



SCR Trigger Board

Monitors the incoming 3-phase power



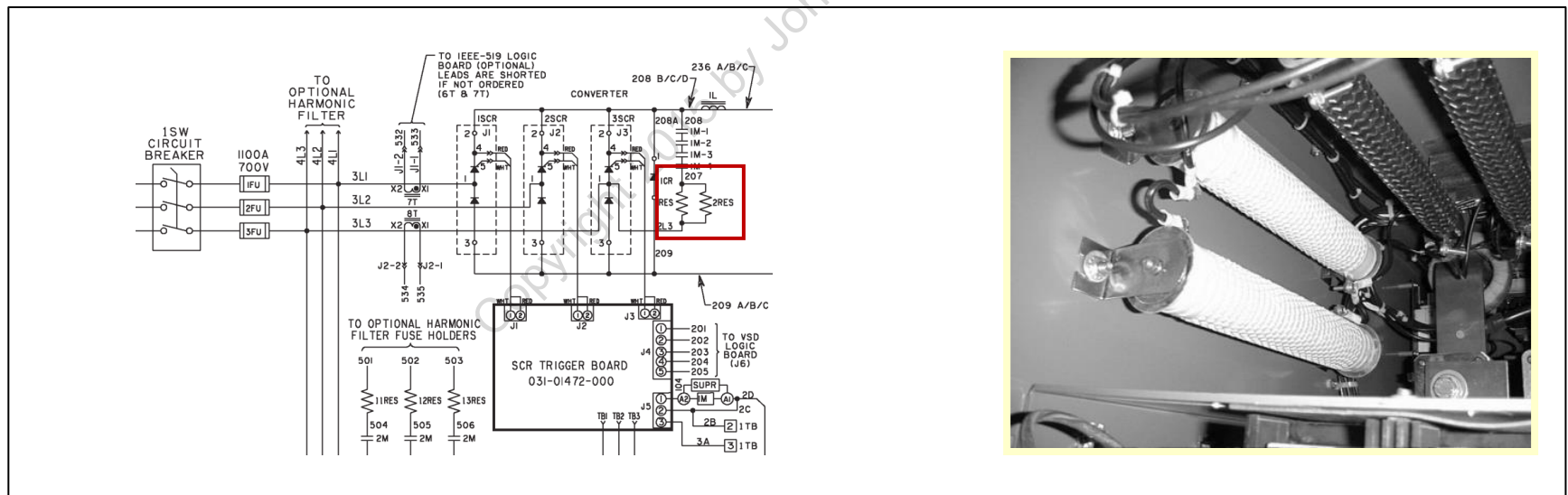
MOV Wiring



Bridge Rectifier Components

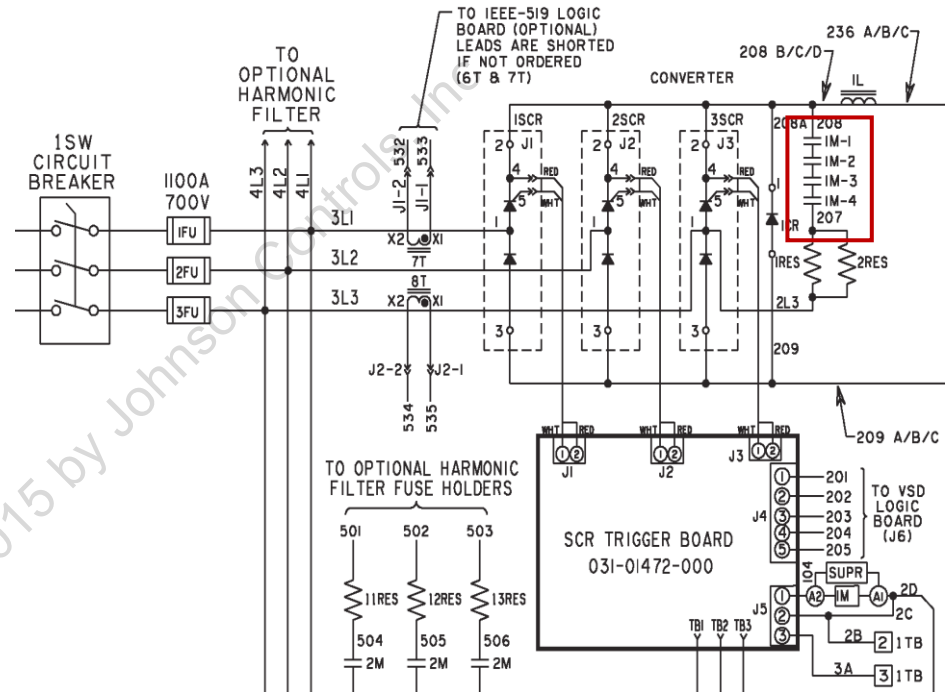
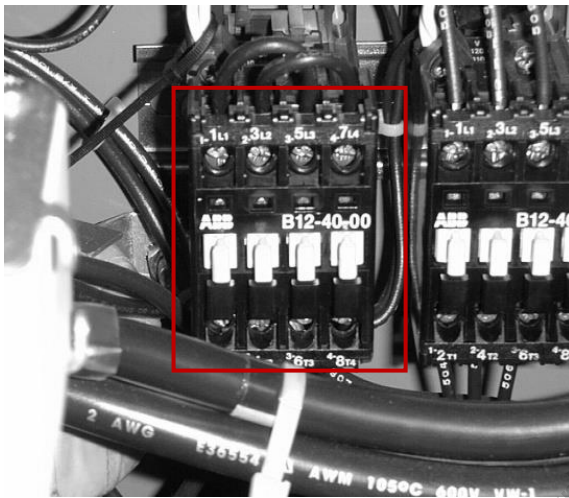
Pre-Charge Resistors

- Controls the inrush current to the VSD
- Energizing 1M Allows
 - Current flow from C phase across the Pre-Charge Resistors
 - The capacitors to charge slowly without damage
- Once Pre-Charge period expires (15 sec), de-energize 1M



Bridge Rectifier Components

Pre-Charge Contactor

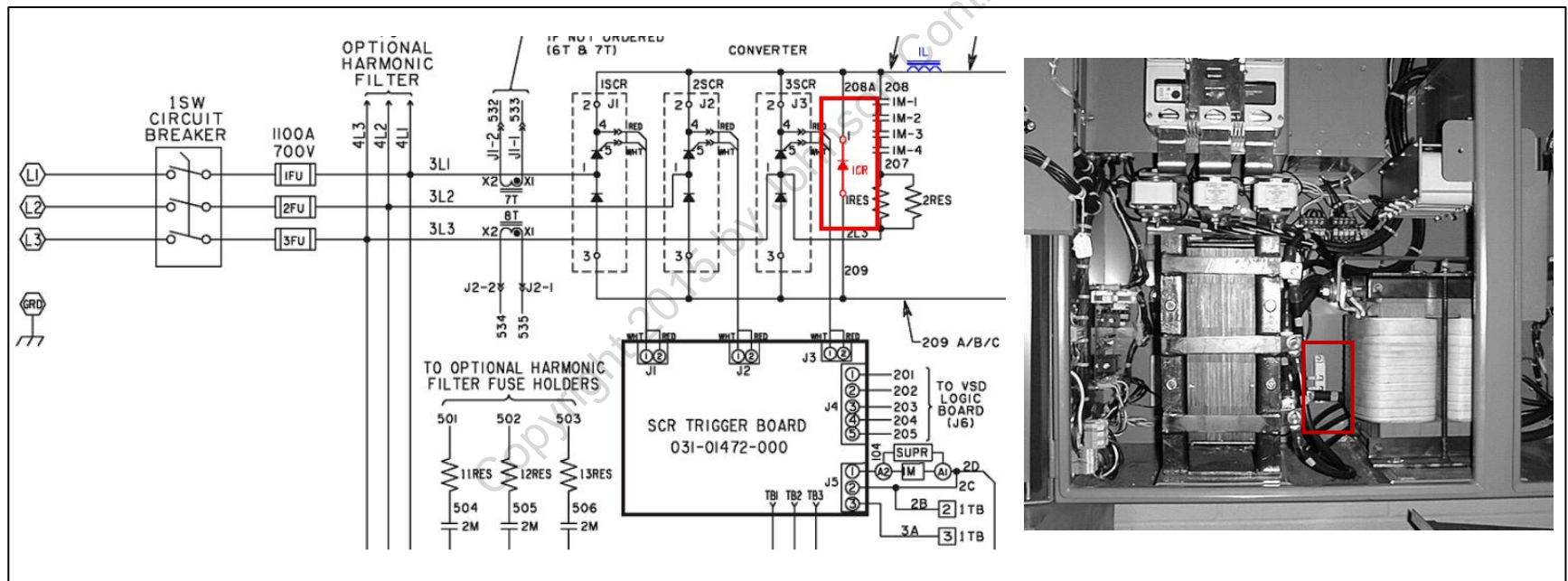


4 contacts to share 650 VDC

Bridge Rectifier Components

Free-Wheeling Diode

- Works with the Discharge / Balance Resistors to create a current path for the DC bus on shut down.
- Current flow reverses with collapsing magnetic field



Filter Section Components

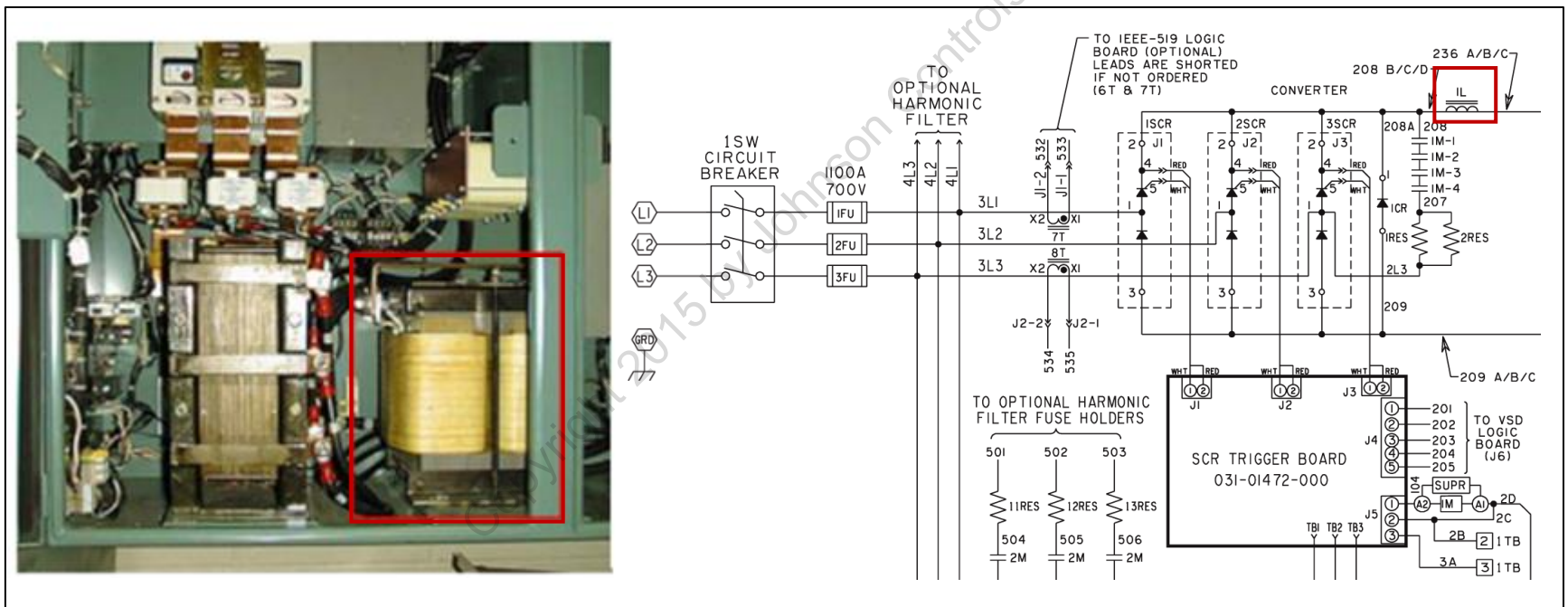
- DC Link Inductor
- DC Bus Capacitors
- DC Balancing Resistors
- DC Bus Isolation Board

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Filter Section Components

DC Link Inductor

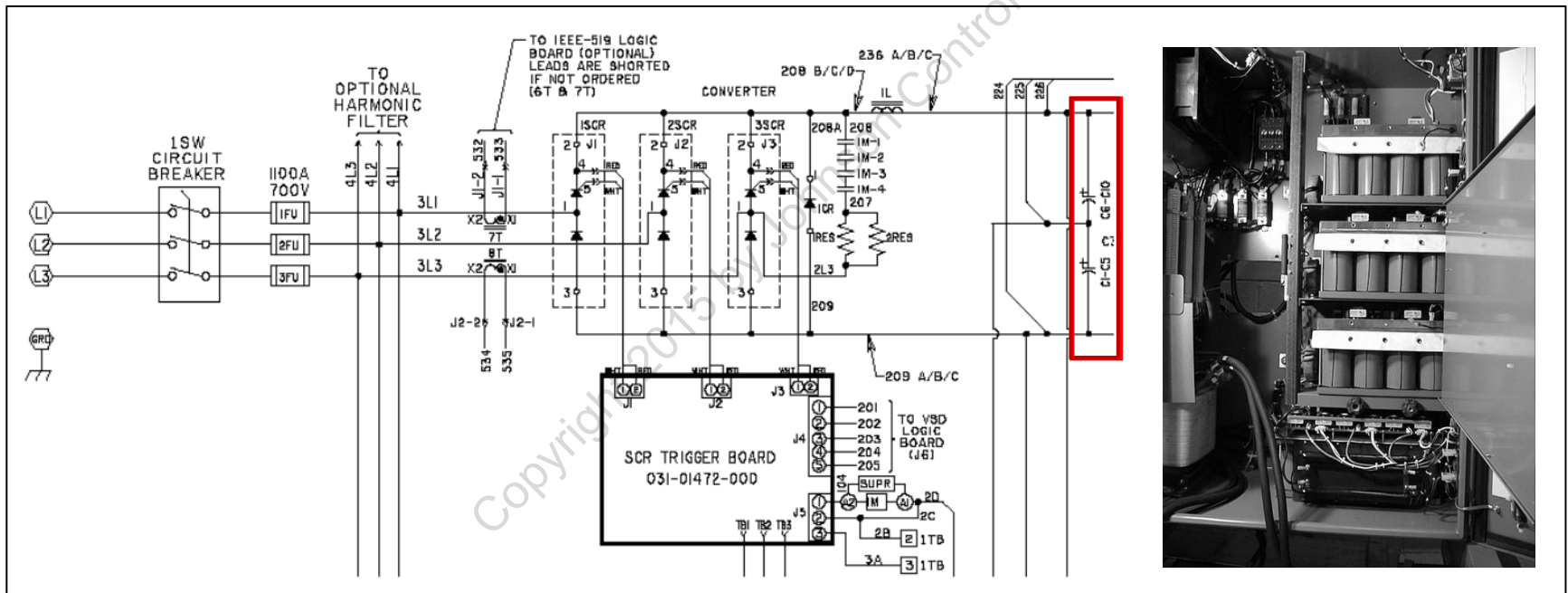
- Inhibits the flow of current until it builds up a magnetic field.
- Maintains the flow of current until the magnetic field collapses



Filter Section Components

DC Bus Capacitors

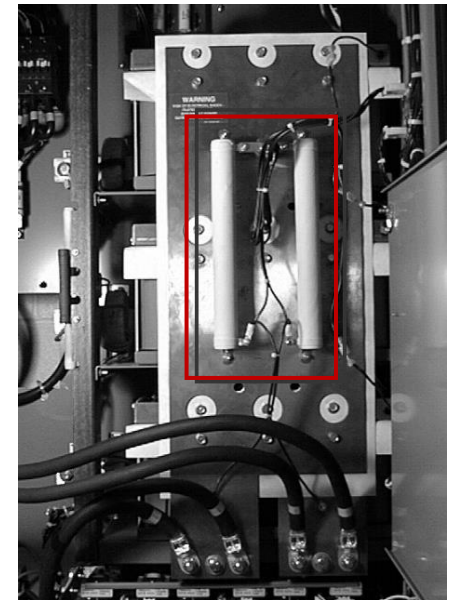
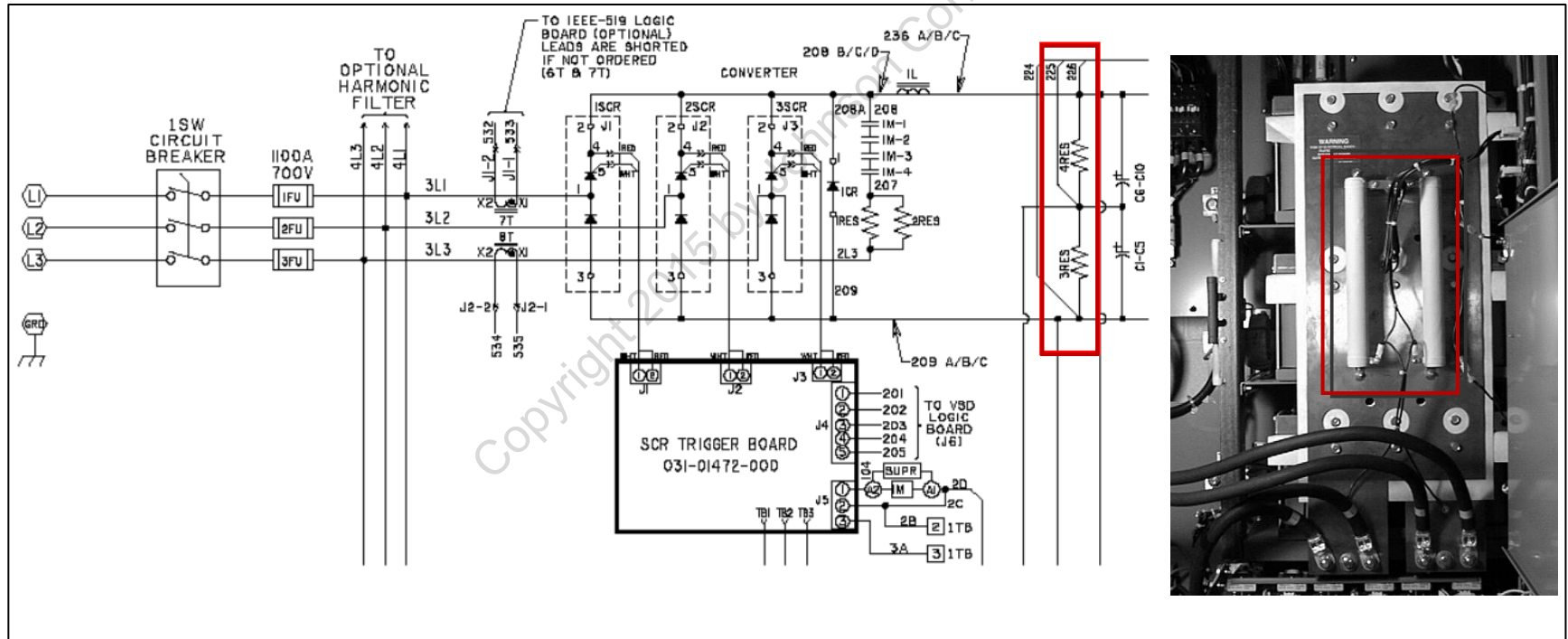
- Smooths the ripple voltage
- Provides a large energy reservoir.



Filter Section Components

DC Balancing Resistors

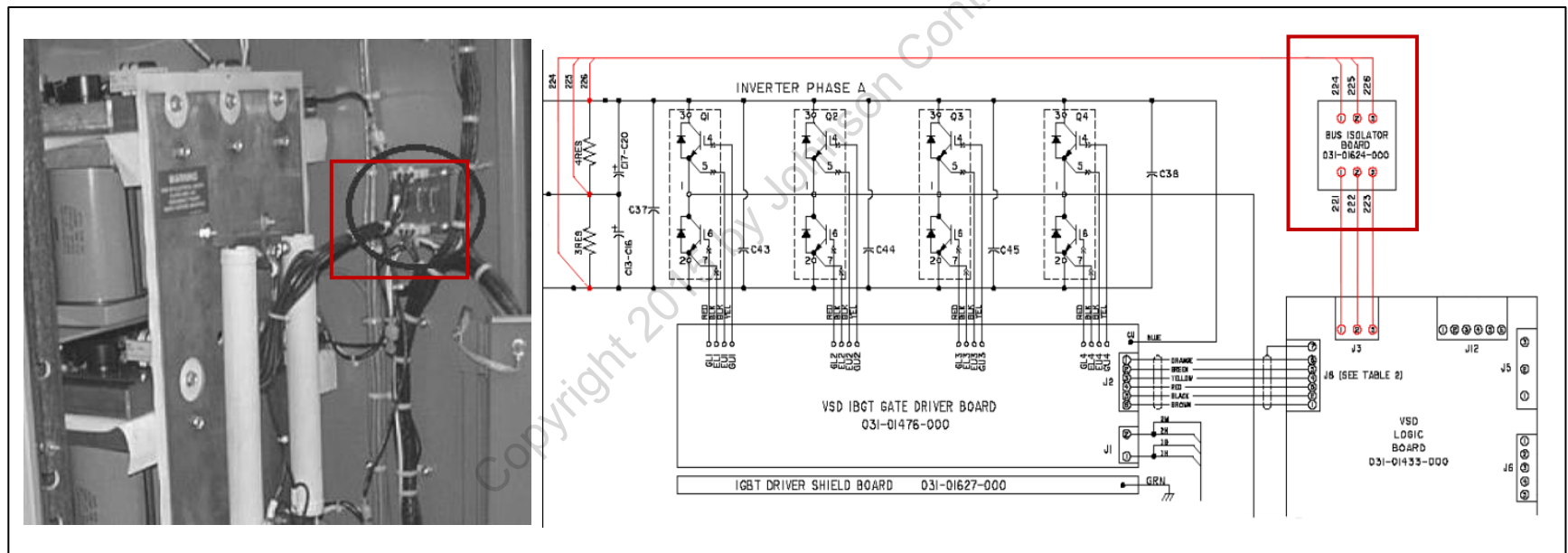
- Maintains balanced current flow across the entire DC bus during operation.
- Bleeds down the DC bus voltage after the VSD has been shutdown.
- Equalizes the effect of capacitive reactance between capacitor banks.



Filter Section Components

DC Bus Isolation Board

- Monitors the Positive, Middle, and Negative DC Bus.
- Provides “safe” impedance between the DC filter capacitors and the Logic Board



Inverter Section Components

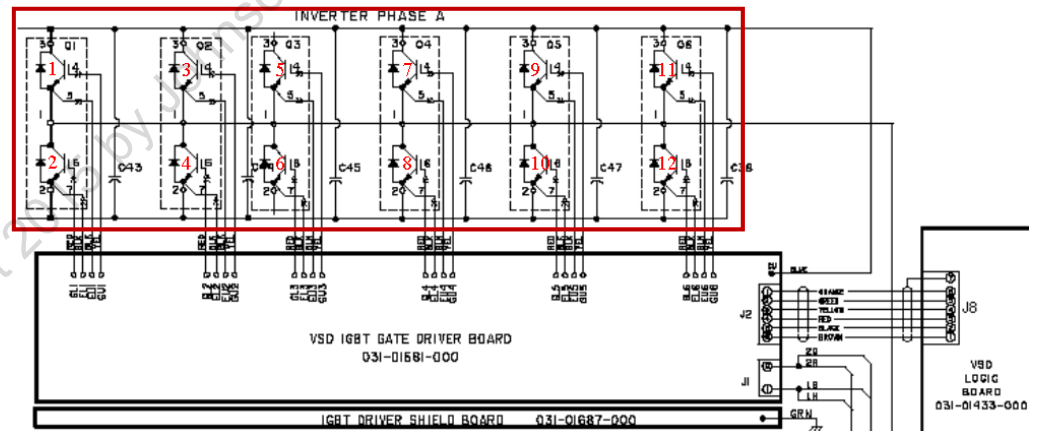
- Transistors (IGBT's)
- Gate Driver Board
- Output Current Transformers
- dV/dt Output Filter

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Inverter Section Components

Transistors (IGBT's)

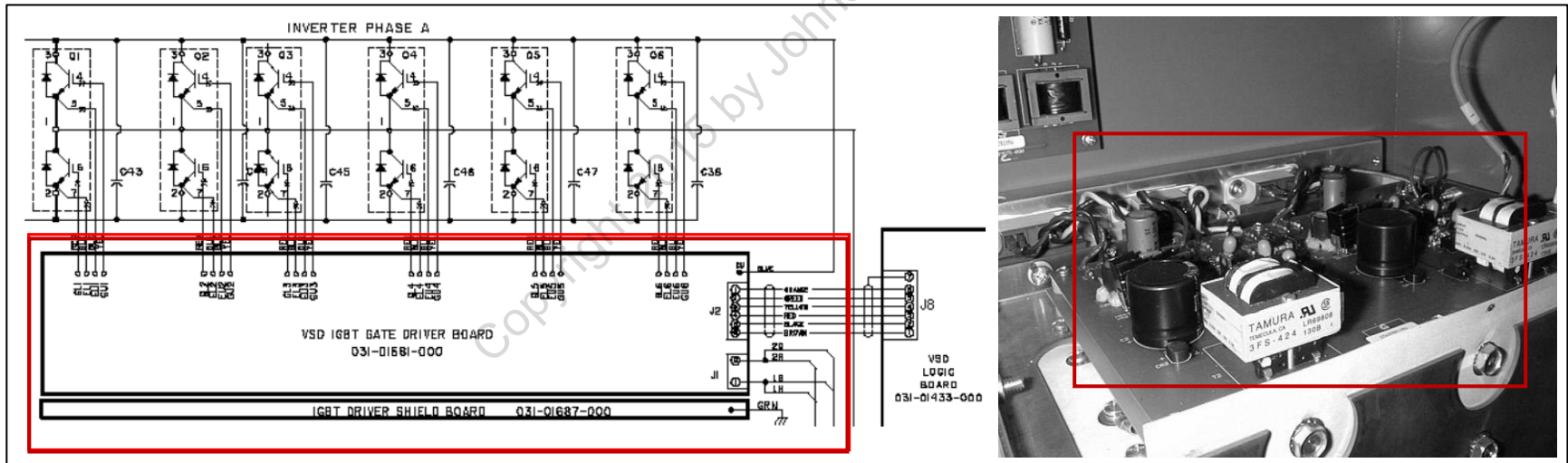
- 12 total IGBT's make up one phase.
- 6 IGBT's create the positive side of one phase of the output sine wave.
- 6 IGBT's create the negative side of one phase of the output sine wave



Inverter Section Components

Gate Driver Board

- Receives gate pulses from the VSD Logic Board.
- Provides isolation between the VSD Logic Board gate firing pulses and the IGBT's.
- Monitors the IGBT's for proper operation and notifies the VSD Logic Board of problems.



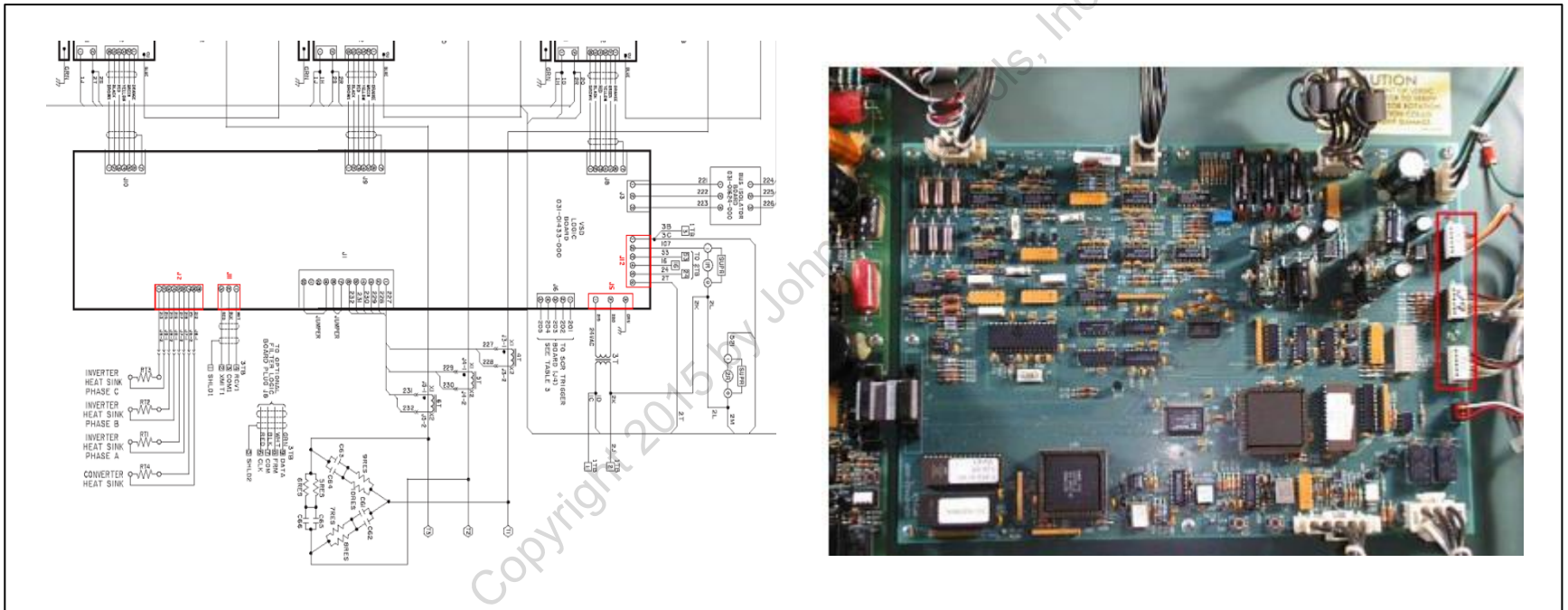
Inverter Section Components

dV/dT Output Filter

- Limits the rate of change and the peak voltage applied to the motor windings.
- If motor wiring is lengthened AT ALL, then add a second output filter
- If the VSD is remote mounted, it is limited to a distance of 50 feet.



VSD Logic Board



VSD Logic Board

- Monitors all VSD operating conditions and commands the micro-panel to shutdown the VSD when a failure occurs.
- Makes all logic decisions concerning the VSD's normal operation. (such as enabling pre-charge, turning off pre-charge etc.)
- Communicates all operating conditions and safety conditions via J11 to the micro-panel.
- Receives start/stop, and speed signal from ACC board and creates the Gate pulses needed to fire the IGBT's within the inverter.
- Communicates with the harmonic filter logic board during operation.

Component Lab

- Using
 - Style “D” lab simulators
 - FORM 160.00-RP-2
 - “Style D Component Recognition Lab sheet
 - Locate each item and fill out lab sheet

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Vyper VSD Architecture



Vyper VSD Major Components

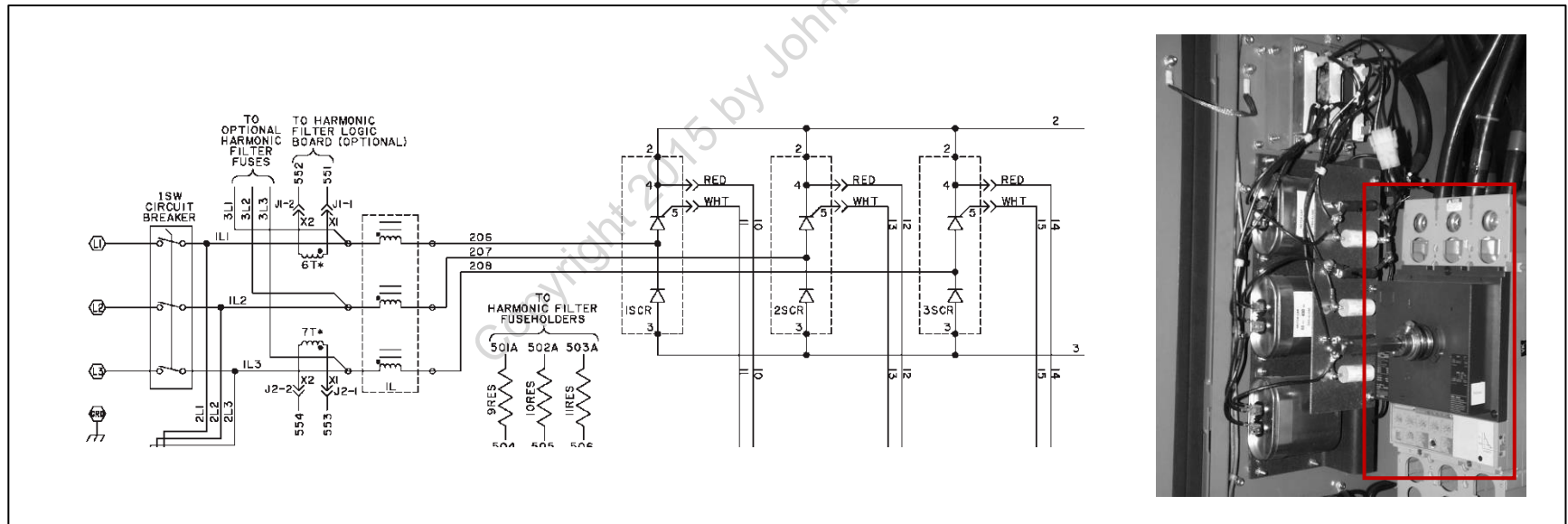
Exclusive of Harmonic Filter

- Electronic Disconnect / Circuit Breaker
- Bridge Rectifier Section
- Filter Section
- Inverter Section
- VSD Logic Board

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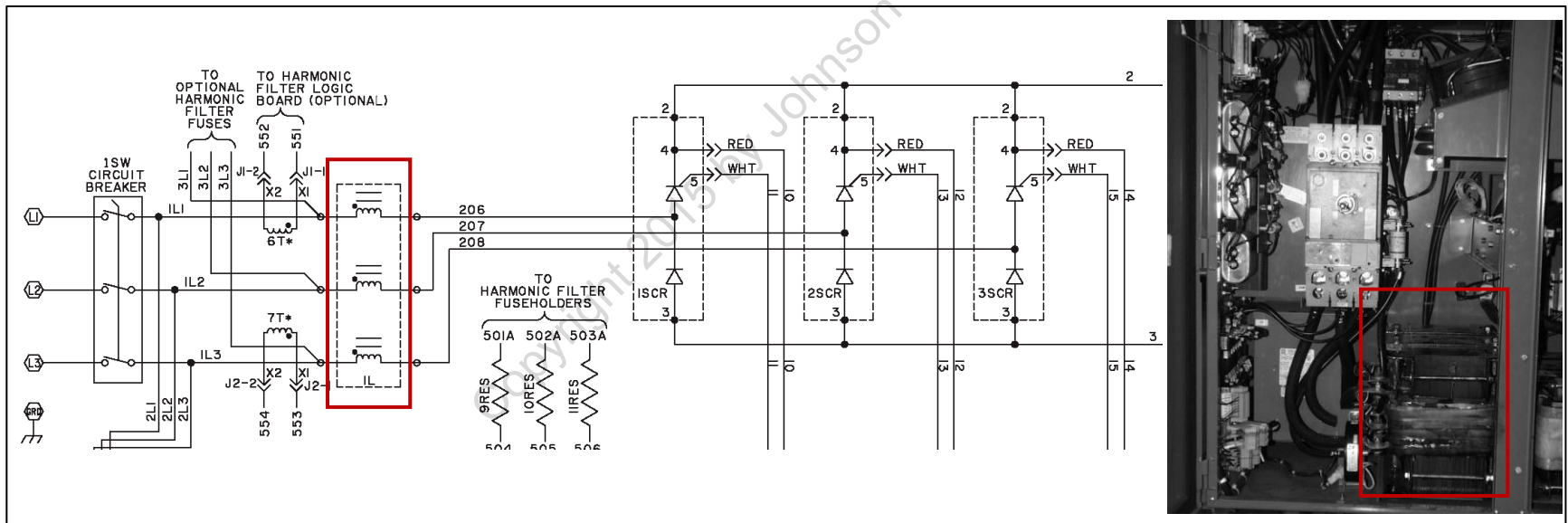
Electronic Disconnect / Circuit Breaker Components

- Has adjustable settings which are factory set.
- Proper settings should be verified prior to start-up.
- The incoming 3-phase power line connects directly to it.
- Note the removal of the Main Line Fuses and the addition of the AC Line Inductor



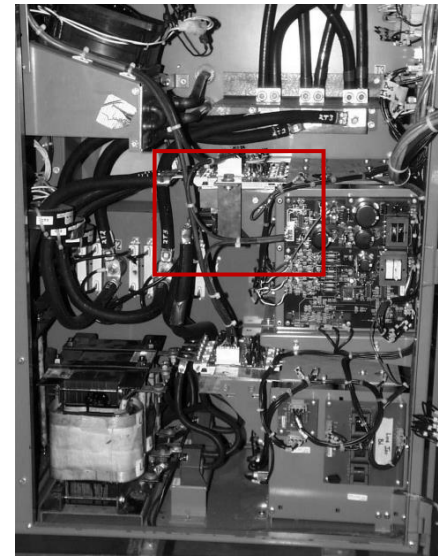
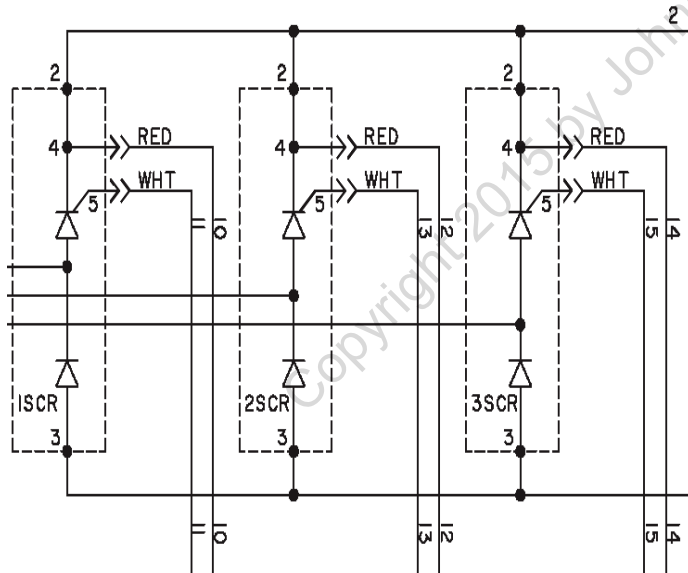
AC Line Inductor

- Eliminates the need for Main Line Fuses.
- Adds inductance to the incoming power slowing the rate at which current rises.
- Allows the Circuit Breaker to react quickly enough in the event of a component failure or a power surge.



Bridge Rectifier Section

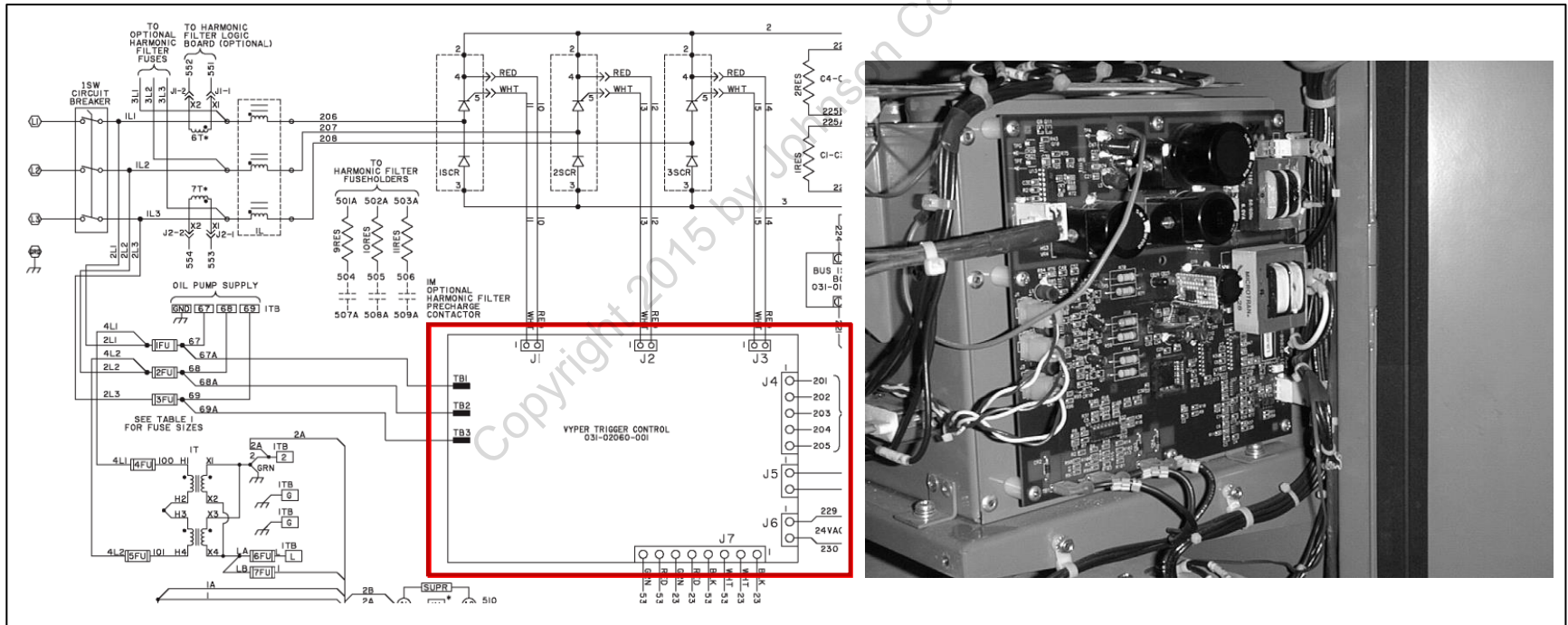
- Identical to that of the Style “D”.
- 3 SCR/Diode Modules.
- Each module contains 1 SCR and 1 Diode.
- Each module handles 1 phase of the incoming power line.



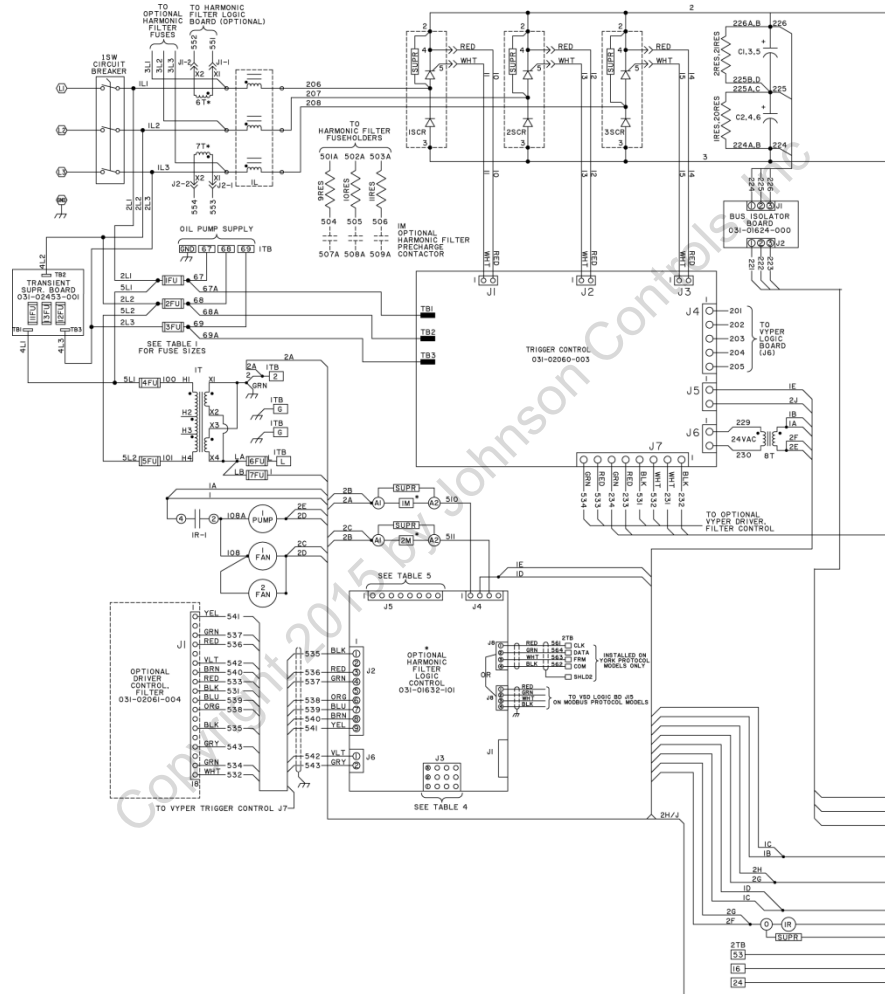
Trigger Control Board

■ The Pre-Charge Circuit

- Controls the inrush current to the VSD by pulsing the SCR's by “chasing the sine wave” (20 sec)
- This allows the capacitors to charge slowly without damage.



Trigger Control Board



Filter Section

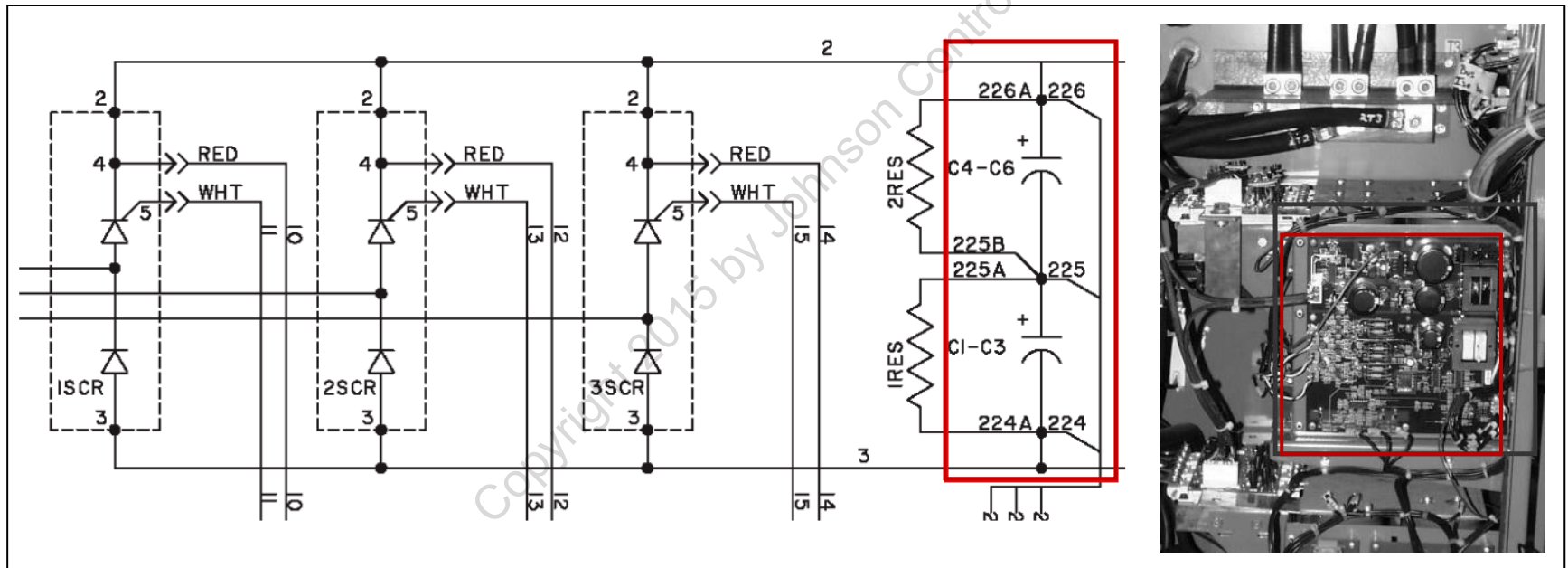
- DC Bus Capacitors
- DC Balancing Resistors
- DC Bus Isolation Board

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Filter Section

DC Bus Capacitors

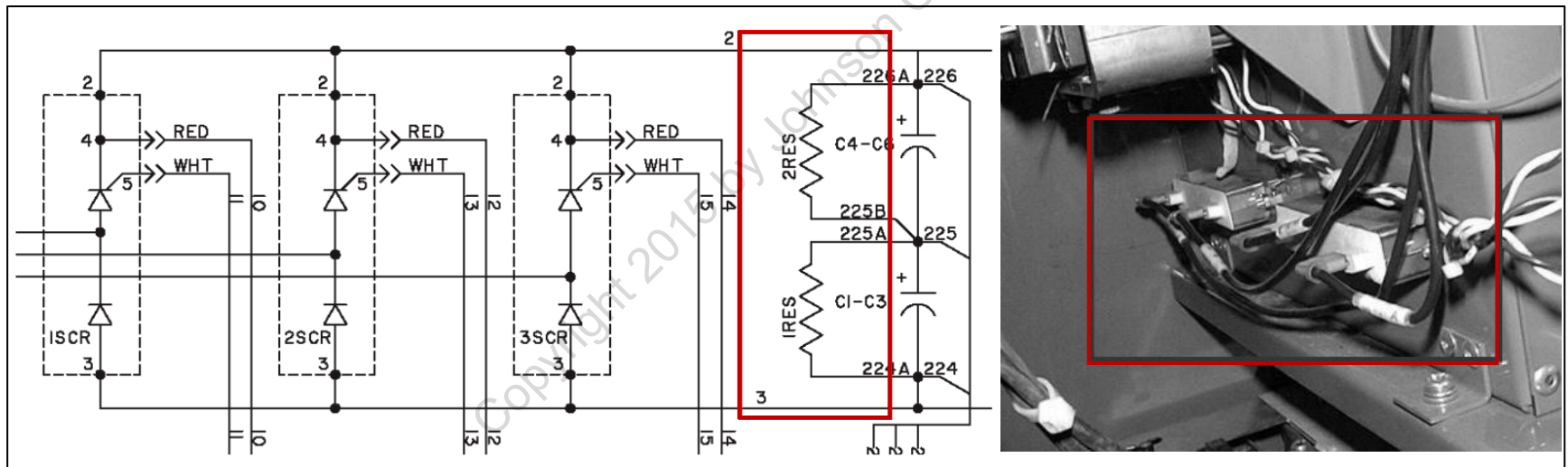
- Smooths the ripple voltage
- Stores energy



Filter Section

DC Balancing Resistors

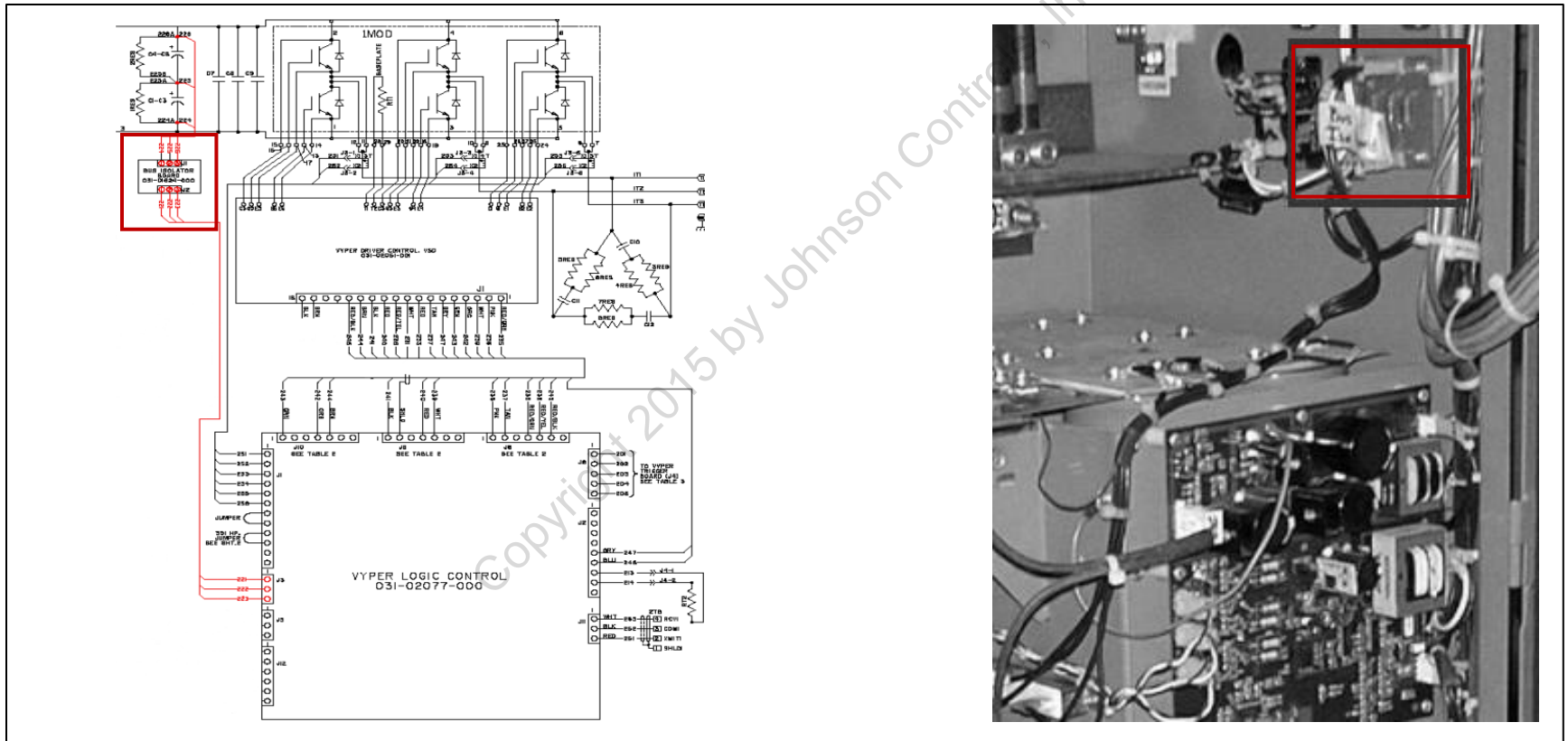
- Balances current flow across DC bus
- Bleeds down the DC bus voltage
- Equalizes the effect of capacitive reactance between capacitor banks.



Filter Section

DC Bus Isolation Board

- Monitors the DC bus voltage
- Identical to the style “D”



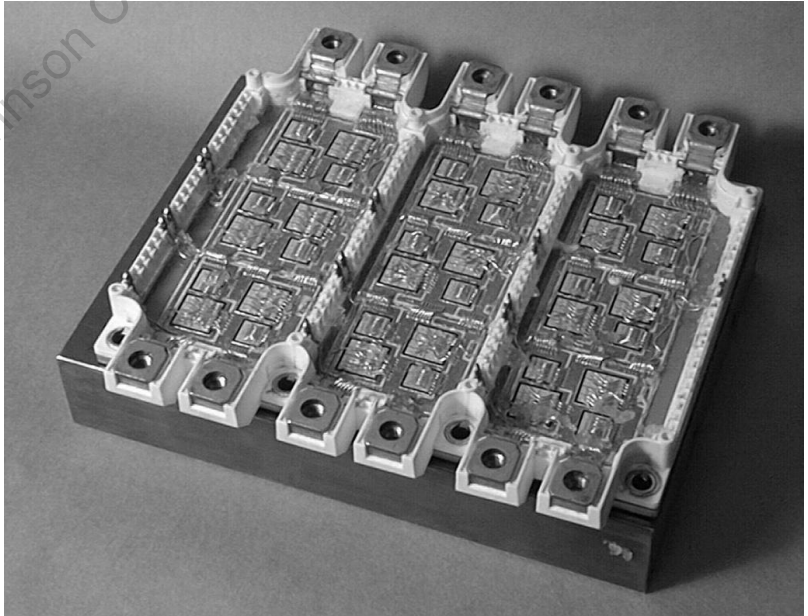
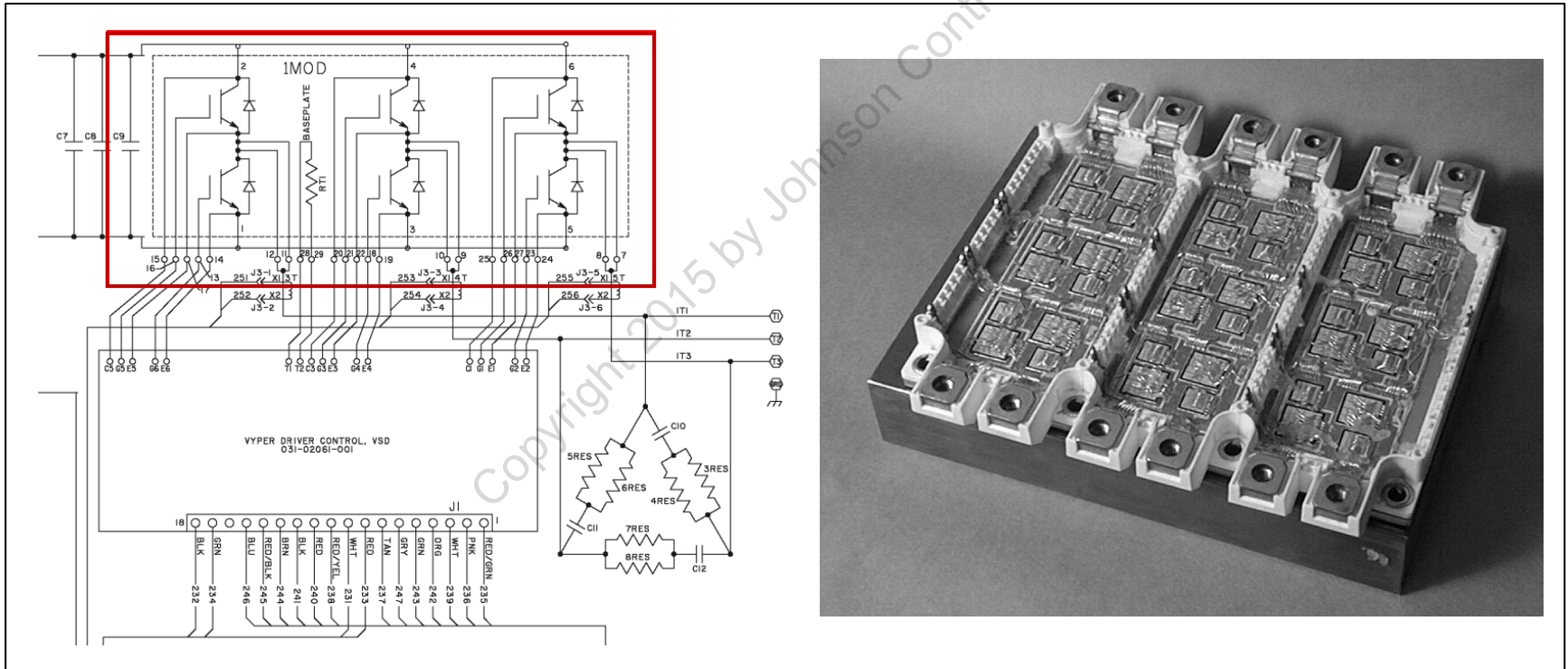
Inverter Section Components

- Transistors (IGBT's)
- Driver Control Board / Output Power Module
- Output Current Transformer
- dV/dt Output Filter

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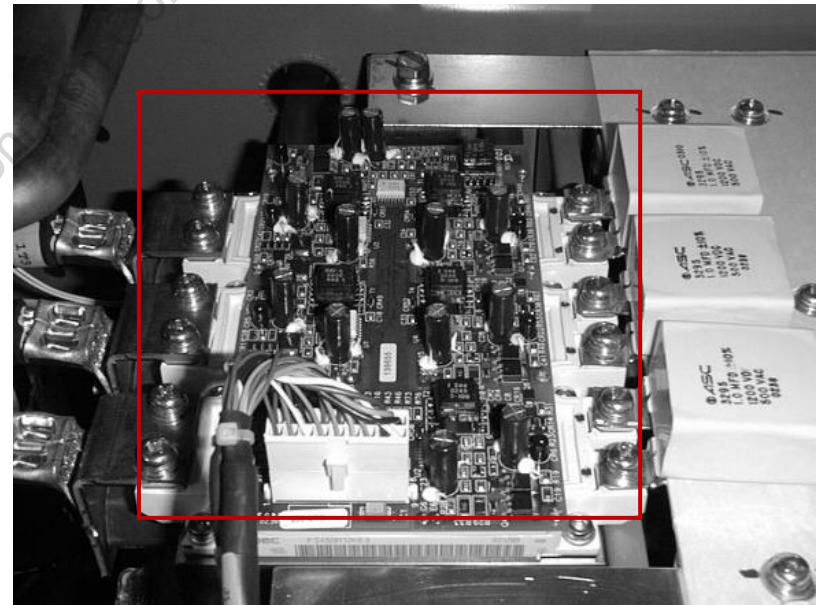
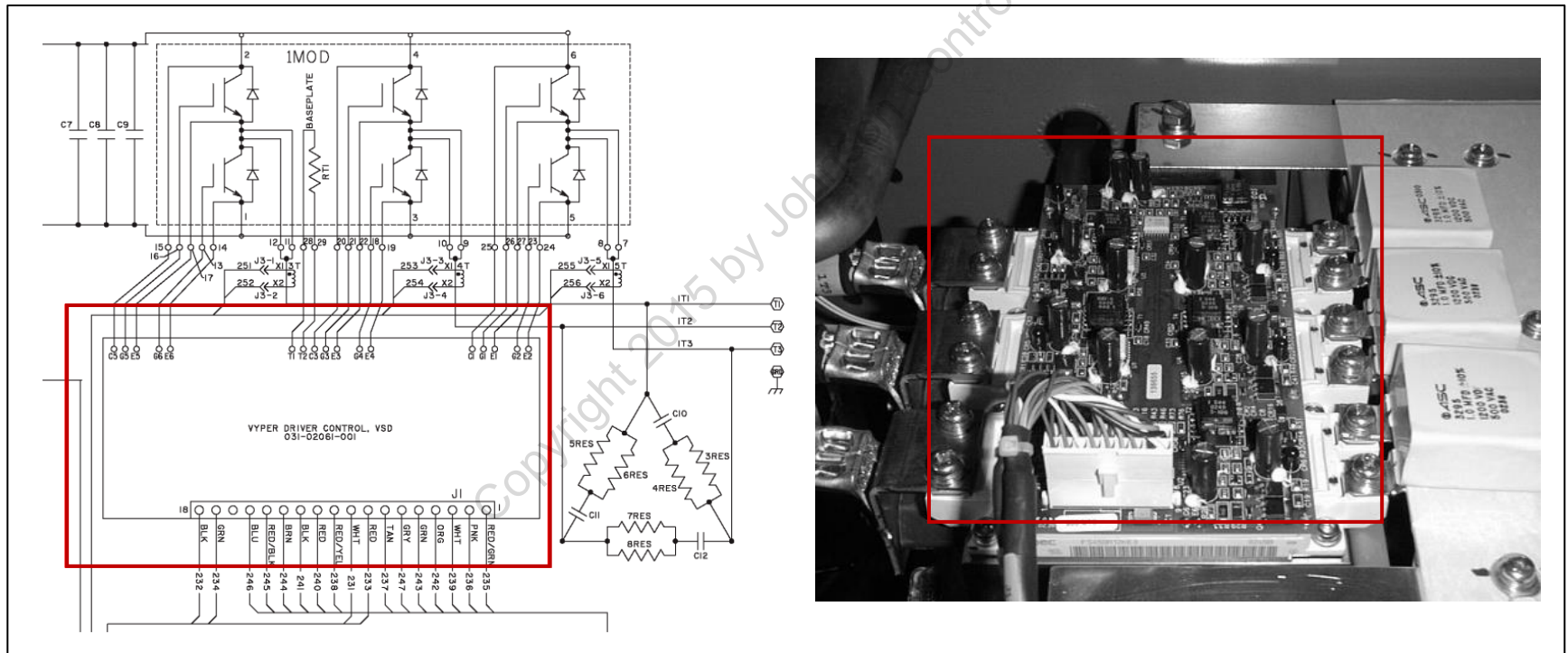
Transistors (IGBT's)

- The Vyper Power Modules contains six IGBT's.
- Three IGBTs for the positive DC bus
- Three IGBT's for the negative DC bus



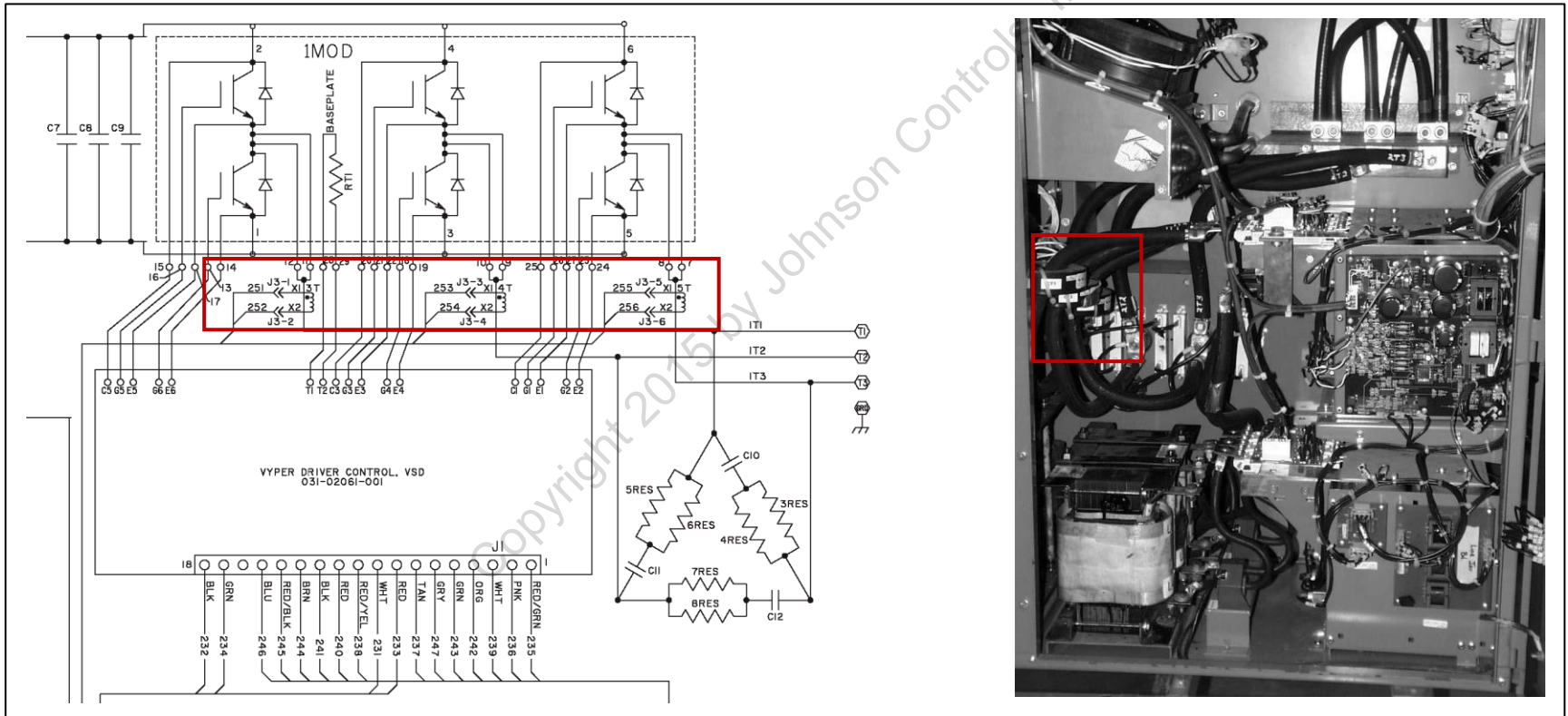
Driver Control Board / Output Power Module

- Serves the same purpose as the Style “D” Gate Driver Board.
- Used in the 351 HP & 503 HP and are smaller than the Style “D” Gate Driver Board.



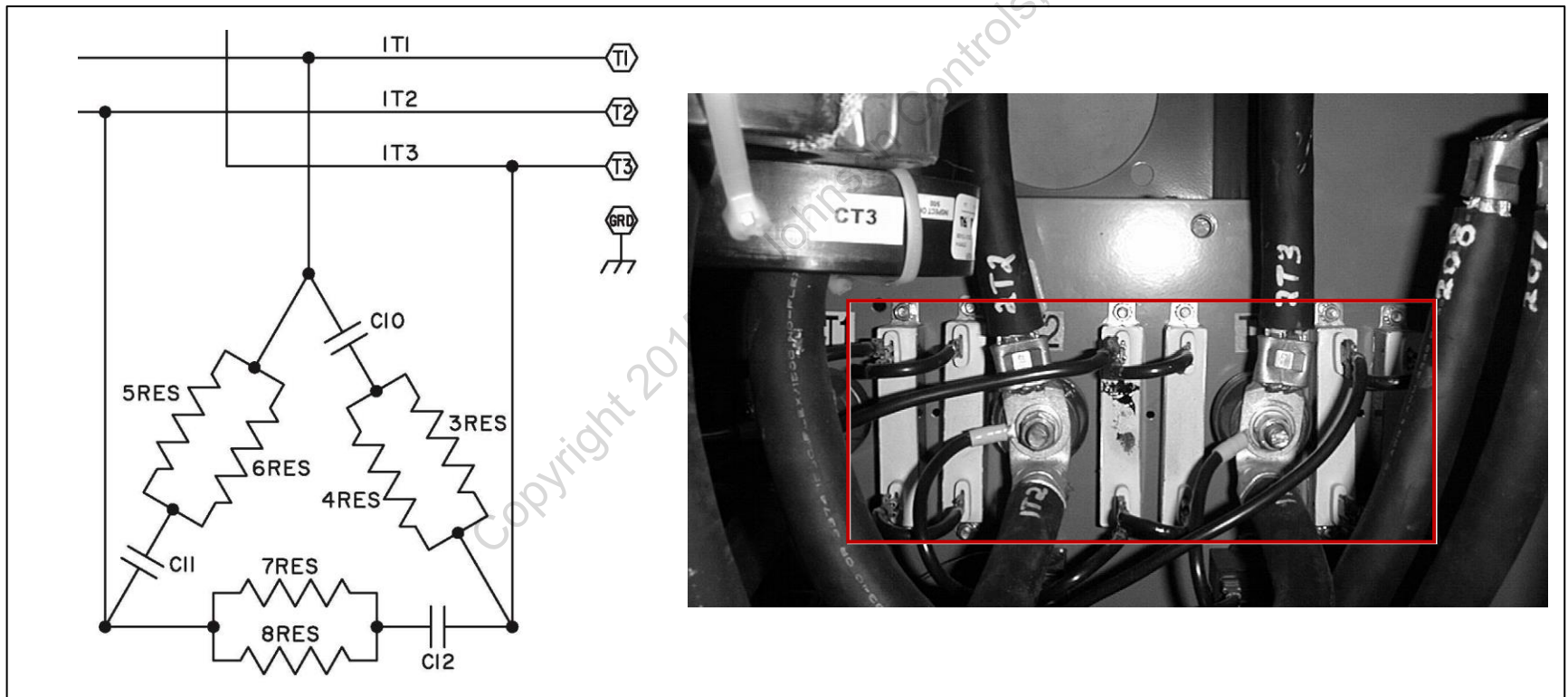
Output Current Transformer

- Provides motor current information to the VSD Logic Board.
- Polarity sensitive.



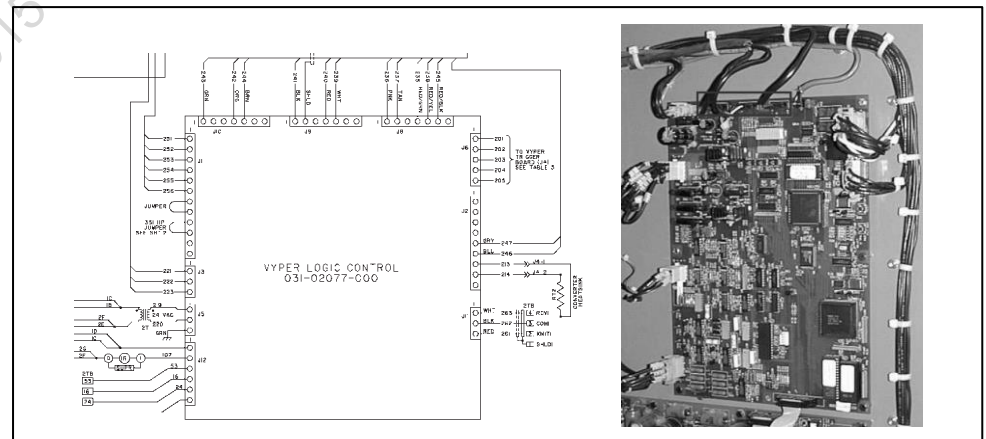
dV/dT Output Filter

- Limits the rate of change and the peak voltage applied to the motor windings.
- If motor wiring is lengthened AT ALL, then add a second output filter



VSD Logic Board

- Monitors operating conditions and commands the micro-panel to shut down the VSD when a failure occurs.
- Makes all logic decisions concerning normal operation.
- Communicates all operating and safety conditions to the micro-panel.
- Receives start/stop, and speed signal from ACC board and creates the Gate pulses needed to fire the IGBT's within the inverter.
- Communicates with the harmonic filter logic board during operation.



Lab

- Using
 - Vyper lab simulators
 - FORM 160.00-RP-4
 - Vyper Component Recognition Lab sheet
 - Locate each item and fill out lab sheet

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Harmonic Filter



Harmonic Filter

Style “D” & Vyper

- 460 VAC Circuitry
- 120 VAC Circuitry
- Low Voltage Circuitry

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-
- First and foremost, IEEE-519-1992 describes the RECOMMENDED Practices and Requirements for Harmonic Control in Electrical Power Systems.

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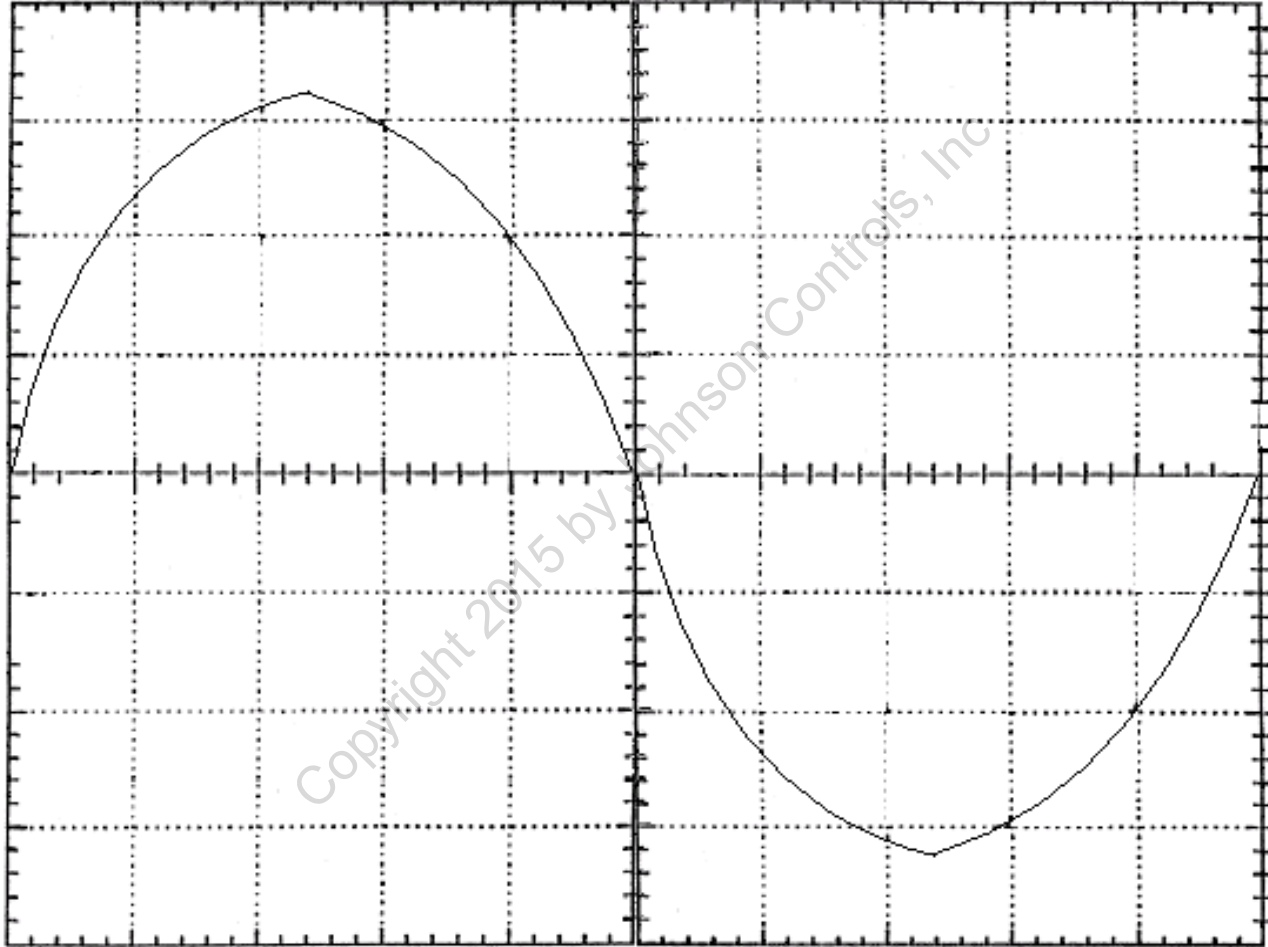
-
- IEEE 519, “Recommended Practices and Requirements for Harmonic Control in Electric Power Systems,” was published in 1981. The document established levels of voltage distortion acceptable to the distribution system. This document has been widely applied in establishing needed harmonic correction throughout the electrical power industry.

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Harmonic Filter Components

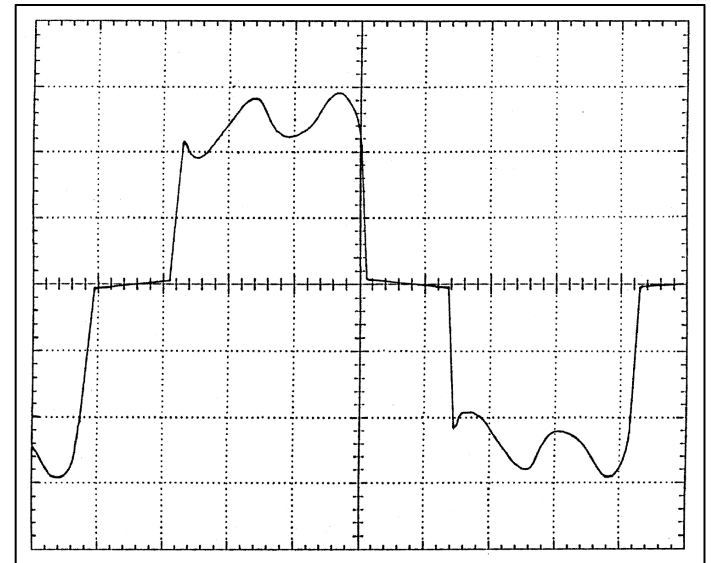
- Filter Pre-Charge Resistors and Contactors
- 3-Phase Filter Inductor
- Filter Trap
- Electronic Current Sensors
- Line Isolator Board
- Bus Isolator Board
- Main Filter Assembly
- Filter Logic Board
- All Drives create harmonic distortion as they are NON-LINEAR loads
- Harmonic Filter Option cleans up the input current waveform drawn by the VSD from the AC line
- Corrects the system power factor to nearly unity.

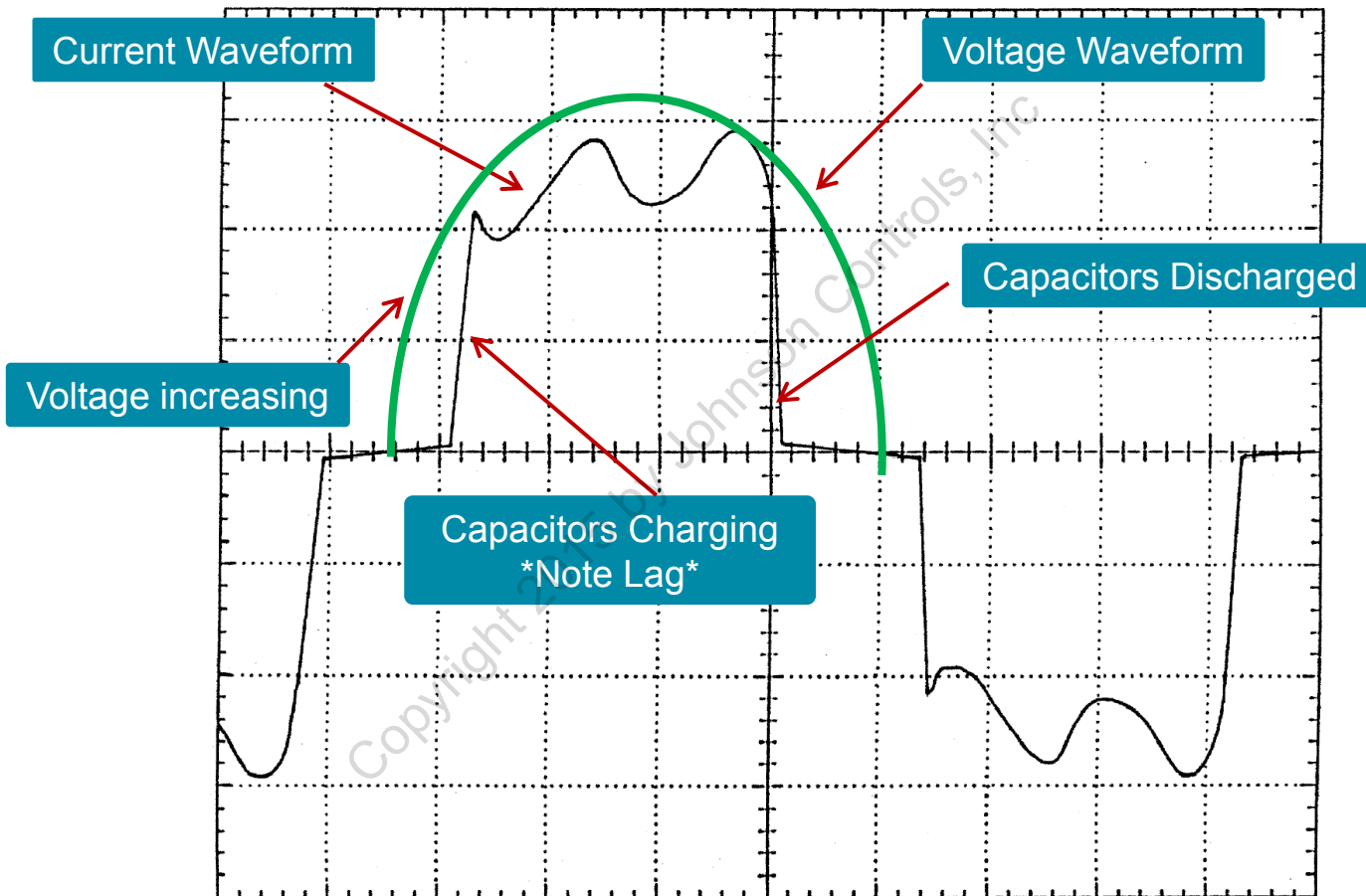
Perfect AC Waveform



The VSD input current waveform without a harmonic filter.

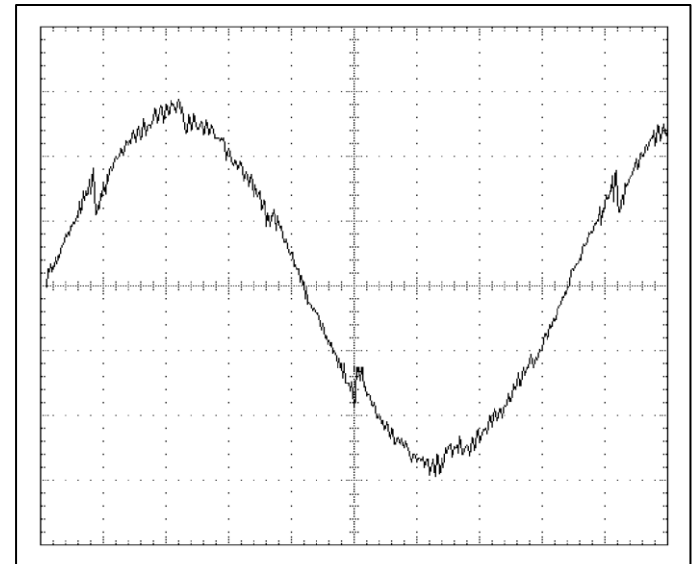
- The two “toes” within the half phase are the other 2 phases charging their capacitors.
- Filter works at 15k to 20k cycles per second.
- Harmonics are currents that flow in both directions on the Line.
- Our Harmonic Filter reduces harmonics to less than 5%.





The VSD input current waveform with a harmonic filter

- The frequency of correction is dependant on VSD horsepower. **(15-KHZ or 20-KHZ)**
- The filter logic then compares the actual current wave form to where a perfect sine wave would be
- It then makes a correction by zapping the line with the appropriate counter-active voltage at the frequency the filter is set to



STYLE "D" HARMONIC FILTER

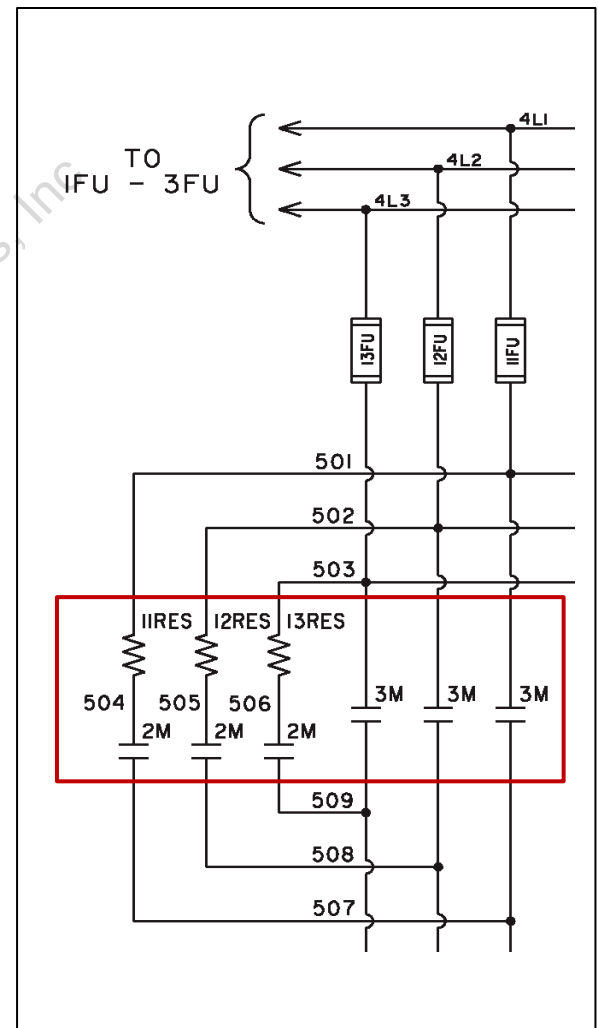
Reference Form 160.00-PW1, page 10 & 11, figure 3



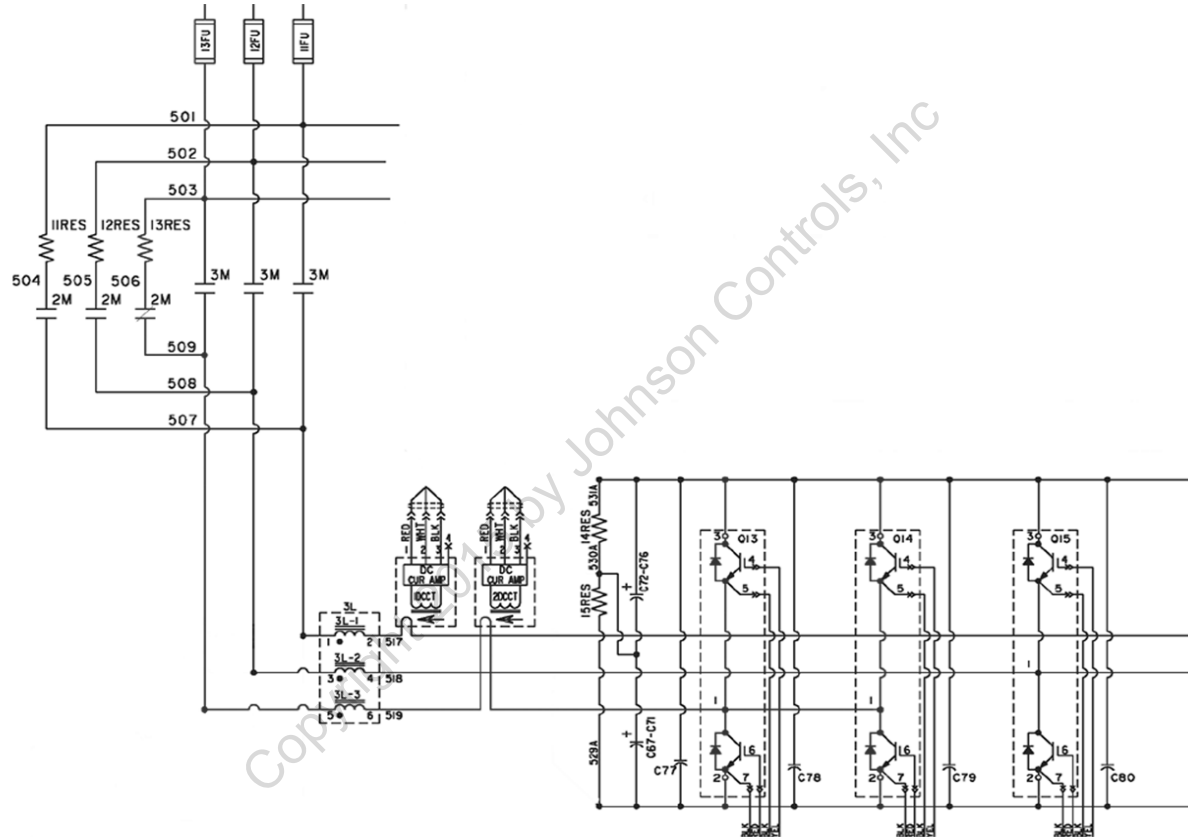
Our Policy prohibits printing. Save GREEN.

