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Rockwell Liquiflo1 & Liquiflo 2

Chee Nee Bong

March 2012

ROCKWELL LF1 & LF2



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Overview

- LF1 & LF2 drive basics
- VFD Control – PWM, Control Method
- Liquiflo 1
 - Ratings
 - Design
 - Panel Layout
- Components
- Drive Troubleshooting
- Keypad
- Alarms
- Parameters
- Other (Replacement check list, bulletin)

- Liquiflo 2
- Model #
- Ratings
- Power module
- Components
- Panel layout & components
 - Wiring and Control setup
 - Cooling Control and Algorithm
 - VFD Configuration on ICVC
 - Start/Stop sequence
- VFD Fault Code

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NOTICE

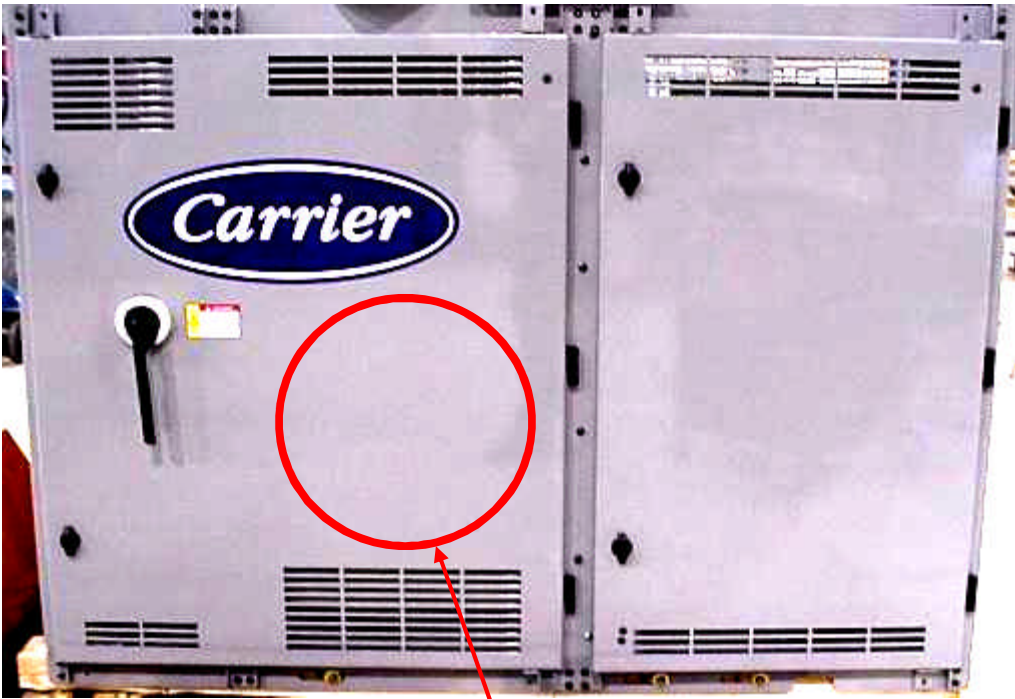
Do not drill holes through the top of this cabinet. Installing signal or control wiring conduit openings drilled through the top of this enclosure will void warranty. Use knockouts on the back or side of this enclosure.

19XV05012801

There are labels on the cabinet to prevent damage to the drive.
There are knock outs in the back of the drive for electrical connections.

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Unit Mounted VFD



LiquiFlo II – No Keypad



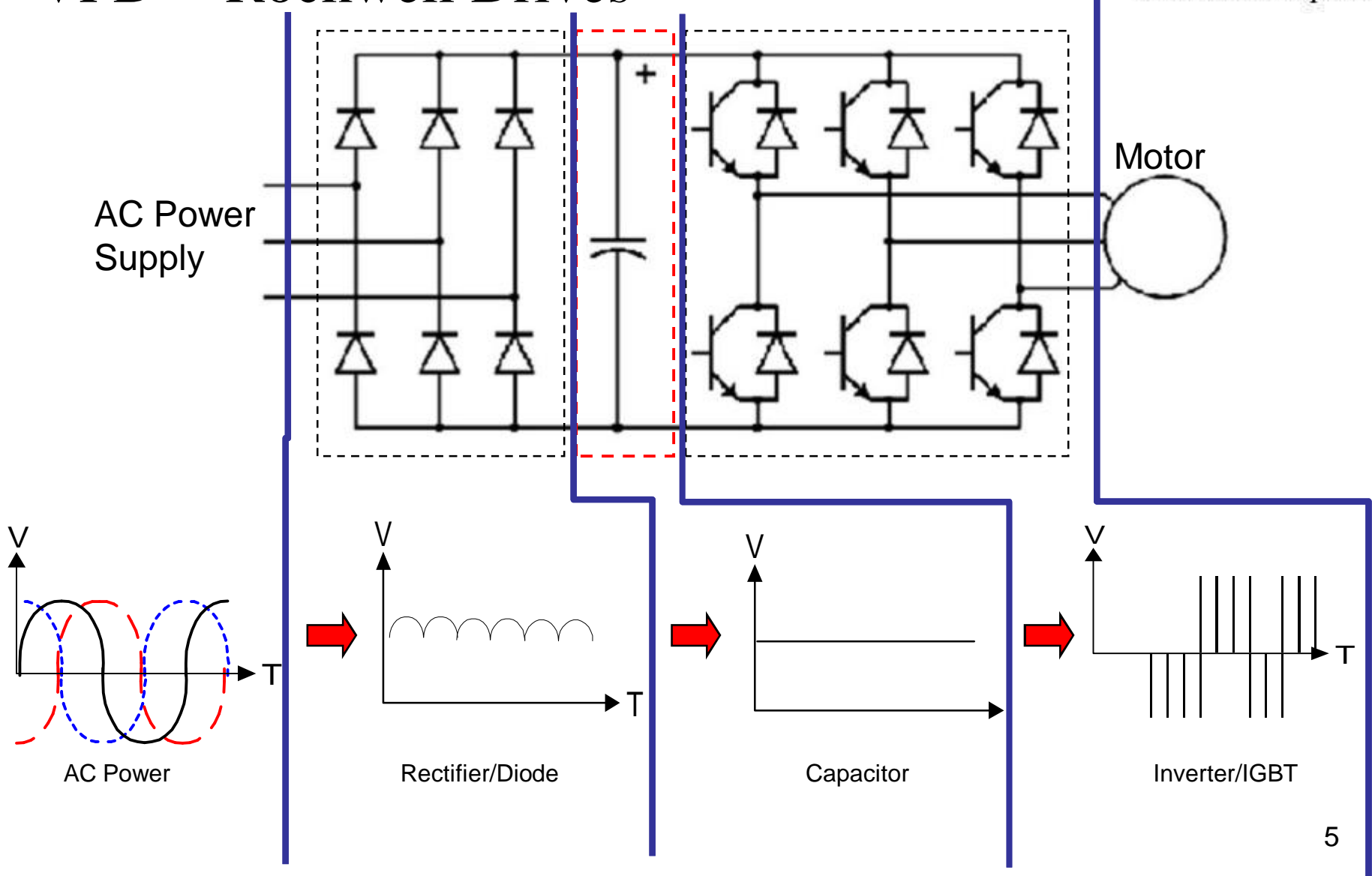
LiquiFlo I – With Keypad



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VFD -- Rockwell Drives

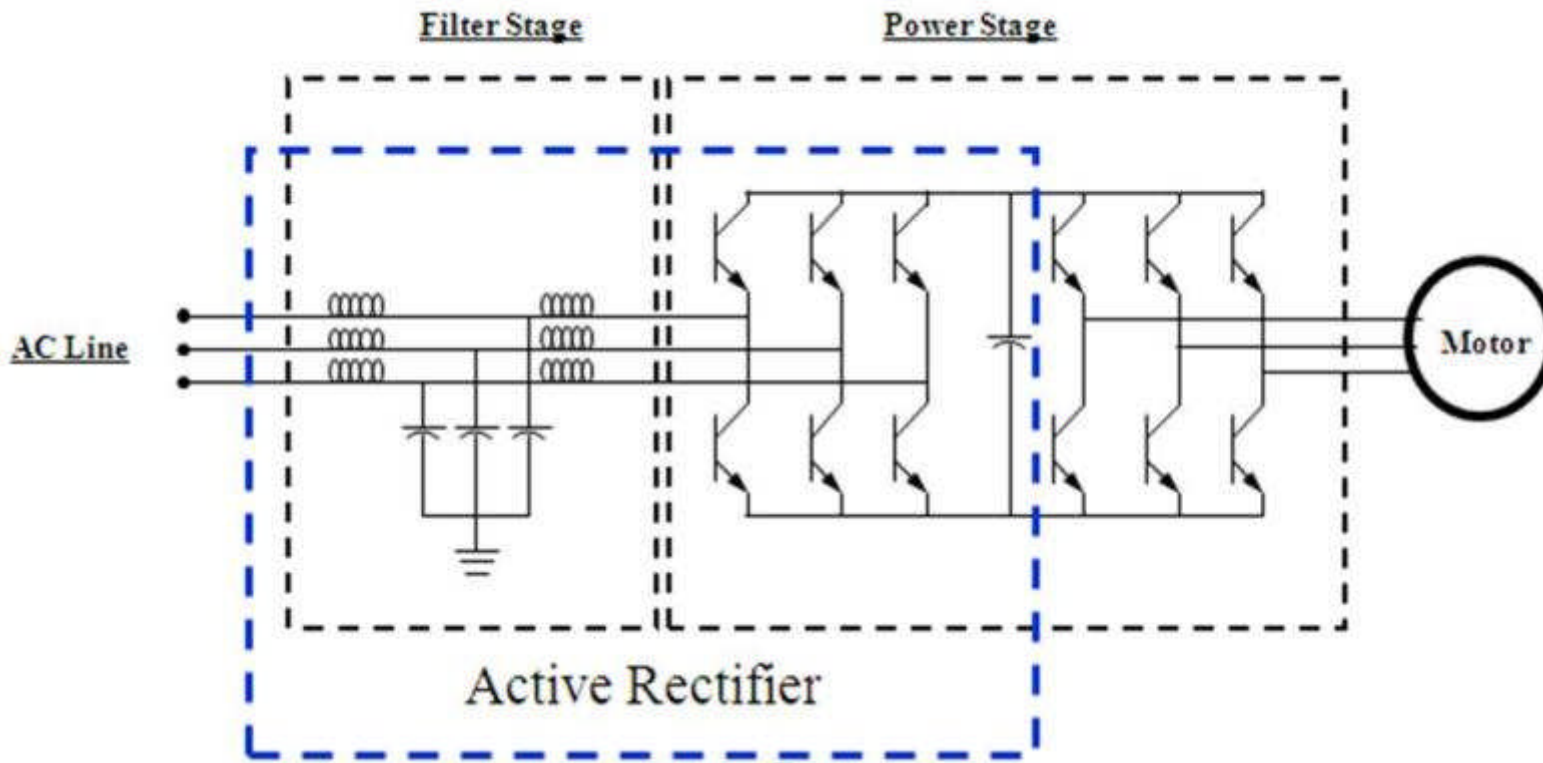


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VFD – LIQUIFLO II



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Meets or beats 18 pulse in lower harmonic distortion

LF2 maintains balanced low harmonic currents in the presence of unbalance lines

Meets IEEE519 - 1992

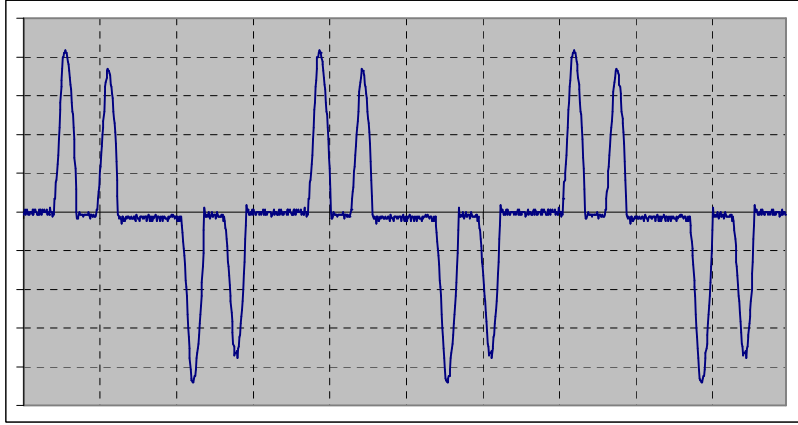
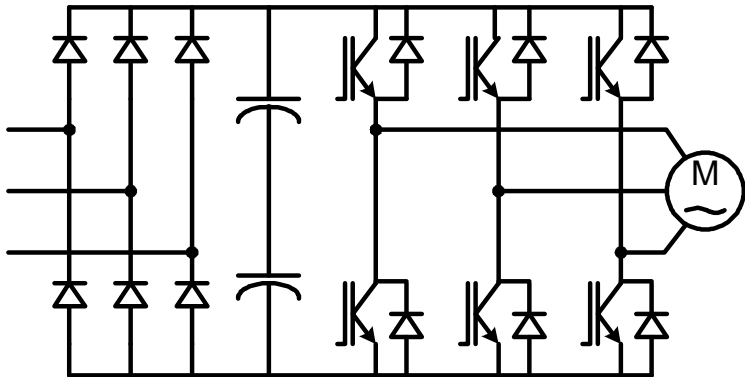


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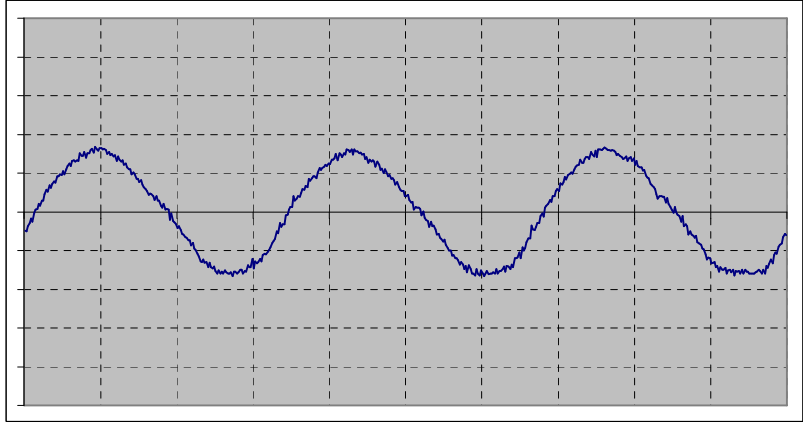
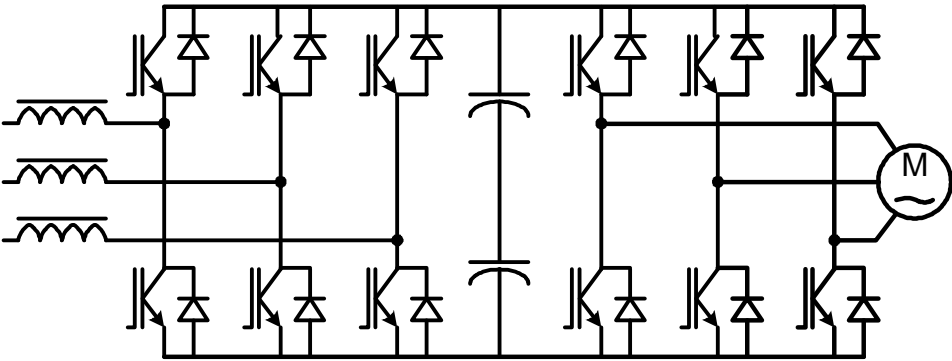
VFD – LF I vs. LFII

Diode Front End



Input Current Waveform

Active Converter



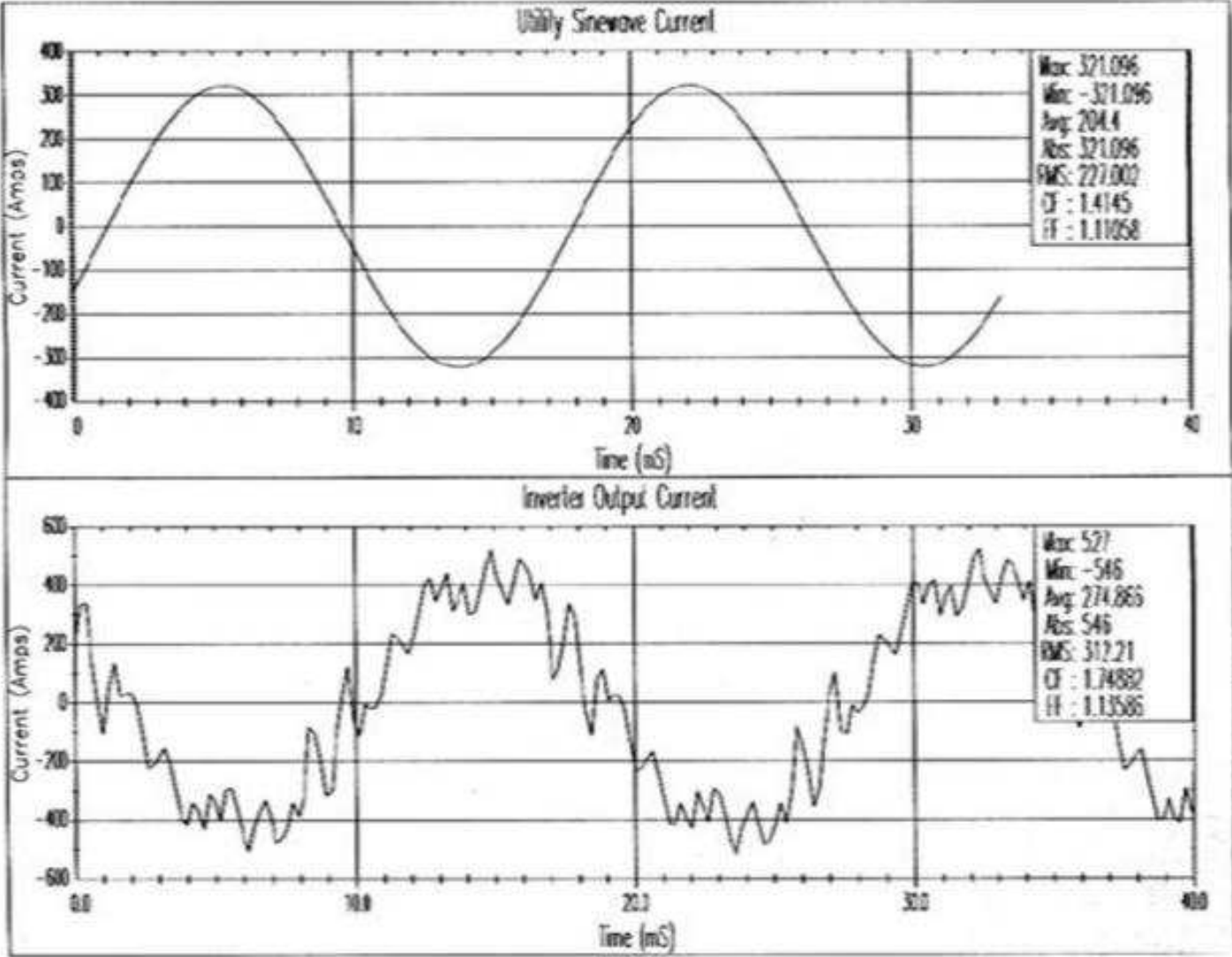
Input Current Waveform

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Utility Sinewave vs. VFD



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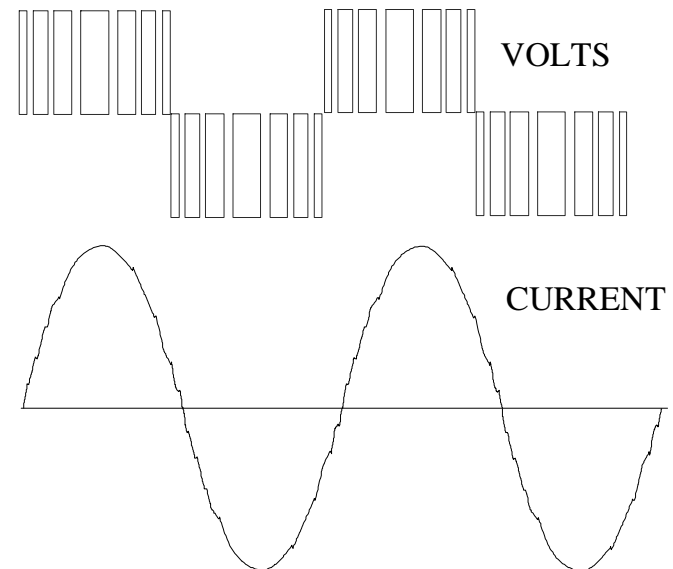
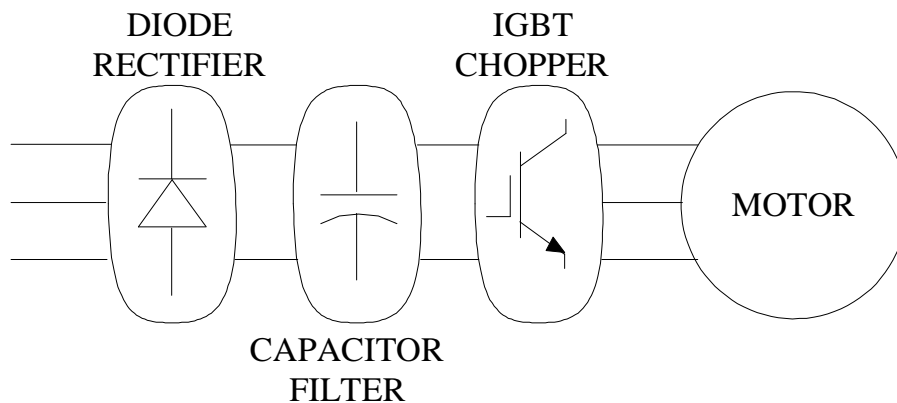
VFD Control – PWM

PWM – Pulse Width Modulation

Pulse width is varied to vary the voltage to the motor.