Harmonic Filter Pre-Charge Circuit

- Serves two purposes
 - Slowly charge the DC link filter capacitors
 - Provide a means of disconnecting the filter power components from the power mains.
- When VSD is commanded to run
 - Pre-charge resistors are energized via contactor 2M for 5 seconds
 - This allows the filter capacitors to slowly charge.
 - After the 5 second pre-charge
 - 3M is pulled in and the pre-charge contactor 2M is dropped out

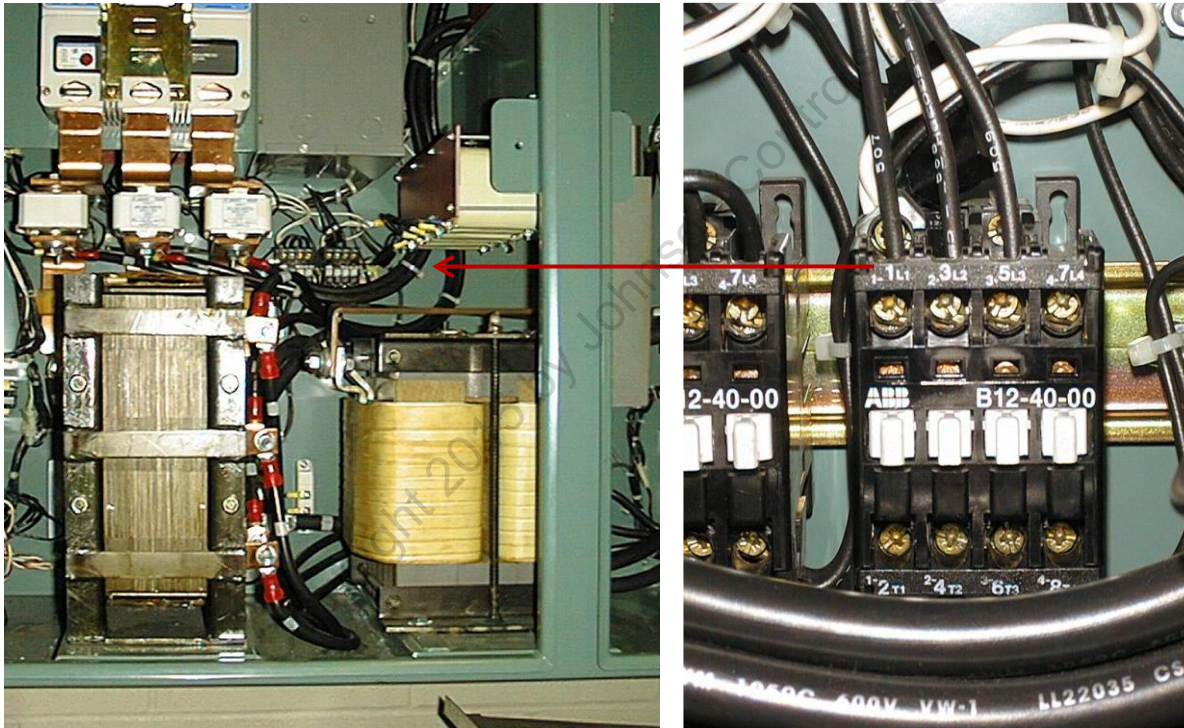


The Harmonic Filter Pre-Charge Circuit



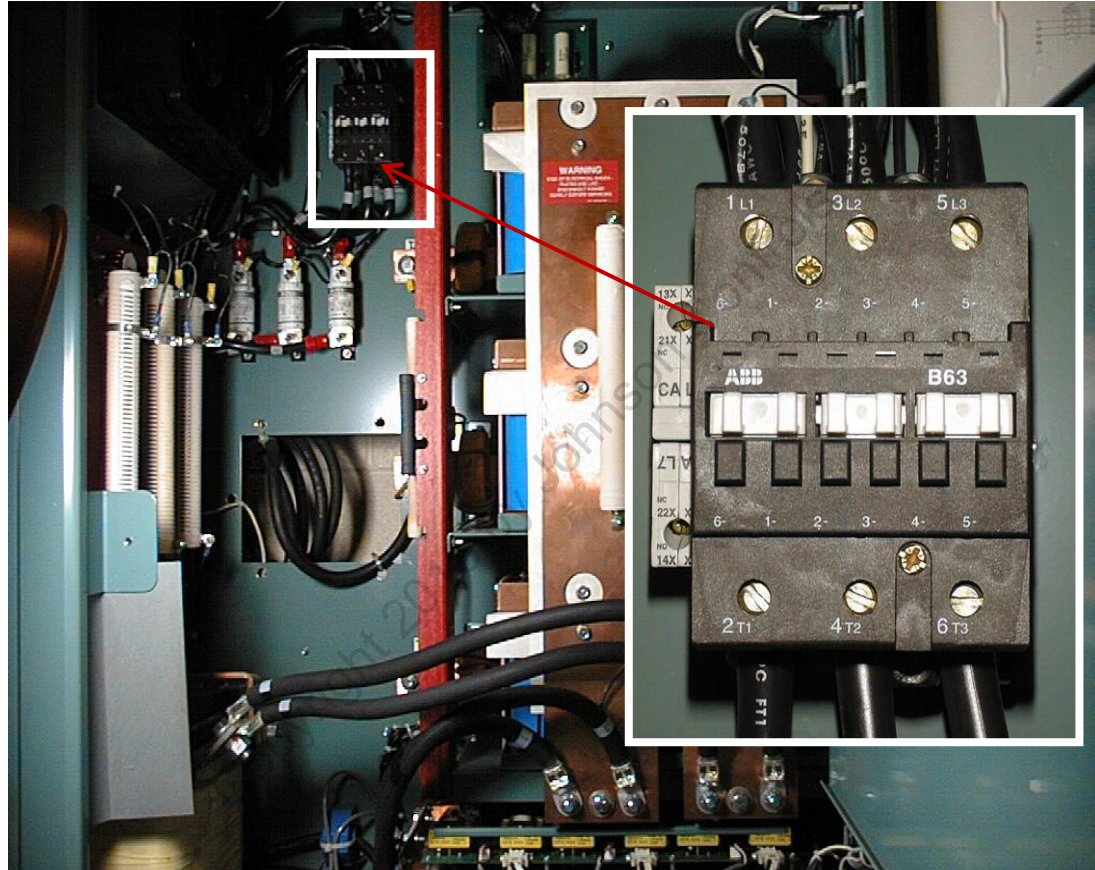
Reference Form 160.00-PW1, page 10 & 11, figure 3

■ The Harmonic Filter Pre-Charge Contactor 2M



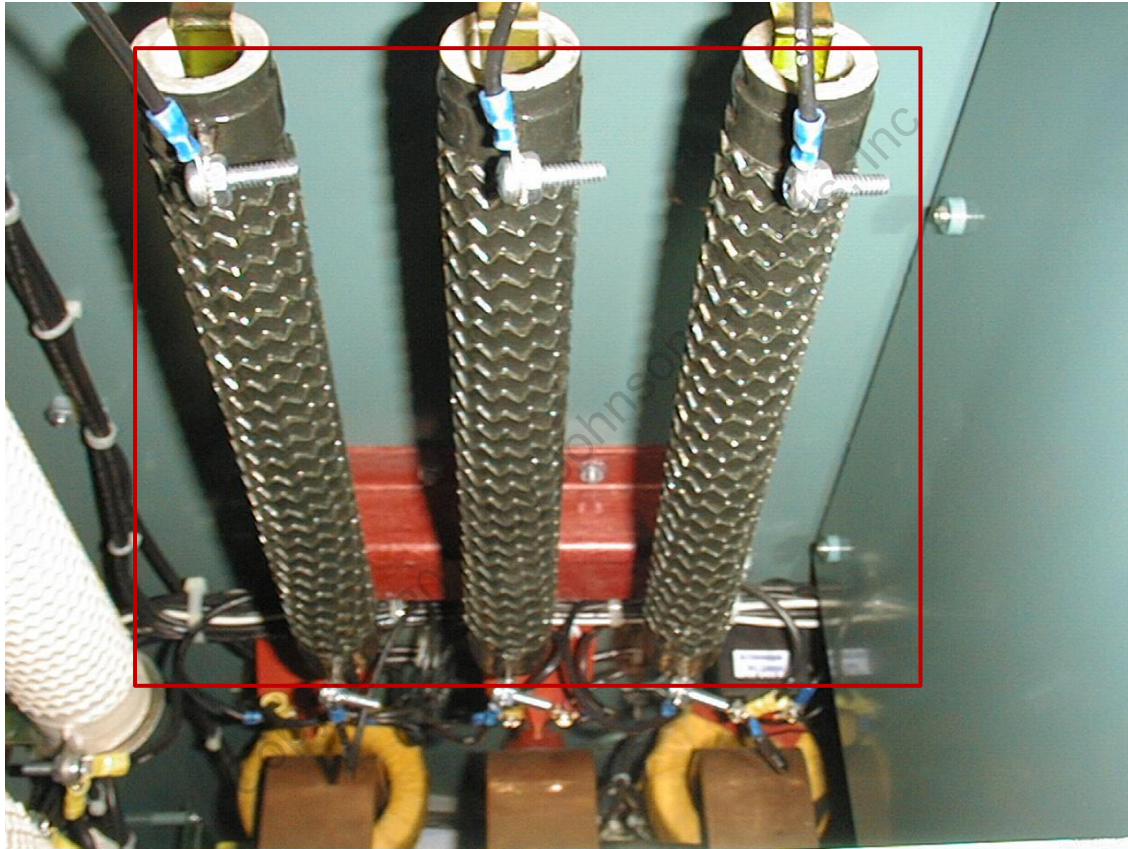
Reference Form 160.00-RP2, page 3A, figure 3, item 46

The Harmonic Filter Input Contactor 3M



Reference Form 160.00-RP2, page 3A, figure 3, item 44

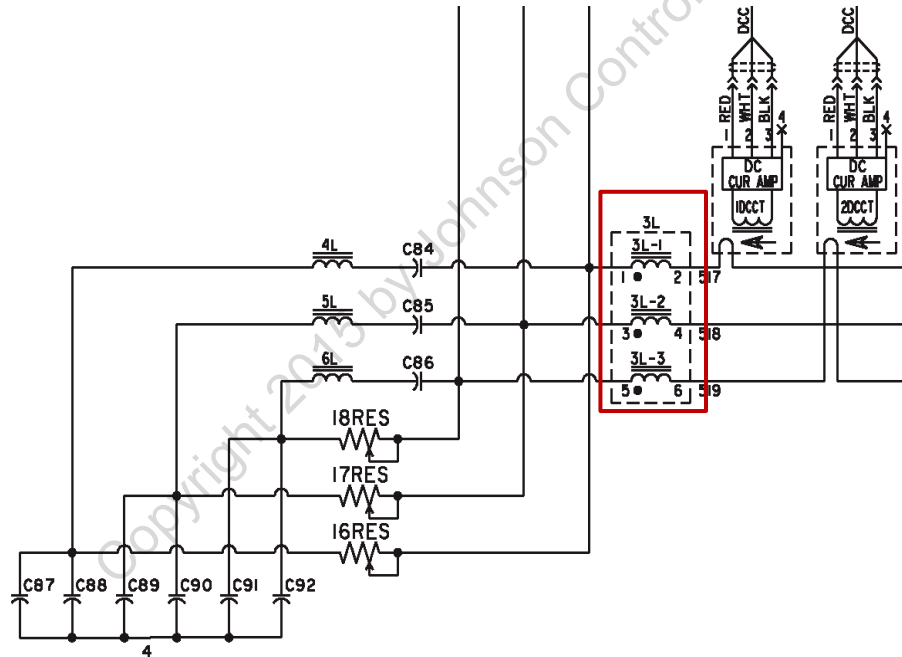
The Harmonic Filter Pre-Charge Resistors



Reference Form 160.00-RP2, page 3A, figure 3, item 14

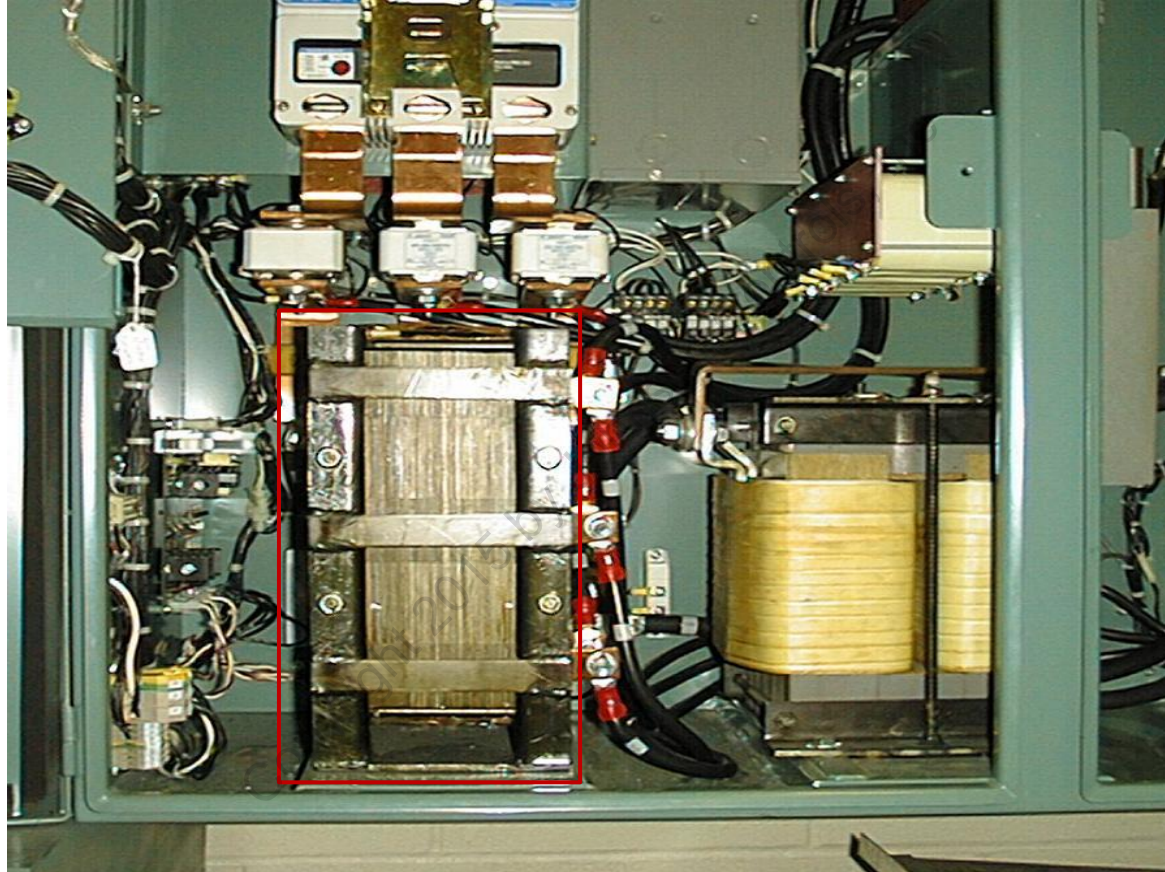
The 3-Phase Harmonic Filter Inductor

- The 3-Phase Inductor provides some impedance for the filter to work against. It effectively limits the rate of change of current at the input to the filter to a reasonable level



Reference Form 160.00-PW1, page 10, figure 3

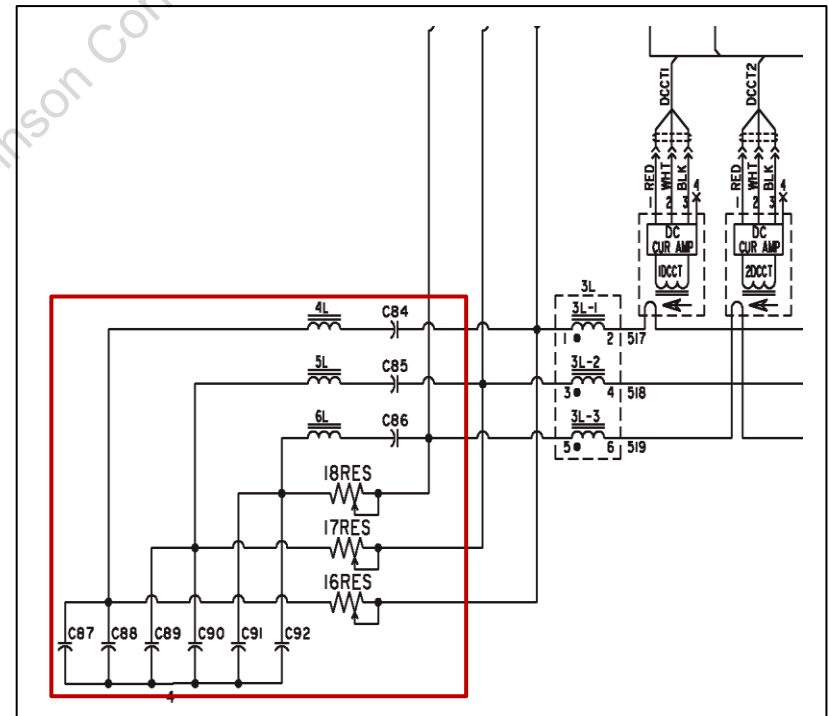
The 3-Phase Harmonic Filter Inductor



Reference Form 160.00-RP2, page 7B, figure 10, item 43

The Harmonic Filter Trap Assembly

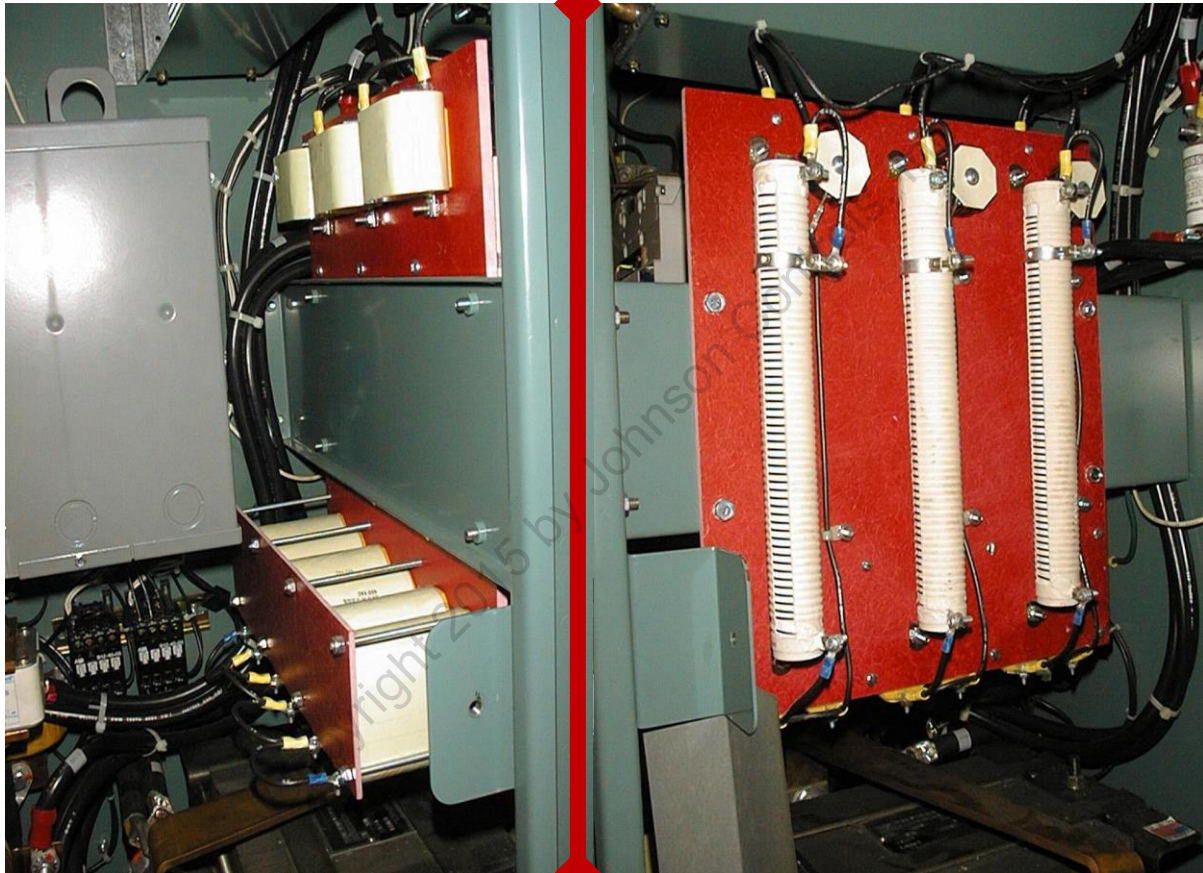
- The “Trap Assembly” is composed of a series of capacitors, inductors, and resistors.
- The purpose of the “Trap” is to block currents at the switching frequency of the filter from getting onto the power mains
- Continued Next Slide



The Harmonic Filter Trap Assembly

- The Harmonic filter corrects the incoming current waveform at **15KHZ** or **20-KHZ**. (Based on VSD horsepower rating.)
- This can cause a carrier frequency (@ **15khz** or **20khz**) to appear on the incoming line's current waveform.
- This could be seriously offensive to other sensitive equipment connected to the same power line.
- The filter is tuned to the carrier frequency that the VSD's Harmonic filter can produce.
- The trap absorbs the carrier frequency produced by the filter, and prevents it from going back out on the current waveform.
- The trap has a tolerance of **.5khz**, which gives the trap a total bandwidth of **1khz**. **(If VSD uses a 20-KHZ filter...The Trap would be sized @ 20-KHZ, and would absorb a carrier frequency between 19.5-KHZ and 20.5-KHZ)**

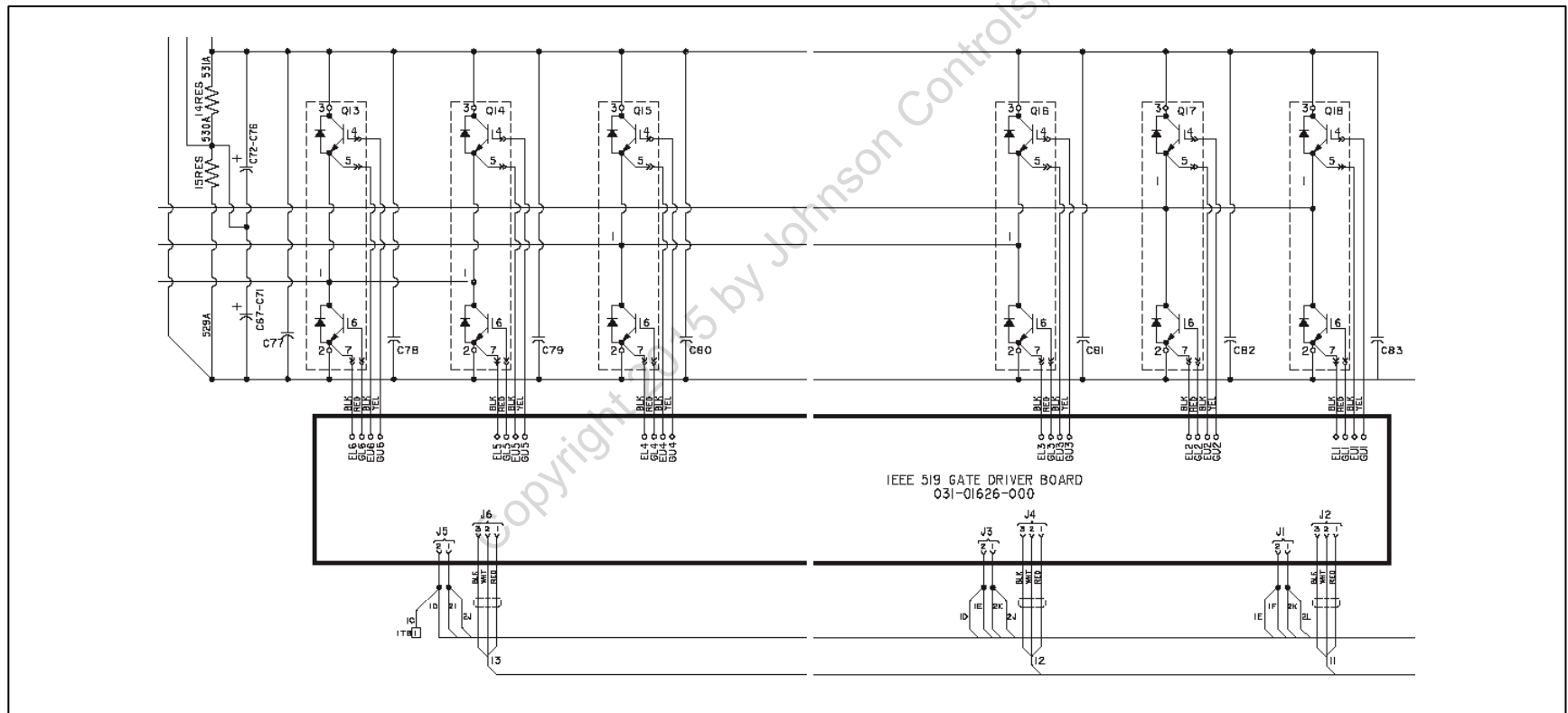
Harmonic Filter Trap Assembly



This is a split screen shot of both sides of one panel

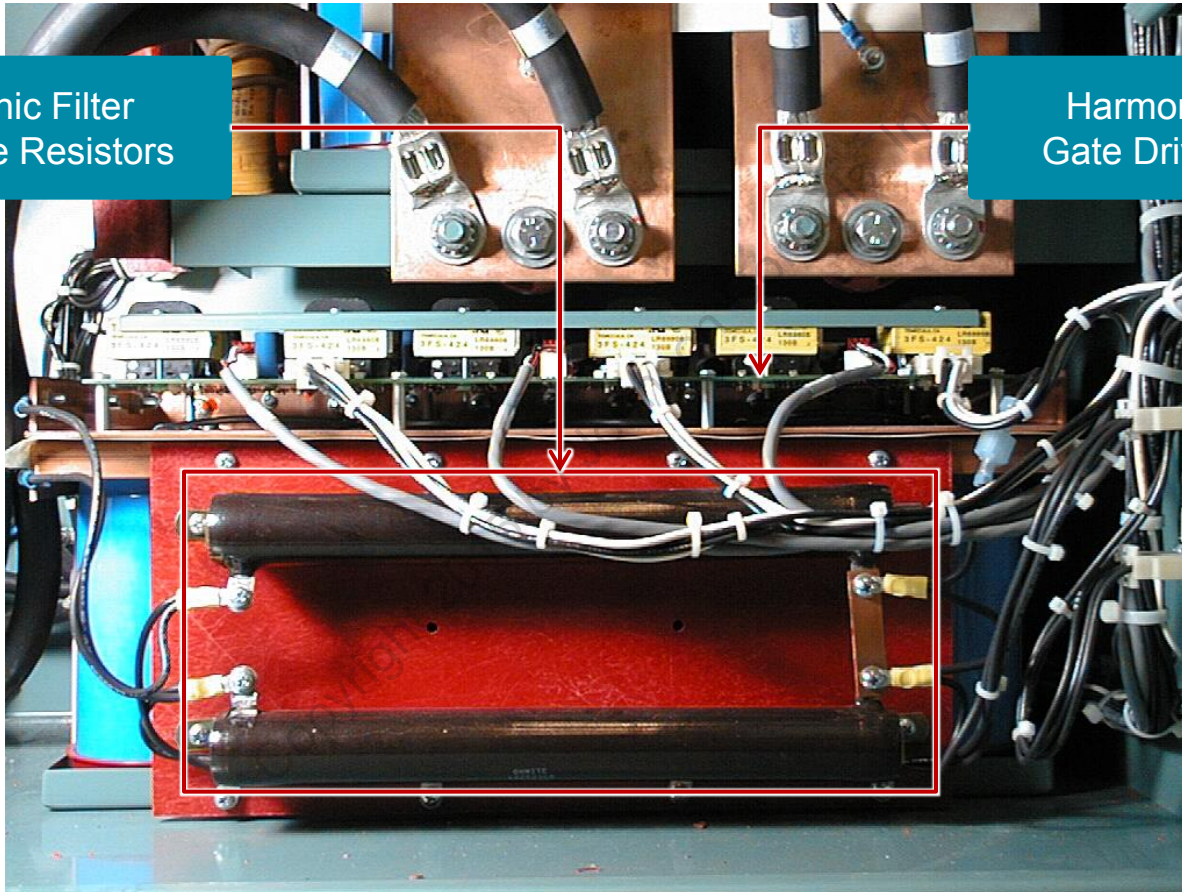
Harmonic Filter Pole Assembly

- The purpose of the Pole Assembly is to generate the harmonic currents required by the VSD's AC-to-DC converter so that these harmonic currents are not drawn from the power mains



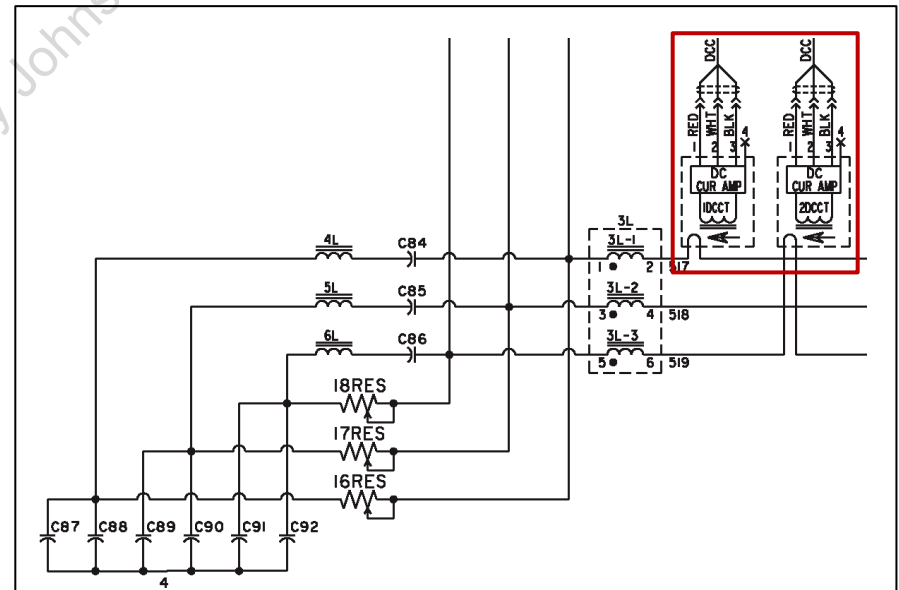
Harmonic Filter
Discharge Resistors

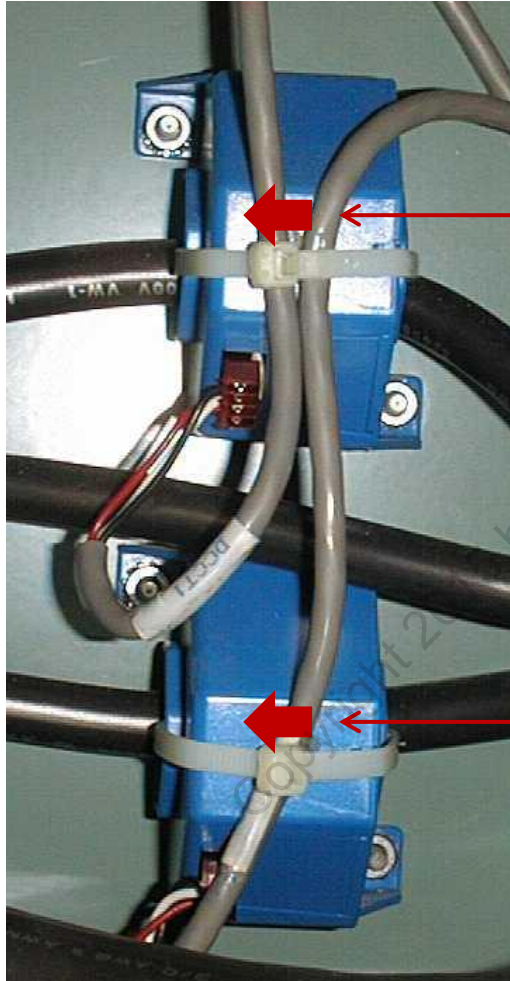
Harmonic Filter
Gate Driver Board



Harmonic Filter Electronic Current Sensors.(DC Current Transformers)

- The DCCT's monitors the current being drawn by the Harmonic Filter to differentiate between
 - current being consumed by the Filter Main Unit to keep it's capacitors charged
 - the current being sent out of the Unit to make line corrections.
- The Harmonic filter's logic board only senses two of the three output phases of the Harmonic filters main unit.
(A phase & C phase)

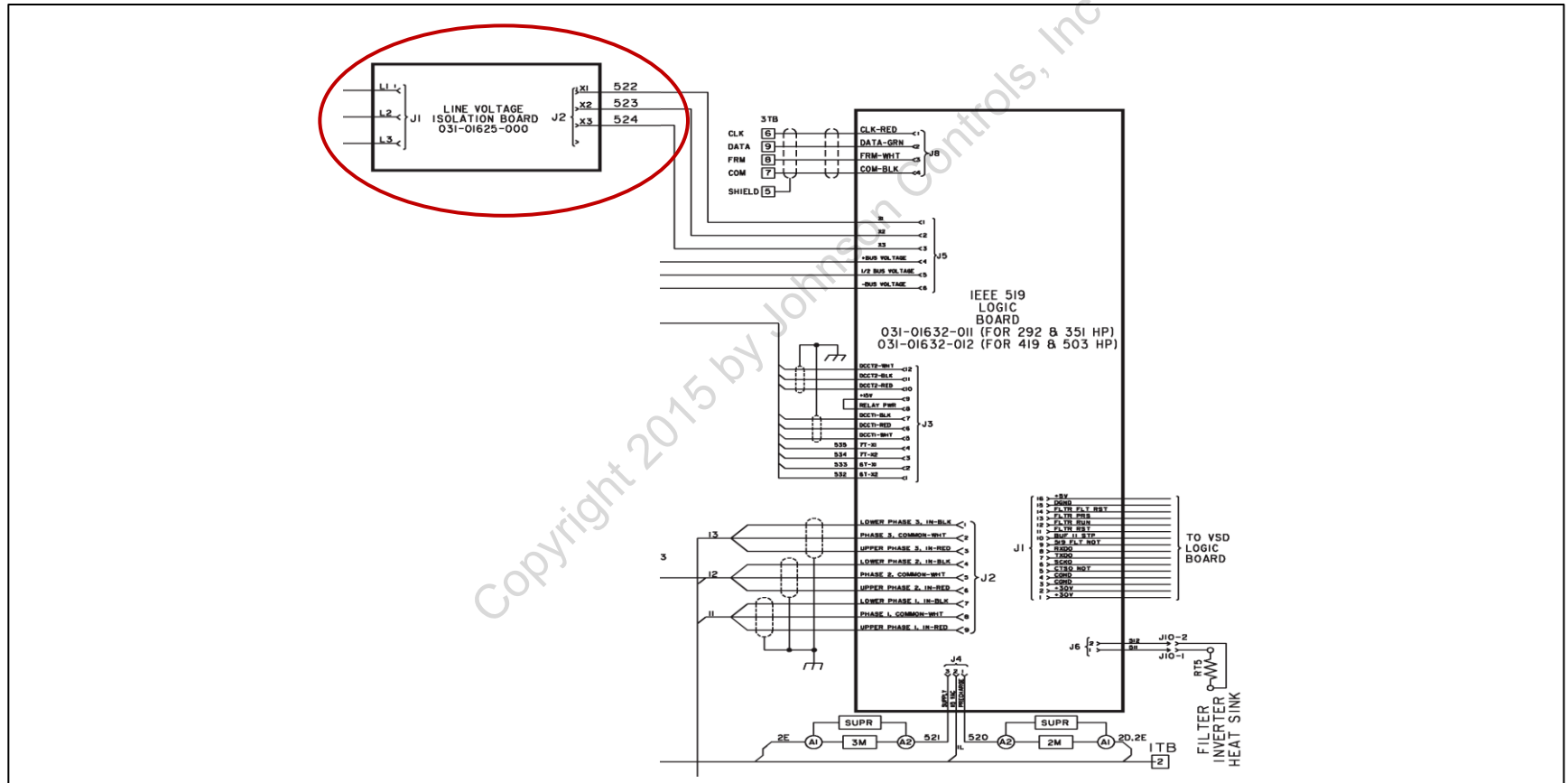




There will be an arrow on each DCCT pointing to the left

Harmonic Filter Line Isolator Board

- The Line Isolator Board conditions the AC line voltage down to a safe level for the Harmonic Filter Logic Board to monitor the AC line voltage

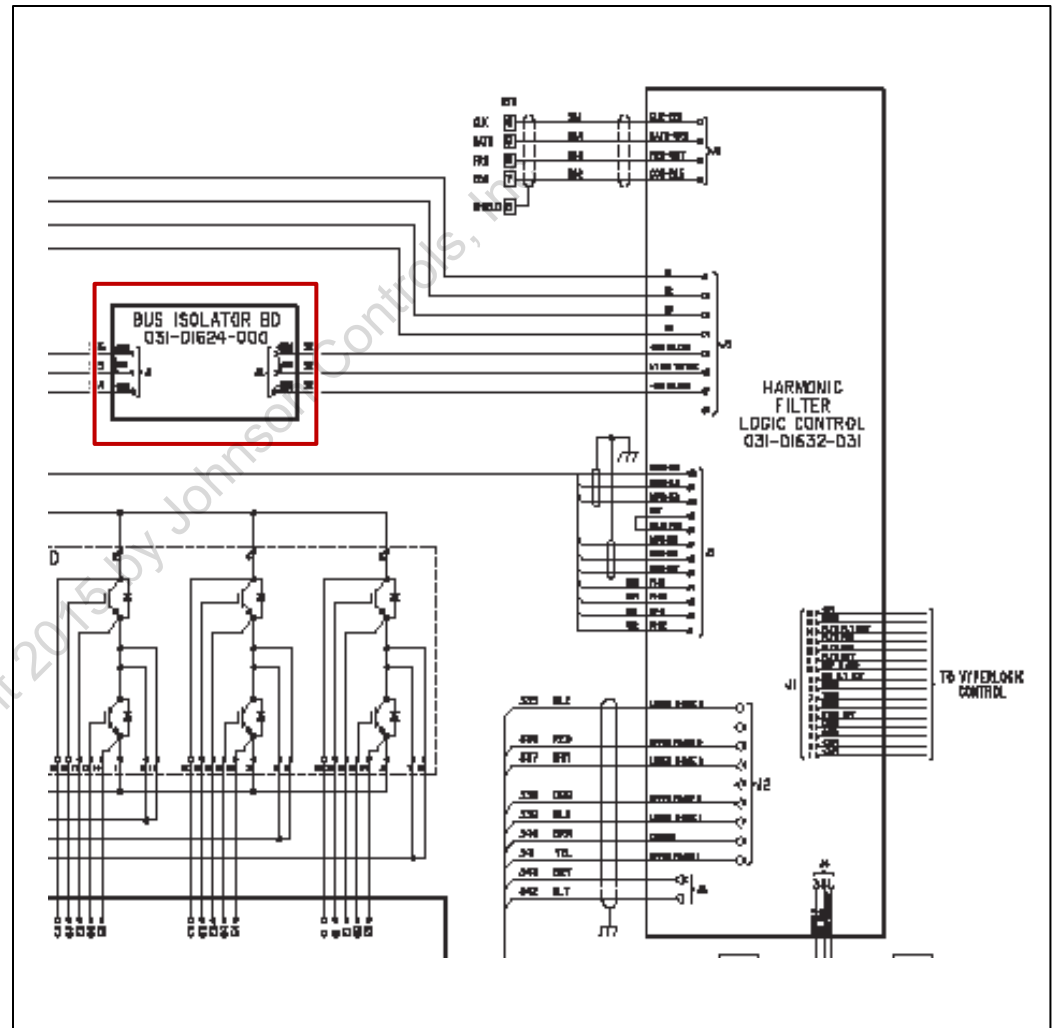


Harmonic Filter Line Isolator Board

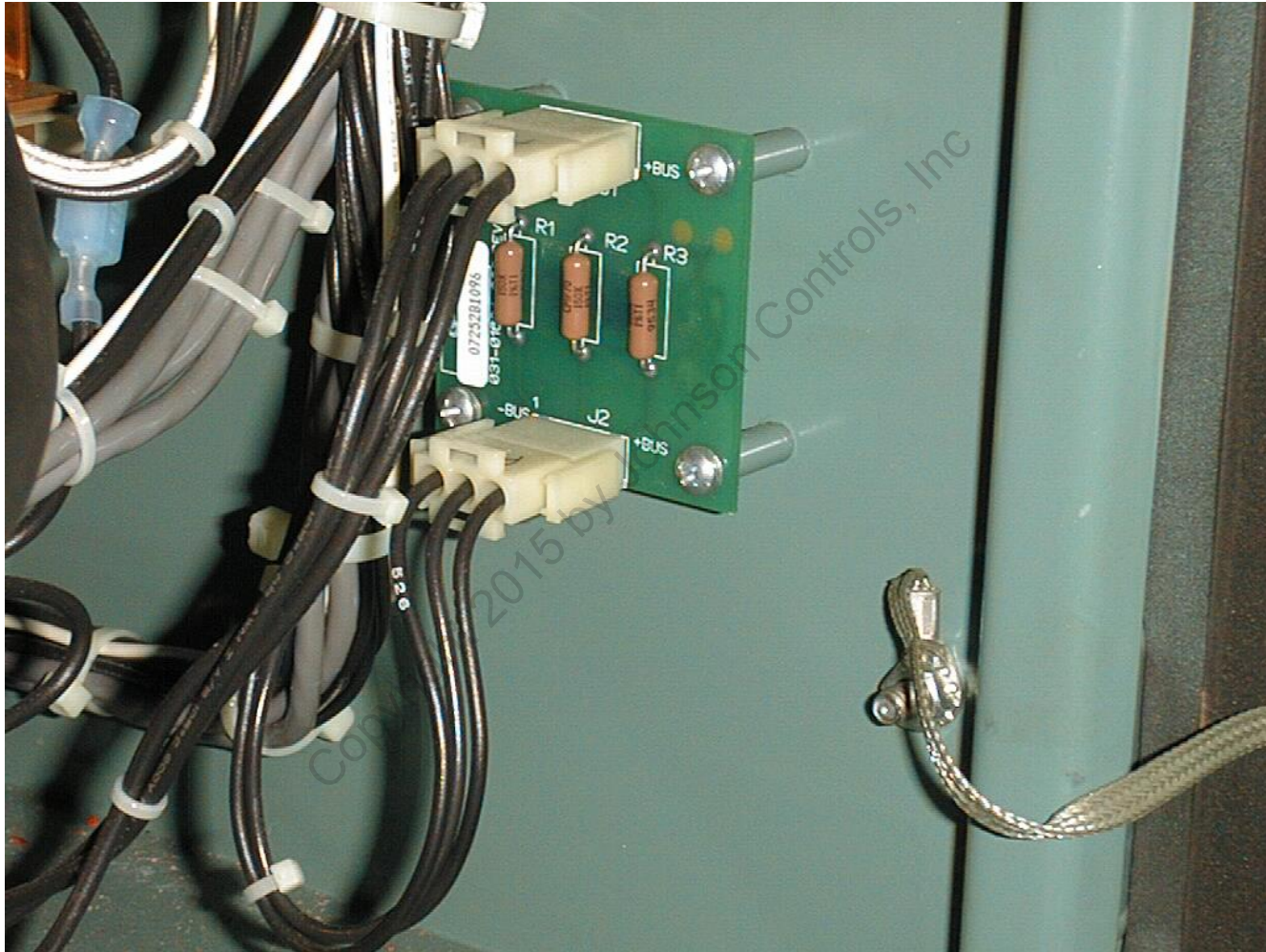


Harmonic Filter Bus Isolator Board

- The DC Bus Isolator Board conditions the Filter DC bus voltage down to a safe level for the VSD Logic Board to monitor the Filter DC bus voltage

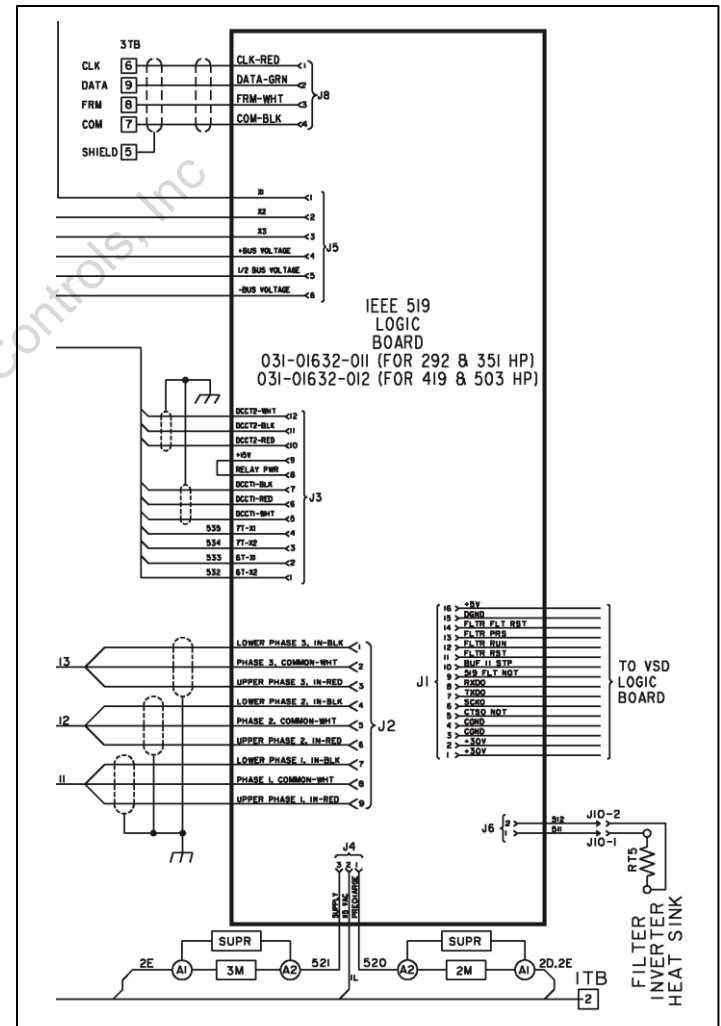


Harmonic Filter Bus Isolator Board



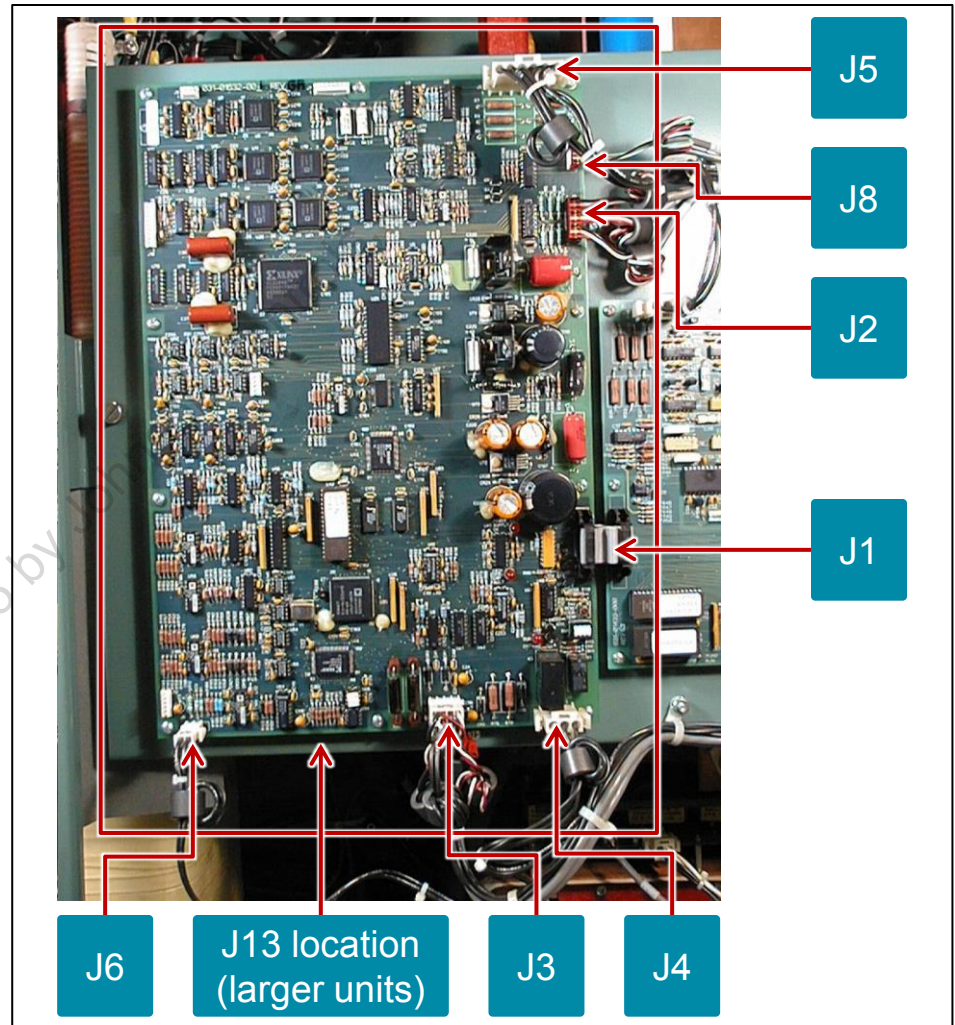
Harmonic Filter Logic Board

- Monitors the 3-Phase AC voltage, current, and the Harmonic Filter DC bus current and generates the appropriate IGBT gate driver pulses to produce the harmonic currents necessary to correct the waveform
- Interfaces with the VSD Logic Board



Harmonic Filter Logic Board

- Jacks explained on next slide



Harmonic Filter Logic Board

- J8 is interfacing with the ACC Board in the Panel
- J5 connects with
 - the Bus Isolator Board
 - the Line Voltage Isolation Board
- J3 is inputting the signals from ...
 - the Phase “A” and “C” input CT’s,
 - the two DCCT’s
- J2 comprises all the connections with the Main Filter Unit
- J4 operates the 2M and 3M contactors that control the
 - pre-charge
 - the ultimate line - Harmonic Filter connection
- J6 inputs the Filter Heat sink Thermistor
- J1 is the ribbon cable connecting between the two Logic Boards.
- On larger units there’s...
 - a J13, that inputs a second thermistor.

Vyper Harmonic Filter



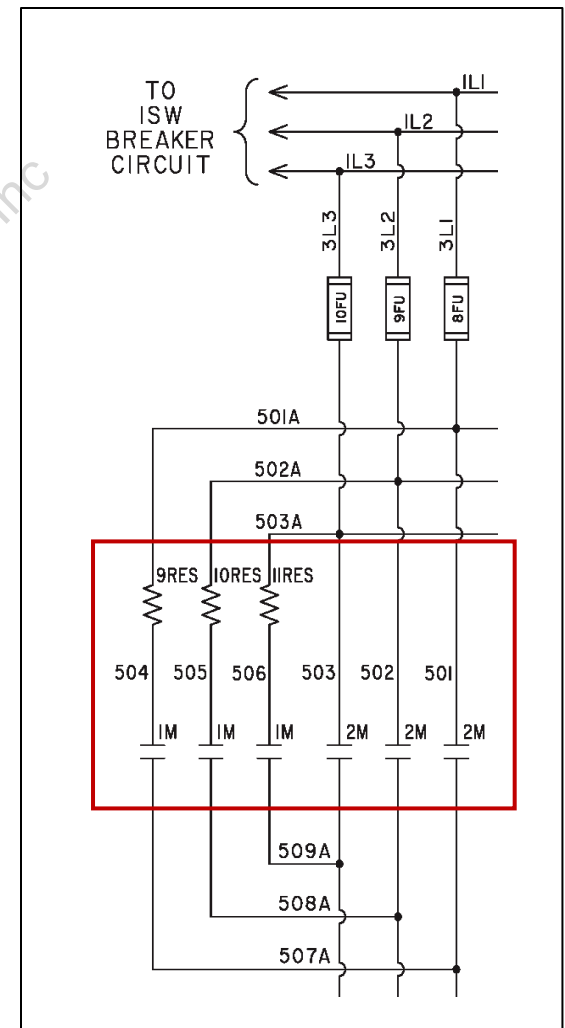
BY JOHNSON CONTROLS



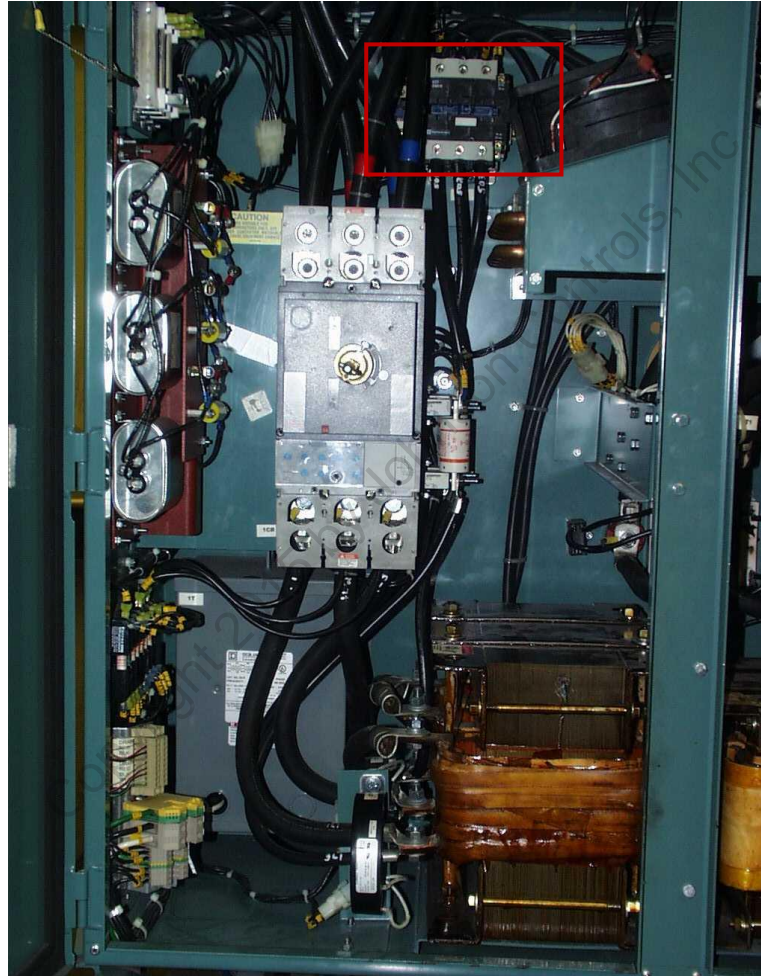
Our Policy prohibits printing. Save GREEN.

Harmonic Filter Pre-Charge Circuit

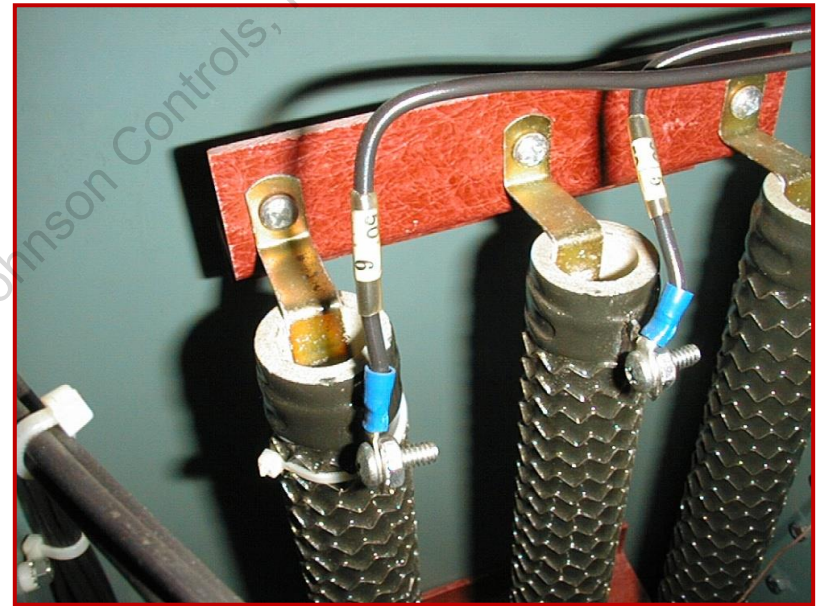
- The Pre-Charge circuit serves two purposes, to slowly charge the DC link filter capacitors and to provide a means of disconnecting the filter power components from the power mains.
- When the VSD is commanded to run, the pre-charge resistors are switched into the circuit via contactor 1M for a fixed time period of 5 seconds
- This allows the filter capacitors to slowly charge.
- After the 5 second pre-charge period, the supply contactor 2M is pulled in and the pre-charge contactor 1M is dropped out.



Harmonic Filter Pre-Charge Contactor

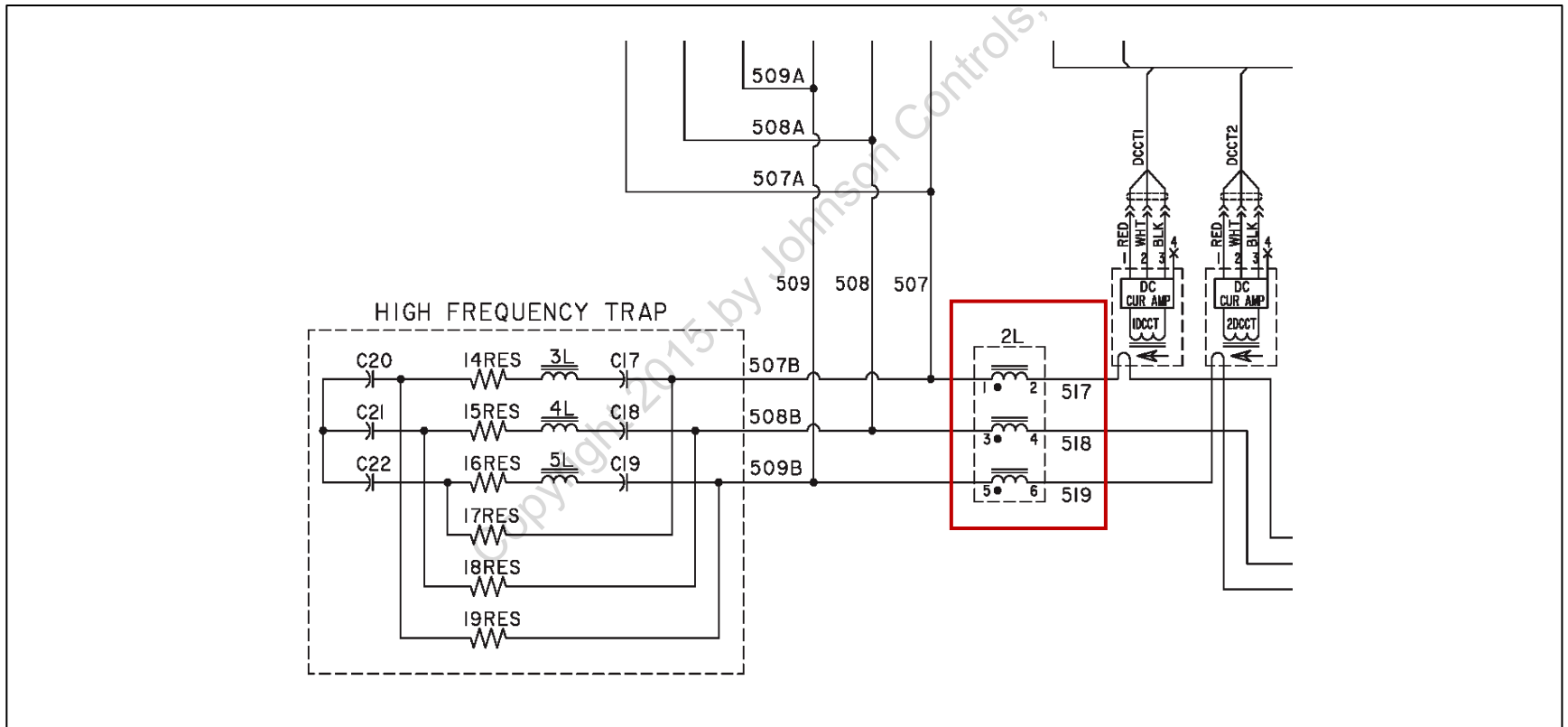


Harmonic Filter Pre-Charge Resistors

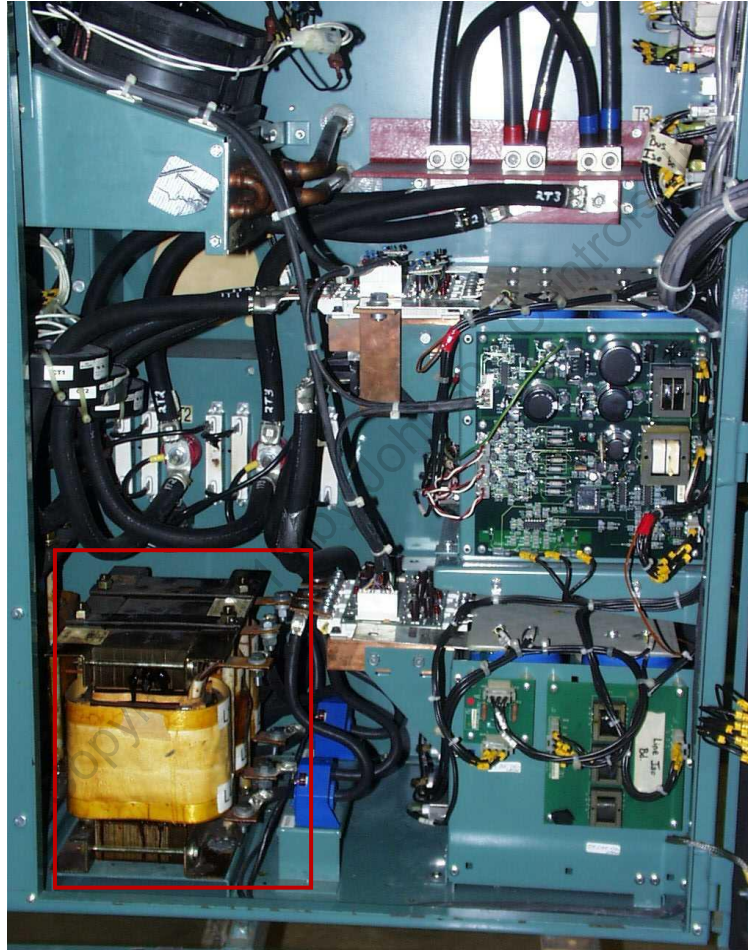


3-Phase Harmonic Filter Inductor

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

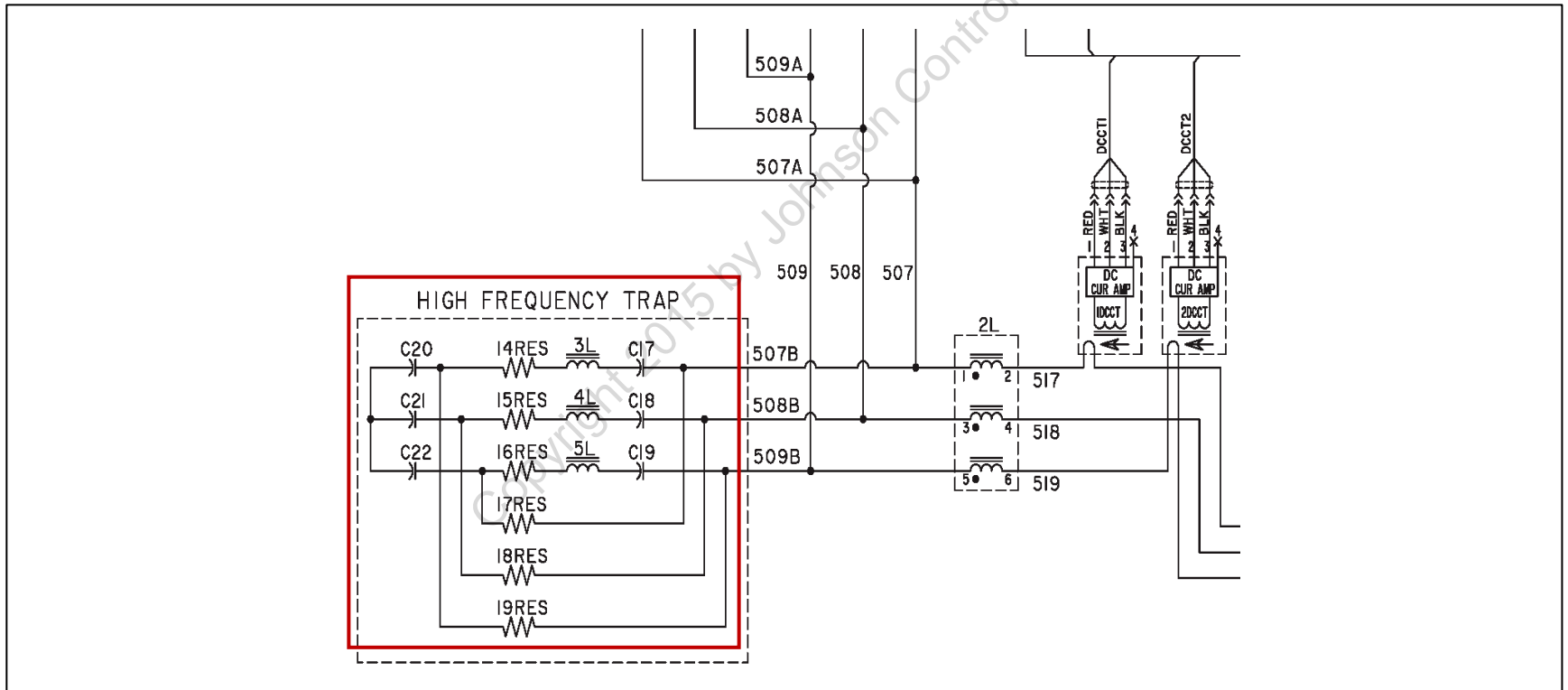


3-Phase Harmonic Filter Inductor



Harmonic Filter Trap Assembly

- The “Trap” is composed of a series of capacitors, inductors, and resistors.
- The purpose of the “Trap” is to block currents at the switching frequency of the filter from getting onto the power mains.



Harmonic Filter Trap Assembly

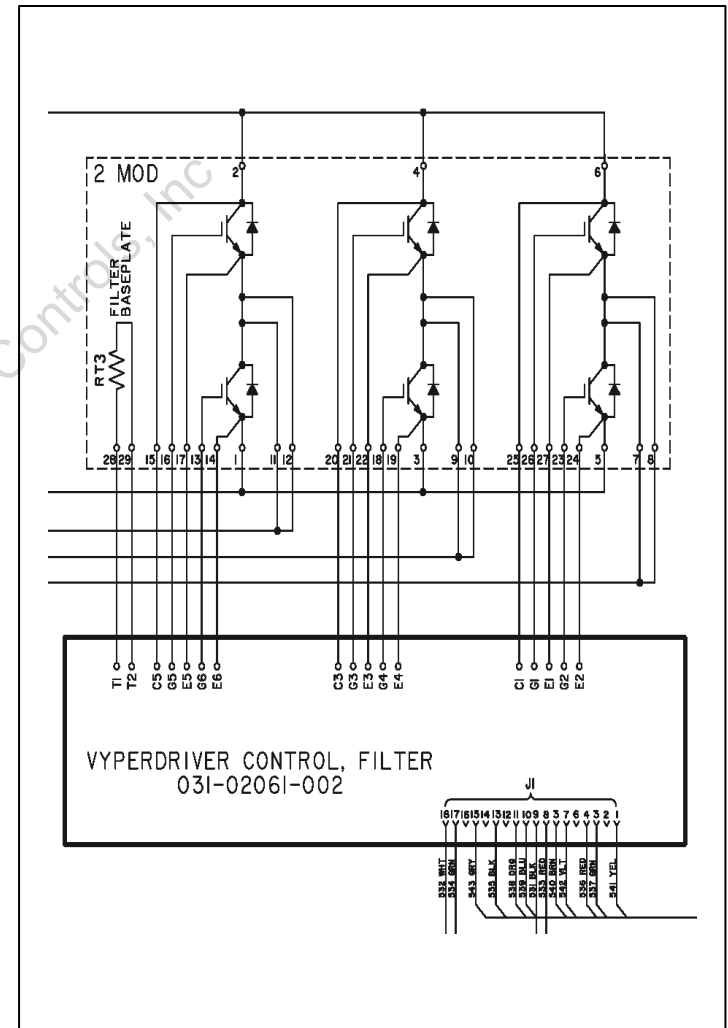
- The Style #D filter trap has a bandwidth of **1khz**.(Ex. Filter eliminates the carrier frequency from 19.5khz to 20.5khz)
- The filters main assembly has a tolerance of **3khz**. This means that the carrier frequency produced by the Harmonic filter could be anywhere from 13.5khz to 16.5khz.
- The Vyper's filter trap has a wider deadband to match the main filters tolerance level. This ensures that the filter trap will be trapping some if not all of the carrier frequency during operation.
- Notice that the filter trap for the Vyper drive has an extra set of resistors.

Harmonic Filter Trap Assembly

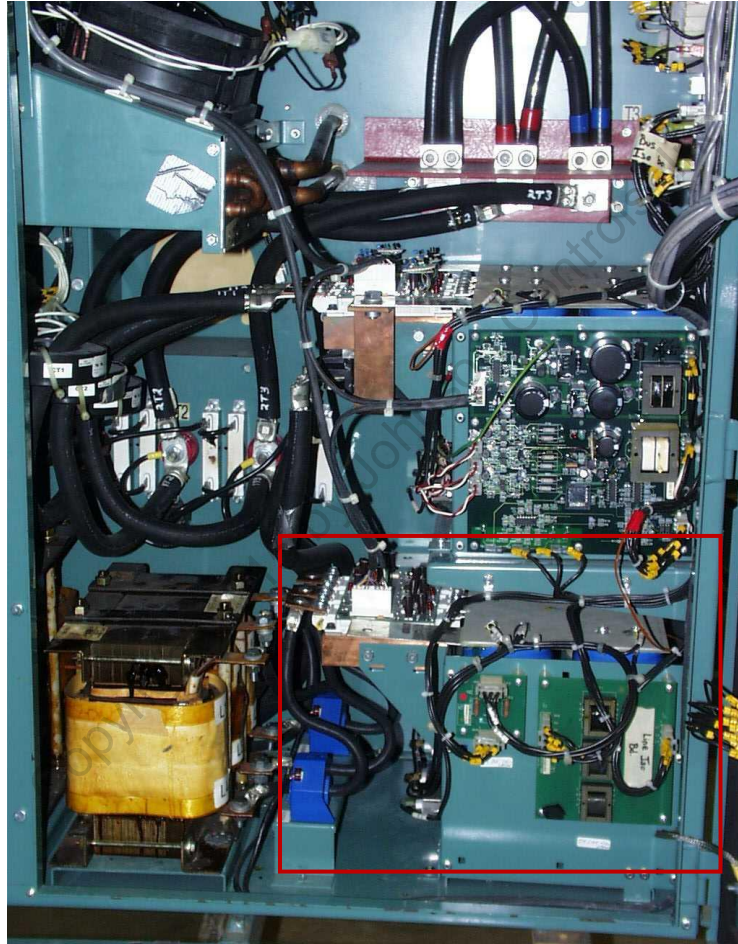


Harmonic Filter Power Assembly

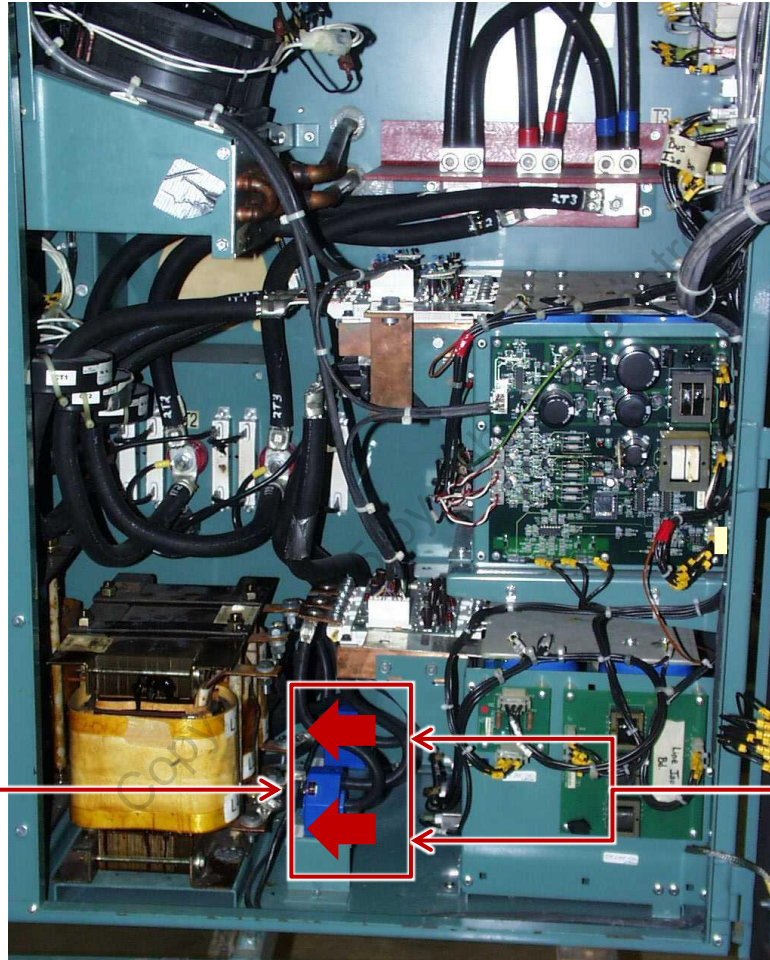
- The purpose of the Pole Assembly is to generate the harmonic currents required by the VSD's AC-to-DC converter so that these harmonic currents are not drawn from the power mains



Harmonic Filter Power Assembly



Harmonic Filter Electronic Current Sensors.(DC Current Transformers)

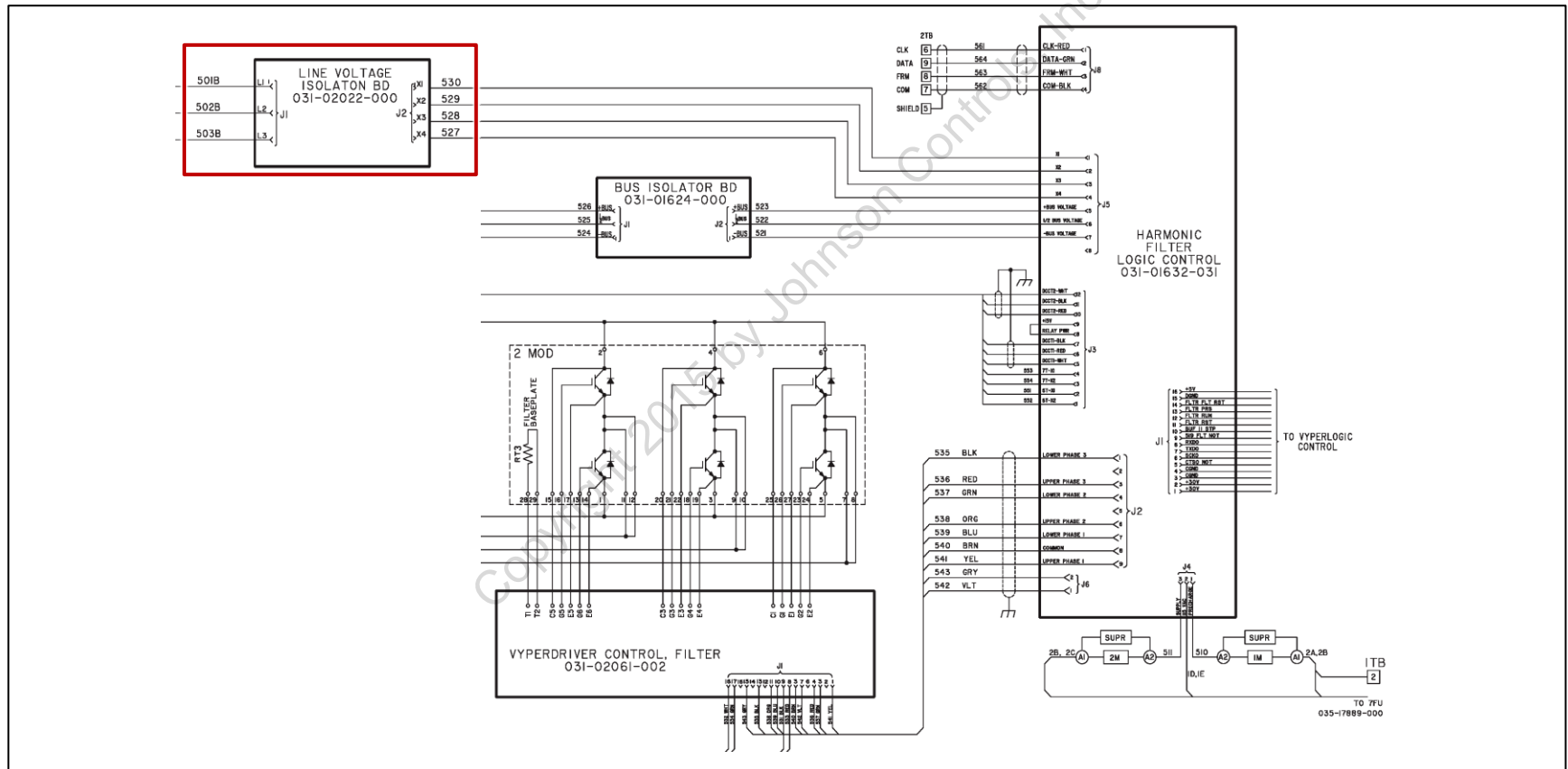


DCCT's

There will be an arrow on each DCCT pointing to the left

Harmonic Filter Line Isolator Board

- The Line Isolator Board conditions the AC line voltage down to a safe level for the Harmonic Filter Logic Board to monitor the AC line voltage

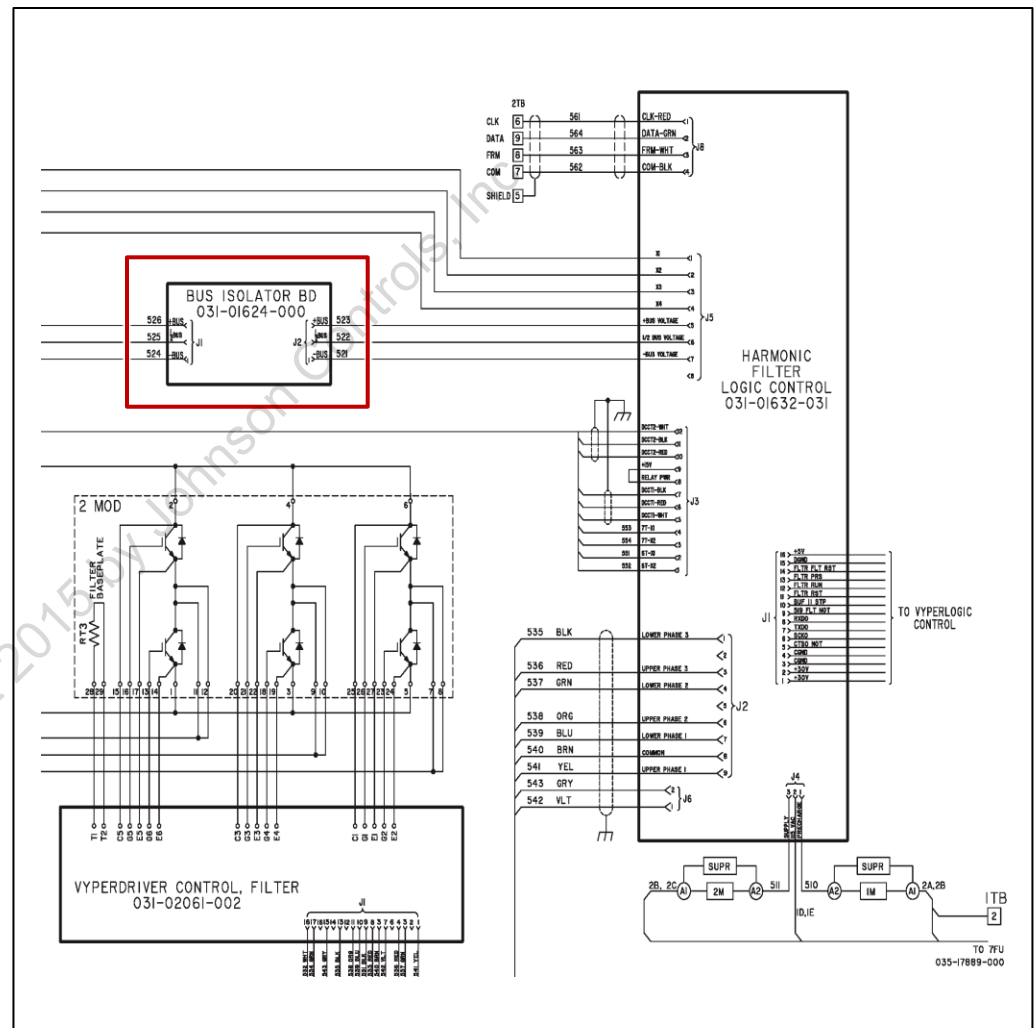


Harmonic Filter Line Isolator Board

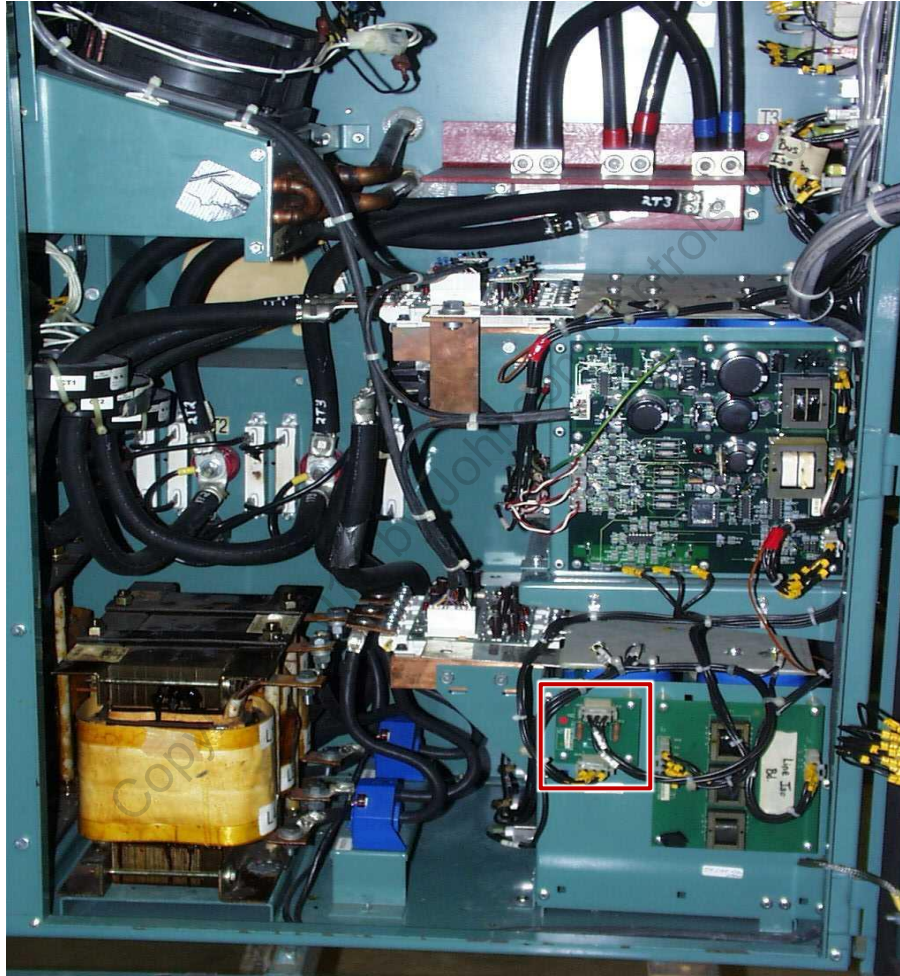


Harmonic Filter Bus Isolator Board

- The DC Bus Isolator Board conditions the Filter DC bus voltage down to a safe level for the Harmonic Filter Logic Board to monitor the Filter DC bus voltage.

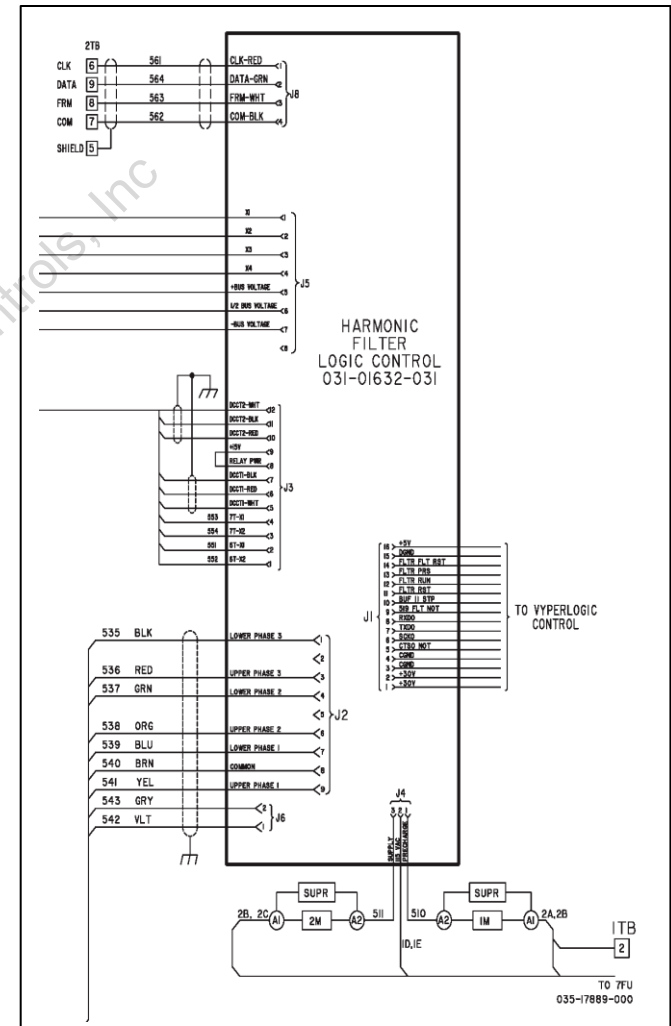


Harmonic Filter Bus Isolator Board



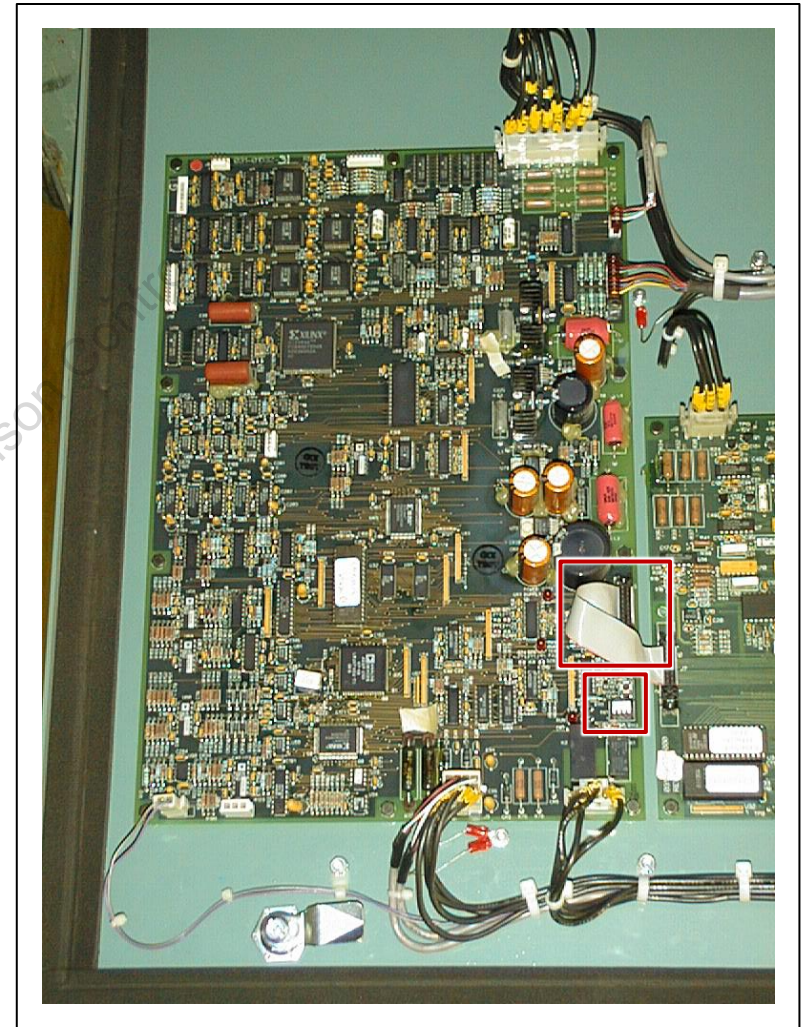
Harmonic Filter Logic Board

- Monitors the 3-Phase AC voltage, current, and the Harmonic Filter DC bus current and generates the appropriate IGBT gate driver pulses to produce the harmonic currents necessary to correct the waveform
- Interfaces with the VSD Logic Board



Harmonic Filter Logic Board

- To troubleshoot, turn switch on logic board off, disconnect ribbon cable to VSD Logic board, re-boot chiller



The ACC Board



The ACC Board

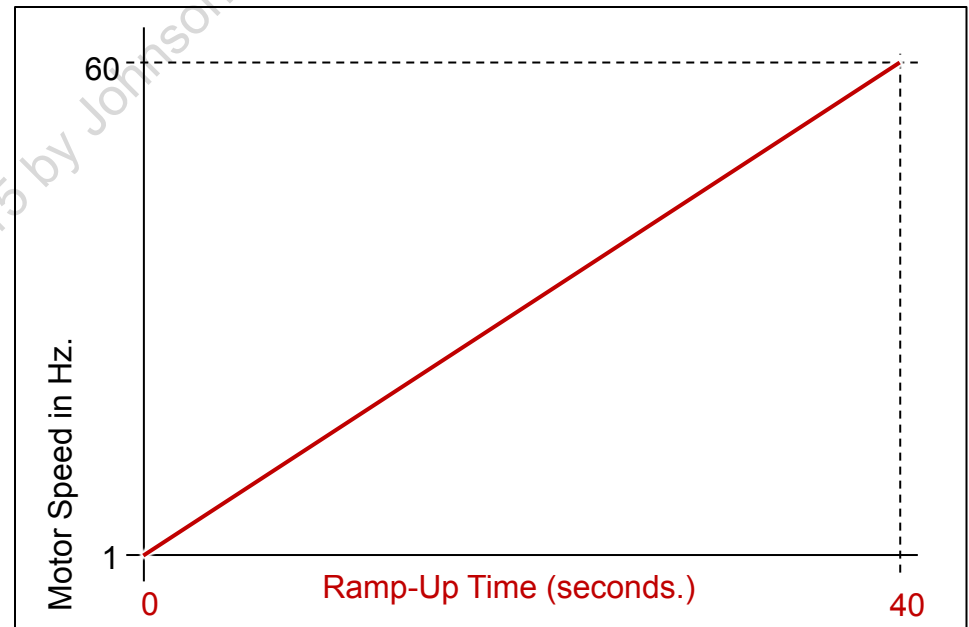
- This lesson will explain:
 - How the capacity control sequencing is achieved.
 - How the PRV and VSD interact to achieve and maintain LCWT.
 - How the boards in the control panel and VSD communicate with one another.
 - The differences between one-line panel and OPTIVIEW ACC Boards.

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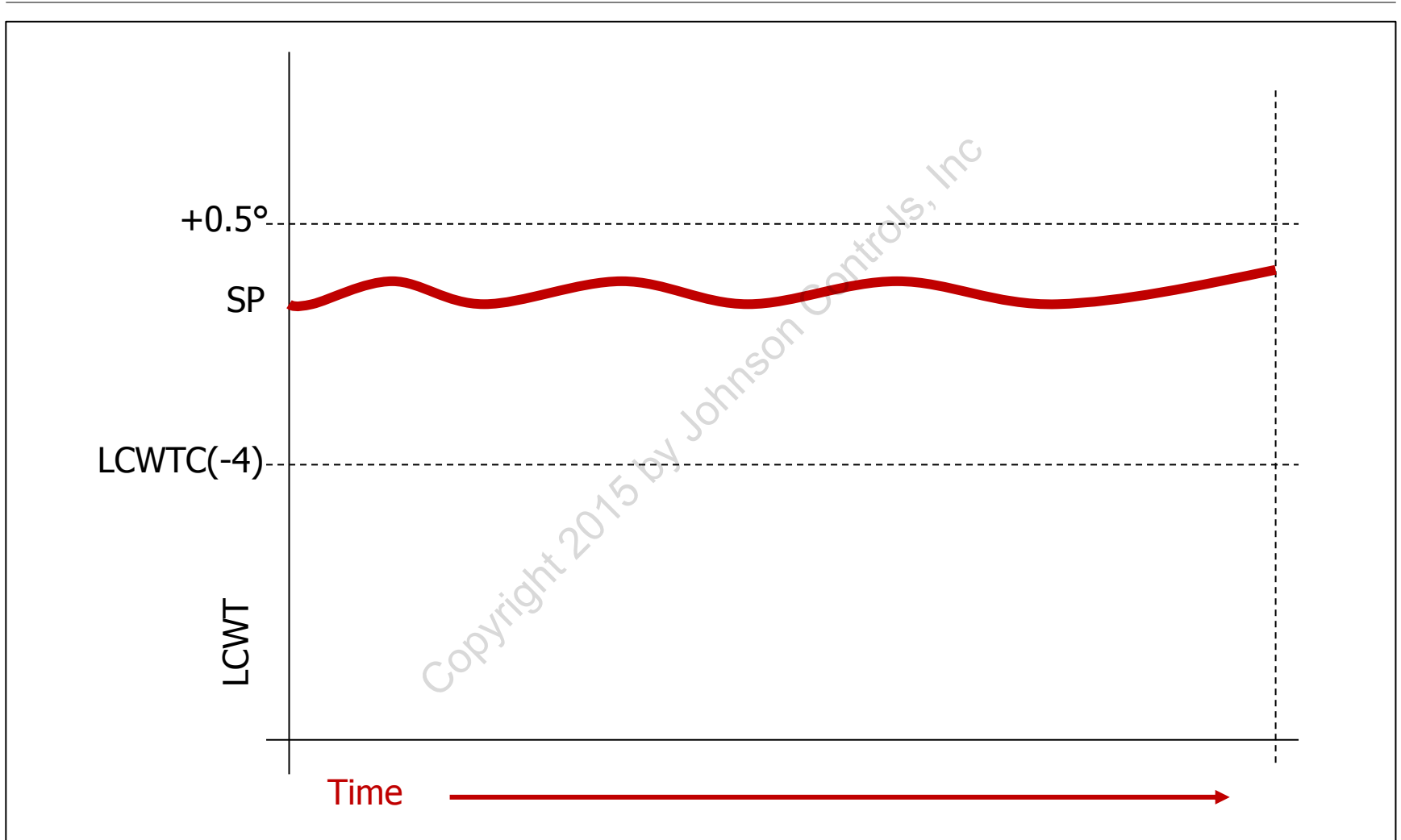
Chiller Start Up

- VSD ramps the Motor

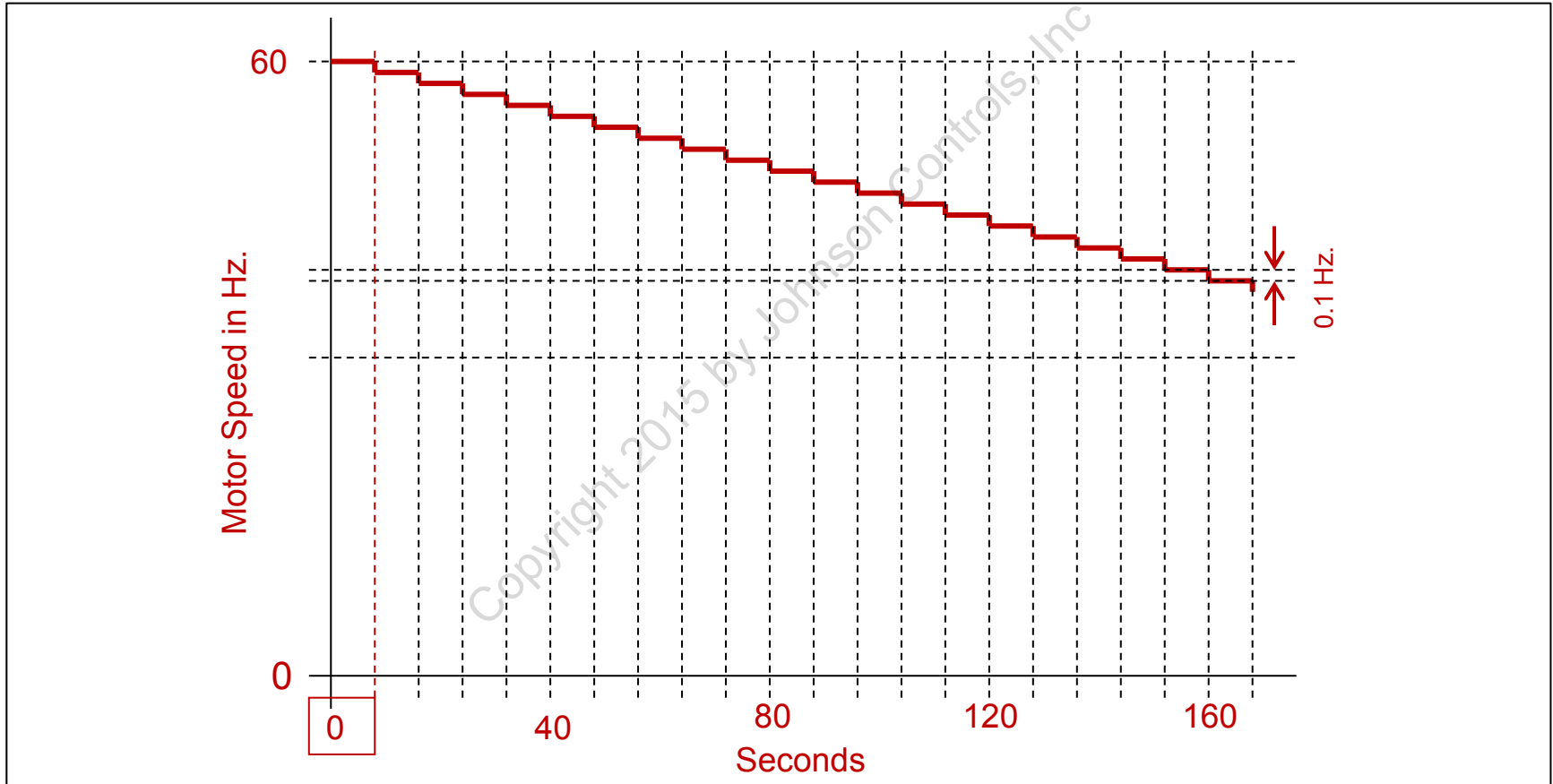
- from 0 RPM to full motor speed or 0 to 60 Hz over a period of 40 seconds
- The motor will remain at full speed while the PRV adjusts to achieve the desired LCWT.
- **With ACC Software version 1.03A or less**



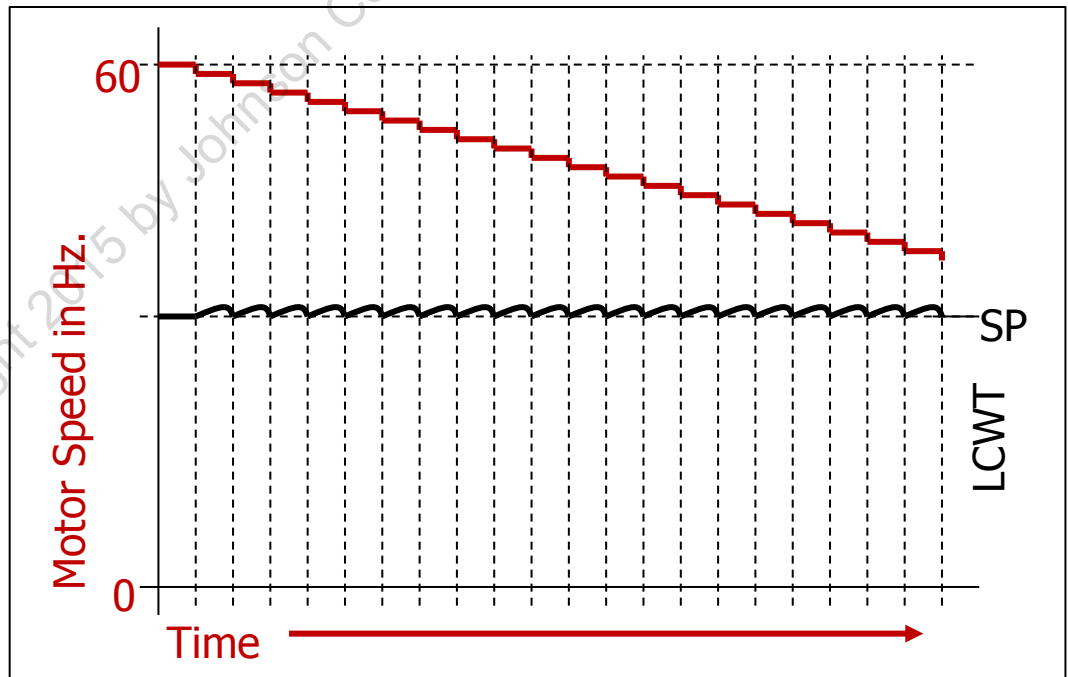
LCWT is “stabilized”



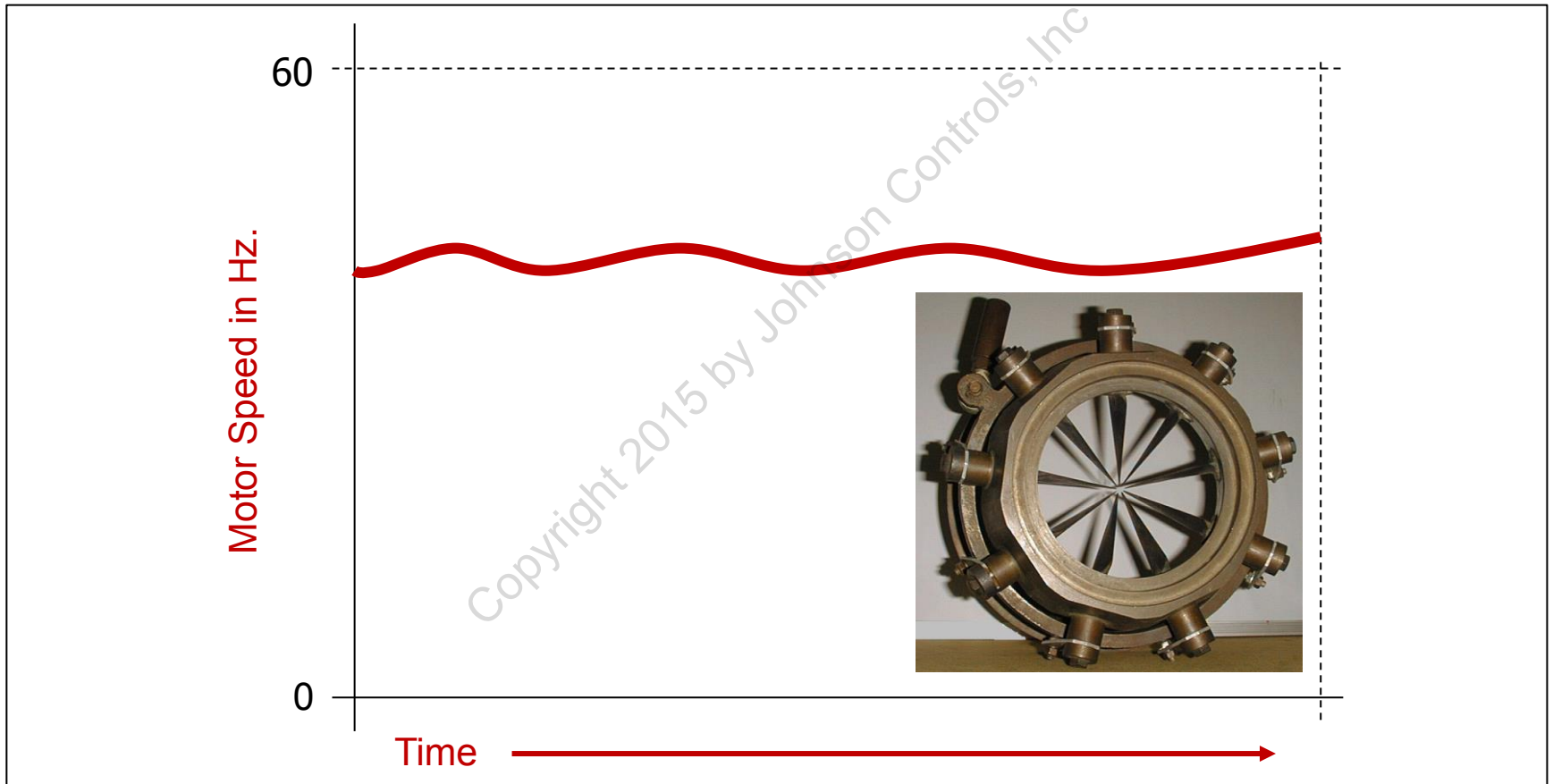
Once the LCWT stabilizes, the VSD begins reducing motor speed at a rate of 0.1 Hz every 8 seconds



- As capacity is reduced, the LCWT begins to increase. As a result the vanes are modulated open to compensate for the reduced capacity.
- If the LCWT rises more than $+0.5^\circ$ above the LCWT setpoint, the VSD will suspend further reduction in motor speed until the LCWT once again becomes stabilized.



The ideal capacity control situation would be for the vanes to have modulated to their full open position and motor speed controlling capacity

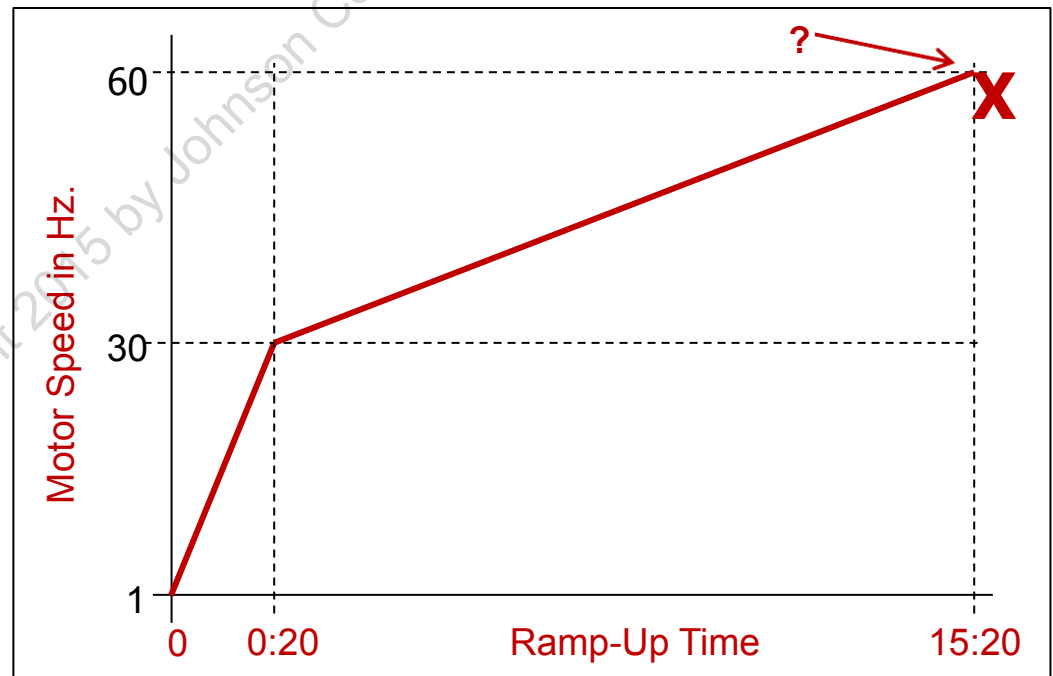


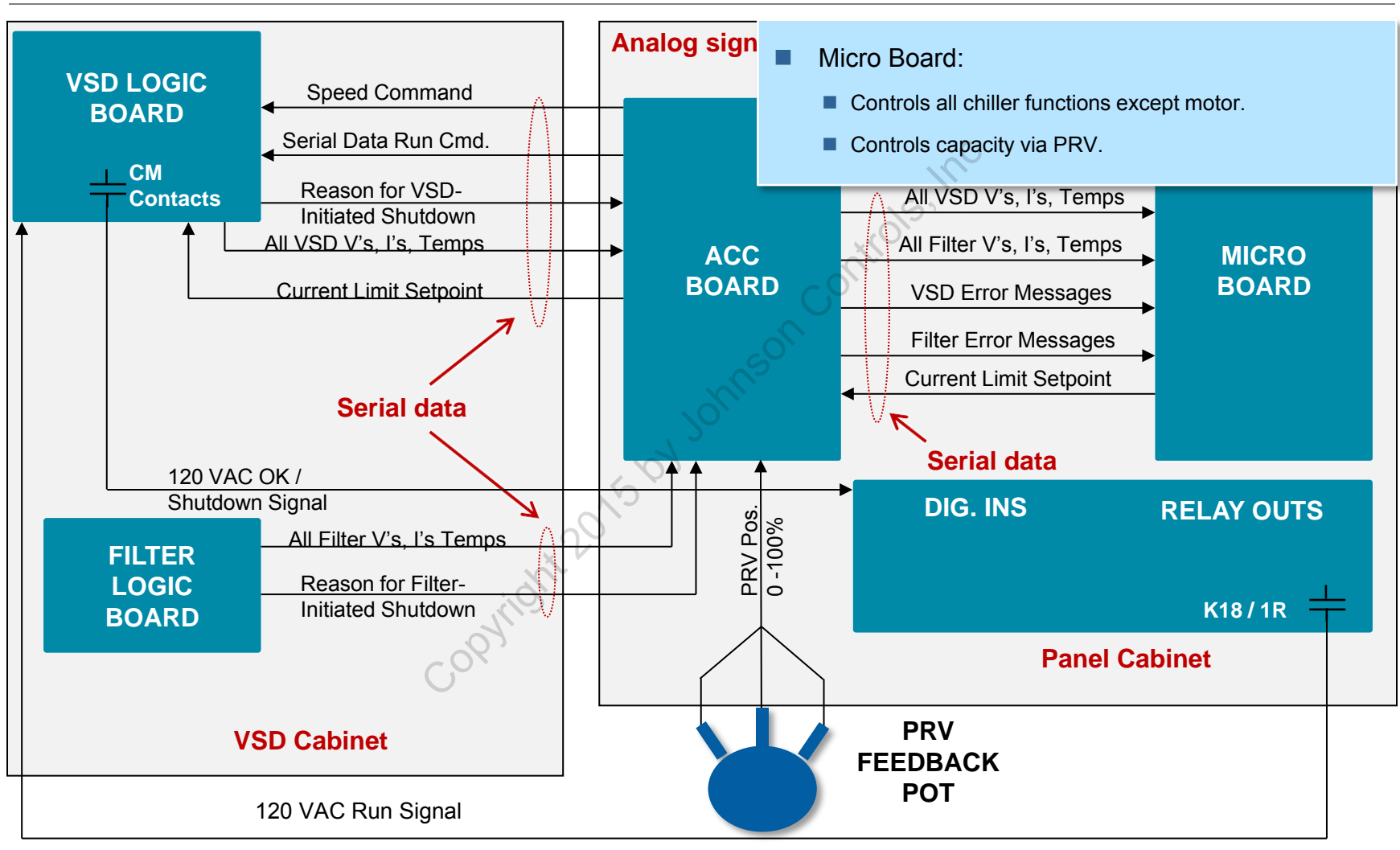
Conditions That Will Prevent The Motor From Reducing Speed:

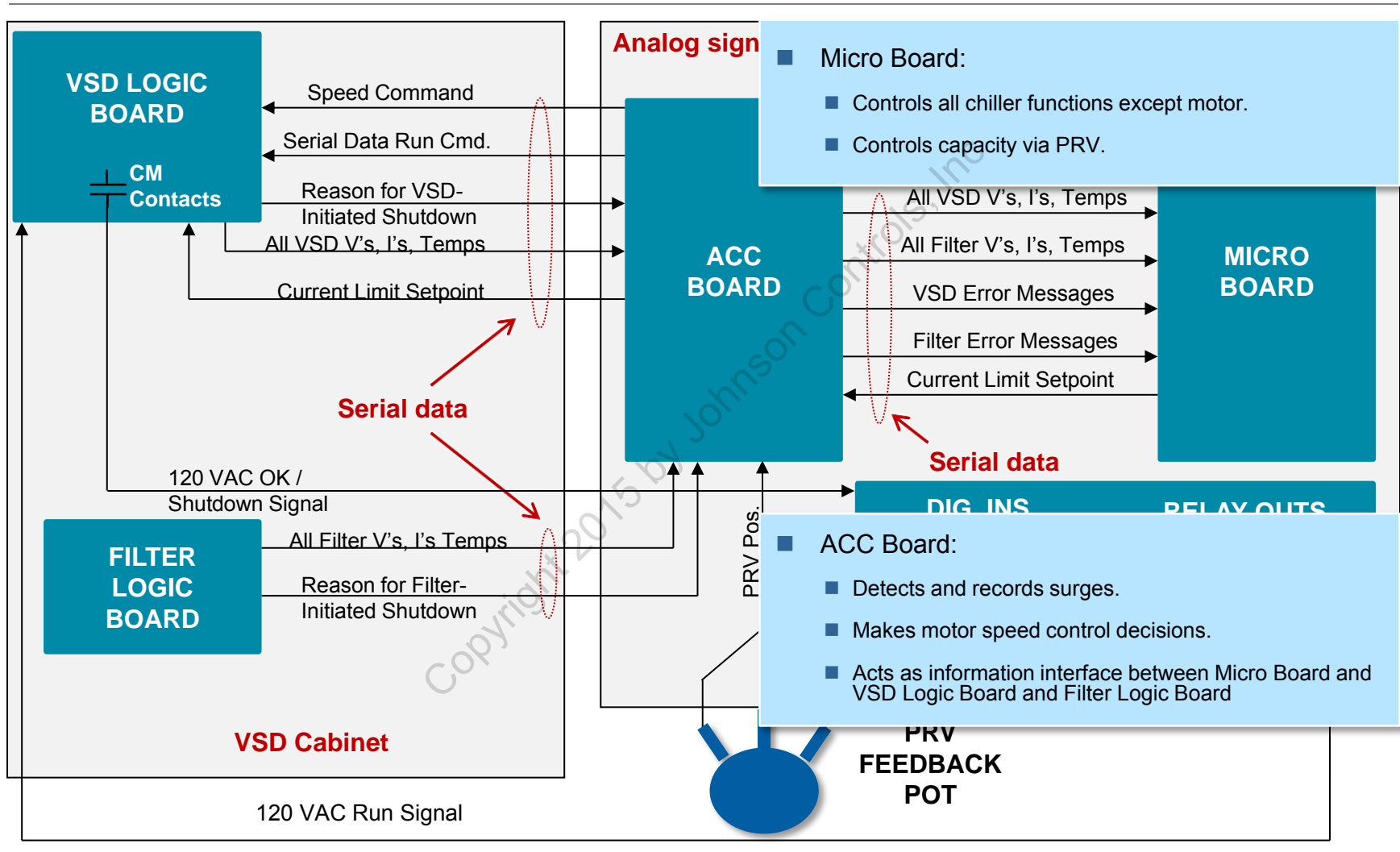
- Unstable LCWT
- Actual Surge Condition
- Potential Surge Condition Identified by the Surge Map.
- 30 Hz
- Current Limit Setpoint

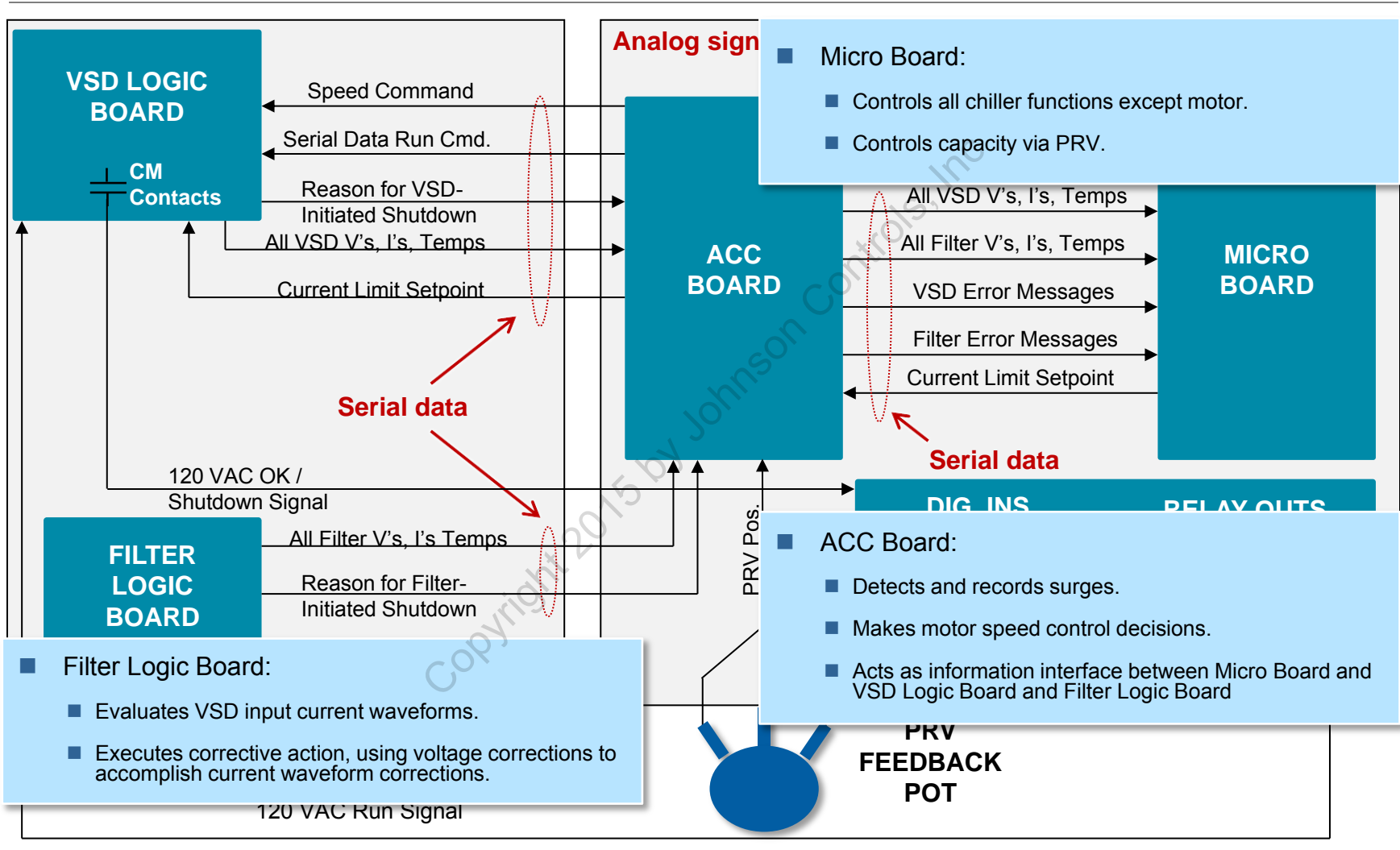
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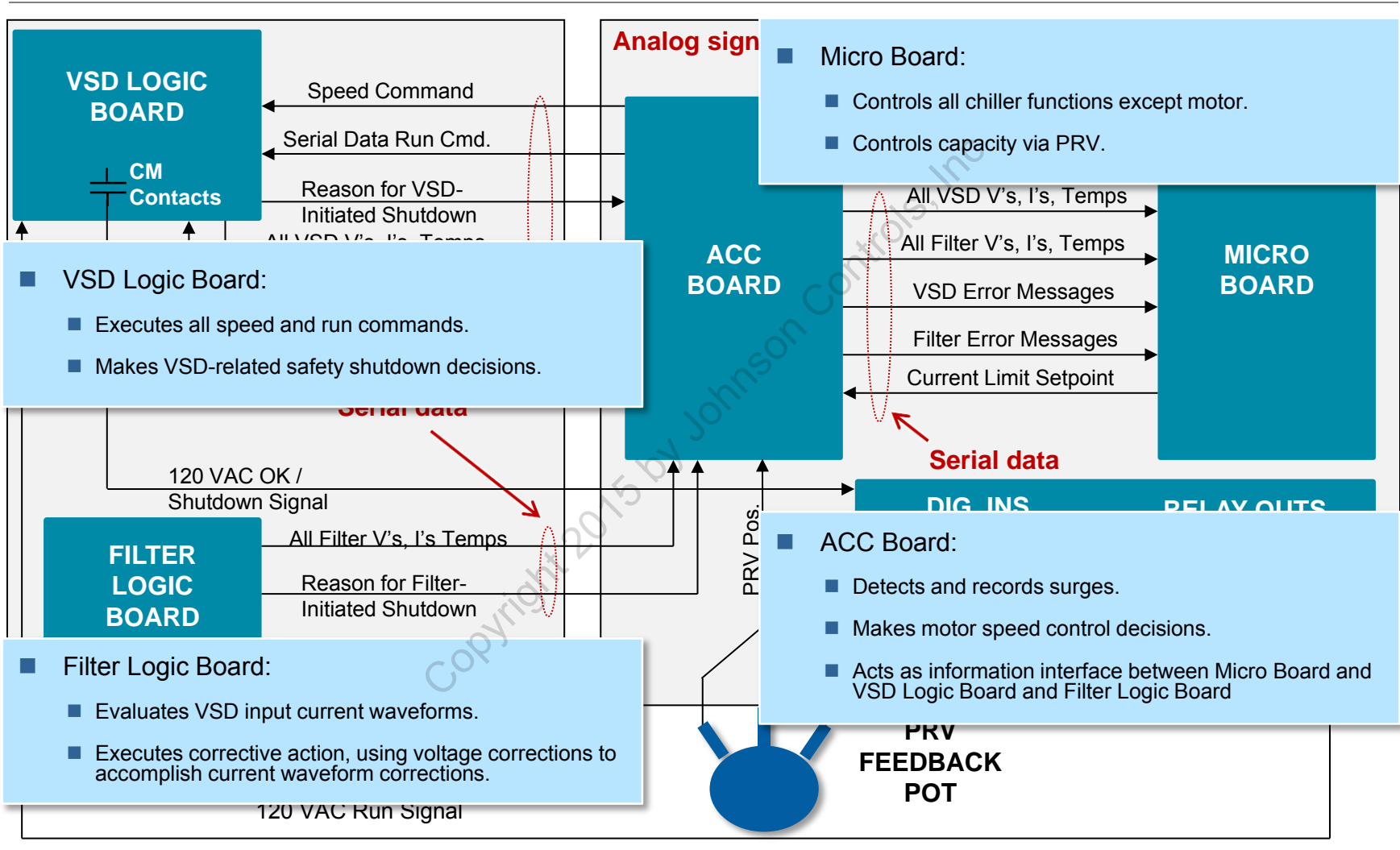
- **With ACC Software version after 1.03A**
- **A change was made to how the VSD ramps.**
- This new approach involves ramping the motor from 0 to half motor speed or 0 to 30 Hz in 20 seconds and then from half motor speed to full motor speed or 30 to 60 Hz over a 15 minutes period.
- During this period the vanes are being modulated to achieve the desired LCWT.
- If the LCWT is achieved prior to the motor reaching full speed or 60 Hz, ramping will stop and the motor speed will begin reducing.





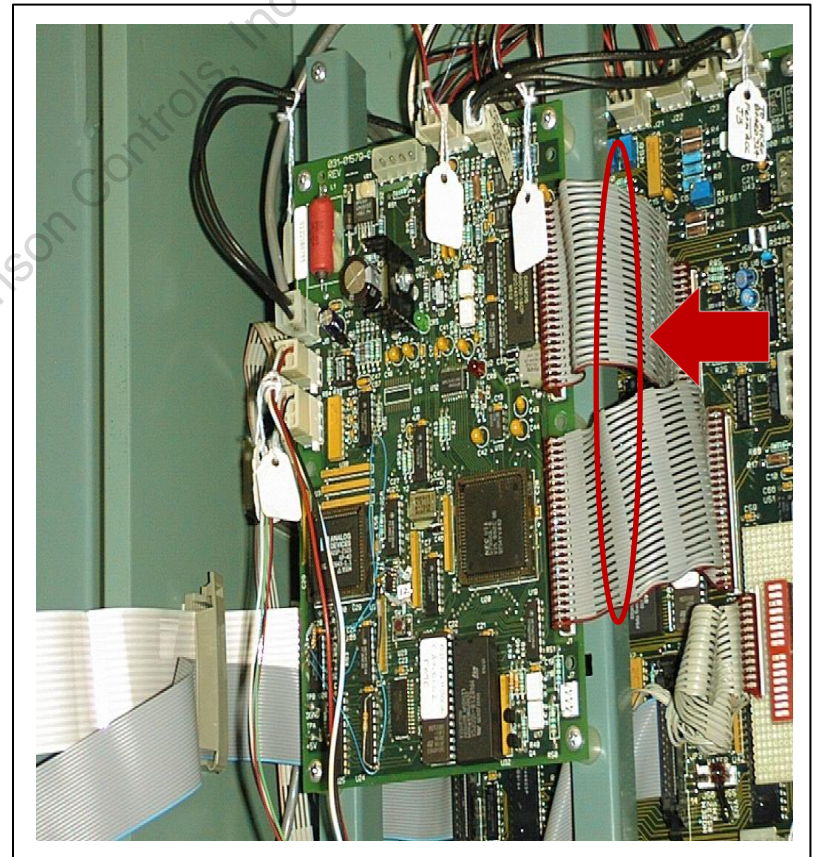






One Line Panel

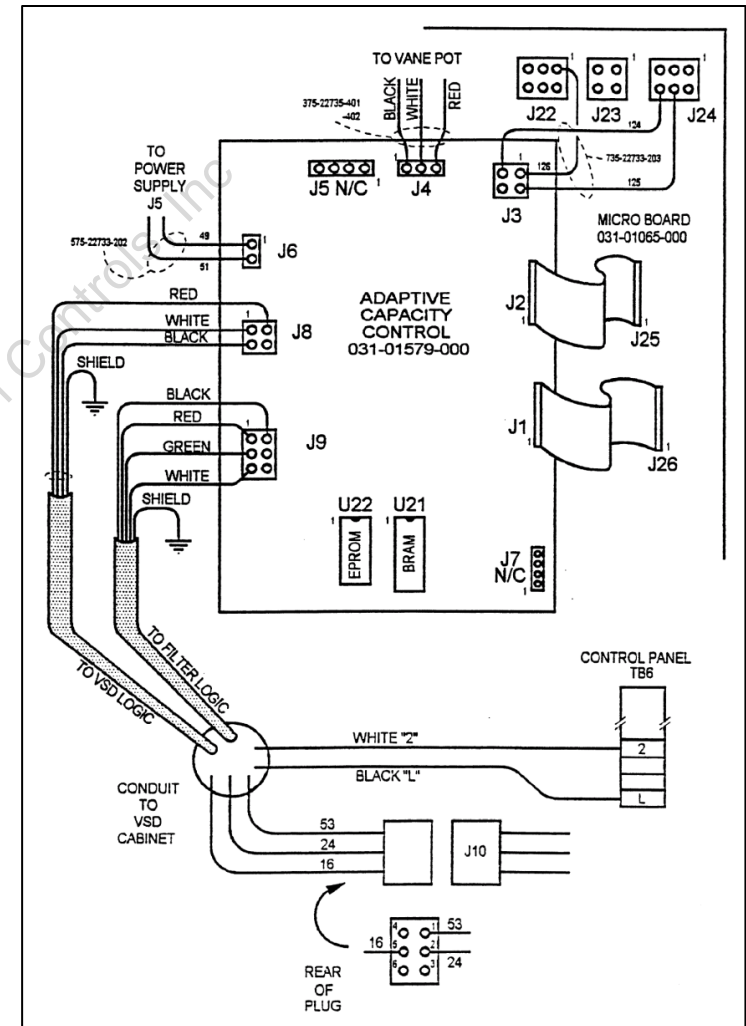
- ACC Board communicates with the microprocessor board via ribbon cables.
- All communication takes place approximately every 2 seconds.



One Line Panel ACC Board

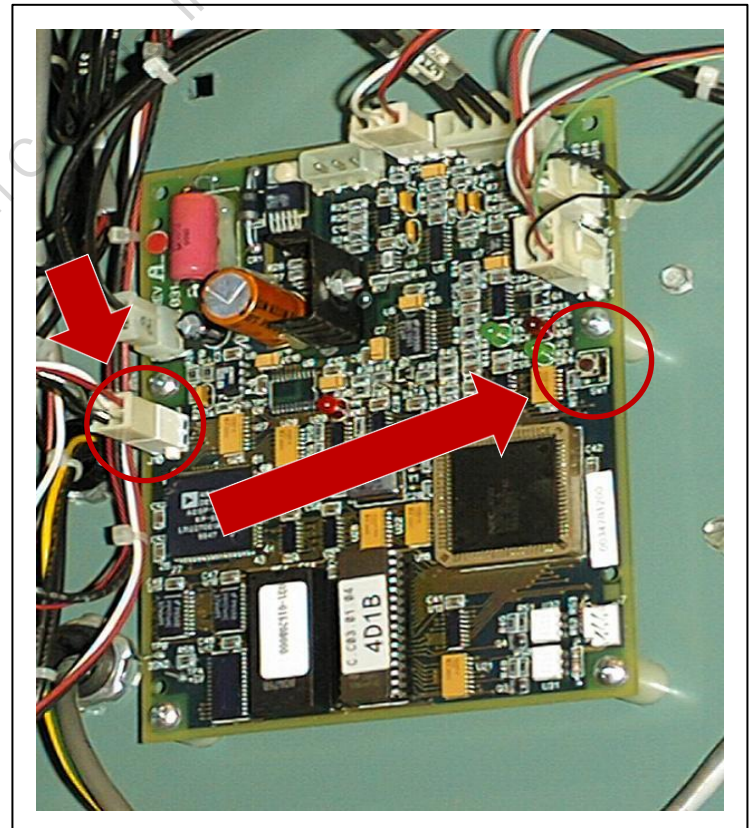
■ Connections:

- (J3) Condenser and evaporator pressure transducer signals from the Microprocessor Board.
- (J4) Feedback potentiometer of the vane motor linkage.
- (J5) Not used.
- (J6) Unregulated 30-35 VDC from the Panel's Power Supply Board.
- (J8) Serial communications port with the VSD Logic Board.
- (J9) Serial Communications port with the Filter Logic Board.



OptiView ACC Board

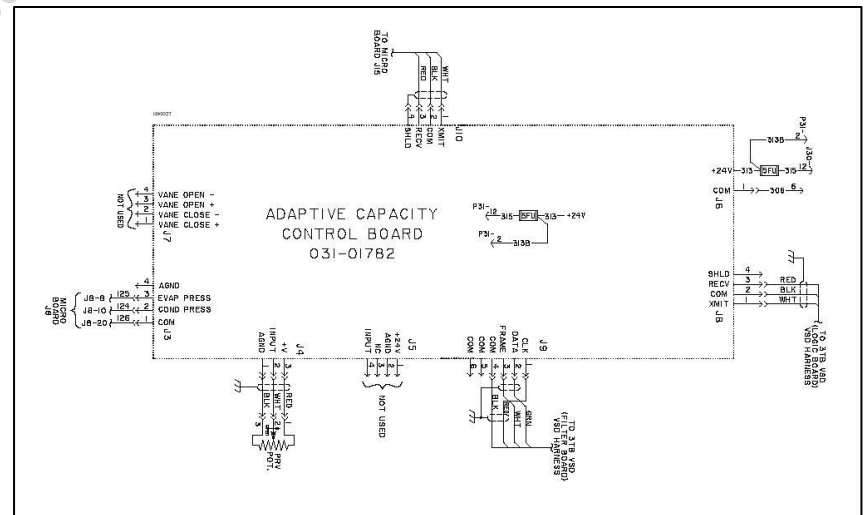
- Designed to communicate with the microprocessor board via the COM5 serial port
- Resets Surge Map
 - Passcode = 0368
 - Enter Code then press reset button
 - Then re-calibrate vane pot



OptiView ACC Board

■ Connections:

- (J3) Condenser and evaporator pressure transducer signals from the Microprocessor Board.
- (J4) Feedback potentiometer of the vane motor linkage.
- (J5) Not used.
- (J6) Regulated 24 vdc from the Panel's Power Supply Board.
- (J7) Not used.
- (J8) Serial Communications port with the VSD Logic Board.
- (J9) Serial Communications port with the Filter Logic Board.
- (J10) Serial Communications port with the Microprocessor Board (COM5).



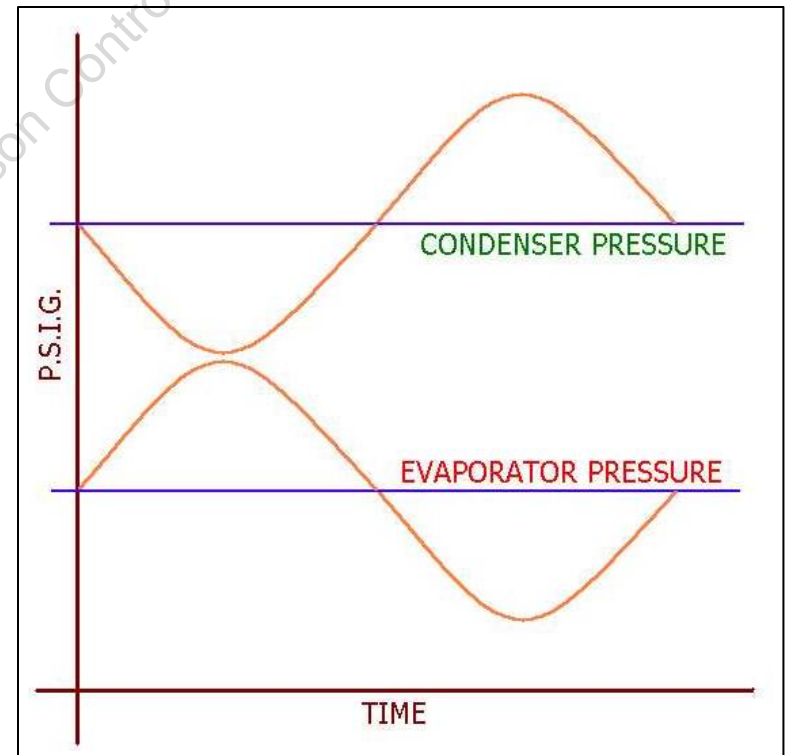
Surge

- The ACC Board Qualifies a Surge by:
 - Monitoring the Condenser and Evaporator Pressure
 - Monitoring the Motor Current

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Detecting Surge

- The ACC Board detects a surge by monitoring the condenser and evaporator pressure.
- When a high and a low pressure differential is detected within a specific range of time a surge conditions is identified



Detecting Surge

- Along with the Motor Speed in Hz and PRV position in %, the DP/P is the third piece of information written into BRAM memory

$$DP/P = \frac{P_{COND} - P_{EVAP}}{P_{EVAP}}$$

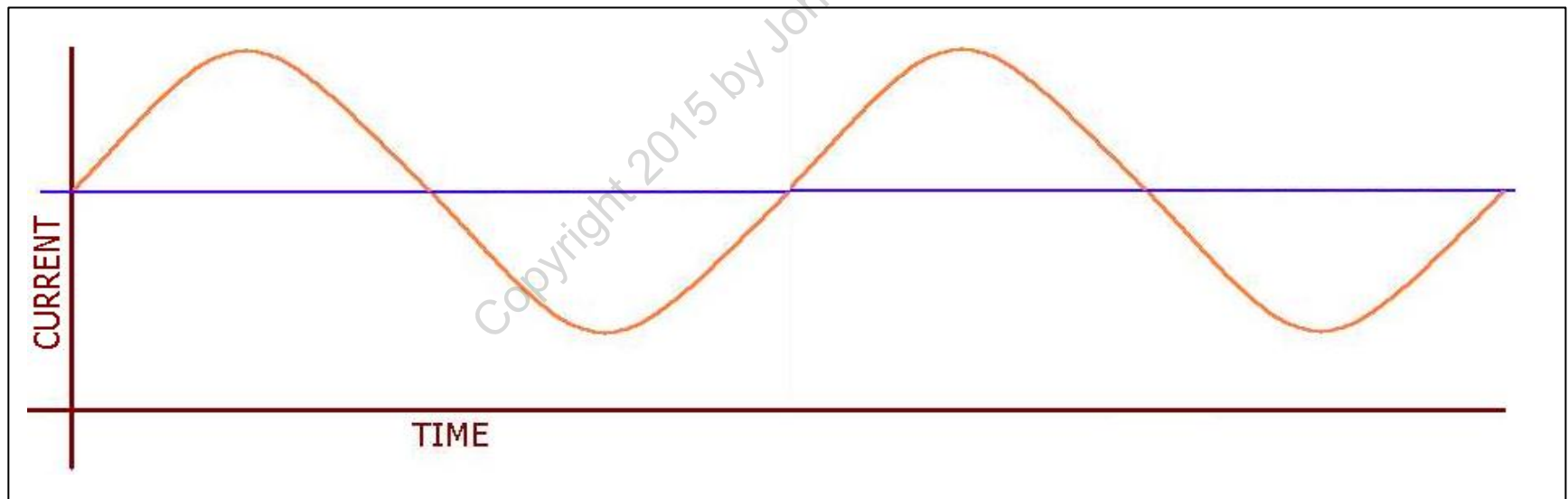
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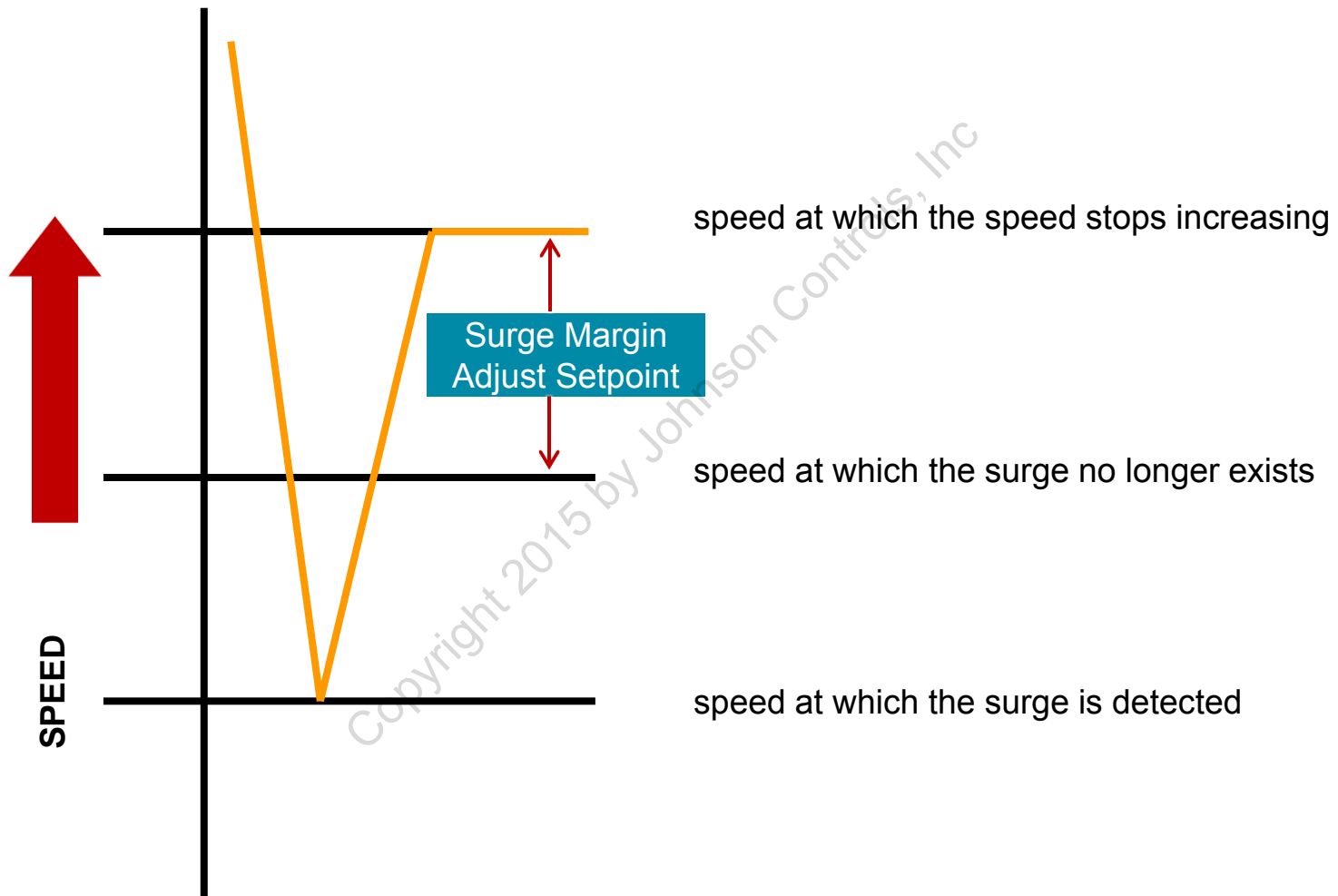
Detecting Surge

- DP/P less than 1.2 should cause a reduction in speed.
- DP/P of 3.5 {which is maximum} or greater should cause the VSD to ramp to 60 HZ
- Surges that occur at 60 HZ go into the surge count not the Surge Map.
- Surge Point is mapped once the unit comes out of surge
 - Mapped Points include
 - Motor Hz
 - DP/P
 - Vane Position

Detecting Surge

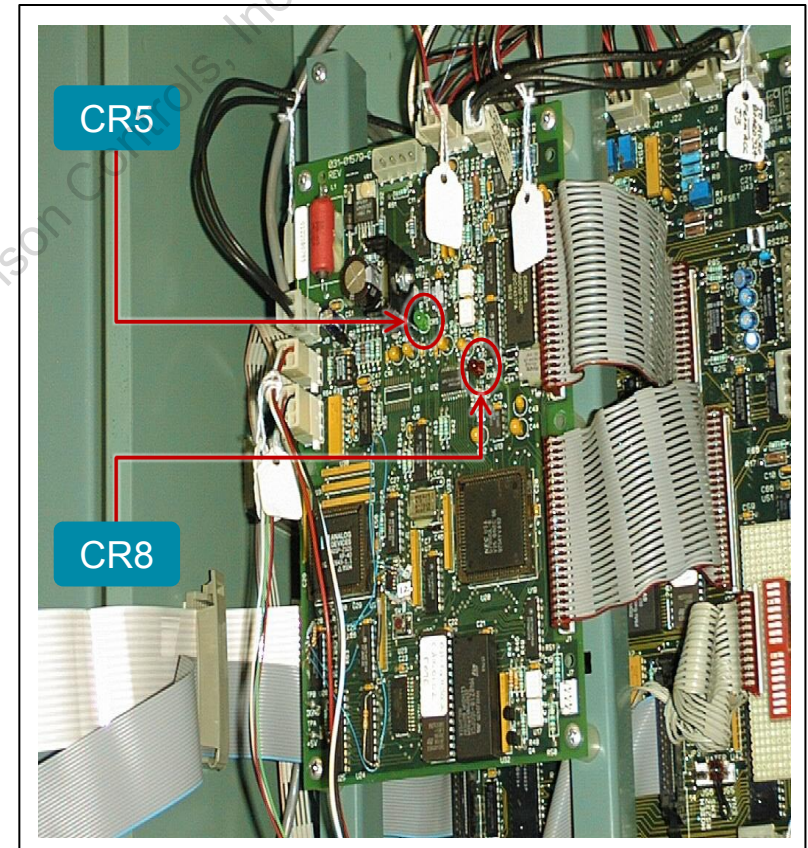
- The ACC Board also detects a surge by observing the motor current.
- If the motor current begins fluctuating rhythmically a surge condition is identified.





One-Line Panel ACC Board

- The green LED (CR5) will light if:
 - The chiller is in manual speed control mode.
 - The chiller is running in current limit.
 - The rate-of-change of the LCWT is greater than the programmed stability limit.
 - **The LCWT is away from the LCWT-SP by more than $+0.5^{\circ}$ or less than the LCWT-CO setpoint.**
- The red LED (CR8) will light if:
 - A surge is detected and has not recovered

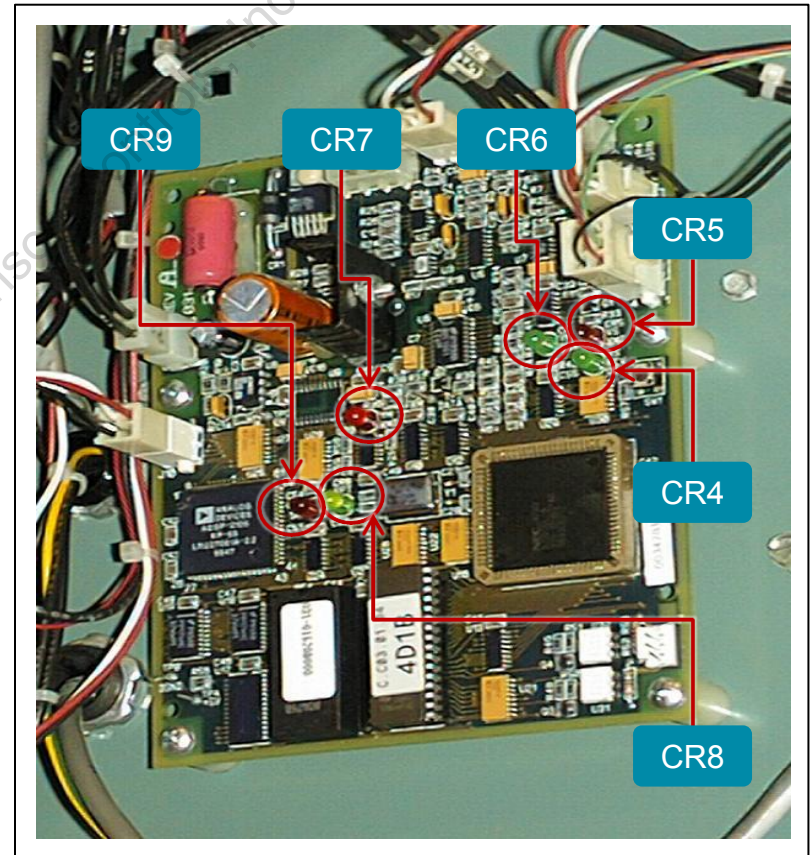


OptiView Panel ACC Board

- The green LED (CR6) is lit if RX serial comms from the Micro
- The red LED (CR7) is lit if TX serial comms to the Micro
- The green LED (CR4) is lit if RX serial comms from the VSD Logic Board.
- The red LED (CR5) is lit if TX serial comms to the VSD Logic Board.
- The green LED (CR8) is lit if:
 - The chiller is in manual speed control mode.
 - The chiller is running in current limit.
 - The rate-of-change of the LCWT is greater than the programmed stability limit.
 - The LCWT is away from the LCWT.SP by more than $+0.5^{\circ}$ or less than the LCWTCO setpoint.

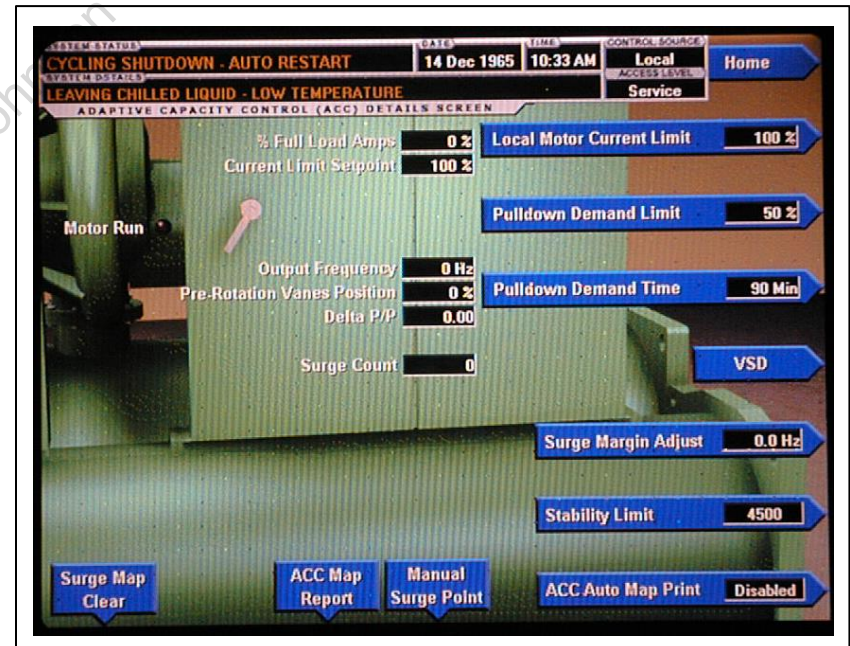
The red LED (CR9) is lit if:

- A surge is detected and has not recovered.



Stability Limit/Surge Margin

- Stability limit should be set to 7000.
 - Newer software discontinued this.
 - This was an overkill tuning adjustment that ended up not being needed.
- Surge Margin should be set to zero.



Checking for Catastrophic Faults

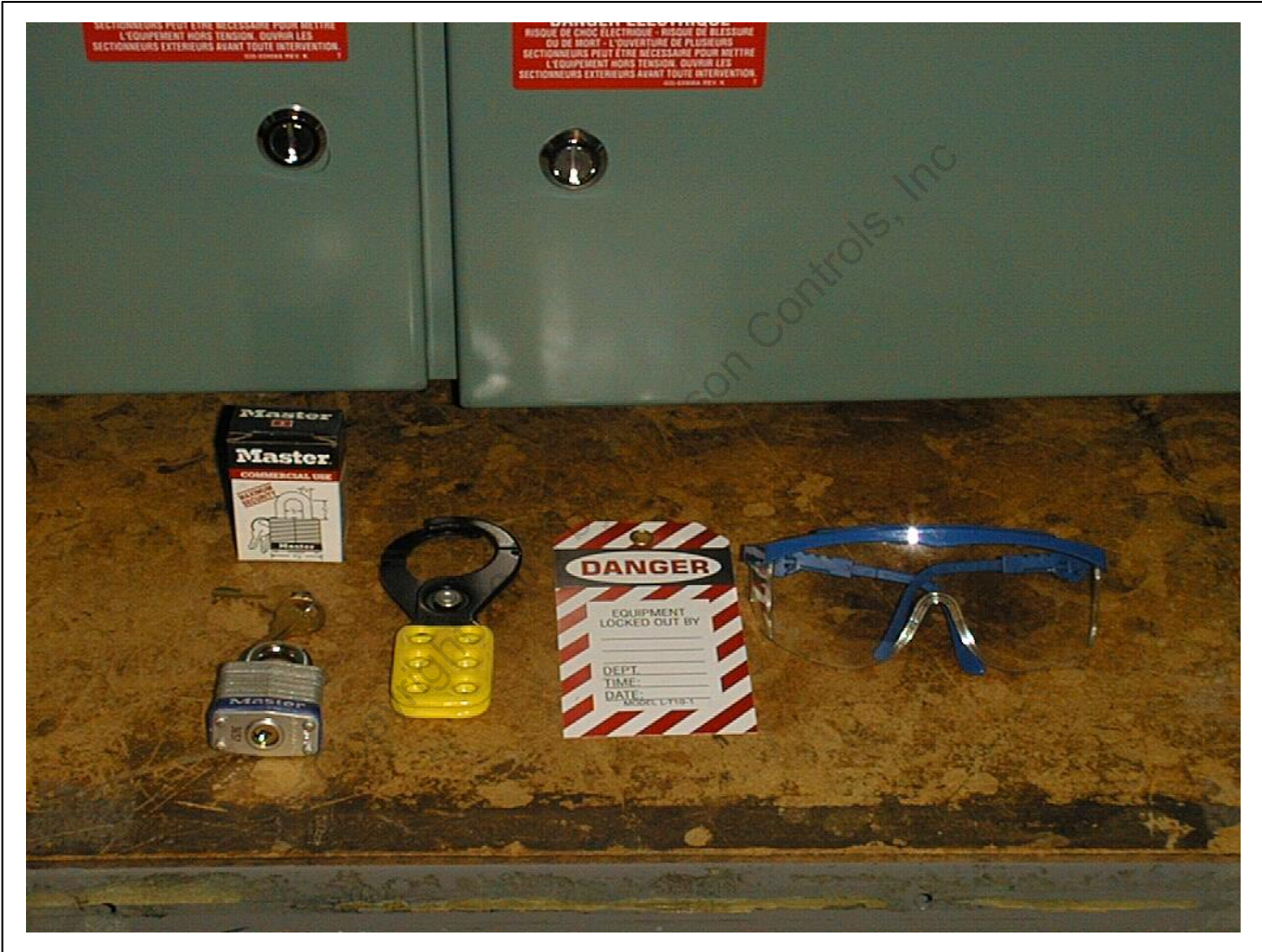


PRELIMINARY PREPARATIONS

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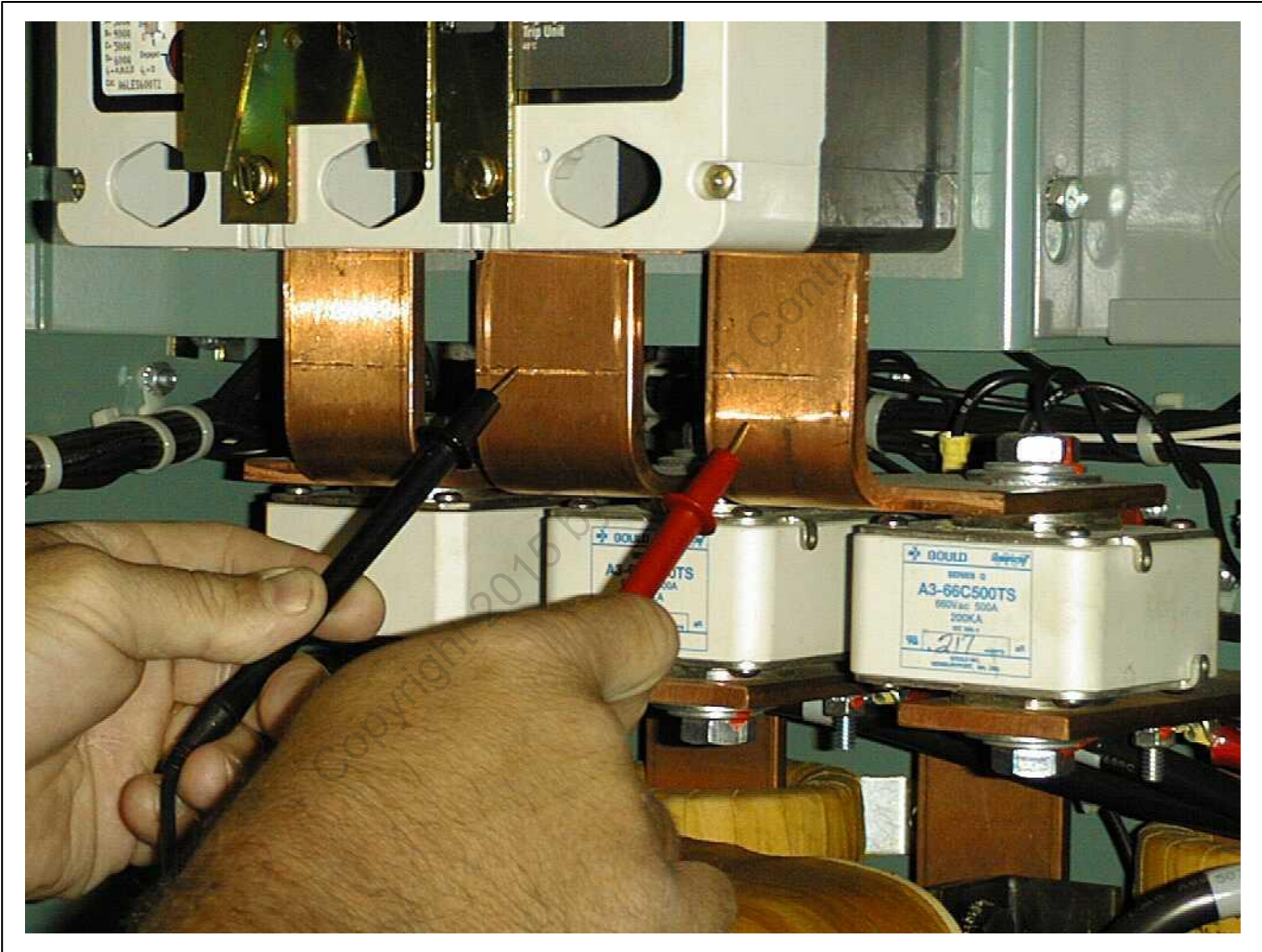
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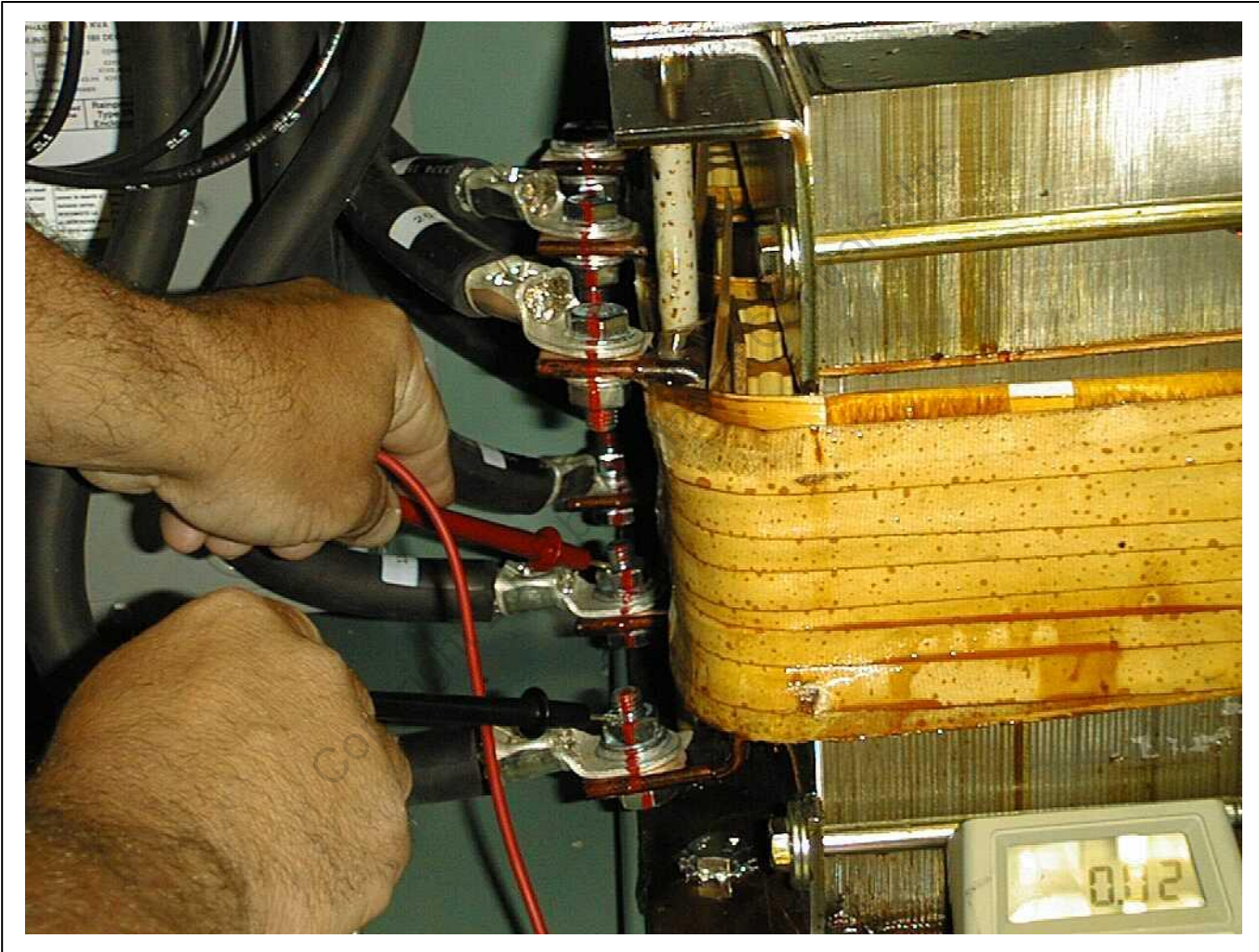




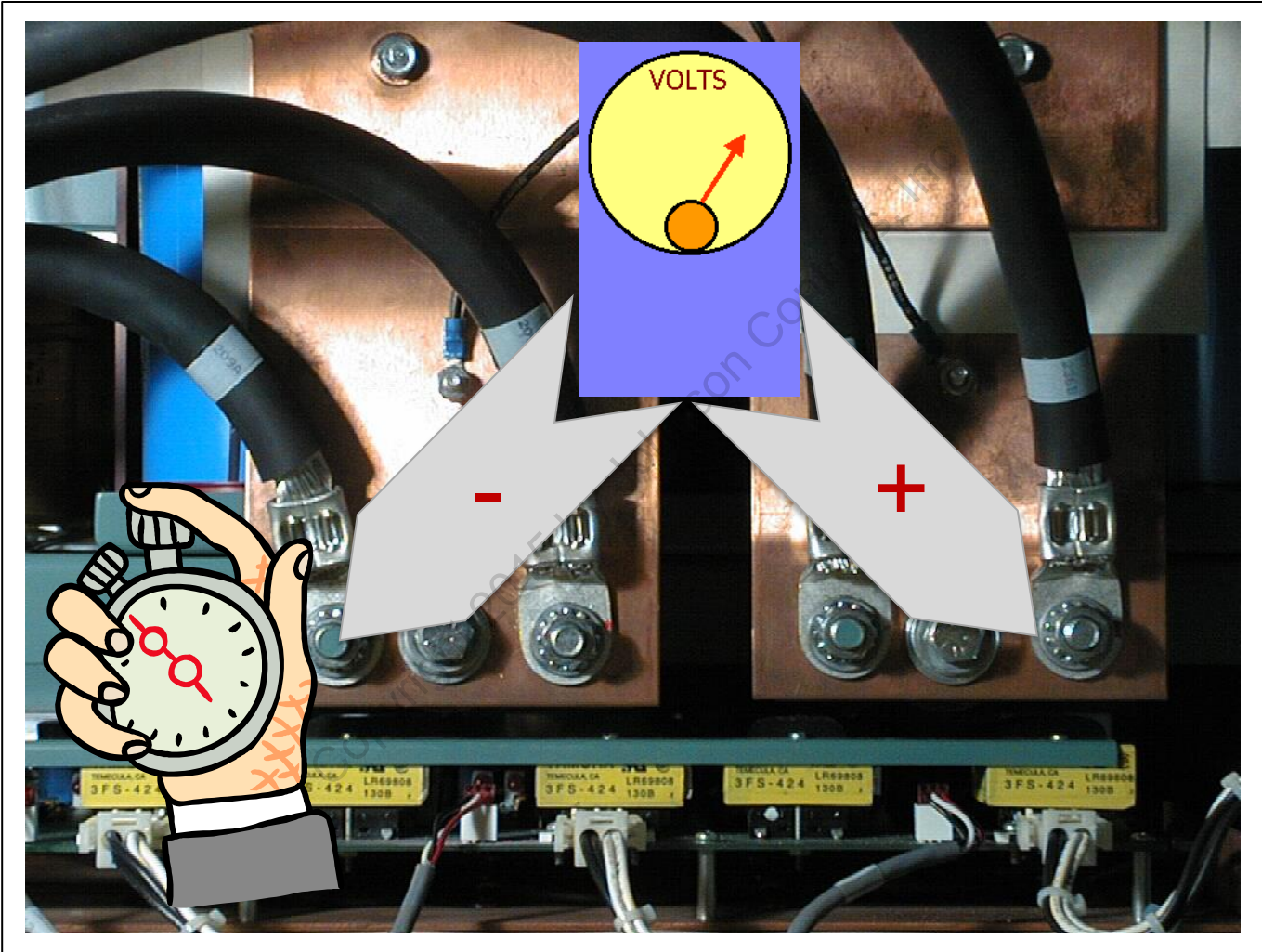
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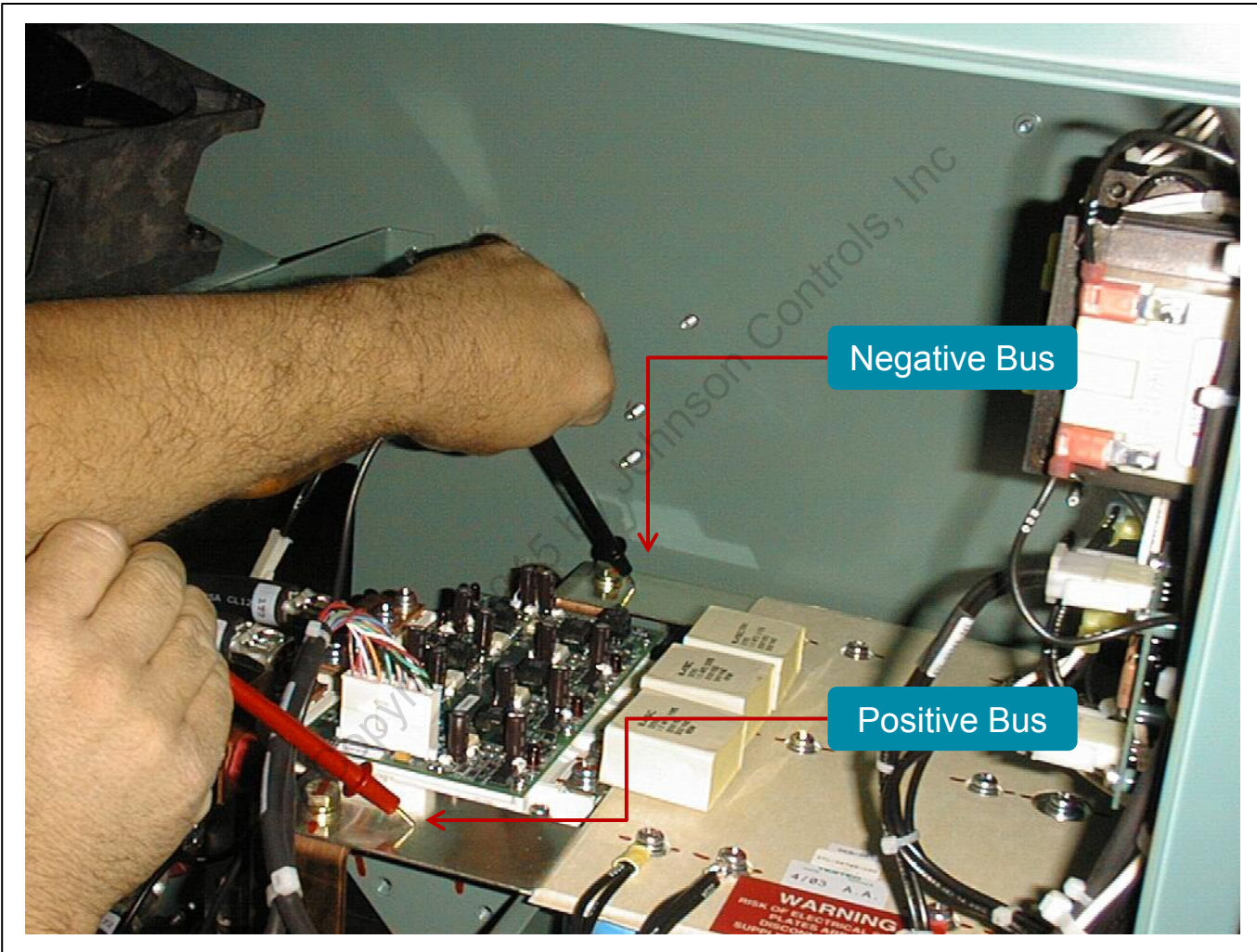






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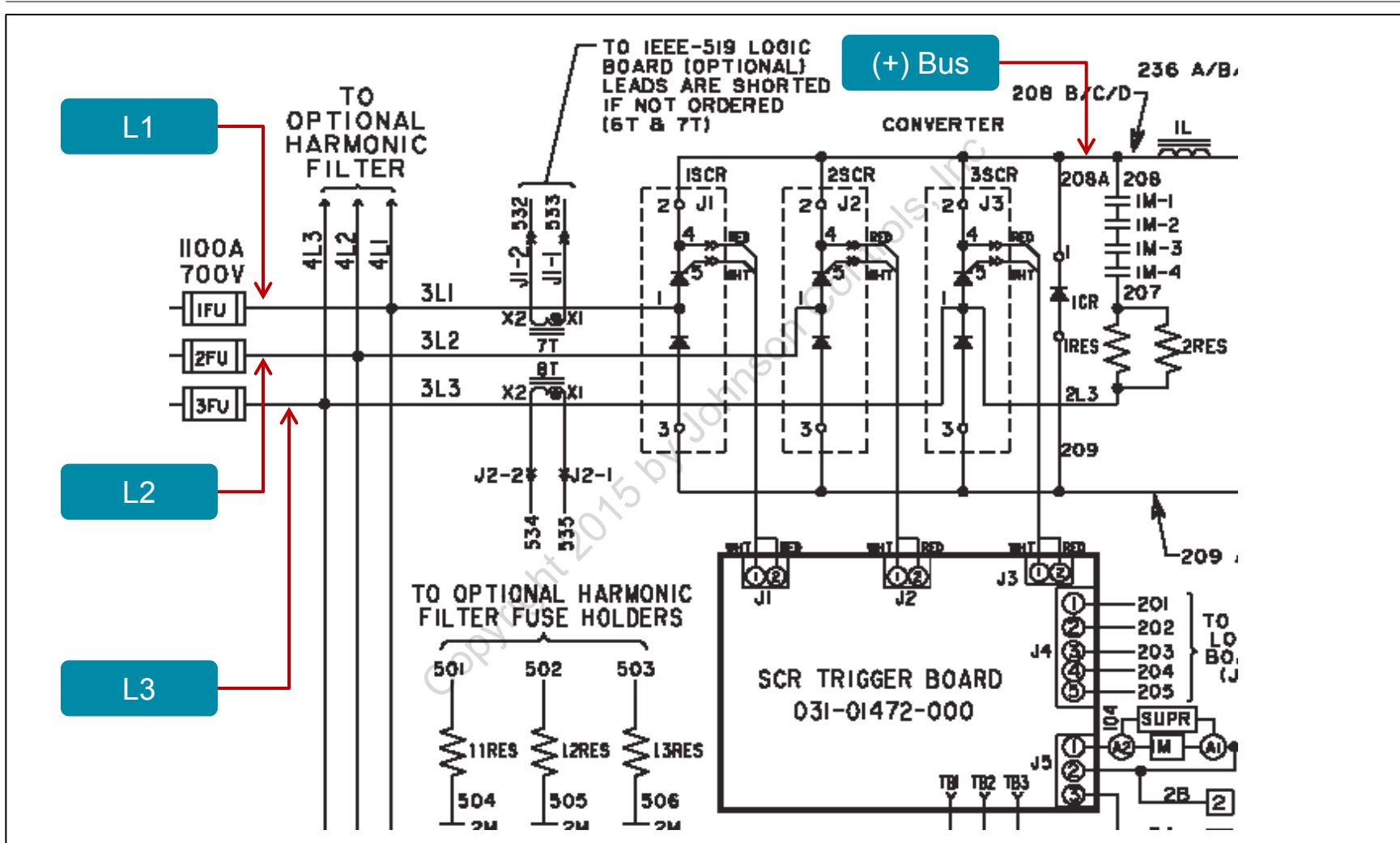
STYLE "D" CATASTROPHIC FAULTS

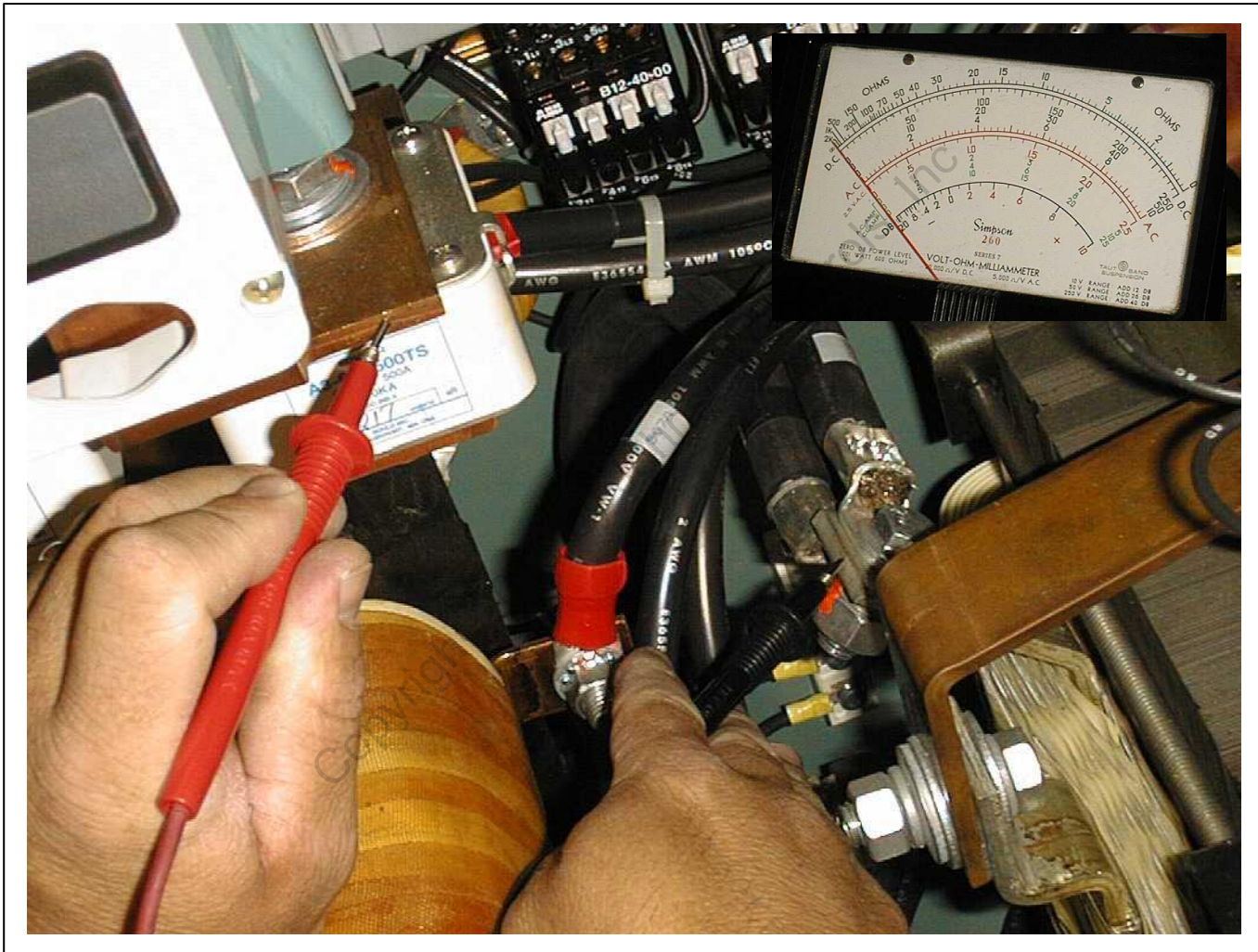


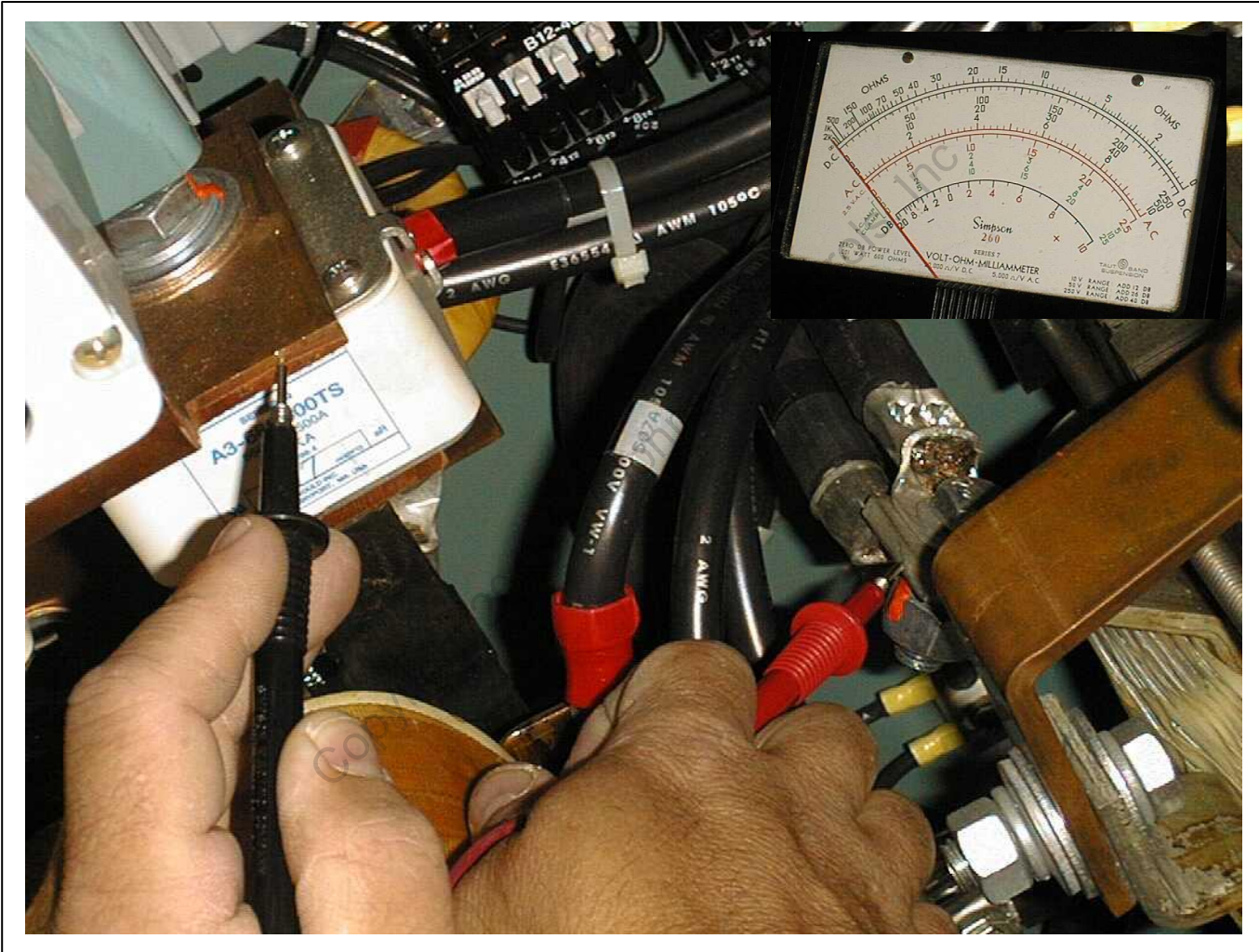
BY JOHNSON CONTROLS

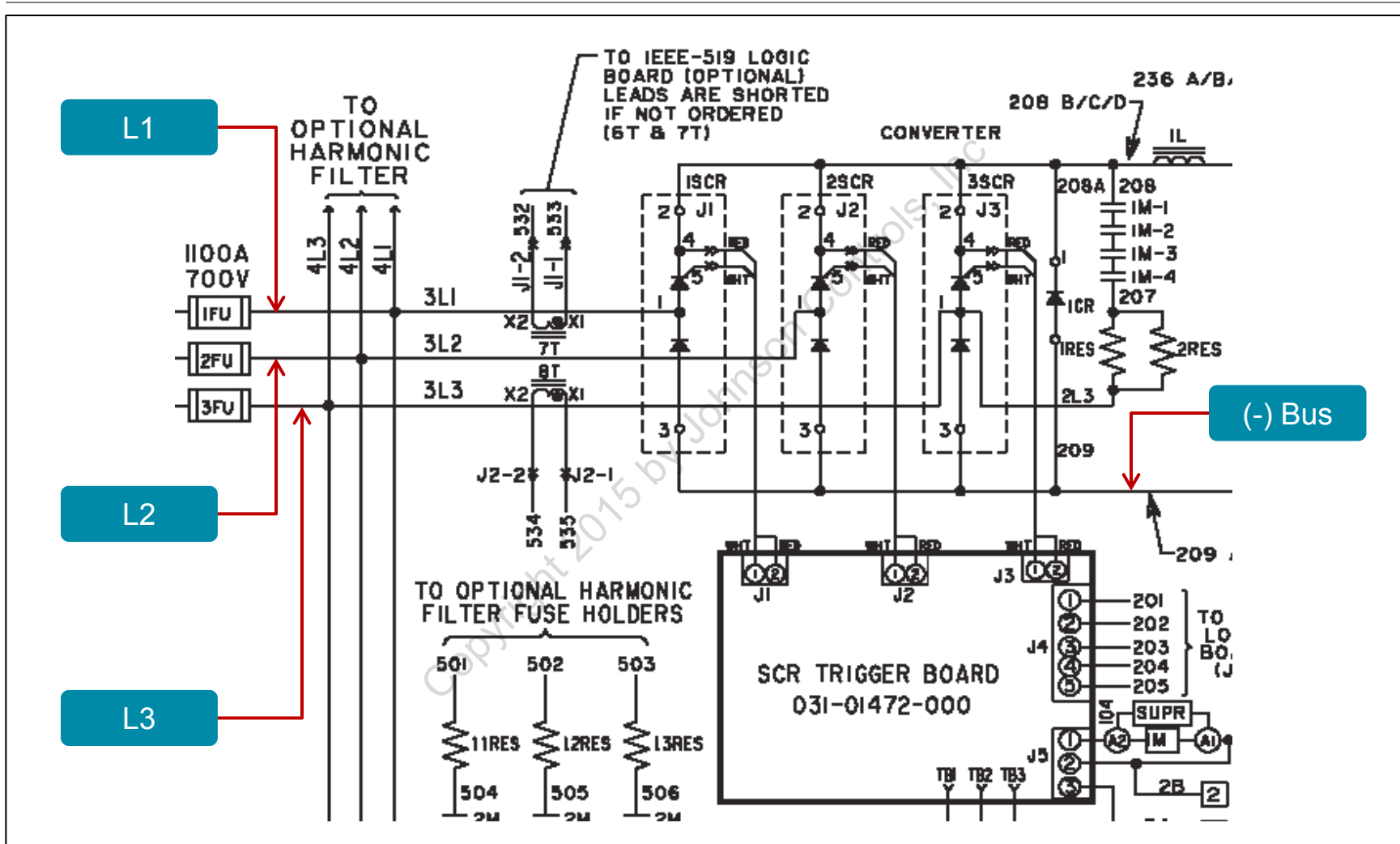


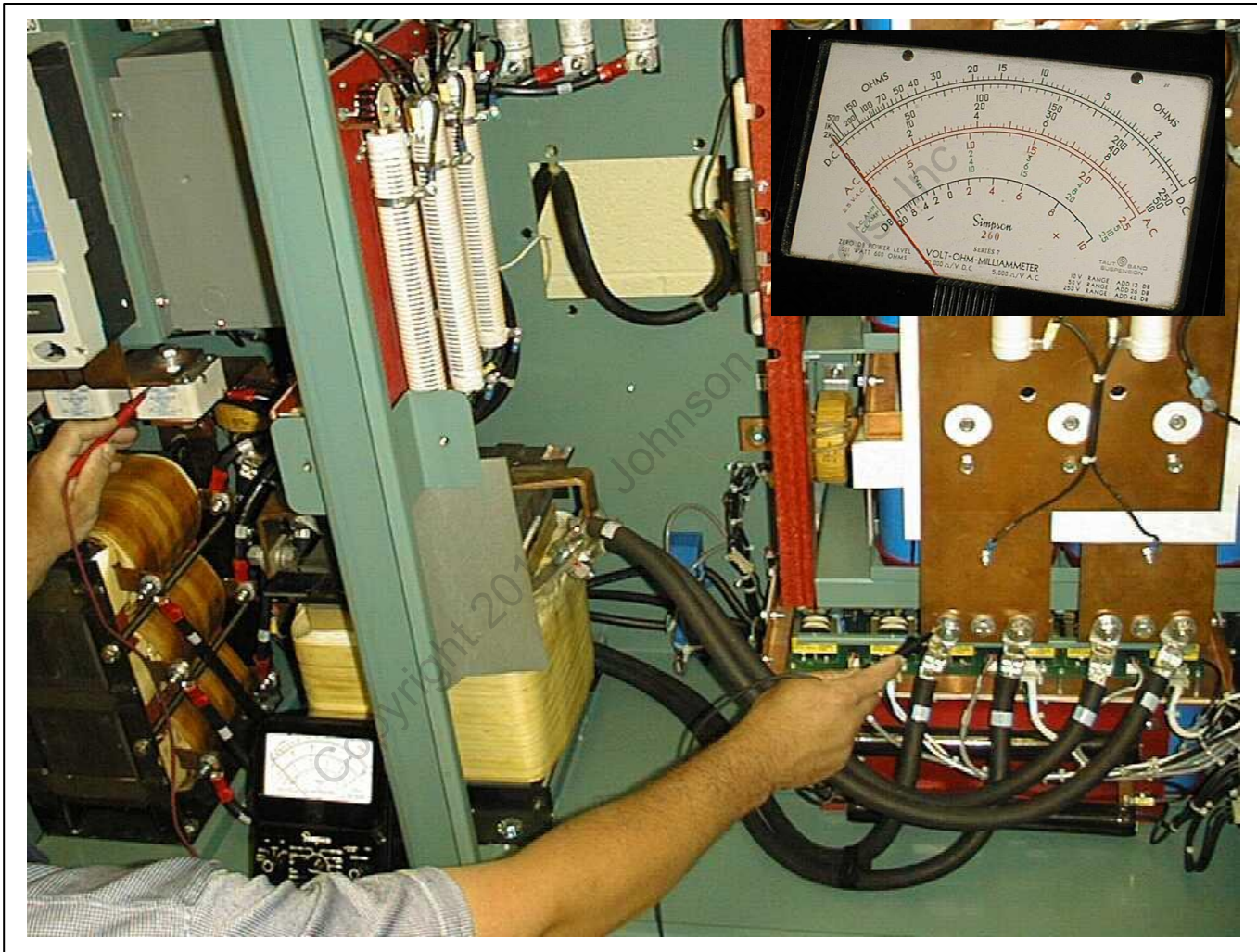
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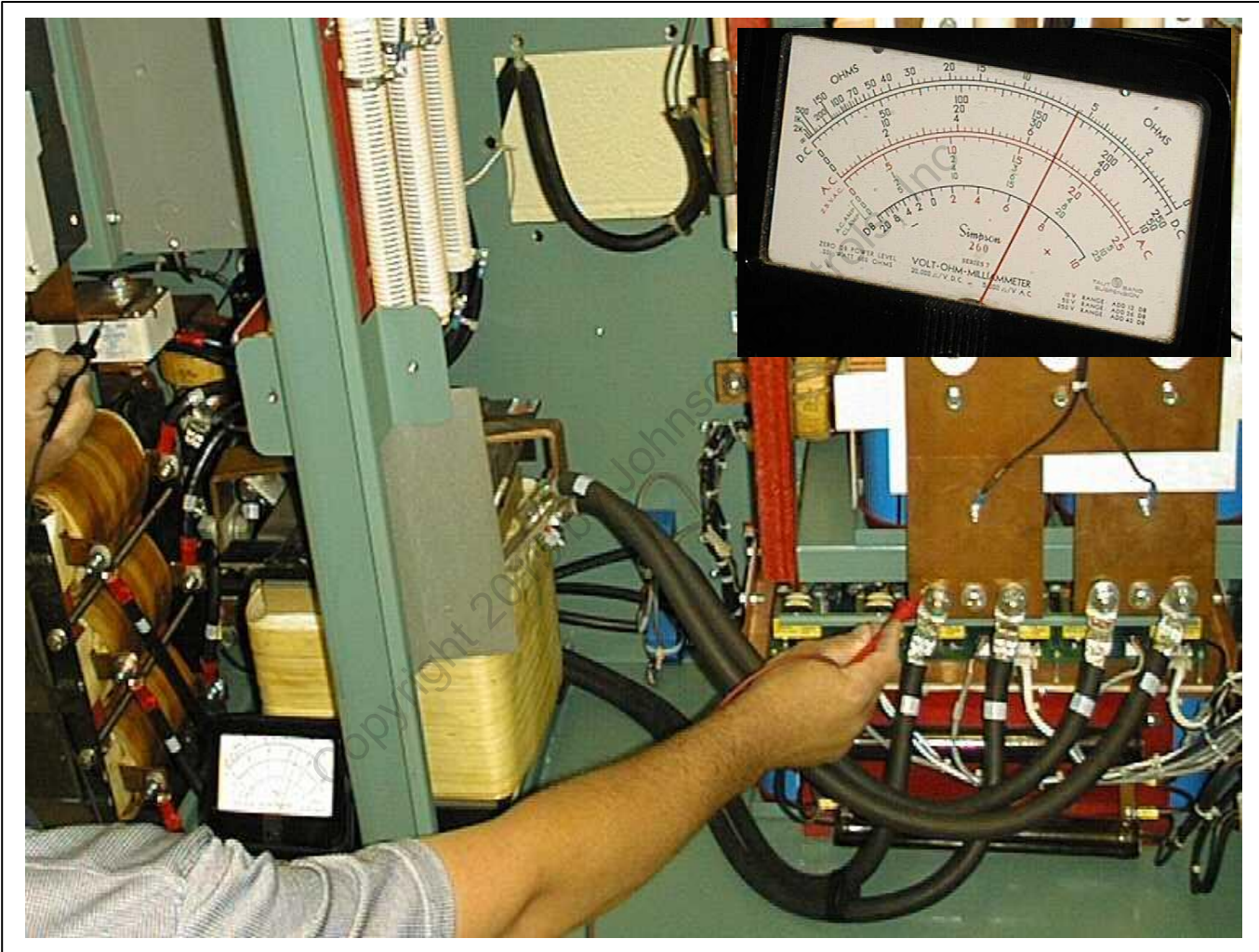