Wide pulses give high voltage, and narrow pulses give low voltage.

Increase in switching speed allows for output current to more closely approximate a sinusoidal wave form

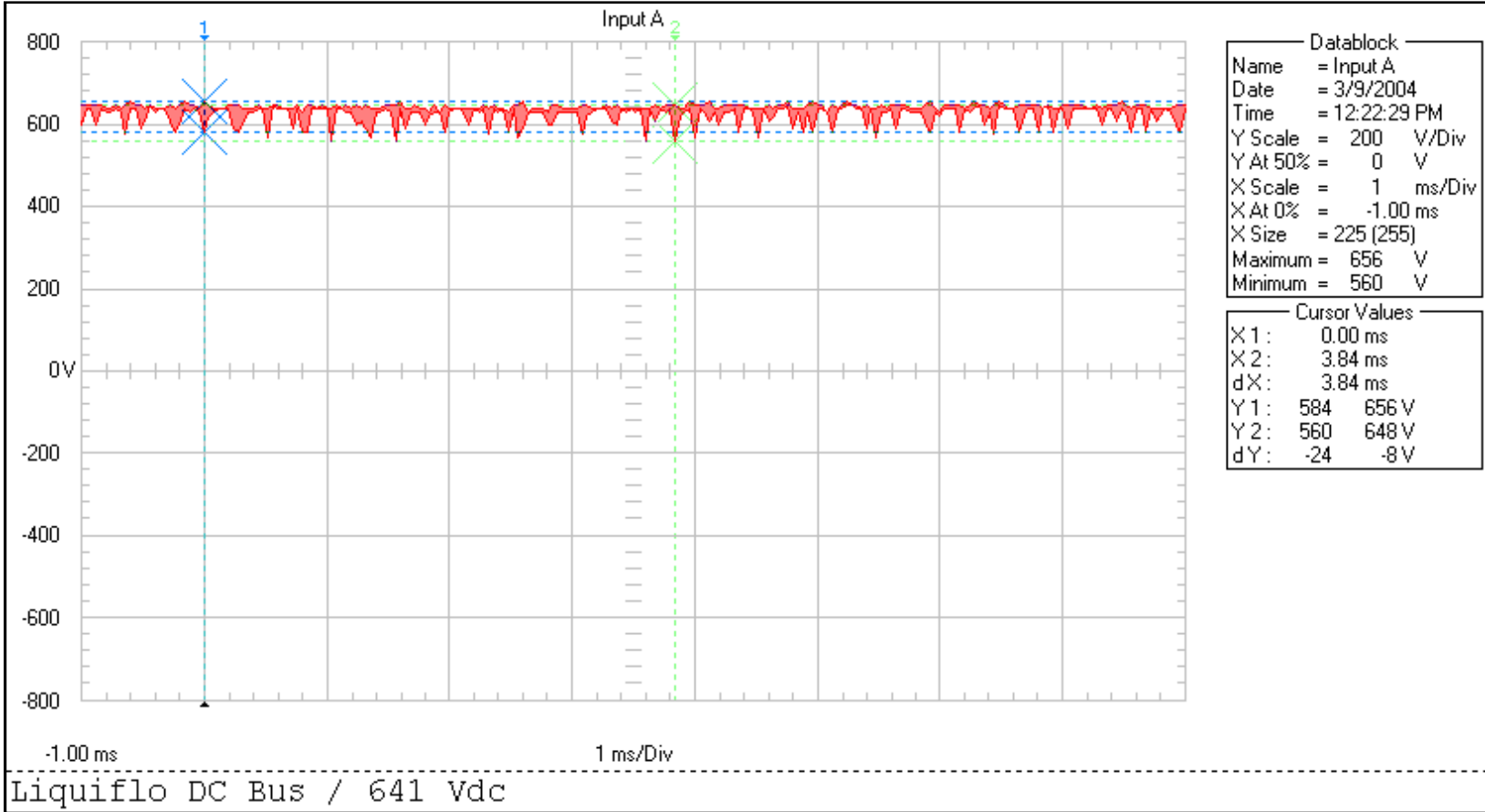


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VFD – DC Bus Voltage



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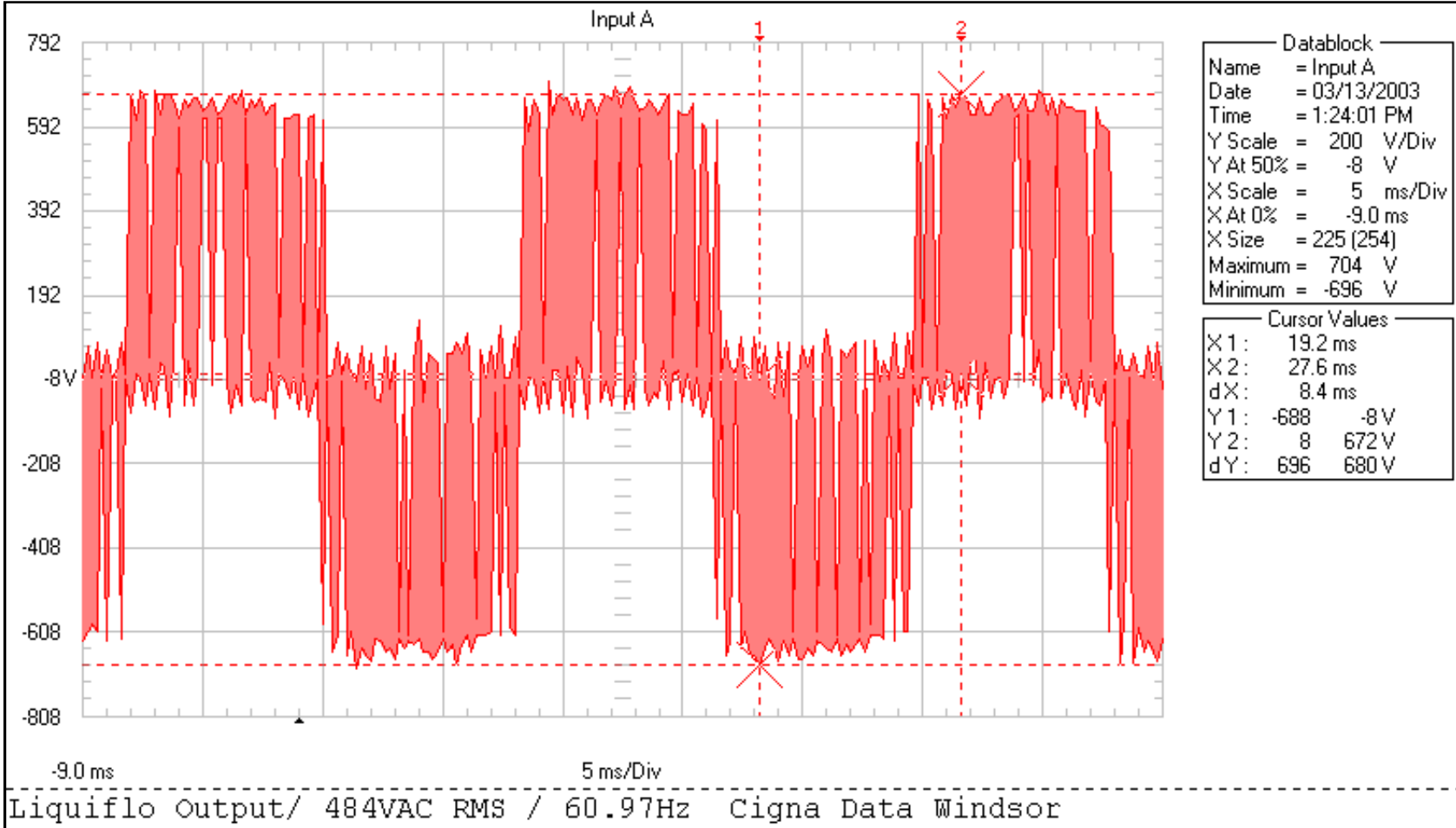
The DC bus equates to the inverse RMS or the peak AC input voltage
(460Vac x 1.414 = 650 VDC)

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VFD – DC Bus Voltage



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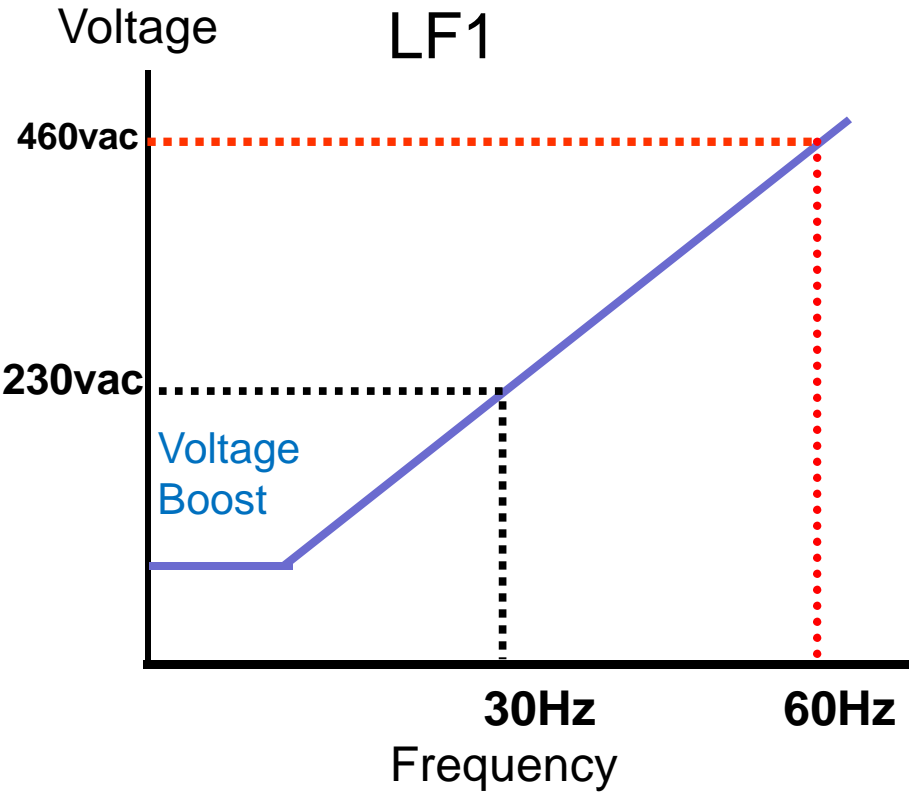
Note slight gaps in output voltage waveform. Carrier Frequency @ 2 kHz equates to 16.66 IGBT pulses per half cycle @ 60 Hz

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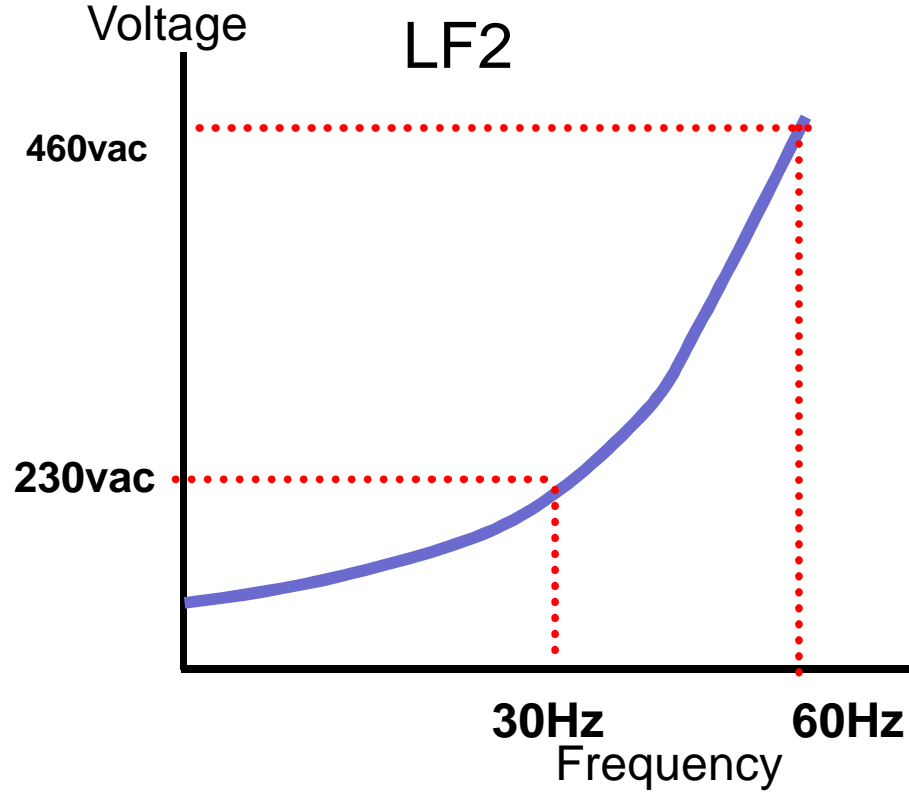


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VFD – Control Method



Constant volts per hertz control of the IGBTs



Sensorless Vector Control of the IGBTs

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VFD – LF1 vs. LF2 summary

	LF1	LF2
Keypad	Yes	No
Front End	Passive	Active
VFD Control	Volt/hertz	Sensorless Vector
Chiller Control	PIC II	PIC III

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Rockwell LF1



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Liqui FLO
LIQUID COOLED AC DRIVE



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What is LiquiFlo ?

Patented liquid-cooled heatsink with IGBTs, capacitors, and SCRs

Industry's smallest HP/square inch footprint.

80% drive generated heat dissipated through liquid, well suited for harsh environment

Rockwell Automation

Features

- 6 or 12 pulse AC to DC converter (414-643 Amp only)

- Standard DC link inductor

- AC PWM inverter

- Combined power supply and power module interface control board

- Single regulator accepts all common network communications

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LiquiFlo 1 Ratings

Voltage Input:	440 to 480 VAC
Frequency Input:	60 Hz, \pm 2 Hz
2 Power Modules:	B Frame:414 Amps
	C Frame:500 Amps & 643 Amps
	D Frame: 1200 Amps
Temperature Range:	0 - 55°C
Enclosure Type:	Chassis or NEMA Configured
Cooling System:	HFC-134a

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LiquiFlo Ratings

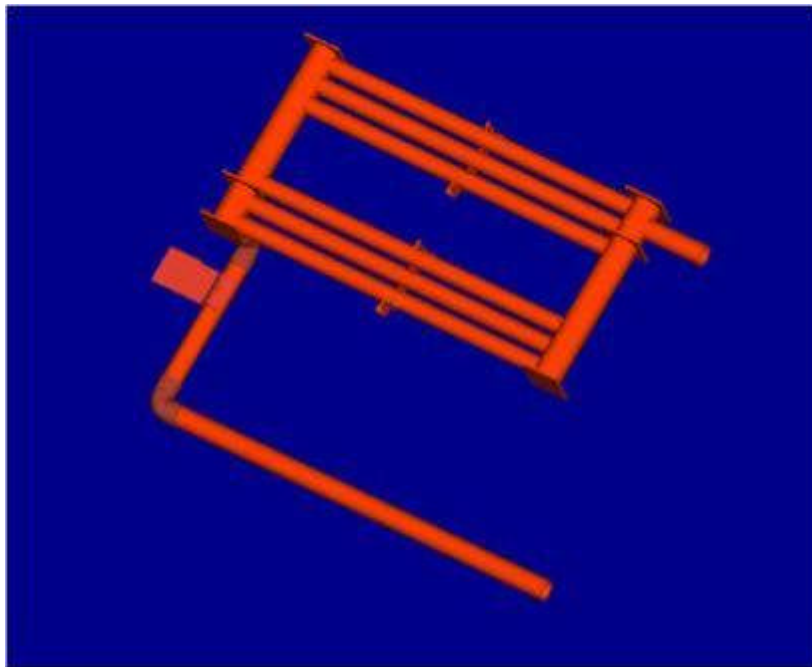
Condition	Specification
Operating Temperature (inside NEMA1 enclosure)	0°C to 55°C (32° to 131°F)
Ambient Temperature (outside NEMA1 enclosure)	0°C to 40°C (32° to 104°F)
Storage Temperature (Ambient)	-40°C to 65°C (-40° to 149°F)
Humidity	5% to 95% (non-condensing)

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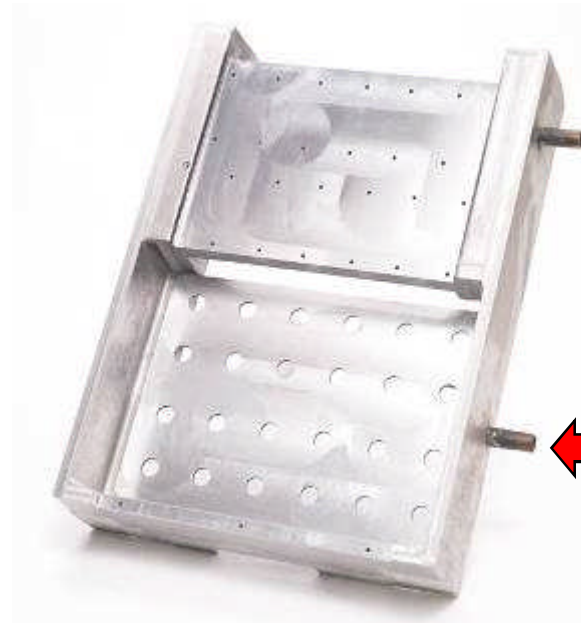
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LiquiFlo I B Frame (414 Amps)



Braced Copper Tube Manifold

Burst Test up to 2500 psi
without failure



Copper
tube inlet
and outlet

B Frame (414 amps)

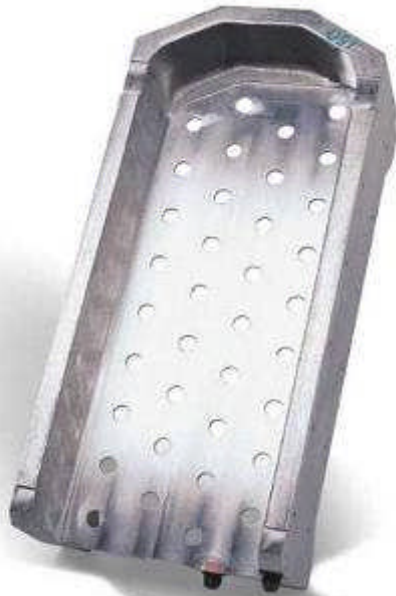
Burst pressure ratings up to 2500
PSI for copper cast in aluminum
heatsink

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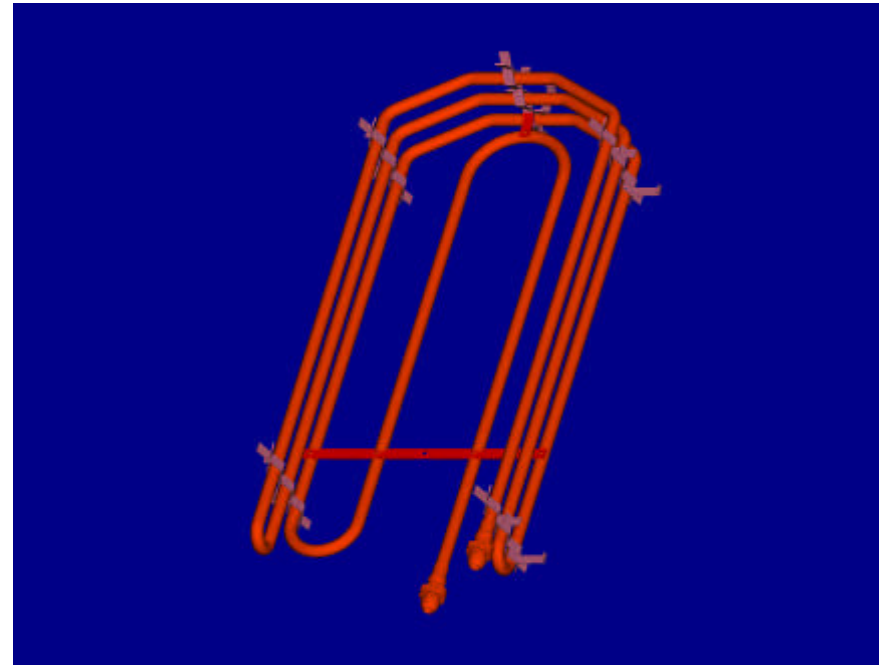


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LiquiFlo I C Frame (500 & 643 Amps)



Standard copper fittings for ease of liquid connections in and out of casting



C Frame (500 & 643 Amps)

Swaged Copper Tube Formed

Solid Single piece of tube, no seams

Reduce possibility of leaks inside casting

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Casting Design

Special design stud mounted capacitors

Effective cooling of key components

Increase product lifespan by regulating the operating temperature of the capacitors



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Casting with Power Devices



Input SCRs

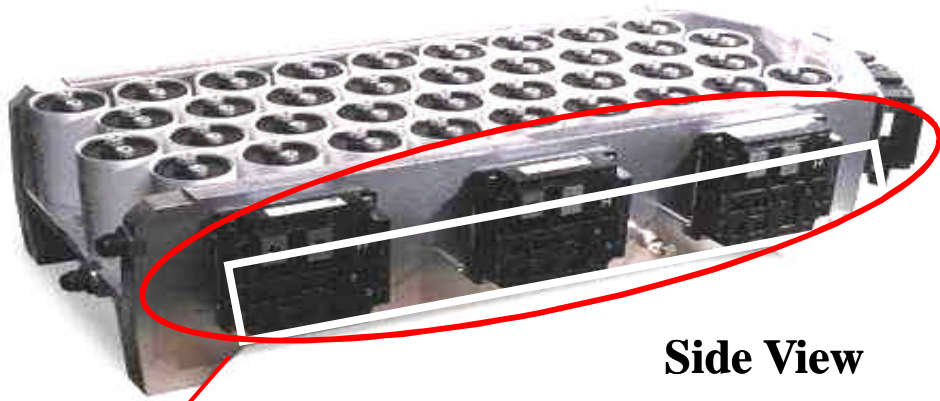


Front View

Low Transistor Junction Temperature

Maximize use of power devices

Increase running output amp rating



Side View

Output IGBT

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Patented Laminated Low Inductance DC Bus Turn to the Experts.™

Wireless design of 5-layer DC bus makes all the connections between the input line, power devices and motor output

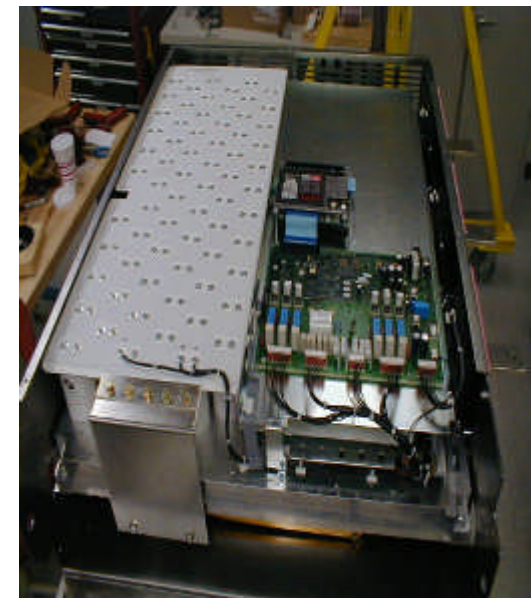
Technology provides lower emitted noise from the drive



414 Amp B-Frame
LiquiFlo I



500-643 Amp C-Frame
LiquiFlo I



1200 Amp D-Frame
LiquiFlo I

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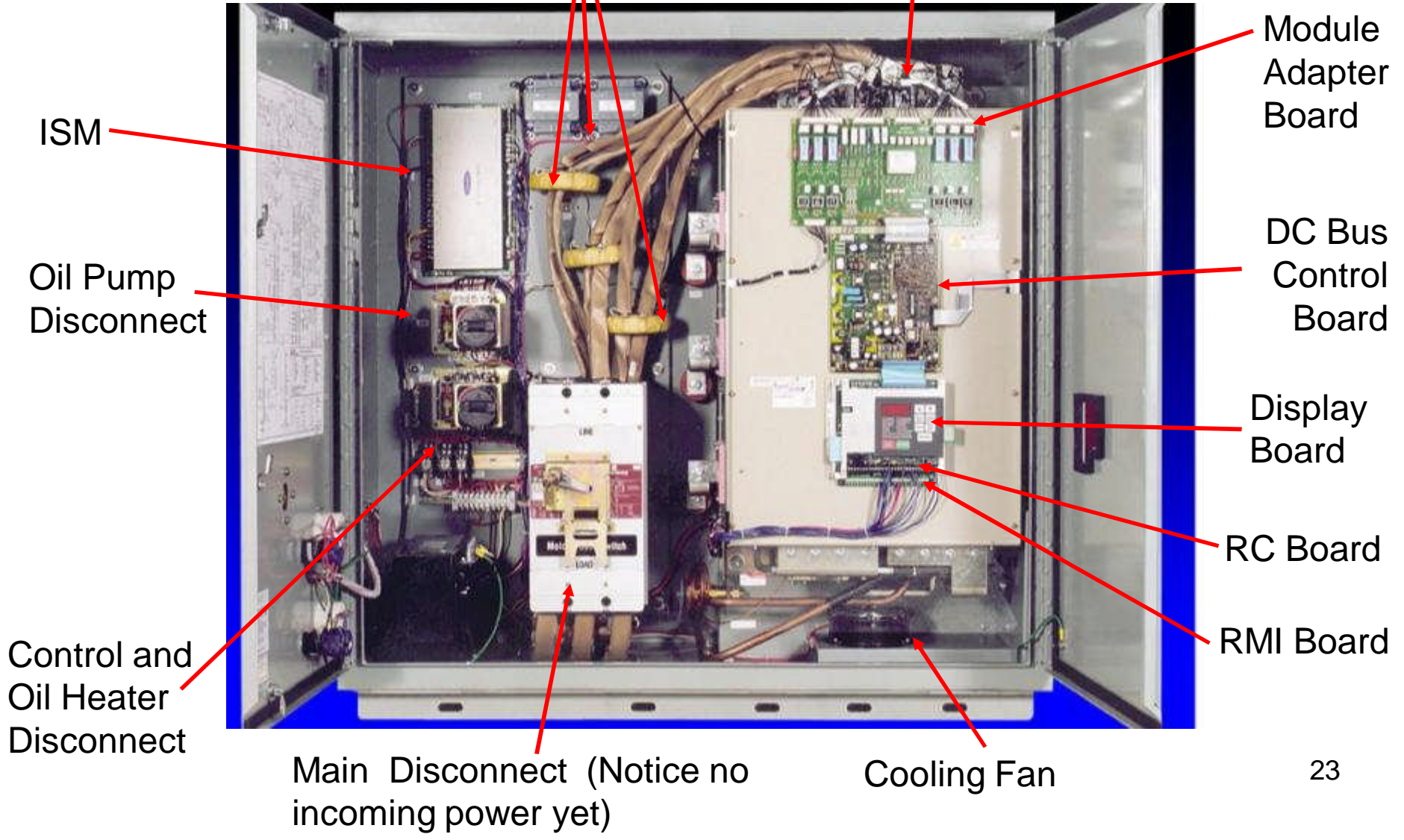


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Liquiflo I

CTs for ISM

480VAC to drive
Power Module



Power
Module
Adapter
Board

DC Bus
Control
Board

Display
Board

RC Board

RMI Board

Main Disconnect (Notice no
incoming power yet)

Cooling Fan



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Liquiflo I

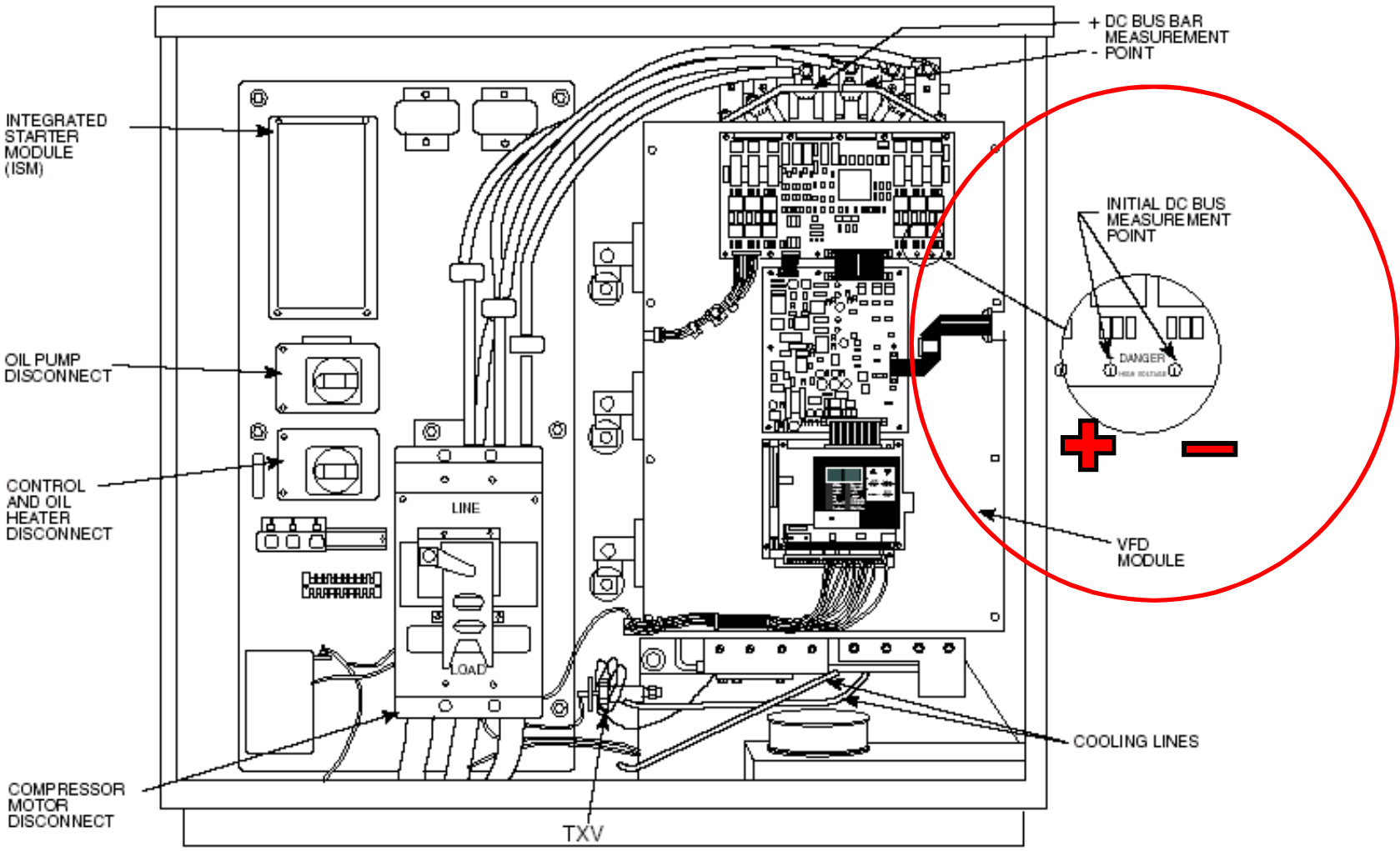


Fig. 8 — Variable Frequency Drive (VFD) Starter Internal View

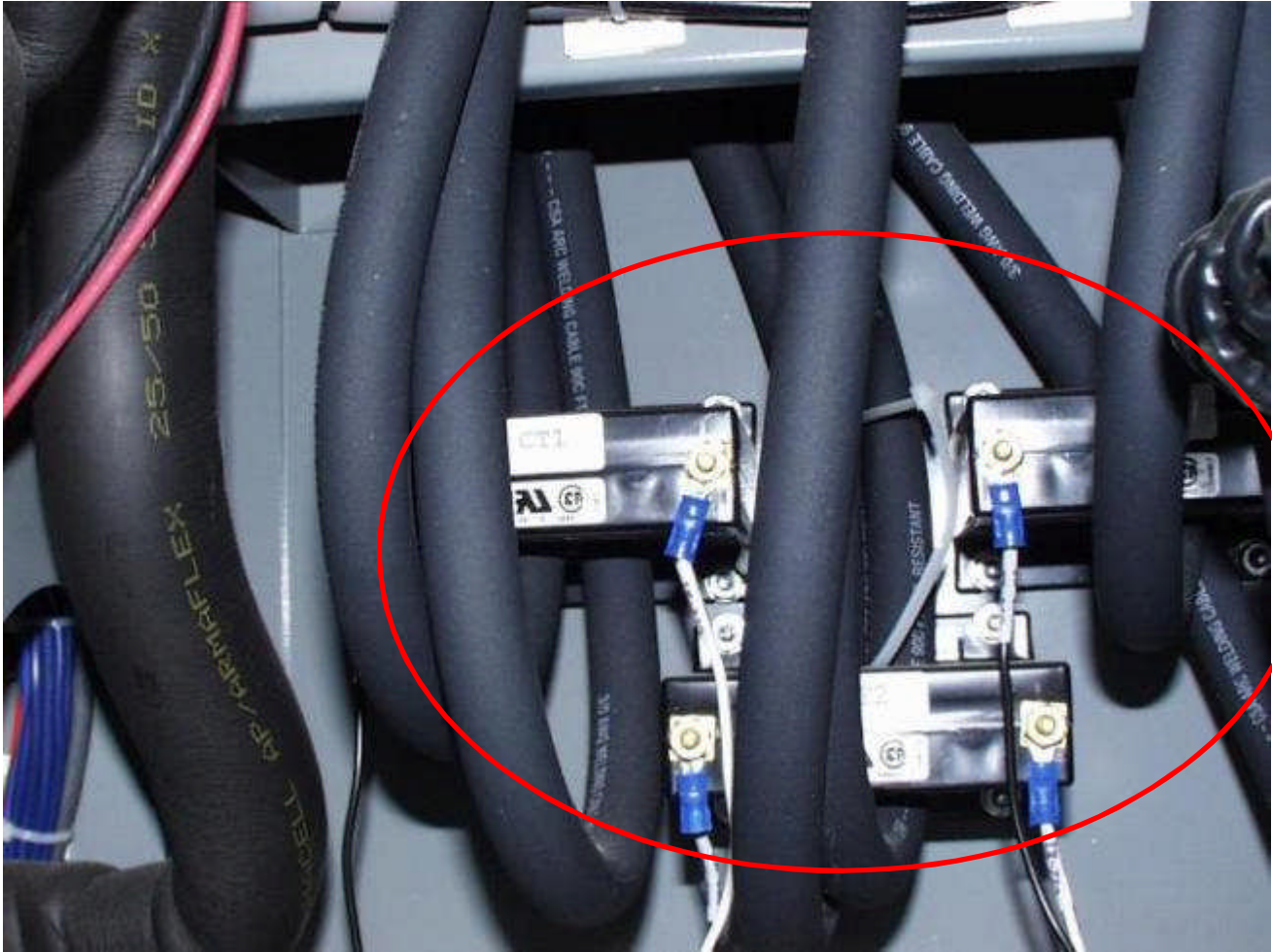
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Liquiflo I



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LiquiFlo I-CT for ISM

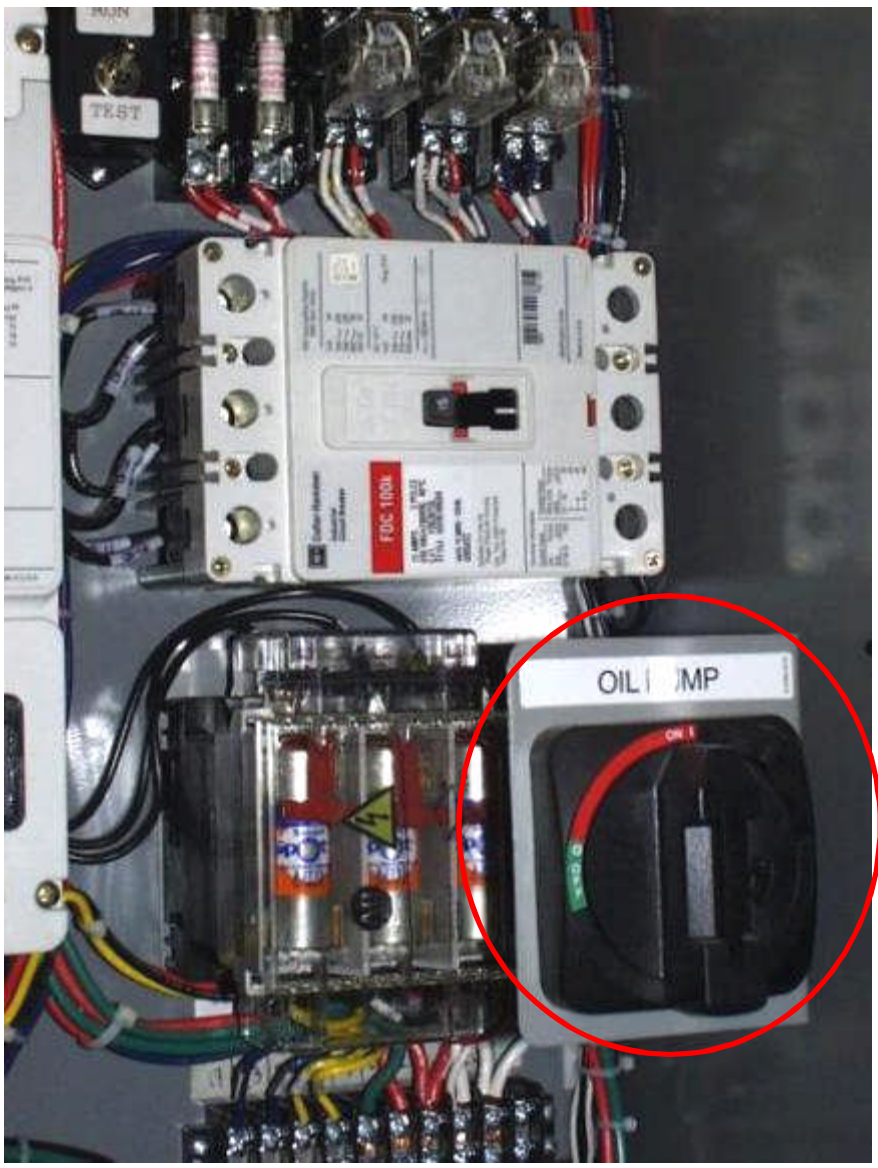


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LiquiFlo I – Oil pump disconnect and fuses