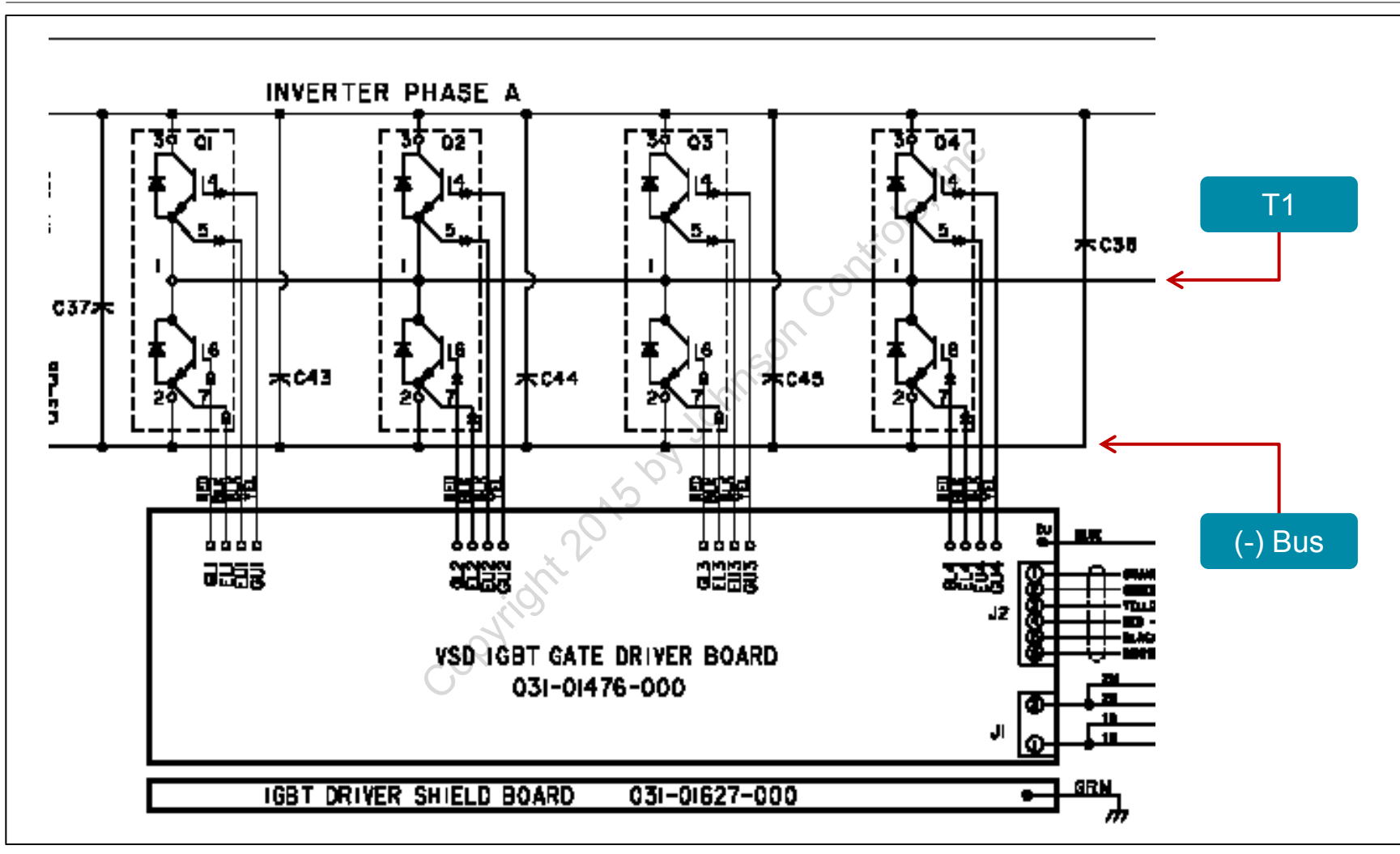


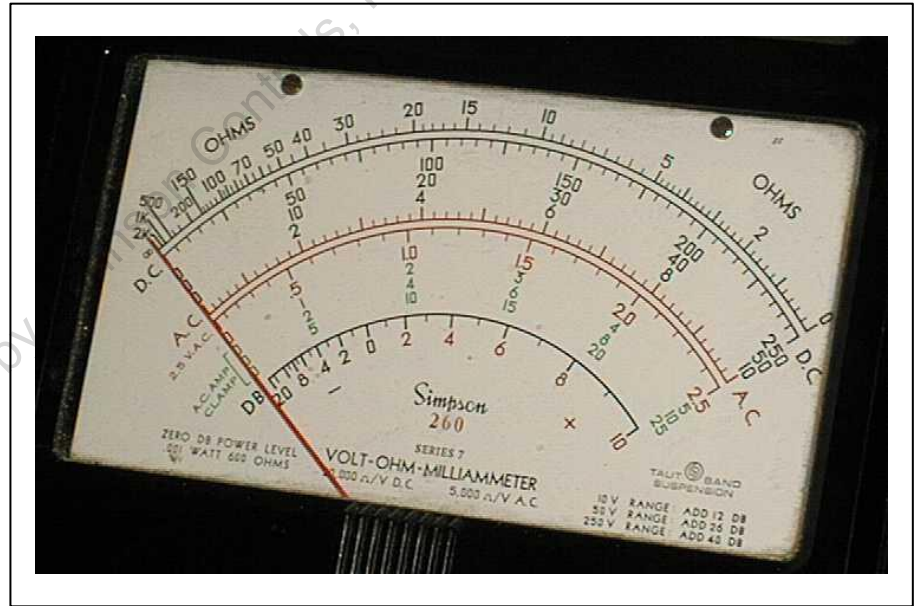
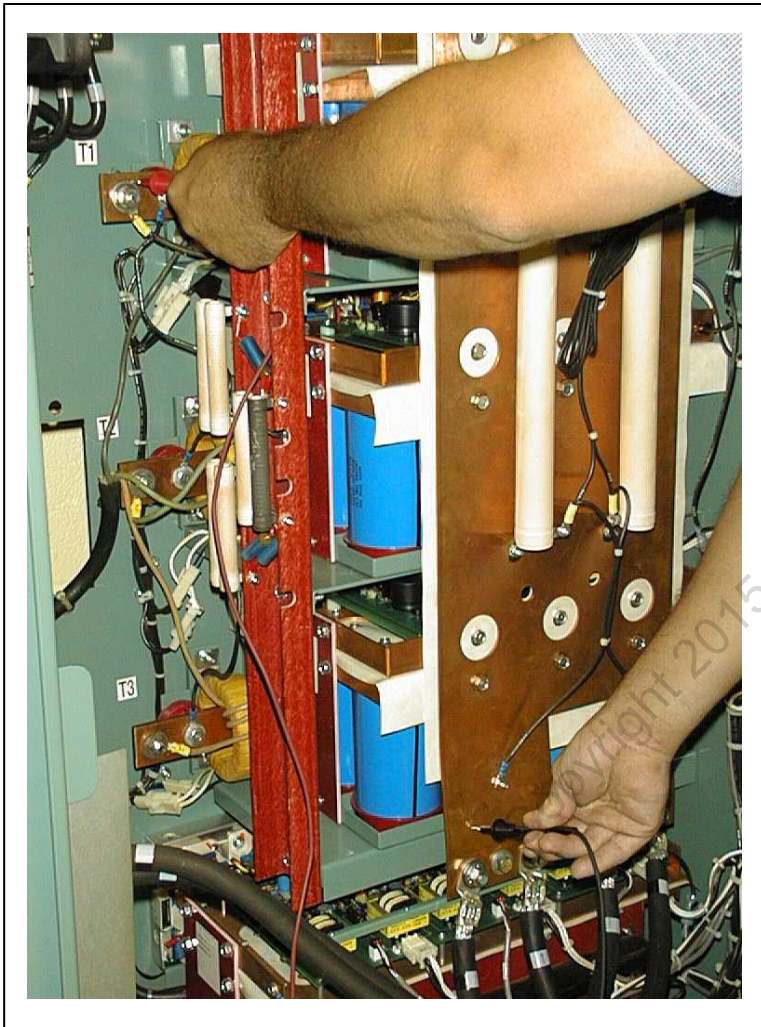


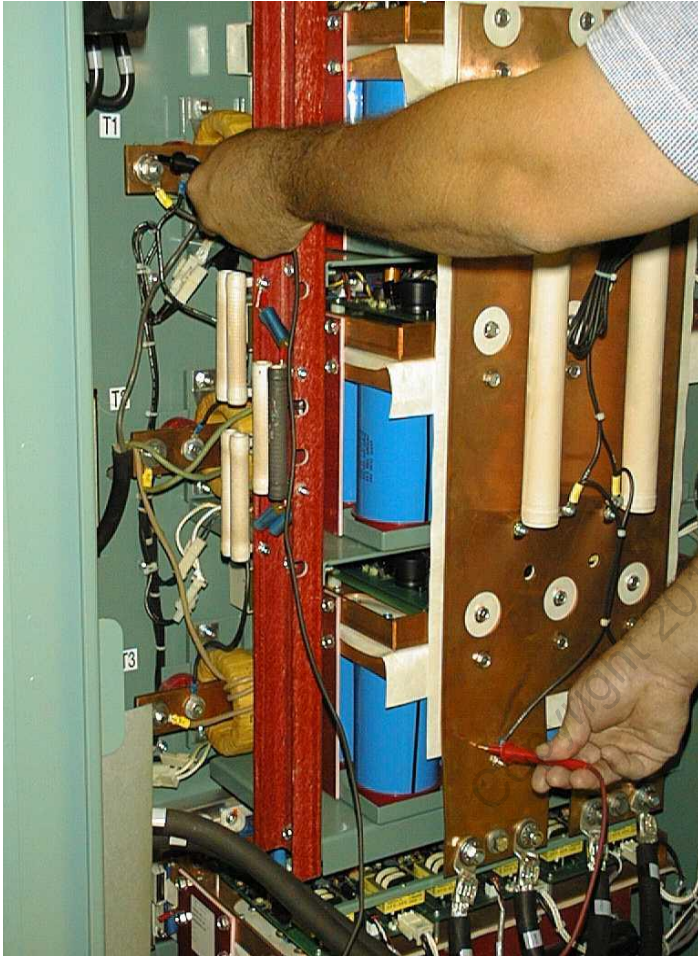


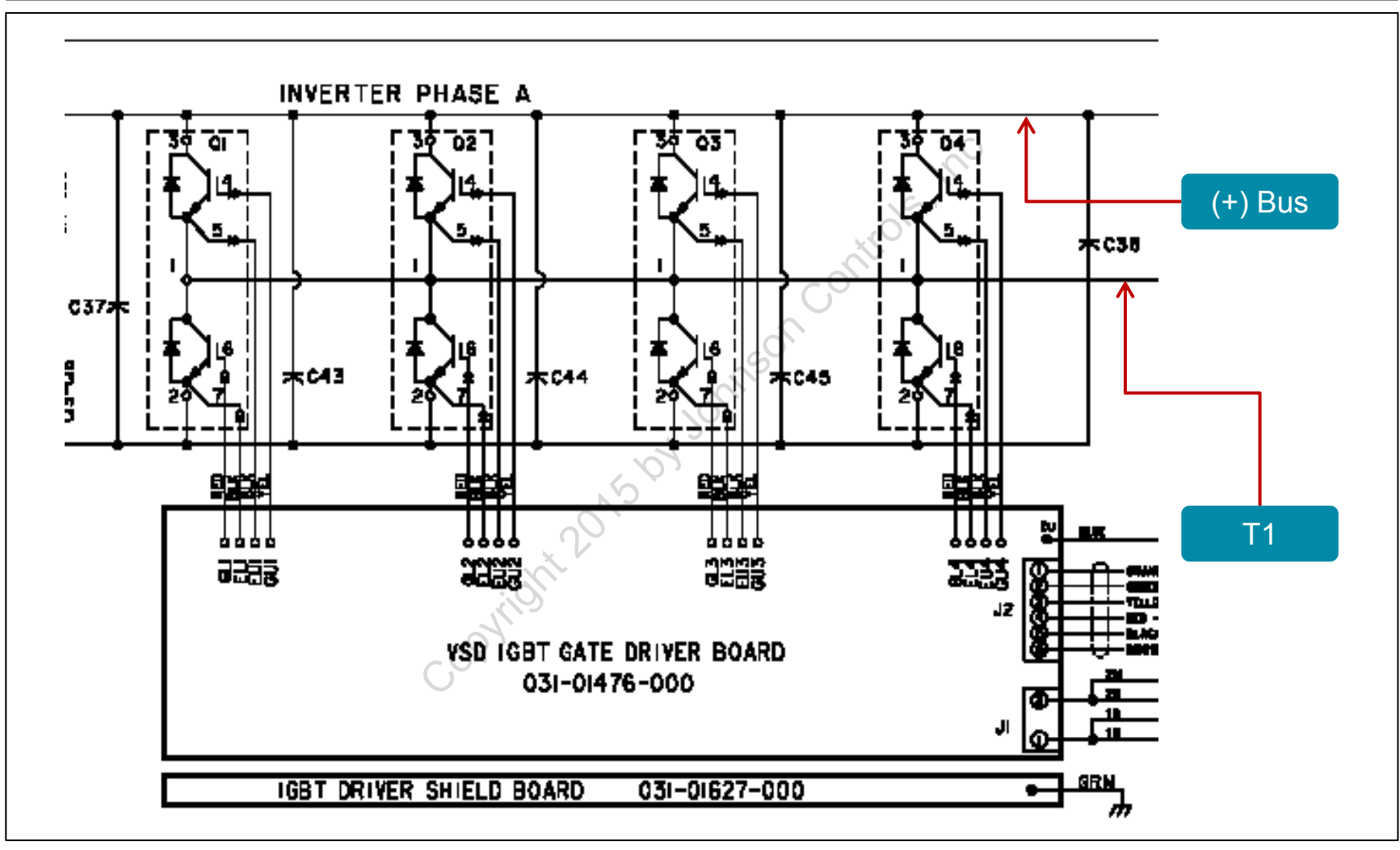


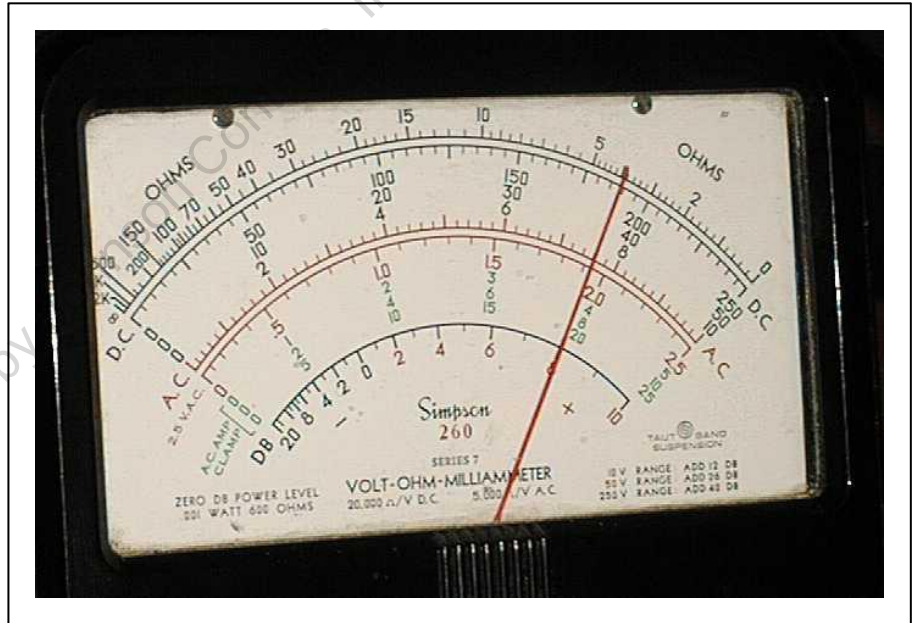
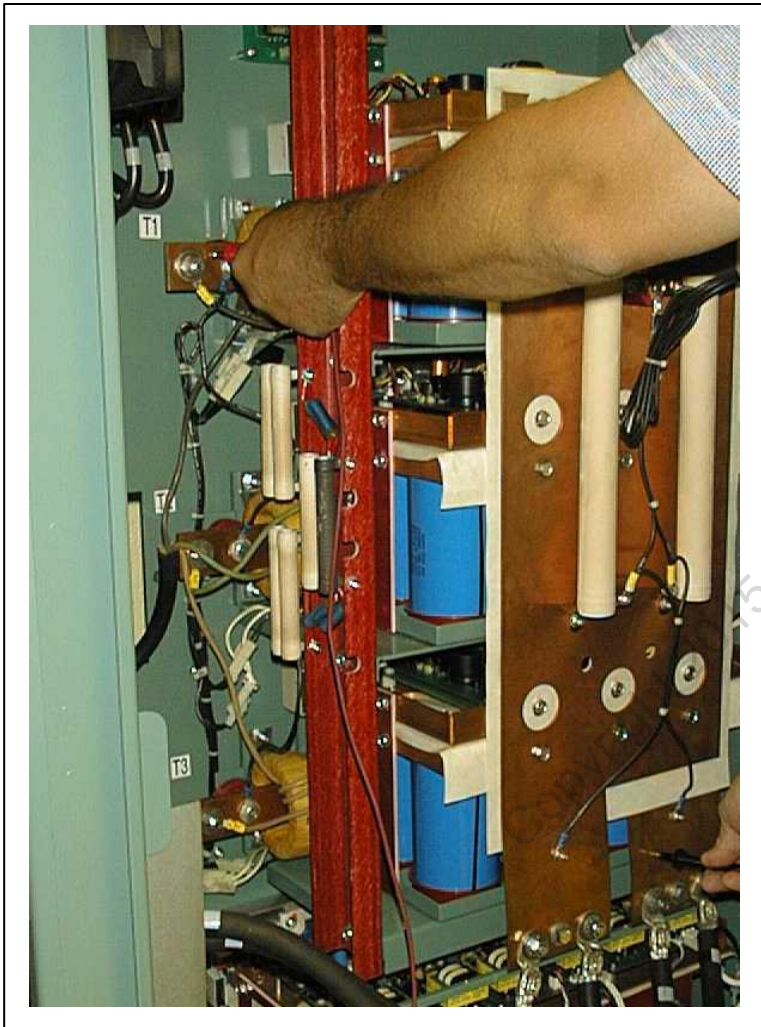


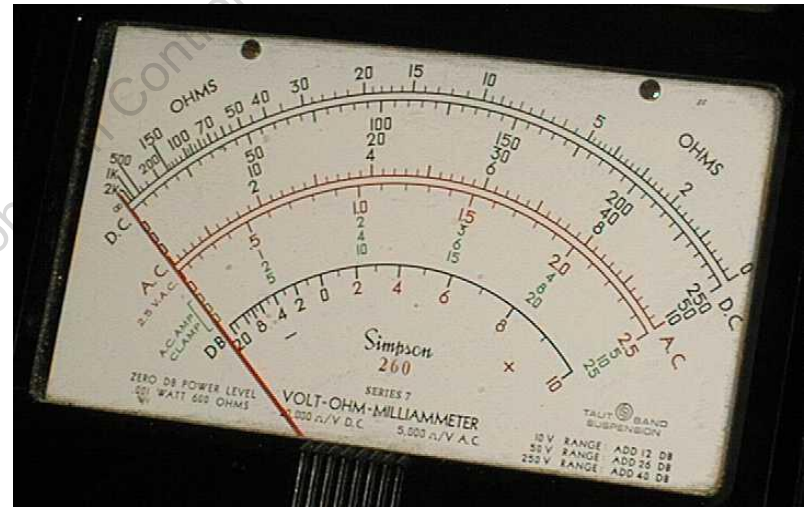
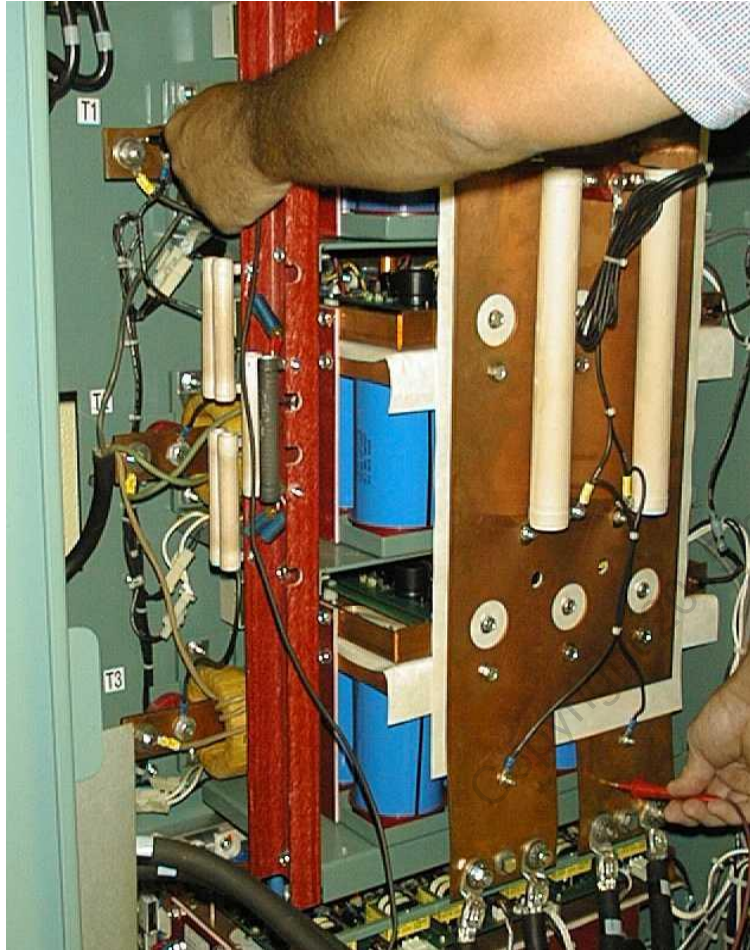


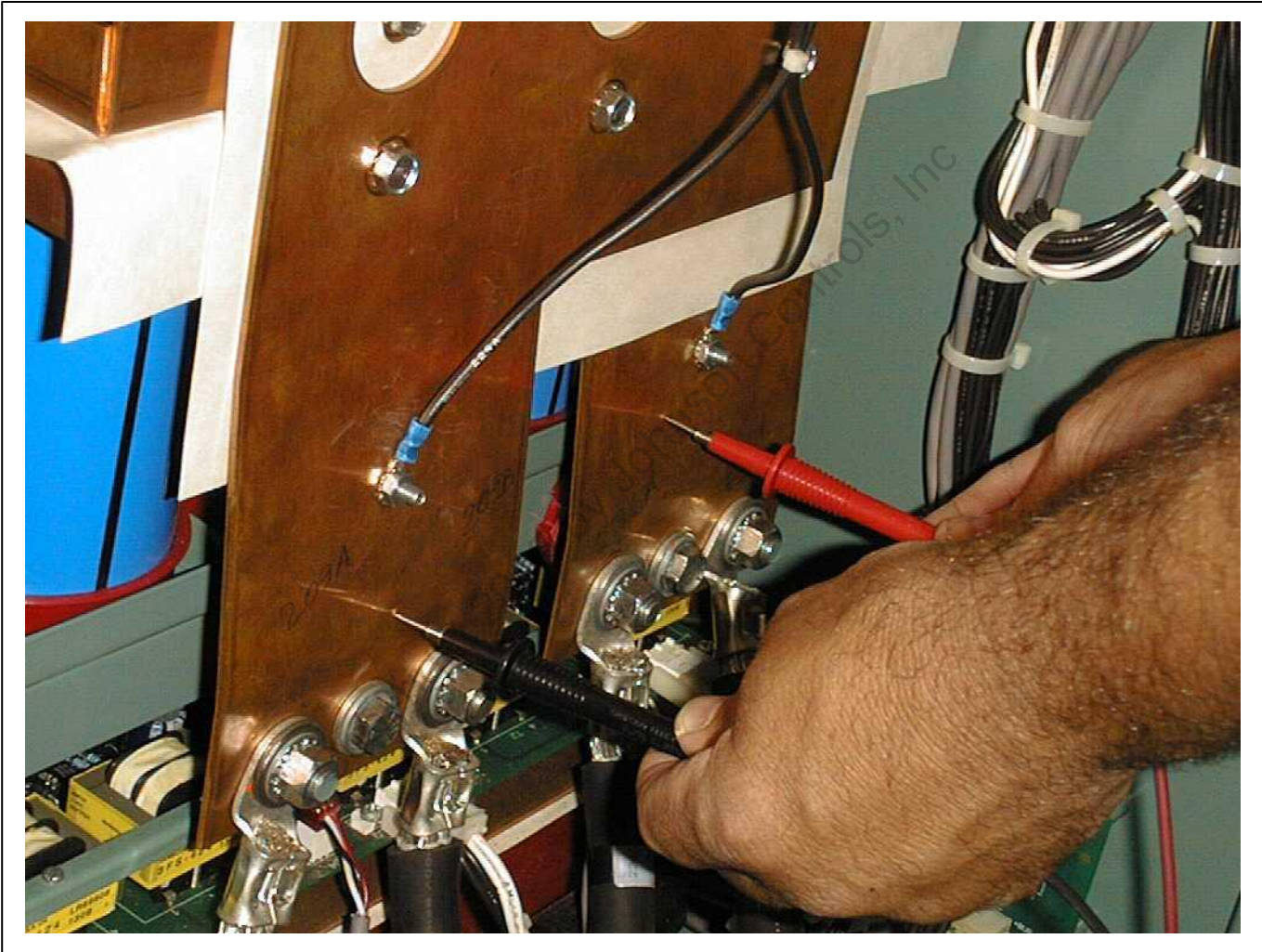




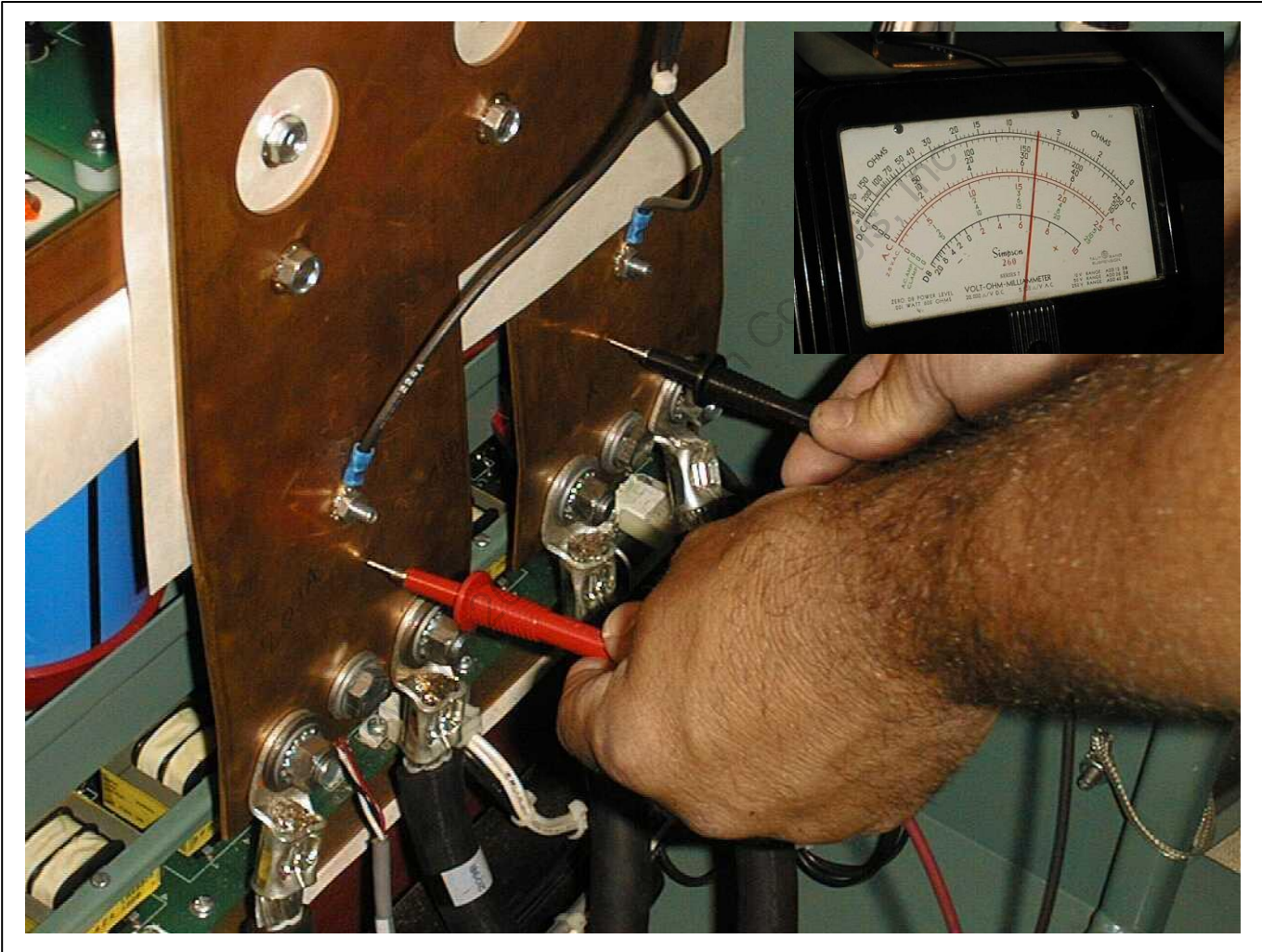








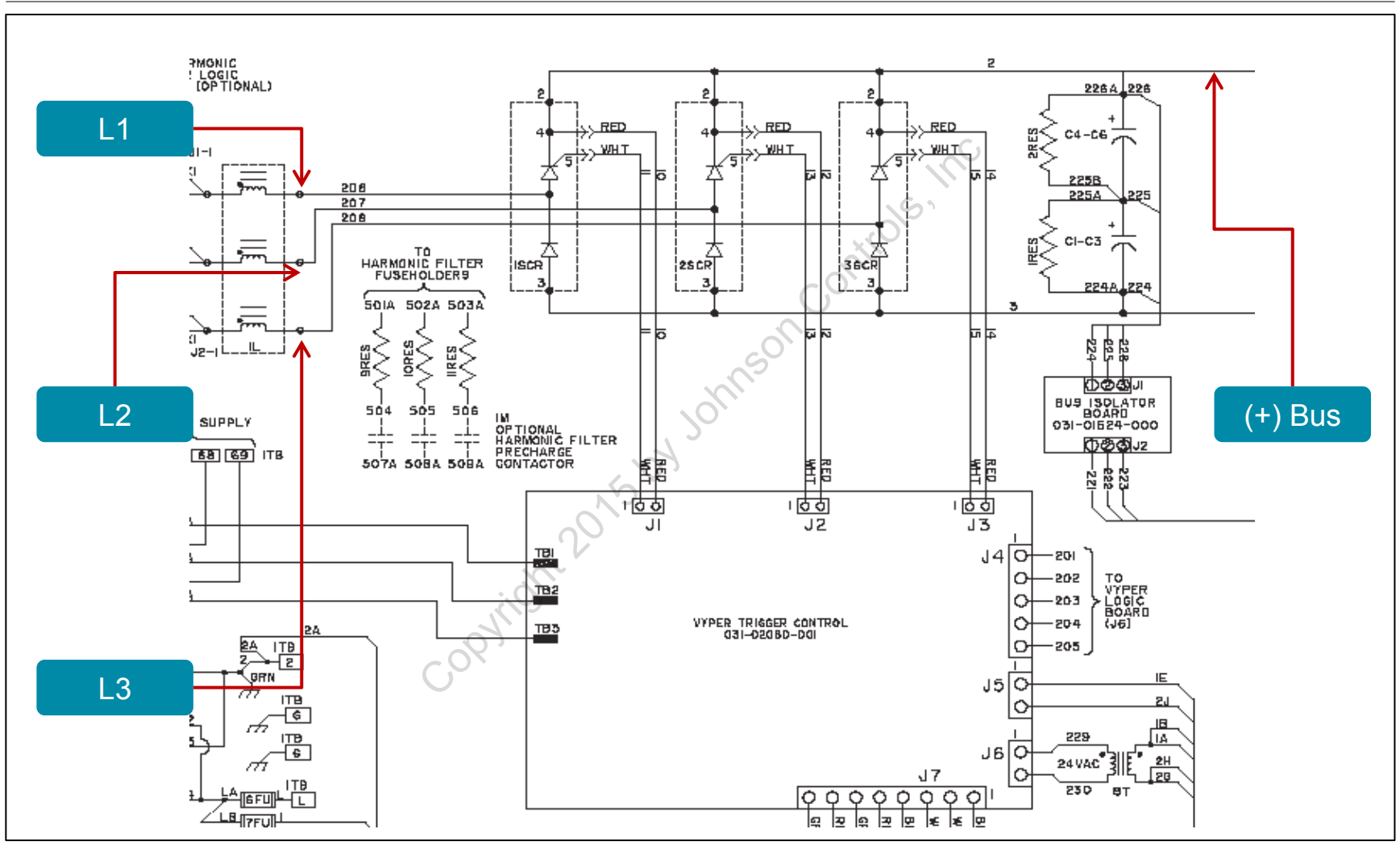
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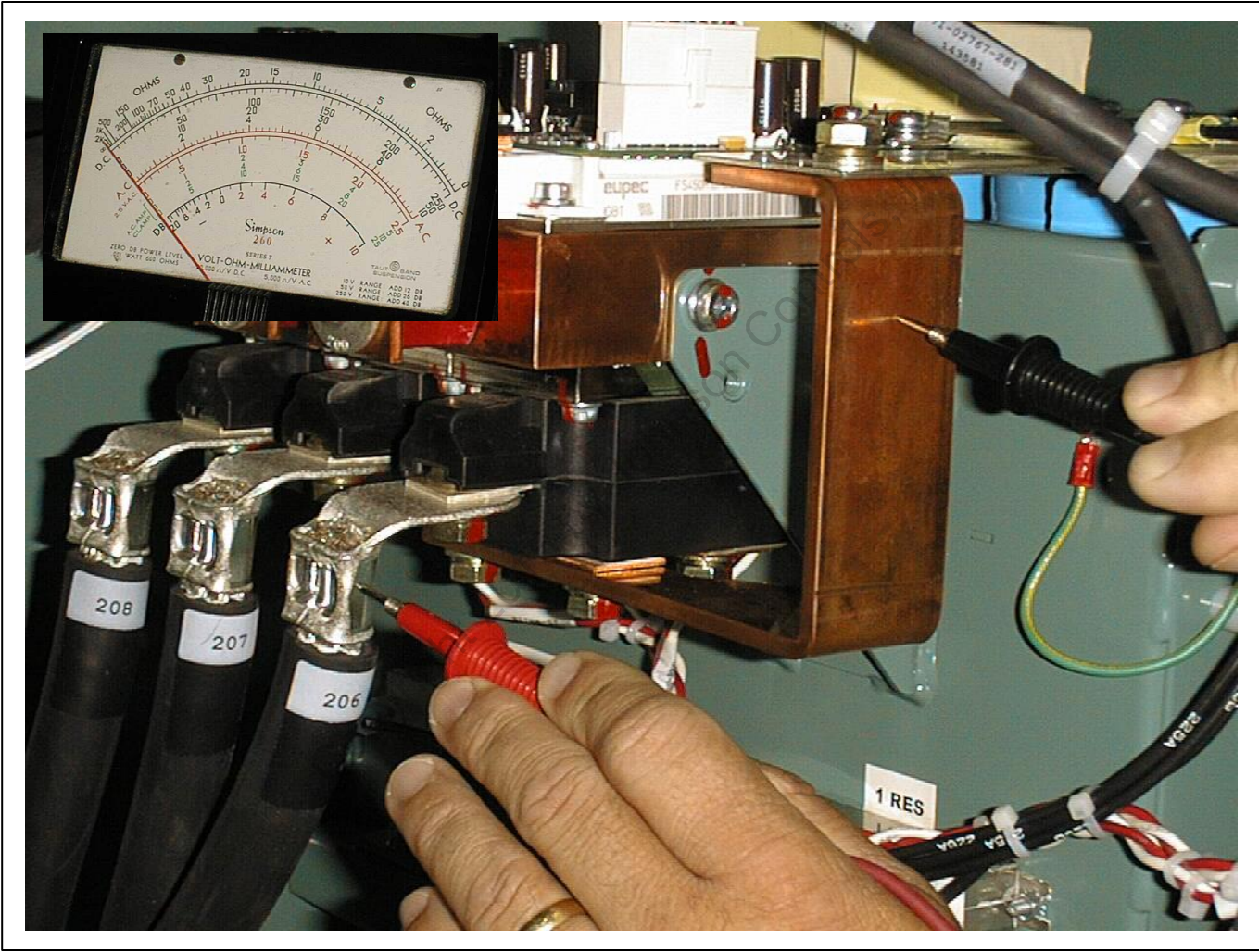


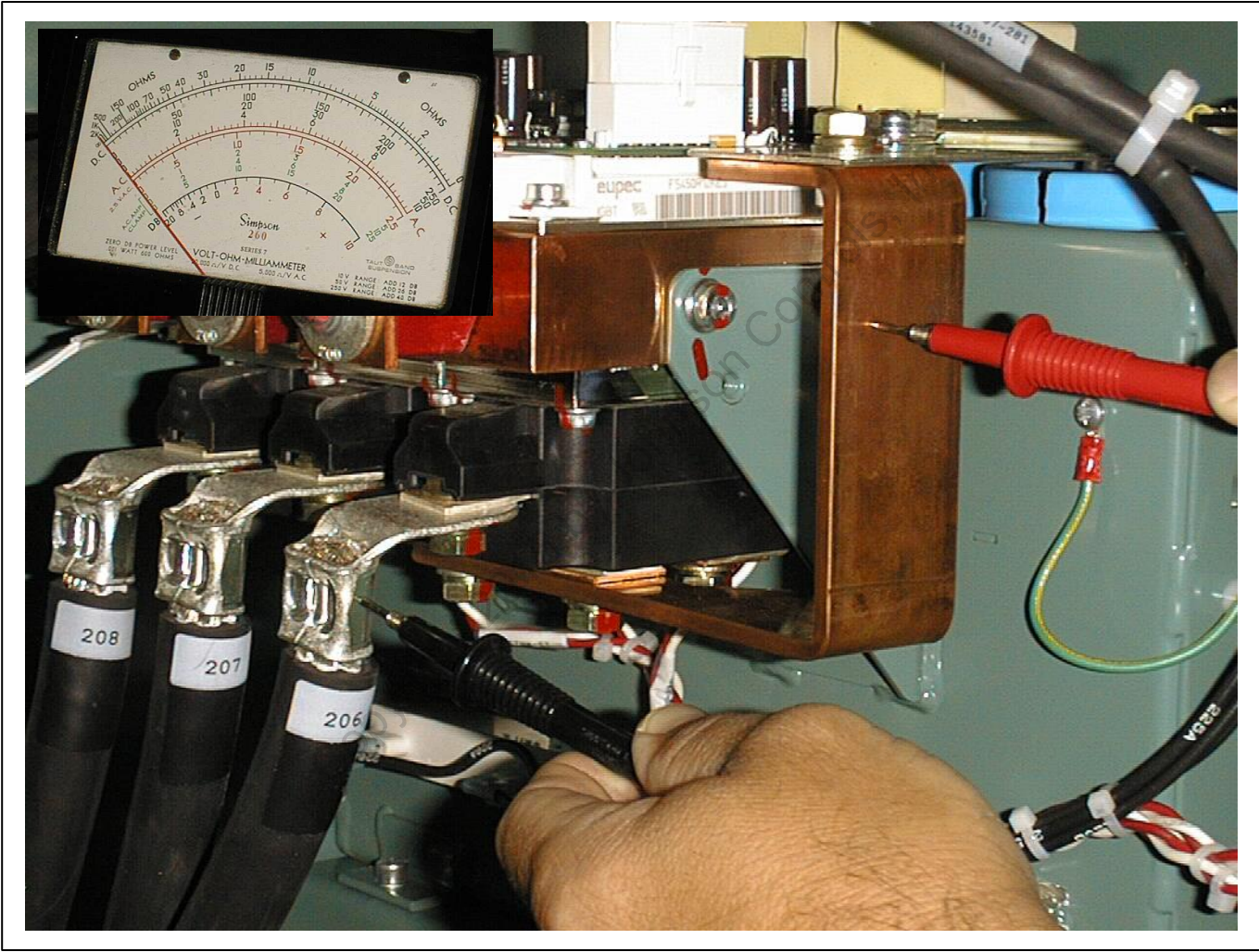
VYPER CATASTROPHIC FAULTS

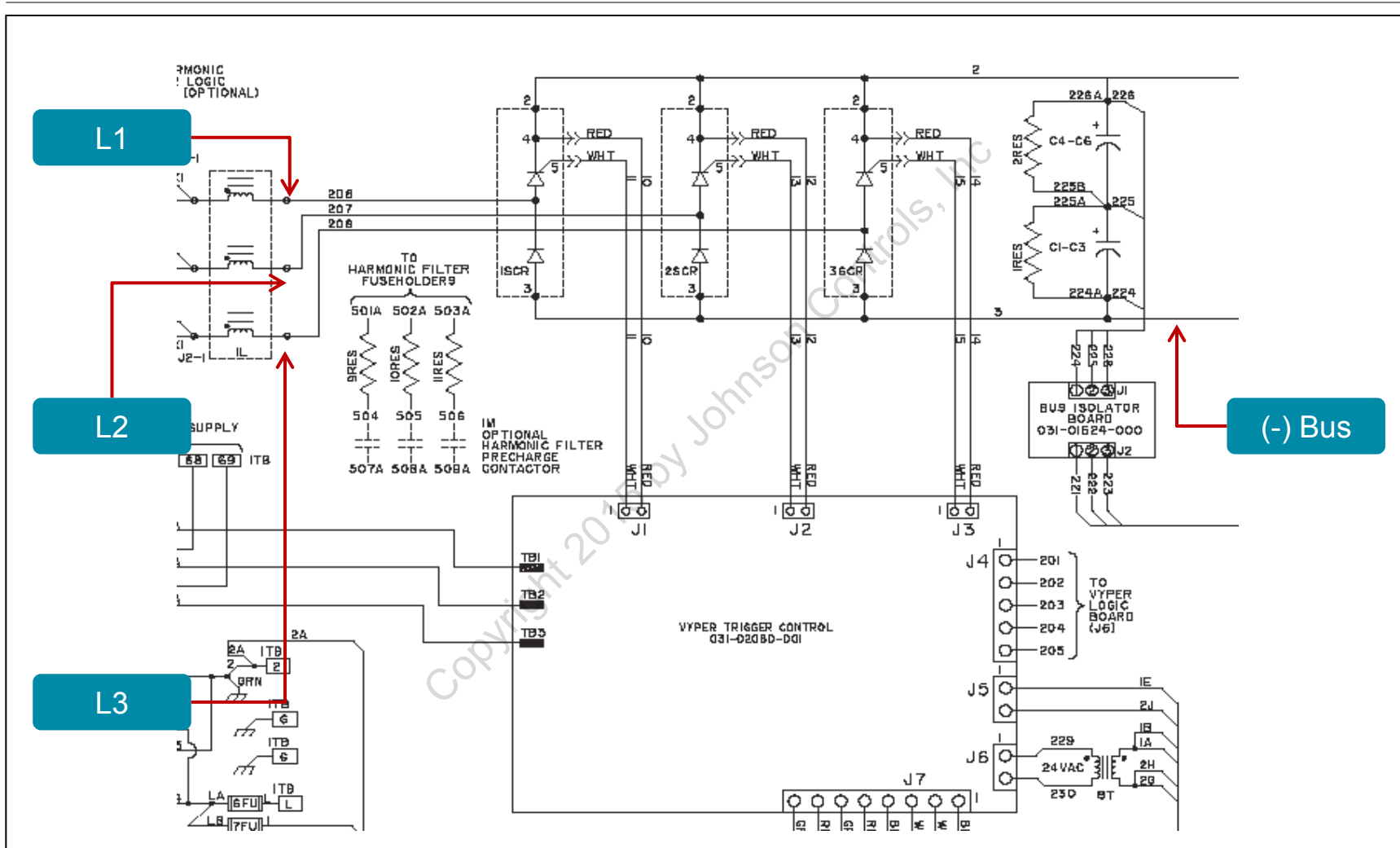
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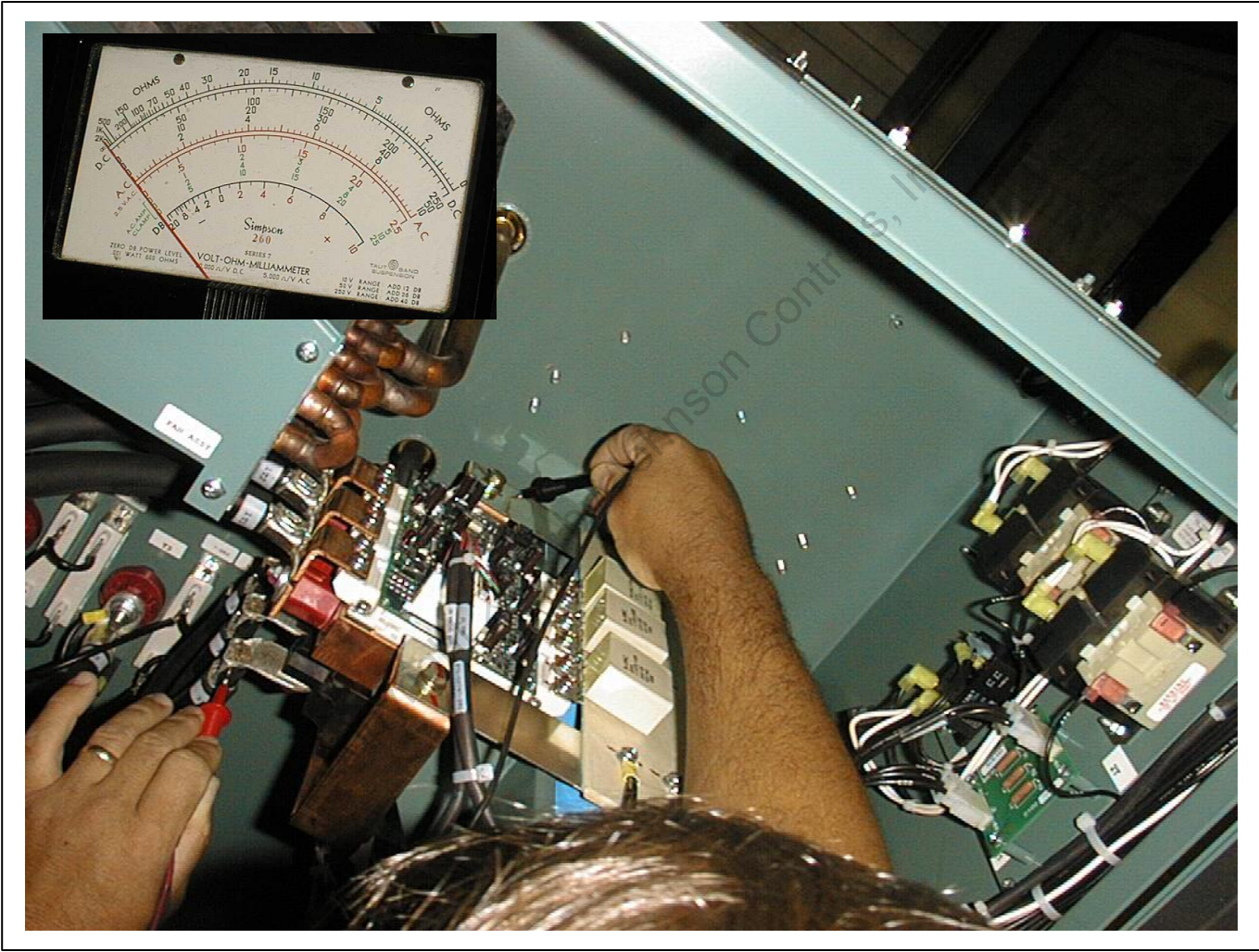


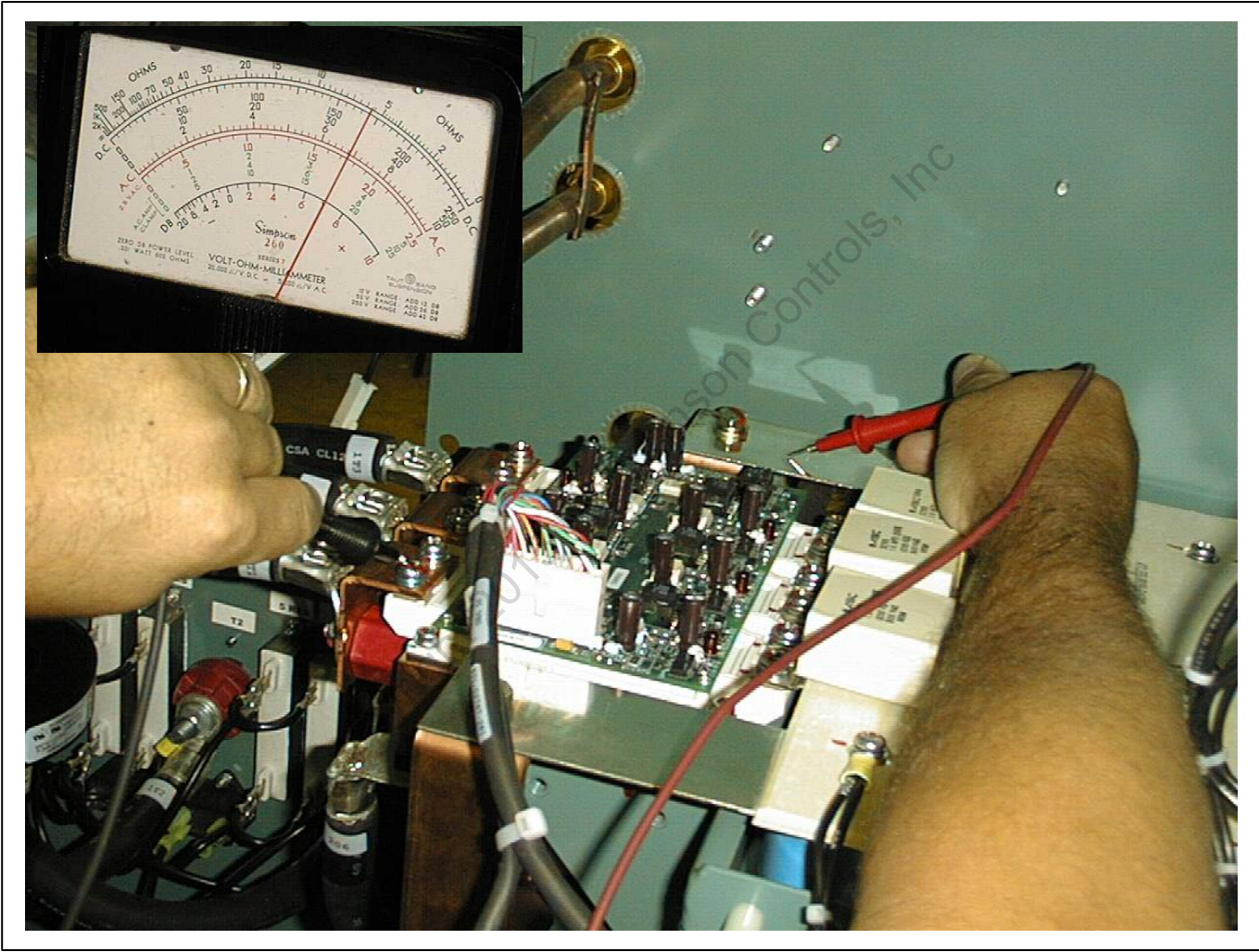


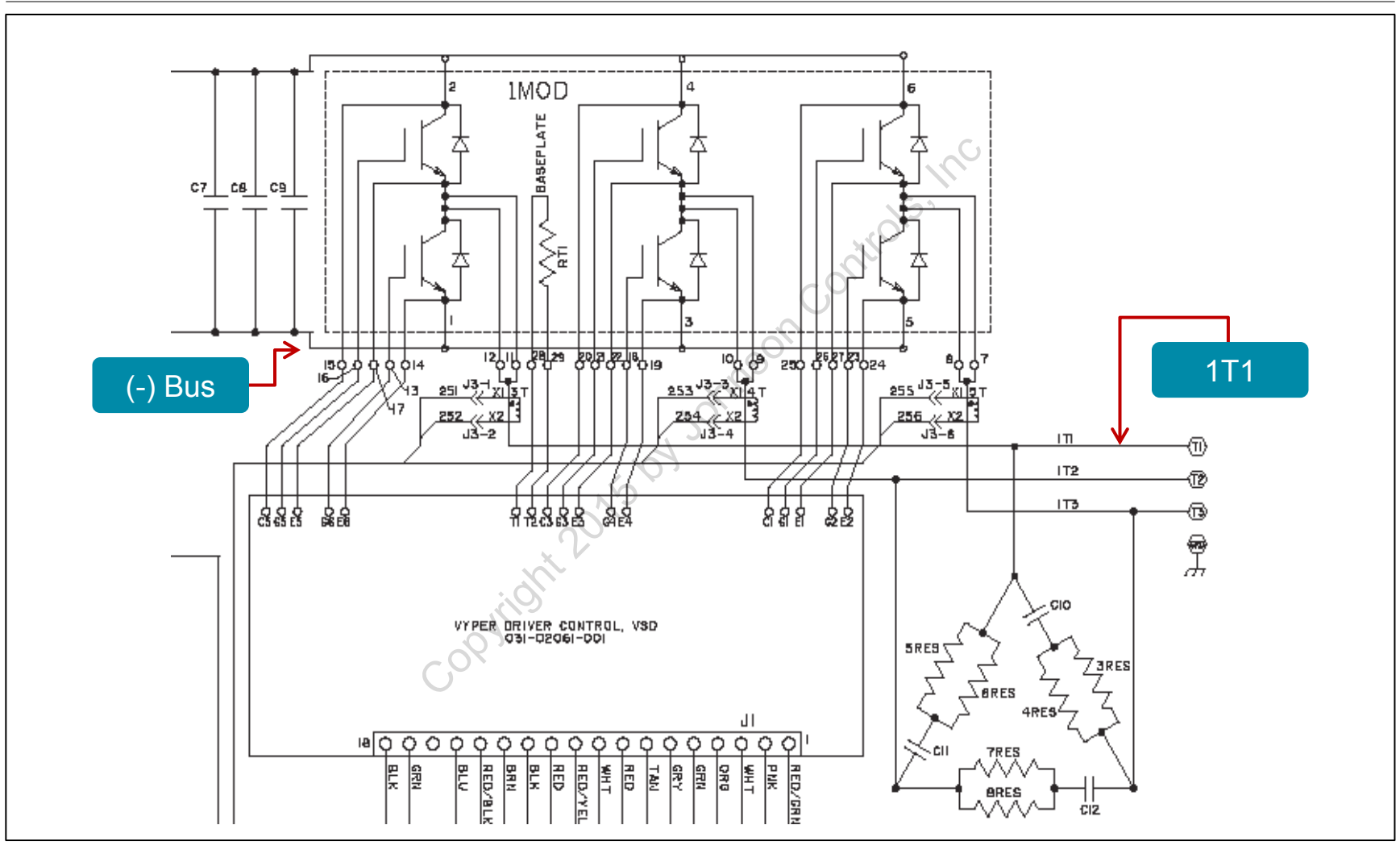


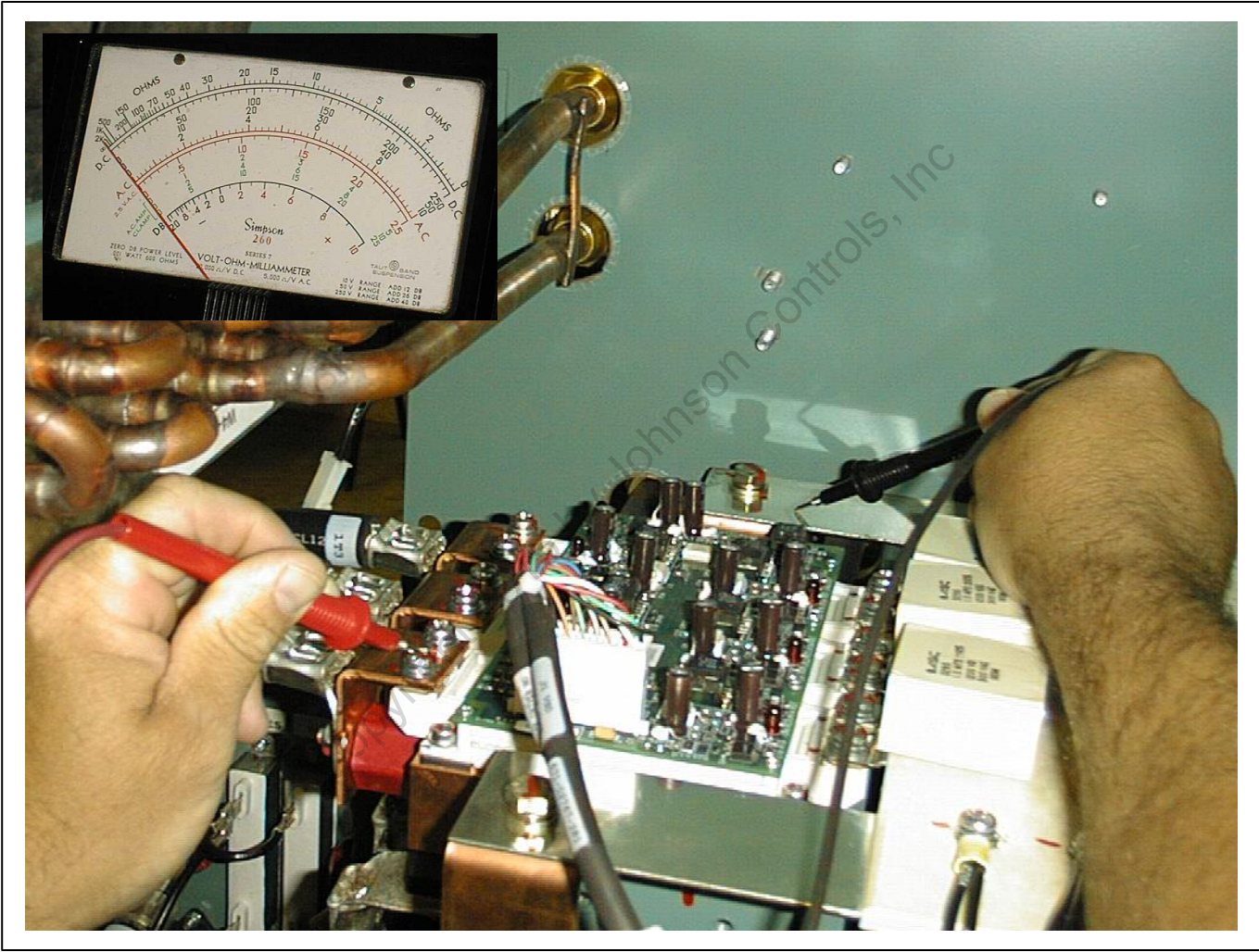


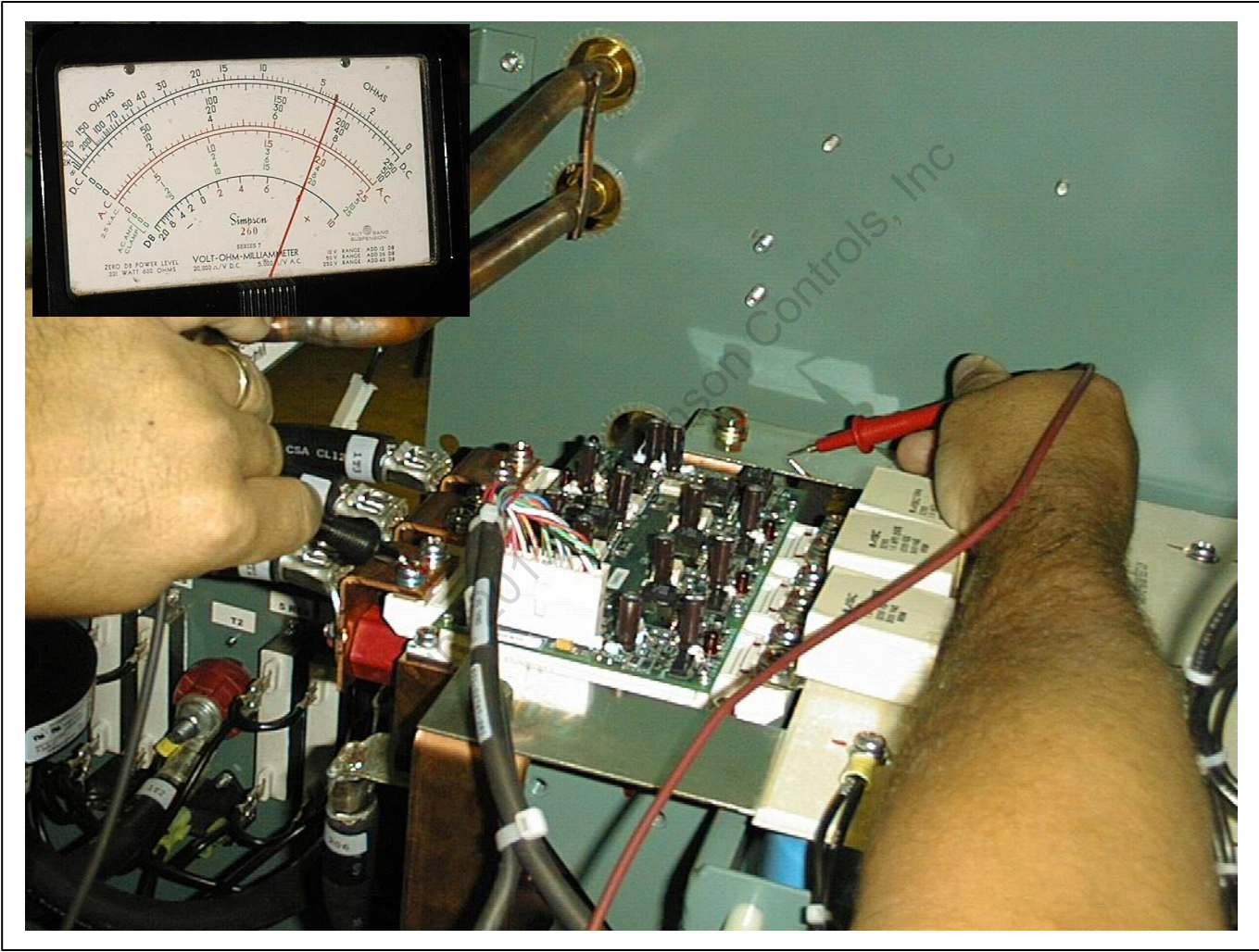


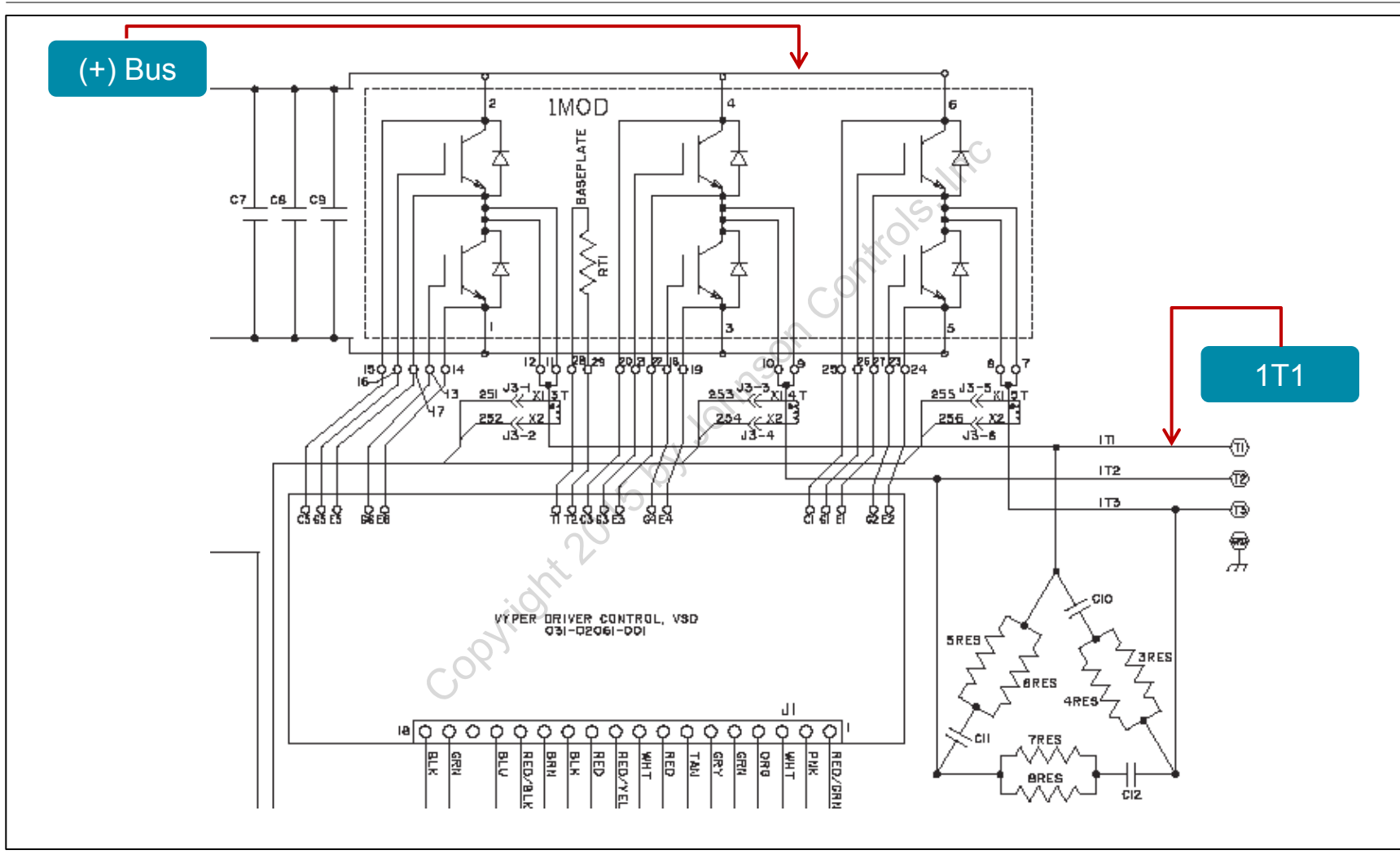


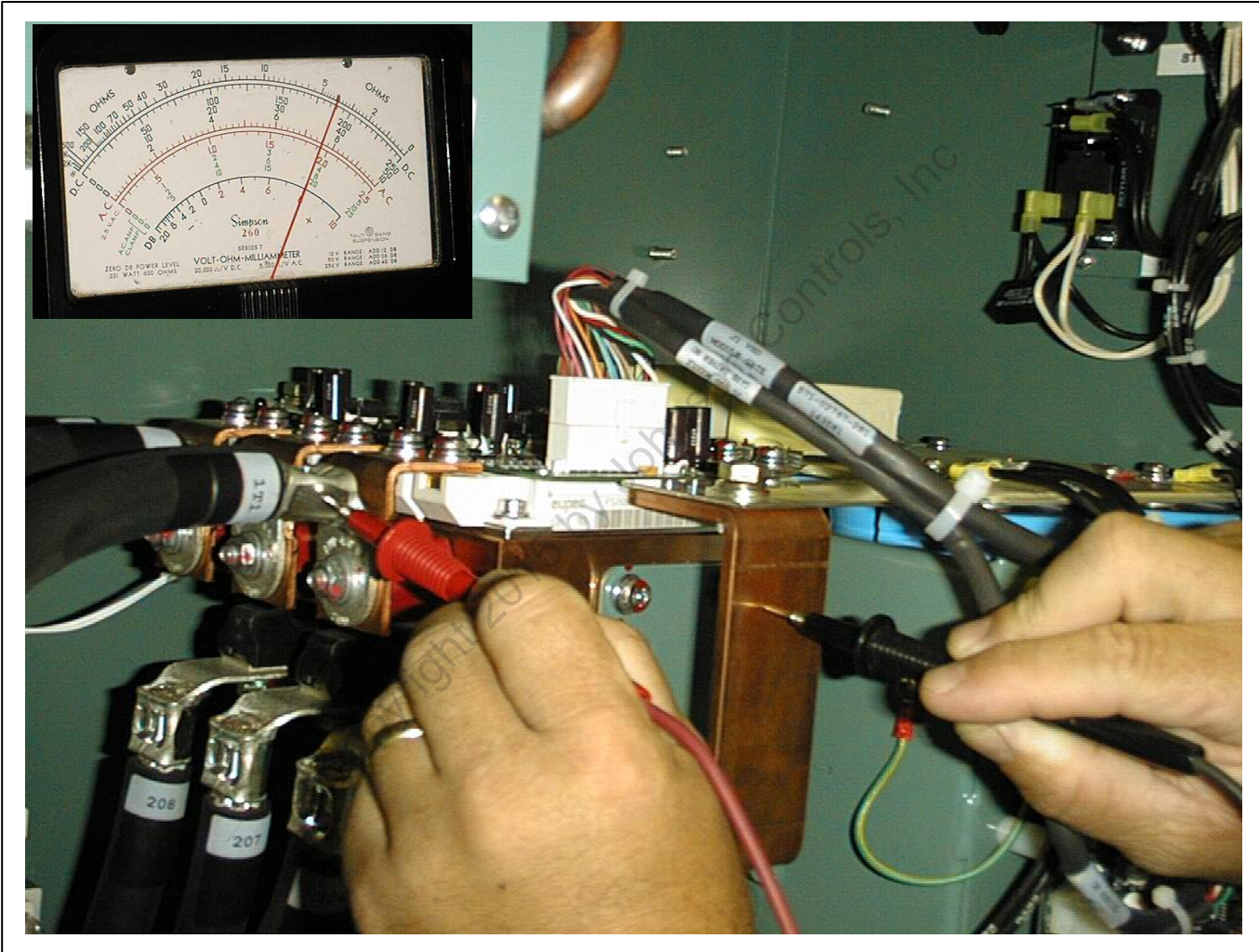


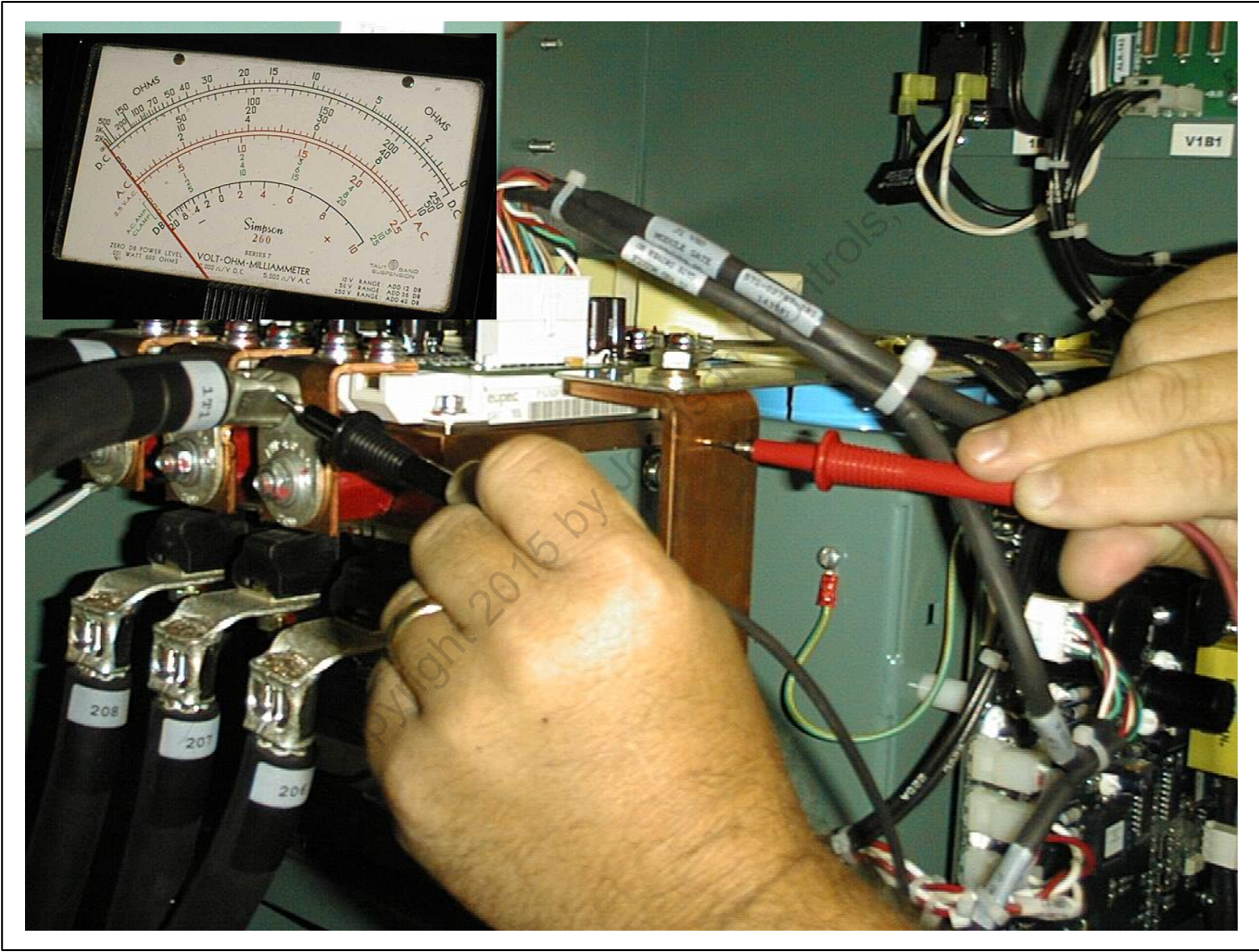














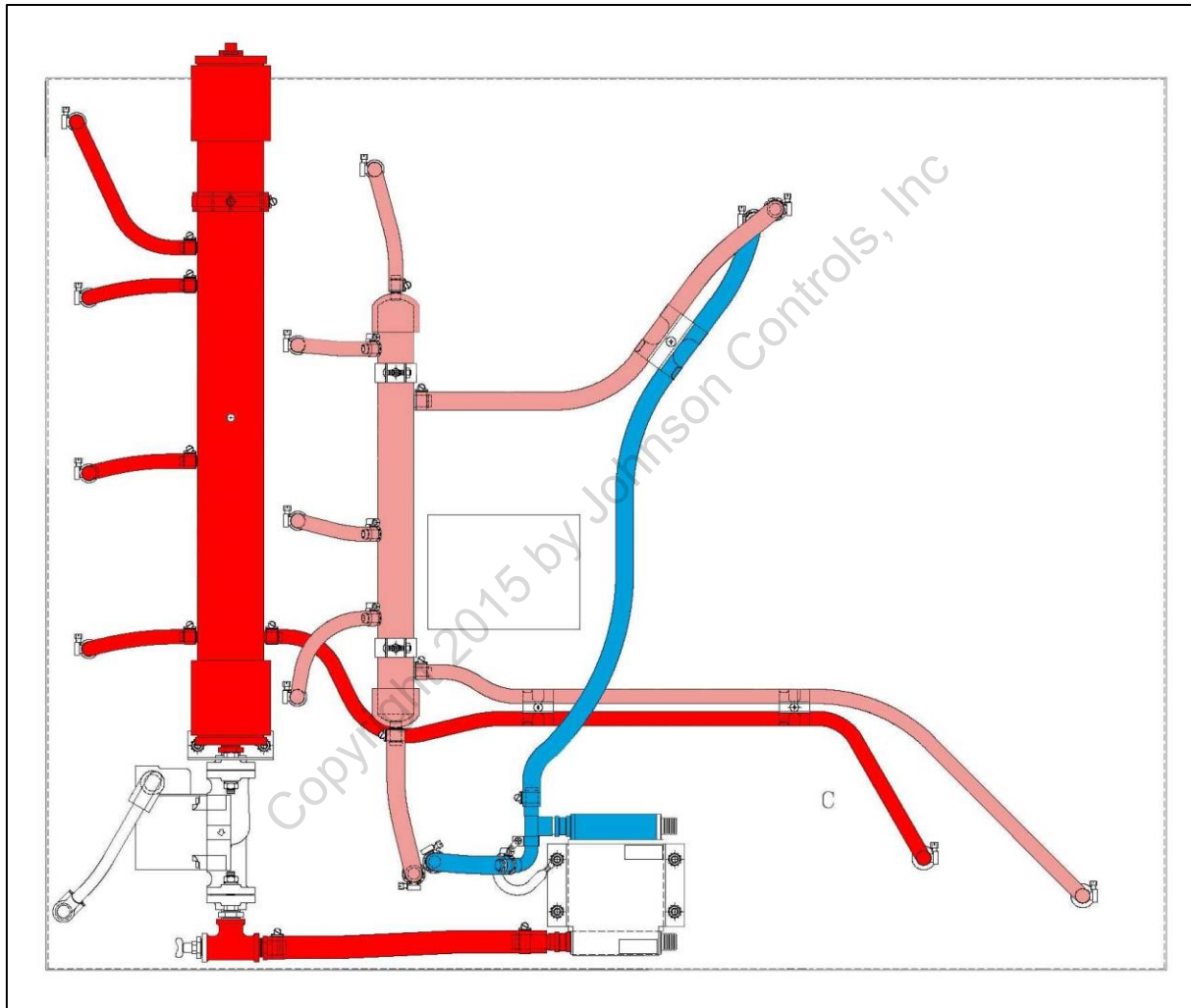
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The Cooling System

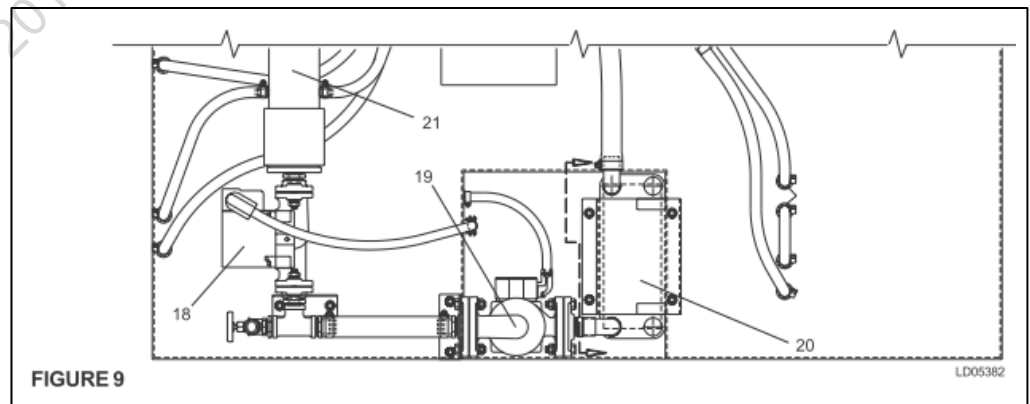
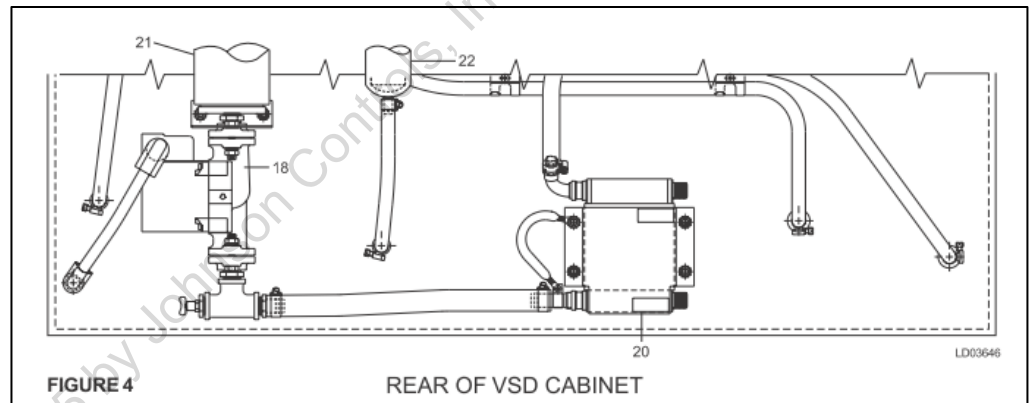


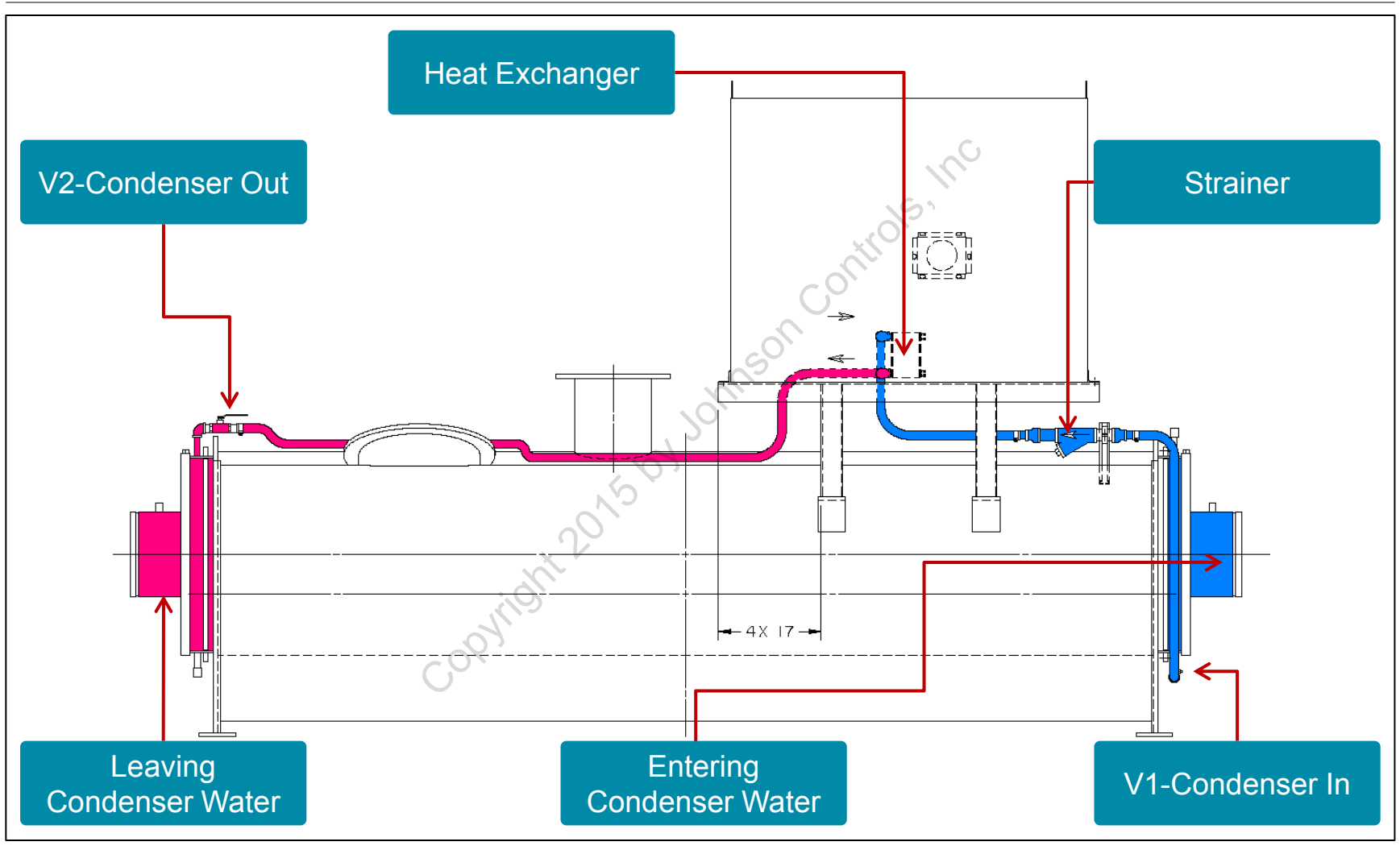
Style "D" Cooling System General Architecture



Closed Loop Side

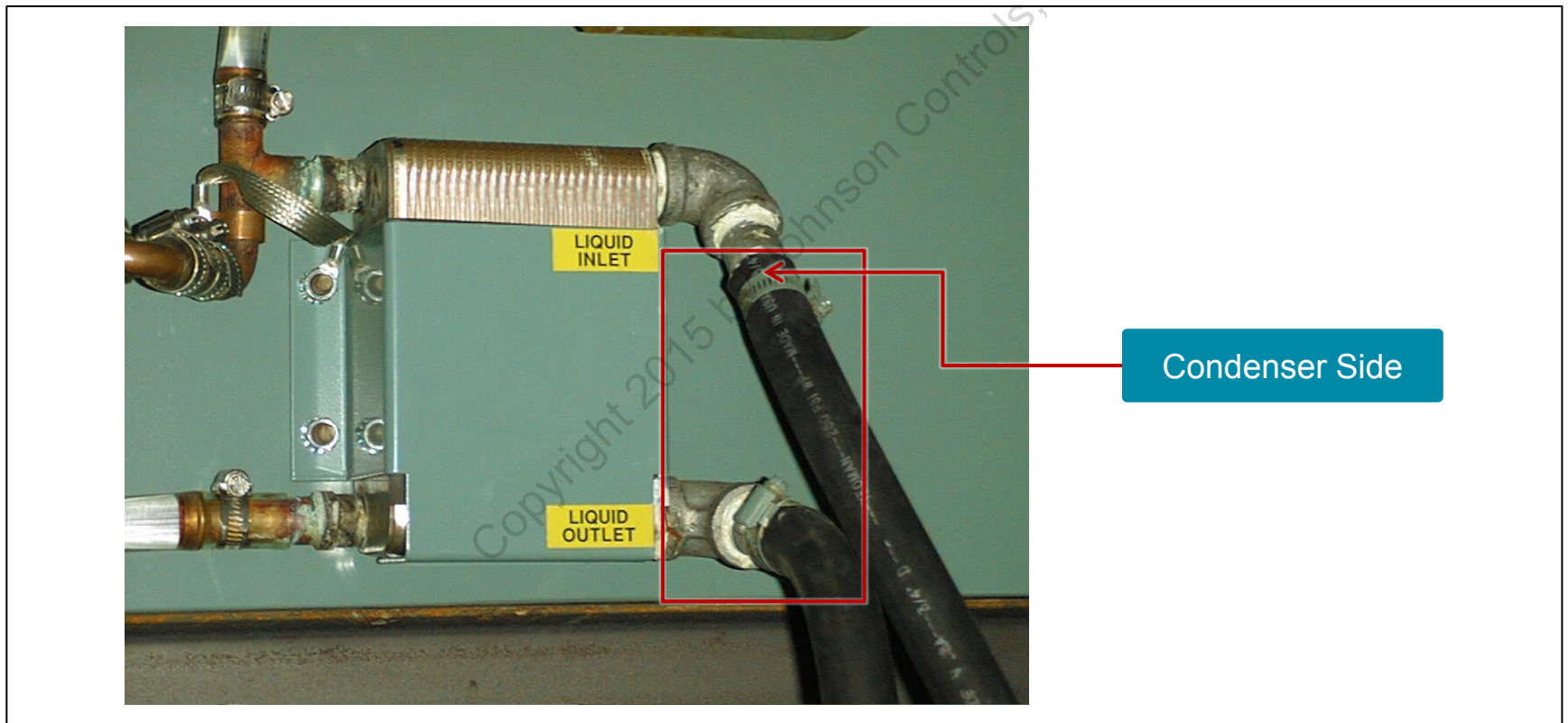
- 351 and 503 HP
 - 160.00-RP2, page 3A, figure 4.
- 790 and 1100 HP
 - 160.00-RP2, page 7A, figure 9.





Heat Exchanger

- Tendency to clog frequently
- Corrected by cleaning the strainer and back-flushing



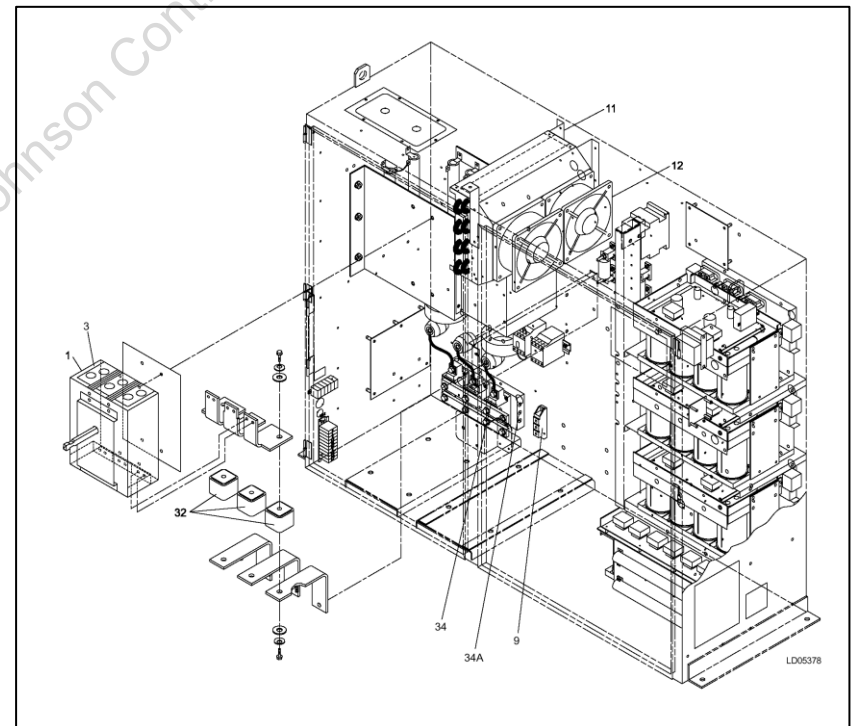
Tube in Shell

- The Style "D" can be retrofitted with a Tube-In-Shell type Heat Exchanger.
- This is essentially the same heat exchanger used on the Vyper.



Style “D”

- Form 160.00-RP2
 - Fig 5. (351 & 503 HP)
 - Fig 10. (790 & 1100 HP)
 - internal cooling coil
 - input rectifier chill plate
 - output pole IGBT chill plates

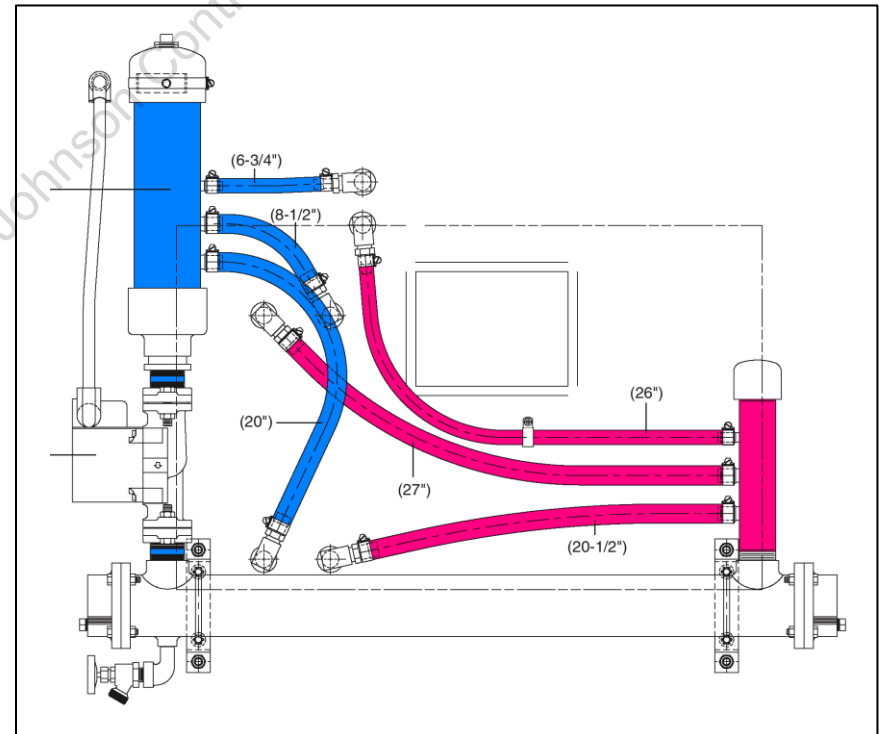


VYPER
COOLING SYSTEM
GENERAL ARCHITECTURE

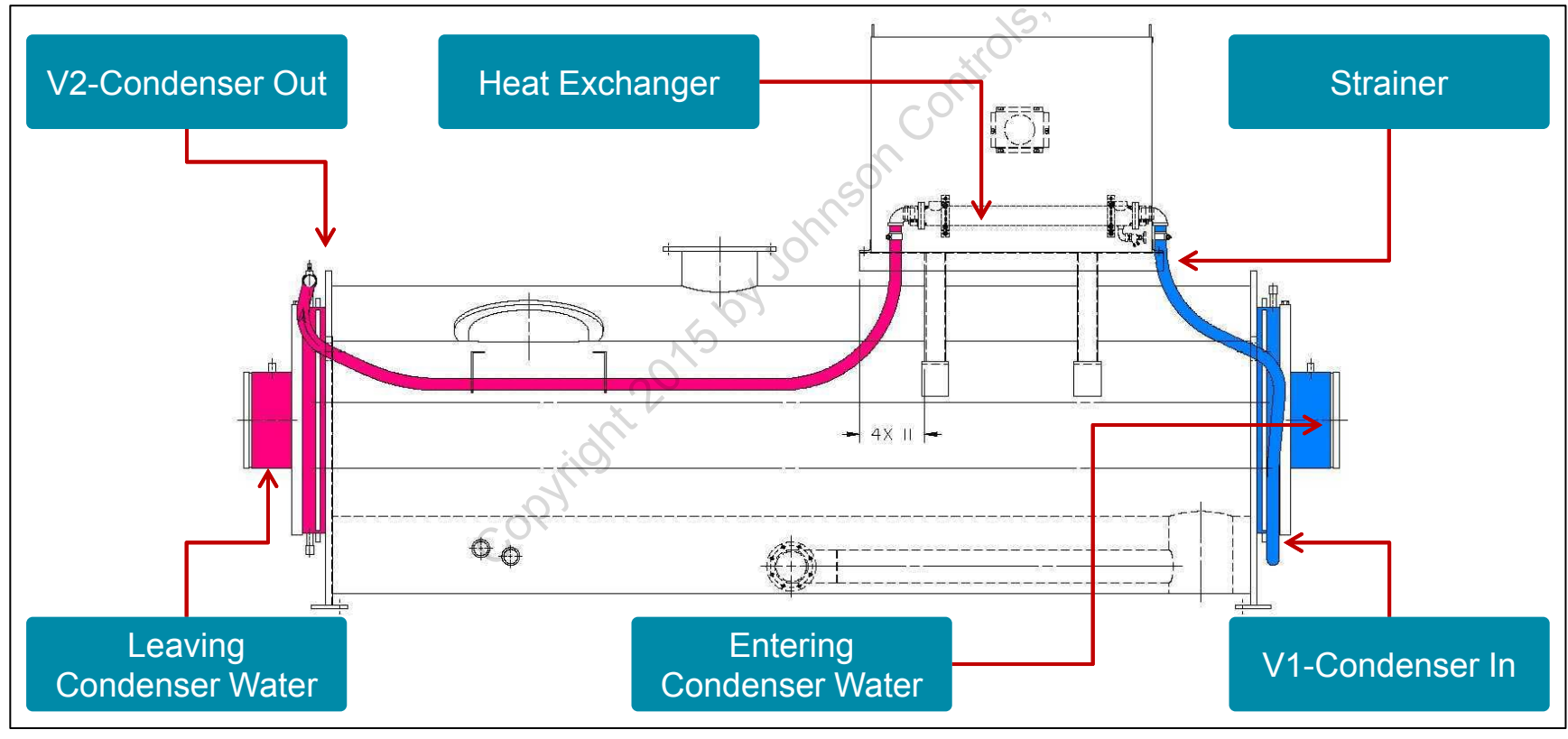


Vyper Closed Loop

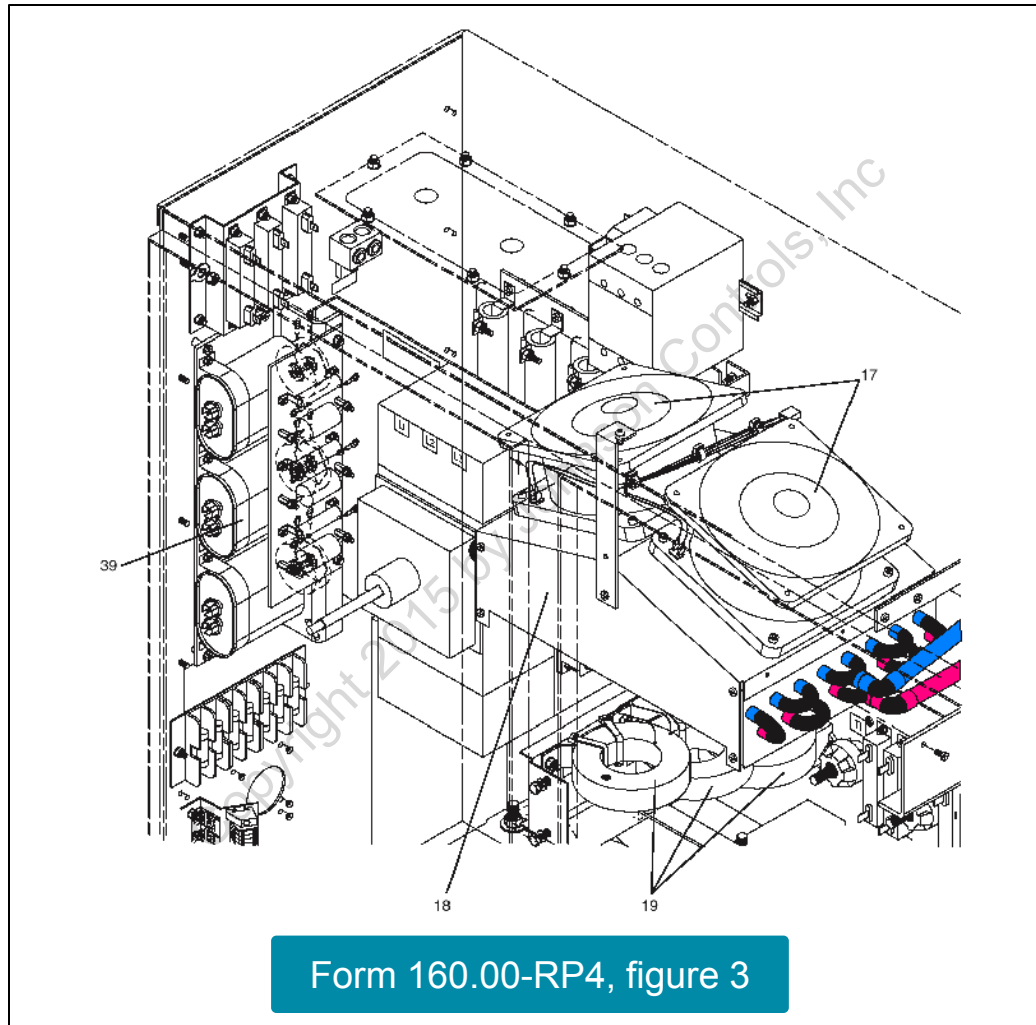
- 160.00-RP4, figure 6
 - Item 7, Coolant Pump
 - Item 23, Shell and Tube Heat Exchanger
 - Item 8, Coolant Reservoir
 - Item 6, Coolant Manifold



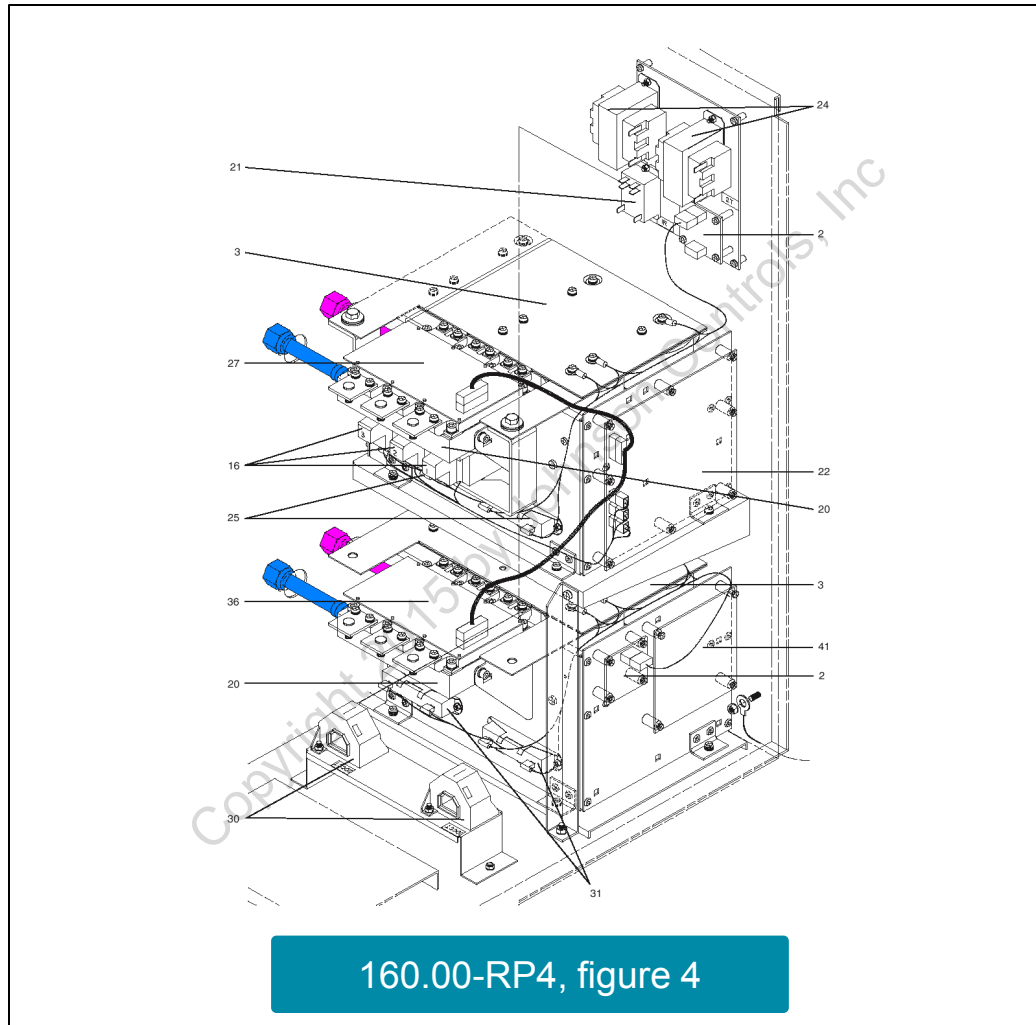
The condenser water lines are larger than on the Style "D"
The condenser water strainer is no longer required due to the shell & tube type heat exchanger.