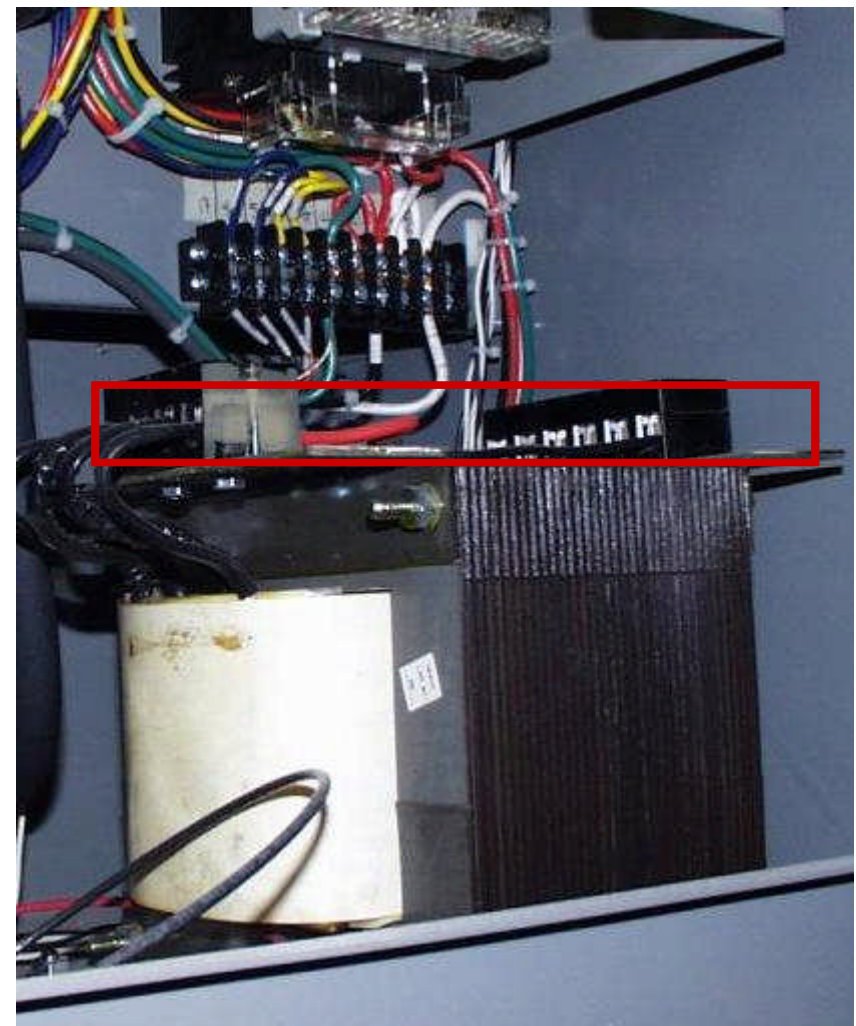
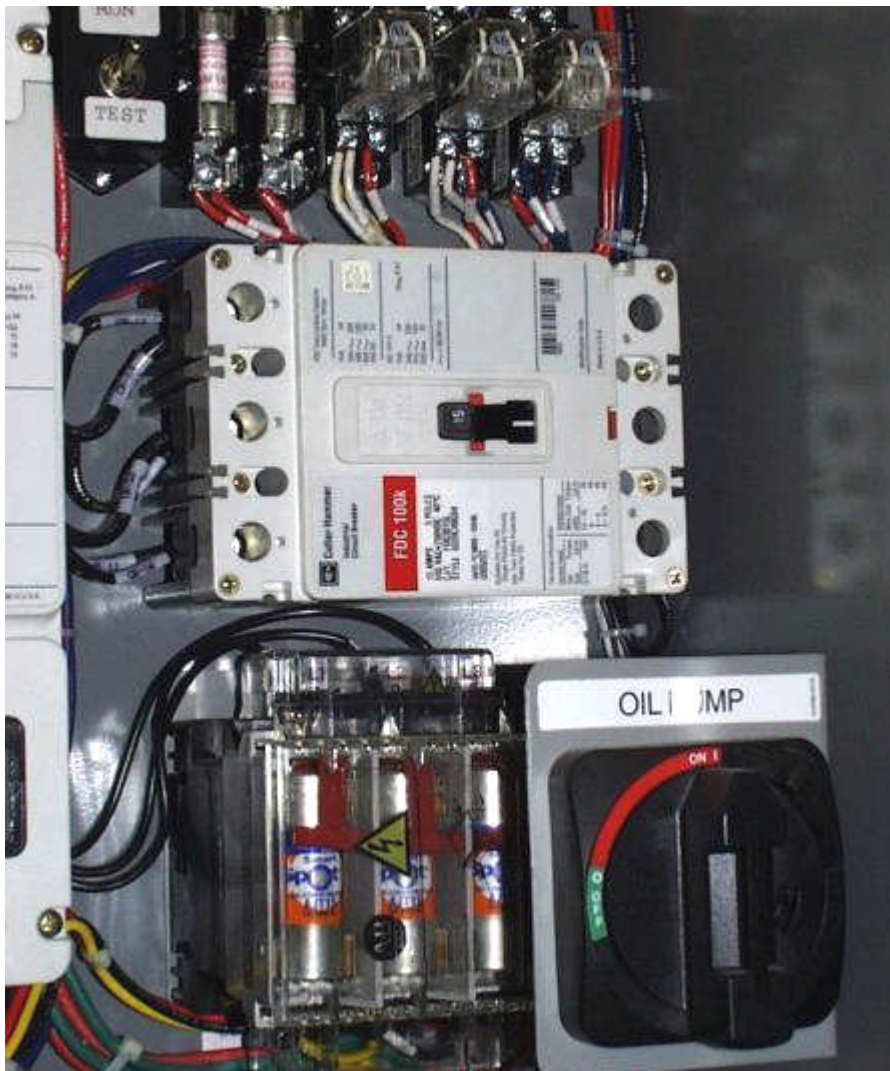


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LiquiFlo I – Control transformer



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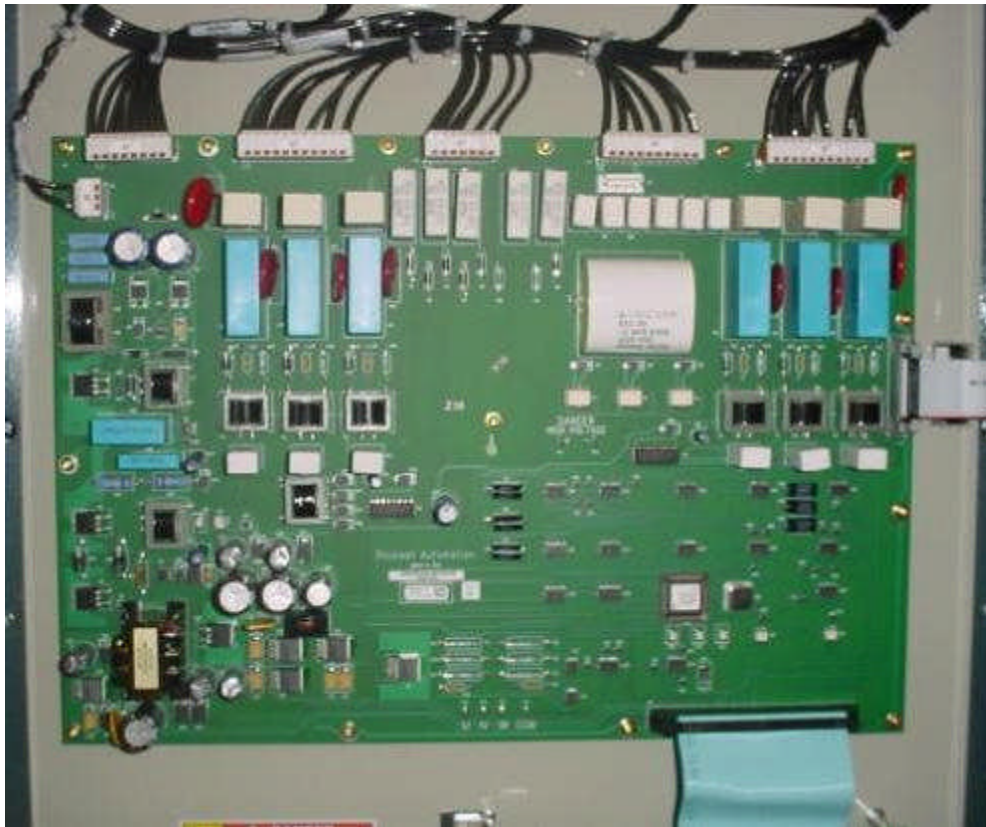


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LiquiFlo I – Power Control Board (PCB)



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Provides Interface to SCR & balance/discharge resistors

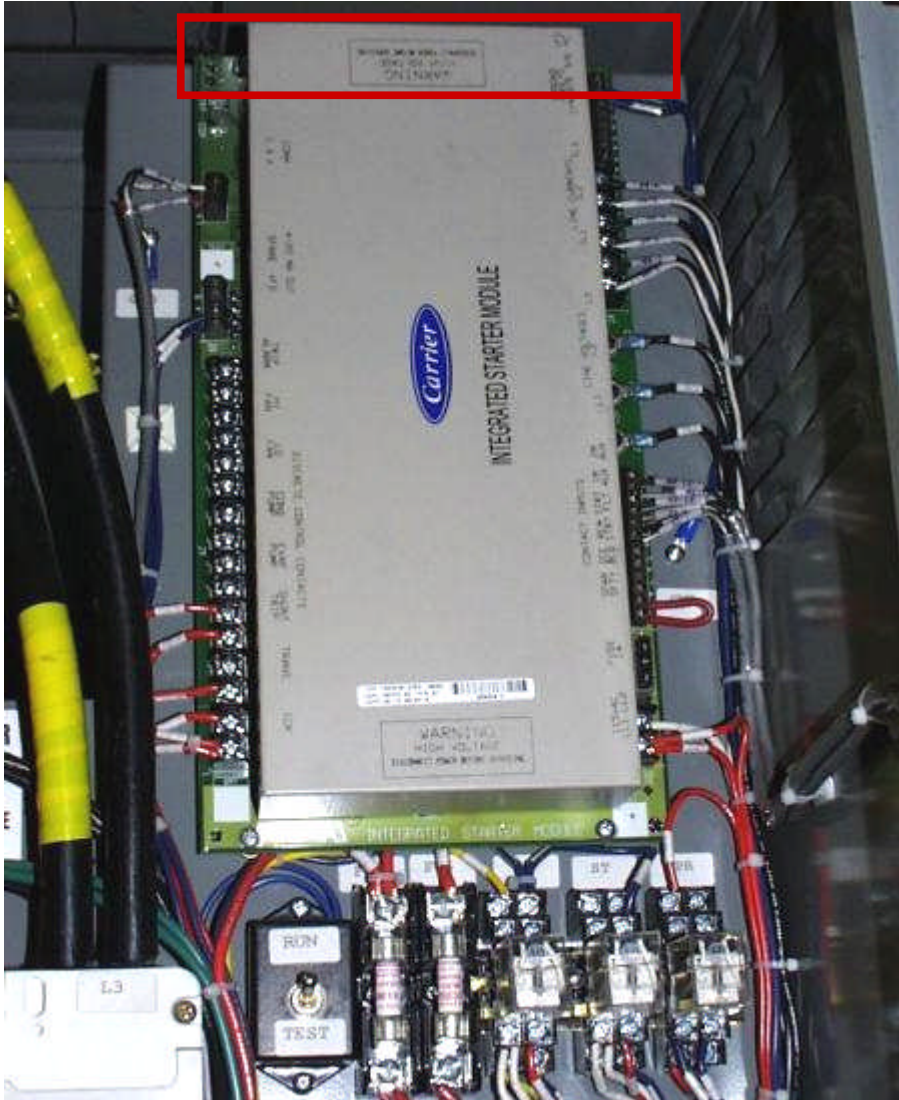
Senses output current from U,V,W

Provide interface from regulator board to gate driver boards

Interface to adaptor board for DC bus regulation

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LiquiFlo I – ISM module

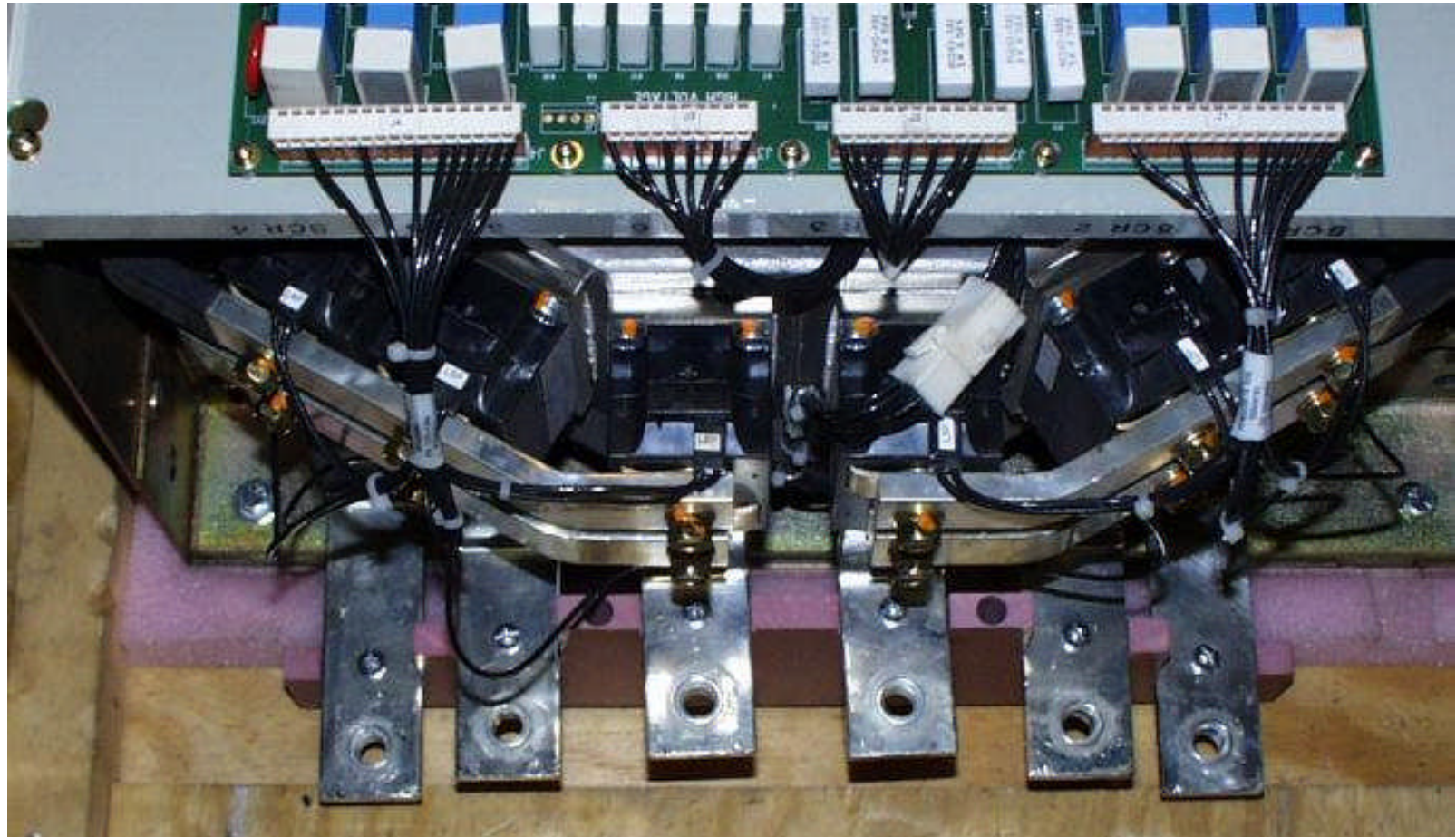


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LiquiFlo I – Input Section (From Breaker)

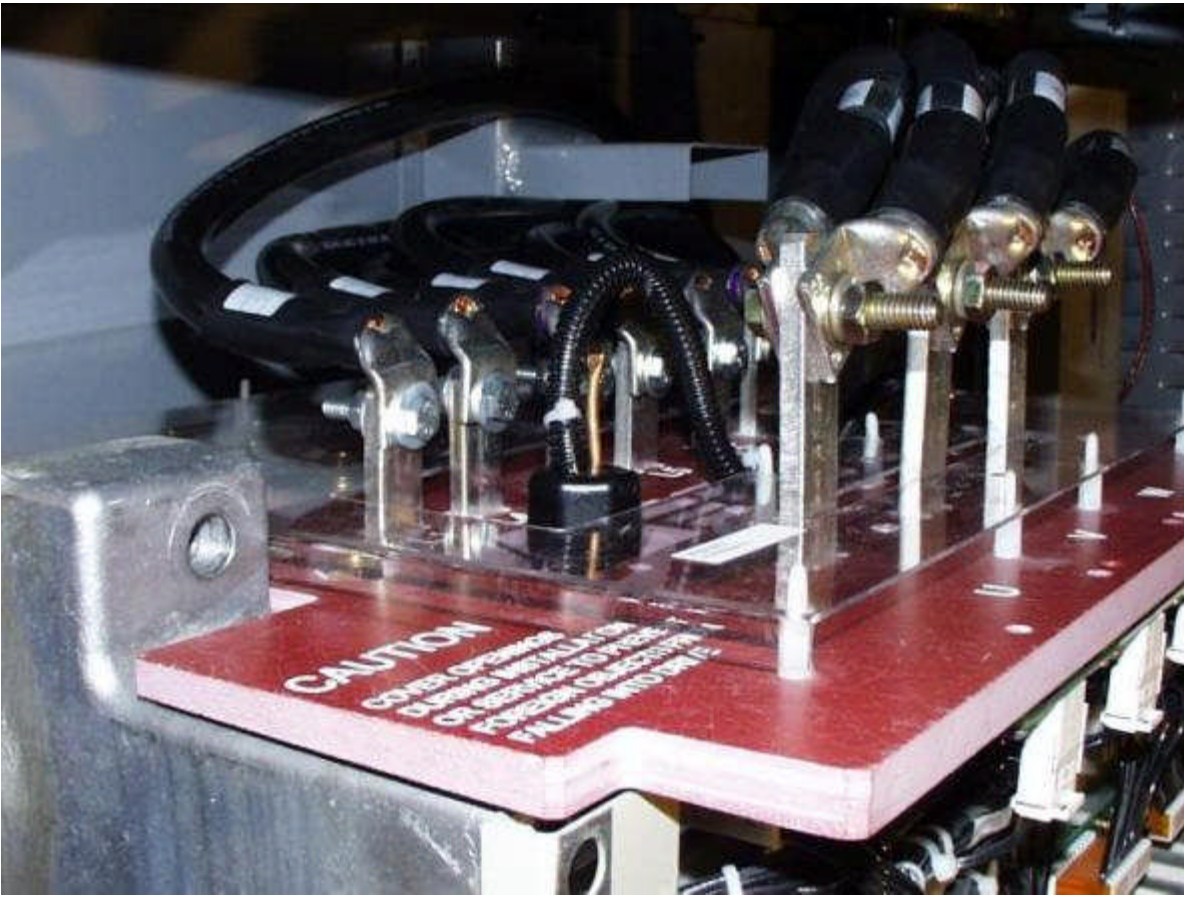
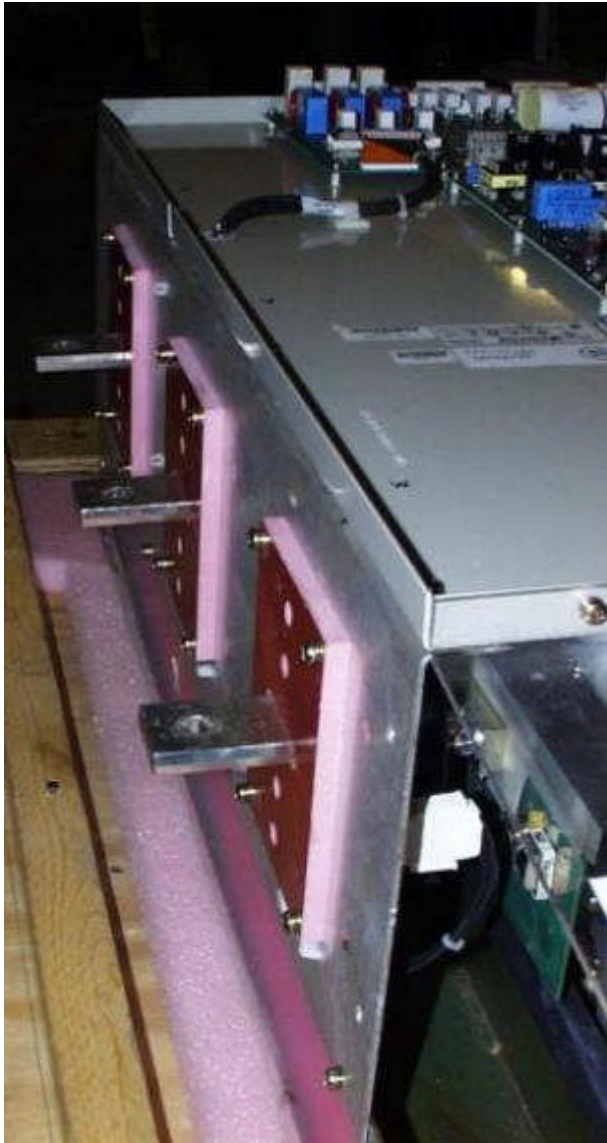


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LiquiFlo I – Output Section (to Motor)

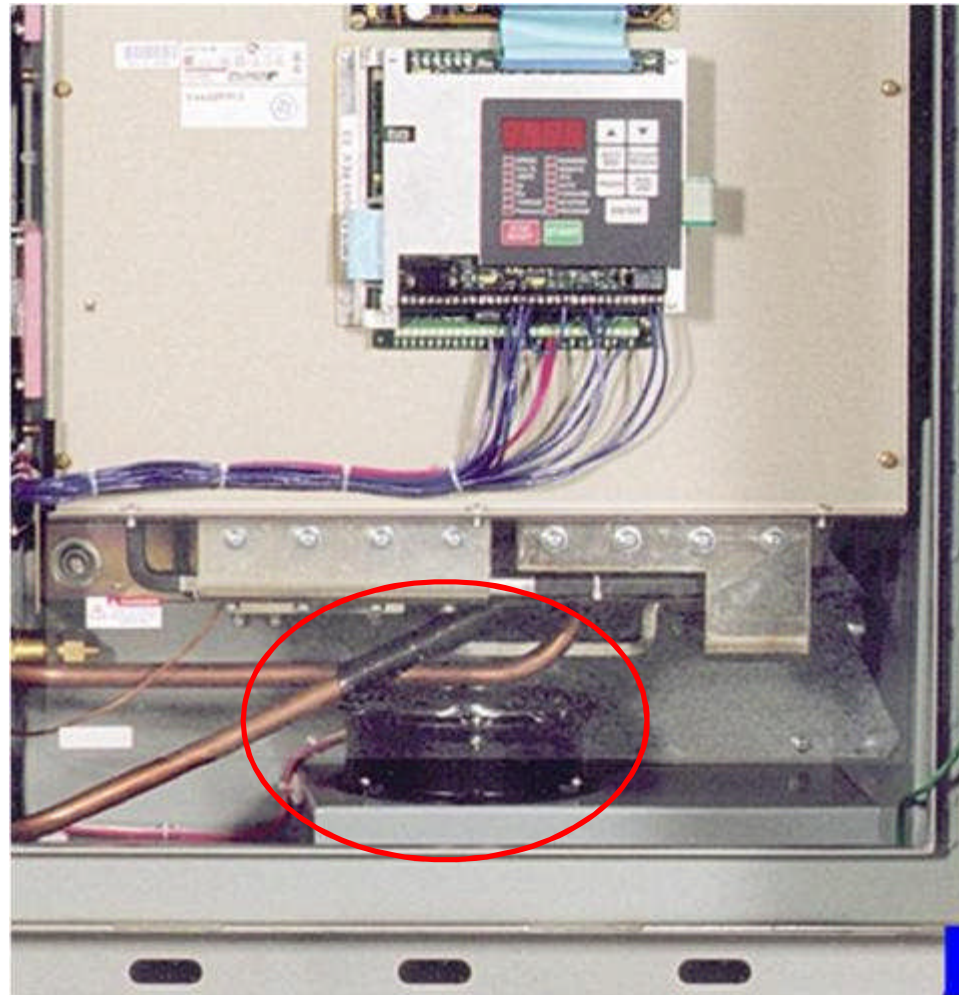




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LiquiFlo I – Cooling Fans on Frame C & D



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LiquiFlo I – Drive Components

Drive module components

SCR/diode modules convert three phase AC line voltage to a pulsating DC voltage. The SCR firing angle is controlled only when charging the DC bus; Otherwise, the SCRs are gated to operate in a rectifier mode.

Reactor reduces input current harmonics by lowering peak currents

DC bus balancing resistors are used to balance voltage across series connected capacitors

DC Bus Capacitors filter the pulsating DC voltage

IGBT modules are switched to provide PWM voltage that supplies sinusoidal current to the motor

LEMs are output current sensors used for current feedback

Temperature switches are used for the reactor and chillplate

Chillplate assembly is a liquid-cooled heatsink

Unique drive module components

Fan cools the reactor

- One fan in B-Frame

- Two fans in D-Frame

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LiquiFlo I – Drive Components

Printed Circuit Board assemblies

Regulator board provides user interface, I/O, network or serial interfaces, processes feedback signals and provides drive protection and control

Gate driver boards control the IGBT gates

Remote Meter Interface board, RMI, provides an extended set of terminal strip inputs and outputs

Unique Printed Circuit Board assemblies

C-Frame

Power Module Adapter, PMA, assembly contains three phase rectifier, motor voltage feedback, voltage scaling, SCR gate drive, burden resistors for current feedback

Bus Control Board has power supplies, SCR control and driver circuits, motor current feedback, DC link voltage feedback, and line voltage feedback

B and D-Frame

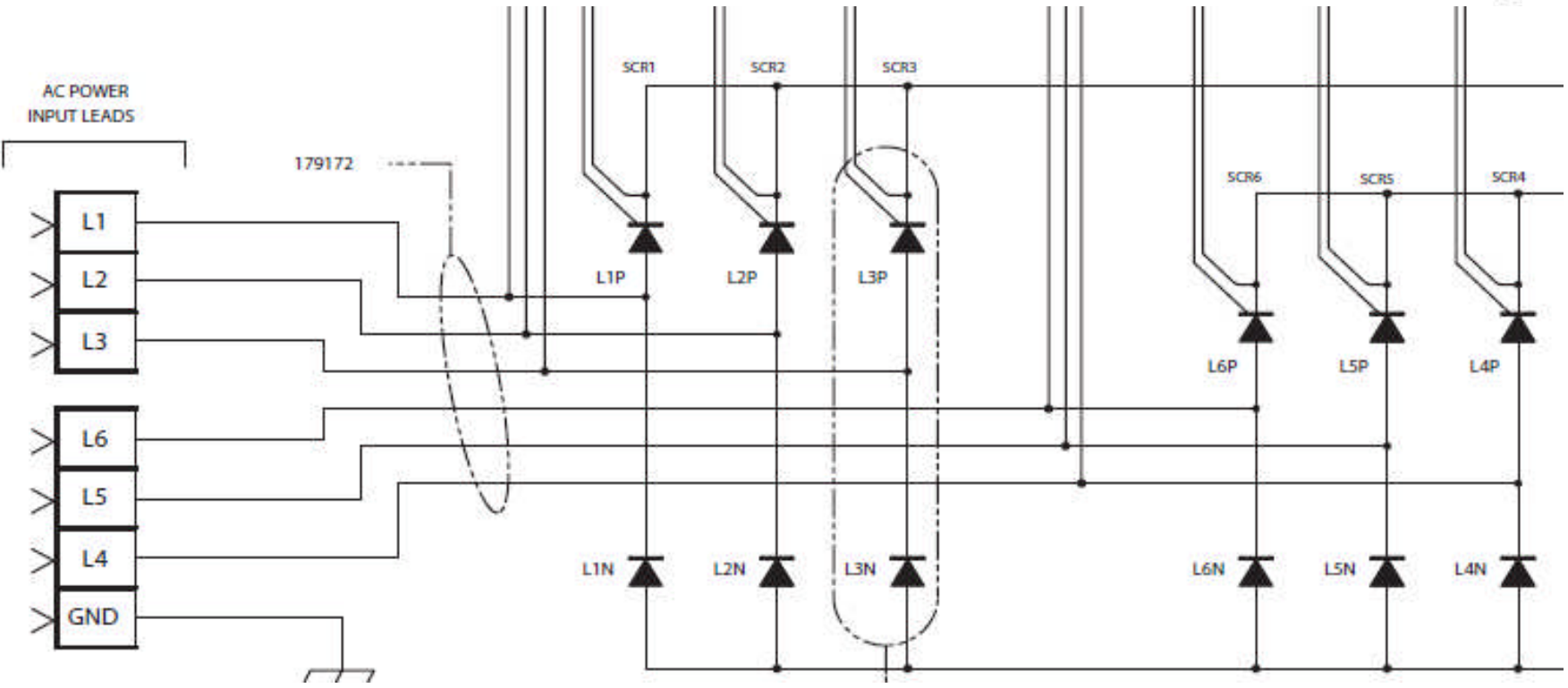
Power Module Control Assembly, PMC, combines the functions of the C-Frame Power Module Adapter and Bus Control Boards

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VFD – LF1 Rectifier



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Rectifier

Diode/SCR rectify AC input to DC

6 Pulses/Full Wave

6SCR/Diode sets, 2 per phase

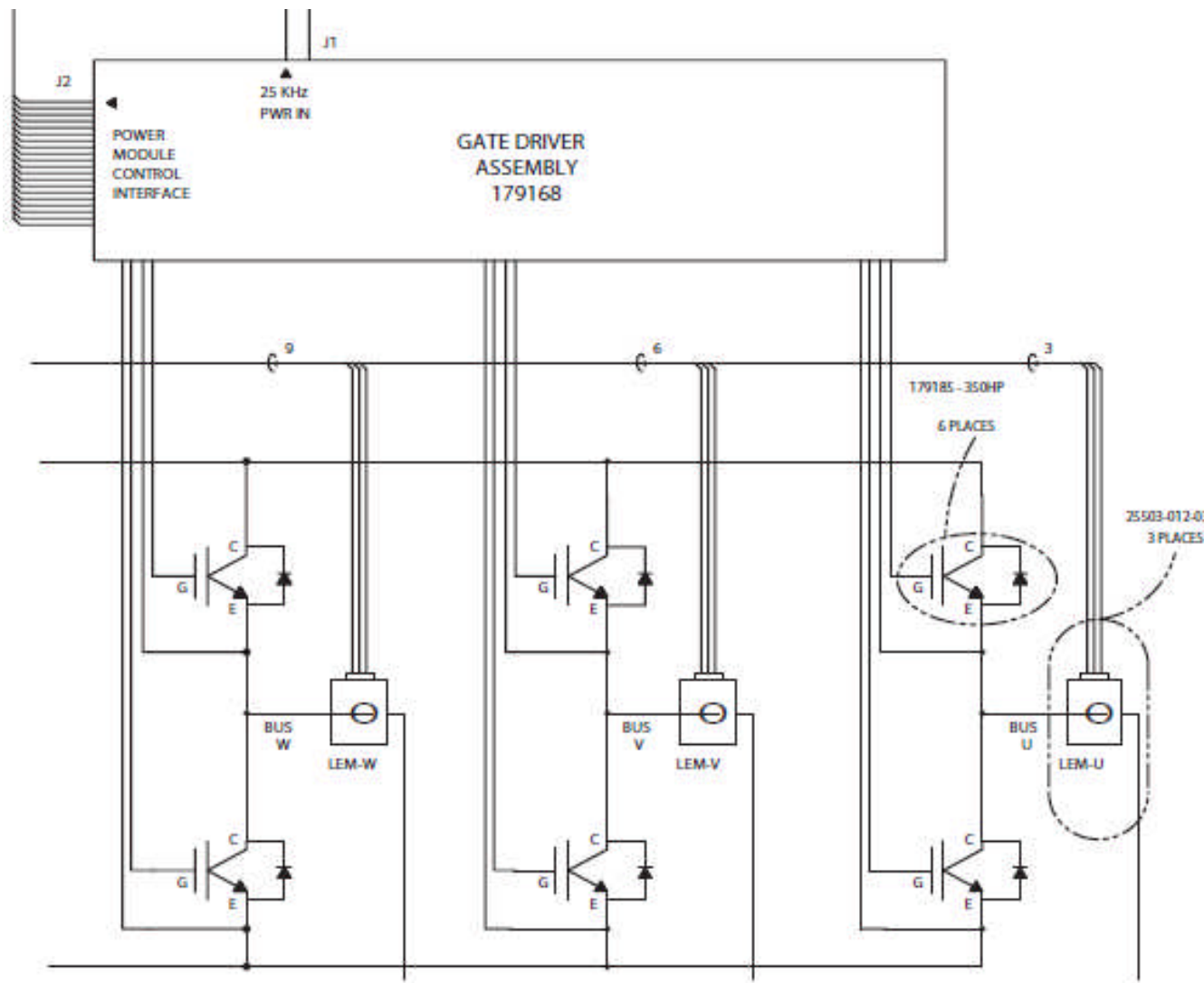
Controlled by Power Module Control Assembly (PCB)

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VFD – LF1 Inverter



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Inverter

IGBT/Diode Pair

2 IGBT per phase,
180° each for +/-
side of sine wave

Controlled via Gate
Driver Assembly

LEM – output
current sensors

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LiquiFlo I – Troubleshooting Drive


CHAPTER 6
Troubleshooting the Drive

This chapter describes how to troubleshoot the drive and the equipment that is needed to do so.

6.1 Test Equipment Needed To Troubleshoot

An isolated multimeter will be needed to measure DC bus voltage and to make resistance checks. Note that dedicated troubleshooting test points are not provided.

6.2 Verifying That DC Bus Capacitors Are Discharged

 **ATTENTION:** DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this procedure could result in personal injury or death.

The drive's DC bus capacitors are discharged when the drive's DC bus voltage is less than 100V.

Step 1. Turn the drive's DC bus capacitors off.

Step 2. Verify that the drive's DC bus capacitors are discharged.

Step 3. Measure the DC bus voltage with a voltmeter. The DC bus voltage should be less than 100V.

Step 4. Once the DC bus voltage is less than 100V, the drive's DC bus capacitors are discharged.

Troubleshooting the Drive

6-1

Troubleshooting
See Chapter 6 – Carrier VFD Quick
Reference Guide

Troubleshooting the Drive	
6.1	Test Equipment Needed To Troubleshoot..... 6-1
6.2	Verifying That DC Bus Capacitors Are Discharged..... 6-1
6.3	Checking the Power Modules and Motor with Input Power Off 6-4
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6.4.1	Identifying Alarm Codes and Recovering..... 6-7
6.4.2	Identifying Fault Codes and Recovering..... 6-8
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6.6	Identifying PMC Board Fault Codes and Recovering..... 6-15
6.7	Resetting a Checksum (CHS) Fault 6-15

Resistance Check

Manual: Carrier VFD Quick Reference 3466-1
Chapter 6: Troubleshooting the Drive

6.2 Verifying That DC Bus Capacitors Are Discharged



ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

The drive's DC bus capacitors retain hazardous voltages after input power has been disconnected. Perform the following steps before touching any internal components:

- Step 1. Turn off and lock out input power. Wait five minutes.
- Step 2. Verify that there is no voltage at the drive's input power terminals.
- Step 3. Measure the DC bus potential with a voltmeter while standing on a non-conductive surface and wearing insulated gloves (1000 V).

Measure the DC bus potential at the test points on the Power Module Interface board. See figure 6.1 for 414 amp drives; see figure 6.2 for 500 amp and 643 amp drives.

- Step 4. Once the drive has been serviced, reapply input power.

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Resistance Check

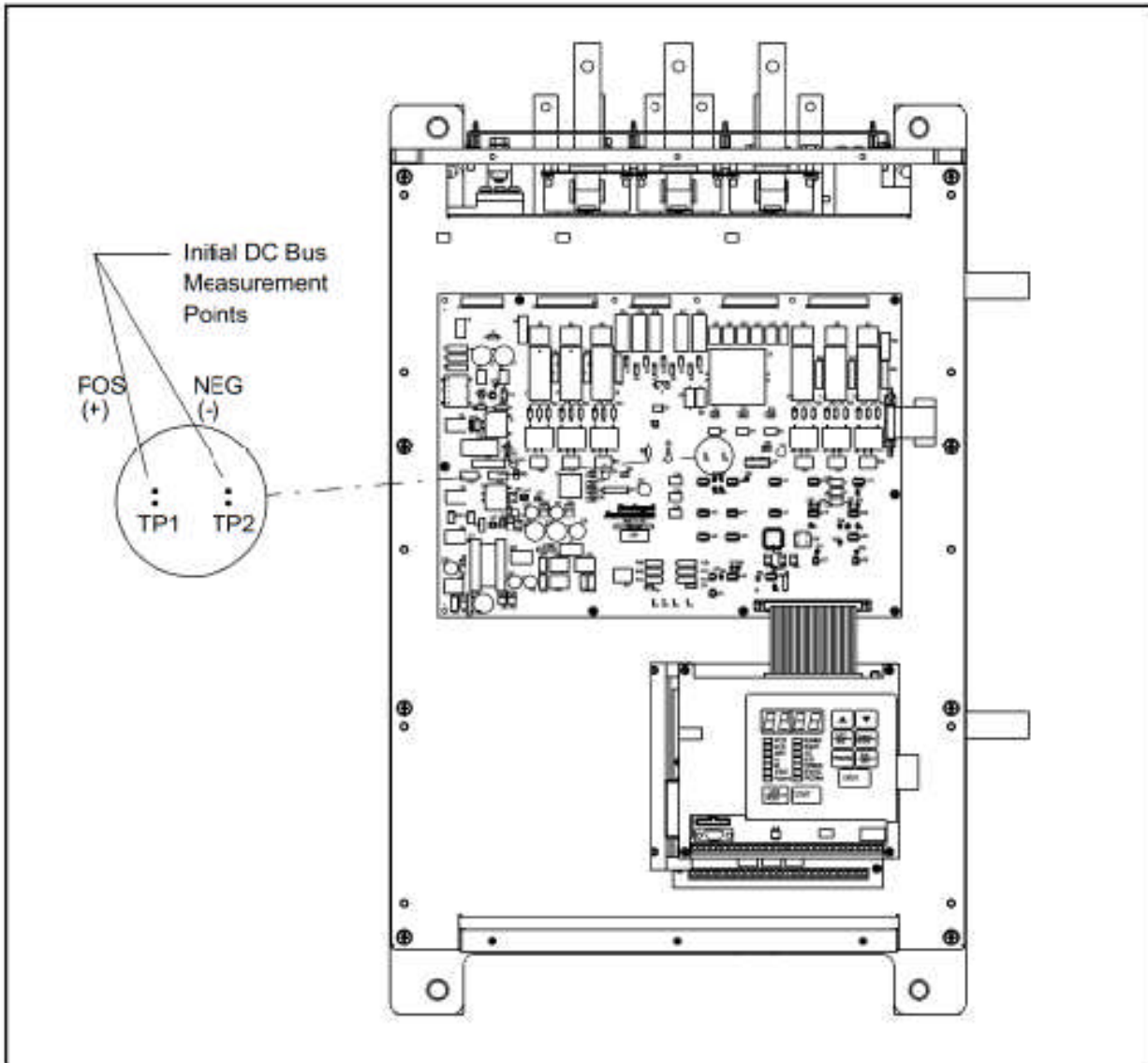


Figure 6.1 – DC Bus Voltage Terminals (414 Amp Drives)