Internal Cooling Coil



Input rectifier and power module chill plates



CONDENSER CONTAMINATION

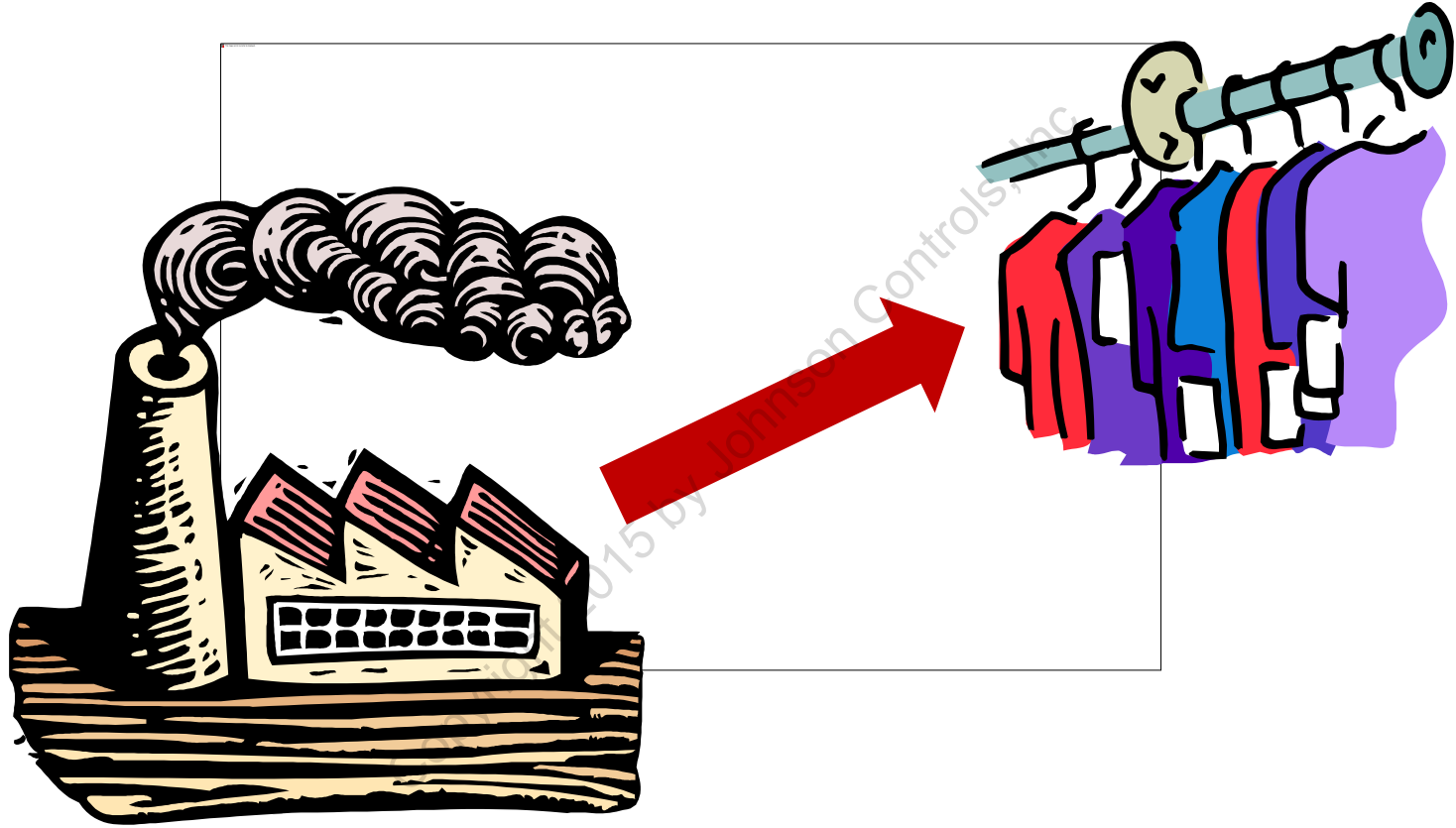




Construction Site Contamination



Environmental Contamination



Process Contamination



Improper Water Treatment



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COOLANT

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Coolant

- Properties
 - Review
- Contamination
 - Cleanup



Shipping Liquids in New VSD's

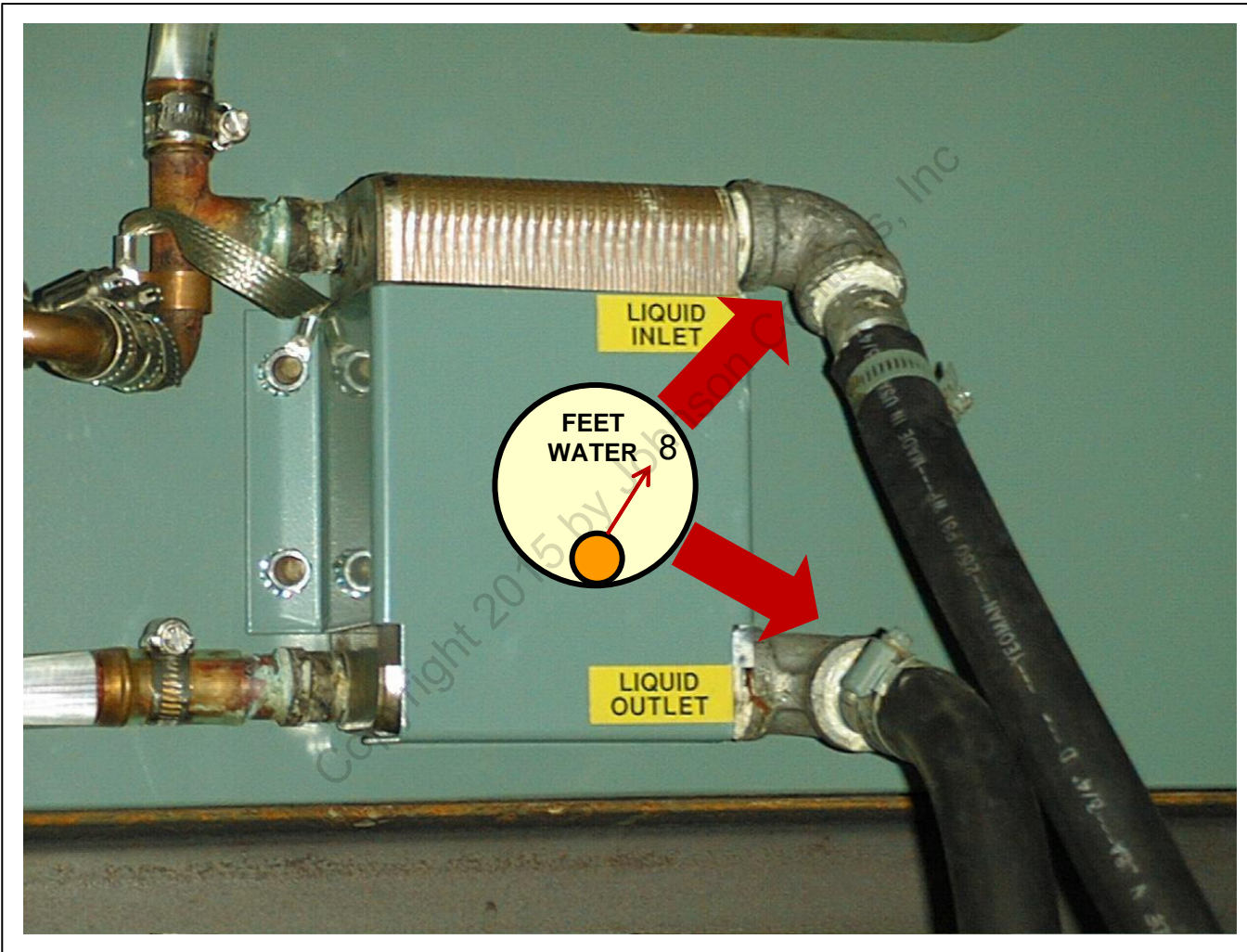
- The VSD's are shipped with a 50/50 mixture of propylene glycol and a corrosion inhibitor.
 - Provided to protect the inner surfaces of the cooling loop from corrosive reactions and from freezing during shipment.
 - Prior to VSD startup, the 50/50 mix must be drained and replaced with York coolant.
 - It is not necessary to perform a system flush after draining this mixture.

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Bacteria, Booster Pumps and Retrofits

- Bacteria
 - Flush with ethylene glycol for several days
 - Diluted Hydrogen Peroxide
- Pumps and Retrofits
 - Reference Form 160.05-N4 (handout)

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VSD Start-up



VSD START-UP

VSD Start-Up Preparations Consists of:

- Circuit Breaker Settings Verification

**Settings for the 292/351 Hp OSCD Circuit Breaker
Part Number 224-30987-000 (Used Before 6/06)**

<u>Name of Adjustment</u>	<u>Abbreviation of Adjustment</u>	<u>Setting Value</u>
• Long Time Overload Protection Coarse Multiplier	"LO"	"1"
• Long Time Overload Protection Fine Multiplier	"LR"	"1"
• Short Time Overload Protection Multiplier	"LSD"	"1.5"
• Instantaneous Short Circuit Protection Multiplier	"LI"	"2"
• Ground Fault Protection Multiplier	"LG"	"0.2"
• Short Time Overload Trip Time	"TR"	"0.5"
• Instantaneous Short Circuit Trip Time	"TSD"	"0.1" ON
• Ground Fault Trip Time	"TG"	"0.1" ON

**Settings for the 292/351/424 Hp OSCD Circuit Breaker
Part Number 224-35428-000 (Used After 6/06)**

<u>Name of Adjustment</u>	<u>Abbreviation of Adjustment</u>	<u>Setting Value</u>
• Long Time Pickup	"LR"	"E"
• Short Time Overload Protection Multiplier	"LSD"	"1.5"
• Instantaneous Short Circuit Protection Multiplier	"LI"	"2"
• Ground Fault Protection Multiplier	"LG"	"0.2"
• Short Time Overload Trip Time	"TR"	"0.5"
• Instantaneous Short Circuit Trip Time	"TSD"	"0.1" ON
• Ground Fault Trip Time	"TG"	"0.1" ON

Settings for the 419/503/608 Hp OSCD Circuit Breaker

<u>Name of Adjustment</u>	<u>Setting Value</u>
• Short Delay Pickup	"2"
• Short Delay Time	"inst"
• Ground Fault Pickup	"1"
• Ground Fault Time	"inst"

160.00-M4 (113)
Page 71

VSD START-UP

VSD Start-Up Preparations Consists of:

- Circuit Breaker Settings Verification
- EPROM's Verification and Orientation
 - Wiring Connections Check (as needed)

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SOFTWARE REFERENCE LIST 60 HZ ONLY

OptiView Control Center Minimum Versions Required for the 351 Hp Drive

<u>Location</u>	<u>Part Number</u>	<u>Minimum Version Number</u>
Microboard U45	031-01795-003	C.MLM.00.03
YT Microboard U46	031-02004-001	C.MLM.02.02B.102
YK Microboard U46	031-01797-001	C.MLM.01.05B.102
YKP Microboard U46	031-02073-001	C.MLM.04.01B.100
ACC Board U22	031-01674-002	C.ACC.01.03
OSCD Logic Board U34	031-01617-006	C.VSD.01.10
OSCD Logic Board U40	031-01619-003	C.VSD.03.02
OSCD Logic Board U45	031-01618-001	C.VSD.02.02
Filter Logic Board U25	031-01680-003	C.FTR.02.05
Filter Logic Board U42	031-01633-006	C.FTR.01.14

OptiView Control Center Minimum Versions Required for the 424/608 Hp Drive (for 031-02430-000 board only)

<u>Location</u>	<u>Part Number</u>	<u>Minimum Version Number</u>
YT Microboard U46	031-02469-001	C.OPT.02.09.008
YK & YKP Microboard U46	031-02474-001	C.OPT.01.15A.307
Microboard U45	031-01795-003	C.MLM.00.03
ACC Board U22	031-01674-002	C.ACC.01.03
OSCD Logic Board U34	031-01617-009	C.VSD.01.23
OSCD Logic Board U40	031-01619-003	C.VSD.03.04
OSCD Logic Board U45	031-01618-001	C.VSD.02.02
Filter Logic Board U25	031-01680-003	C.FTR.02.05
Filter Logic Board U42	031-01633-006	C.FTR.01.20

OptiView Control Center Minimum Versions Required for the 503 Hp Drive

<u>Location</u>	<u>Part Number</u>	<u>Minimum Version Number</u>
YT Microboard U46	031-02004-001	C.MLM.02.04.104
YK & YKP Microboard U46	031-01797-001	C.MLM.01.05.105
Microboard U45	031-01795-003	C.MLM.00.03
ACC Board U22	031-01674-002	C.ACC.01.03
OSCD Logic Board U34	031-01617-006	C.VSD.01.13A
OSCD Logic Board U40	031-01619-003	C.VSD.03.04
OSCD Logic Board U45	031-01618-001	C.VSD.02.02
Filter Logic Board U25	031-01680-003	C.FTR.02.05
Filter Logic Board U42	031-01633-006	C.FTR.01.18

Micro Computer Control Center Versions Required for the 351 Hp Drive

<u>Location</u>	<u>Part Number</u>	<u>Minimum Version Number</u>
YT Microboard U17	031-01676-003	C.YTV.05.20
YK Microboard U17	031-01675-003	C.YKV.06.24
ACC Board U22	031-01674-002	C.ACC.01.03
OSCD Logic Board U34	031-01617-006	C.VSD.01.10
OSCD Logic Board U40	031-01619-003	C.VSD.03.02
OSCD Logic Board U45	031-01618-001	C.VSD.02.02
Filter Logic Board U25	031-01680-003	C.FTR.02.05
Filter Logic Board U42	031-01633-006	C.FTR.01.14

160.00-M4 (113)
Page 89

Micro Computer Control Center Versions Required for the 424/508 Hp Drive

<u>Location</u>	<u>Part Number</u>	<u>Minimum Version Number</u>
YT Microboard U17	031-01676-003	C.YTV.05.24
YK Microboard U17	031-01675-003	C.YKV.06.32
ACC Board U22	031-01674-002	C.ACC.01.03
OSCD Logic Board U34	031-01617-009	C.VSD.01.23
OSCD Logic Board U40	031-01619-003	C.VSD.03.04
OSCD Logic Board U45	031-01618-001	C.VSD.02.02
Filter Logic Board U26	031-01680-003	C.FTR.02.05
Filter Logic Board U42	031-01633-008	C.FTR.01.20

Micro Computer Control Center Versions Required for the 503 Hp Drive

<u>Location</u>	<u>Part Number</u>	<u>Minimum Version Number</u>
YT Microboard U17	031-01676-003	C.YTV.05.22
YK Microboard U17	031-01675-003	C.YKV.06.30
ACC Board U22	031-01674-002	C.ACC.01.03
OSCD Logic Board U34	031-01617-006	C.VSD.01.13A
OSCD Logic Board U40	031-01619-003	C.VSD.03.04
OSCD Logic Board U45	031-01618-001	C.VSD.02.02
Filter Logic Board U26	031-01680-003	C.FTR.02.05
Filter Logic Board U42	031-01633-006	C.FTR.01.18

160.00-M4 (113)

Page 89

EPROM REFERENCE LIST

Original and Style "A" Units

Location	Part Number
YT Microboard	031-01676-001
YK Microboard	031-01675-001
ACC Board	031-01674-001
VSD Logic u34	031-01617-001
VSD Logic u45	031-01618-001
VSD Logic u40	031-01619-001
Filter Logic u42	031-01633-001
Filter Logic u26	031-01680-001

Style "B & C" Units - 60 HZ Only

Location	Part Number
YT Microboard	031-01676-003
YK Microboard	031-01675-003
ACC Board	031-01674-002
VSD Logic u34	031-01617-003
VSD Logic u45	031-01618-001
VSD Logic u40	031-01619-001
Filter Logic u42	031-01633-003
Filter Logic u26	031-01680-002

Style "B & C" Units - 50 HZ Only

Location	Part Number
YT Microboard	031-01676-002
YK Microboard	031-01675-002
ACC Board	031-01674-002
VSD Logic u34	031-01617-002
VSD Logic u45	031-01618-002
VSD Logic u40	031-01619-001
Filter Logic u42	031-01633-002
Filter Logic u26	031-01680-002

Style "D" Units - 60 HZ Only

Location	Part Number
YT Microboard	031-01675-003
YK Microboard	031-01676-003
ACC Board	031-01674-002
VSD Logic u34	031-01617-005
VSD Logic u45	031-01618-001
VSD Logic u40	031-01619-001
Filter Logic u42	031-01633-005
Filter Logic u26	031-01680-003

Style "D" Units - 50 HZ Only

Location	Part Number
YT Microboard	031-01675-002
YK Microboard	031-01676-002
ACC Board	031-01674-002
VSD Logic u34	031-01617-004
VSD Logic u45	031-01618-002
VSD Logic u40	031-01619-001
Filter Logic u42	031-01633-004
Filter Logic u26	031-01680-003

160.00-M1 (702)
(Style A-D) Last Page



VSD START-UP

VSD Start-Up Preparations Consists of:

- Circuit Breaker Settings Verification
- EPROM's Verification and Orientation
 - Wiring Connections Check (as needed)
- Setting Full Load Amps

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VSD Details Screen

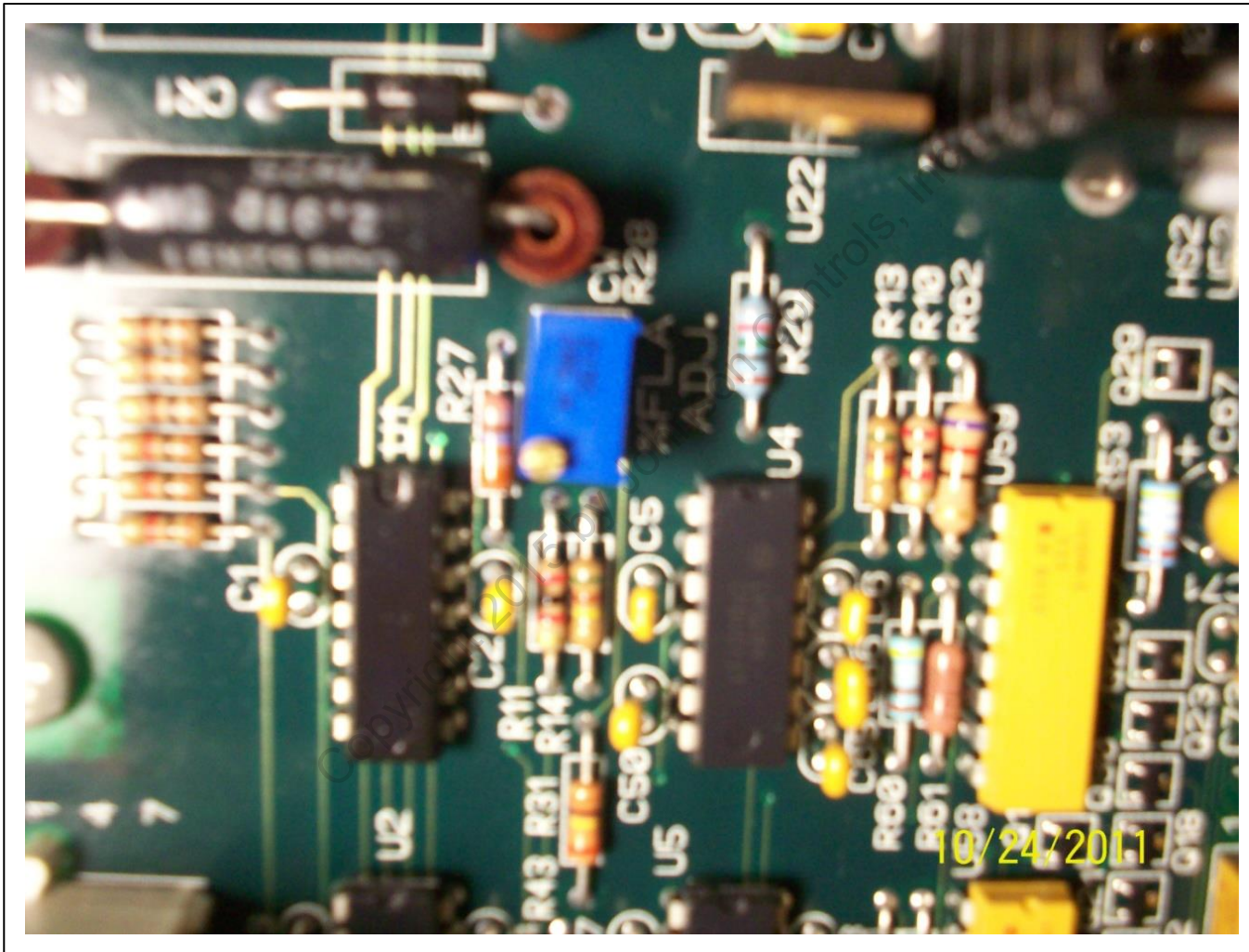
Setting Full Load Amps

The screenshot displays the 'VARIABLE SPEED DRIVE (VSD) DETAILS SCREEN' for a 'LEAVING CHILLED LIQUID CONTROL' system. The interface includes a top status bar with 'SYSTEM RUN', 'DATE' (24 Oct 2011), 'TIME' (9:42 AM), and 'CONTROL SOURCE' (Local). A 'Home' button is visible in the top right. Below the status bar, there are several adjustable parameters and status indicators:

- % Full Load Amps:** 17%
- Current Limit Setpoint:** 100%
- Local Motor Current Limit:** 100%
- Pulldown Demand Limit:** 100%
- Full Load Amps:** 152 A
- VSD Model:** 351 HP
- Pulldown Demand Time:** 0 Min
- Motor Run:** Indicated by a red light and a key icon.
- Water Pump Output:** Indicated by a red light.
- Precharge Relay Output:** Indicated by a red light.
- Trigger SCR Output:** Indicated by a red light.
- DC Bus Voltage:** 625 V
- DC Inverter Link Current:** 3 A
- Internal Ambient Temperature:** 85 °F
- Converter Heatsink Temperature:** 93 °F
- Baseplate Temperature:** 98 °F

A 'VSD' button is located on the right side of the screen. The date '10/24/2011' is displayed in the bottom right corner.

Setting Full Load Amps



VSD START-UP

VSD START-UP

VSD Start-Up Preparations Consists of:

- Circuit Breaker Settings Verification
- EPROM's Verification and Orientation
 - Wiring Connections Check (as needed)
- Setting Full Load Amps
- Draining and Filling the Coolant Loop

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VSD START-UP

VSD START-UP

VSD Start-Up Preparations Consists of:

- Circuit Breaker Settings Verification
- EPROM's Verification and Orientation
 - Wiring Connections Check (as needed)
- Setting Full Load Amps
- Draining and Filling the Coolant Loop
- Clear Surge Map

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VSD START-UP

VSD START-UP

VSD Start-Up Preparations Consists of:

- Circuit Breaker Settings Verification
- EPROM's Verification and Orientation
 - Wiring Connections Check (as needed)
- Setting Full Load Amps
- Draining and Filling the Coolant Loop
- Clear Surge Map
- Calibrating the Vane Pot

Calibrating the PRV Potentiometer



New Style



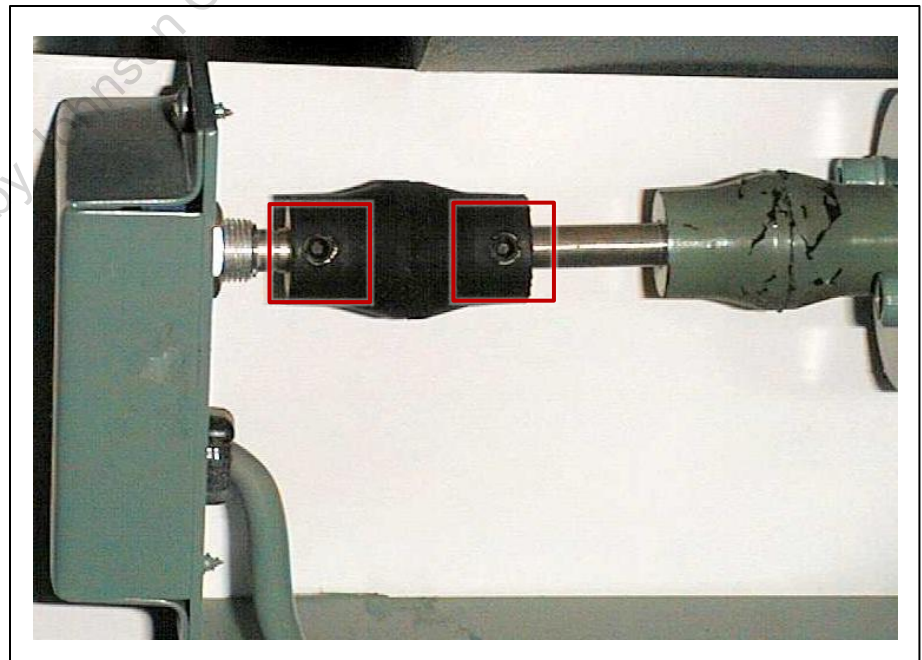
 Our Policy prohibits printing. Save GREEN.

PRV potentiometer linkage arrangement
Prior to calibrating, the chiller should be shutdown



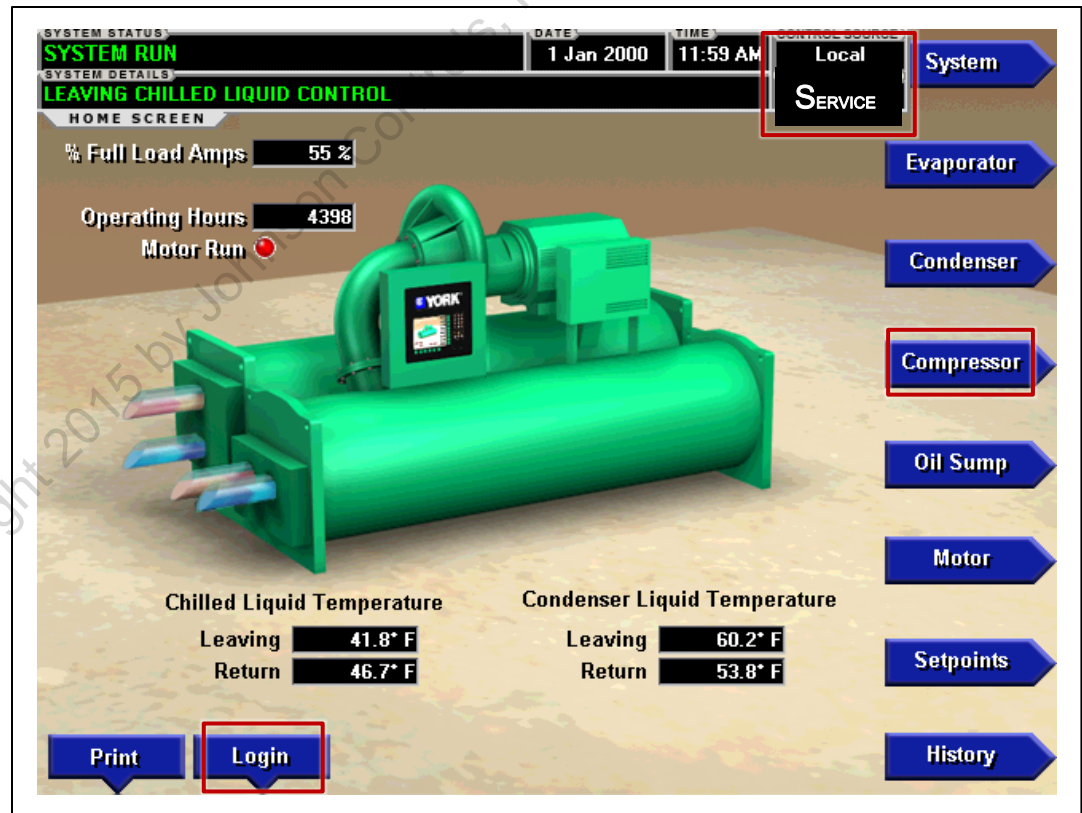
Coarse Adjustment

- Accomplished by adjusting the coupling with 2 set screws.
- Since the potentiometer rotation is greater than the linkage rotation, the potentiometer should be set so it is not against its maximum rotation in either direction when the vane motor is against its positive stops
- Before locking the pot in place
 - Understand the direction of travel
 - Set the DC volts to about .25 - .5 (Check on ACC Board)



Optiview

- Make certain a jumper is between terminals 3 and 4, which is in series with the “OPEN” winding of the vane motor. (For EM starters that have been retrofitted)
- Log in at Service Level
 - Navigate to Compressor Screen



SYSTEM STATUS: **SYSTEM RUN**

DATE: 1 Jan 2000 **TIME:** 11:59 AM **CONTROL SOURCE:** Local

SYSTEM DETAILS: **LEAVING CHILLED LIQUID CONTROL**

COMPRESSOR SCREEN

ACCESS LEVEL: Service

Home

34.3 PSID Oil Pressure

123.7° F Oil Sump Temperature

88.1° F Discharge Temperature

165.3° F High Speed Thrust Bearing Oil Drain Temperature

-13 MILS High Speed Thrust Bearing Proximity Differential

Pre-Rotation Vane Calibration

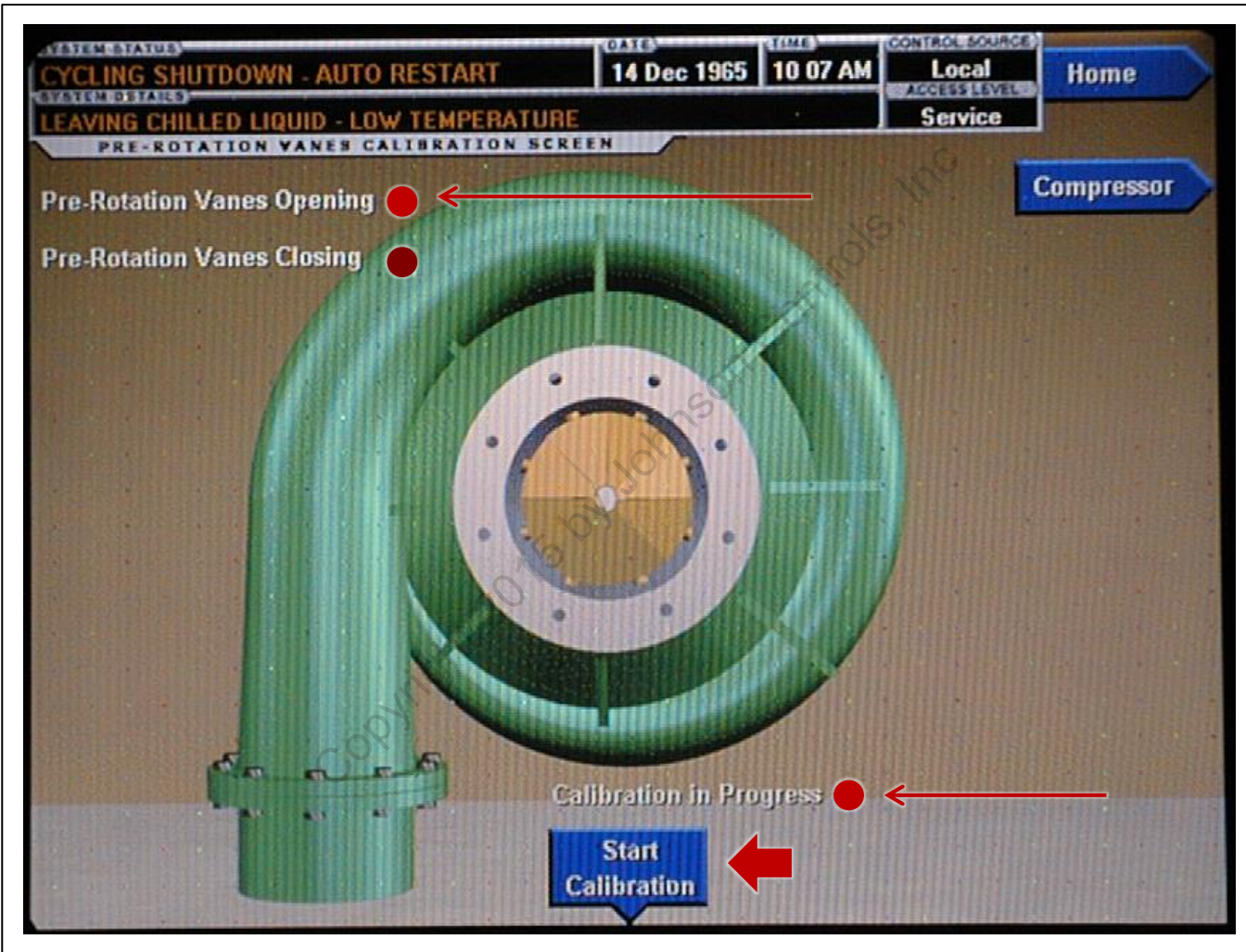
A 0 A B 0 A C 0 A Phase Current

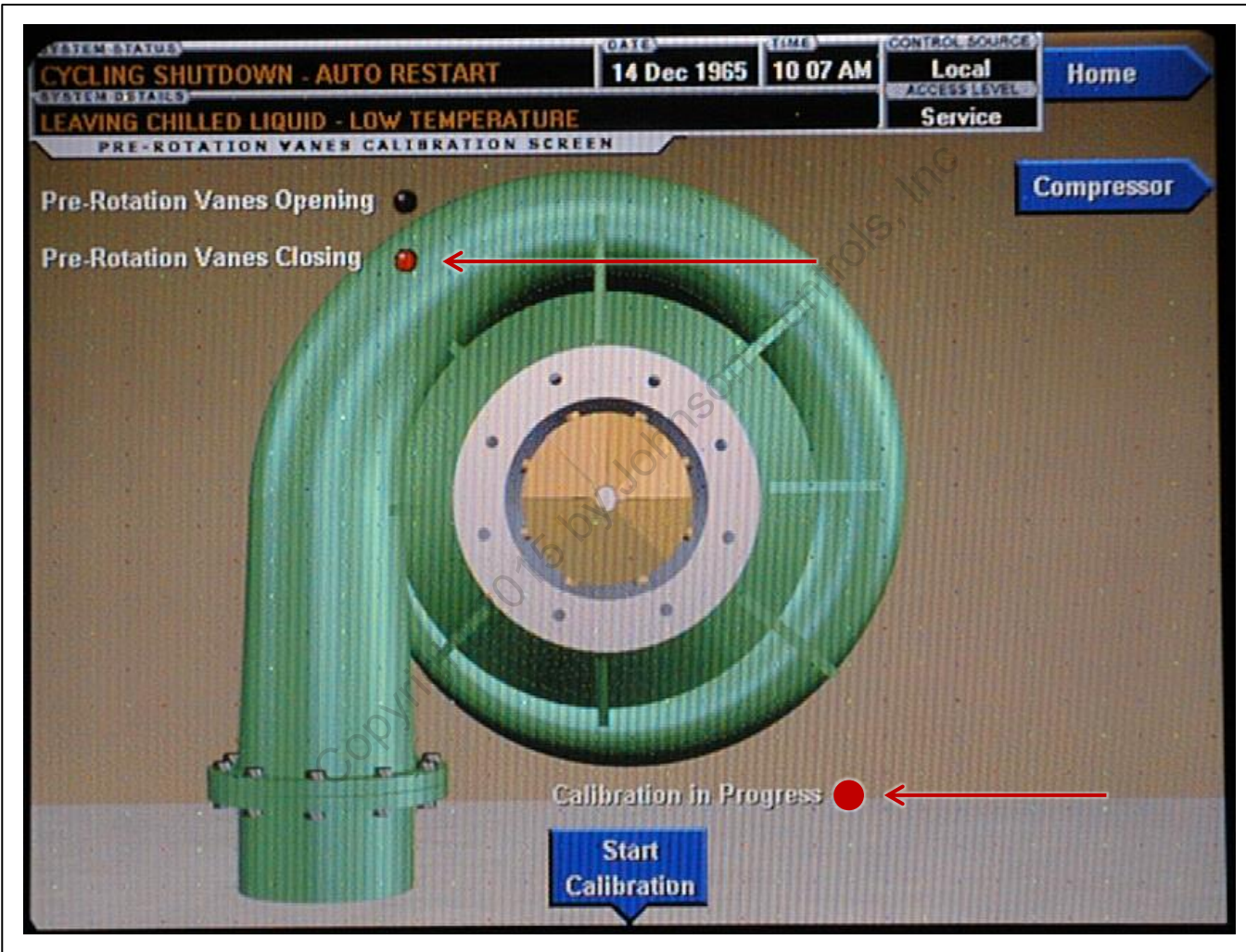
0 % Full Load Amps

Oil Pump Drive Command Frequency 0 Hz

Vane Motor Switch

Oil Return Solenoid





SYSTEM STATUS	DATE	TIME	CONTROL SOURCE	Home
CYCLING SHUTDOWN - AUTO RESTART	14 Dec 1965	10 07 AM	Local	
SYSTEM DETAILS	LEAVING CHILLED LIQUID - LOW TEMPERATURE		ACCESS LEVEL	
PRE-ROTATION VANES CALIBRATION SCREEN			Service	

Pre-Rotation Vanes Opening ●

Pre-Rotation Vanes Closing ●

Compressor

Calibration in Progress ●

Start Calibration

Calibration Successful

Power Distribution



Power Distribution

Style “D” and Vyper

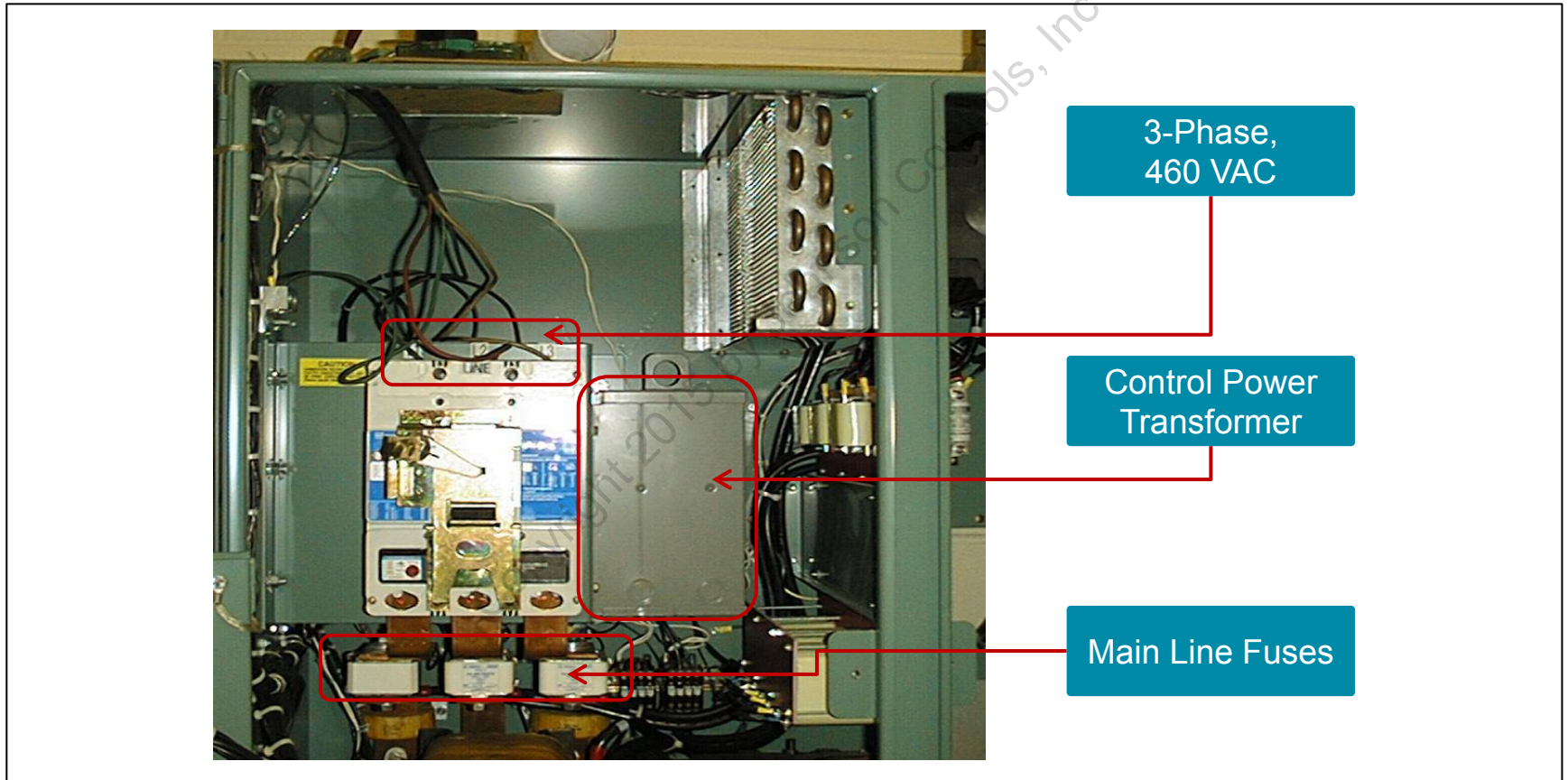
- 460 VAC Circuitry
- 120 VAC Circuitry
- Low Voltage Circuitry

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STYLE "D"
460 VAC
CIRCUITRY



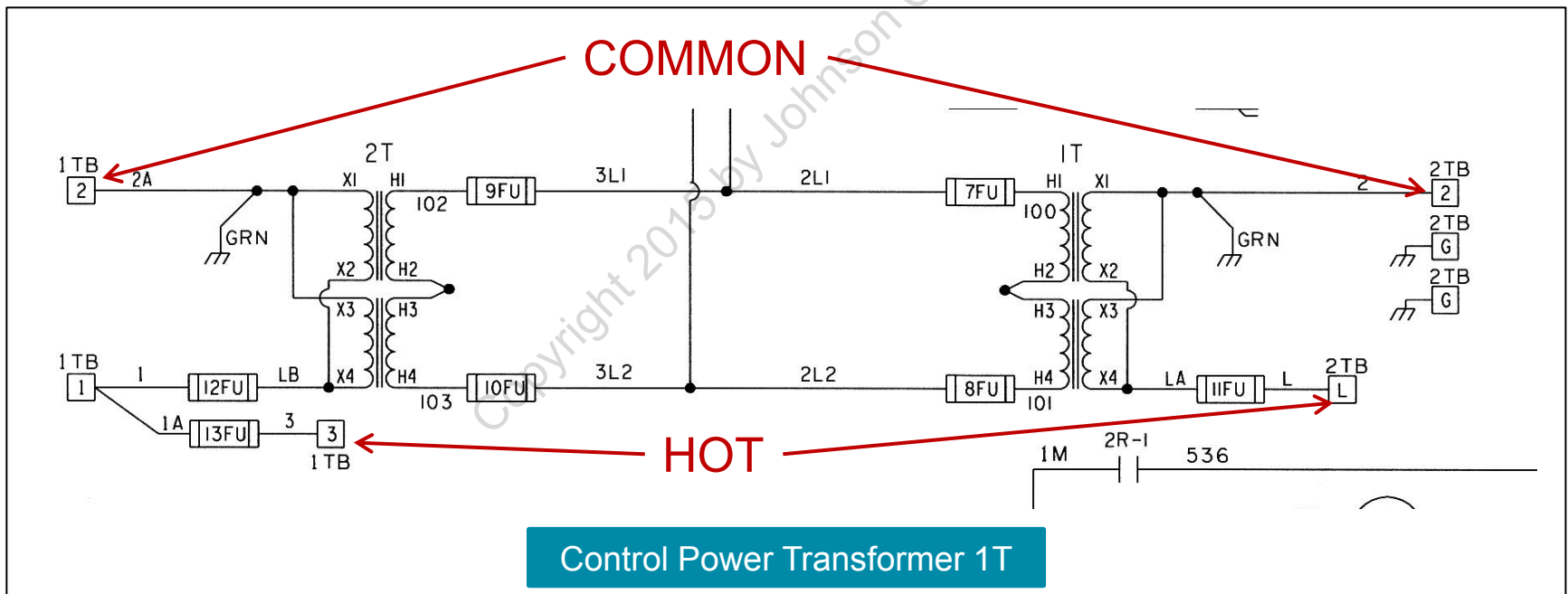
Circuit Breaker / Disconnect, Main Line Fuses, and the Control Power Transformer



STYLE "D"
120 VAC
CIRCUITRY



- Reference Form 160.00-PW1, page 3B, Figure 1.
 - 7FU and 8FU supplies 460 VAC to the 120 VAC control power transformer supplying power to the control panel and chiller components.
 - 9FU and 10FU supplies 460 VAC to the 120 VAC control power transformer supplying power to the VSD panel.



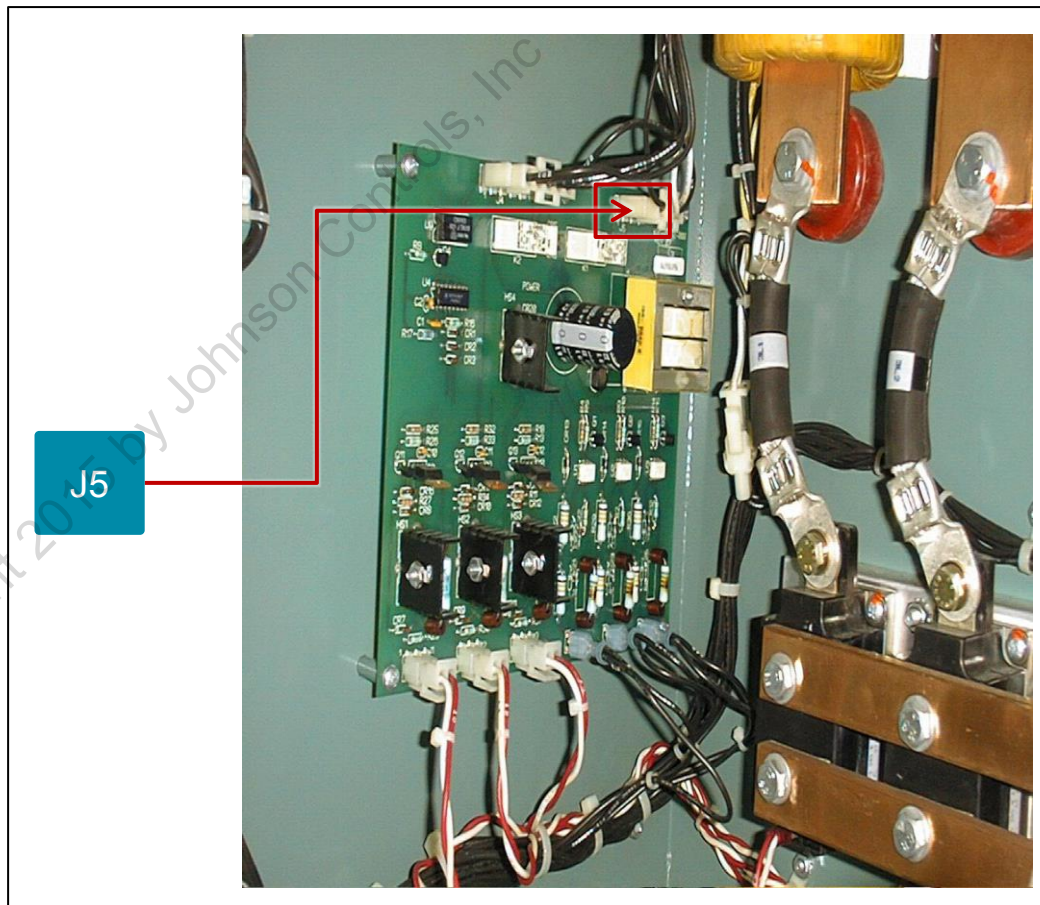
Reference Form 160.00-RP2, page 3, Figure 2.

Be Careful – Easy to snap off when panel is open



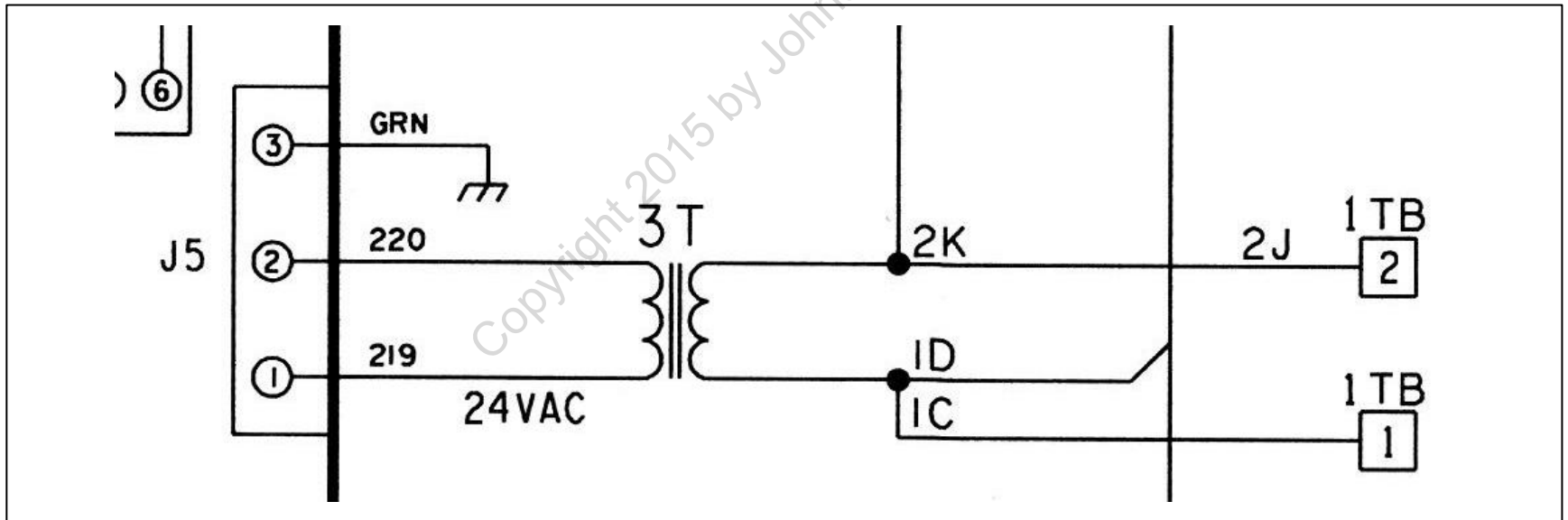
Control Power Transformer Primary and Secondary Fusing

Wire 3A to J5, pin 3 of the SCR Trigger Board.

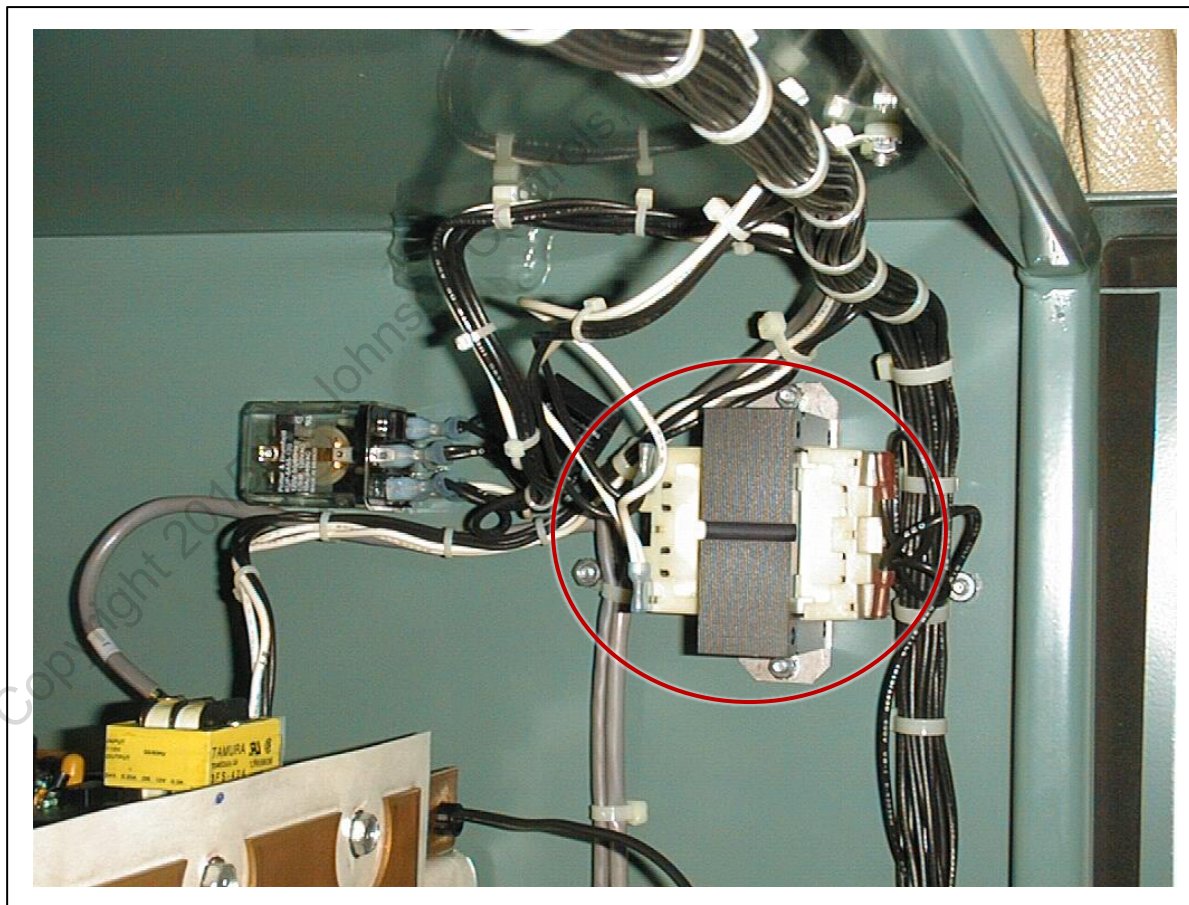


Reference Form 160.00-PW3, page 3A, Figure 1.

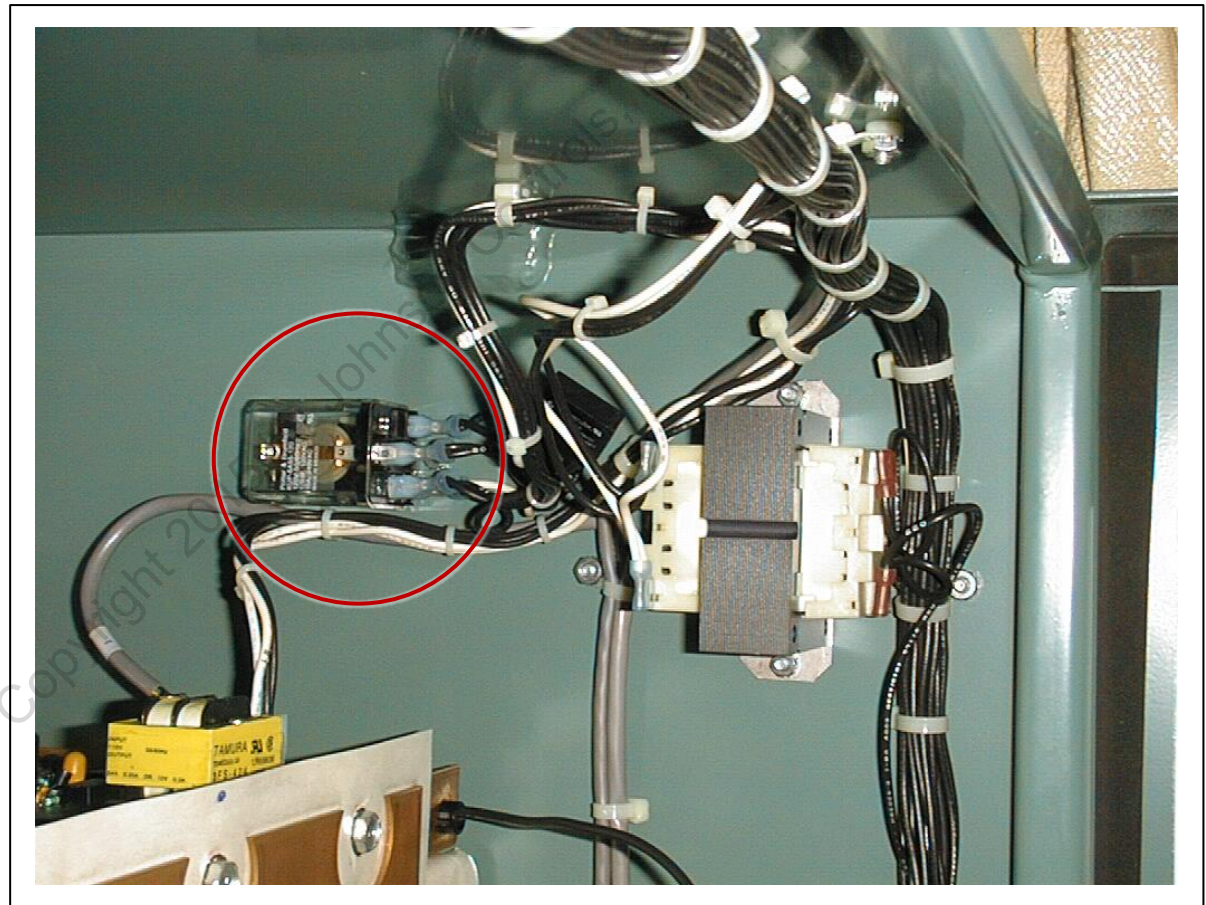
Wire 1C to the primary side of transformer 3T for power to VSD Logic Board – J5



Reference Form 160.00-RP2, page 3A, Figure 3, Item 24.



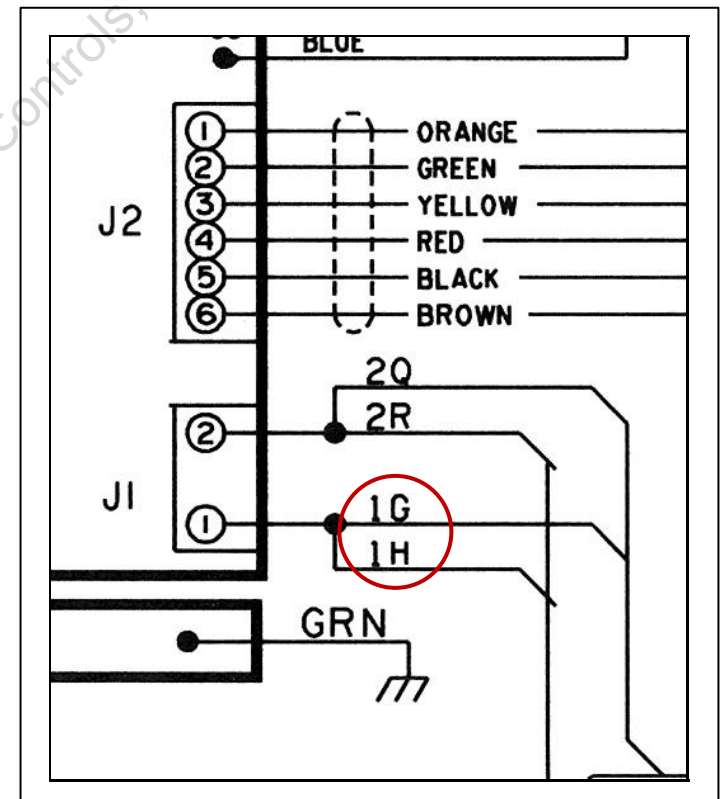
1R - Reference Form 160.00-PW3, page 3A, Powered by VSD Logic Board.



Gate Driver Board Power

Reference Form 160.00-PW3 pages 3A & 5

- Wire 1G & 1H to J1, pin 1 of Gate Driver Board on Output Pole Assembly Phase “A”.
- Wire 1H & 1J to J1, pin 1 of Gate Driver Board on Output Pole Assembly Phase “B”.
- Wire 1J to J1, pin 1 of Gate Driver Board on Output Pole Assembly Phase “C”.



Gate Driver Board



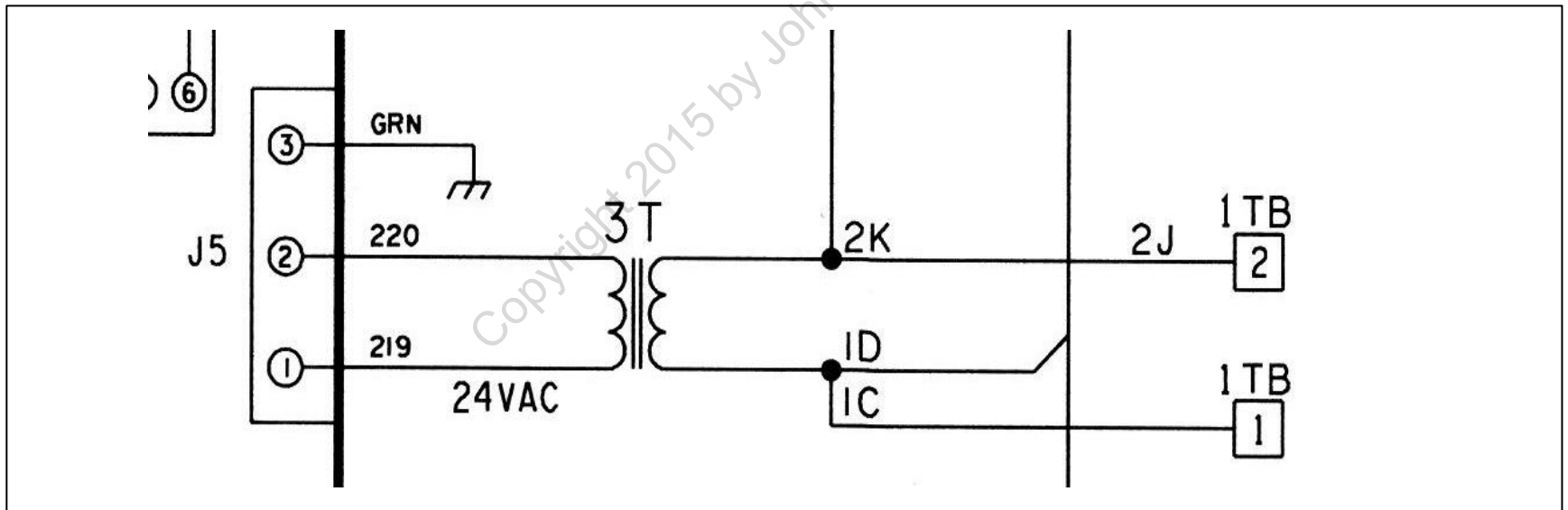
J1

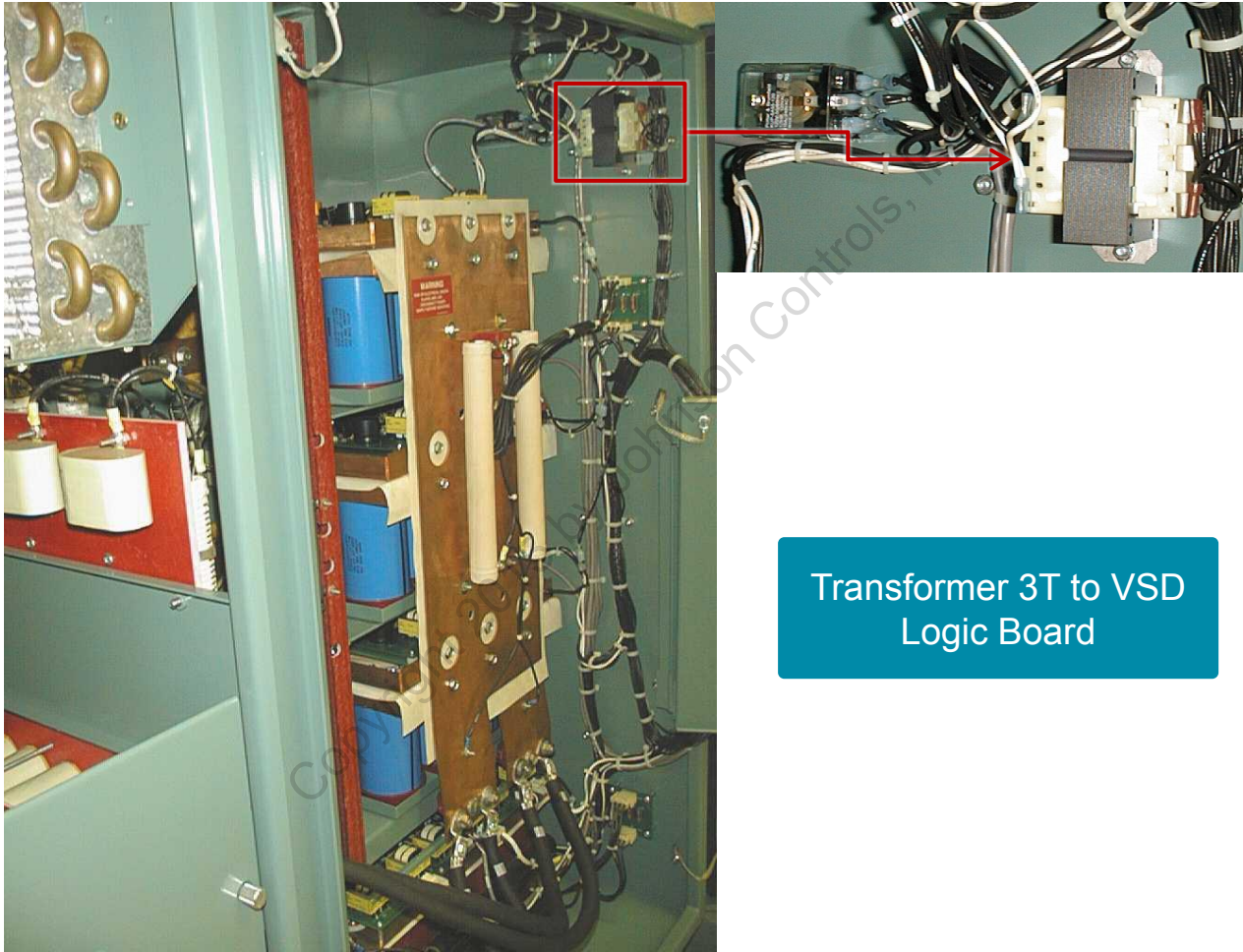
STYLE "D"
LOW VOLTAGE
CIRCUITRY



VSD Logic Board Power

- Wire numbers 219 & 220 from secondary side of Transformer 3T to VSD Logic Board J5, 24 VAC.





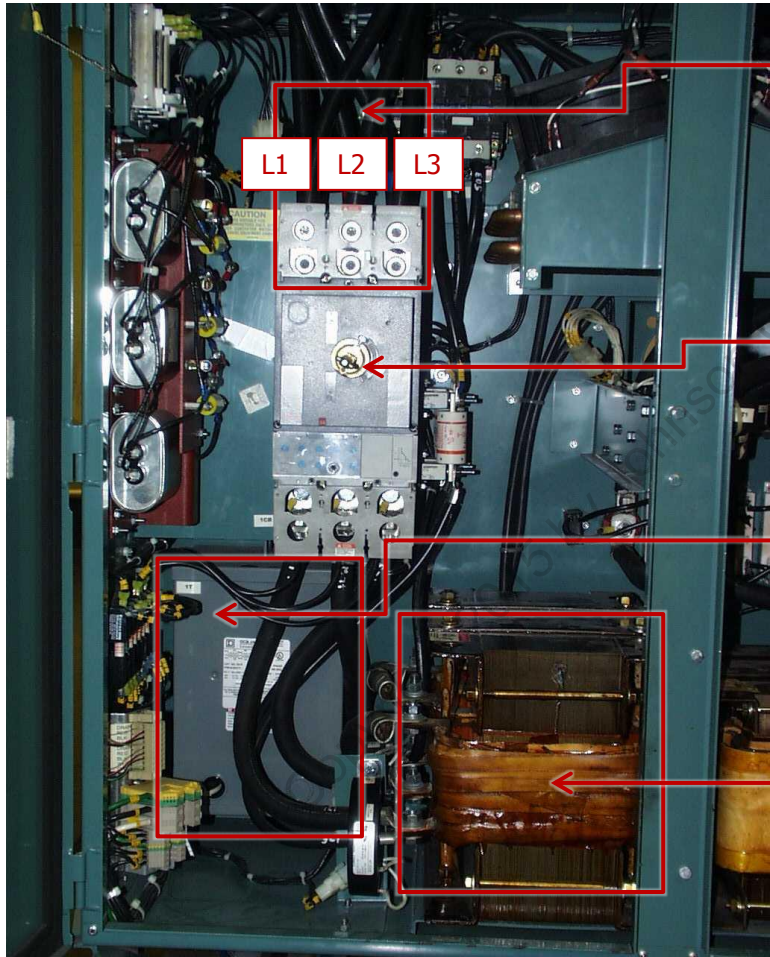
Transformer 3T to VSD
Logic Board

VYPER 460 VAC CIRCUITRY

Reference FORM 160.00-M4



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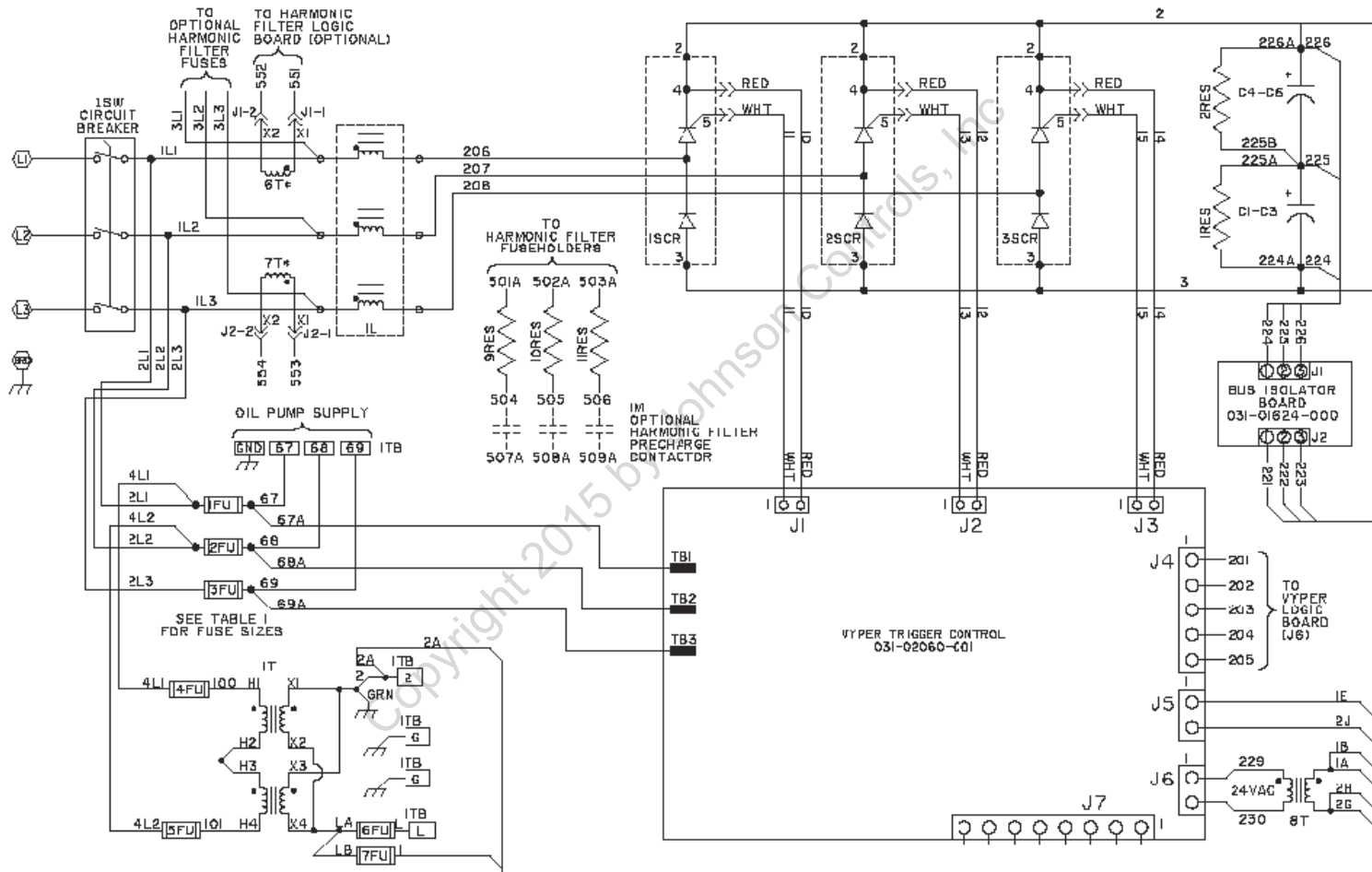
3-Phase, 460 VAC

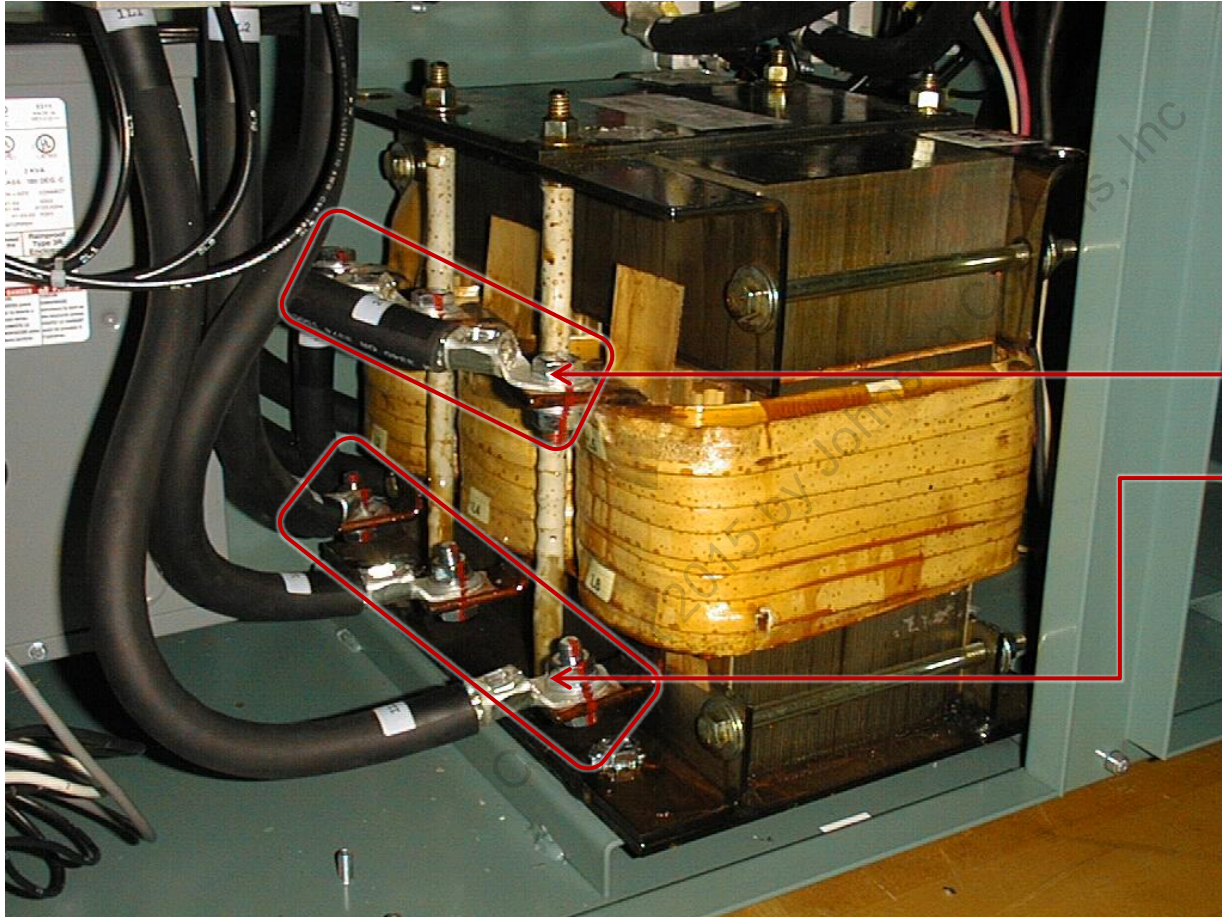
L1 L2 L3

Circuit
Breaker/Disconnect

Control Power
Transformer

Line Inductor





206, 207, 208
To Input Rectifiers

1L1, 1L2, 1L3
From Circuit Breaker

VYPER
120 VAC
CIRCUITRY

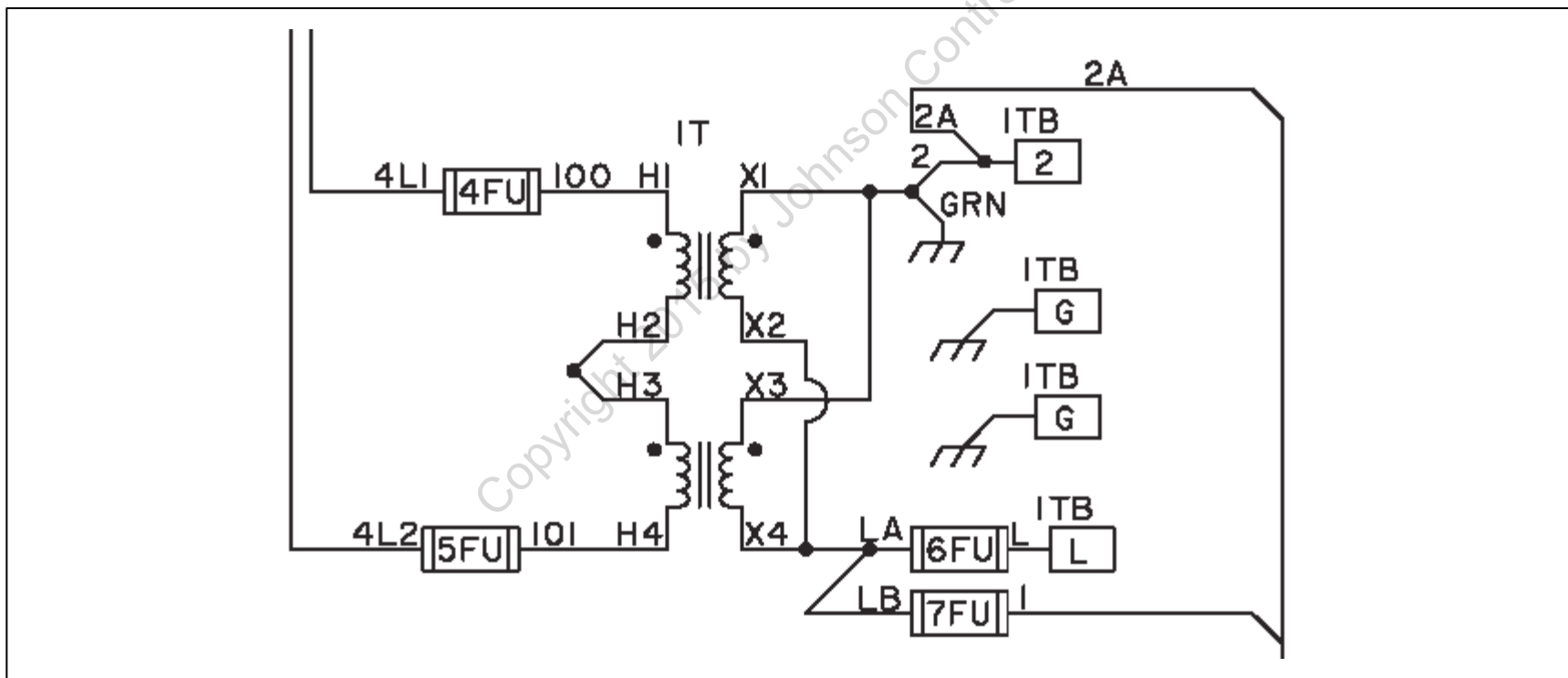


BY JOHNSON CONTROLS

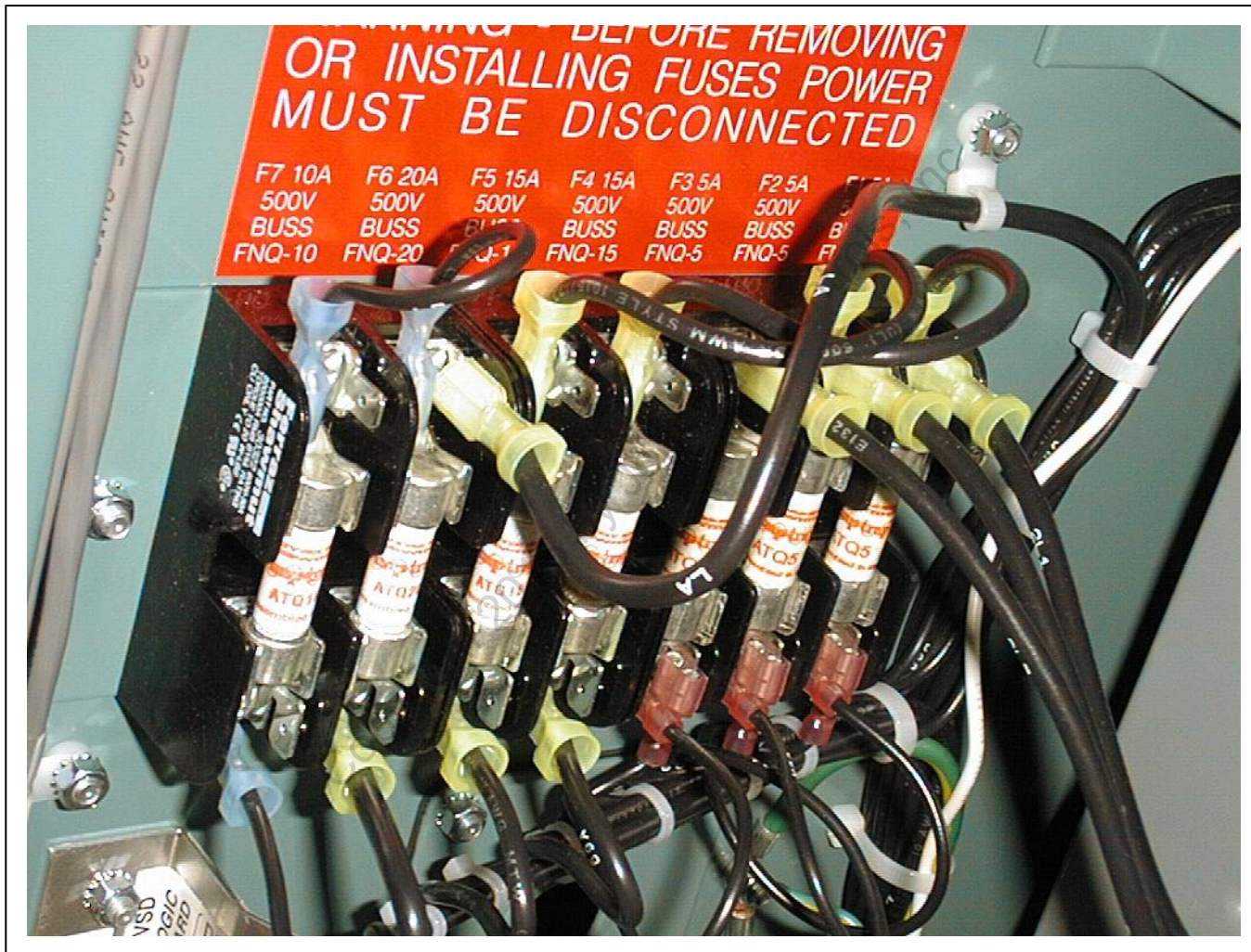


Our Policy prohibits printing. Save GREEN.