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Resistance Check -- Diode

Table 6.1 – Resistance Checks

Input Diode No.	Meter Connection		Component is OK if resistance (R) is:	Component is defective if:
	(+)	(-)		
1	*	SCR1	10 < R < 1 megohm	Continuity (short circuit) or open when the meter is connected with reversed polarity.
2	*	SCR2		
3	*	SCR3		
4	*	SCR4		
5	*	SCR5		
6	*	SCR6		
7	SCR1	**		
8	SCR2	**		
9	SCR3	**		
10	SCR4	**		
11	SCR5	**		
12	SCR6	**		

* (+) DC Bus Volts power terminal
 ** (-) DC Bus Volts power terminal

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Resistance Check -- IGBT

Table 6.1 - Resistance Checks (Continued)

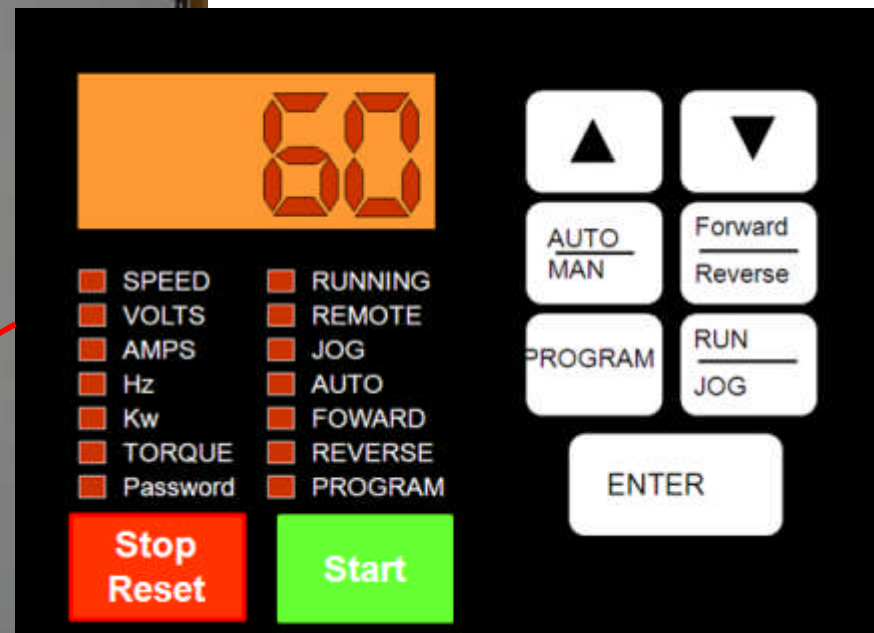
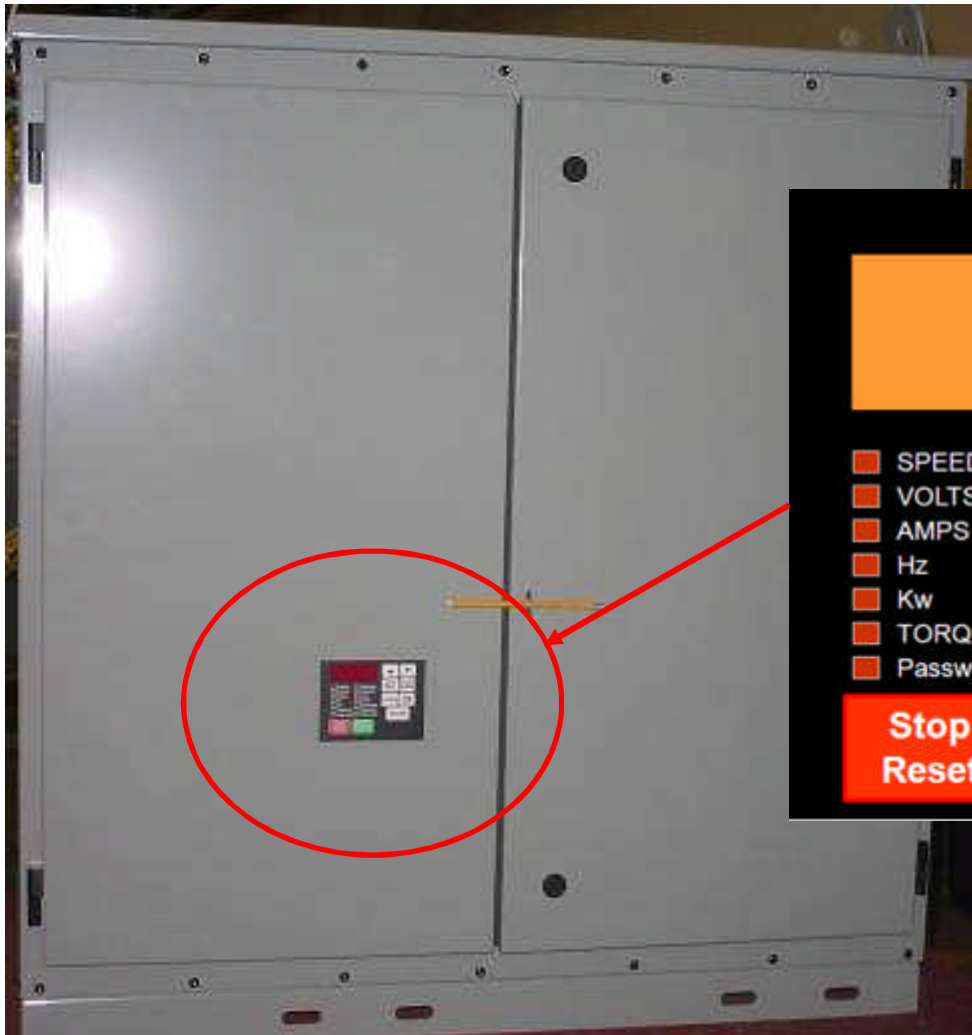
IGBT No.	Meter Connection		Component is OK if resistance (R) is:	Component is defective if:
	(+)	(-)		
1	*	W/T3	10 < R < 1 megohm	Continuity (short circuit) or open when the meter is connected with reversed polarity.
2	*	V/T2		
3	*	U/T1		
4	W/T3	**		
5	V/T2	**		
6	U/T1	**		
* (+) DC Bus Volts power terminal ** (-) DC Bus Volts power terminal				

19XRV

VFD – Liquiflo 1 Keypad



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VFD – Liquiflo 1 Keypad

Chapter 3: Carrier Quick Reference 3466-1 & D2-3410-7 manuals

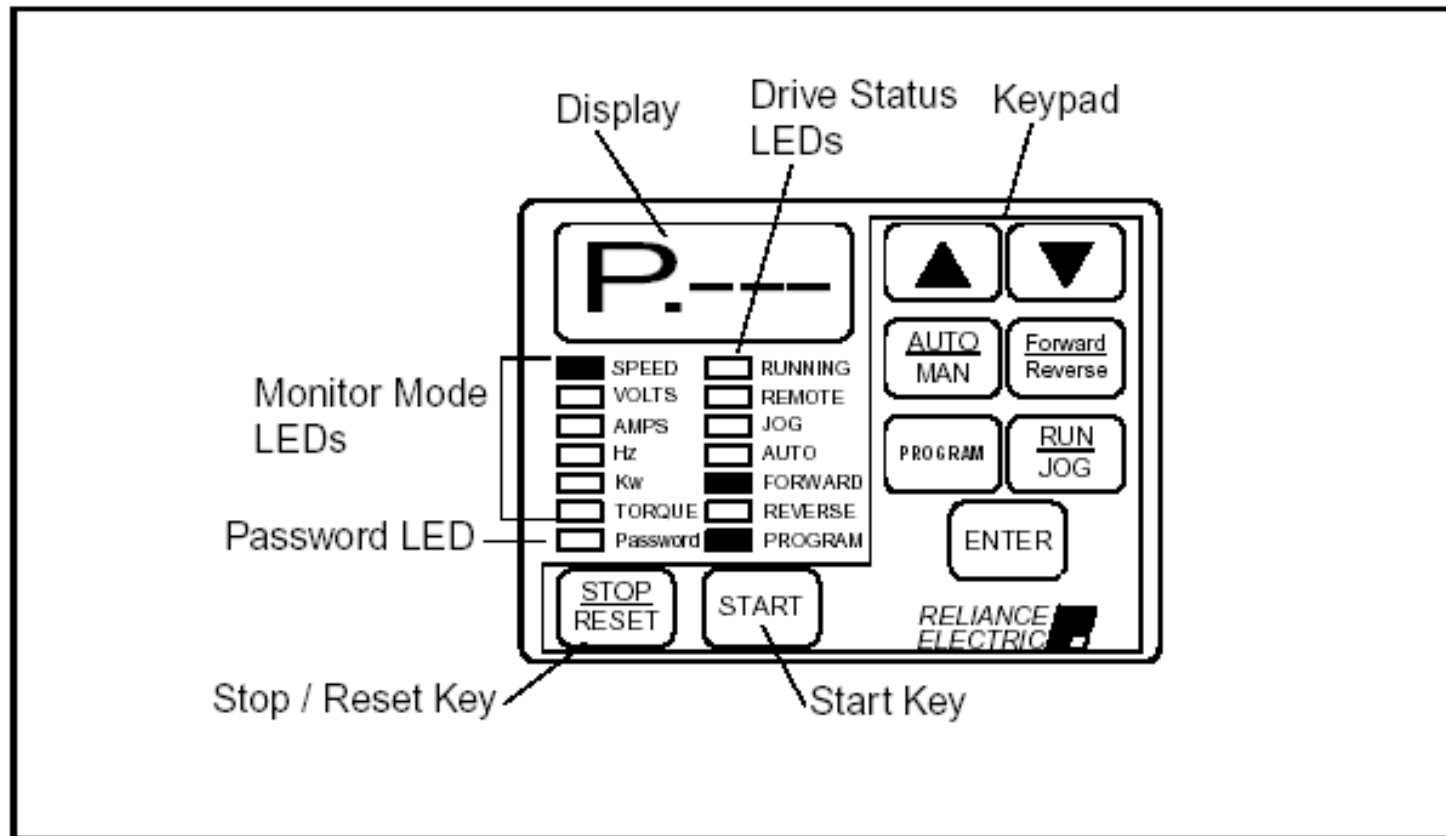


Figure 3.1 – Keypad/Display

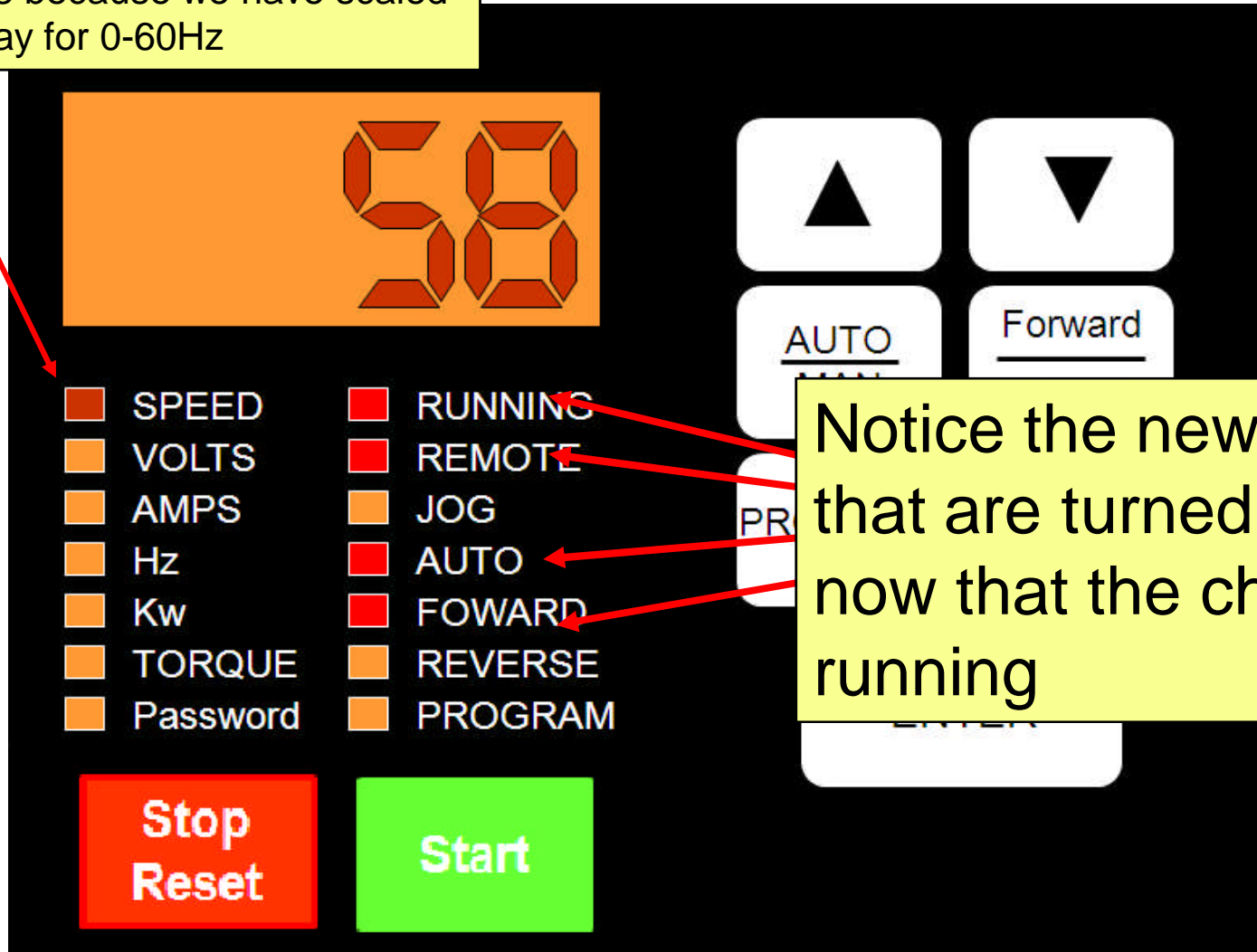
19XRV



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VFD – Liquiflo 1 Keypad

Reads 58 because we have scaled the display for 0-60Hz



Notice the new LED's that are turned on now that the chiller is running

19XRV



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VFD – Liquiflo 1 Keypad

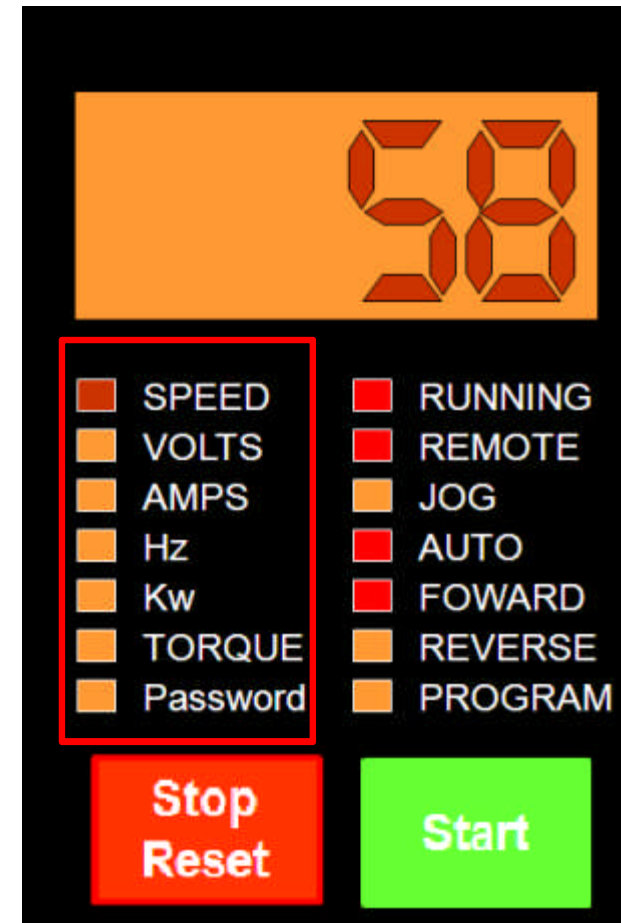
Speed – Frequency in Hz rounded up to the nearest Hz

Volt – The actual voltage to the motor

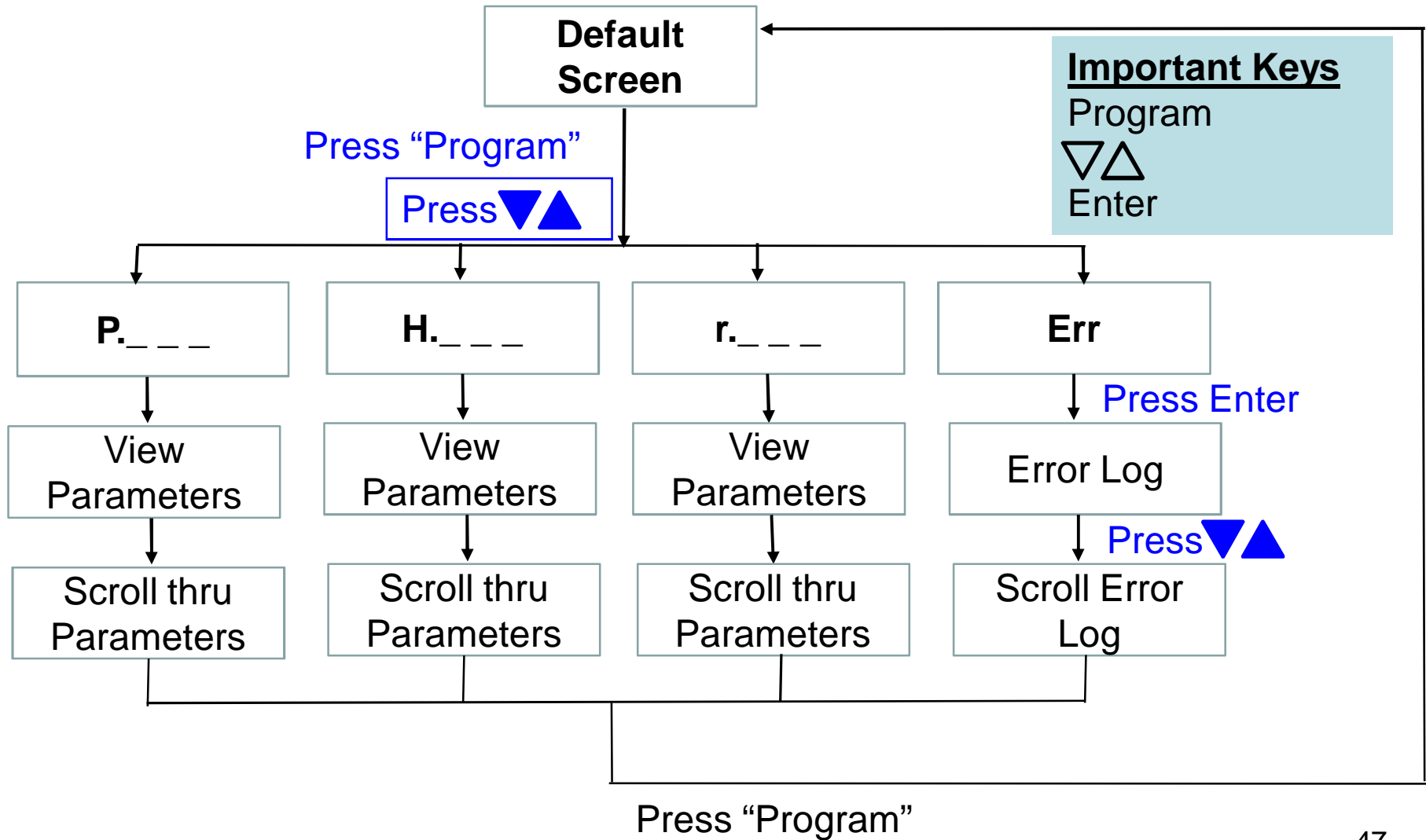
Amps – The actual amps to the motor

Hz – Running frequency in Hz not rounded to the nearest Hz

KW – Calculated KW

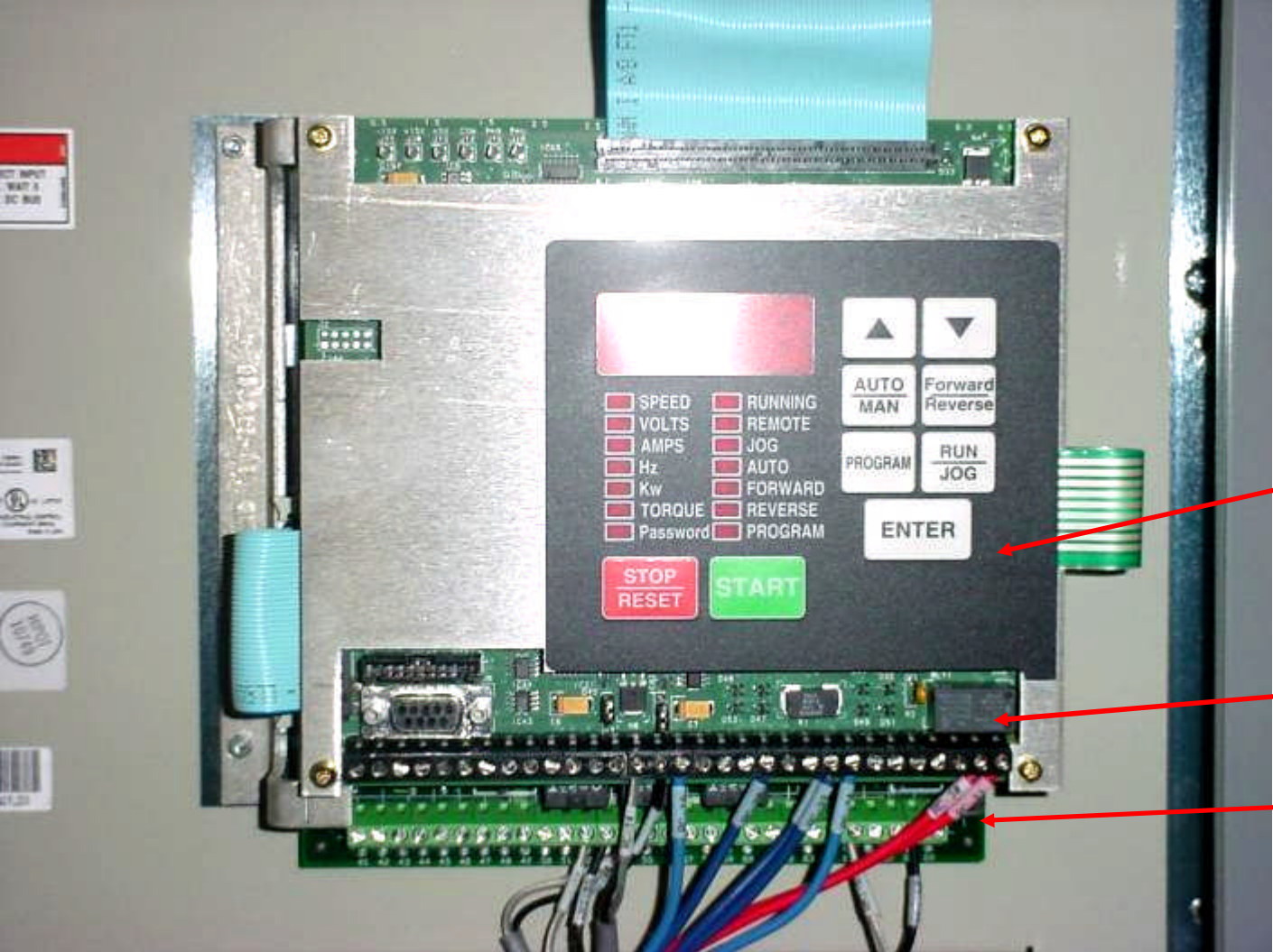


VFD – Liquiflo 1 Keypad



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LiquiFlo I



Display Board

RC Board

RMI Board

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LiquiFlo I

Regulator Card and Remote Interface Board connections:

1M Contact – Start (RC)

ISM J9-1,2 send signal to drive RC 16,24

2M Contact – Up to Speed

Code 201: 2M contact Failure

The 2M input on the ISM did not see a contact closure from the VFD.

This contact should close at approximately 35Hz.

Check Wiring on ISM, on VFD, and VFD programming.

Speed Control – 4-20ma signal from ISM

Speed Feedback – 1-5V signal from RMI board



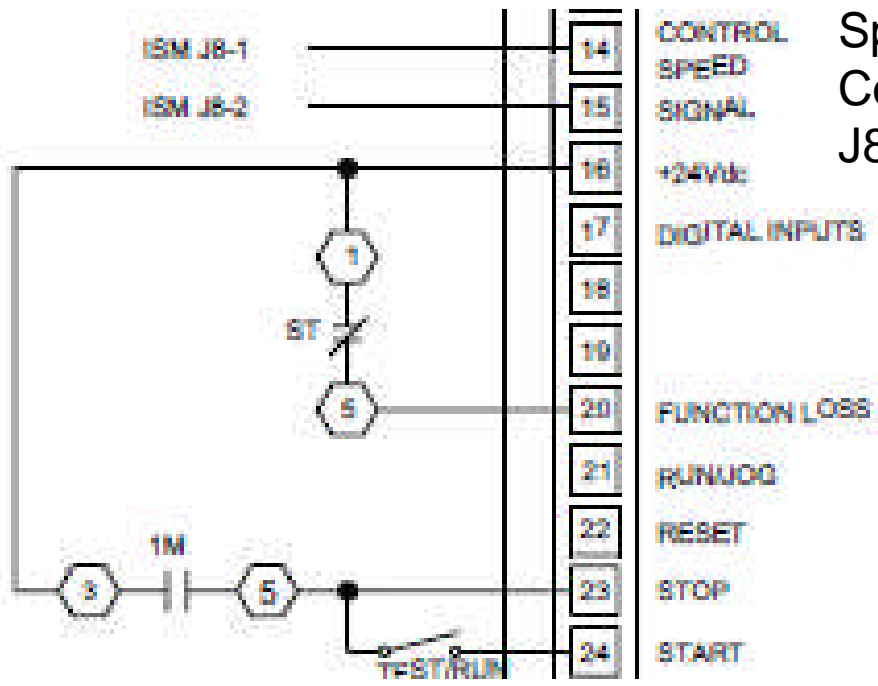
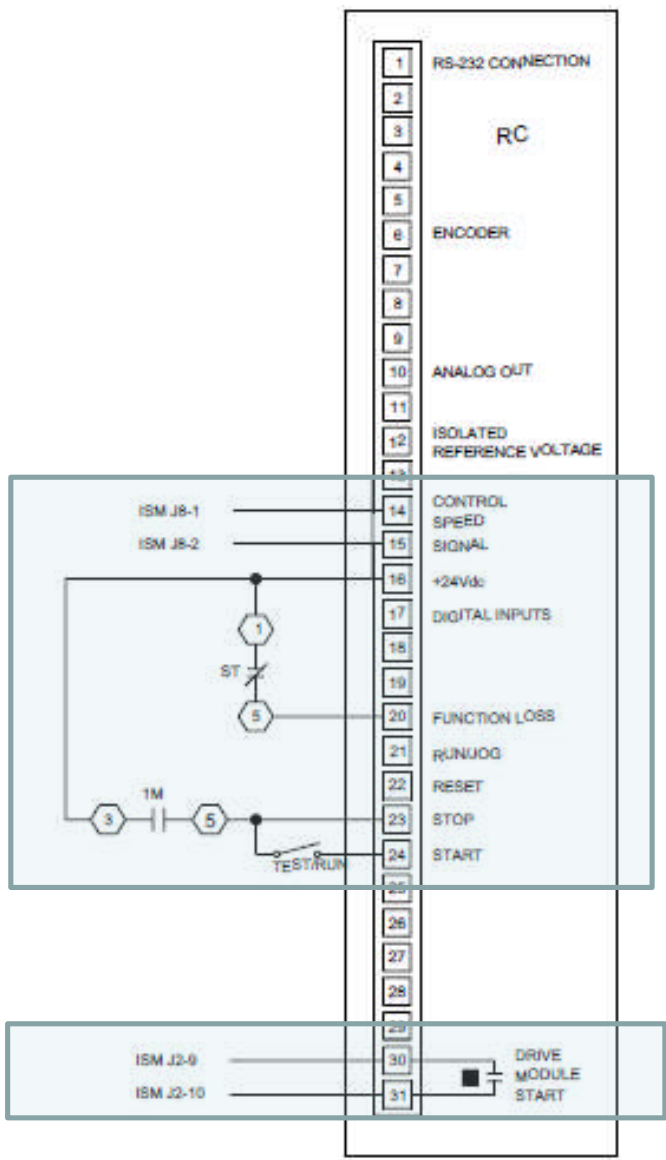
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ROCKWELL LF1 & LF2

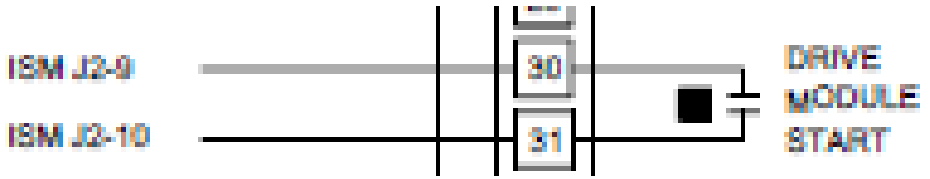
LiquiFlo I – RC board wiring

Speed Control & IM contact

Speed Control ISM J8-1,2



Drive Start ISM J2-9,10



ROCKWELL LF1 & LF2



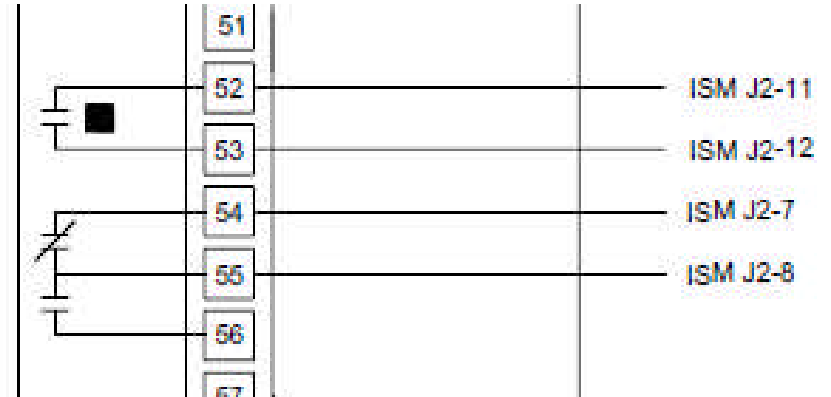
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LiquiFlo I – RMI board wiring

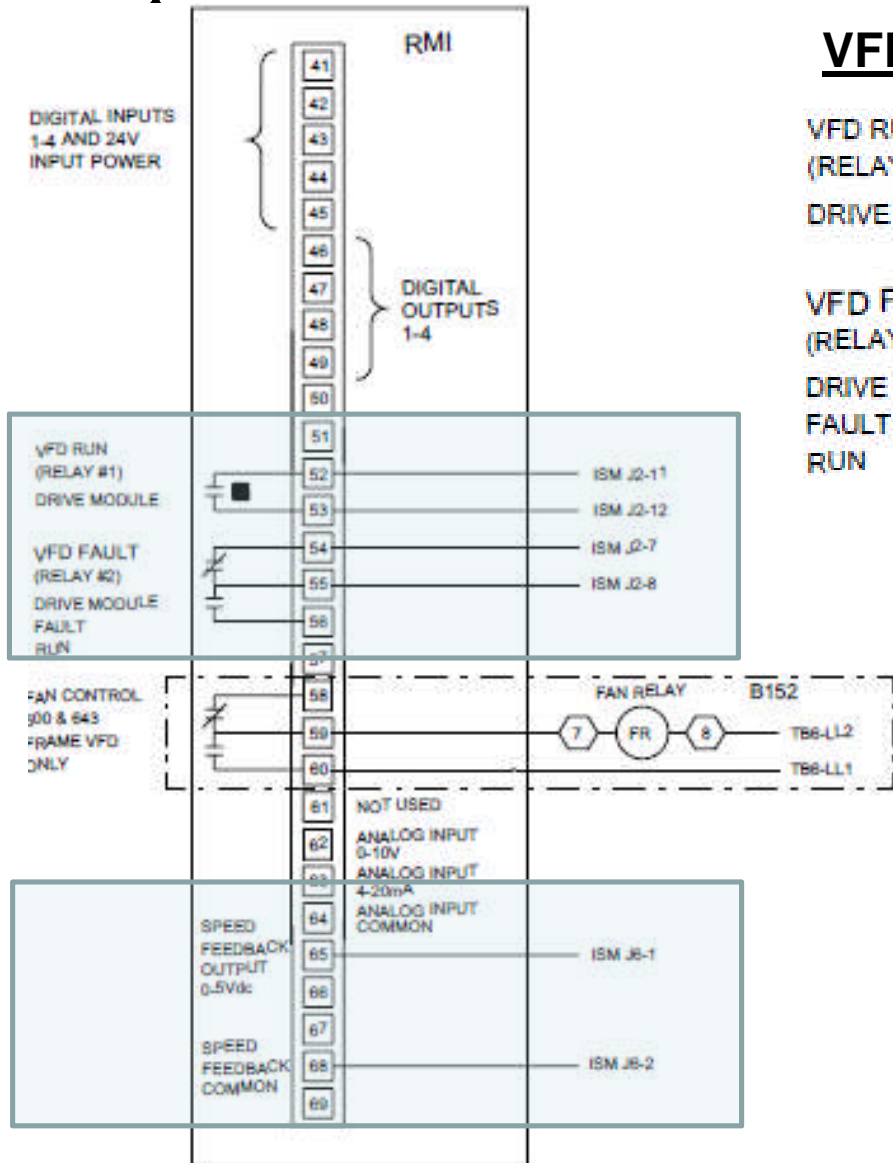
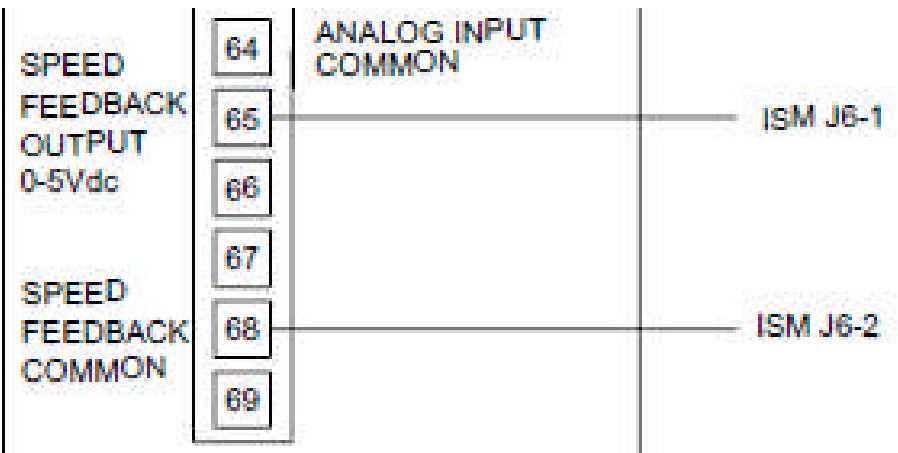
VFD Run ISM J2-11,12,7,8

VFD RUN
(RELAY #1)
DRIVE MODULE

VFD FAULT
(RELAY #2)
DRIVE MODULE
FAULT
RUN



Speed feedback ISM J6-1,2



19XRV

Common Alarms



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Code 208: Excessive Motor Amps

Code 217: Motor Overload

Code 228: Low Oil Pressure

Code 229: Low Chilled Water Flow

Code 230: Low Condenser Water Flow

Code 230: Excessive surging

Code 247: Diffuser Position Fault

Code 208: Excessive Motor Amps

If the average motor current exceeds the limit of 110%.
For 30 seconds.

Code 217: Motor Overload

If any phase current >106% RLA
If any ONE power lead exceeds I²T excessive amps
relative to motor temperature

Code 228: Low Oil Pressure

If the compressor oil pressure drops below 13psid

Chiller Troubleshooting

Code 229: Low Chilled Water Flow

Code 230: Low Condenser Water Flow

Check water flow. Also look at symptoms, low evaporator temperature with a very high approach or high condenser pressure, with a very high condenser approach

Chilled Water Flow:

Evaporator Saturation Temp < Evap Refrigerant Trippoint+ 1°F or
Evaporator temperature derived from evaporator pressure < Evap
Refrigerant Trippoint & Evaporator Approach > Evap. Approach Alert
Threshold

Condenser Water Flow:

Condenser Pressure > Condenser Pressure Override + 5 psi &
Condenser Approach > Cond. Approach Alert Threshold

Code 230: Excessive Surging

If the average motor current Swings more than 20% (adjustable) 5 times in 8 minutes

Code 247: Diffuser Position Fault

If rotational stall is detected in the 850 Ton Chiller Compressor's Casting, it is usually an indication of surging, or a bad Guide Vane Feedback potentiometer

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LiquiFlo I – Troubleshooting Drive VFD Related Fault

Code 201: 2M contact Failure

Code 202: Motor amps not Sensed

Code 205: Amps sensed when Stopped

Code 206: Starter Fault

Code 207: High Pressure (Pressure of 65psi exceeds limit of 165 psi)

Code 208: High Motor Amps

Code 215: Phase Imbalance Amps

Code 238: Excessive surging

Code 245: VFD speed NOT MATCHED

Code 271: VFD speed too LOW

Code 273: VFD speed too HIGH

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LiquiFlo I – Troubleshooting Drive

Code 201: 2M contact Failure

The 2M input on the ISM did not see a contact closure from the VFD.

This contact should close at approximately 35Hz.

Check Wiring on ISM, on VFD, and VFD programming.

Code 202: Motor amps not Sensed

Test/Run switch is in test position (see SB C0205)

P.000 is not in rE mode

Wrong CT Ratio

VFD Keypad AUTO light is not illuminated, temporarily set

P.052 to OFF press AUTO/MAN key, set P.052 back to ON

P.011 is not set to 4 (sets speed input for 4-20ma)

VFD OPTION on ICVC in SETUP2 is not ENABLED

ROCKWELL LF1 & LF2



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LiquiFlo I – Troubleshooting Drive

Code 205: Amps sensed when Stopped

P.025 set to 1 instead of 0 (want a Coast to Stop)

ISM senses current pre-charging DC bus when power is first applied to VFD.

New ISM required set STARTER TYPE in ISM_CONF screen to 2 or 3,
This raises the amps sensed threshold.

Code 207: High Pressure.. 65psi exceeds limit of 165 psi

ISM has not recognized ANY action by the drive or motor.

Check 1M aux and 2M aux relay circuit

Check that VFD 'Remote' and 'Forward' lights are all on.

P.000 should be set to rE to illuminate the remote light

P.027 should be set to 1 to illuminate the forward light

P.052 should be set to ON to disable the AUTO/MAN key

Check adjustment of SXD and VXD on Toshiba

ROCKWELL LF1 & LF2



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LiquiFlo I – Troubleshooting Drive

Code 208: High Motor Amps

Check phase imbalance

Check Guide Vanes

Not really a VFD issue

Code 215: Phase Imbalance Amps

Phase Imbalance VERY COMMON on a VFD

Replace ISM with Version 06 and load new software per service bulletin C0215. This will allow Phase Imbalance trip point to be set much higher.