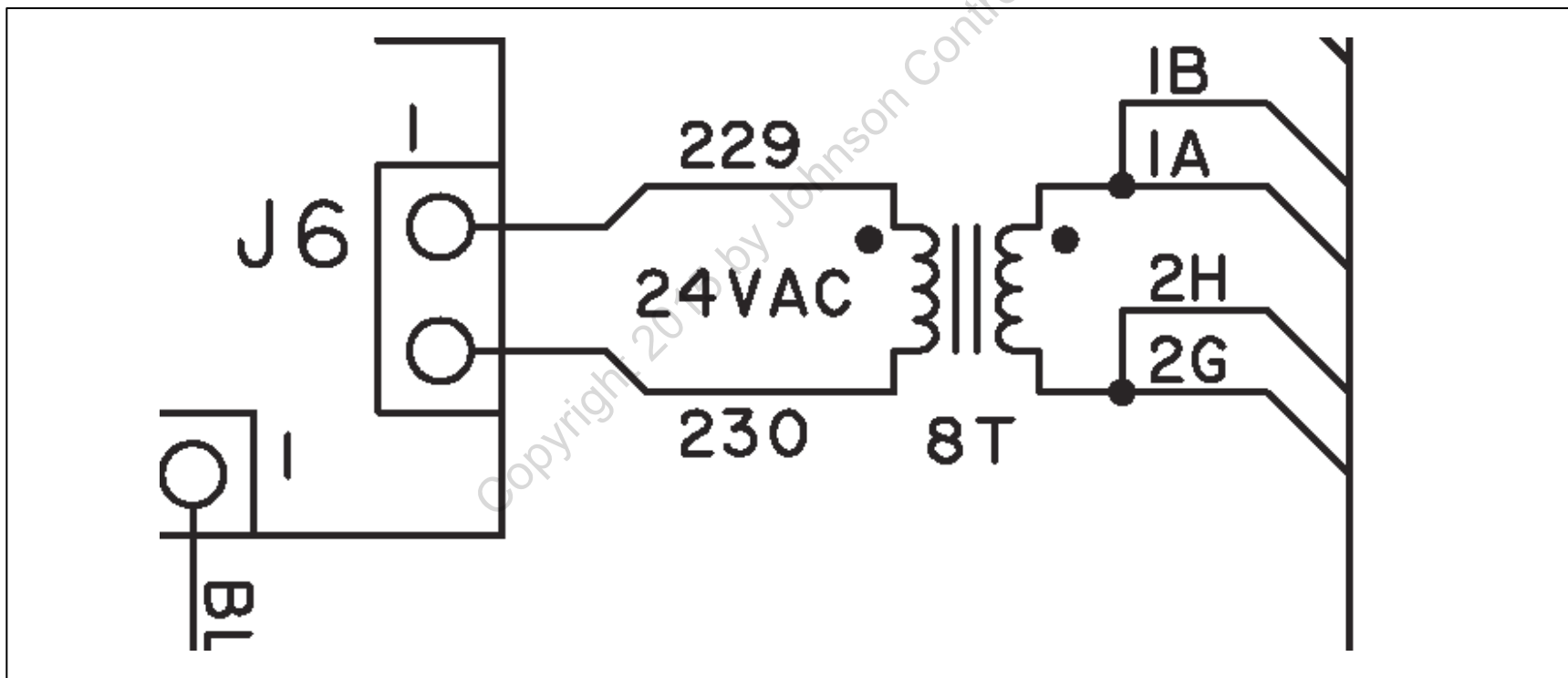
6FU supplies 120 VAC control power to the Control Panel.
7FU supplies 120 VAC control power to the Vyper and the Optional Harmonic Filter



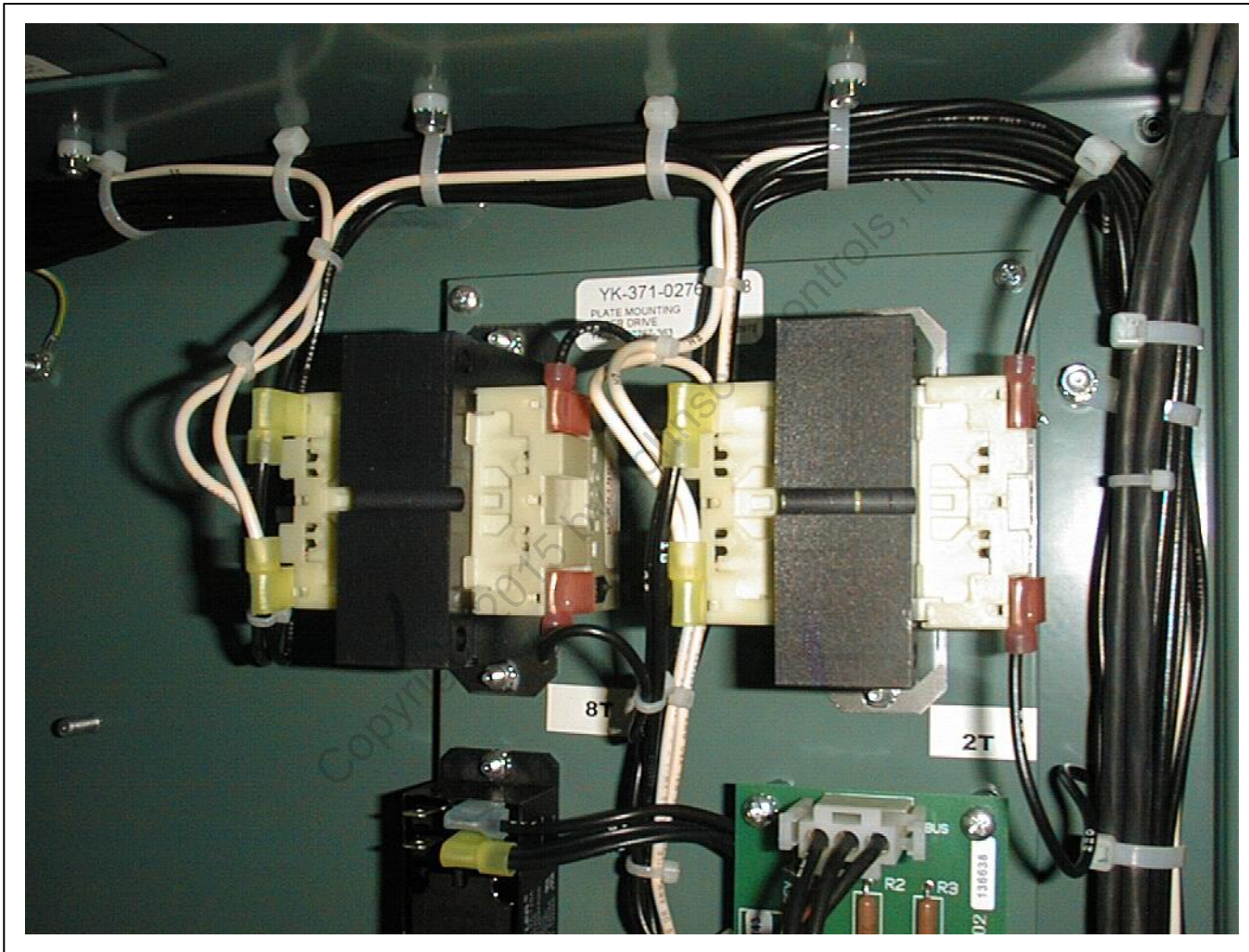
Control Power Transformer Primary and Secondary Fusing



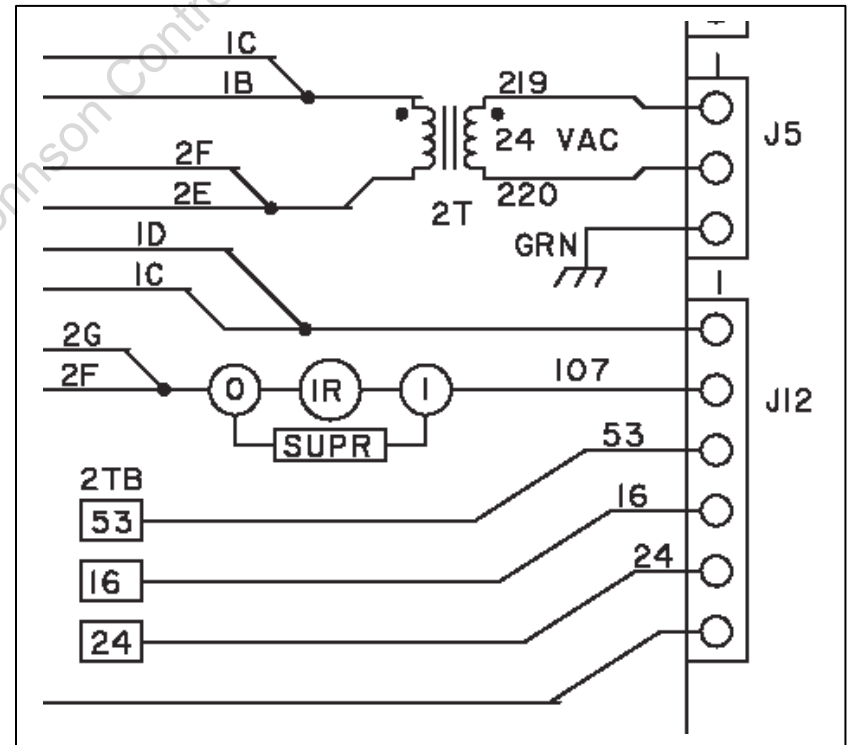
Wire 1A from 1R-1 relay contact to Trigger Control Board transformer 8T



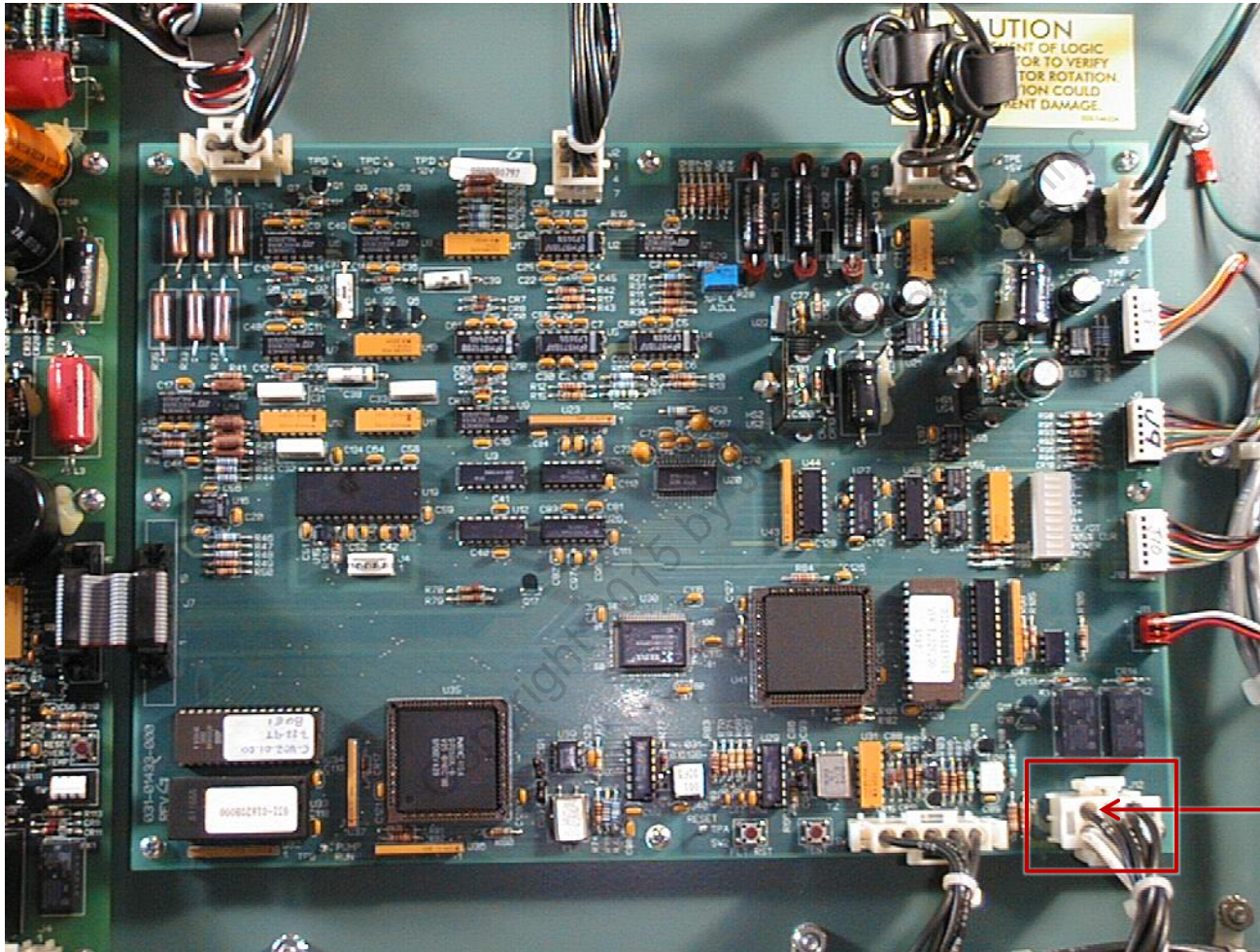
Transformer 8T



- Wire 1B from Trigger Control Board transformer 8T to Vyper Logic Control Board transformer 2T.
- Wire 1C from Vyper Logic Control Board transformer 2T to Vyper Logic Control Board J12, pin 1.
- Wire 1D from Vyper Logic Control Board J12, pin 1 to Optional Harmonic Filter Logic Control Board J4, pin 2

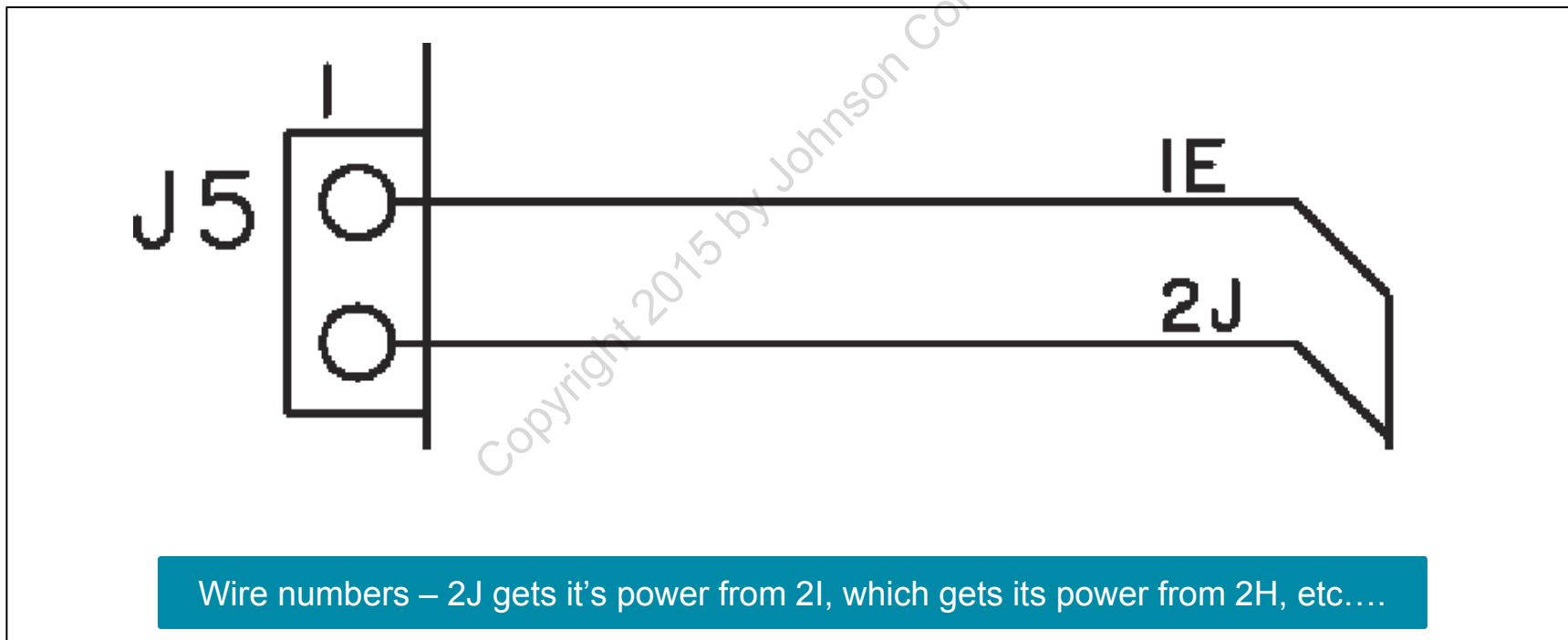


VSD – J12



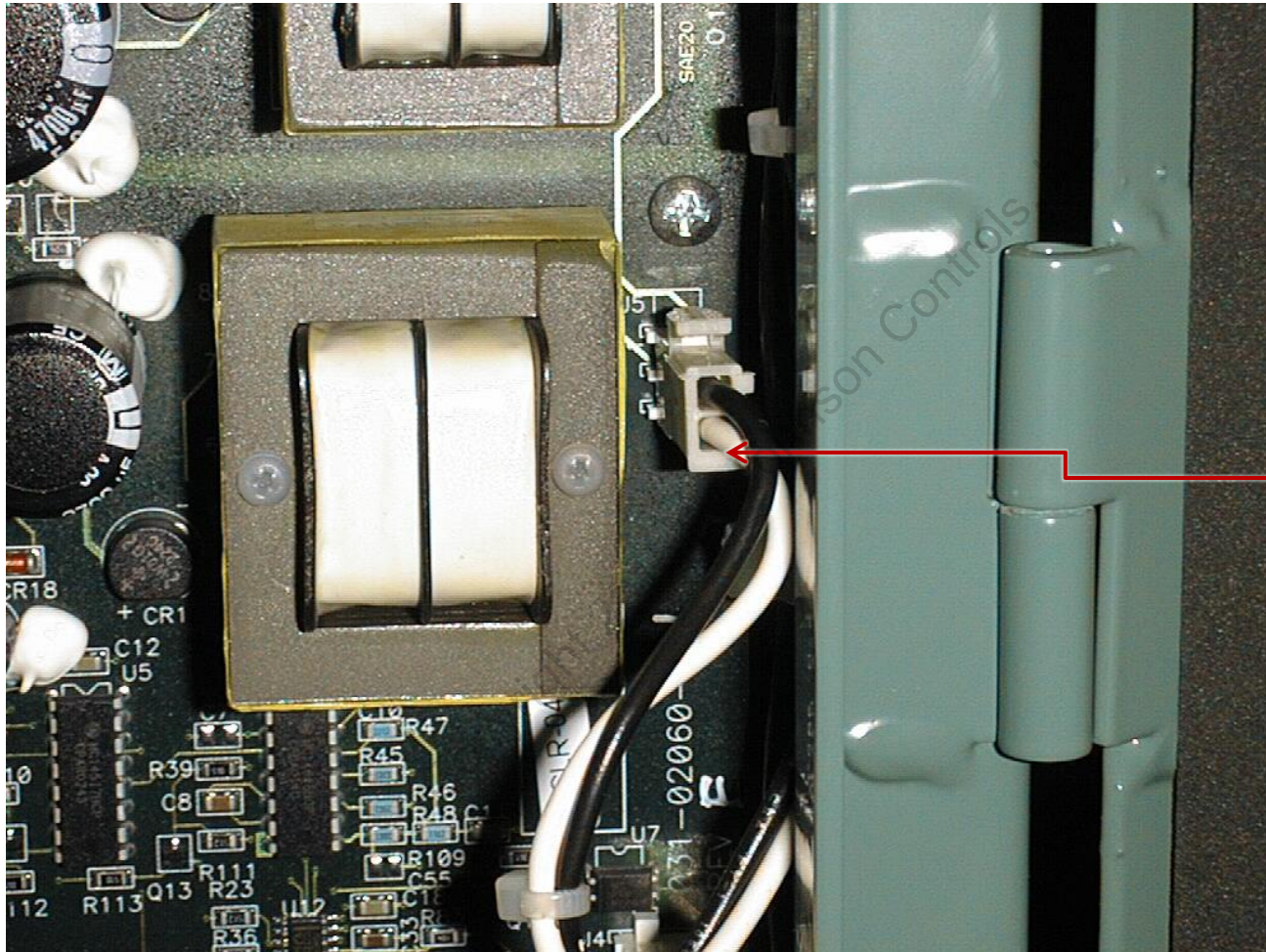
J12

Wire 1E from Optional Harmonic Filter Logic Control Board J4, pin 2 to Vyper Trigger Control Board J5, pin 1



Wire numbers – 2J gets it's power from 2I, which gets its power from 2H, etc....

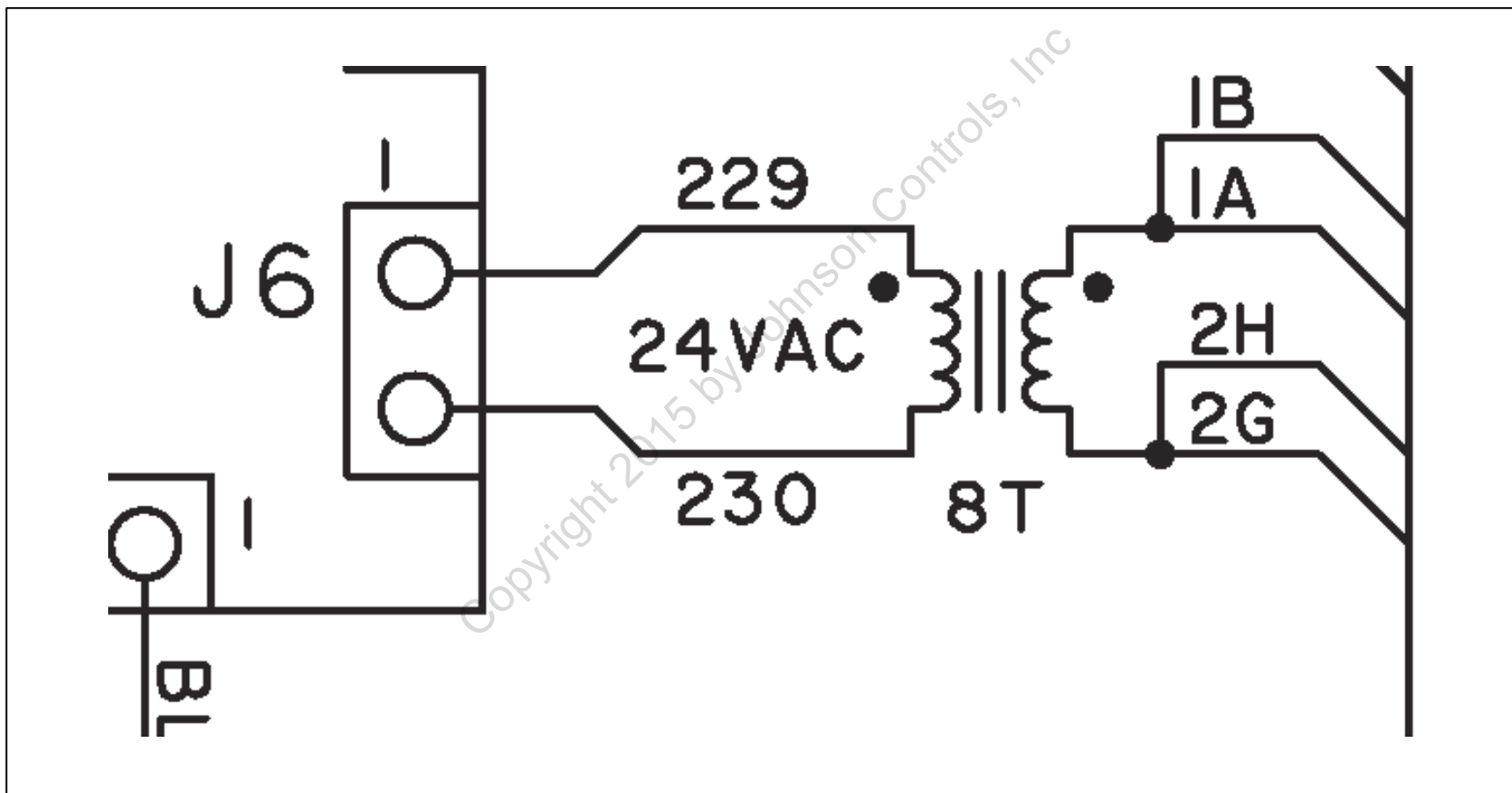
Trigger Control Board



VYPER LOW VOLTAGE CIRCUITRY



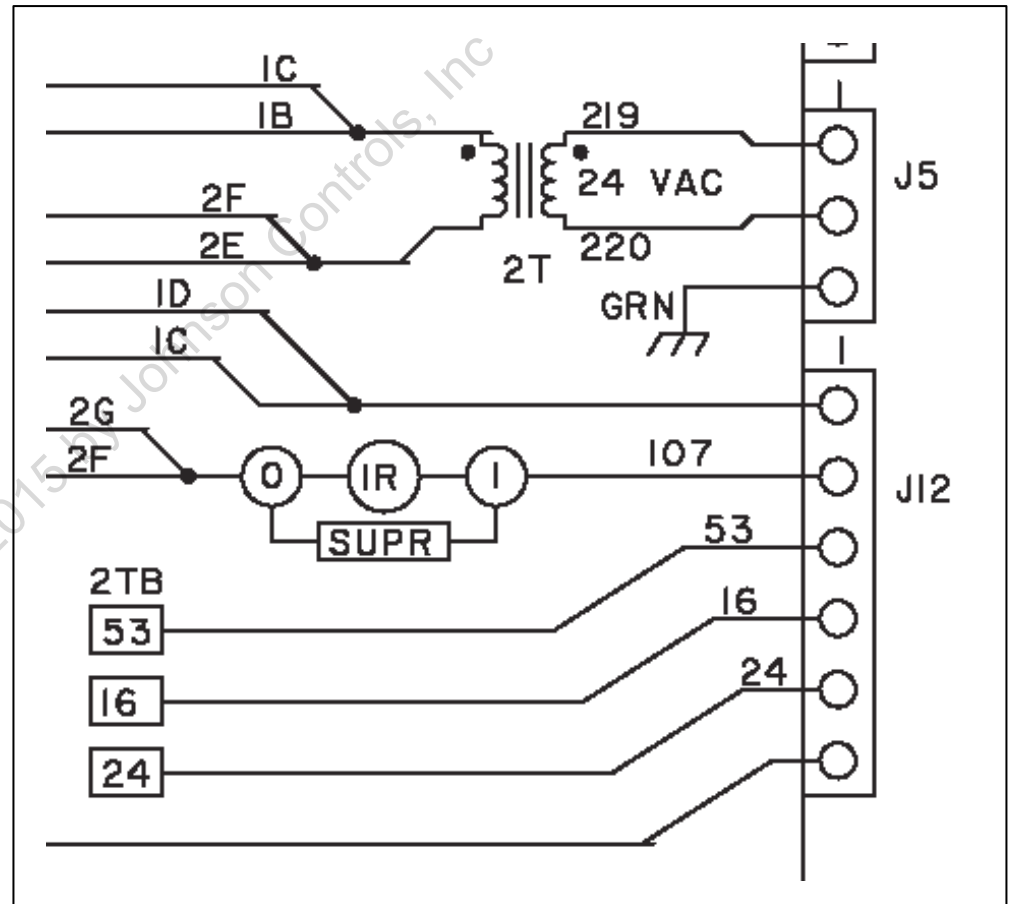
Vyper Trigger Control Board J6, 24 VAC



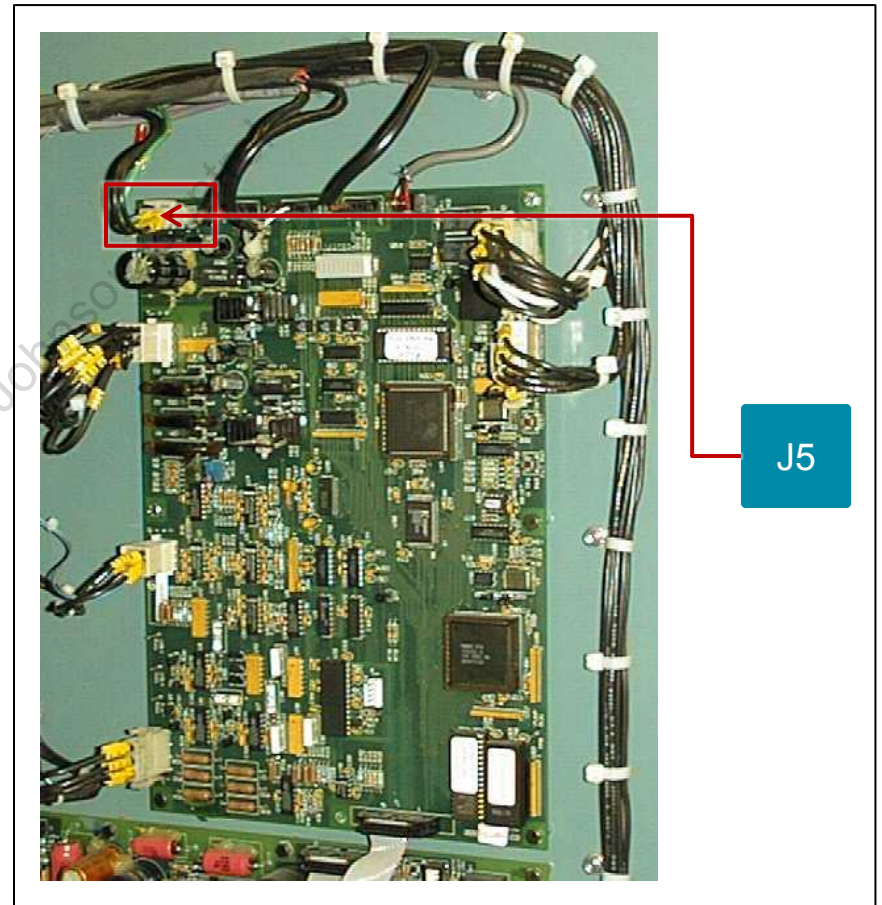
Vyper Trigger Control Board J6, 24 VAC



Vyper Logic Control Board J5, 24 VAC



Vyper Logic Control Board J5, 24 VAC



Input Rectifier Module Replacement



Preliminary Preparations

- Assemble all of the tools and material required to perform the Input Rectifier Module Replacement.
 - Vyper & Style “D”
 - Torque wrench
 - 1/2” drive ratchet
 - 1/2” drive 6” extension bar
 - 1/2” drive, 9/32” and 1/2” socket –Vyper
 - 1/2” drive, 7/16” and 11/16” socket – Style “D”
 - 5/32” Allen Socket
 - Rubbing Alcohol.
 - Rags.



All tools should be 1/4 drive, not 1/2 drive.
Allen socket needs to be 4mm.
Also need 7mm socket

Preliminary Preparations



Turn Off

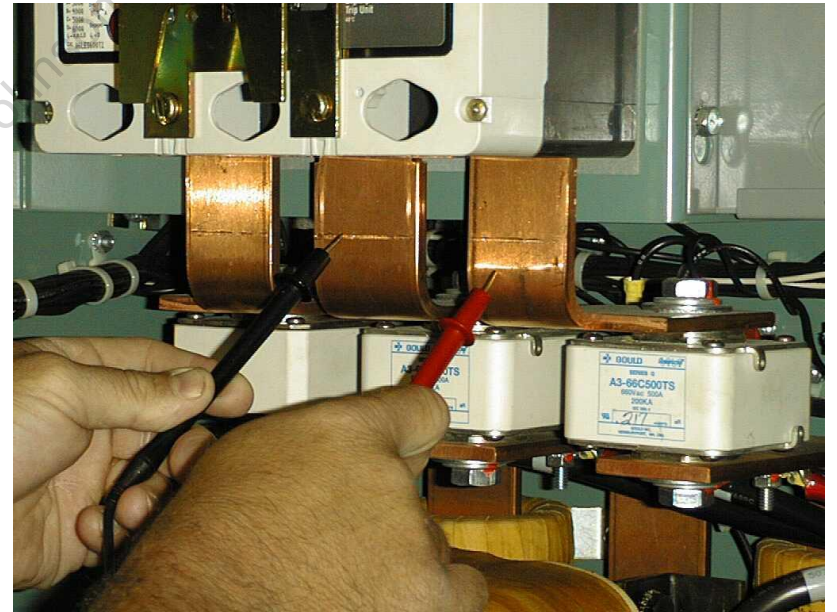
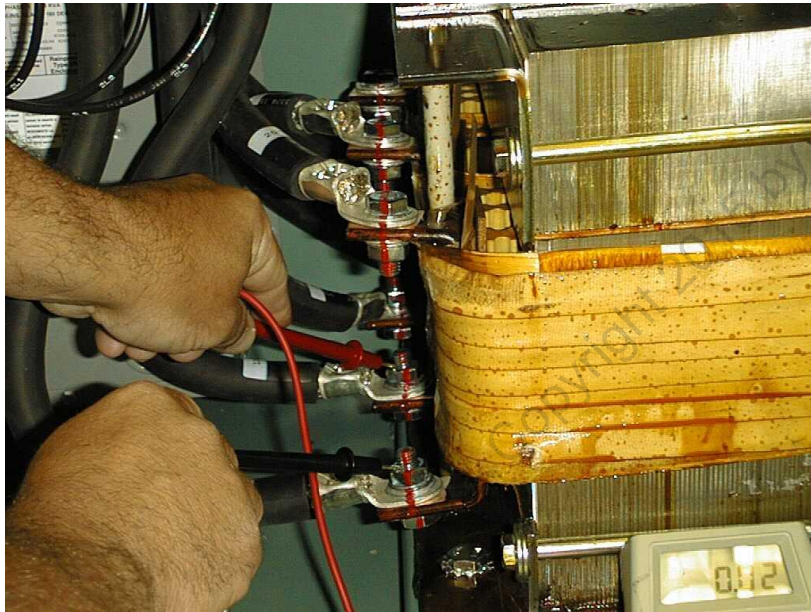


Lock Out-Tag Out

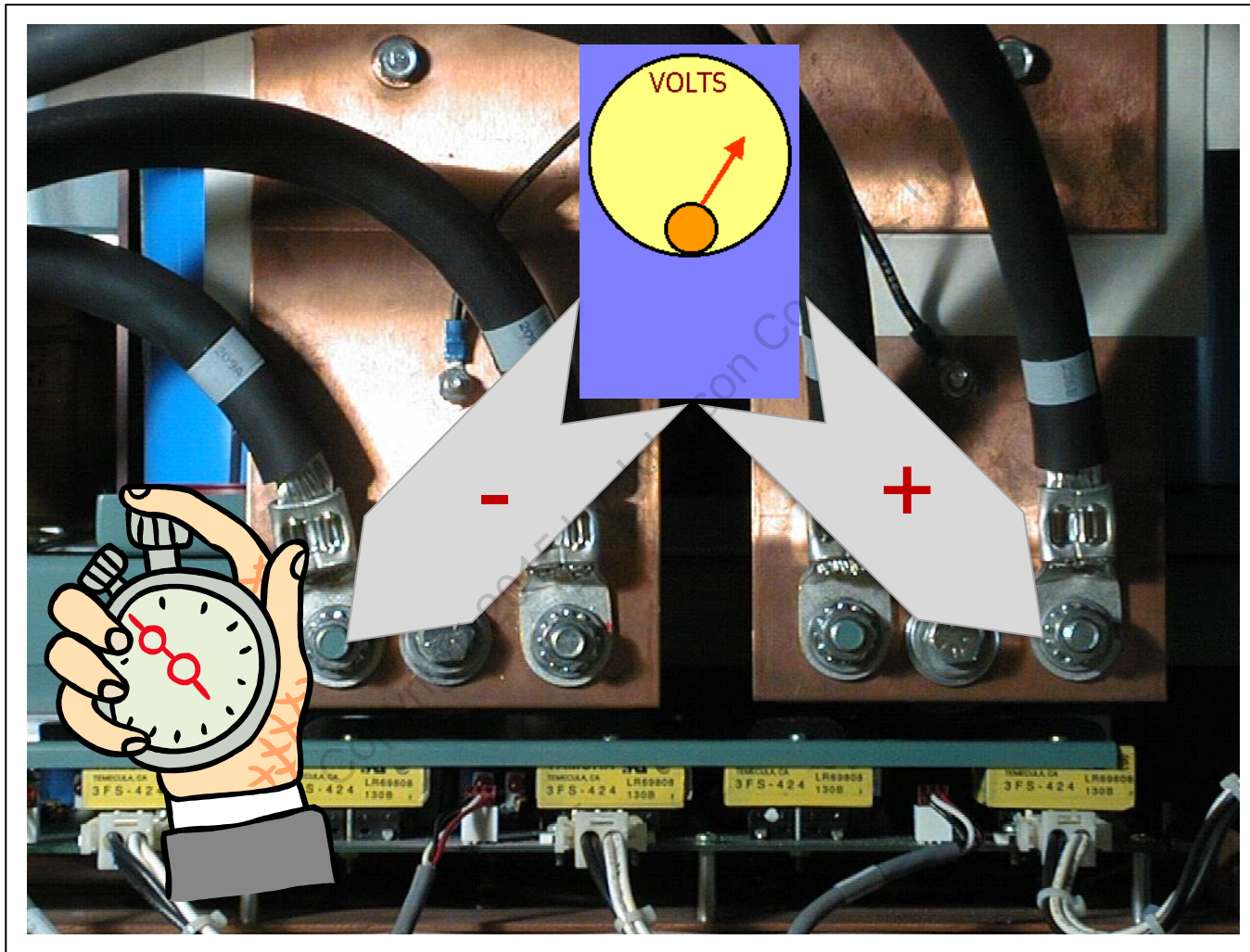


Preliminary Preparations

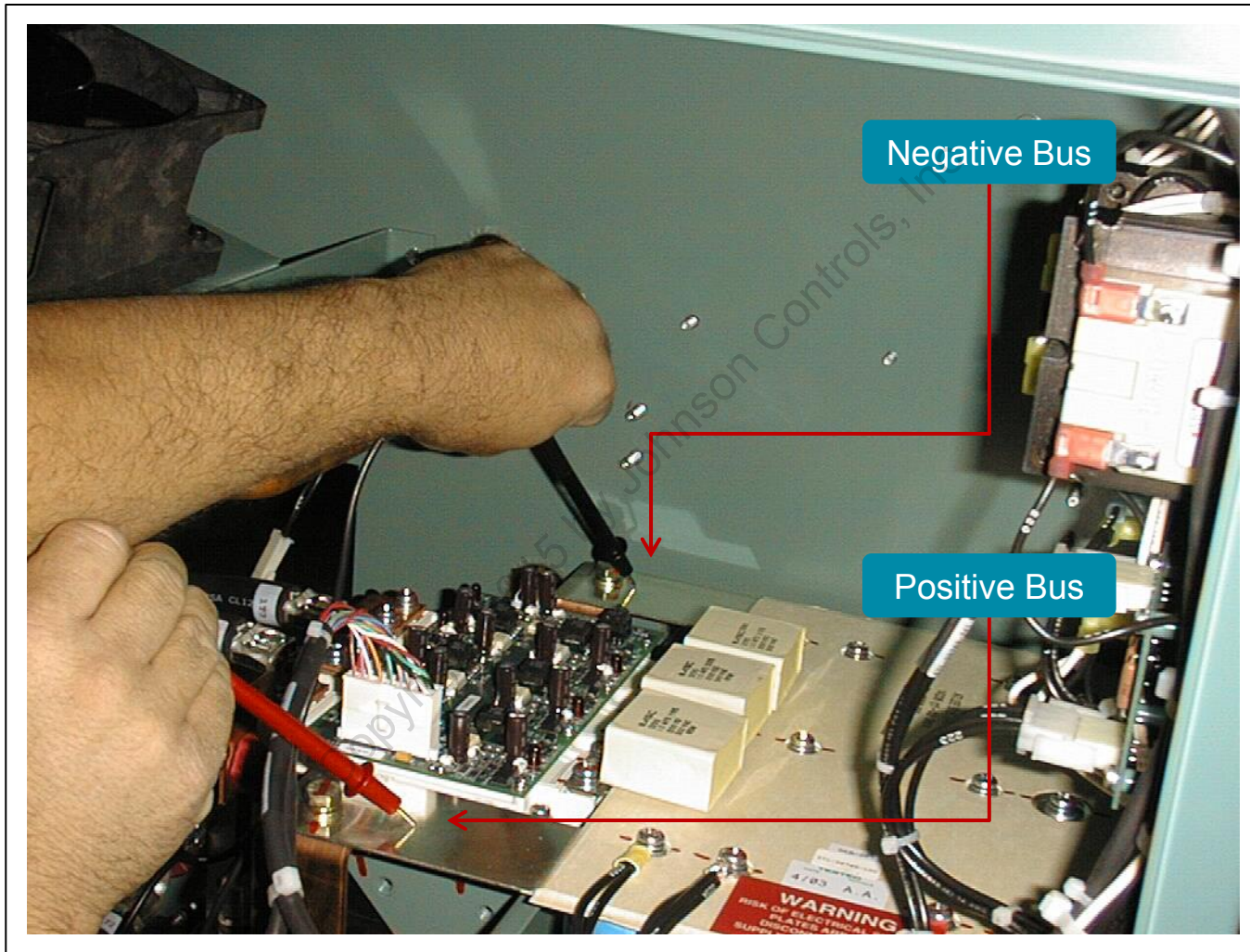
- Verify that the VOM is operational.
- Do not assume that voltages are no longer present!
- With the VOM, verify that there is no voltage present on any of the 3-phases downstream of the circuit breaker / disconnect



Verify that the DC Bus has fully discharged



Verify that the DC Bus has fully discharged



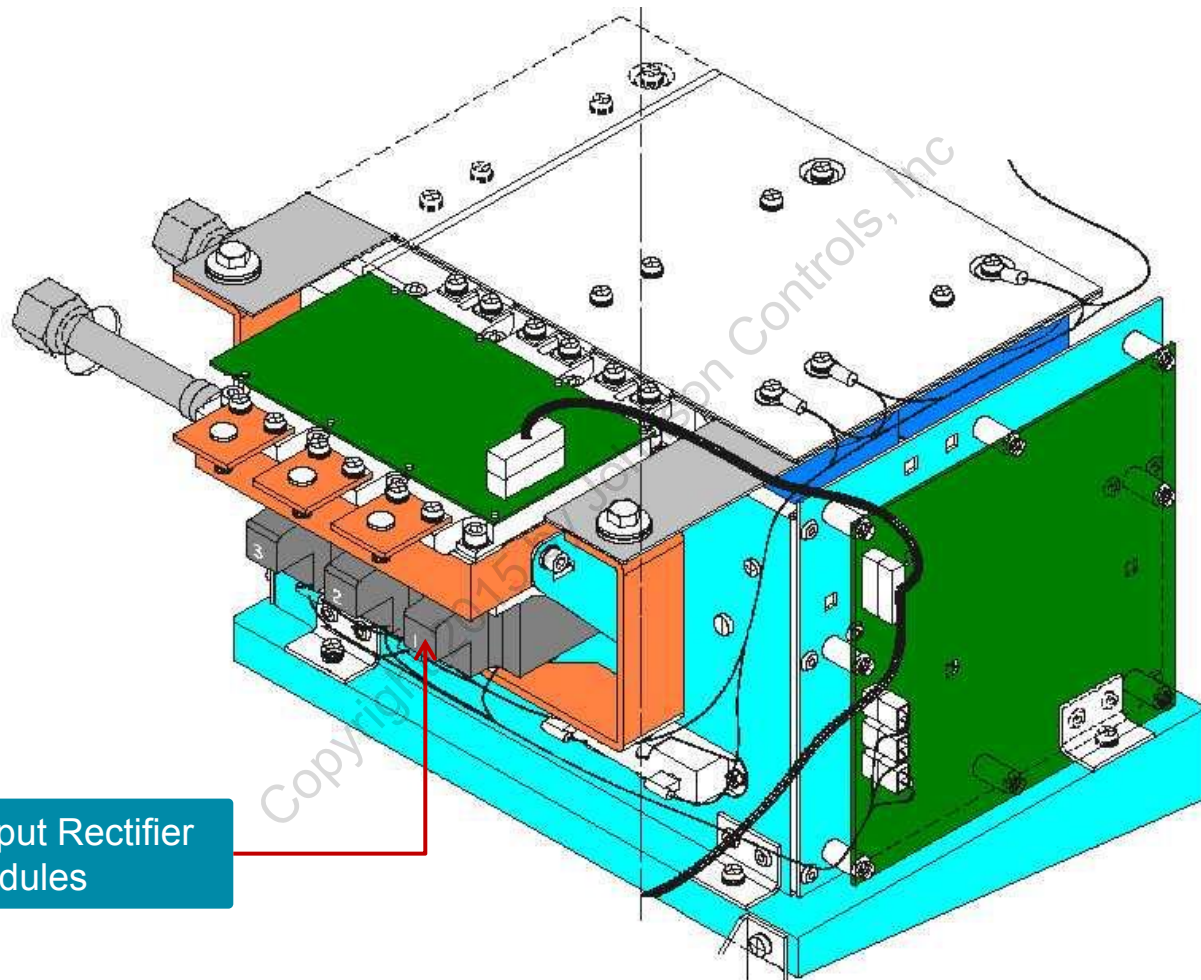
VYPER
INPUT RECTIFIER
MODULE REMOVAL



Input Rectifier Kit

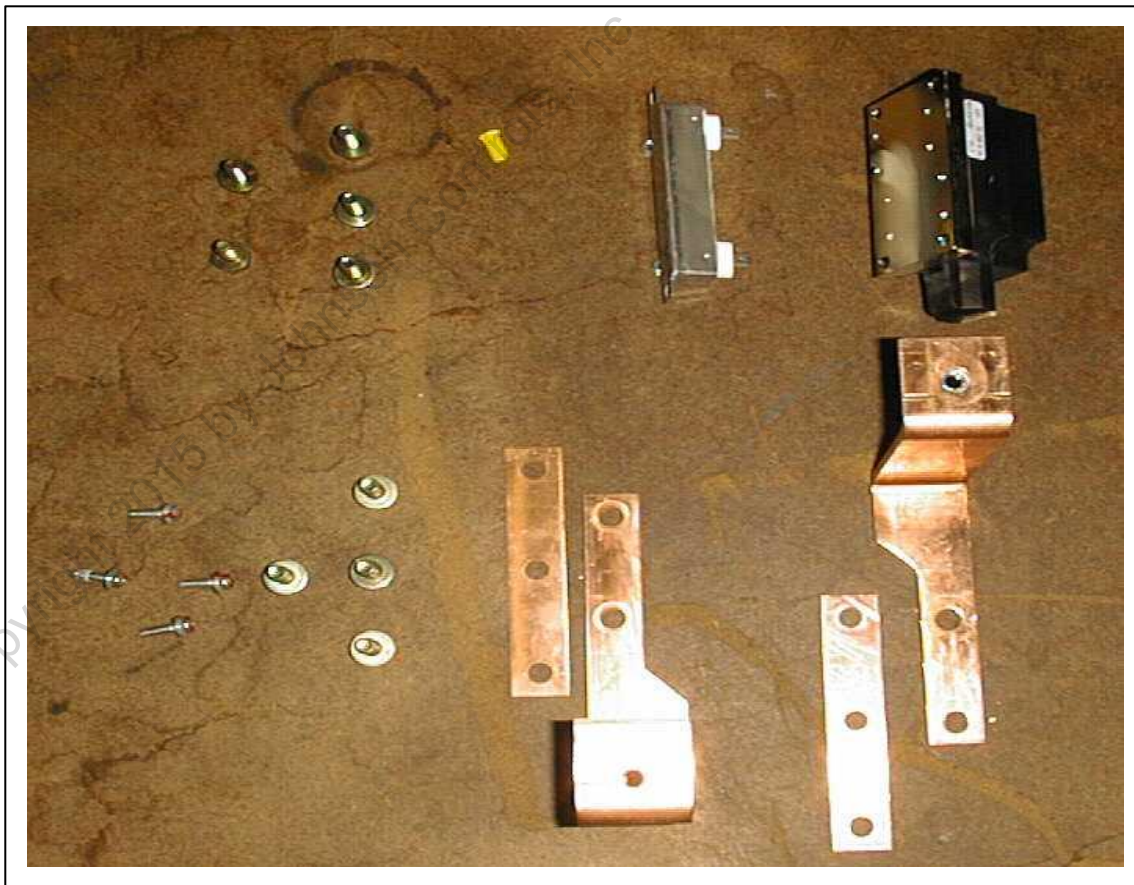
- The Same Kit is Used on both Vyper and Style “D”
 - 1 (ea.) SCR/Diode Module.
 - 4 (ea.) mounting screws.
 - 1 Tube of Heat-Conductive Compound





#1 of 3 Input Rectifier Modules

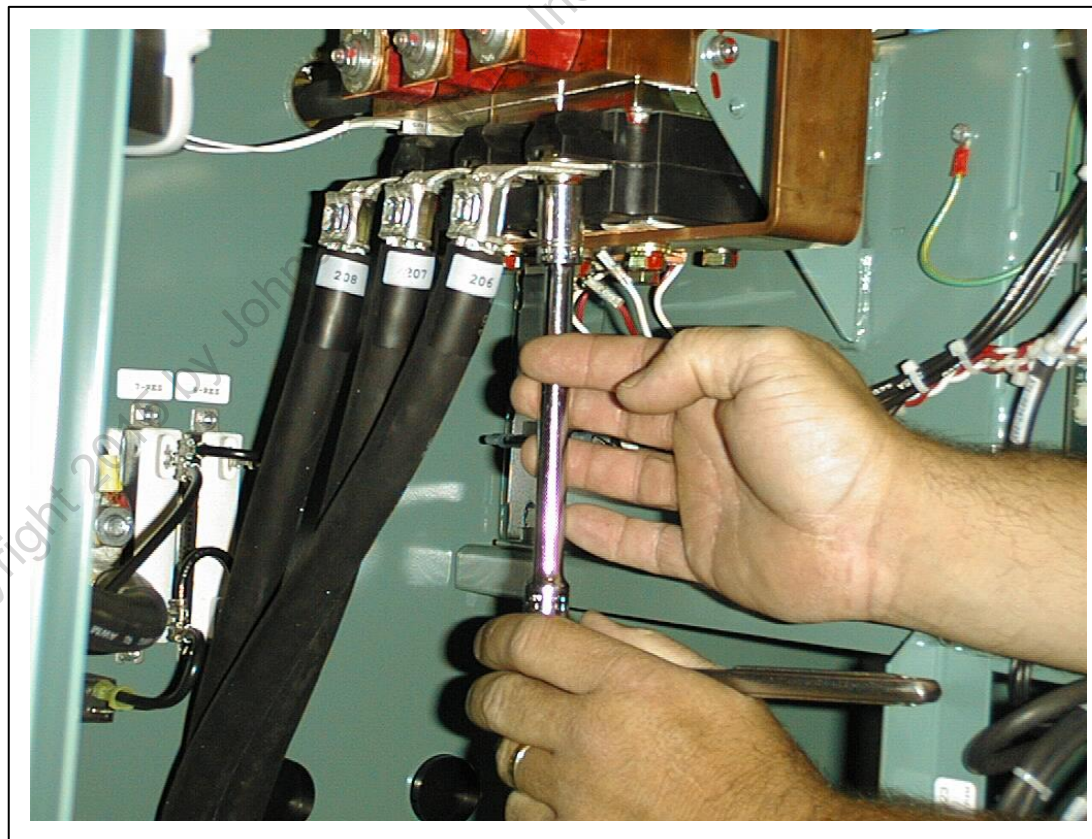
It may be helpful to organize the removal of parts as a guide when reassembling



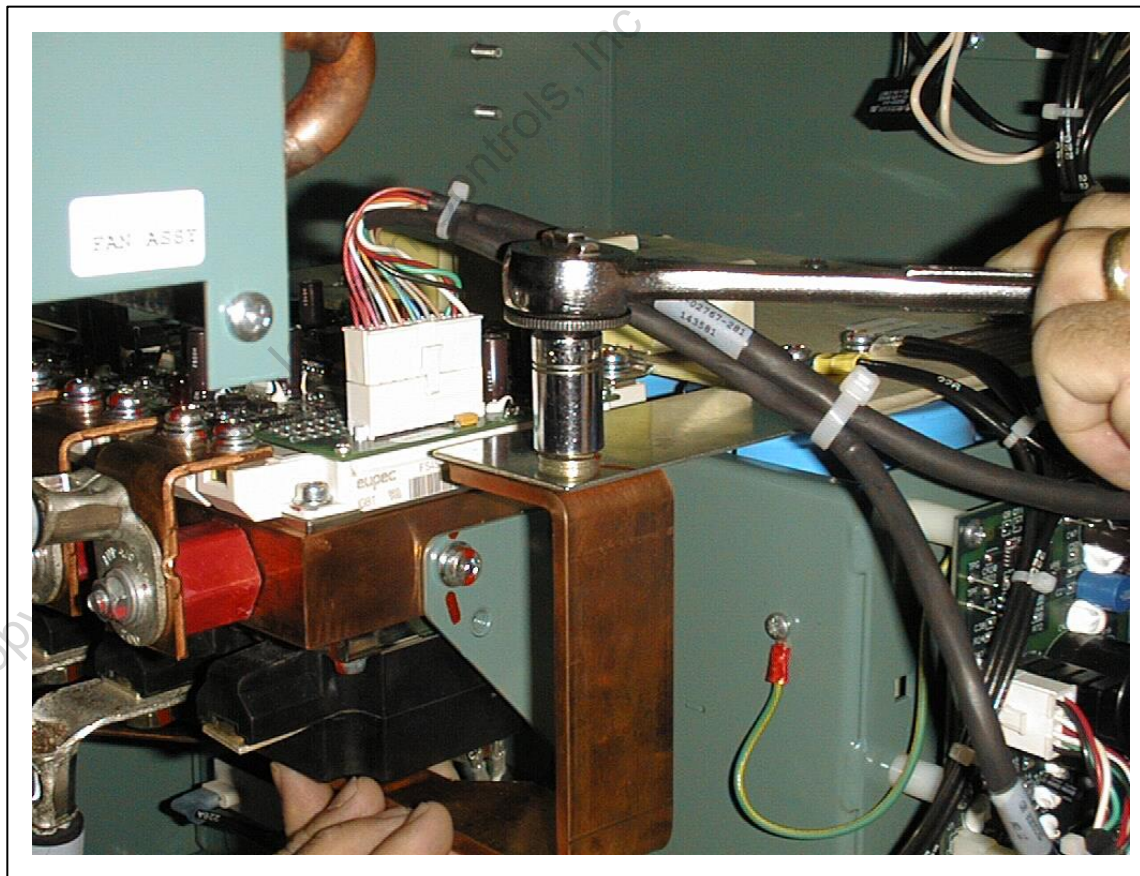
Remove the SCR gate and cathode leads from all 3 Input Rectifier Modules and from the 2 DC Balancing Resistors



Disconnect the AC Line Inductor lead from the Input Rectifier Module being replaced



Disconnect the positive(+) bus bar from the Positive(+) bus plate



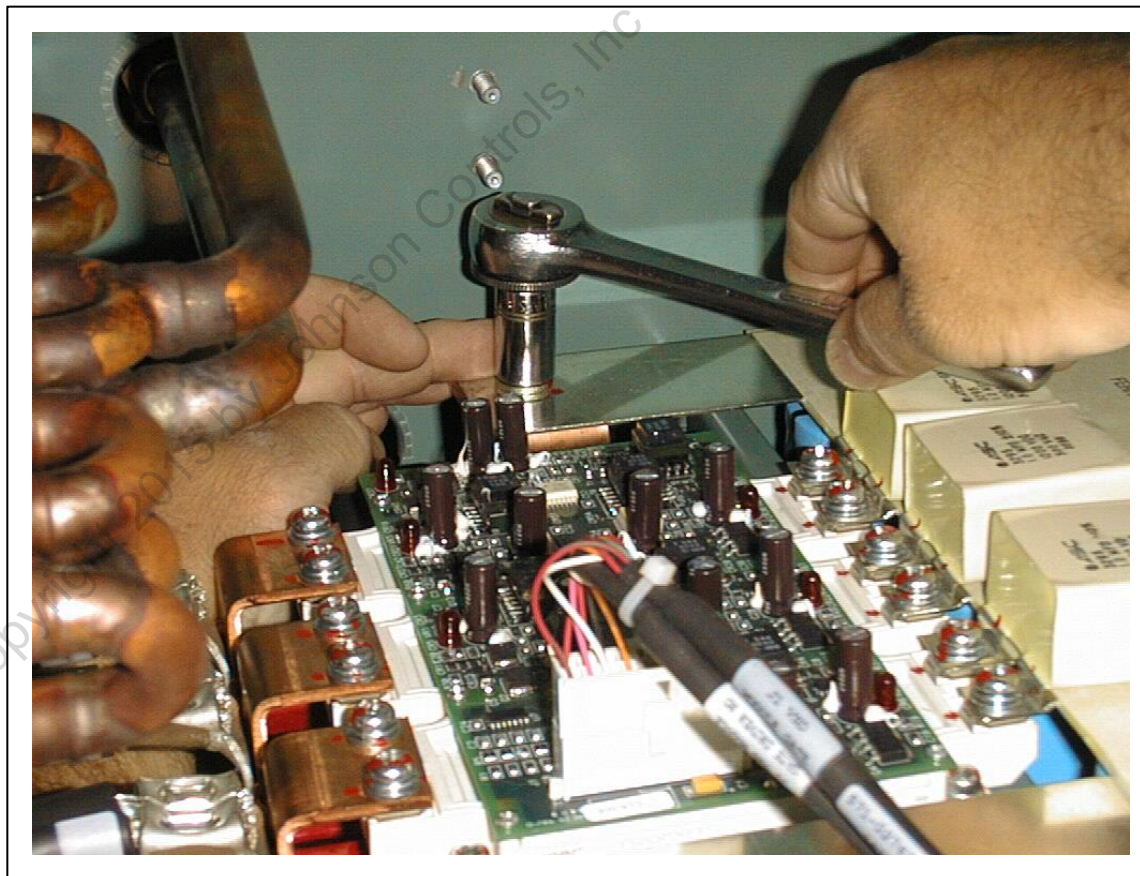
Disconnect the positive(+) bus bar and extender from all 3 Input Rectifier Modules.



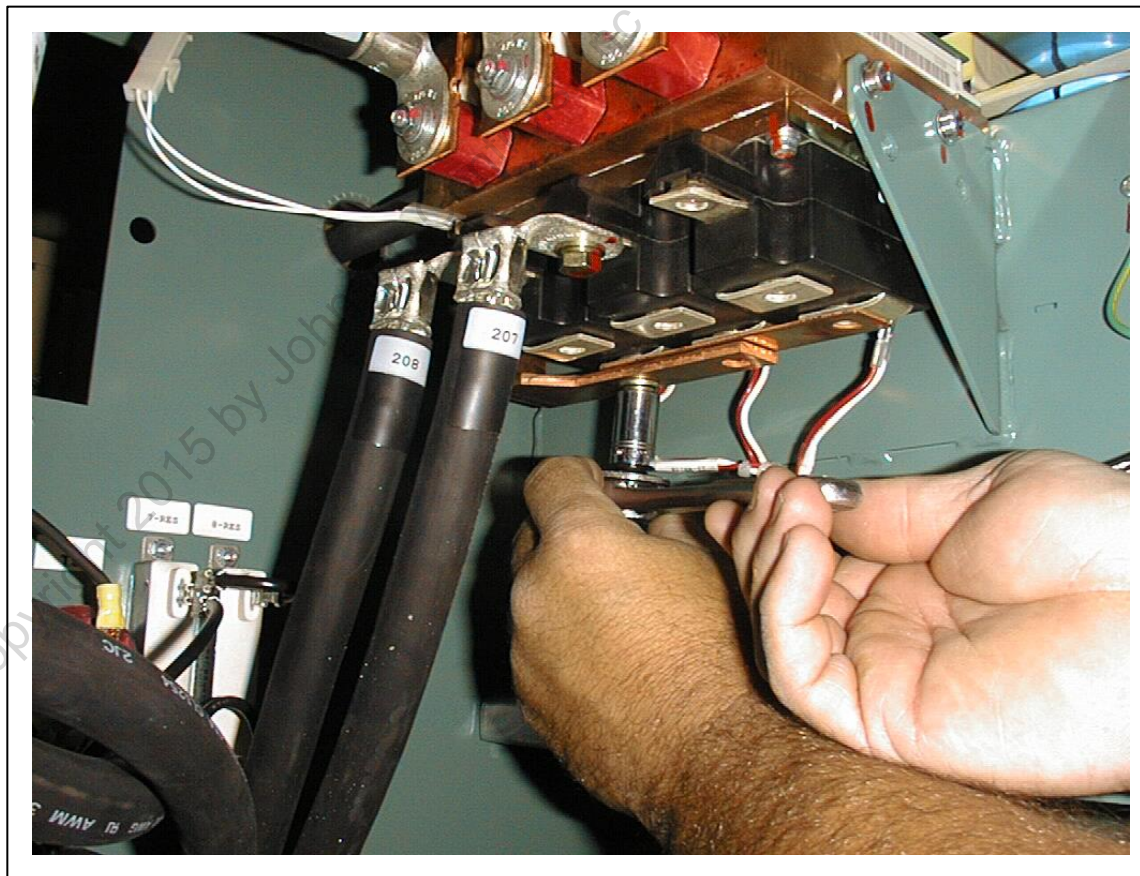
The positive(+) bus bar and extender removed.



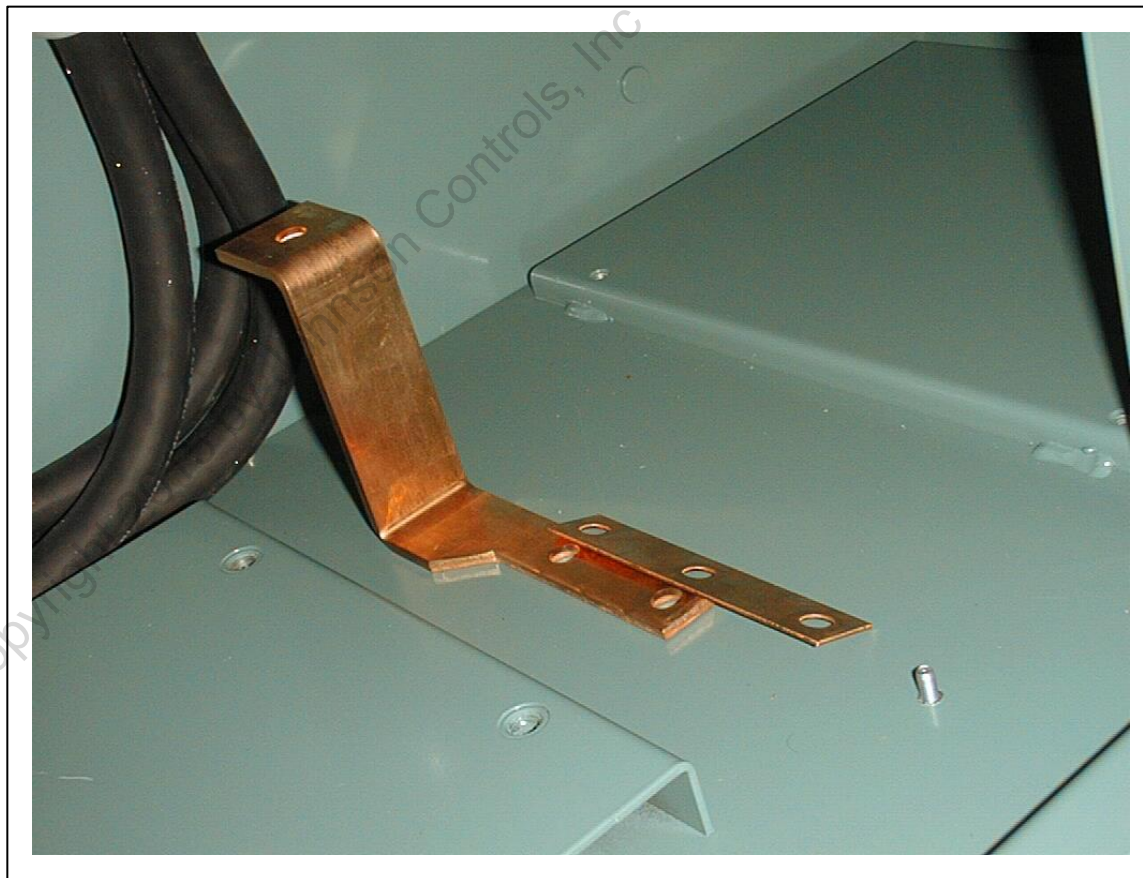
Disconnect the negative(-) bus bar from the negative(-) bus plate.



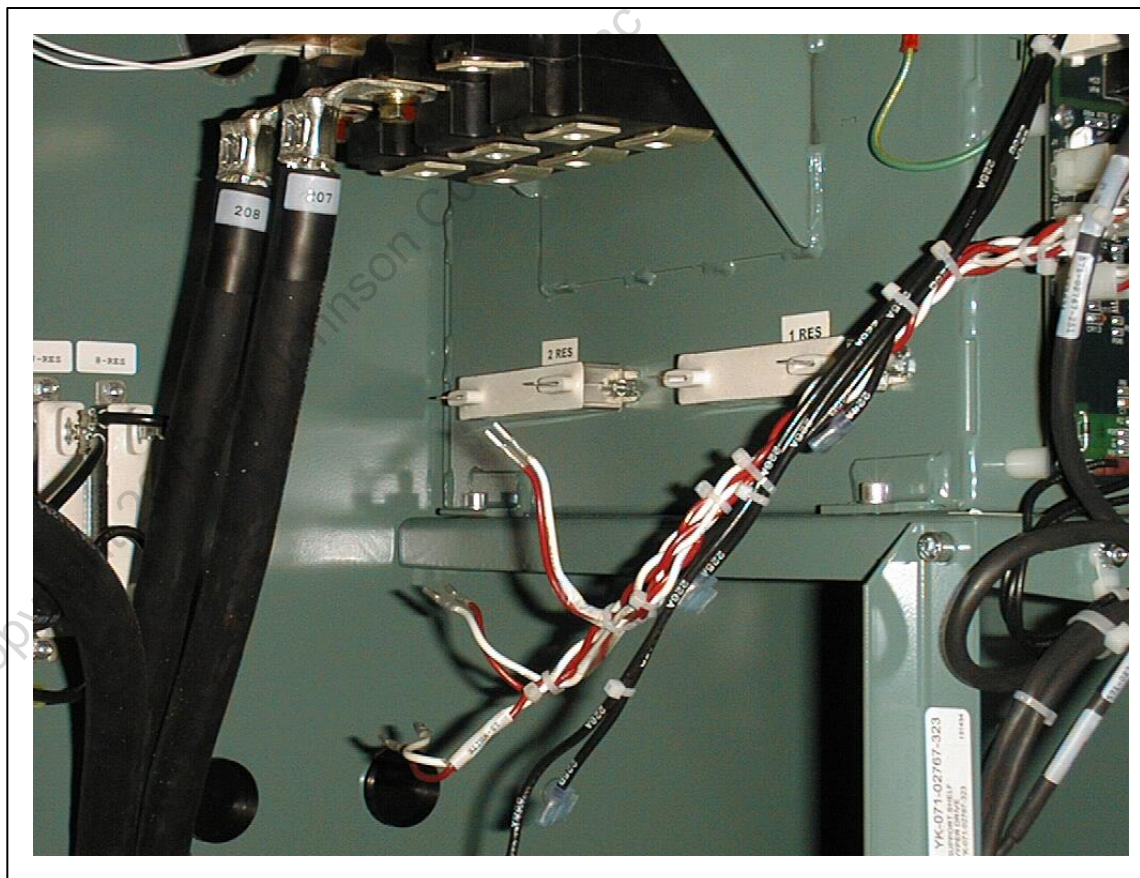
Disconnect the negative(-) bus bar and extender from all 3 Input Rectifier Modules



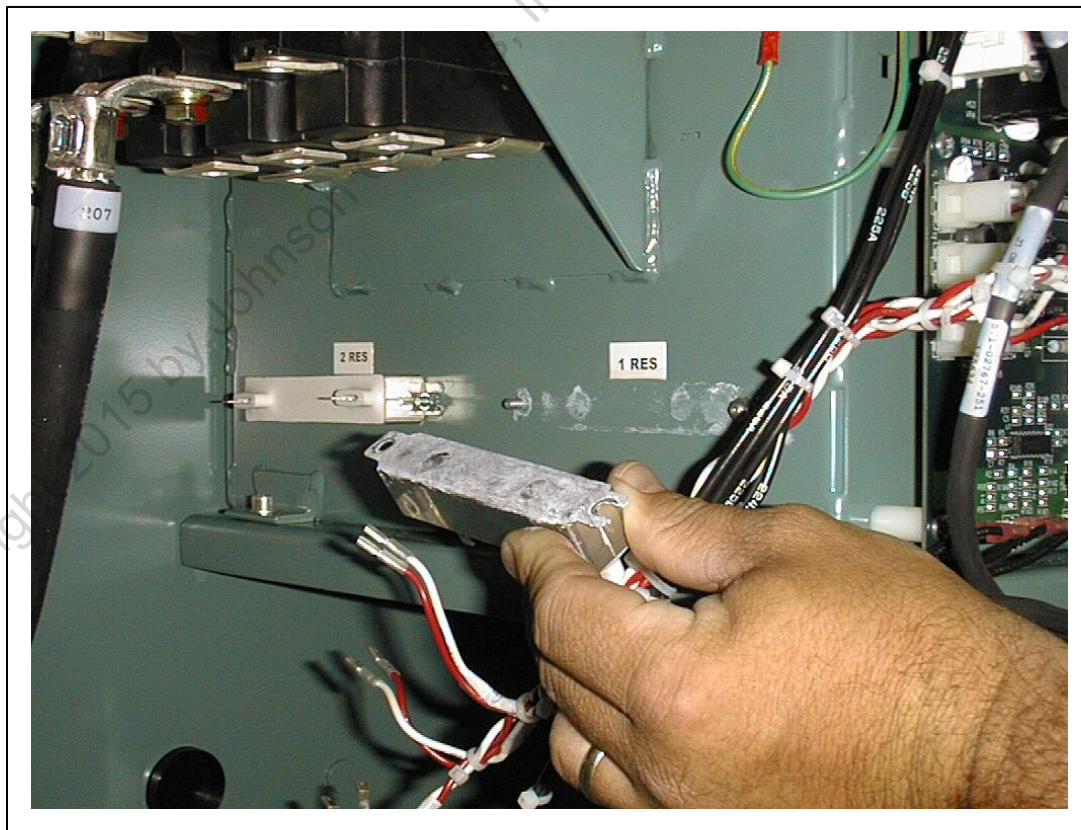
The negative(-) bus bar and extender removed



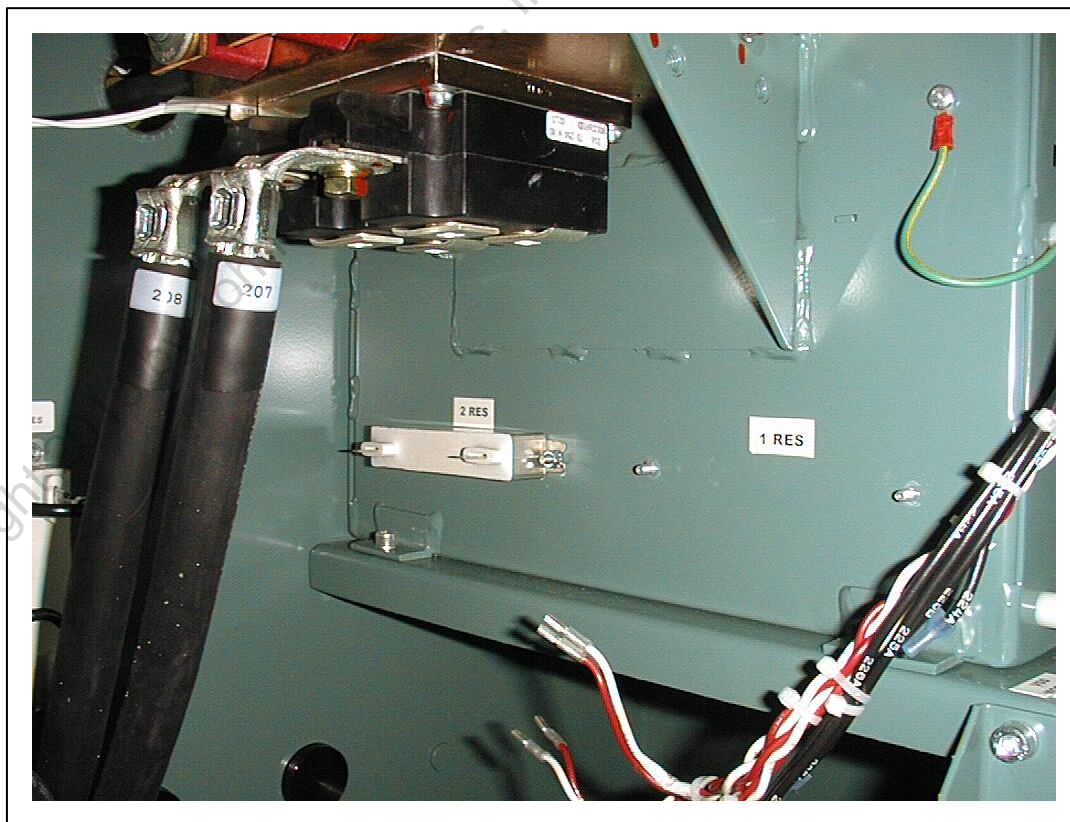
The bus bars removed and wiring disconnected



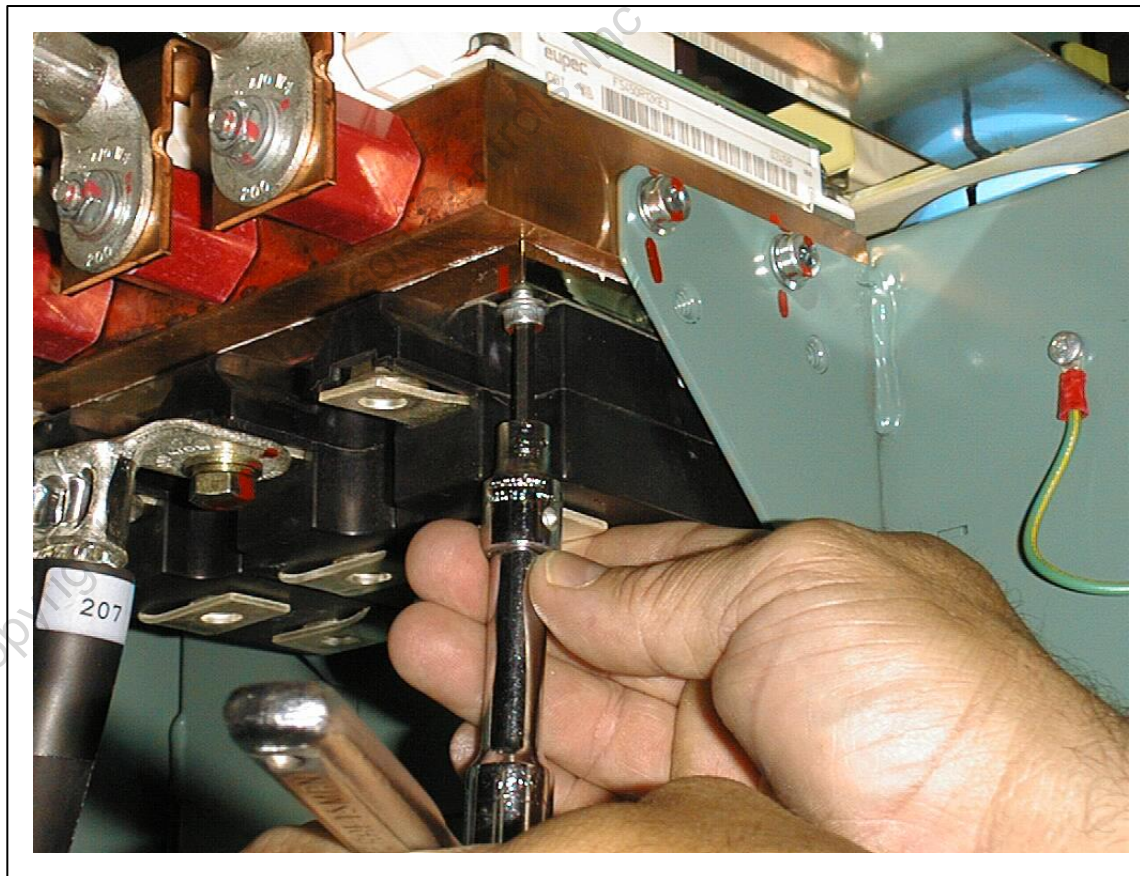
Remove the Balancing Resistor from under the Input Rectifier Module being removed. Using the alcohol, clean the thermal compound from the heat sink of the Balancing Resistor



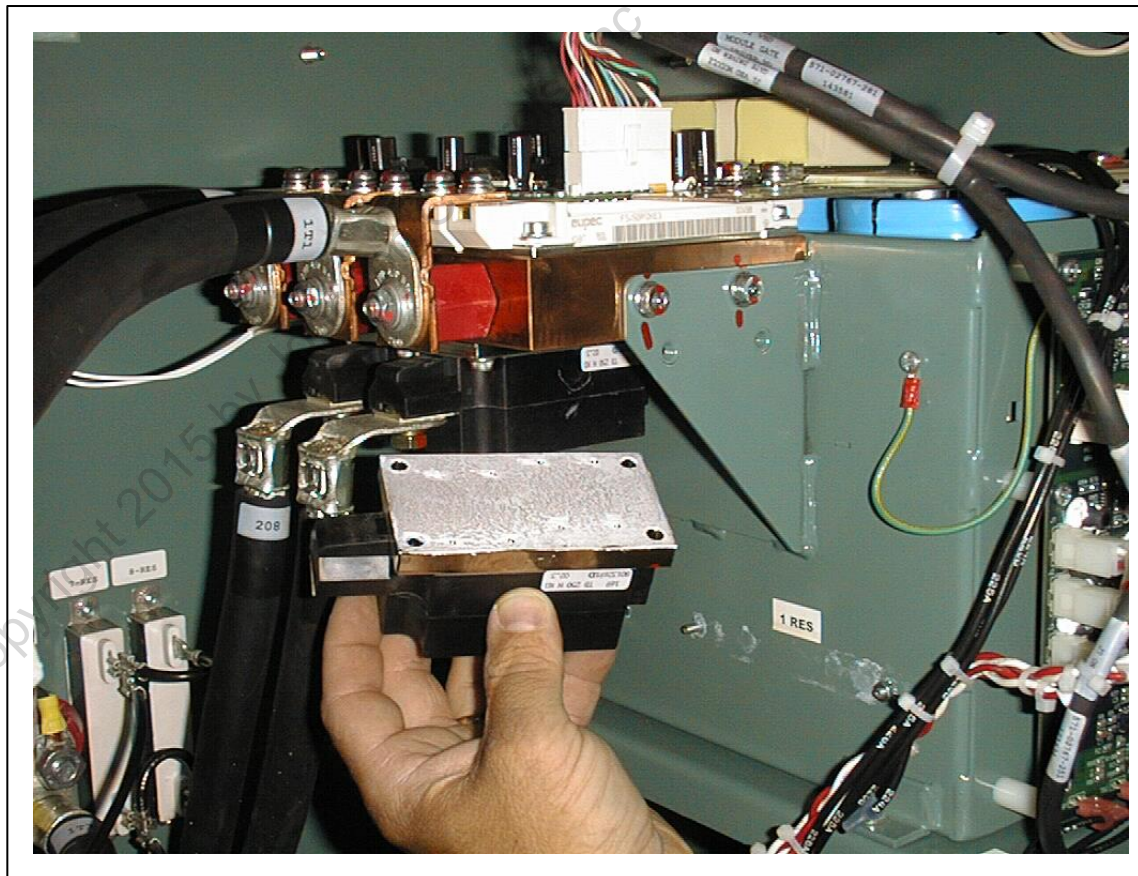
Using the alcohol, clean the thermal compound from the sheet metal surface the DC Balancing Resistor was mounted on



Remove the 4 mounting bolts from the Input Rectifier Module being removed



The Input Rectifier Module removed



With the Input Rectifier Module removed - residual thermal compound will remain on the Chill Plate



Using the alcohol, clean the surface of the Chill Plate prior to replacing the new Input Rectifier Module



The residual thermal compound removed from the Chill Plate



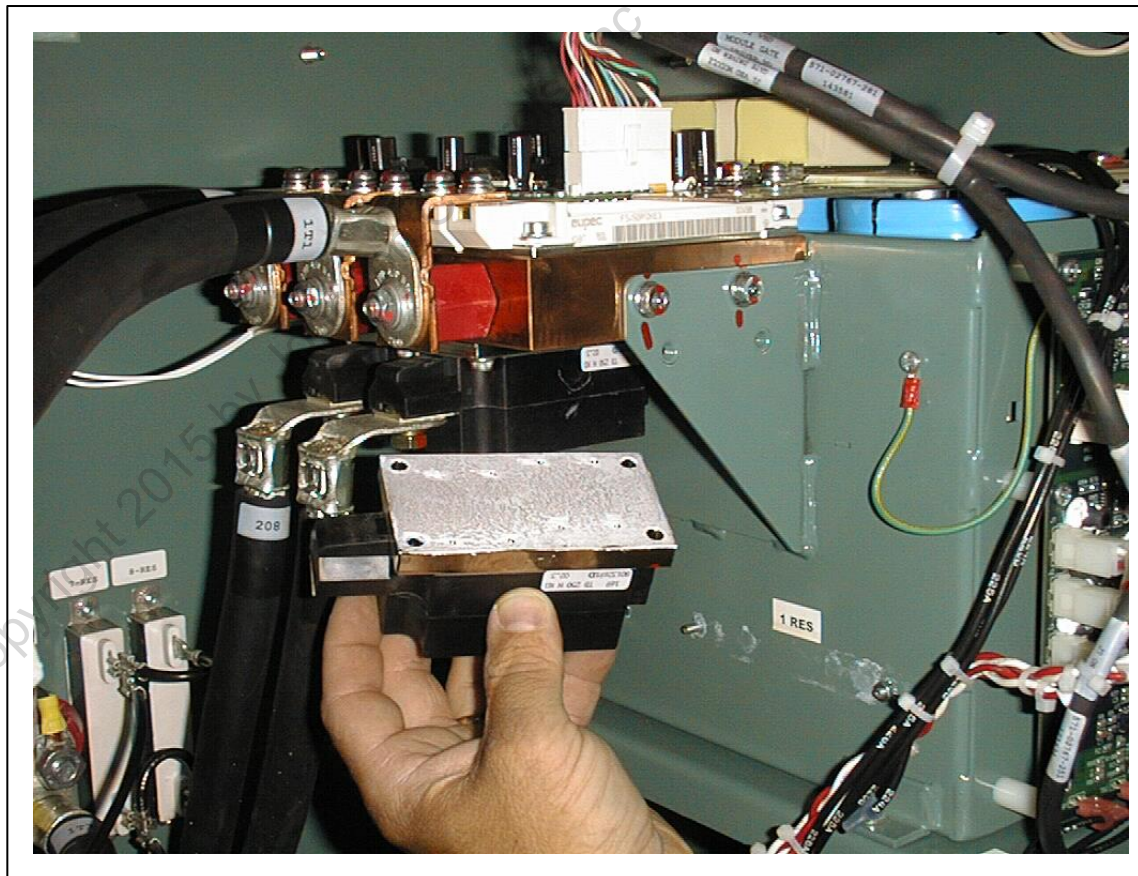
VYPER
INPUT RECTIFIER
MODULE REPLACEMENT



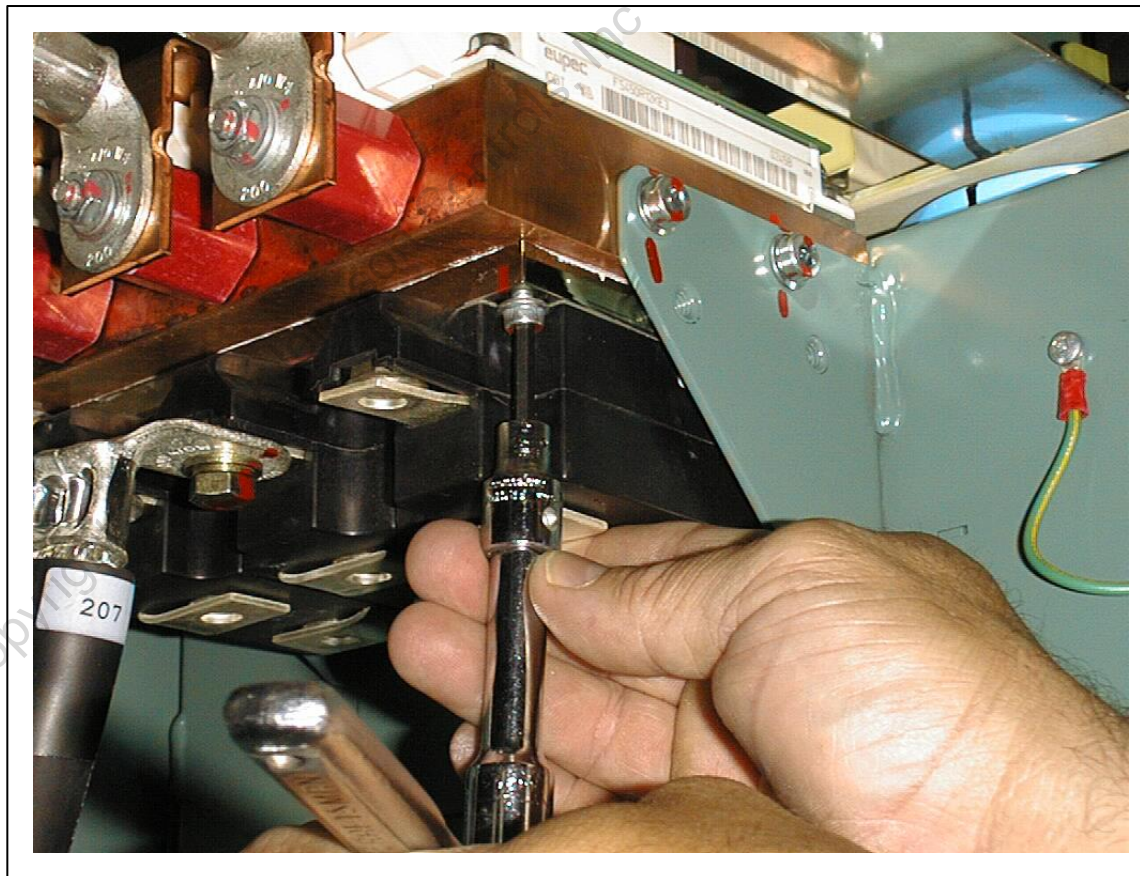
Prepare the heat sink of the new Input Rectifier Module by coating it with the thermal compound provided in the replacement kit



Replace the Input Rectifier Module against the Chill Plate in the same orientation as removed



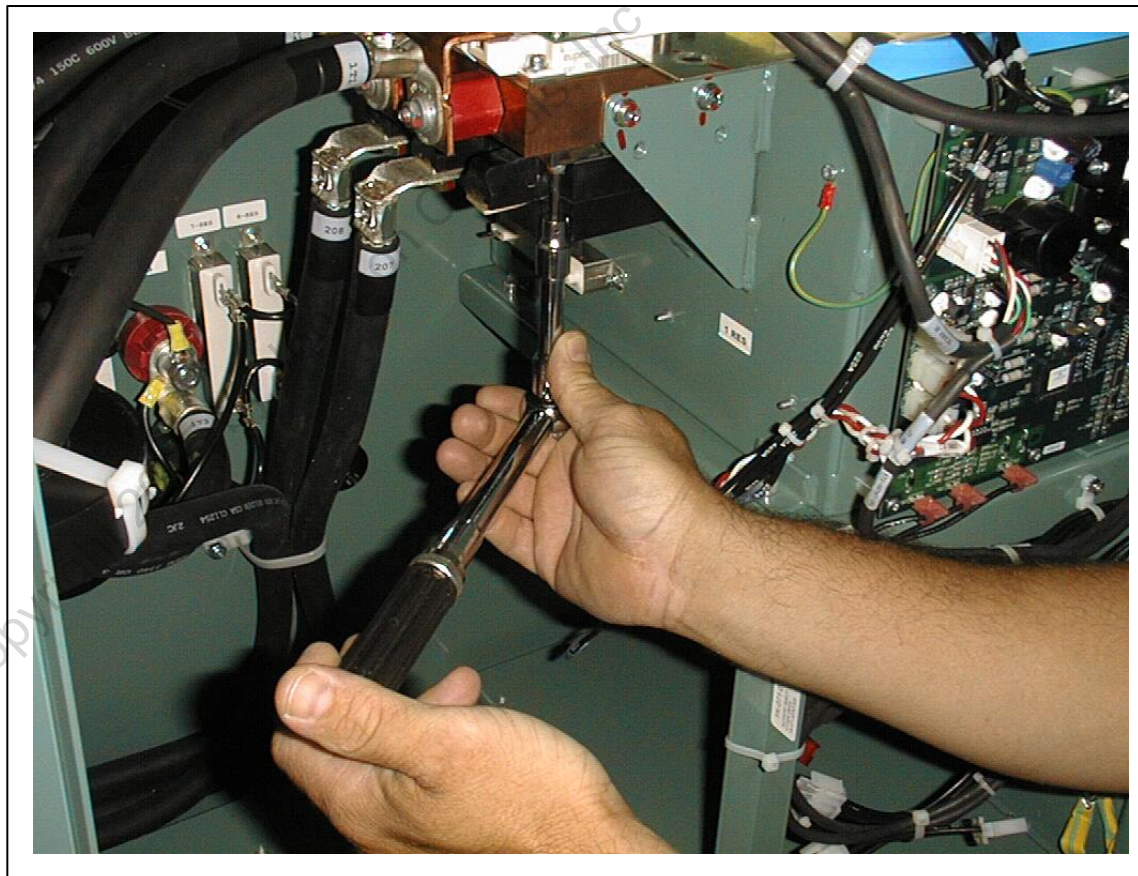
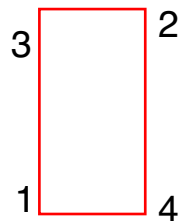
Replace the 4 mounting bolts (Only Finger Tight) of the new Input Rectifier Module



Torque the 4 Input Rectifier Module mounting bolts to 48 lb-in

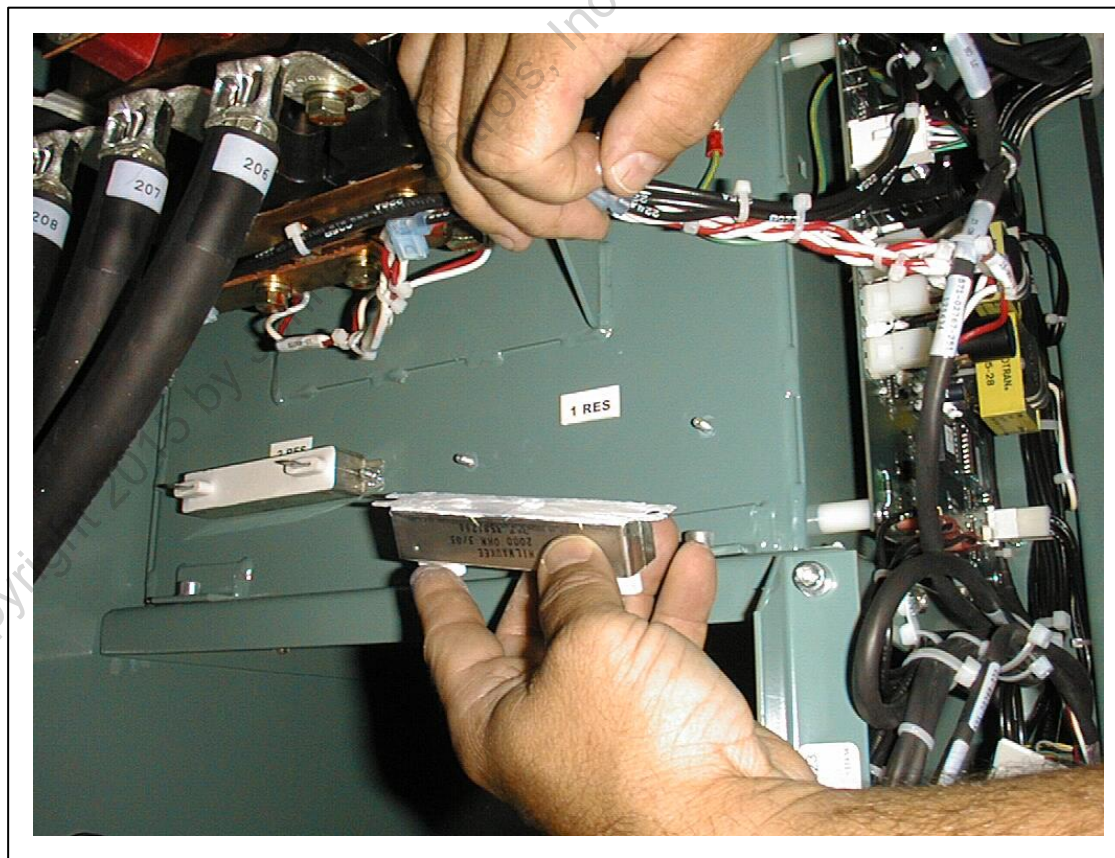
24in lbs
1234

48in lbs
4321

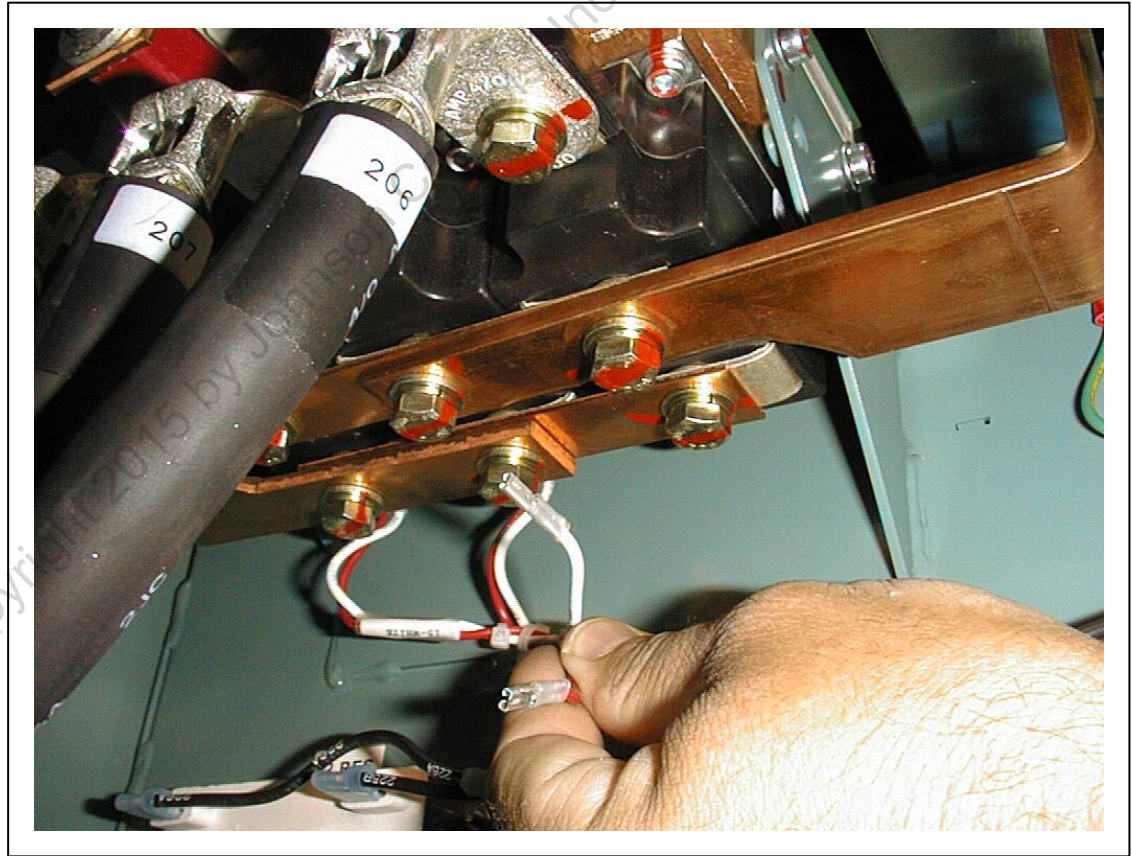


Coat the Balancing Resistor with the thermal compound provided in the replacement kit. Replace the DC Balancing Resistor

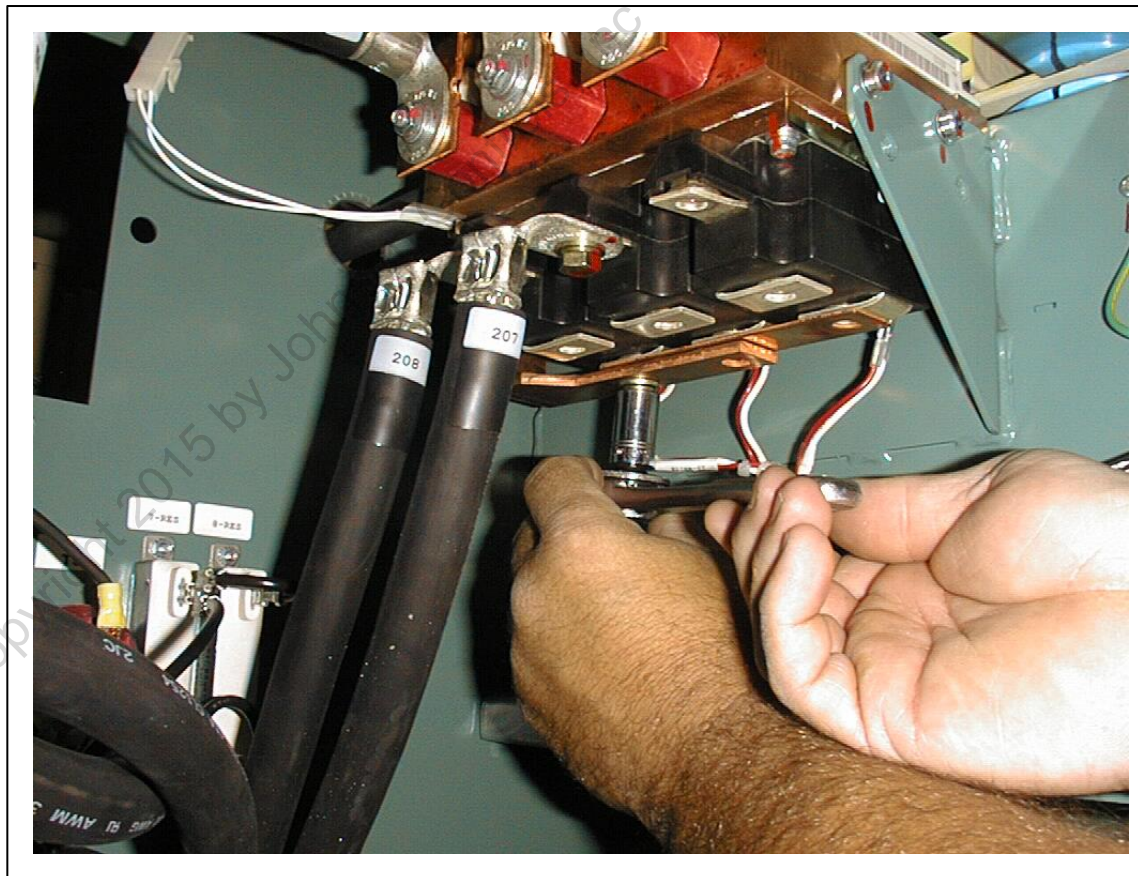
7mm socket
18.6 in lbs



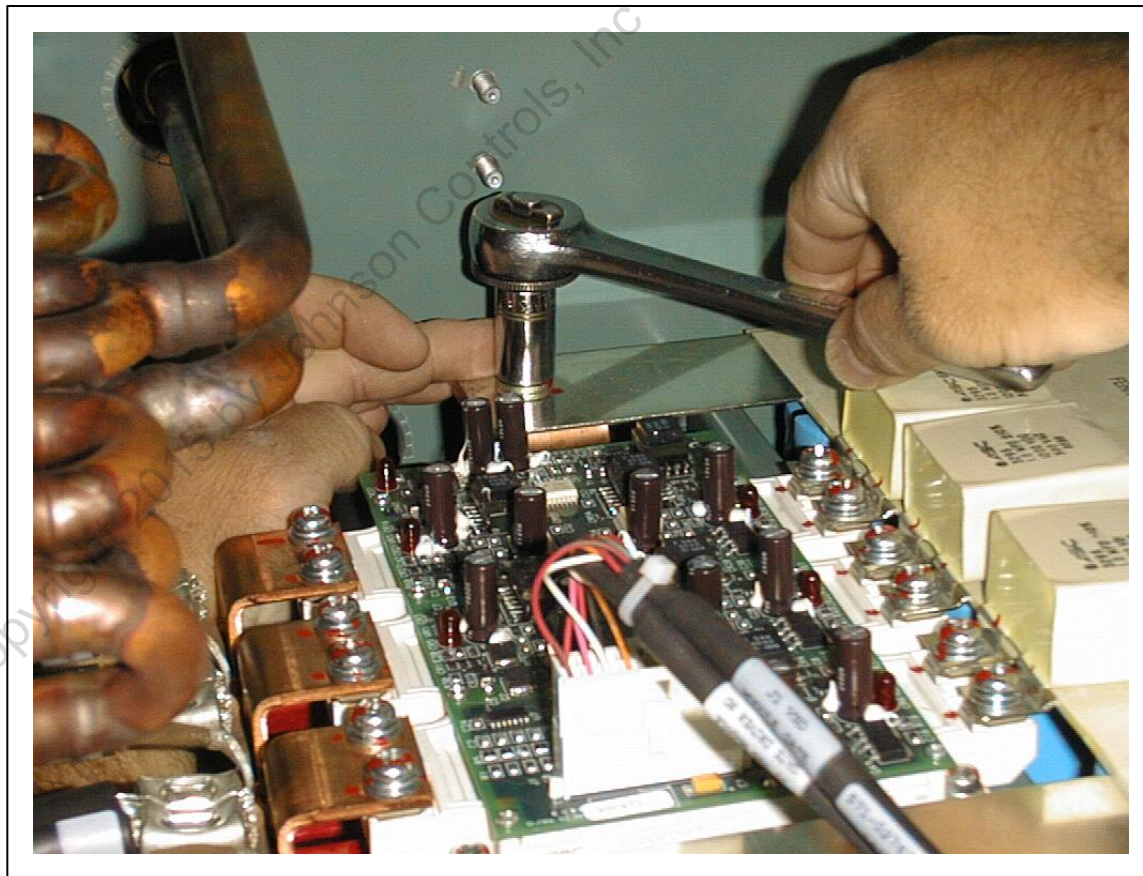
Replace the SCR gate and cathode leads to all 3 Input Rectifier Modules and to the 2 DC Balancing Resistors



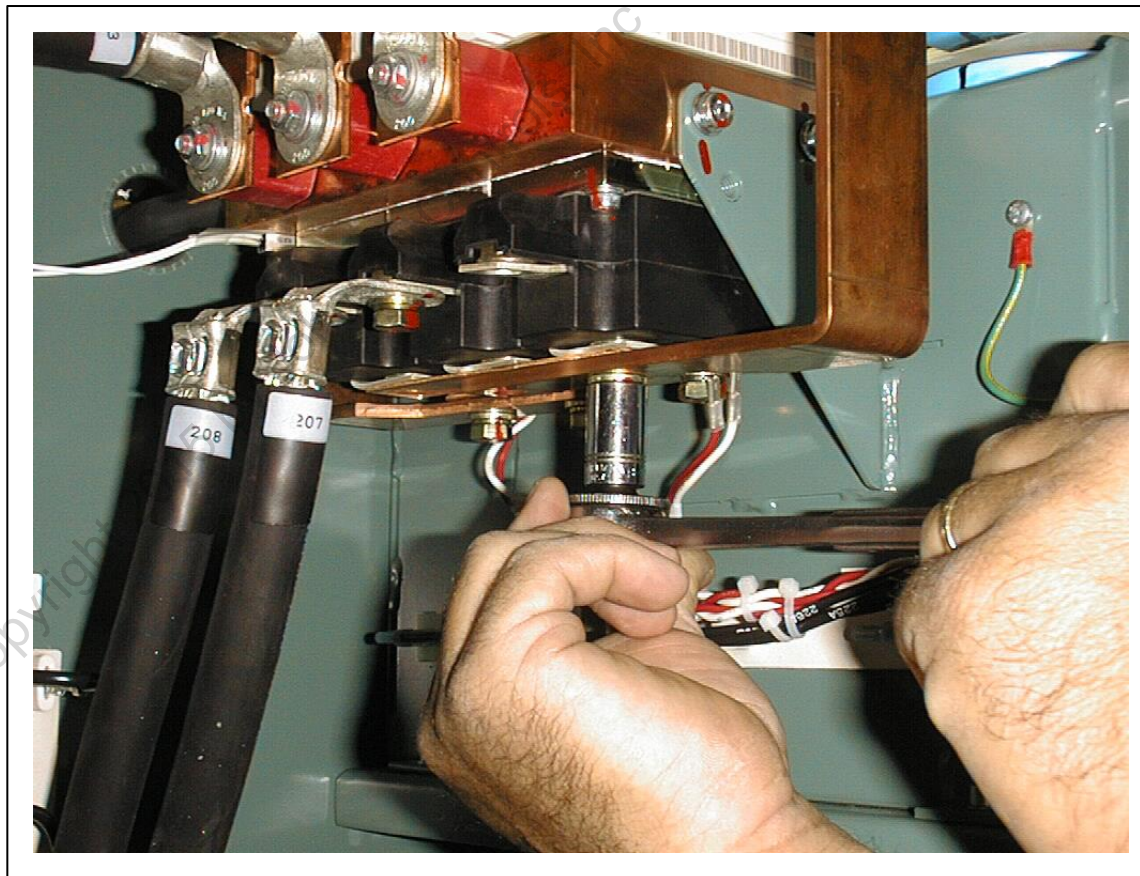
Re-attach (Only Finger Tight) the negative(-) bus bar and extender to the 3 Input Rectifier Modules



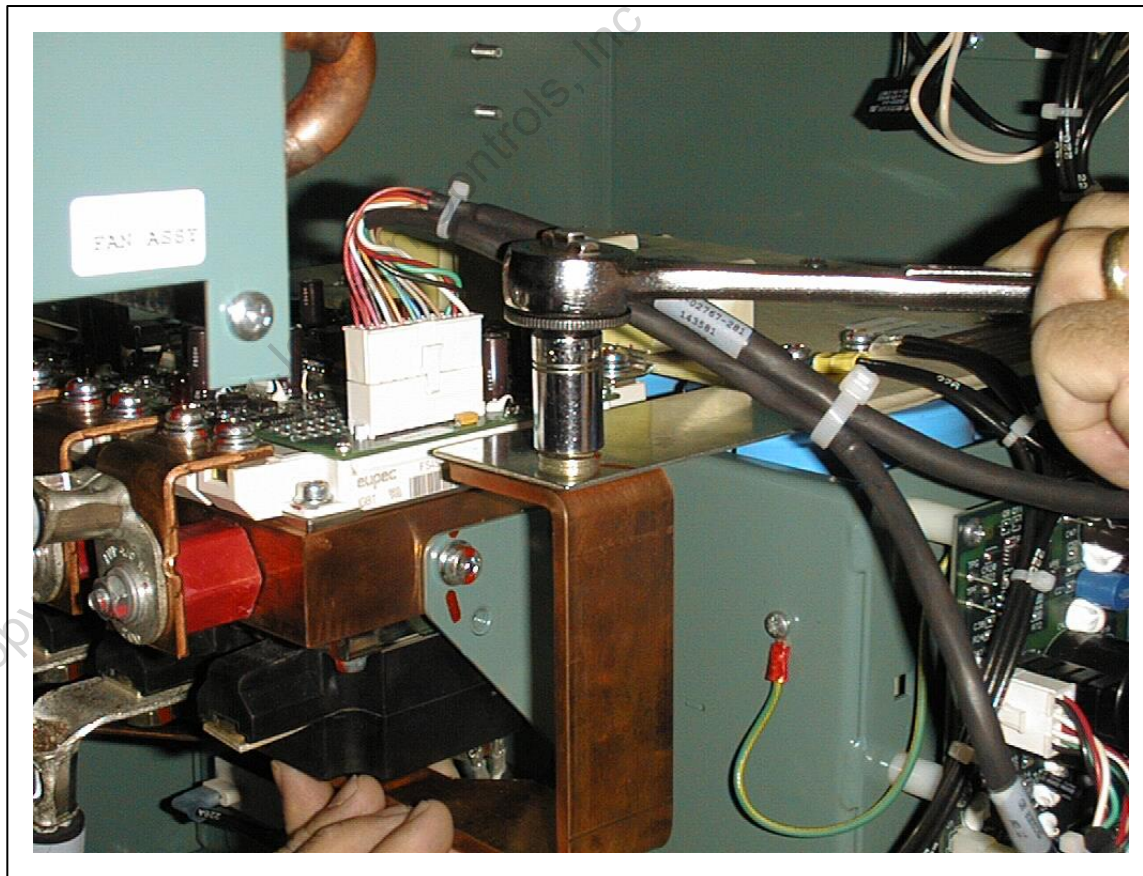
Re-attach (Only Finger Tight) the negative(-) bus bar to the negative(-) bus plate



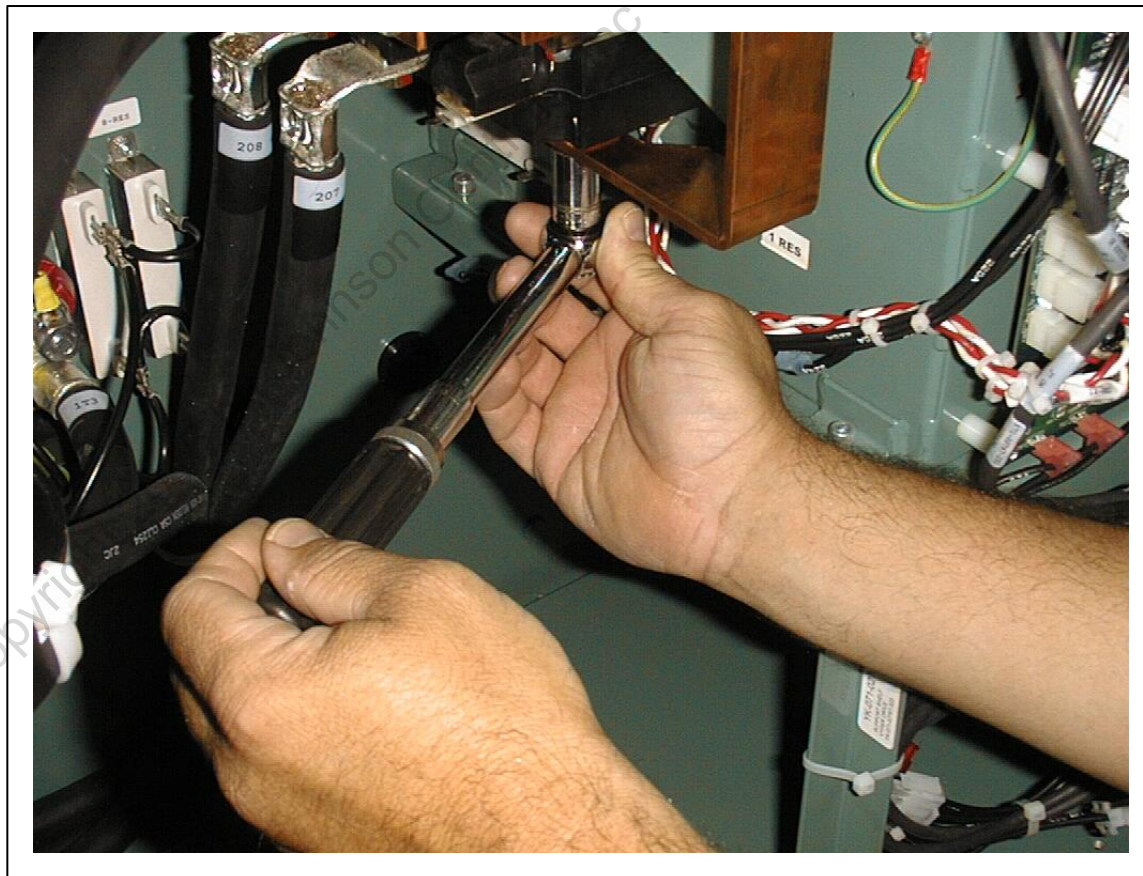
Re-attach (Only Finger Tight) the positive(+) bus bar and extender to the 3 Input Rectifier Modules



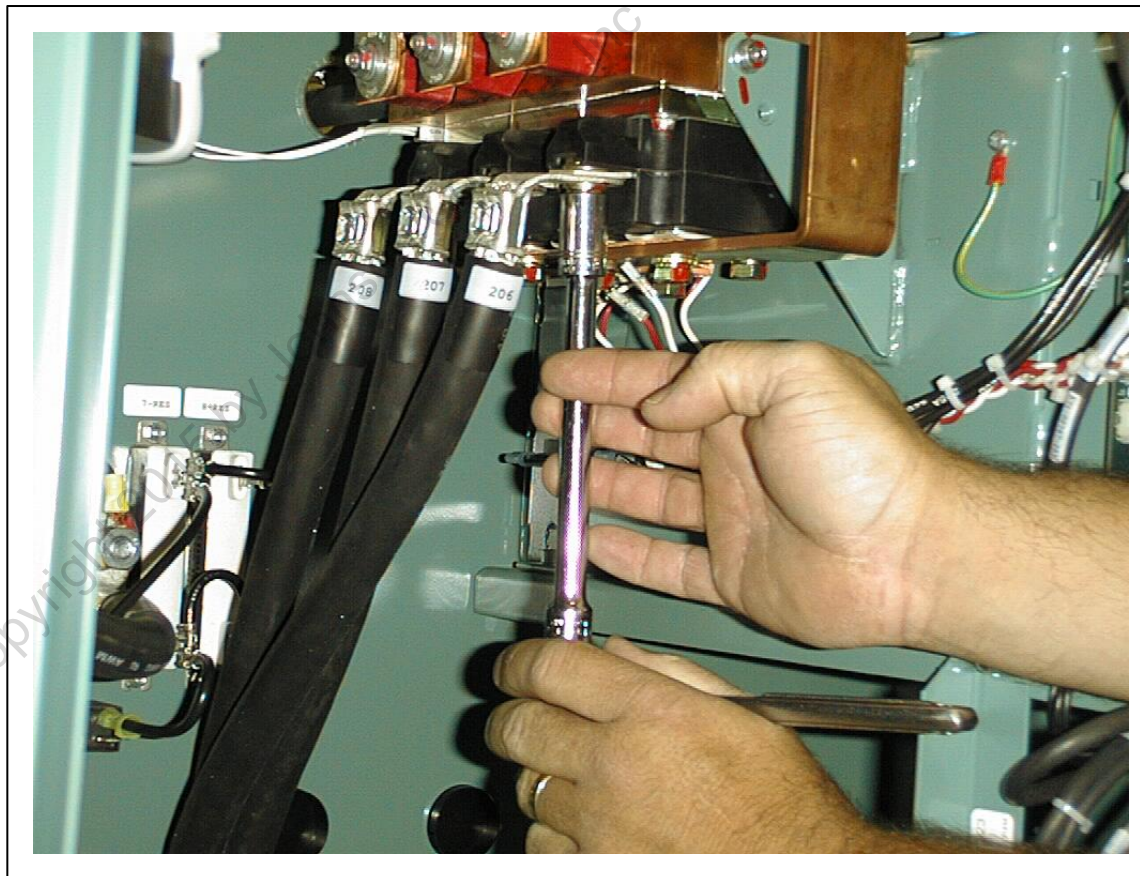
Re-connect (Only Finger Tight) the positive(+) bus bar to the Positive(+) bus plate



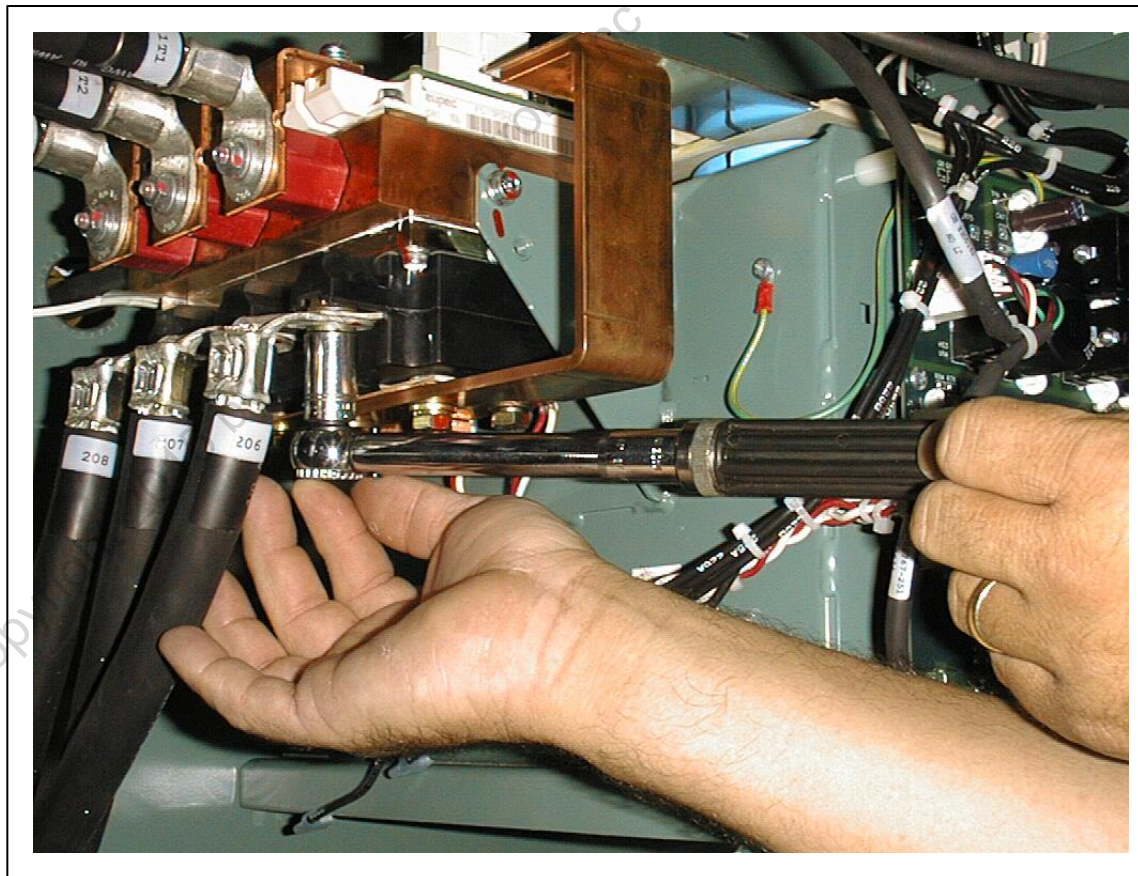
Torque all bus bar to bus plate and Input Rectifier Module connections to 88 lb-in



Replace (Only Finger Tight) the AC Line Inductor lead to the Input Rectifier Module

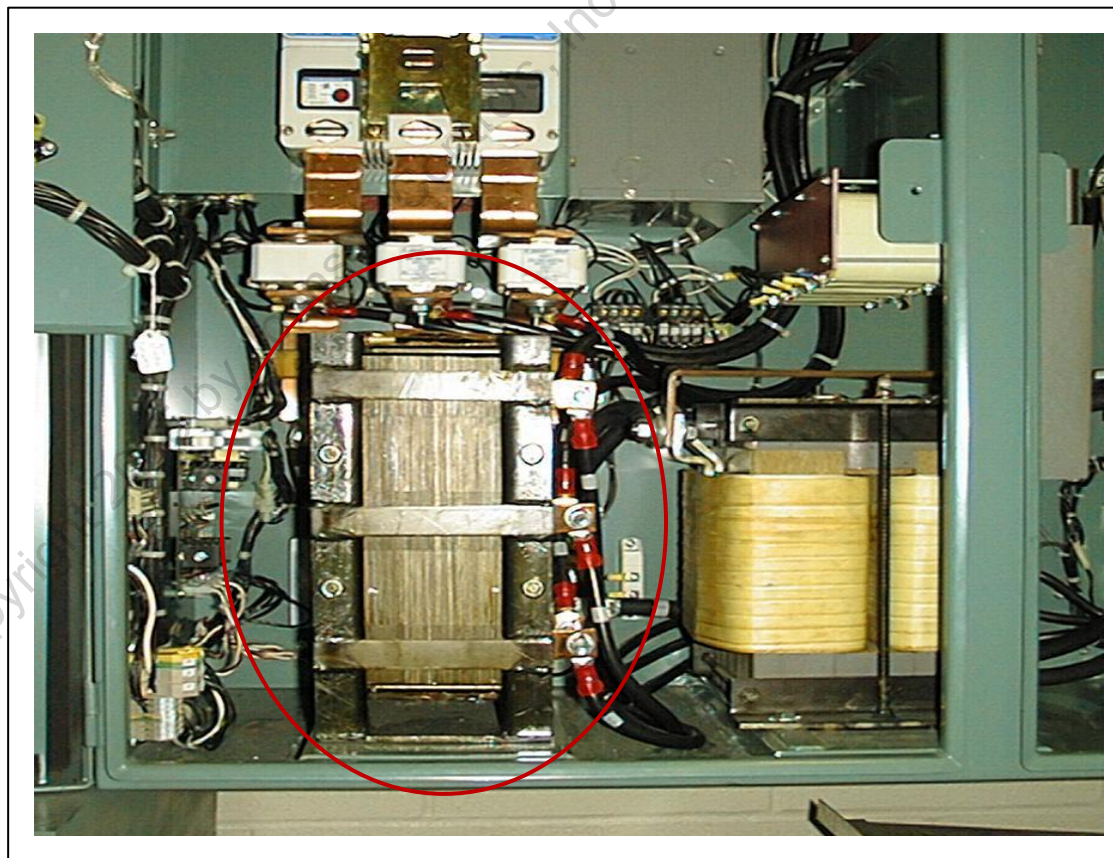


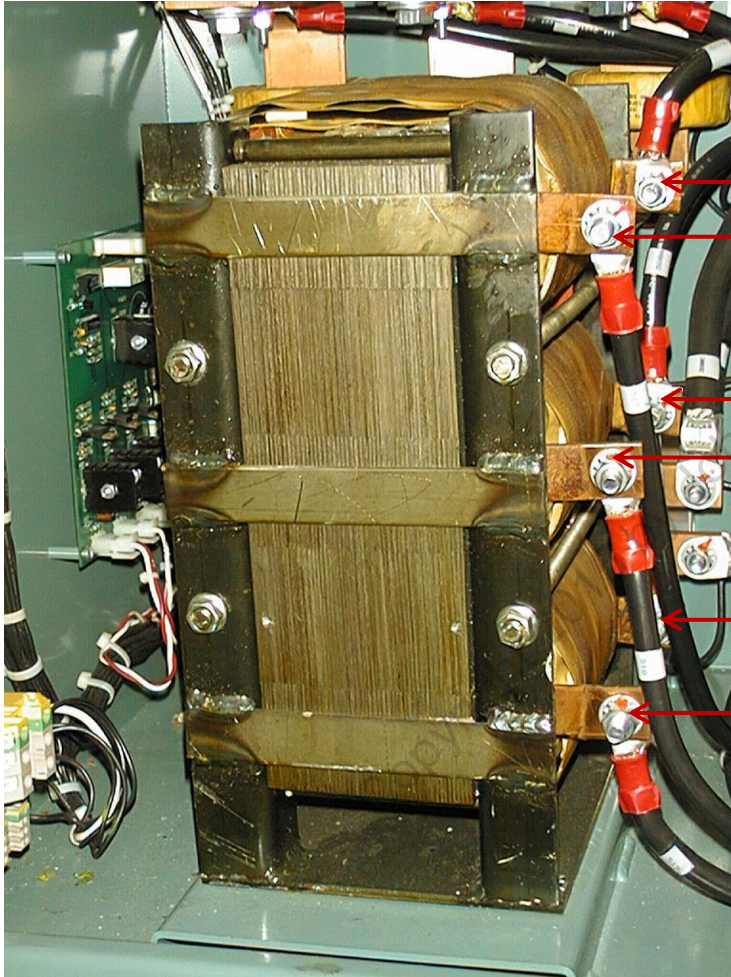
Torque the AC Line Inductor lead to the Input Rectifier Module to 88 lb-in



STYLE "D"
INPUT RECTIFIER
MODULE REPLACEMENT

If the Harmonic Filter option has been installed, the Harmonic Filter's 3-Phase Filter Inductor must be removed prior to the Input Rectifier Module replacement





Wire No. 507

Wire No. 517

Wire No. 508

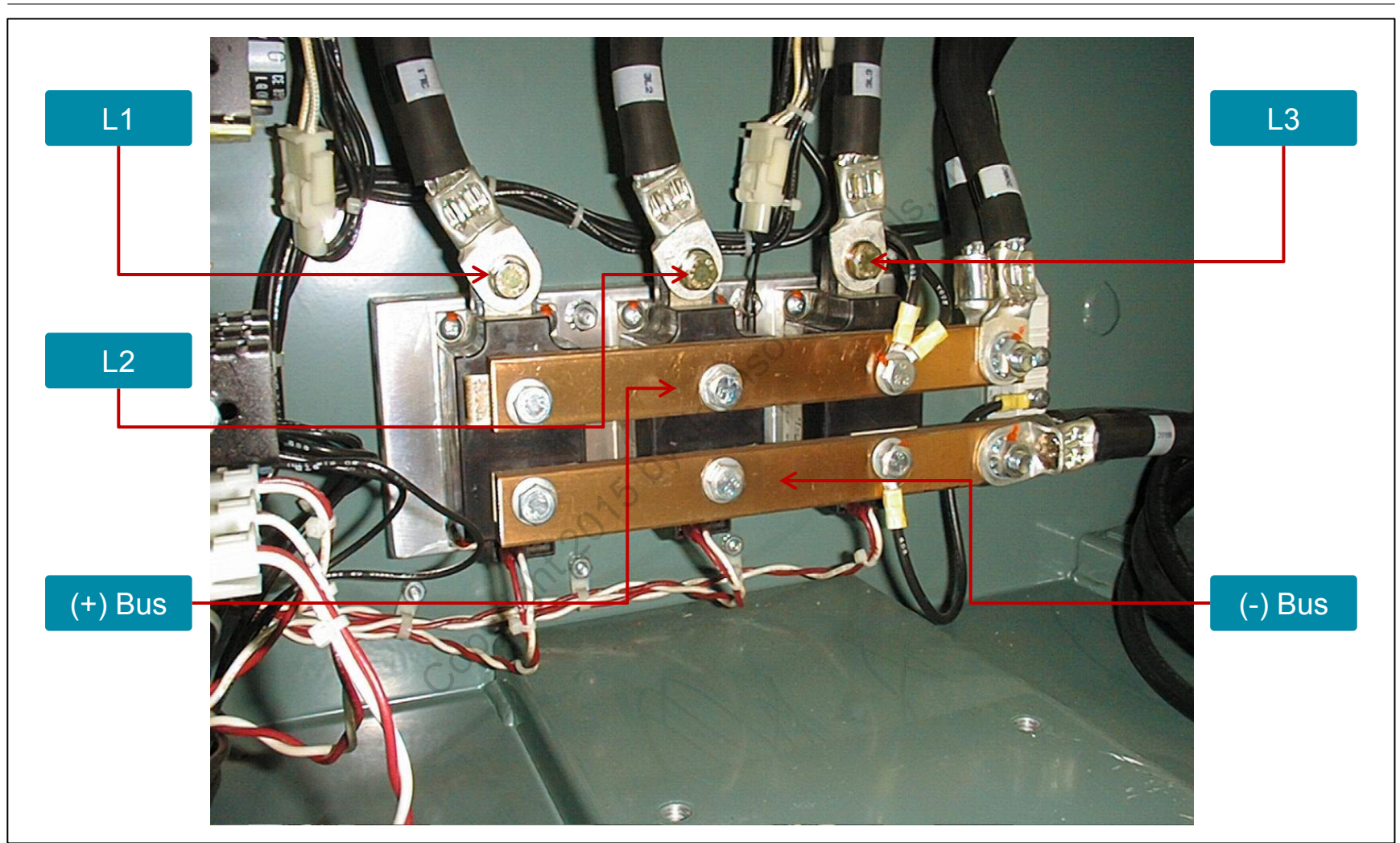
Wire No. 518

Wire No. 509

Wire No. 519

Disconnect all and remove

Remove Bus Bar and SCR



Optispeed 7049 Operational/Input Rectifier Changeout Lab

- Follow All JCI Safety policies for working on this type of equipment
 - Orange Bag PPE is located on the shelf under the drive
 - Tool boxes are located on the shelf under the drive.
- Hook up Optiview simulator to Vyper drive
 - Ensure that the OptiView Simulator Settings for YK match the following:
 - **Software version must be 17 or 19.**
 - Menu Items -
 - Refrigerant Selection: R134a
 - Liquid Type: Water
 - Chiller Style/Compressor: Style E/P Compressor
 - Chilled Liquid Pump Operation: Standard
 - Motor Type: VSD – (Toggle switch VSD/New SSS also required)
 - Anti-Recycle: Disabled
 - Power Failure Restart: Auto
 - Coast down: Standard
 - Pre-Run: Standard
 - Oil Pump Package: Variable Speed – (Toggle switch setting also required)
 - Local Leaving Chilled Liquid Temperature Set point: 45°
 - Local Leaving Chilled Liquid Temperature Range: 10°
 - Leaving Chilled Liquid Temperature Cycling Offset Shutdown: 4°
 - Leaving Chilled Liquid Temperature Cycling Offset Restart: 3°
 - High Pressure Warning Threshold: 150 PSIG
 - Communications type = “York Protocol”
 - Clear VSD communications failures counts
 - Potentiometer settings -

- Chilled Liquid Temperature Leaving: 45°
- Chilled Liquid Temperature Return: 55°
- Condenser Liquid Temperature Leaving: 95°
- Condenser Liquid Temperature Return: 85°
- Discharge Temperature: 130°
- Oil Sump Temperature: 150°
- Condenser Pressure: 120 PSIG
- Evaporator Pressure: 37 PSIG
- Evaporator Refrigerant Temperature: 43°
- Pump Oil Pressure (HOP): 36 PSIG
- Sump Oil Pressure (LOP): 35 PSIG
- PRV Position MUST be at 100% to ramp to 60 hz
- Start VSD to ensure proper operation
- Soft shutdown
- Power down
 - Ensure DC buss is totally discharged
 - Using Workbook Section 5B and SCR Replacement sheet - Remove then re-install an SCR/Diode module
 - Power up and ensure proper operation
 - Shutdown

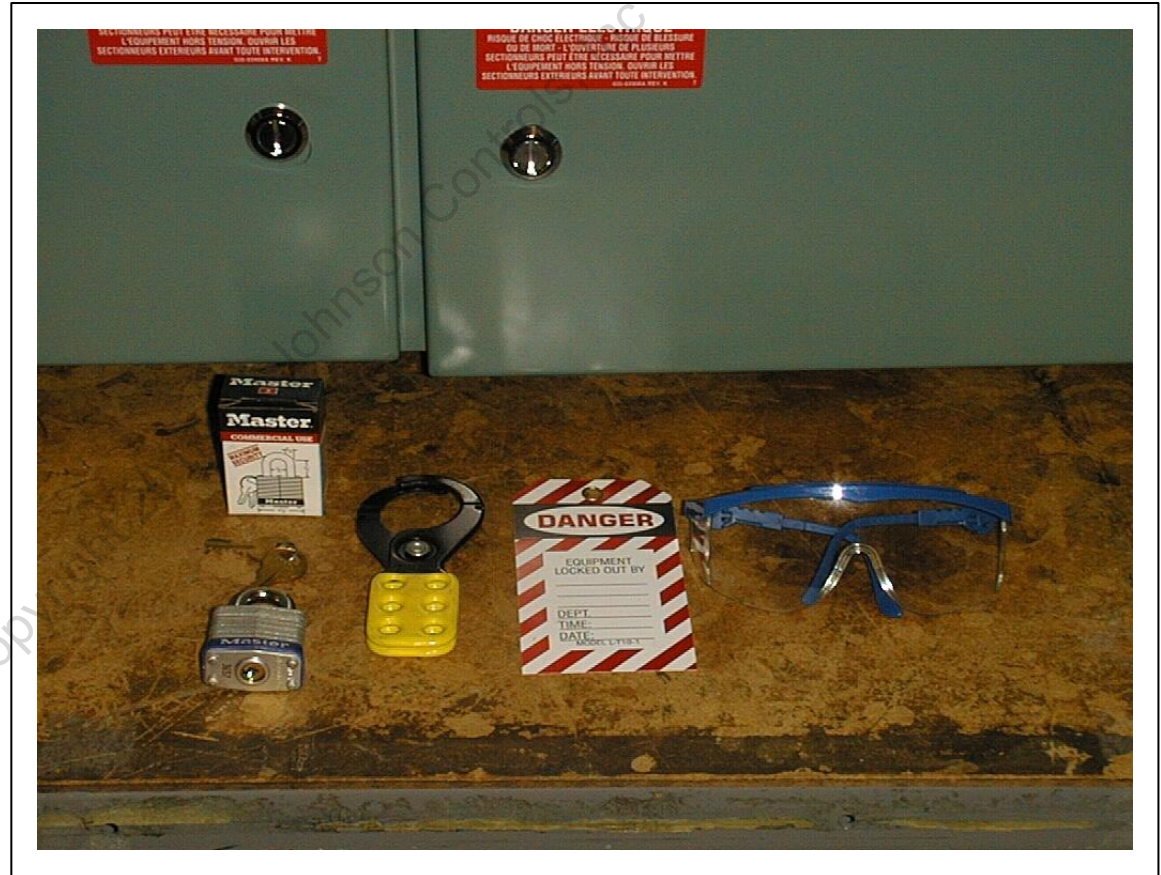
Copyright 2015 by Johnson Controls, Inc

Output Pole Replacement



OUTPUT POLE
REPLACEMENT
PRELIMINARY
PREPARATIONS

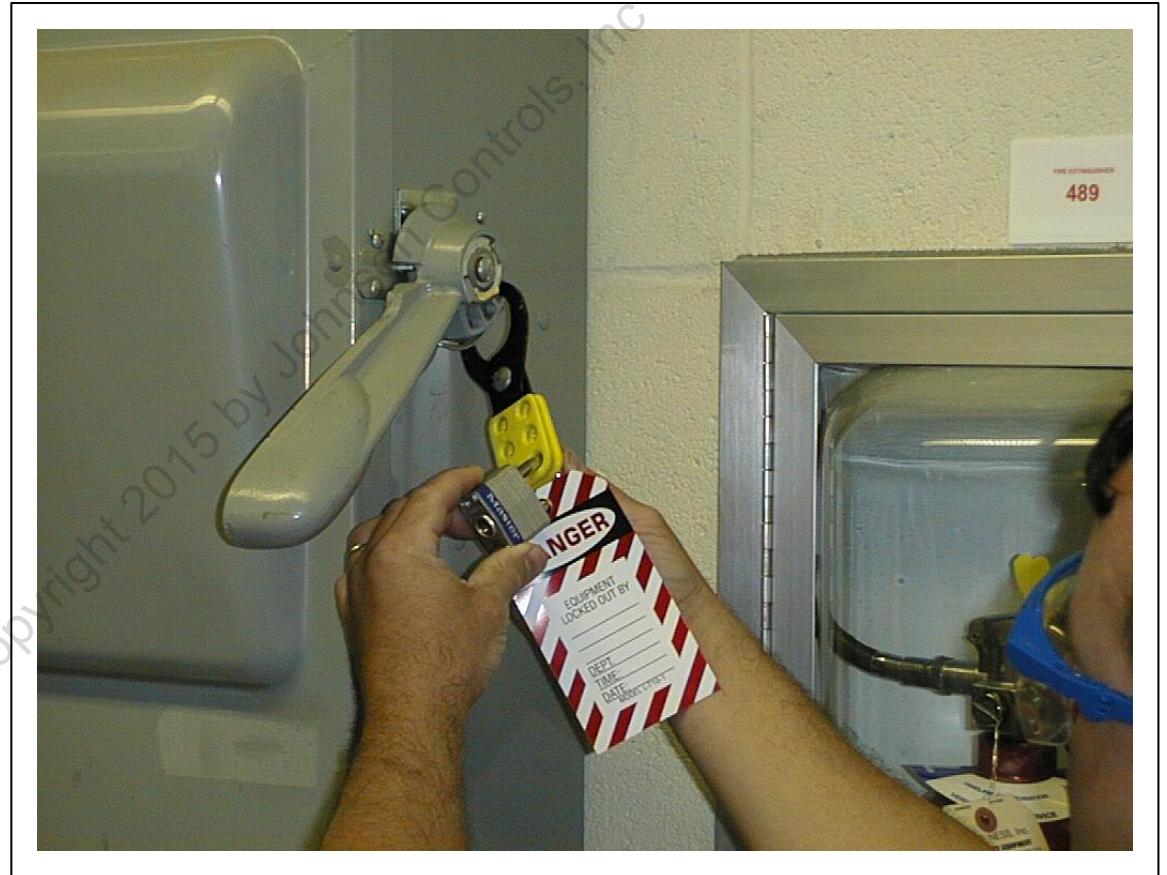
Preliminary Preparations



Turn Off

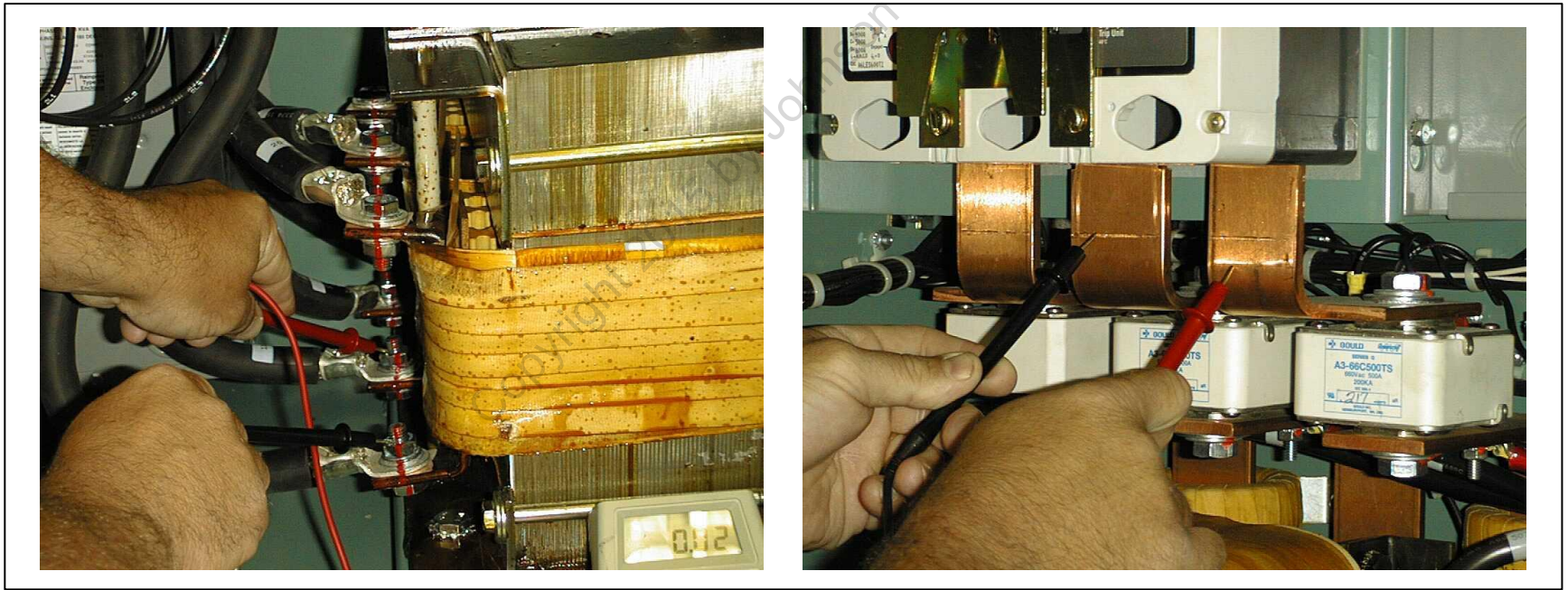


Lock Out-Tag Out

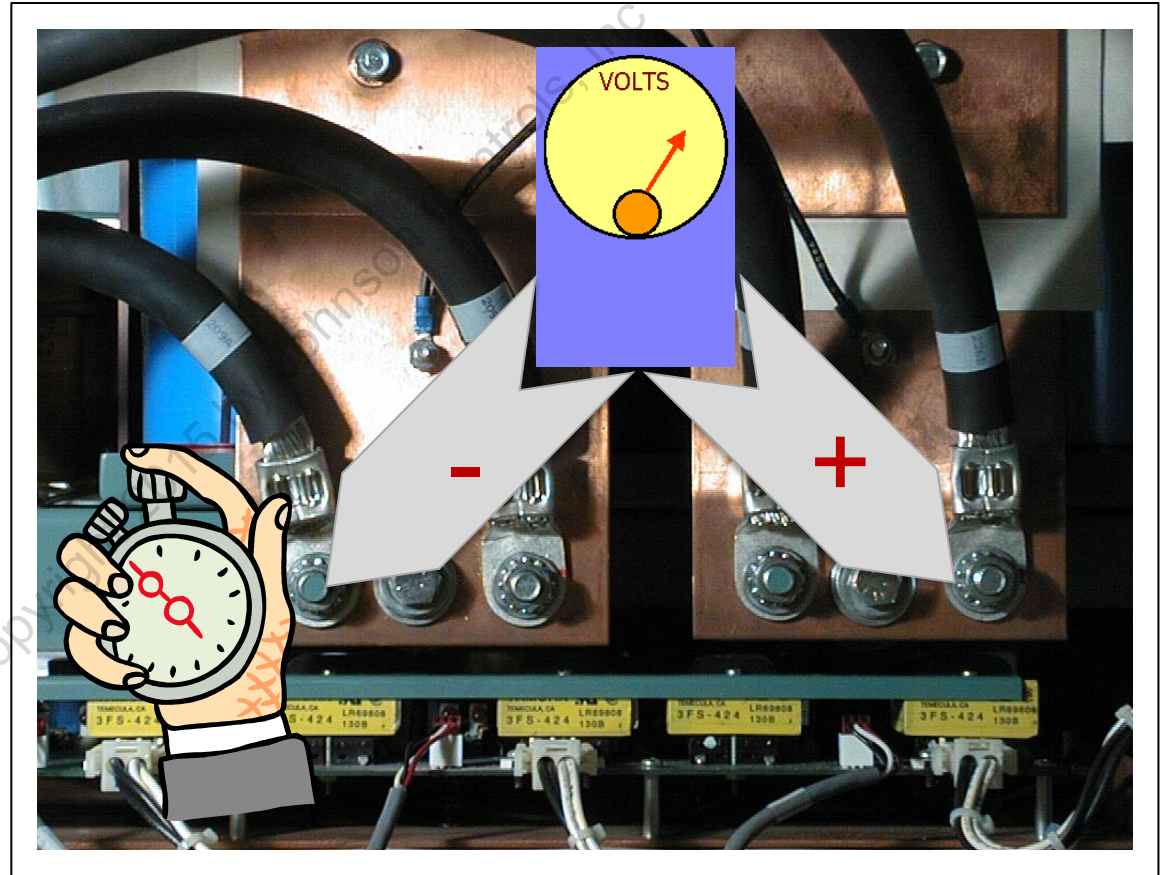


Preliminary Preparations

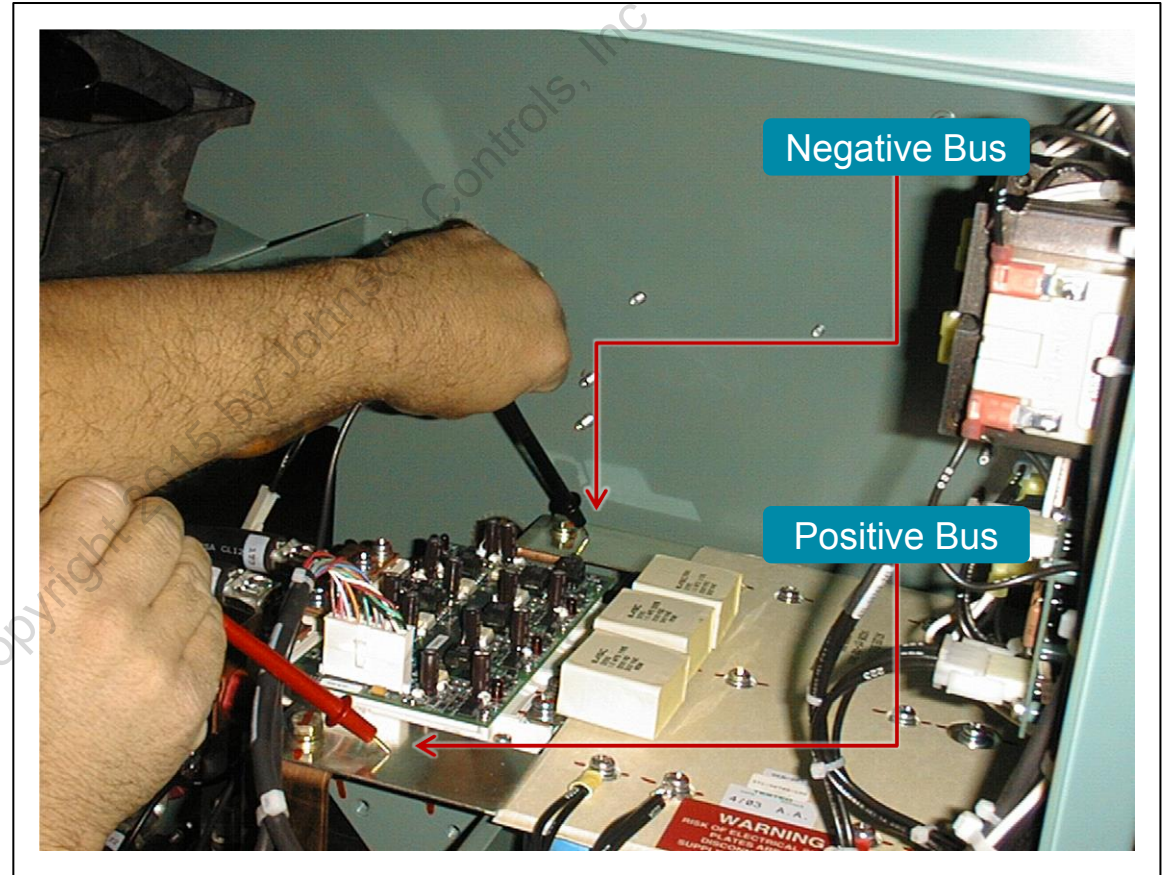
- Verify that the VOM is operational.
- Do not assume that voltages are no longer present!
- With the VOM, verify that there is no voltage present on any of the 3-phases downstream of the circuit breaker / disconnect



Verify that the DC Bus has fully discharged

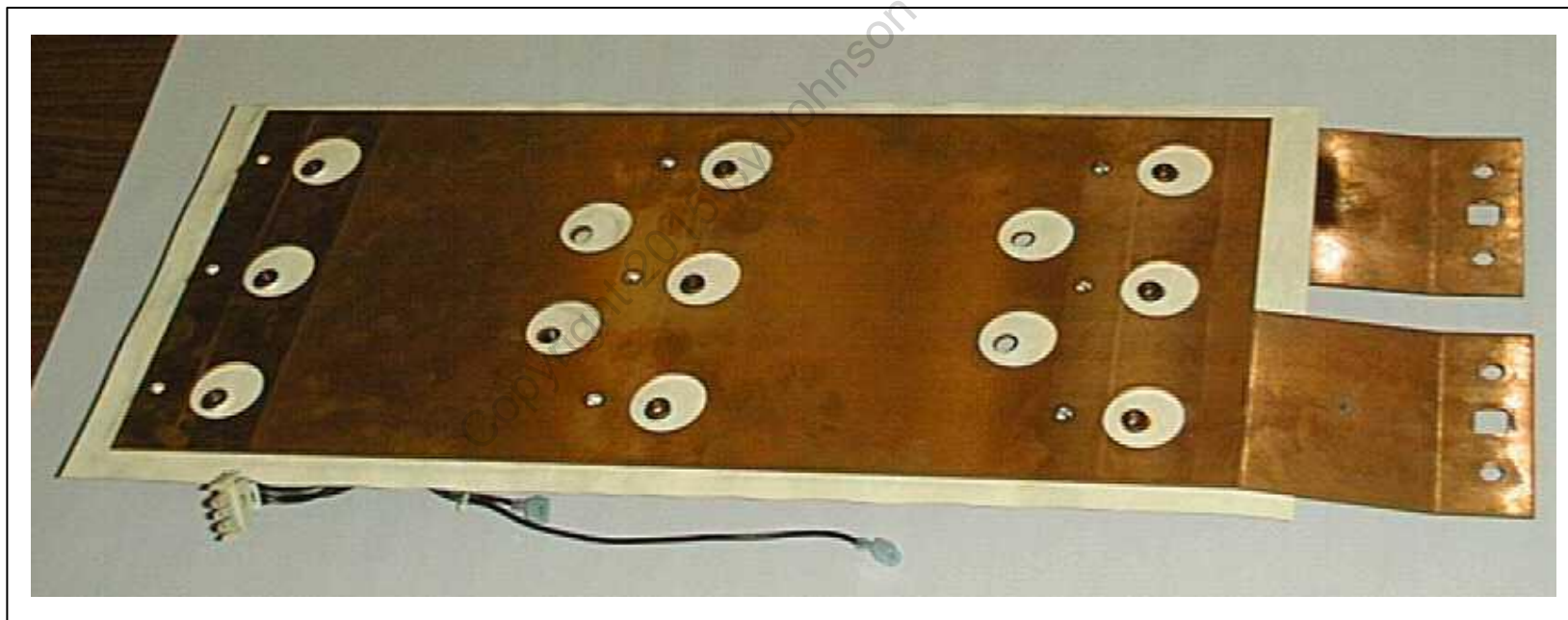


Verify that the DC Bus has fully discharged

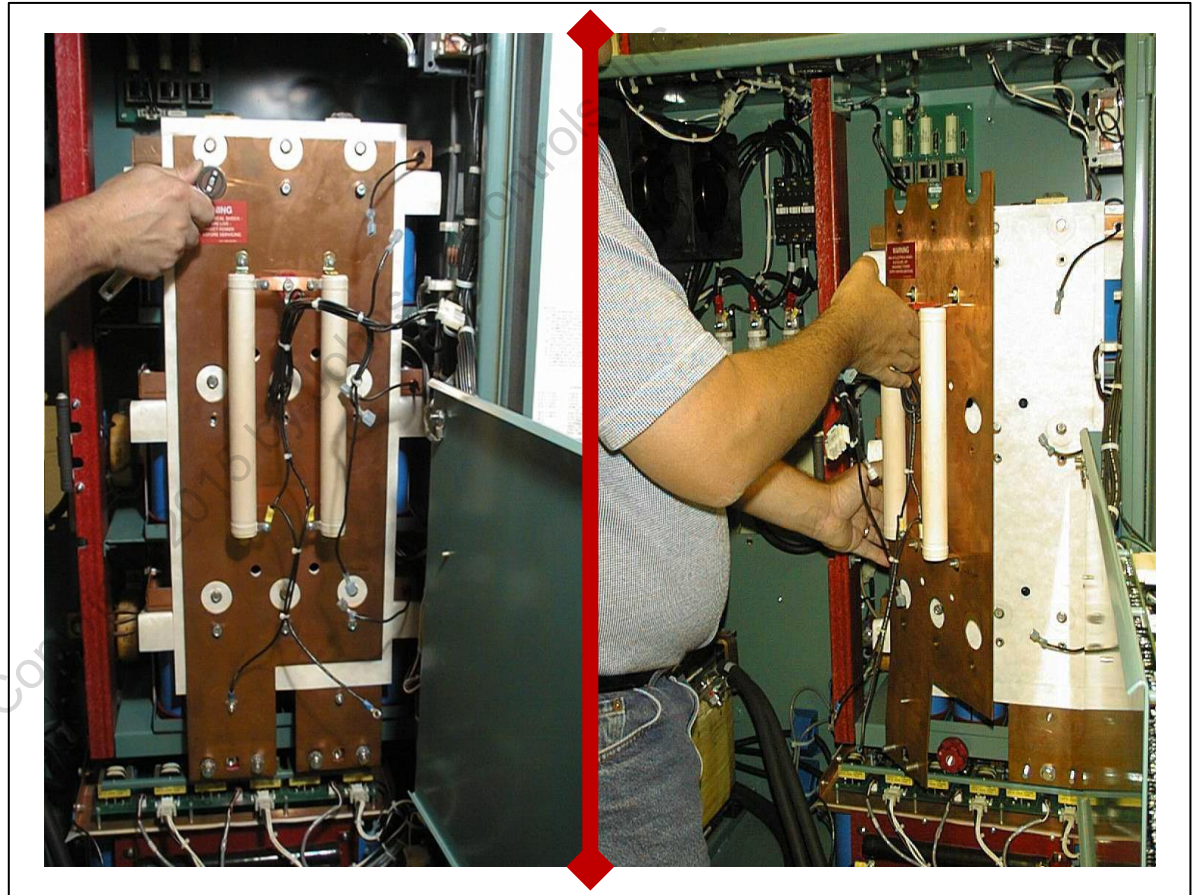


STYLE "D"
OUTPUT POLE
REMOVAL PROCEDURE

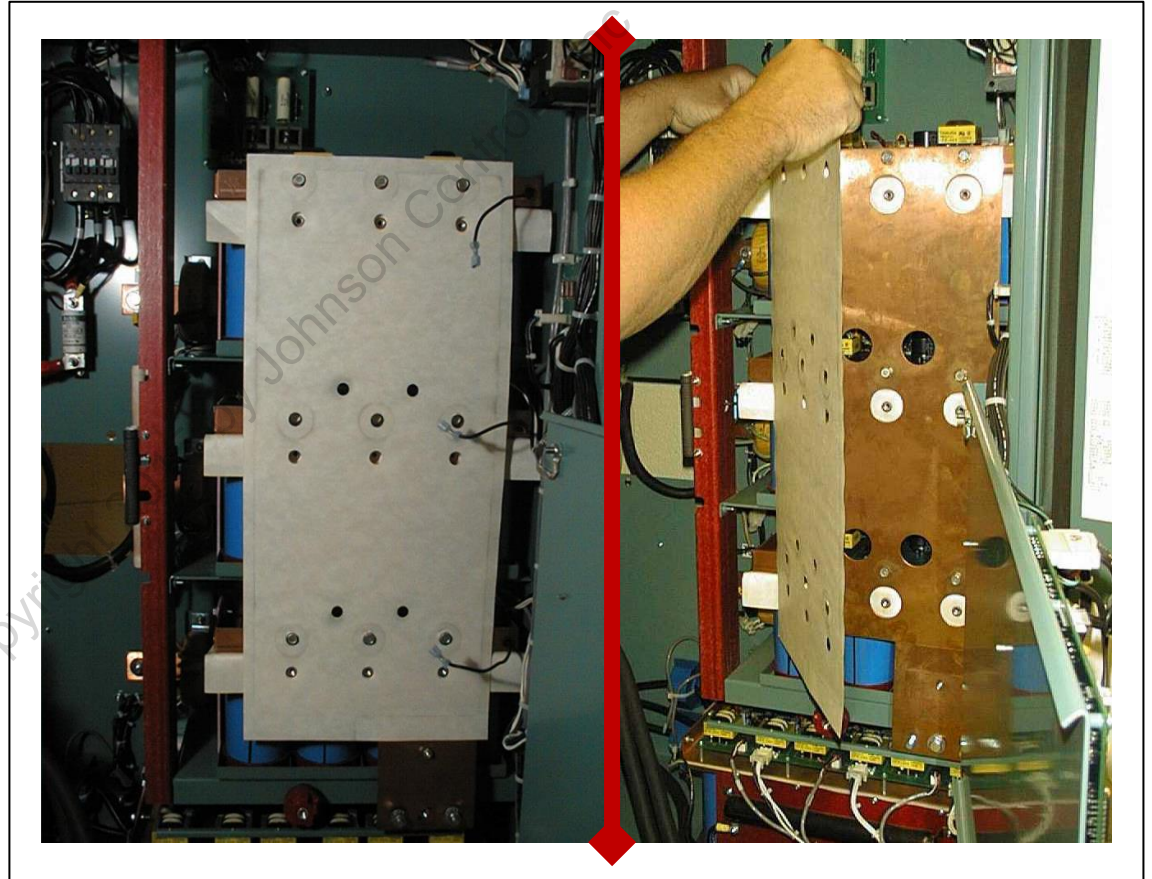
The negative(-) bus plate, insulator sheet, and positive(+) bus plate should be laid out in the order and orientation that they were removed.



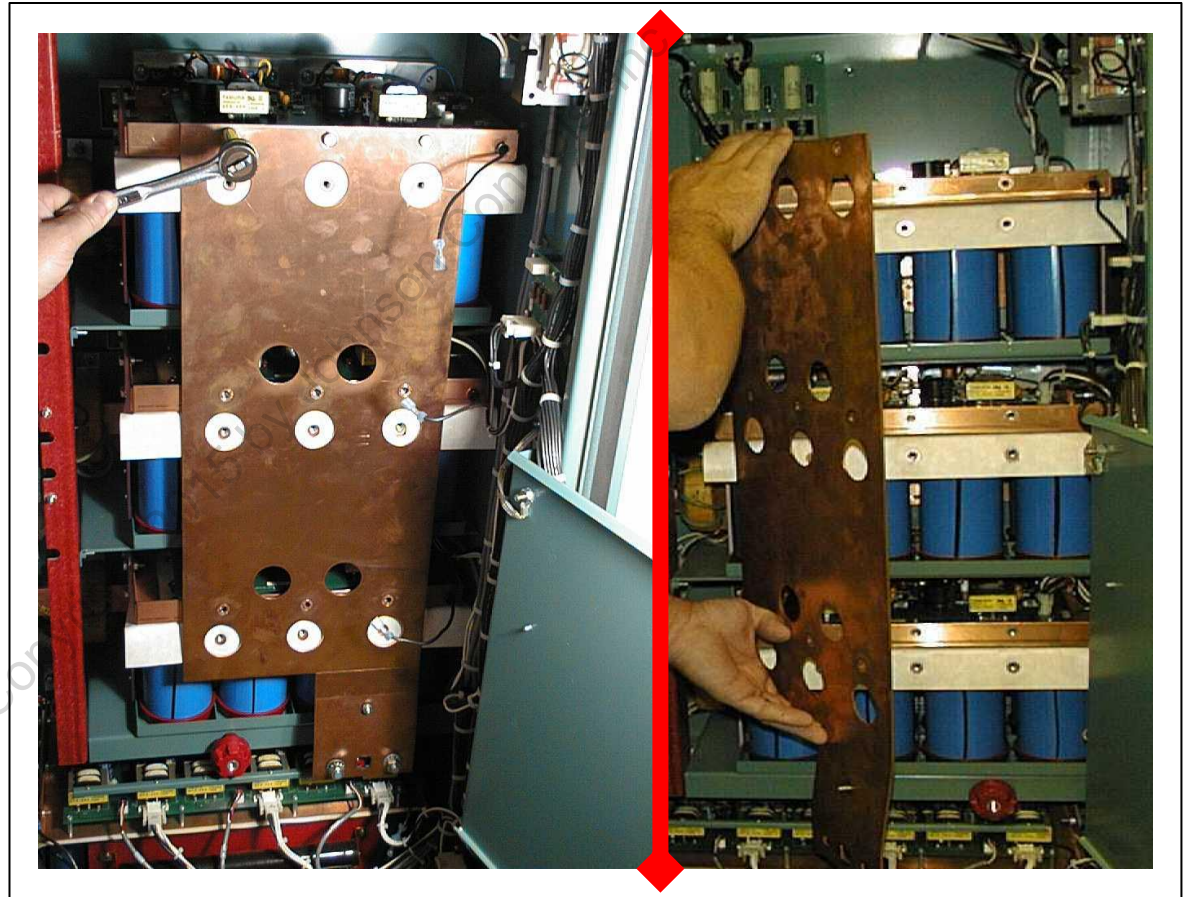
Remove Negative Bus Plate



Remove the insulator sheet and place it in a location where it will not become damaged or contaminated



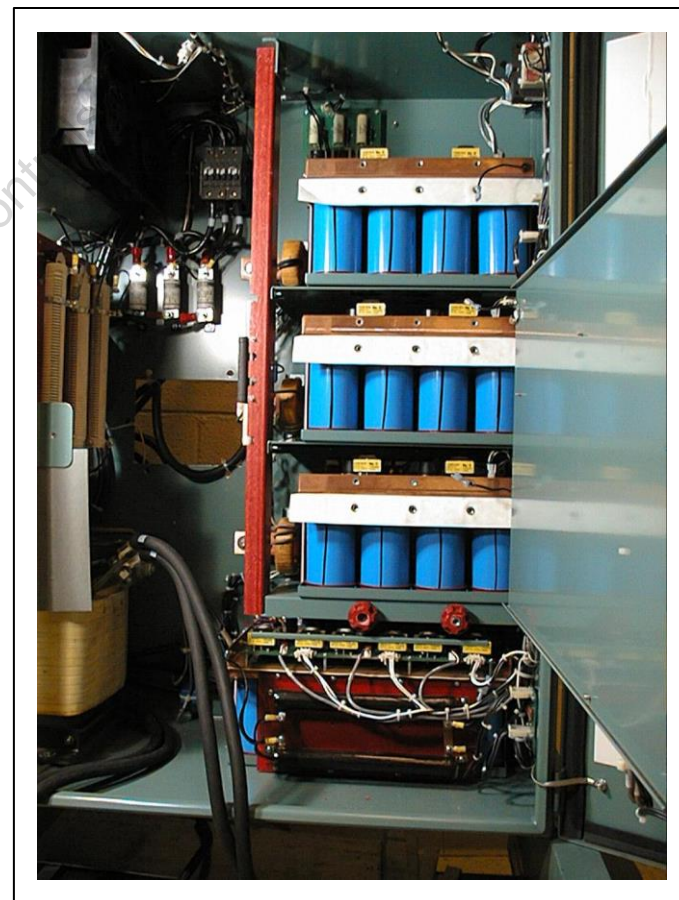
Remove the positive(+) bus plate



The laminated bus structure of each Output Pole Assembly is a continuation of the positive(+) and negative(-) laminated bus that has just been removed



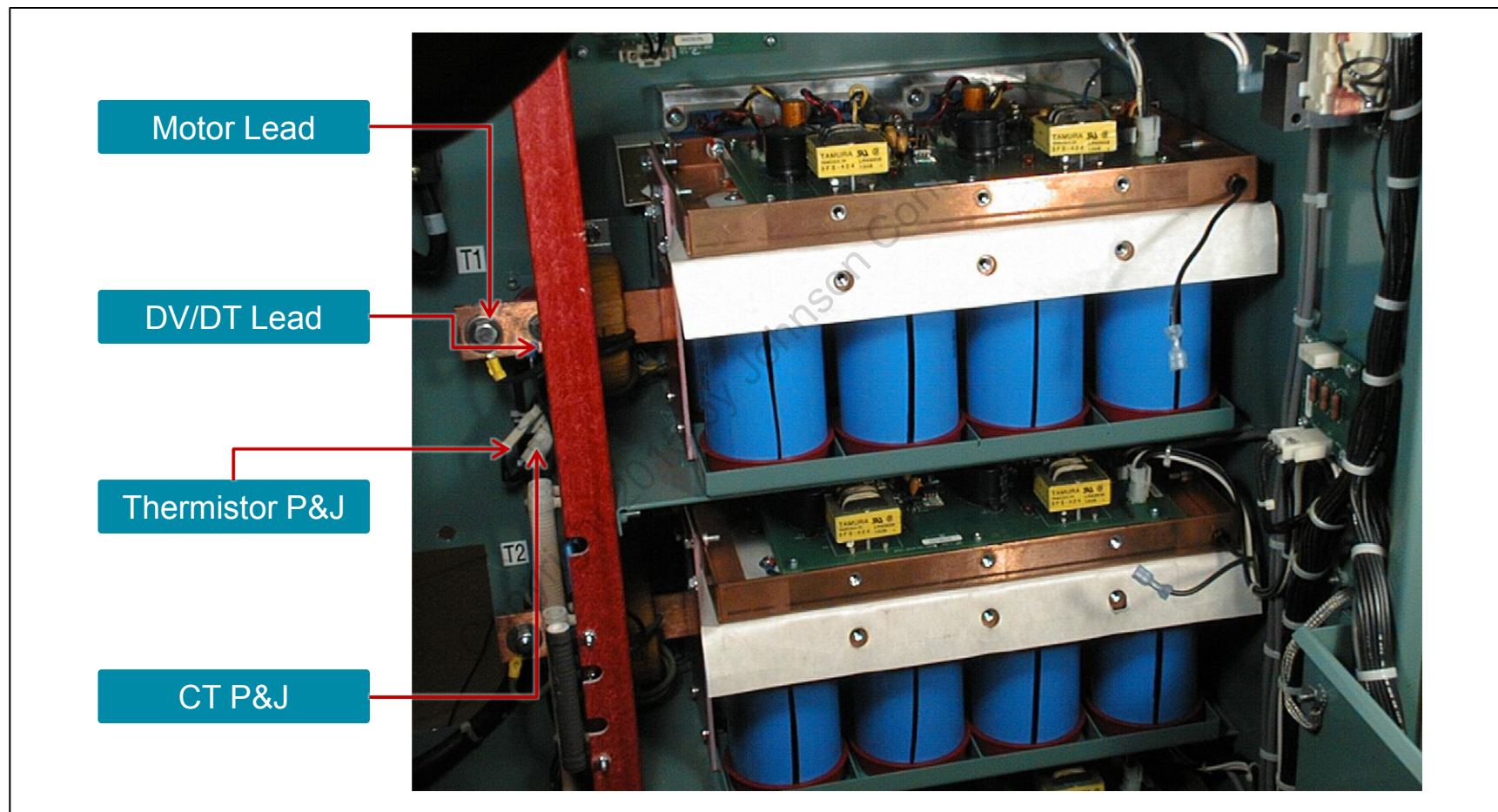
3 Output Pole Assemblies of a 351 HP Style "D" with the laminated bus removed



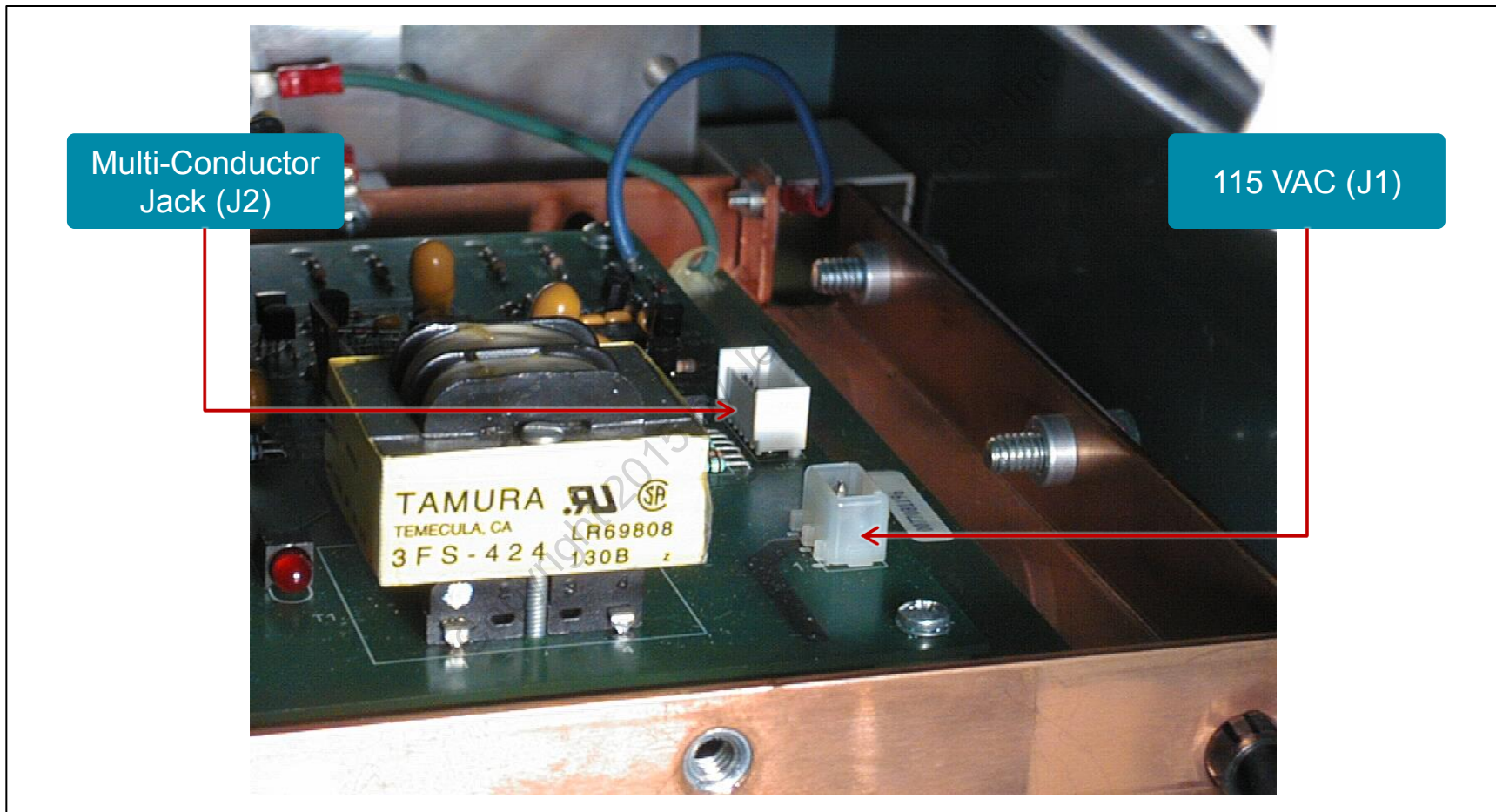
-
- Remove the 2 hose connections from the Output Pole Assembly.
 - Drain the coolant from the hoses and heat sink into a container.
 - Seal the 2 hose barb connections



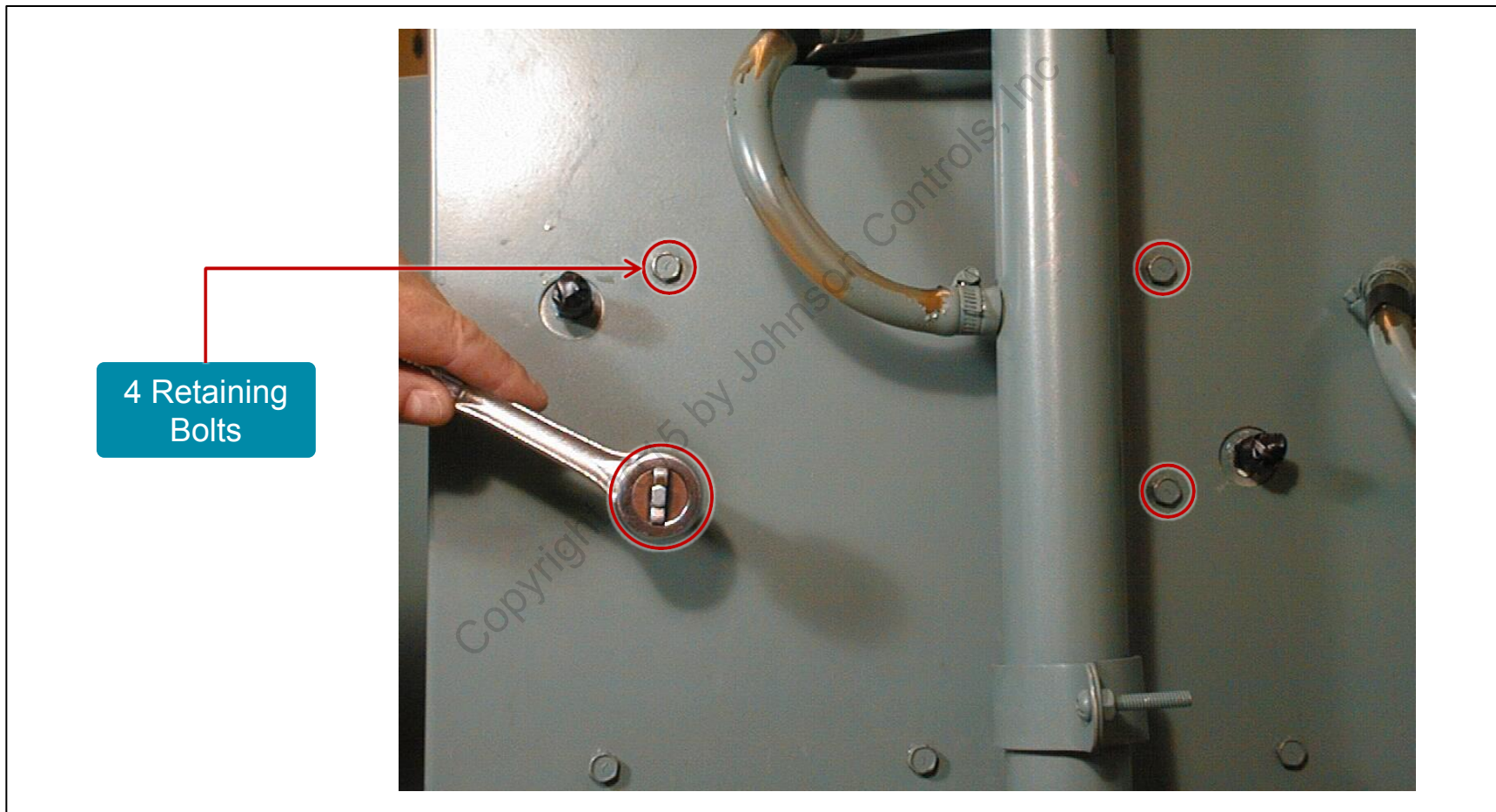
Unplug & Disconnect



Unplug & Disconnect Gate Driver Board



Remove Bolts in back of VSD that secure the Output Pole Assembly



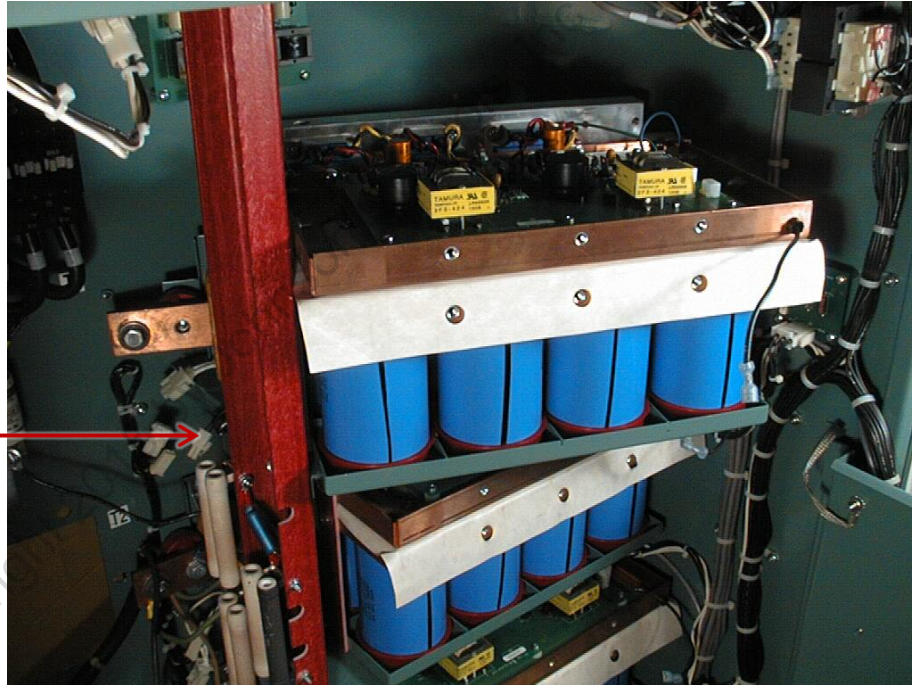
Slide out the pole, rotating it clockwise as necessary for CT to clear the upright beam. If coolant drips onto the gate driver board, remove it from pole then soak it in alcohol to remove it



STYLE "D"
OUTPUT POLE
REPLACEMENT PROCEDURE

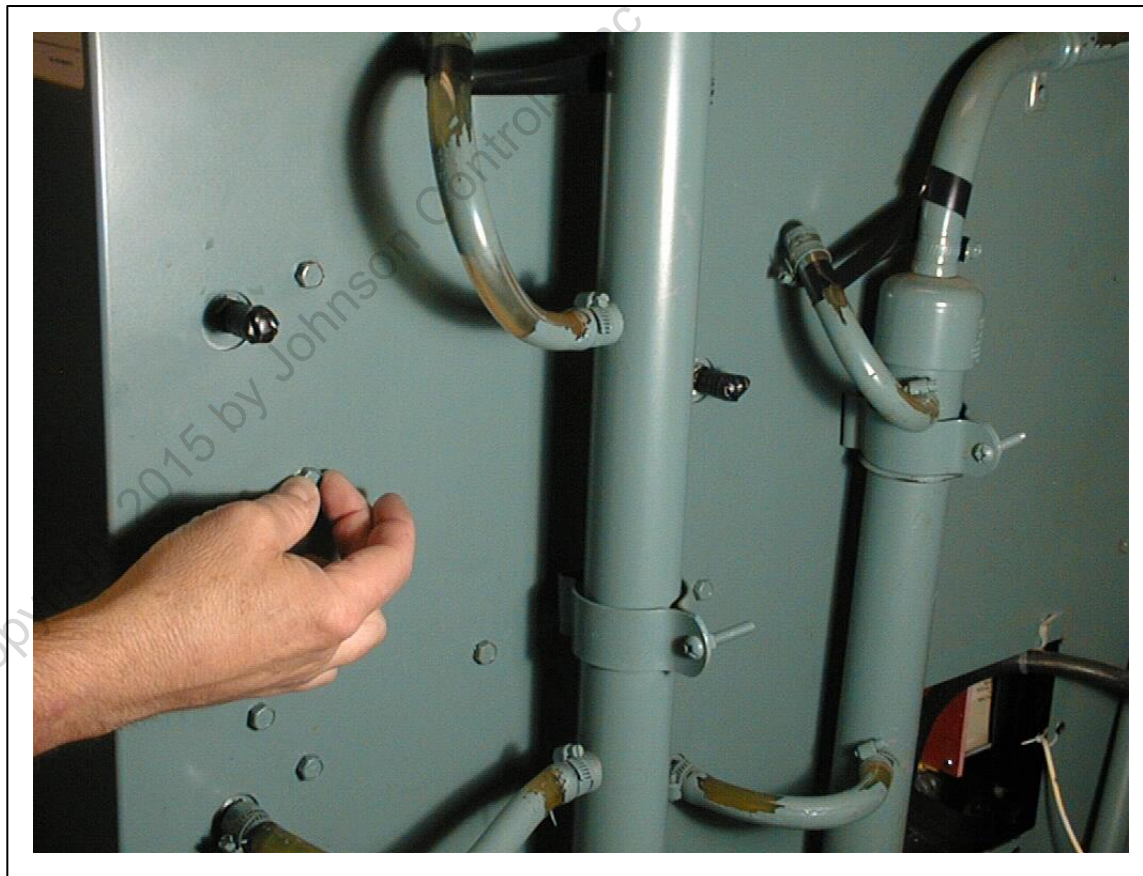
Slide in the pole, rotating it counter-clockwise as necessary for CT to clear the upright beam.

Take Care Not To
Pinch The
Thermistor Wires

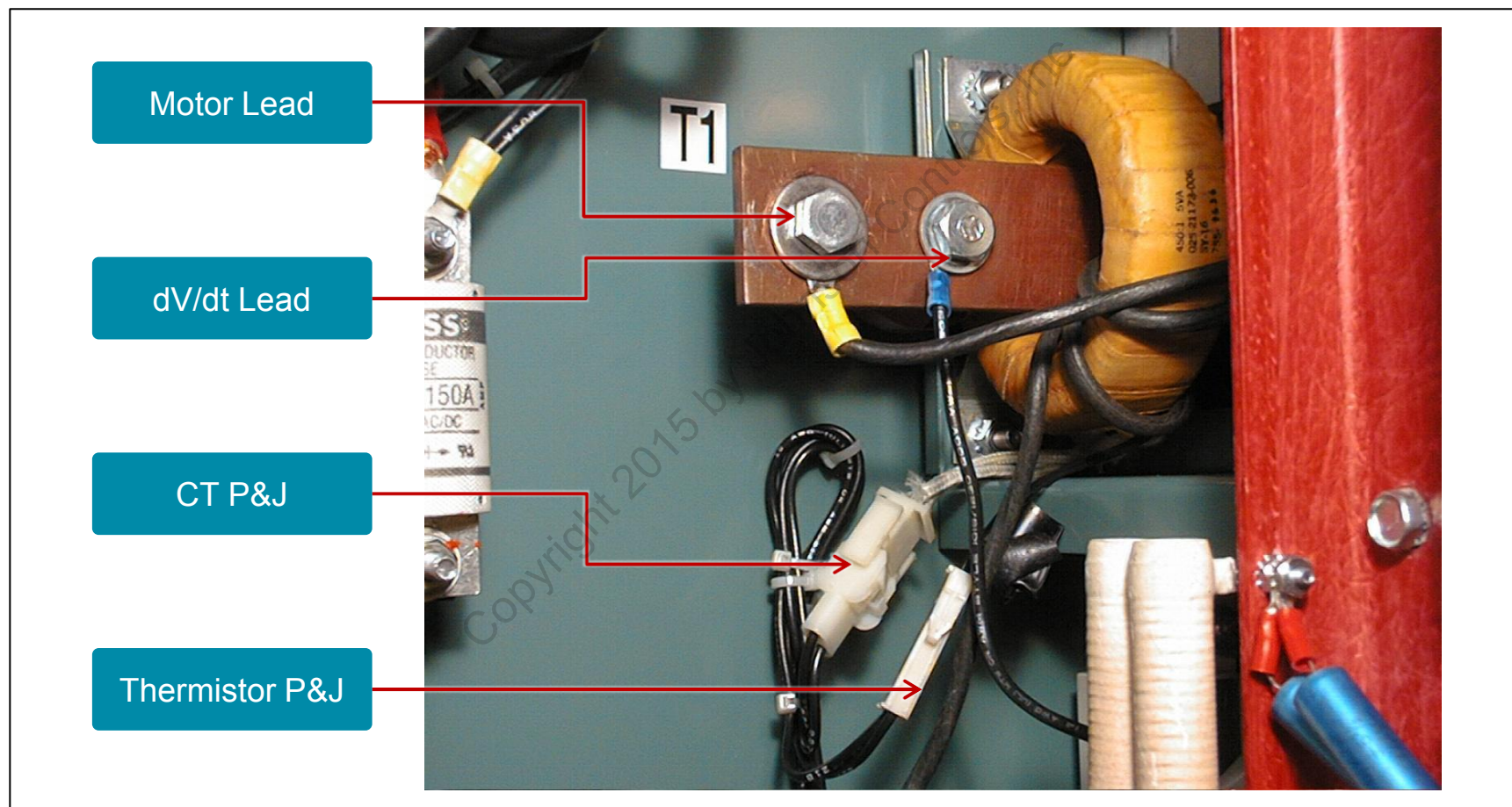


Note: Take care not to damage the Thermistor wires

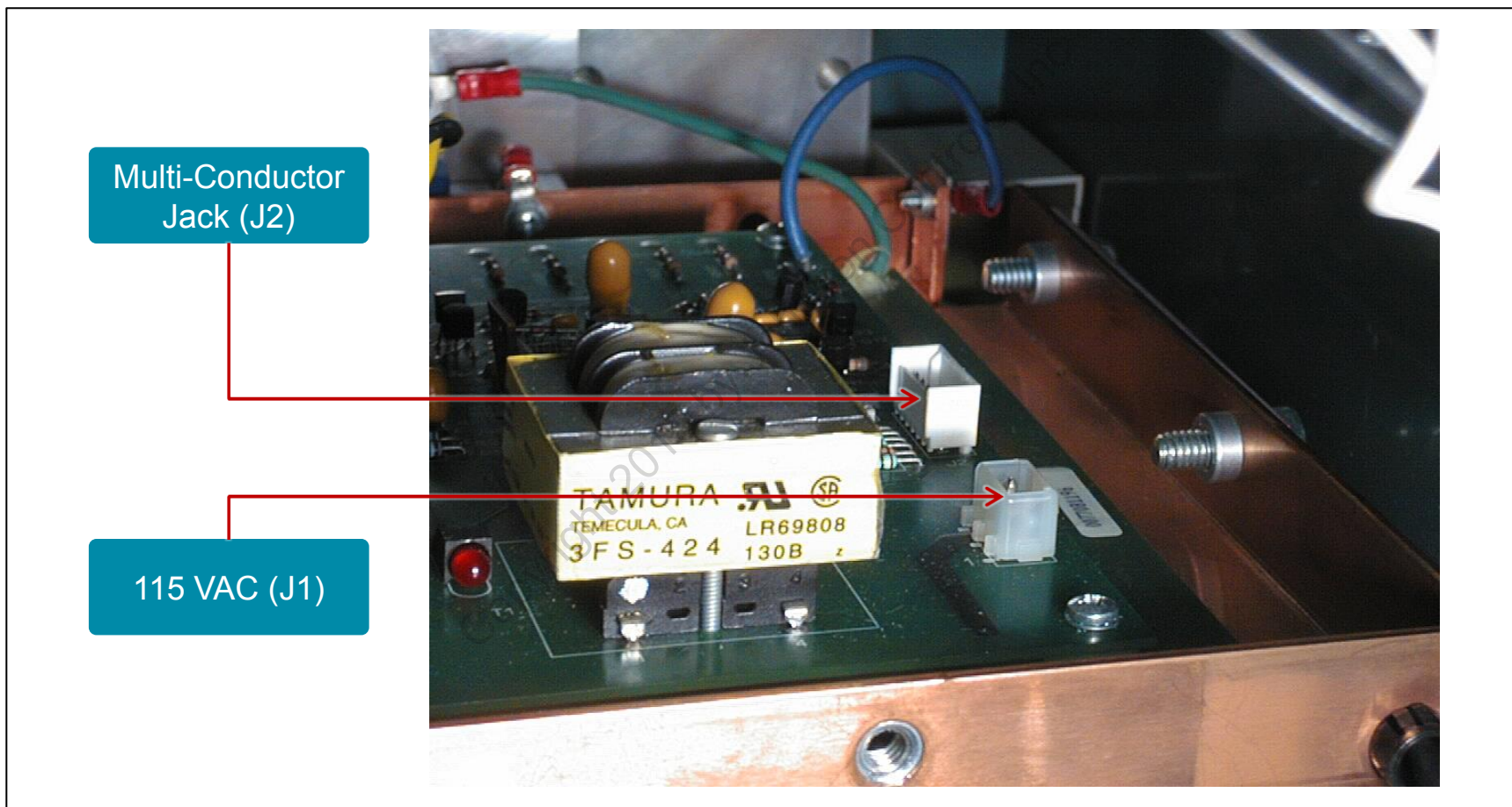
Replace and finger tighten the 4 bolts into back of VSD that hold the Output Pole Assembly in place



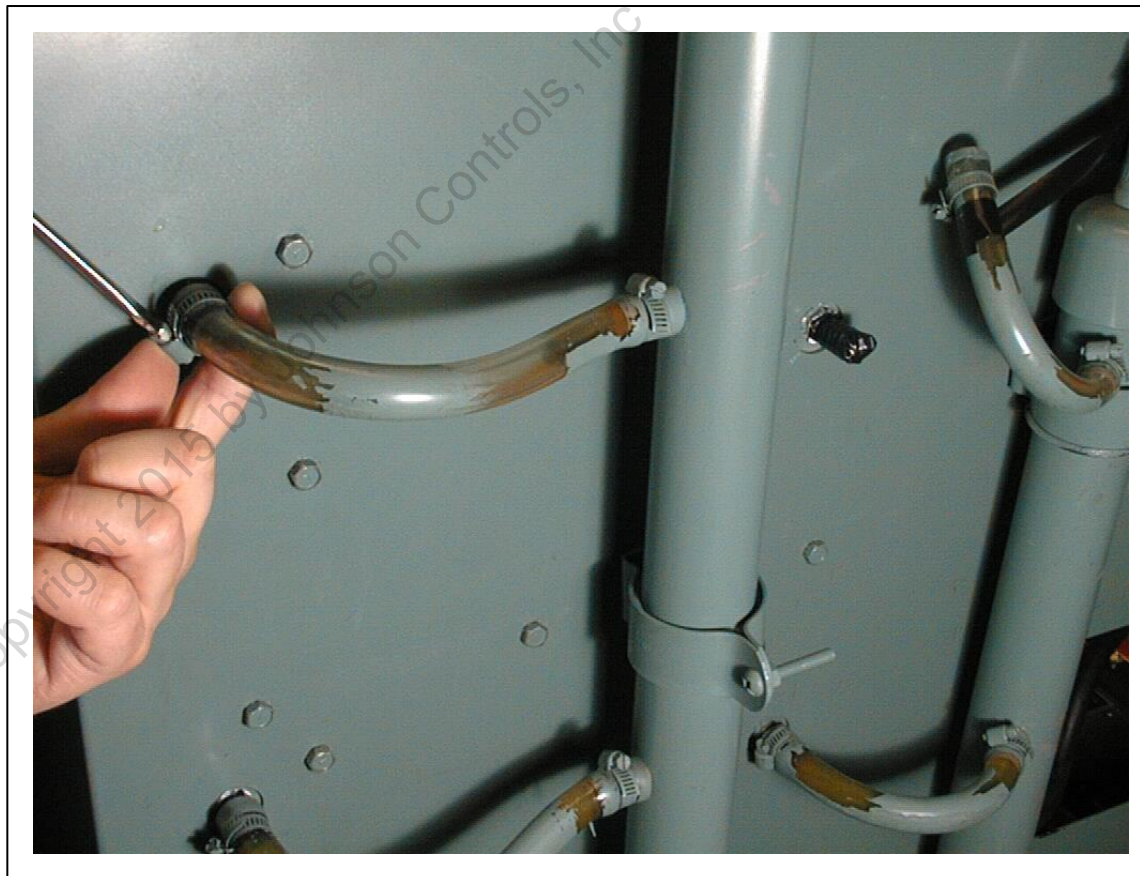
Re-Connect & Re-Plug



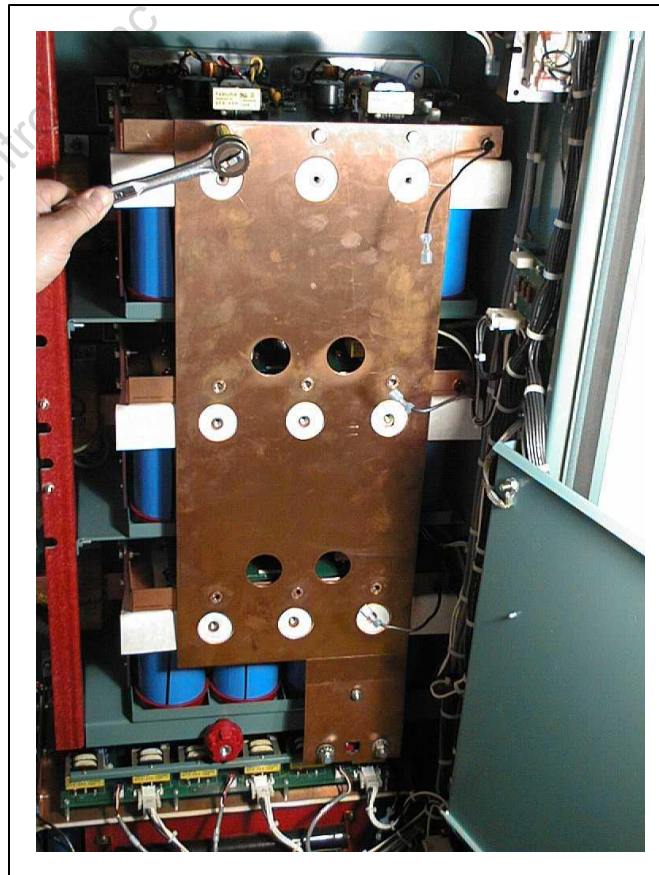
Re-Connect & Re-Plug



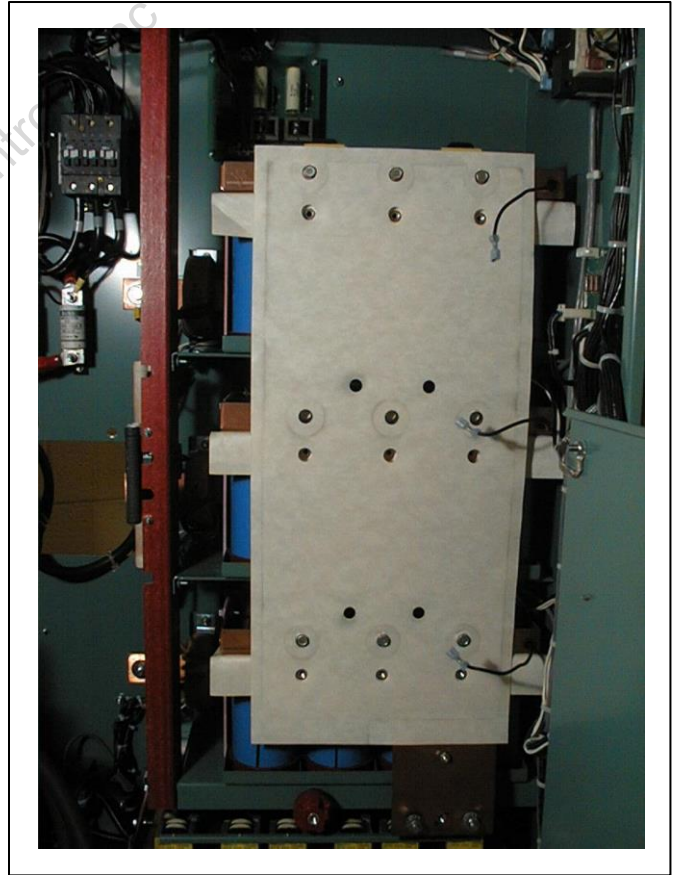
Re-connect the 2 hoses to the barbs of the new Output Pole Assembly



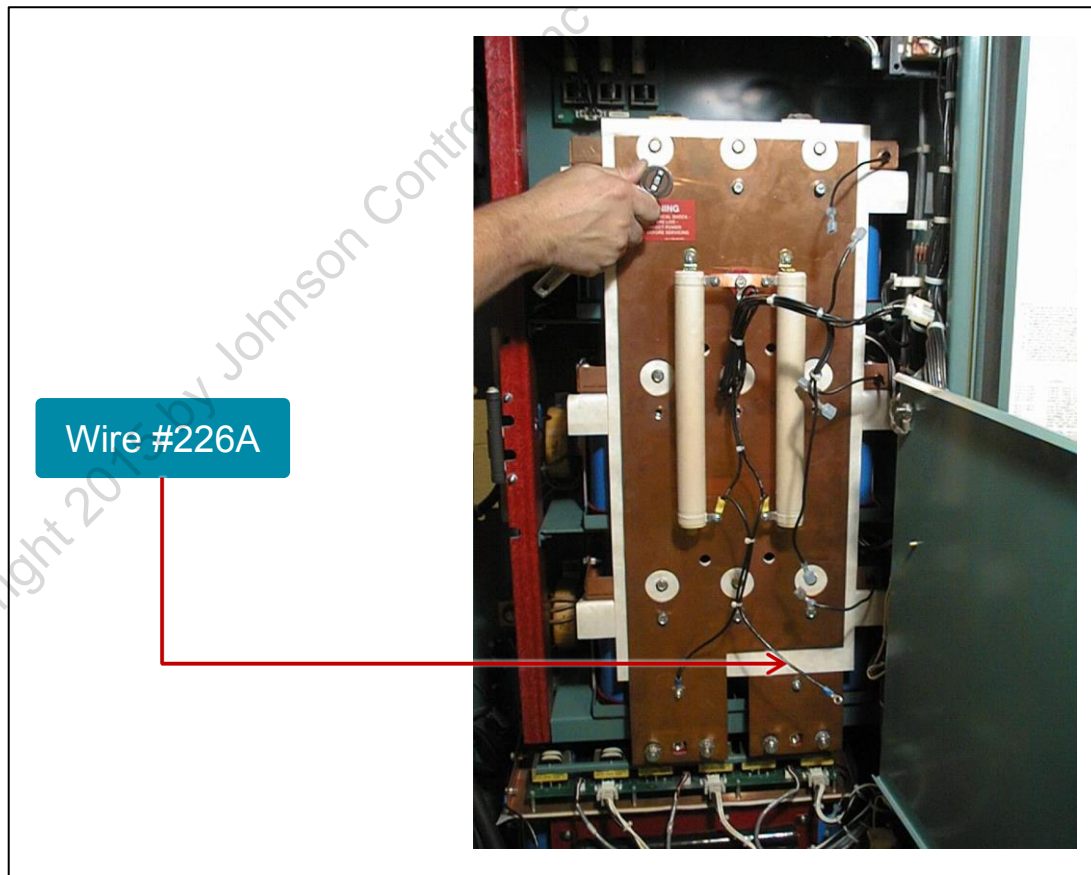
Re-install the positive(+) bus plate.



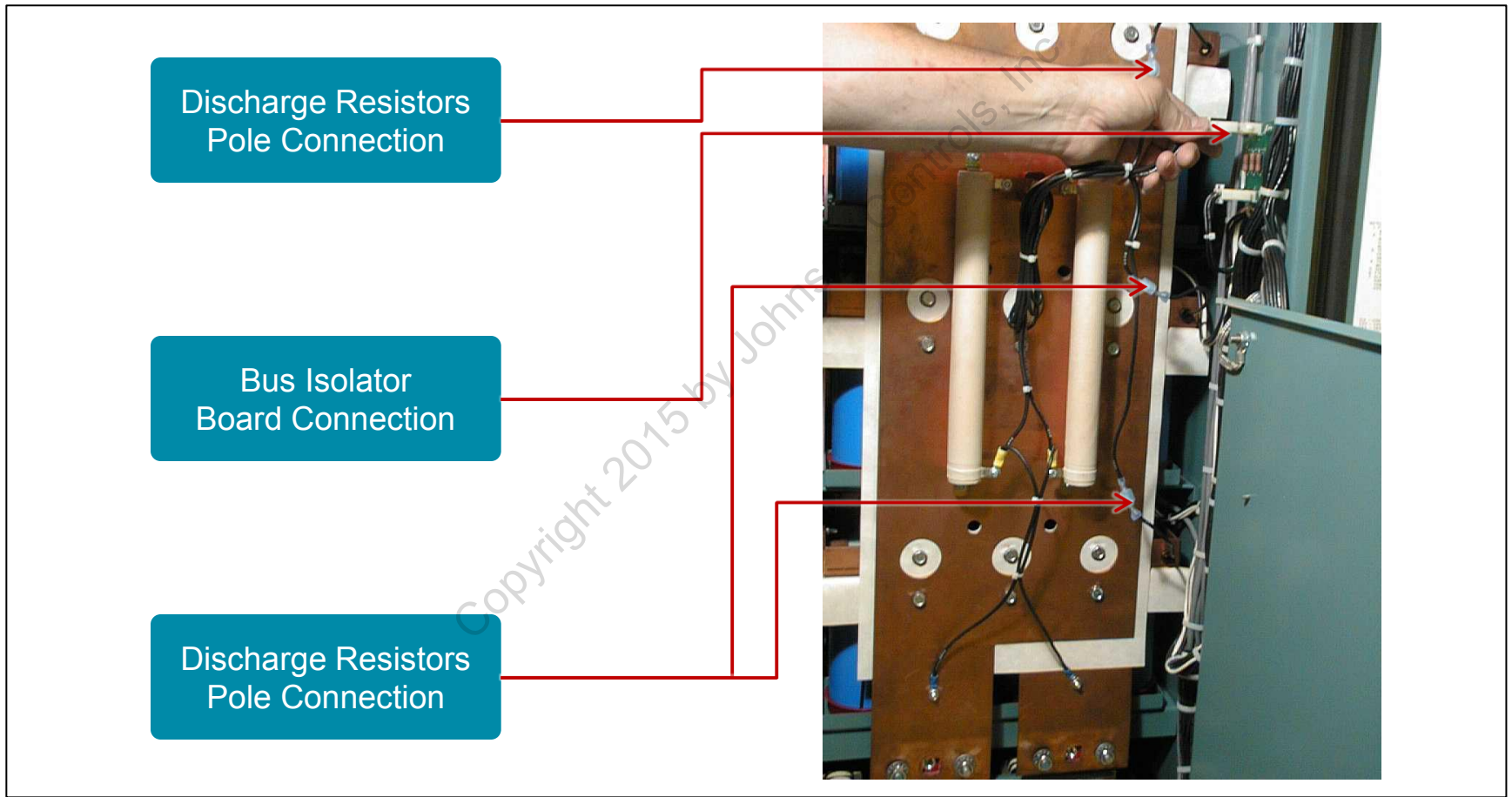
Re-install the insulator sheet verifying proper orientation



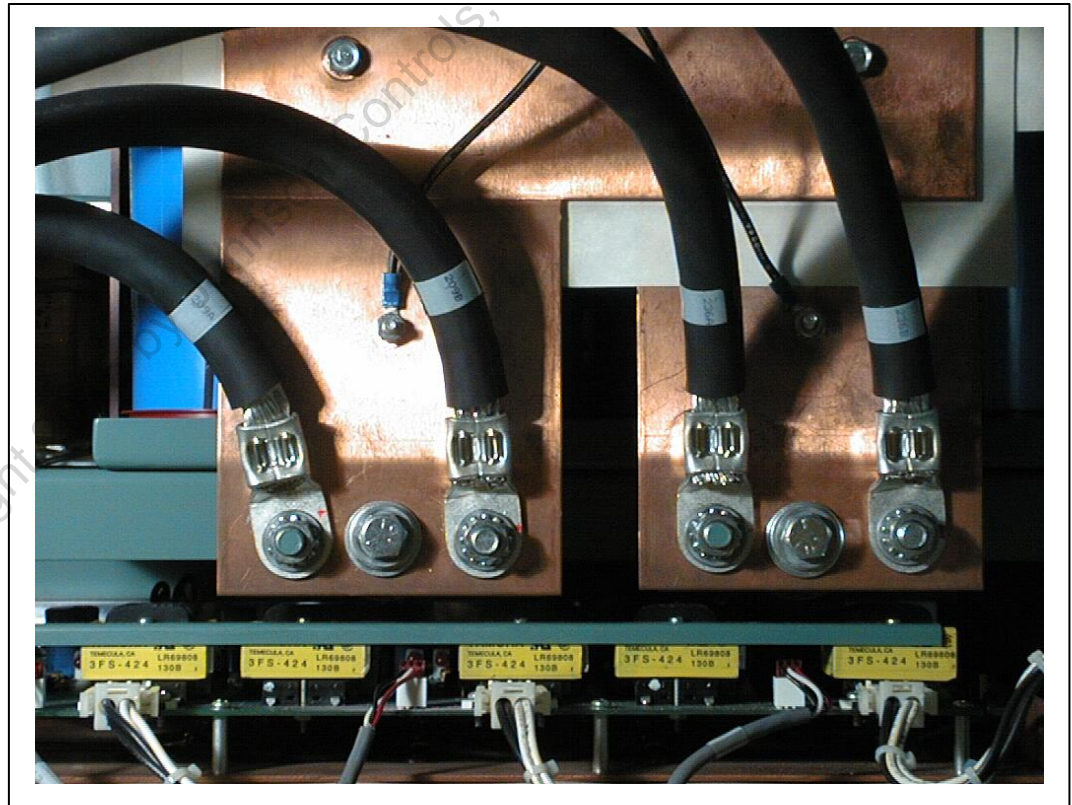
Re-install the negative(-) bus plate.
Reconnect wire 226A



Re-Connect



Re-connect the bus wires to the bottom of the positive(+) and negative(-) bus plates. Tighten the 4 retaining bolts in the back of the VSD that secure the Output Pole Assembly.



VYPER OUTPUT POWER MODULE REMOVAL PROCEDURE

Remove the Vent/Fill plug so the cooling system can vent when draining the system.



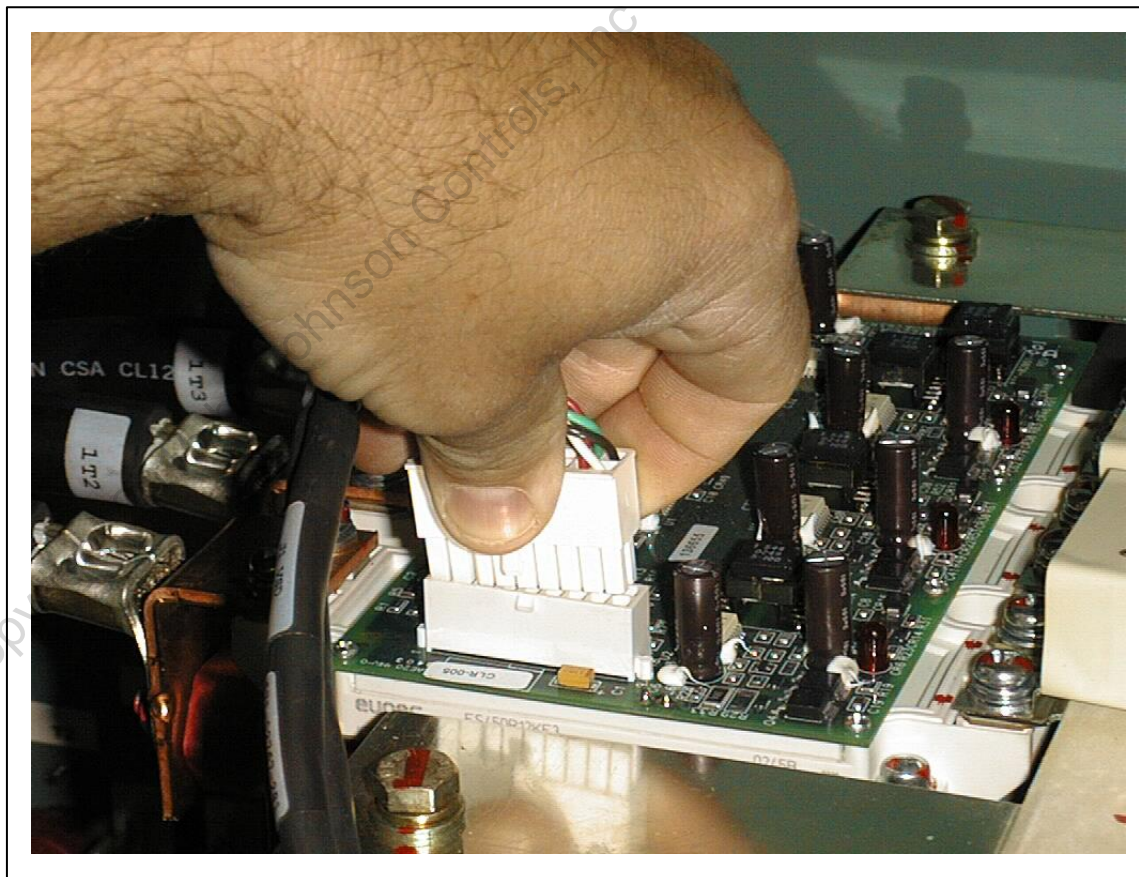
Drain the coolant into appropriate containers and discard appropriately



It may be helpful to organize the removal of parts as a guide when reassembling



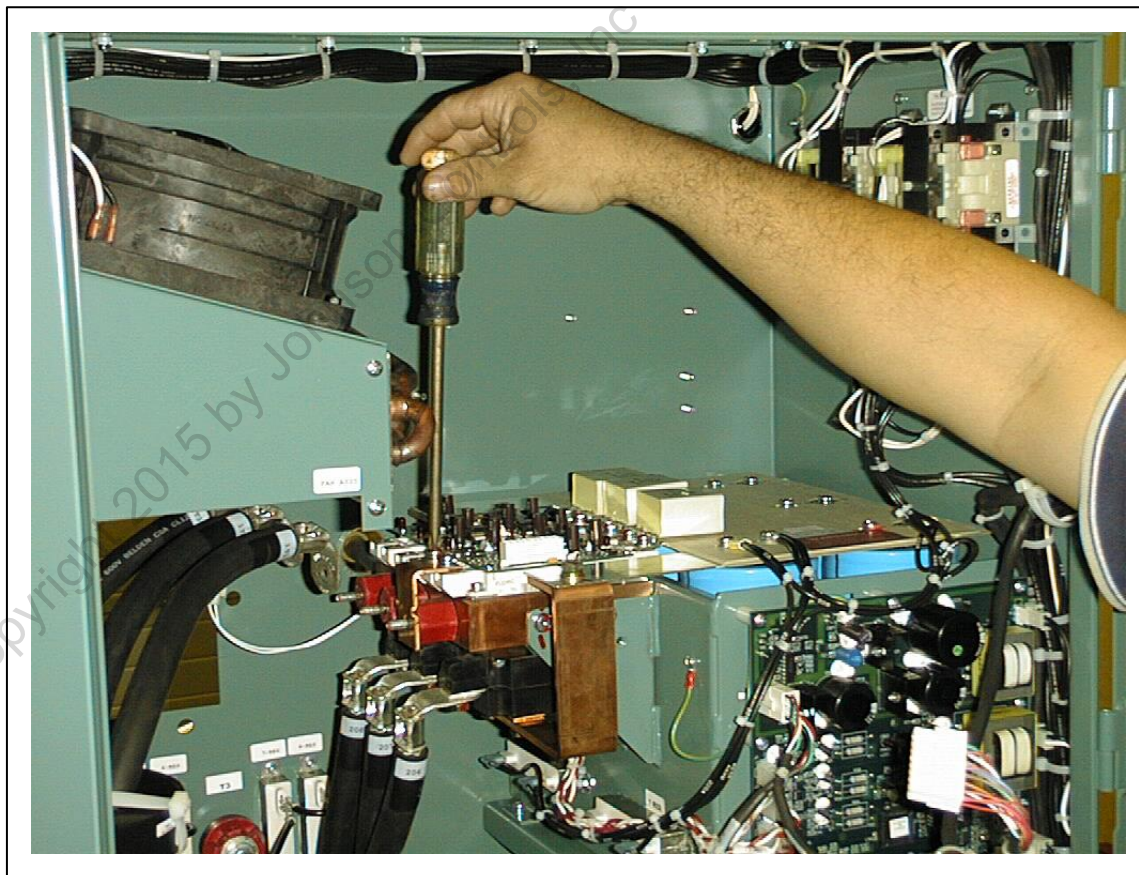
Unplug the Multi-Conductor connector from the 3-Phase Driver Control Board / Output Power Module



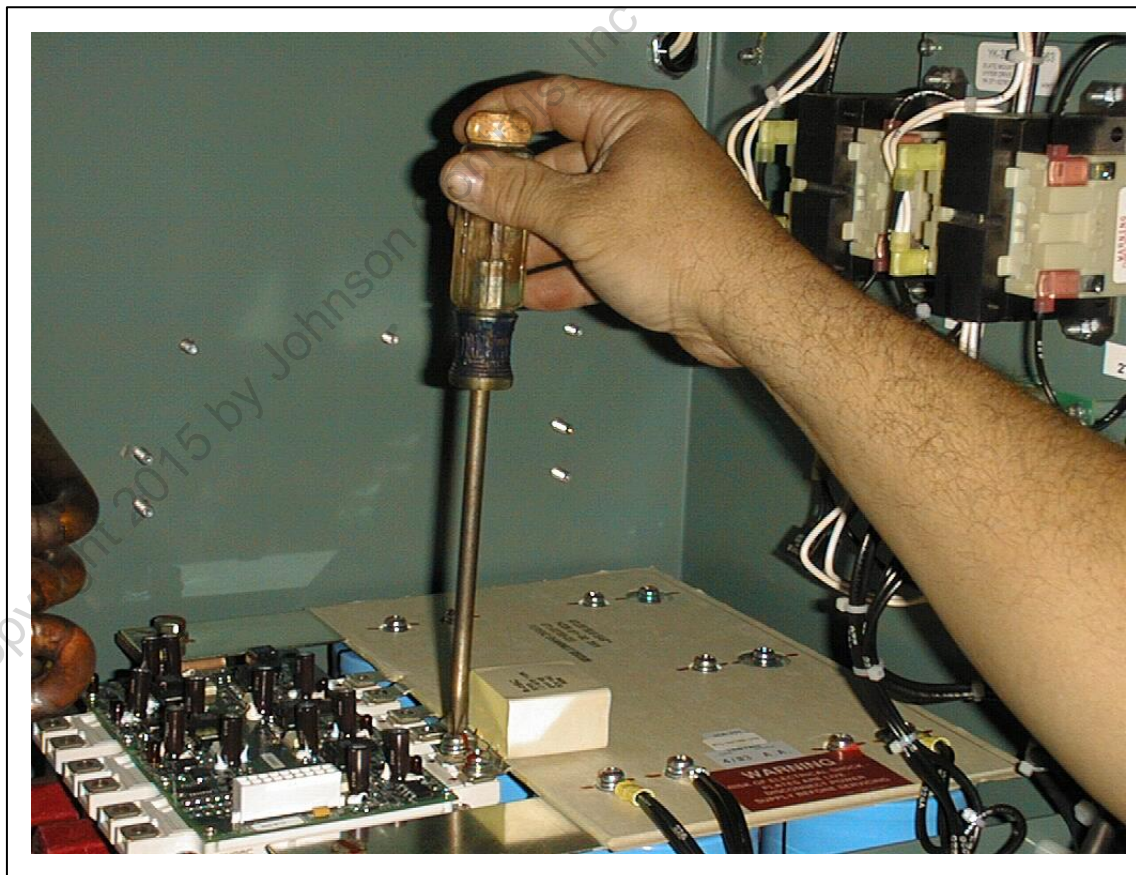
Using the socket, disconnect the motor output leads



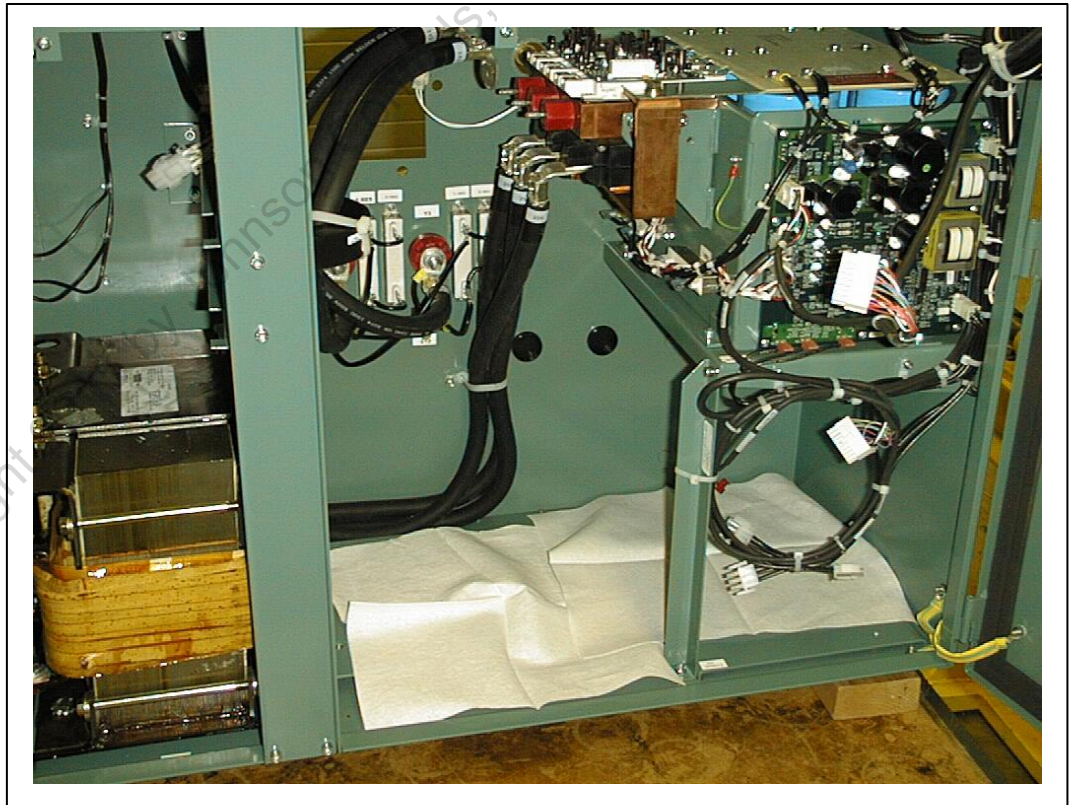
Remove the 6 screws that connect the copper angle brackets to the Output Power Module



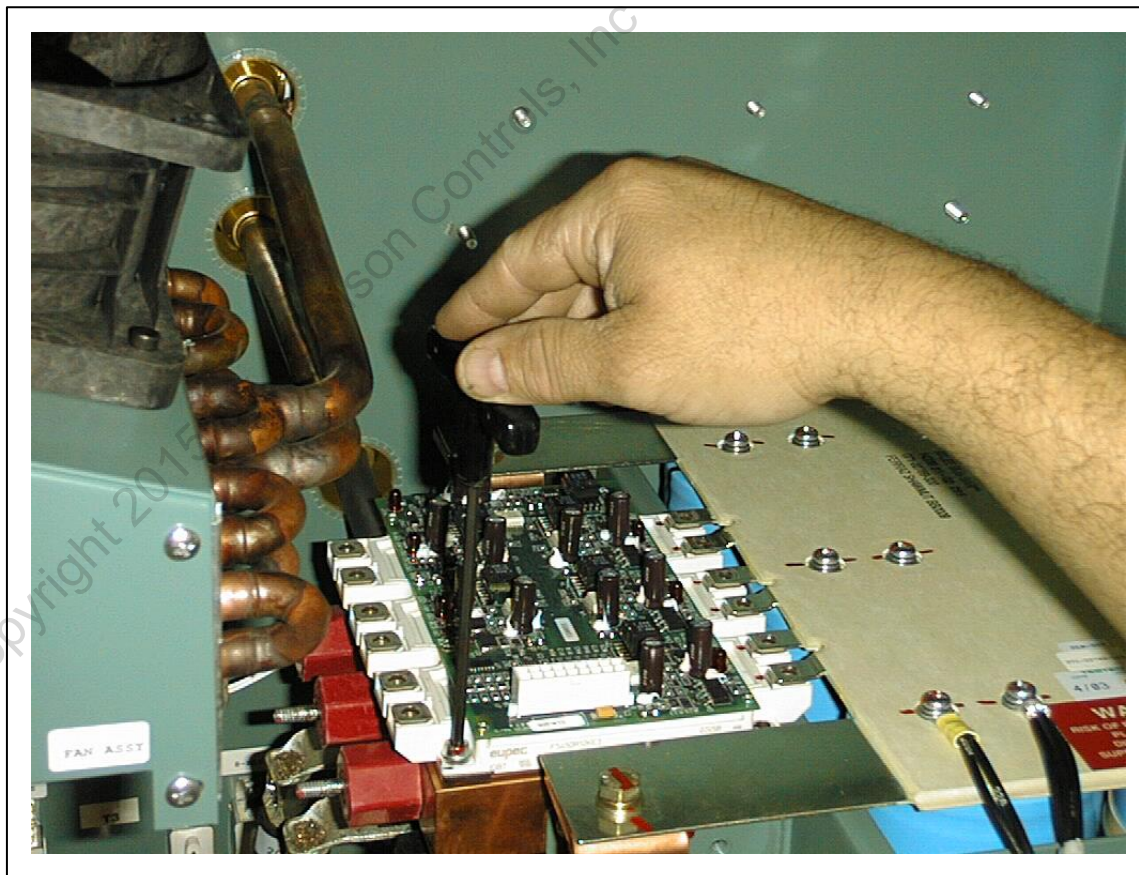
Remove the 6 screws that connect the Output Power Module to the laminated bus



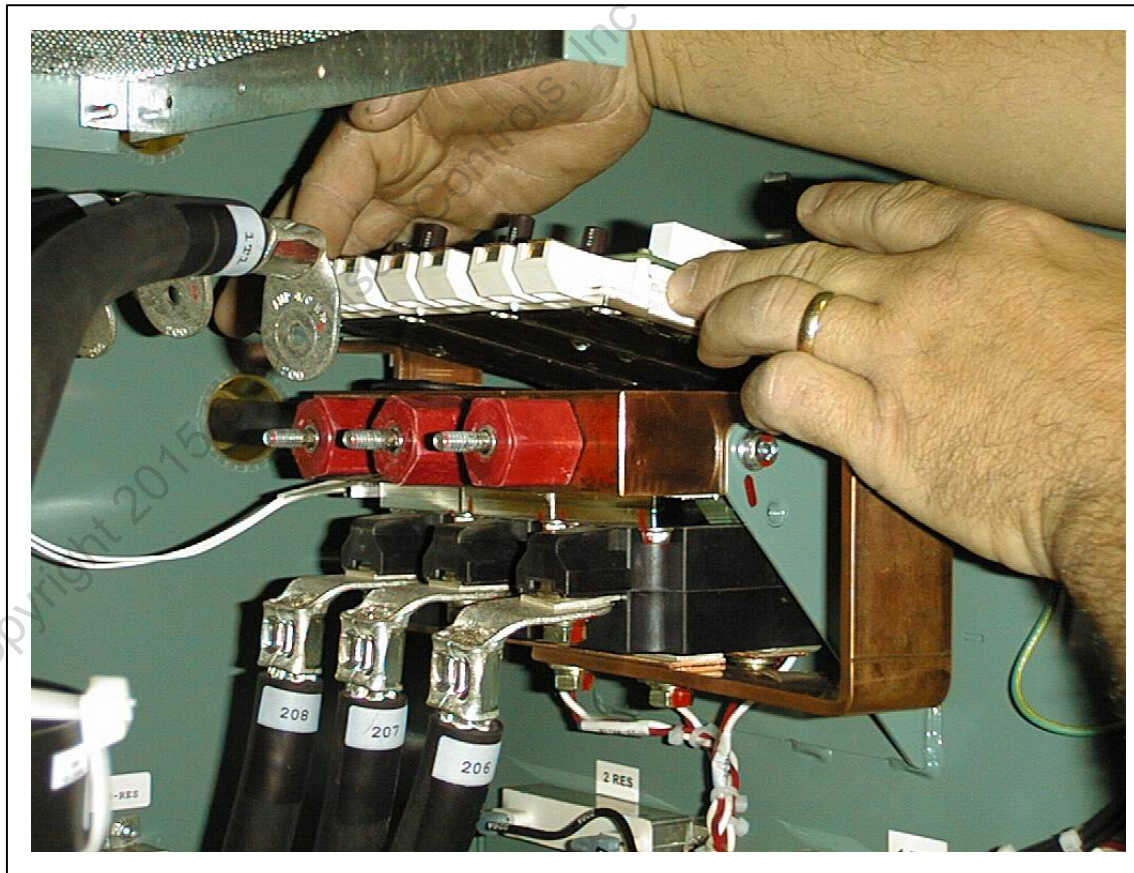
Prior to removal of the Output Power Pole Module, spread absorbent towels over everything below the Output Power Assembly. There will likely to be a small amount of coolant retained in the chill plate cavities



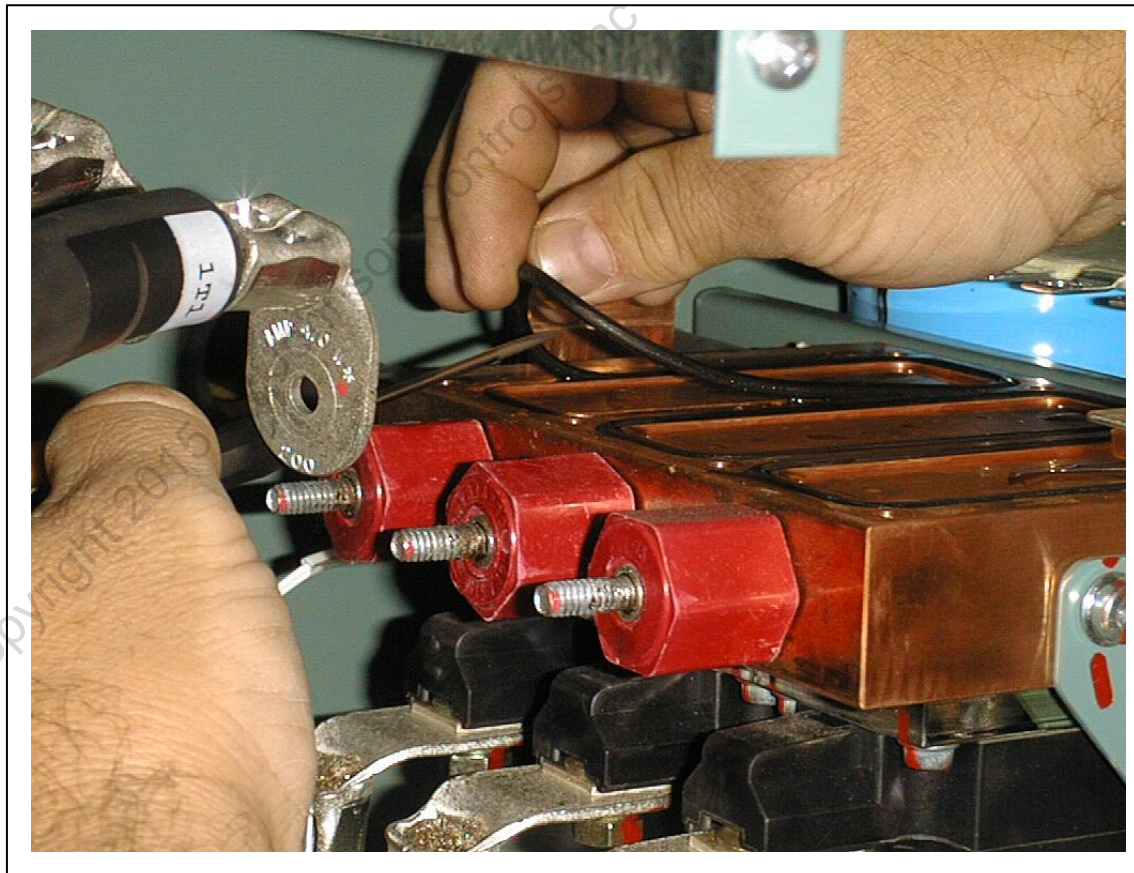
Remove the 8 screws that attach the Output Power Module to the Chill Plate



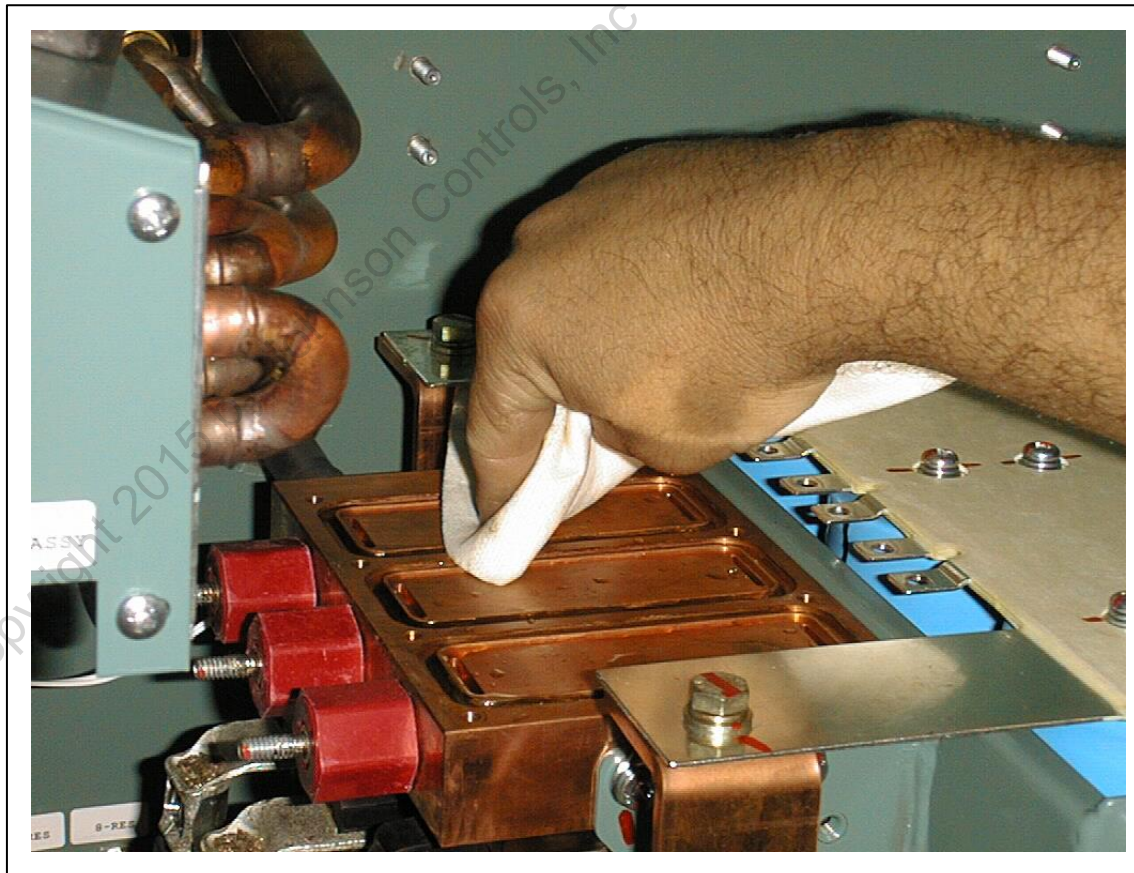
Again, there is likely to be a small amount of coolant retained in the chill plate cavities



Remove the O-rings from the Chill Plate



Thoroughly dry the Chill Plate



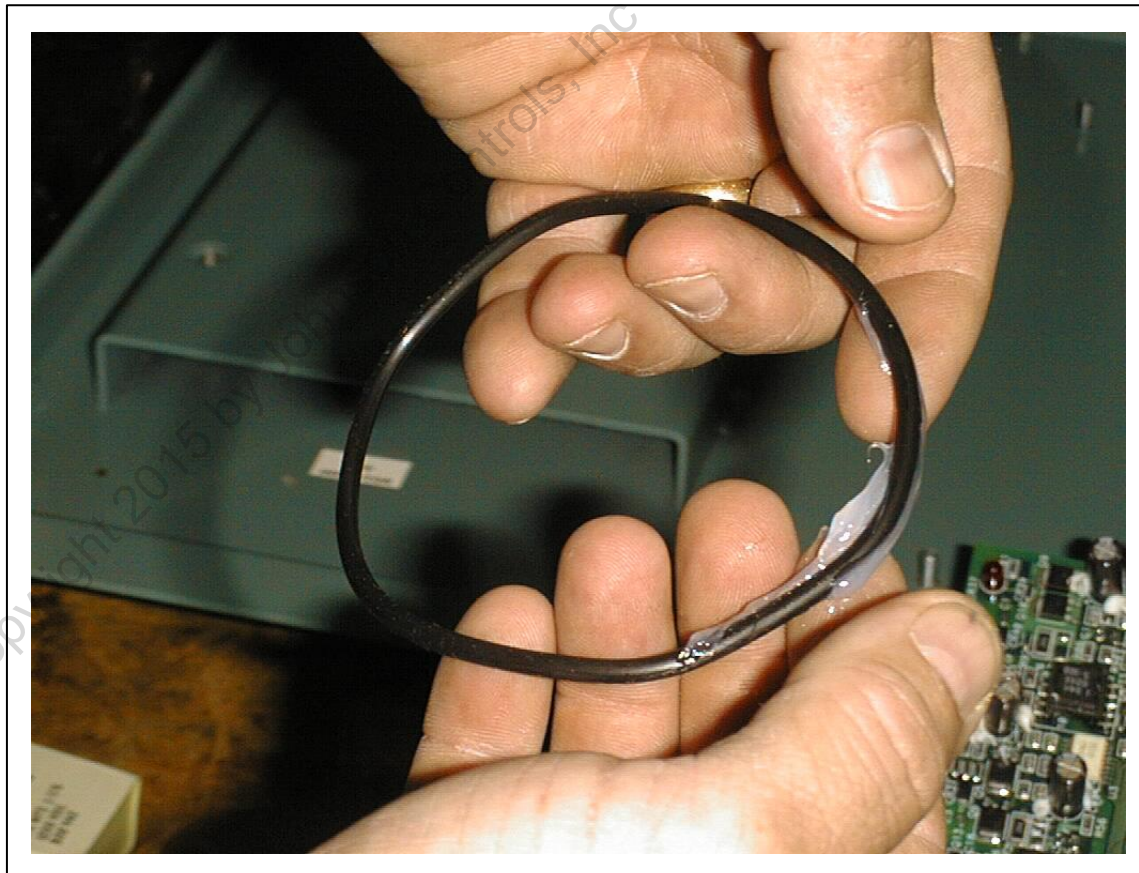
VYPER
OUTPUT POWER MODULE
REPLACEMENT PROCEDURE



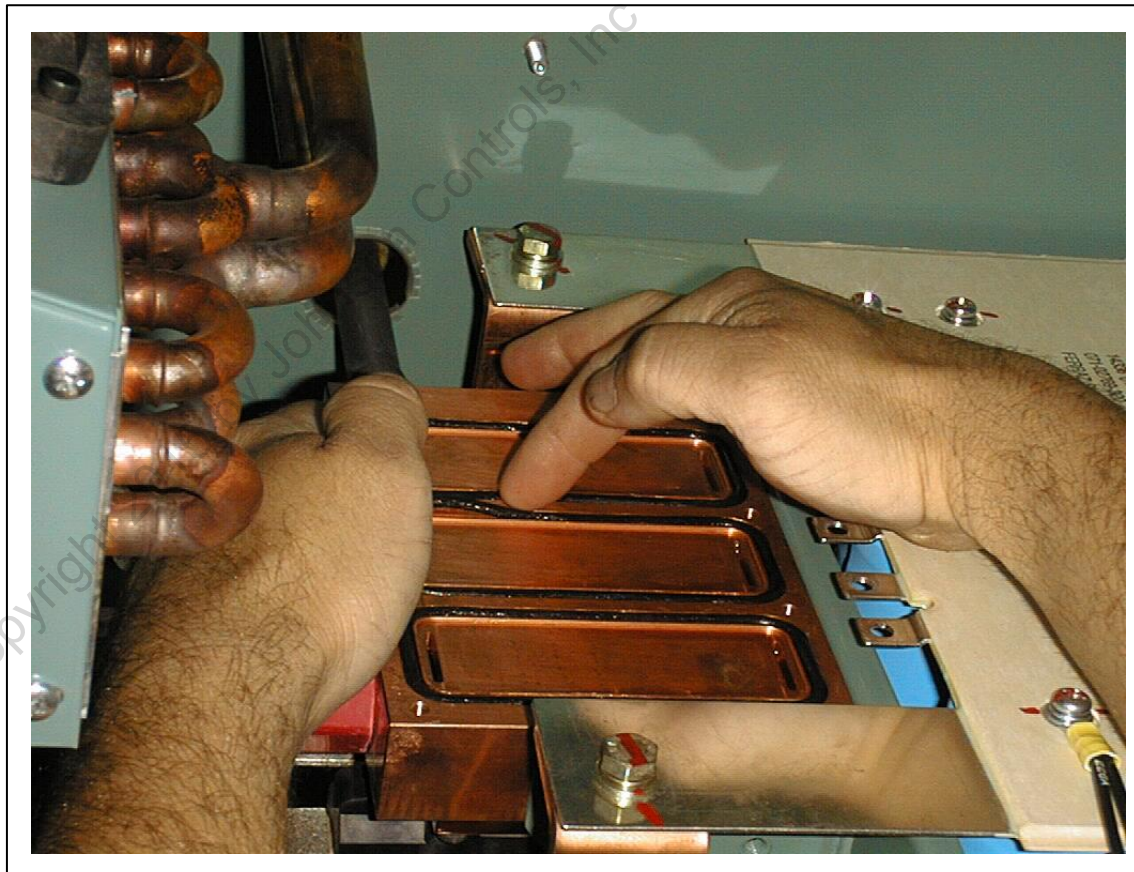
- Output Power Module.
- 3 (ea.) O-rings.
- O-ring lubricant.
- 12 (ea.) electrical terminal connection screws.
- 8 (ea.) mounting screws.
- 2 (ea.) gallons of York coolant.



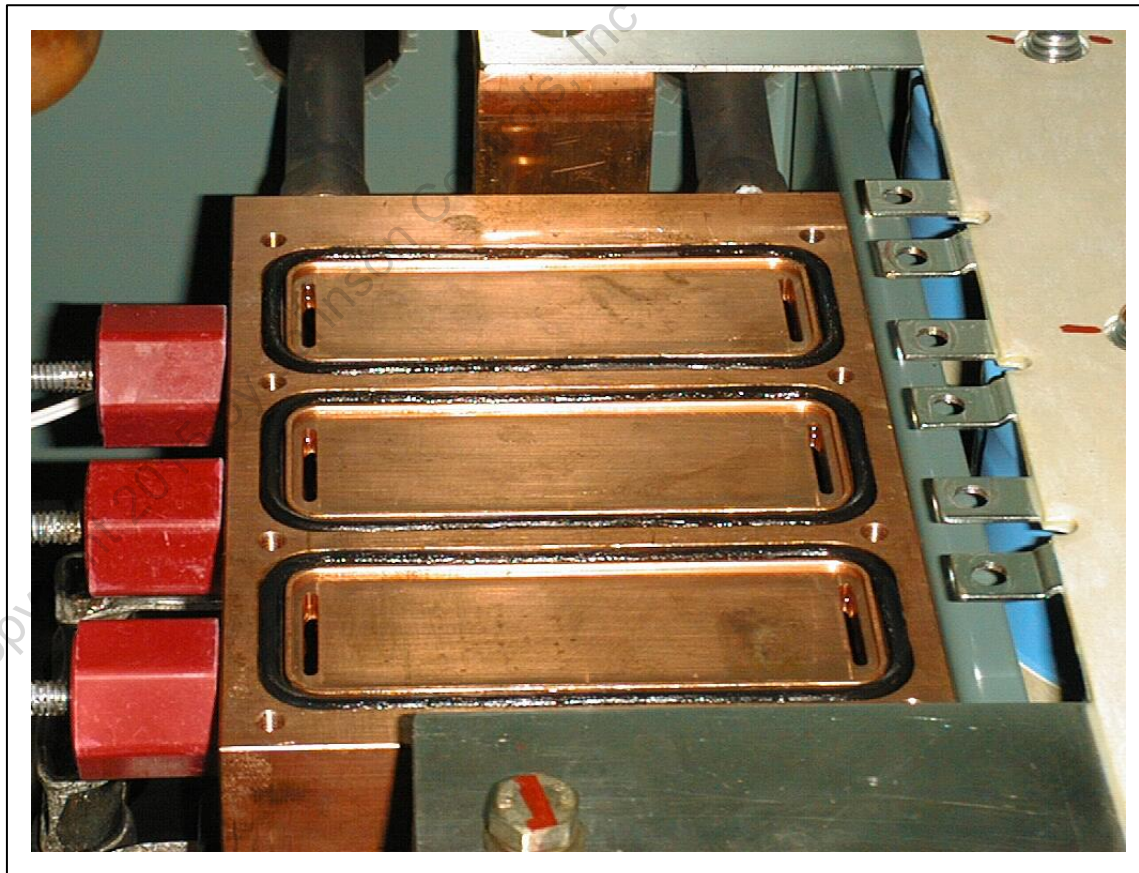
Coat the new O-rings with the lubricant provided in the kit



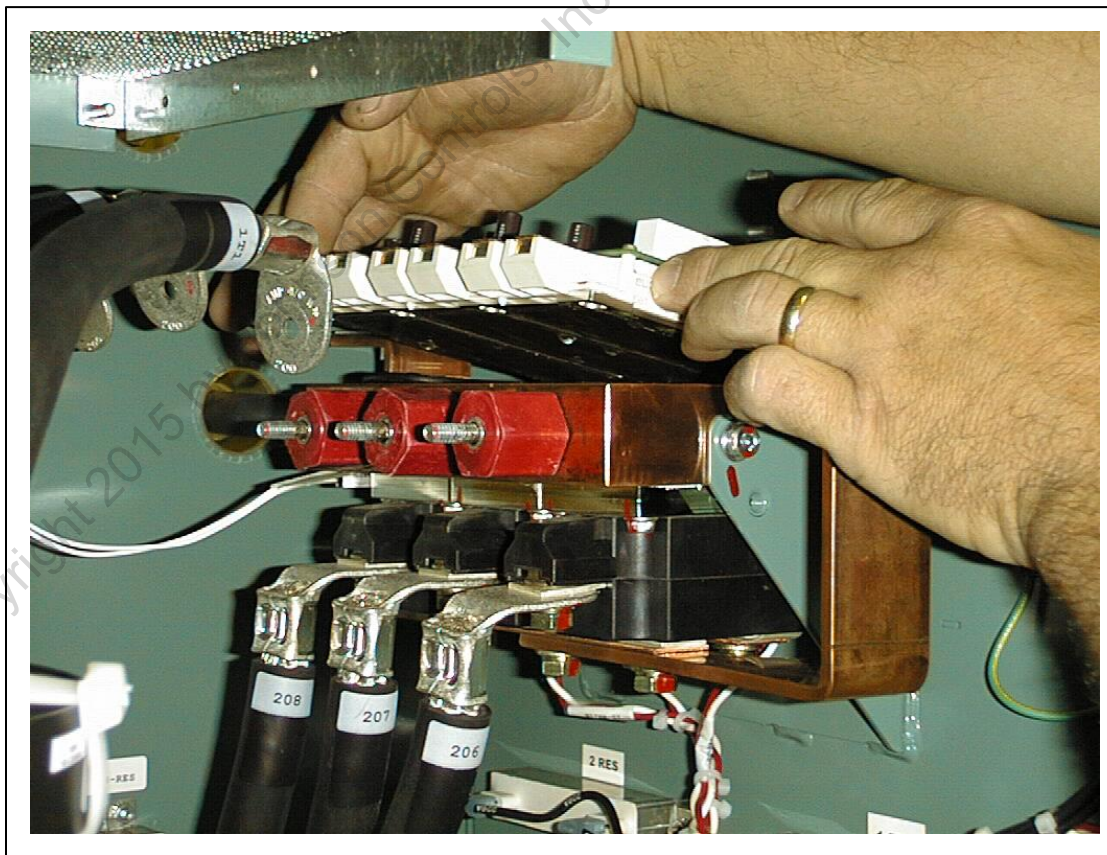
Seat the 3 new lubricated O-rings into the O-ring grooves on the Chill Plate



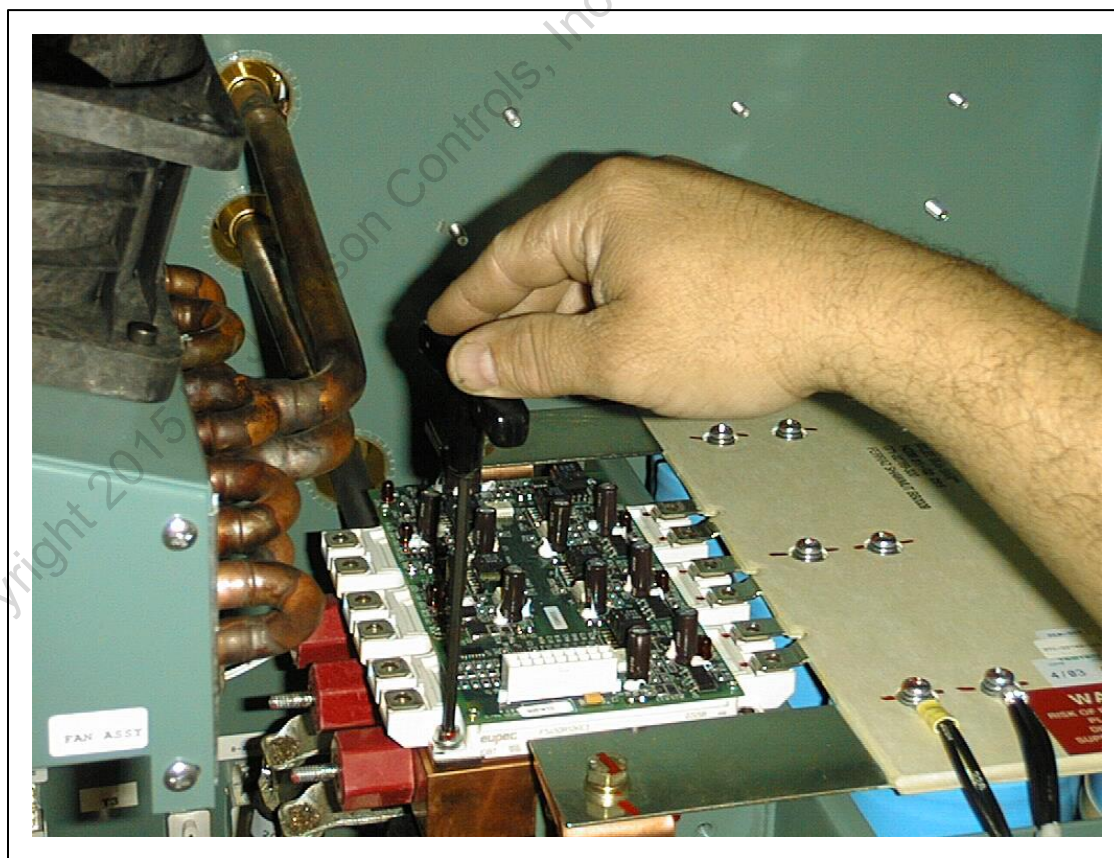
With the new O-rings installed, the Output Power Module is ready to be mounted onto the Chill Plate



Place the Output Power Module heat sink down, onto the Chill Plate O-rings and align the mounting holes. Take care not to dislocate or damage the O-rings



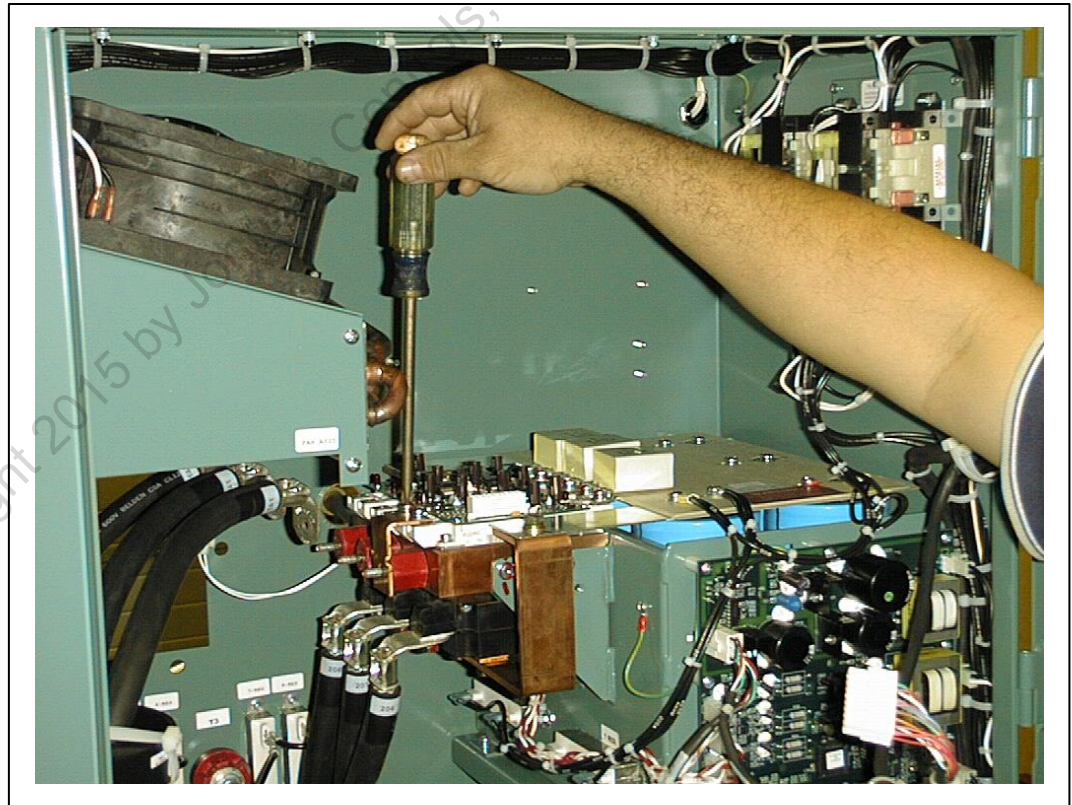
Using the 8 new mounting screws supplied with the Kit, start (do not tighten) the screws into the Output Power Module's mounting holes



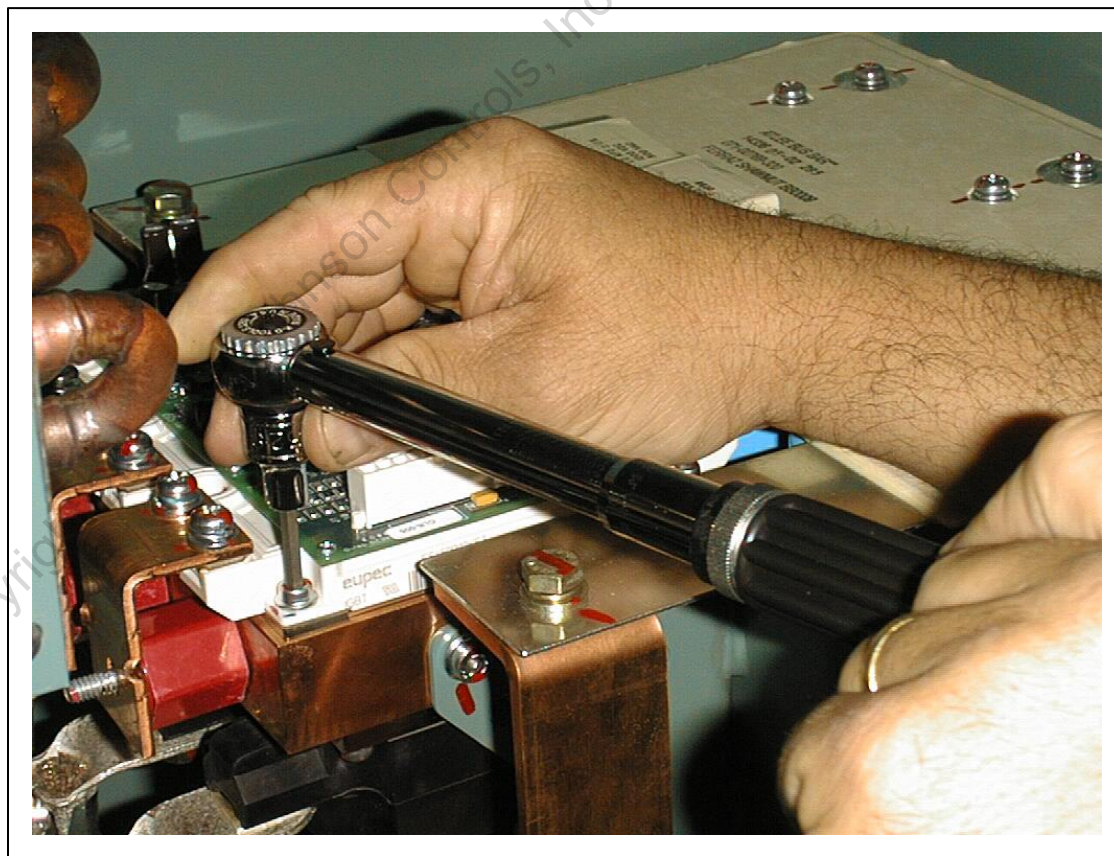
Using 6 of the 12 new screws provided in the kit, Start (do not tighten) the screws that attach the new Output Power Module to laminated bus along with the 3 small capacitors retained earlier

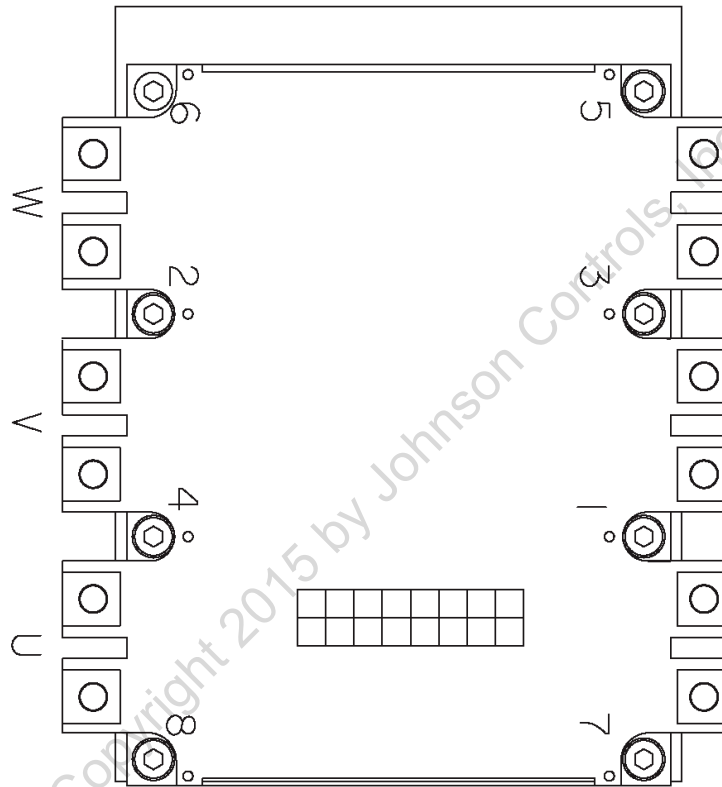


Using the 6 remaining new screws provided in the kit, start (do not tighten) the screws that attach the output-side of the new Output Power Module to the 3 copper angle-brackets



Torque the 8 Output Power Module mounting screws to 48 lb-in, using the sequence provided





(FRONT OF PANEL)

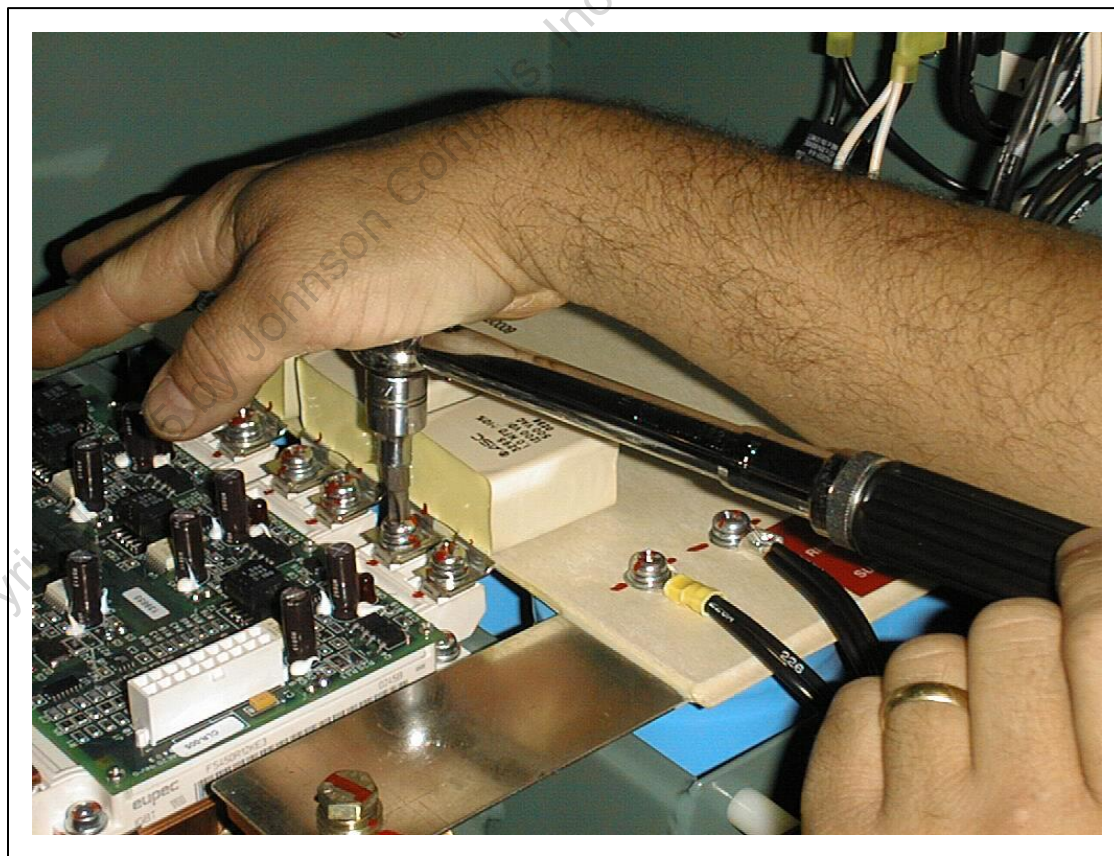
SCREWS TO BE TORQUED IN SEQUENCE - 1, 2, 3, 4, 5, 6, 7, 8

Tightening Sequence



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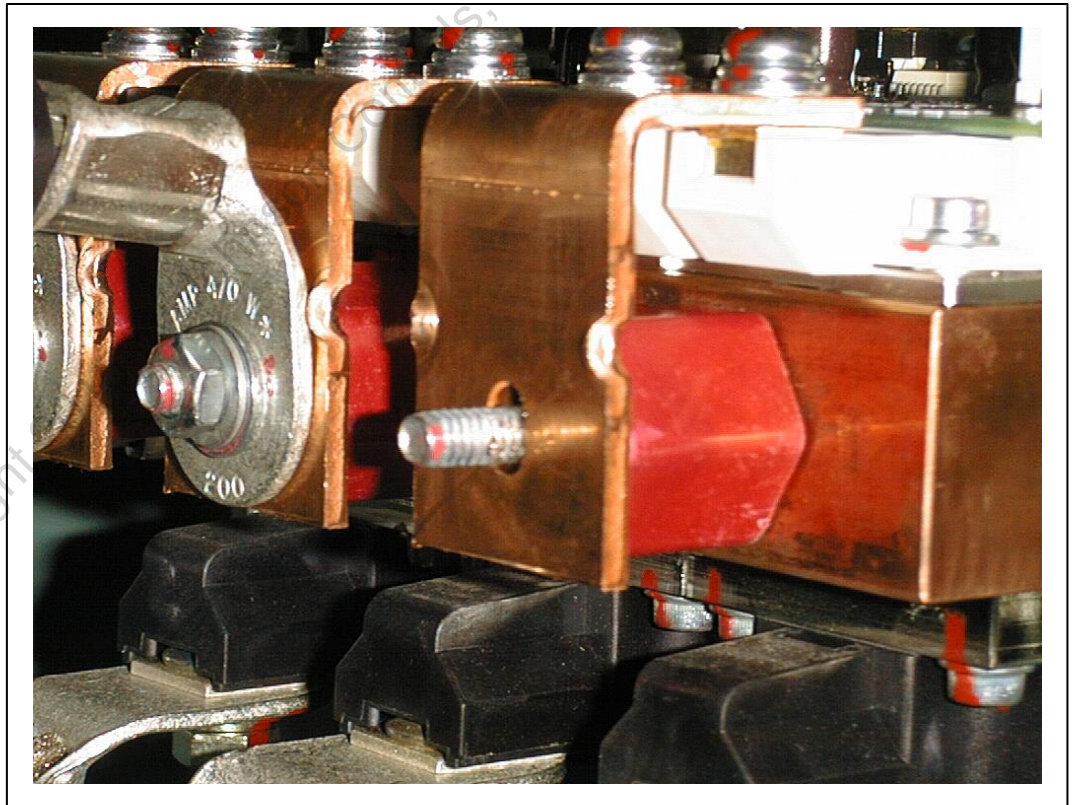
Torque the 6 screws that connect the Output Power Module to the laminated bus to 48 lb-in



Torque the 6 screws that attach the 3 copper angle brackets to the Output Power module to 48 lb-in



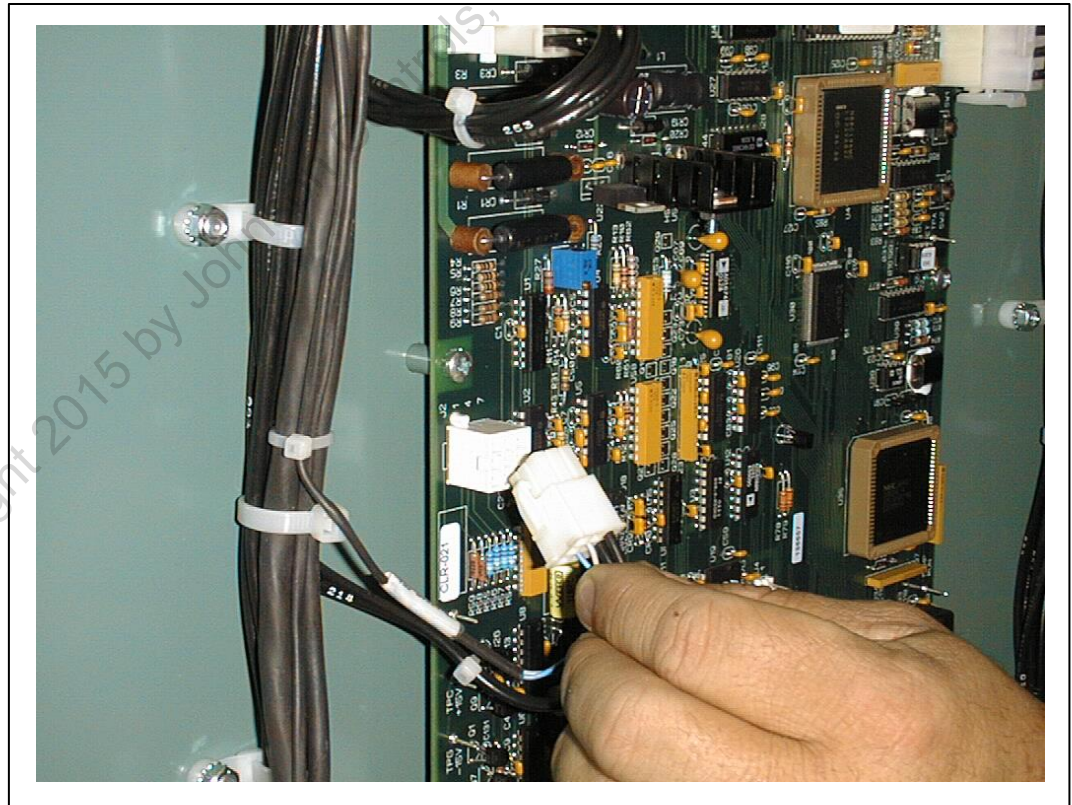
Reconnect the Motor Output Leads observing the wire lug positioning guides on the angle brackets. These are provided to maintain the wire lug orientation and to prevent the lugs from turning



Refill the cooling system with the new coolant supplied with the kit



Re-apply power to the VSD and unplug J2 from the VSD Logic Board to run the coolant circulation pump. Run the pump until the cooling system is purged of any air that may be trapped in the system



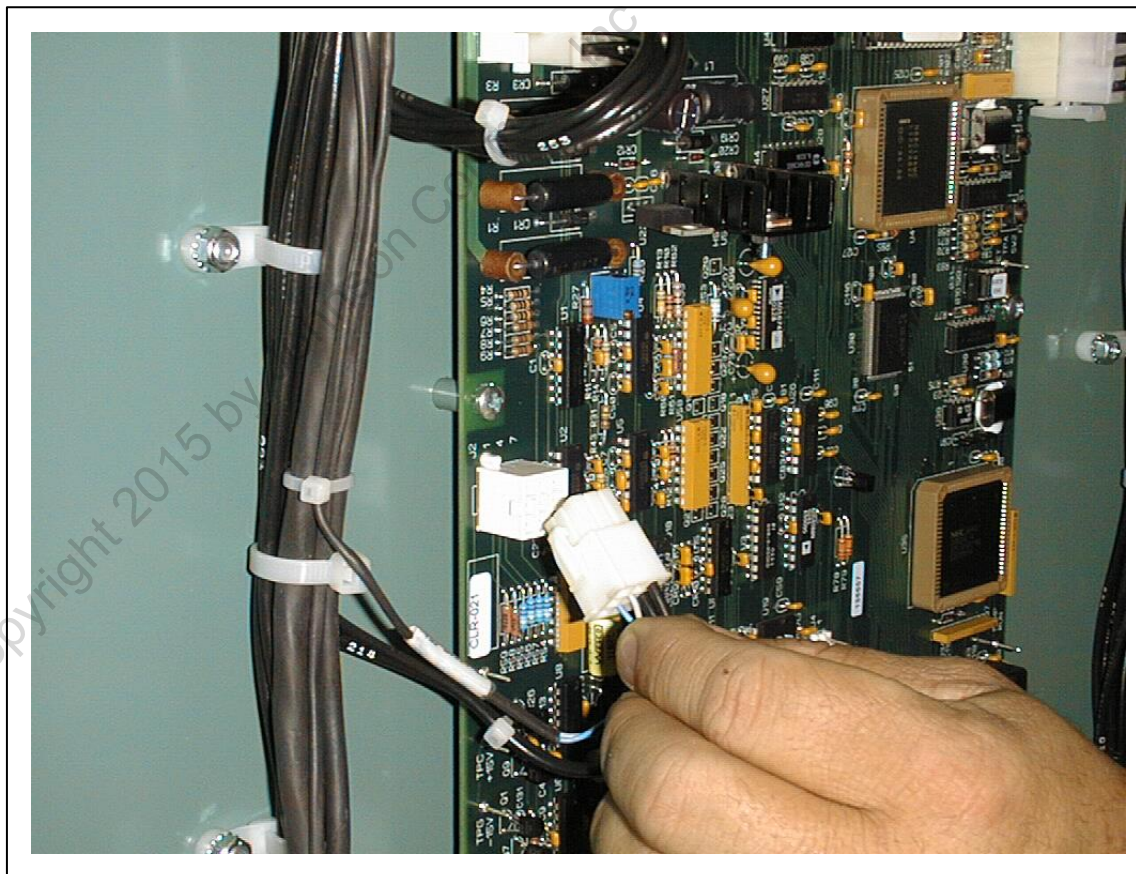
Top off the cooling system until the coolant level remains at a constant level



Re-install the Vent/Fill plug.



Re-plug J2 into the VSD Logic Board to stop the coolant pump



Troubleshooting



Don't change the tail light

Over Current Fault

- TM2 diagnosed as bad and was replaced – new drive

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Don't change the tail light Over Current Fault (Cont'd)

- TM2 diagnosed as bad and was replaced – new drive
 - Started Up and went off on over current
 - Compressor was locked up
 - Motor was fine

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Don't change the tail light Over Current Fault (Cont'd)

- TM2 diagnosed as bad and was replaced – new drive
 - Started Up and went off on over current
 - Compressor was locked up
 - Motor was fine
- Brand New YK – off on over current

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Don't change the tail light Over Current Fault (Cont'd)

- TM2 diagnosed as bad and was replaced – new drive
 - Started Up and went off on over current
 - Compressor was locked up
 - Motor was fine
- Brand New YK – off on over current
 - Current was fluctuating
 - Discharge SH was zero
 - Problem was overcharged

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Don't change the tail light Over Current Fault (Cont'd)

- TM2 diagnosed as bad and was replaced – new drive
 - Started Up and went off on over current
 - Compressor was locked up
 - Motor was fine
- Brand New YK – off on over current
 - Current was fluctuating
 - Discharge SH was zero
 - Problem was overcharged
- This was after a new motor had been installed

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Don't change the tail light Over Current Fault

- 1 chiller with TM1, 1 with SSS – Lead-Lag
- When SSS was lag then TM1 would trip out on over current

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Don't change the tail light Over Current Fault (Cont'd)

- 1 chiller with TM1, 1 with SSS – Lead-Lag
- When SSS was lag then TM1 would trip out on over current
 - Problem was that with the SSS as the lead, they could start the TM1 no problem. When the SSS as the lag it created voltage sag on the incoming power and the TM1 would fault.

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Don't change the tail light Over Current Fault (Cont'd)

- 1 chiller with TM1, 1 with SSS – Lead-Lag
- When SSS was lag then TM1 would trip out on over current
 - Problem was that with the SSS as the lead, they could start the TM1 no problem. When the SSS as the lag it created voltage sag on the incoming power and the TM1 would fault.
 - Transformer was undersized.

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Don't change the tail light

■ Bus Over Voltage

- Exceeds 745 VDC
- 414 to 508
- RMS * 1.414

■ Bus Voltage Imbalance Fault

- Check +, -, and ½ bus with pair of digital meters
- When the pre-charge relay engages, both voltage readings should come up together
- Connect a 12 VDC source (such as a battery charger) – Measure balance

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Don't change the tail light

■ Output Current Imbalance

- Most imbalances will be due to variations in the motor windings.
- If the imbalance is real, you are likely facing a pole problem.
- If not, then likely due to a bad CT, wrong value CT, faulty wiring to the CT, or a bad VSD logic board.

■ Run Relay Fault

- Hard and soft signals required
- Invalid Current Scale Fault
 - Improper jumper configuration

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Don't change the tail light

■ Pre-Charge Low Voltage Fault

- During pre-charge the DC Link must be equal to or greater than 50 VDC within ½ second
- Check the
 - pre-charge relay
 - pre-charge resistors,
 - wiring between the VSD logic board and the pre-charge relay.

■ 105% Motor Current Overload

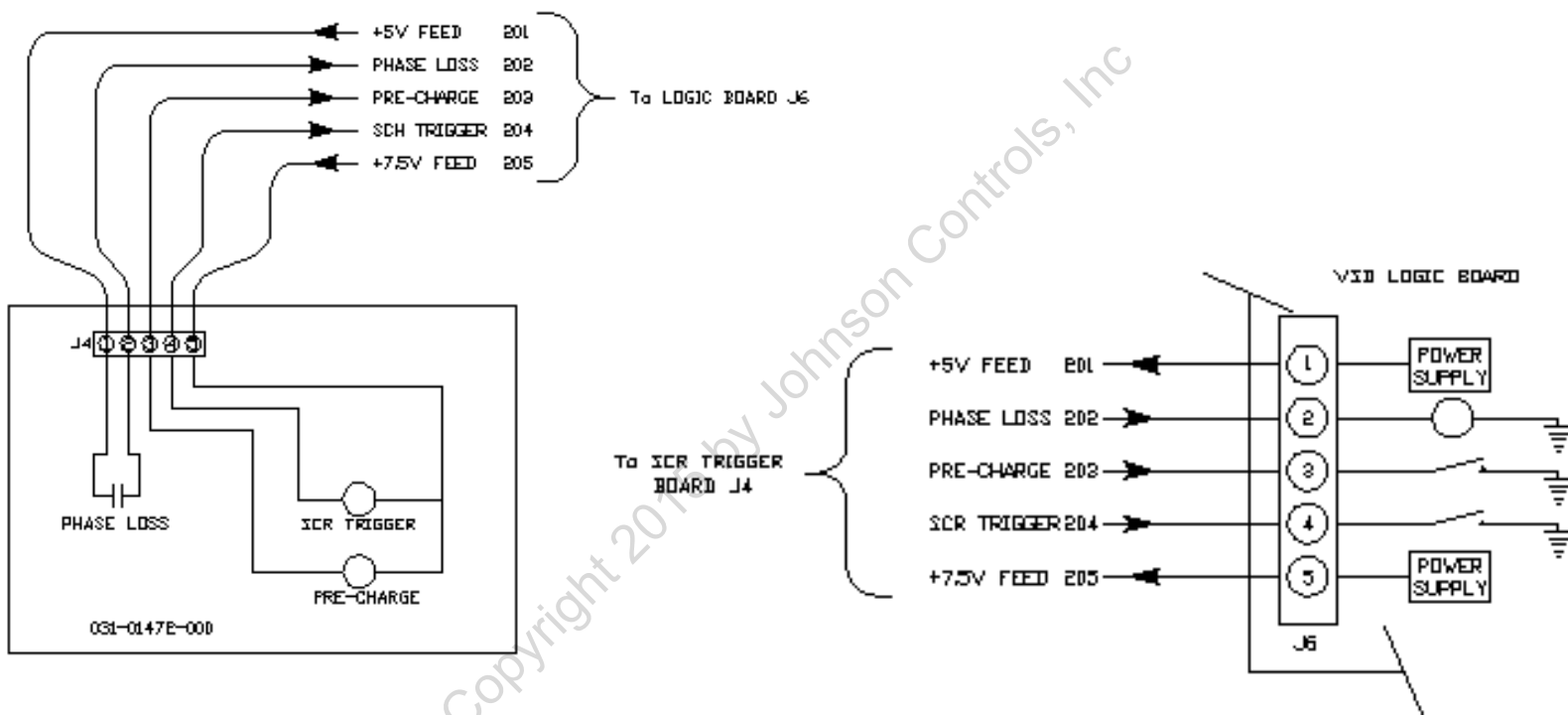
- A motor overload has occurred
- Exceeded 105% of the programmed 100% job full load amps (FLA) value for more than 7 seconds.

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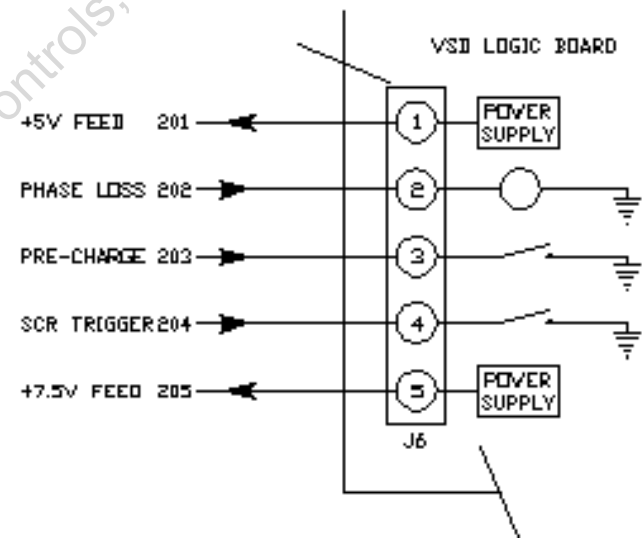
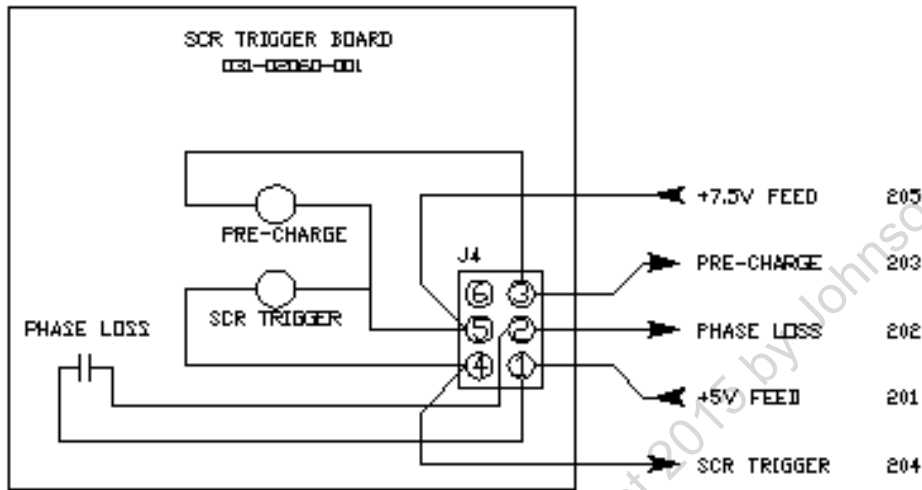
Don't change the tail light

- High Phase A (B, C) Heatsink Temp
 - Adequate level of coolant
 - Be sure the cooling pump is operating when the unit is running
 - Check the strainer in the primary of the heat exchanger for clogs and silt.
 - A bad temperature sensor on an output pole assembly.

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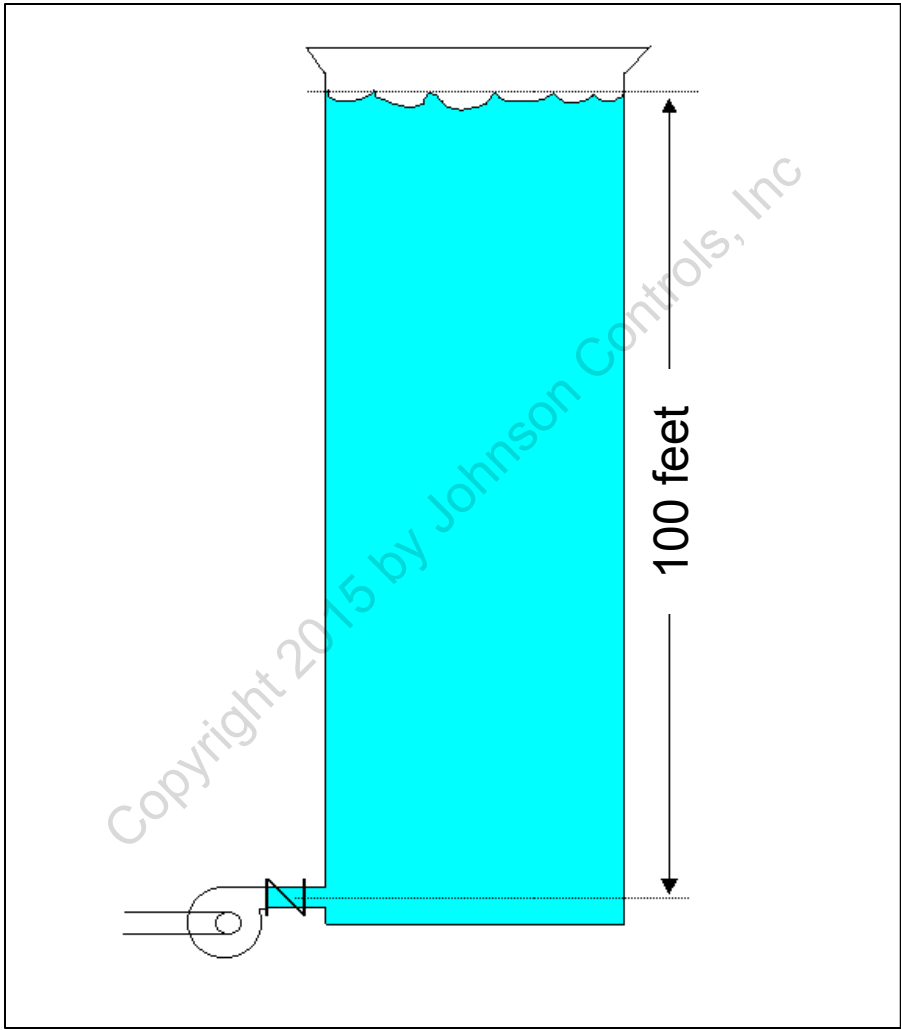


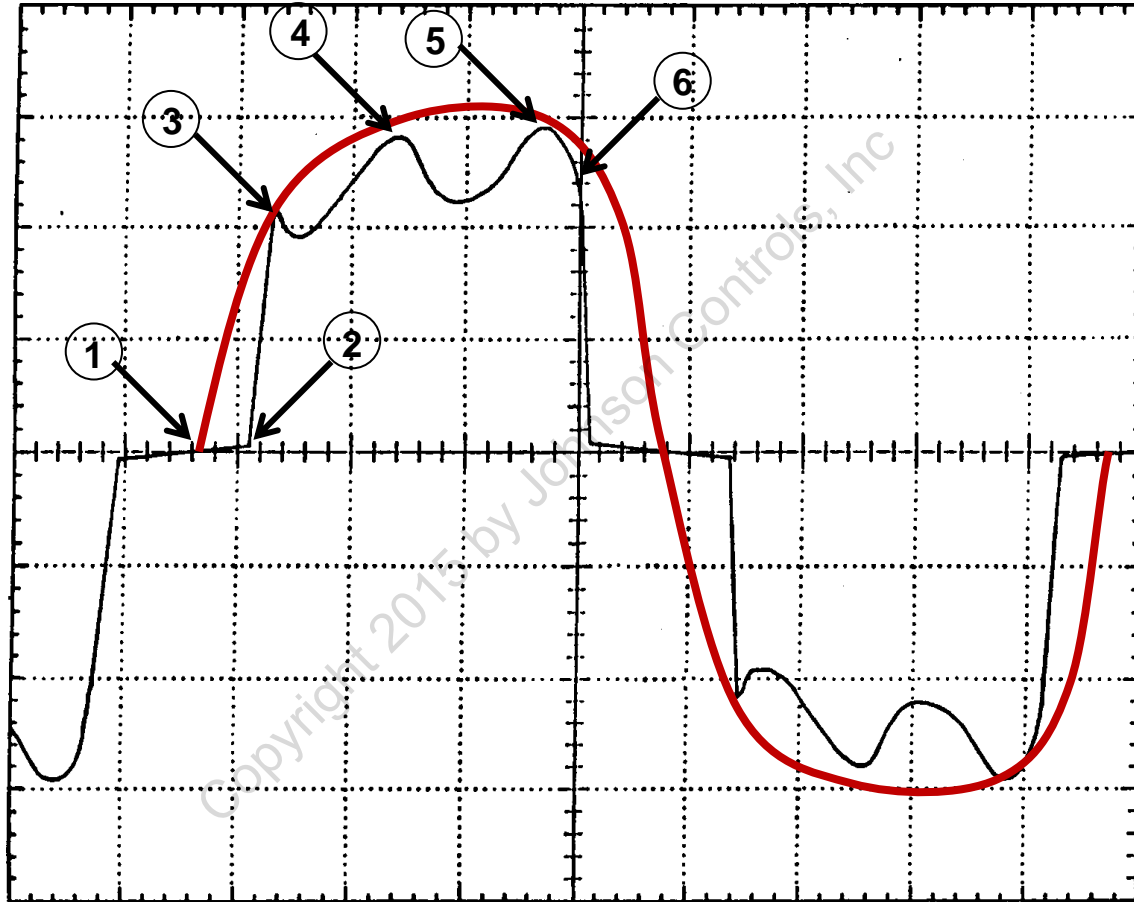
PHASE LOSS ----- PRE-CHARGE ----- SCR TRIGGER



VYPER DRIVE

PHASE LOSS ----- PRE-CHARGE ----- SCR TRIGGER

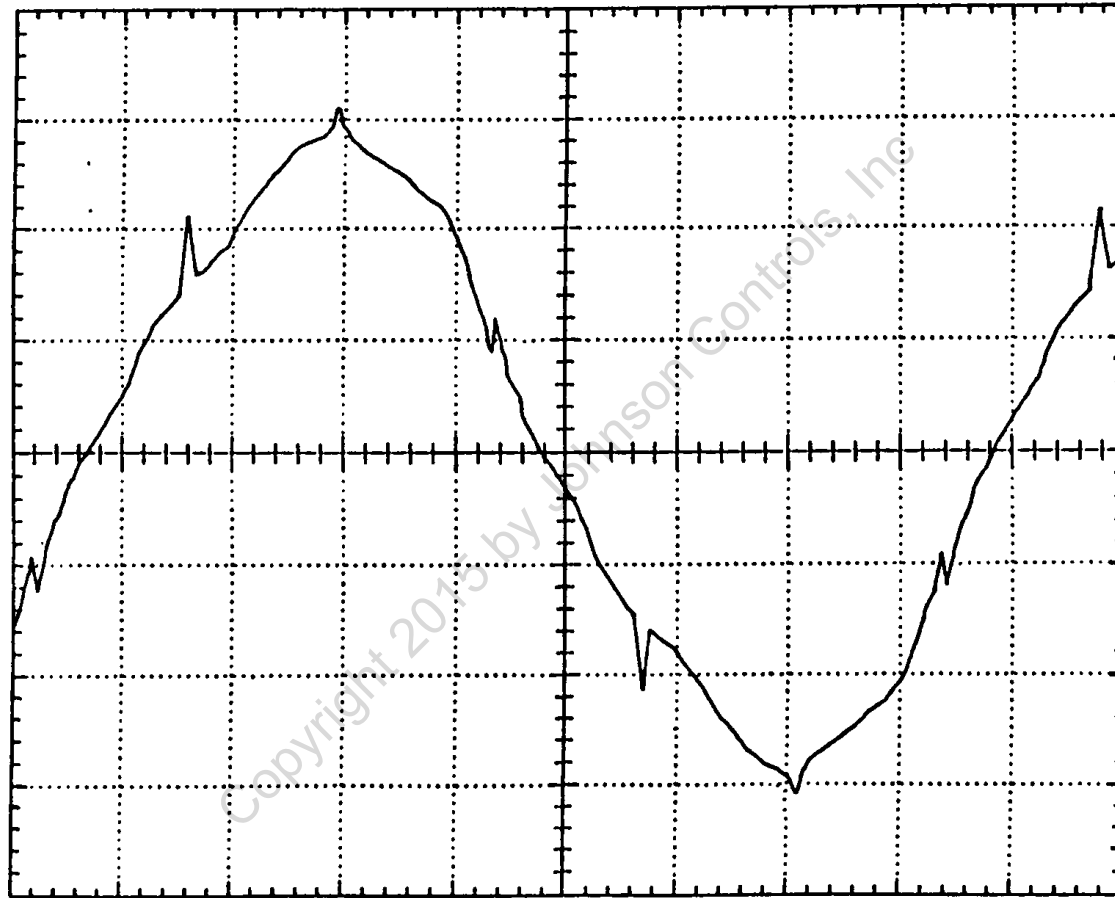




VSD Input Current Without Filter



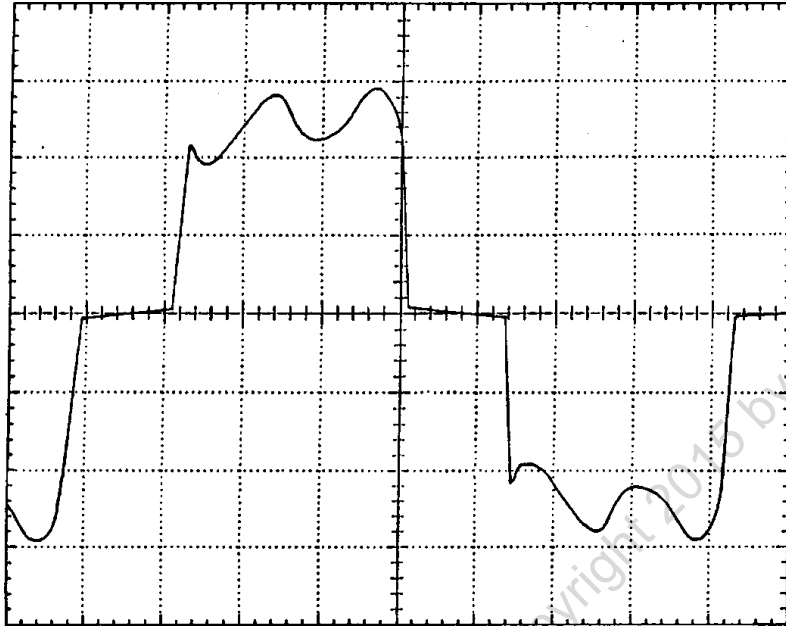
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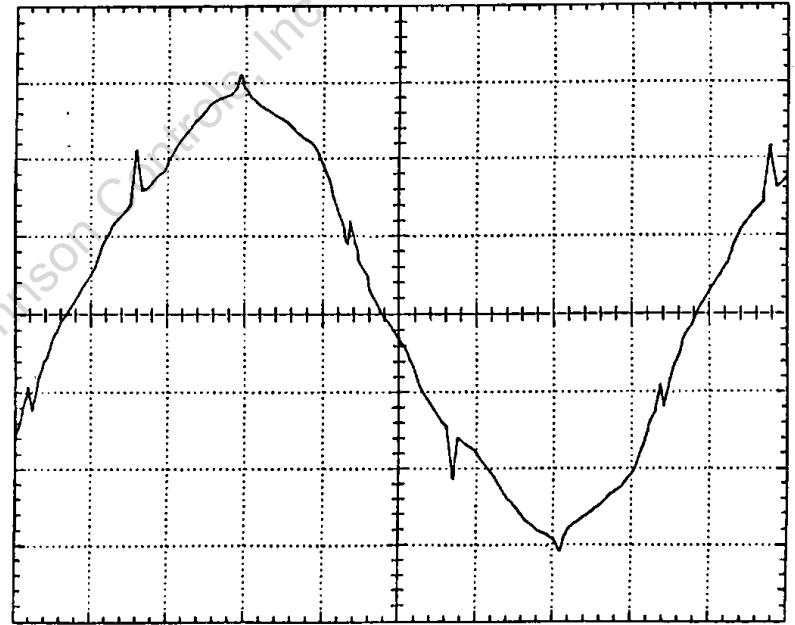
VSD Input Current With Filter



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VSD Input Current Without Filter



VSD Input Current With Filter

Resources

 Day 1

 Day 2

 Day 3



Review Exercises



Technical
Documentation



Handouts



Scratch Pad

Review Exercises

-  Day 1
-  Day 2
-  Day 3
- Resources**

Vyper Component
Recognition
Exercises

Style D Component
Recognition
Exercises

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Forms

 Day 1

 Day 2

 Day 3

Resources

035-16262-000-sht1	035-17889-000-sht2	160.00-m1 IsO3 Shell and Tube Retrofit	160.00-o4 (1)	160.00-rp4
035-16262-000-sht2	035-18685-000-sht1	160.00-m4 (1)	160.00-o4	160.05-N4
035-16264-000-sht1	035-18685-000-sht2	160.00-m4 (113)	160.00-pw1 (1)	
035-16264-000-sht2	035-18685-000-sht3	160.00-m9	160.00-pw2	
035-16265-000	50.20-rp1 Electrical Connectors (1)	160.00-o1 (1)	160.00-pw3	
035-17889-000-sht1	160.00-m1 (1)	160.00-o4 (415)	160.00-rp2	

Handouts



 Day 1

 Day 2

 Day 3

Resources

Bearing Fluting
Overview 2010

Eli the Iceman

motor tip sheet14

VSD Display
Messages

Bearing Fluting
Tools and Materials

Failure Report v3

SCR Changeout
Instruction

VSD Frequently
Asked Questions

Booster Pump
160.05 N4

Fluting on Bearings
technical literature

si0223

York Notes

Corner grounded
delta systems

Instantaneous
Current Fault notes
from Karl Barley

si0227

dv/dt

Line Reactors and
AC Drives1

Sources and Effects
of Harmonics

Ed Mancuso
handouts

Modification of 790
and 1100 VSD's

Transformer
Diagrams