Code 238: Excessive surging

May need to set Min Speed Higher on CVC/ICVC

May need to set Speed Step to higher value

Check Normal Surge causes (Low Condenser water flow, High Tower Water Temperature)

T1, P1 and T2, P2 values may need to be adjusted

Confirm that VFD can run at 60Hz

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LiquiFlo I – Troubleshooting Drive



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Code 245: VFD speed NOT MATCHED

Calibrate Speed signals

Those are (on a Rockwell):

P.009 Analog Input Offset and

P.010 Analog Input Gain (span)

r.002 Analog Output Offset and

r.003 Analog Output Gain (span)

On a Toshiba, SXD and VXD

Code 271: VFD speed too LOW

Code 273: VFD speed too HIGH

Same techniques as just mentioned

ROCKWELL LF1 & LF2



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LiquiFlo I – Troubleshooting Drive

VFD CONTROL VERIFICATION (Non-Running) — In order to verify and, if necessary, tune the speed control signal of the chiller controller to the VFD (ISM terminal J8-1 labeled 4-20 mA OUT VFD) and the speed feedback signal from the VFD to the chiller controller (ISM terminal J8-2 labeled VFD HZ), follow the steps below.

Set *TARGET VFD SPEED* to 0%.

1. Press **MENU**.
2. Press **STATUS**.
3. Press **COMPRESS**.
4. Press **SELECT**.
5. Set *TARGET VFD SPEED* to 0%.

Verify that the *VFD SPEED REFERENCE* shown on the VFD display is within 0 to 1 Hz of zero.

1. Press the ENTER softkey on the VFD keypad until all LEDs on the left side of the keypad are illuminated except the Password LED.

NOTE: The value shown in the VFD display is the frequency at which the VFD is being commanded to operate. This value is called the VFD Speed reference.

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This step is critical after power module replacement

2. Adjust VFD parameter P.009 (Input offset) if outside the tolerance. The VFD will declare an "Aln" Alarm if P.009 is too small.
3. Verify that the actual speed signal feedback to the chiller controller is 0% by accessing the ACTUAL VFD SPEED in the ICVC COMPRESS screen.
4. Verify ACTUAL VFD SPEED is 0% to 1% on the ICVC.
5. Adjust VFD parameter r.002 (Analog Output Offset) if outside the tolerance. A "C" will be displayed next to ACTUAL VFD SPEED if r.002 is too small. The "C" stands for communications fault.

Set *TARGET VFD SPEED* to 100%.

1. Press **MENU**.
2. Press **STATUS**.
3. Press **COMPRESS**.
4. Press **SELECT**.
5. Set *TARGET VFD SPEED* to 100%.

Verify that the VFD Speed Reference shown on the VFD display corresponds to the 50 or 60 Hz setting (100% *TARGET VFD SPEED*).

1. Confirm that the VFD Speed reference displays the *TARGET VFD SPEED* frequency within ± 1 Hz.
2. Adjust parameter P.010 (input Gain) if outside the tolerance.
3. Release the *TARGET VFD SPEED* so that it can operate in automatic mode. (Refer to Override Operations Section on page 19.)

VFD CONTROL VERIFICATION (Running)

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VFD Fault at Drive display

Code 206: Starter Fault (PIC II only)

Examine fault at VFD/Starter

VFD Fault

OC or OL Overload:

Amp draw of motor is too high. Check VFD Load Factor.

LU Low DC Bus Voltage:

Voltage across Caps is too low, may be caused by low incoming 460VAC. Or Drive's input SCR's not firing correctly.

HU High DC Bus Voltage:

Voltage across Caps is too high, may be caused by high incoming 460VAC or compressor Surging.

HU High DC Bus Voltage:

Voltage across Caps is too high, may be caused by high incoming 460VAC. There is a [SNUBBER](#) kit available for jobsites that have a high instance of HU faults.



Chiller Troubleshooting

VFD Fault

UbS / AC Ground Fault:

One of the three incoming 460 VAC power leads is grounded

UbS / Asymmetrical Bus: The capacitor banks did not charge evenly

UbS / Slow Ramp Rate of DC Bus: DC bus did not charge fast enough at power up.

Aln Analog input signal loss:

Check J4 in proper position. Or, the 4-20ma signal from the chiller controls has dropped below the 0Hz speed. Adjust P.009 up so that commanded speed reads 1Hz when unit not running.

FL Function Loss:

Check Jumper between drives terminals 16 and 20. On a chiller without a Shunt Trip Breaker, check there will be a set of N.O. relay contacts from a Shunt Trip pilot relay. Check relay and contacts.

OH Drive Over temperature:

Check drive cooling lines, expansion valve and fan operation.

19XRV

LF1 Parameters

RD is Rockwell Default
CD is Carrier Default
JS is Job Specific



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VFD	Parameter Description	Setting	Type	Comments
P.000	Control Source	rE	CD	Remote control source
P.001	Accel time 1 (Ramp1) (Seconds)	8	CD	
P.002	Decel Time 2 (Ramp1) (Seconds)	20	CD	
P.003	Minimum Speed	0.5	CD	
P.004	Maximum Speed	JS	VAR	Job Sheet; 60 for 60hz and 50 for 50 Hz
P.005	Current Limit (%)	110	CD	% of parameter H.002
P.006	Second Menu password	107	RD	Password to access remaining screen
P.007	Terminal Strip Digital Input	0	RD	NA
P.008	Terminal Strip Speed Reference Source	0	RD	Analog reference, terminals 14 & 15
P.009	Terminal Strip Analog Input Offset	-10	CD	"May need to be
P.010	Terminal Strip Analog Input Gain	FOR 64LR406X 0.99	CD	tuned for
		FOR 50LR406X 0.99	CD	proper operation"
		FOR 41LR406X 1.030	CD	
P.011	Terminal Strip Analog Input Configure	4	CD	4 to 20 mA
P.012	Terminal Strip Analog output source	0	RD	Speed control signal
P.013	Output Relay Configure	2	CD	IM Relay. Closes when drive is running
P.014	Trim Reference Source	0	RD	NA
P.015	Trim Gain Percentage	0	RD	NA
P.016	Draw Gain Percentage	0	RD	NA
P.017	Accel Time 2 (Ramp 2)	20	RD	NA
P.018	Decel Time 2 (Ramp2)	20	RD	NA
P.019	S-Curve Enable	ON	RD	Linear Start & Stop.
P.020	Jog Speed Reference	50	RD	NA
P.021	Jog Ramp Accel Time	20	RD	NA
P.022	Jog Ramp Decel Time	20	RD	NA
P.023	MOP Accel/Decel Time	20	RD	NA
P.024	MOP Reset Configuration	0	RD	NA
P.025	Stop Type	0	RD	Coast to rest stop.
P.026	Function Loss Response	0	RD	Generate a fault (IET) and coast to rest
P.027	Forward/Reverse Configuration	1	CD	Reverse disabled
P.028	Speed display Scaling	JS	VAR	Job Sheet; 60 = 60hz and 50 = 50 Hz

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LF1 Parameters



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P.029	Elapsed Time Meter	Read Only	RD
P.030	Elapsed Time Meter Reset	OFF	RD
P.031	Preset Speed 1	5	RD NA
P.032	Preset Speed 2	5	RD NA
P.033	Preset Speed 3	5	RD NA
P.034	Preset Speed 4	5	RD NA
P.035	Preset Speed 5	5	RD NA
P.036	Preset Speed 6	5	RD NA
P.037	Preset Speed 7	5	RD NA
P.038	Preset Speed 8	5	RD NA
P.039	Encoder Loss Disable	OFF	RD Disable encoder loss diagnostics
P.040	Motor Overload Enable	ON	RD Enable motor thermal overload function
P.041	Motor Overload Type	FC	RD Forced cooled motor.
P.042	Line Dip Ride through time	5	RD NA due to vector regulation.
P.043	Fault auto reset attempts	10	CD Fault Auto Reset Attempts
P.044	Fault auto reset time	30	CD Fault Auto Reset Time
P.045	Output Phase loss enable	ON	RD Enable output phase loss diagnostic
P.047	Carrier Frequency (kHz)	2	RD 2000 hertz carrier frequency.
P.048	Volts/hertz or Vector Regulation	U-H	RD V/Hz Control
P.049	Counter Detail	USA	RD
P.050	Restore Defaults	OFF	RD
P.051	Programming Disable	0	RD Programming enabled. 26 disables programing
P.052	Auto/Man Key Disable	ON	CD Disables local speed control
P.053	Manual Reference Preset Enable	OFF	RD
P.054	Level Sense Start Enable	OFF	RD
P.055	Stop/Reset Key Disable	OFF	RD
P.060	Network Drop Number	1	RD NA
P.061	Network Connection Type	0	RD NA
P.062	Option Port: Communication Loss Response	0	RD NA
P.063	Option Port: Network Reference	0	RD NA
P.064	Option Port: Network Trim Reference Source	0	RD NA
P.065	Option Port: Type & Version	Read Only	RD NA
P.066	Network Output Register Source 1-4	0	RD NA
P.067	Network Output Register Source 1-4	0	RD NA
P.068	Network Output Register Source 1-4	0	RD NA
P.069	Network Output Register Source 1-4	0	RD NA
P.090	Diagnostics Source	0	RD Potential Service Tool
P.091	Diagnostics Display	Read Only	RD Per selection of parameter P.090
P.095	Power Module Maximum Output Amps	Read Only	RD Drive Amp rating
P.097	Custom Software #	Read Only	RD
P.098	Software Version #	Read Only	RD
P.099	Power Module Type	Read Only	RD

RD is Rockwell Default
CD is Carrier Default
JS is Job Specific

19XRV



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LF1 Parameters

Parameter	Description	Setting	Type	Comments
H.000	Motor Nameplate Voltage	JS	VAR	Selected line voltage
H.001	Motor Nameplate Base Frequency	JS	VAR	60hz = 60, 50hz = 50
H.002	Motor Nameplate Amps	JS	VAR	Set to 1.0B x Motor Nameplate Amps
H.003	Torque Boost Voltage	0.5	RD	% of nominal inverter voltage
H.004	Slip Compensation	0	RD	% of base frequency
H.005	DC Braking Enable	OFF	RD	Disable brake
H.006	DC Brake Start Frequency	1	RD	NA, Hz
H.007	DC Braking Current	10	RD	NA, Amps
H.008	DC Braking Time	3	RD	NA, Seconds
H.009	Avoidance Frequency Enable	OFF	RD	NA, Disabled avoidance
H.010	Avoidance Frequency Midpoint	0	RD	NA, Midpoint of avoided frequency
H.011	Avoidance Frequency Band	2	RD	NA, Frequency band
H.012	Avoidance Frequency Midpoint	0	RD	NA, Midpoint of avoided frequency
H.013	Avoidance Frequency Band	2	RD	NA, Frequency band
H.014	Avoidance Frequency Midpoint	0	RD	NA, Midpoint of avoided frequency
H.015	Avoidance Frequency Band	2	RD	NA, Frequency band
H.016	Sync Direction	OFF	RD	NA
H.017	Input Power/Snuffer Configuration	0	RD	NA
H.018	Volts/Hertz Curve Type	0	RD	Linear relationship
H.019	Identification Result	Read Only		
H.020	Identification Request	OFF	RD	NA
H.021	AC Line Voltage	JS	VAR	Selected line voltage
H.022	Over Frequency Limit	JS	VAR	60hz = 69, 50hz = 57
r.001	Analog Output 1 Source	4	CD	Speed Feedback signal, frequency.
r.002	Analog Output 1 Offset	For 41LR406X 135 For 50LR406X 60 For 64LR406X 60	CD	Feedback to PIC II "May need to be tuned"
r.003	Analog Output 1 Gain	For 41LR406X 0.503 For 50LR406X 0.505 For 64LR406X 0.505	CD	Feedback to PIC II for proper operation"
r.035	Relay - 1 Configuration	5	CD	NO, close at minimum speed. Speed
r.036	Relay - 2 Configuration	2	CD	NC, Open at VFD Fault, Term 54.55
r.037	Relay - 3 Configuration	1	CD	NO, closes at VFD Running, Fan
r.044	Relay - 1 Time Delay	-1.0	CD	1 Second Off Delay
r.045	Relay - 2 Time Delay	0	RD	No Delay
r.046	Relay - 3 Time Delay	for 41LR406X 0 For 50LR406X and 64LR406X -999	CD	Relay not used for fan control CD Off delay for fan
r.050	Speed Detection Level 1	35	CD	Minimum Speed detection

19XRV



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LF1 Parameters – 19XR-6SS, Page 76

VFD PARAMETER	TITLE	SETTING
P.004	Maximum Speed	Line Frequency selected. Per Compressor Nameplate. 60 for 60 Hz selection.
P.006	Password	107
P.028	Speed Display Scaling	60 for 60 Hz selection and 50 for 50 Hz selection
H.000	Motor Voltage	VOLTAGE from "Load Side" section of the VFD enclosure nameplate
H.001	Frequency	Line Frequency selected. Per Compressor Nameplate. 60 for 60 Hz selection, 50 for 50 Hz selection
H.002	Motor Amps	1.08 x Motor FLA from "Load Side" section of the VFD enclosure nameplate
H.021	Line Voltage	VOLTAGE from "Line Side" section of the VFD enclosure nameplate
H.022	Over Frequency Limit	69 for 60 Hz selection, 57 for 50 Hz selection
P.009, P.010, r.002, r.003	Input and Output Gains and Offset	Calibrate per instructions on page 77.

Password
P.006-107

ROCKWELL LF1 & LF2

LiquiFlo I – VFD Replacement



Turn to the Experts.™

When performing LF1 drive replacement, the following must be performed prior to startup

- ✓ Check wiring on RC & RMI Board
- ✓ Perform Speed Adjustment
- ✓ Check VFD Parameters
- ✓ Equipment service → Setup2 → VFD Option is Enabled
- ✓ ISM Config → Starter Type is VFD

ROCKWELL LF1 & LF2

LiquiFlo I – Reference



Bulletin

C0403 – Liquiflo I VFD troubleshooting and warranty returns

C0406A – 19XRV Balancing resistor test for “UbS” Fault

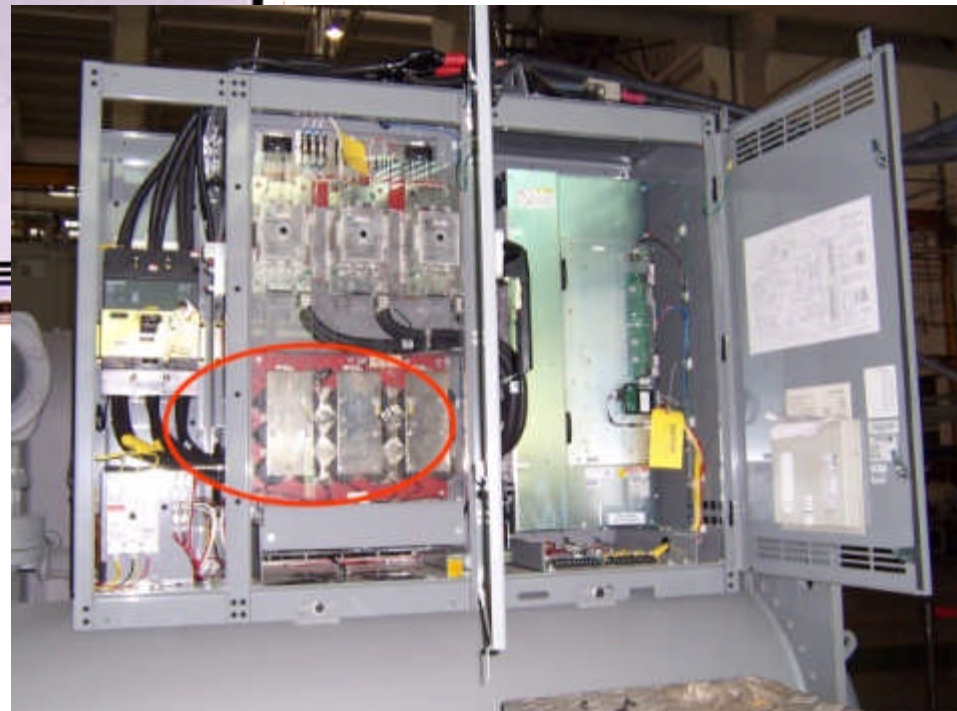
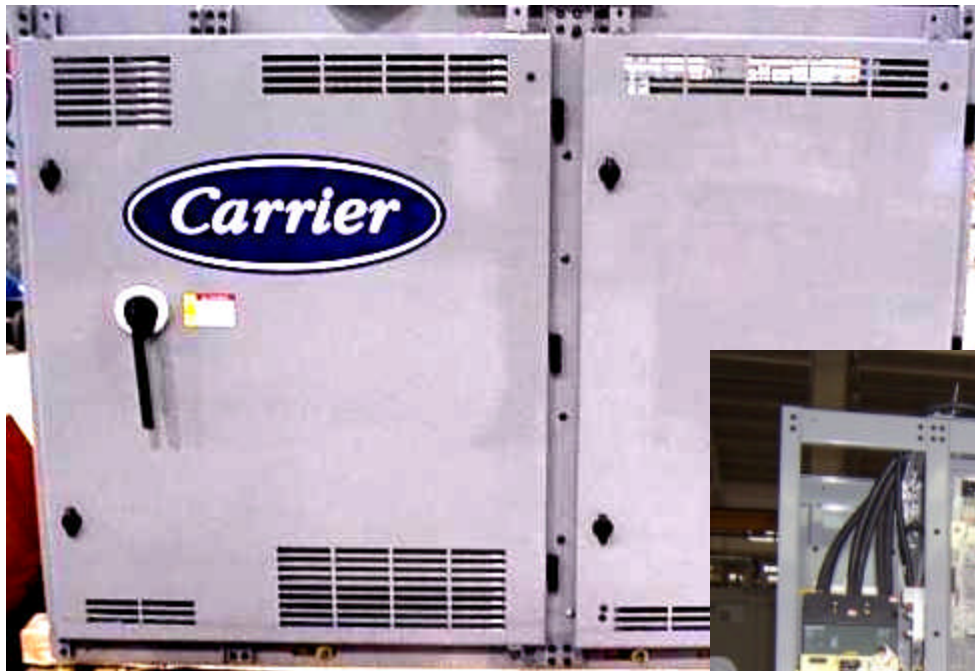
Carrier D2-3466-2 – Carrier VFD Quick Reference Guide

ROCKWELL LF1 & LF2

LiquiFlo II



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ROCKWELL LF1 & LF2

LiquiFlo II

Cabinet Assembly ID Number

180264-A 0 3 - 3 00
180580-A 19 - 6 AA

Frame Code
Frame 3 180264
 3 = 2AA
 4 = 2BA
 6 = 2CC
Frame 4 180580
 7 = 4CC
 9 = 4CC

Voltage (3-PH input)
 3 = 380 - 415V, 50 Hz
 6 = 440 - 480V, 60 Hz
 8 = 346V, 50 Hz

Options
 AA = 3-PH Meter Kit
 BA = 100kAIC Circuit Breaker
 CA = CE Compliance Kit (w/ Shunt Trip)
 KA = Meter Kit + 100kAIC C.B.
 LA = Meter Kit + CE Compliance Kit
 TA = 100kAIC C.B. + CE Compliance Kit
 ZB = Meter Kit + 100kAIC C.B. + CE Compliance Kit
 00 = No Options

RELIANCE ELECTRIC **LIQUI-FLO**

Input: 440-480VAC 60HZ 3PH
 Output: 480VAC 405A 0-250 Hz
 Type Enclosure: TYPE 1
 Short Circuit Rating: 65kAIC
 Max. Ambient: 40°C
 Coolant Type: R134a OR Treated Water
 Design Pressure: 185 psig
 ID NO. Cab. Assy: 180264-A03-600
 Cabinet Assy S/N: XXXXXXXXXX
 Mfg On: XX-XX-XX

PWR Mod. M/N: LF200460AAR
 PWR Mod. S/N: XXXXXXXXXX
 Made in USA by Rockwell Automation

Cabinet Assembly Serial Number

ROCKWELL LF1 & LF2

LiquiFlo II



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Table 2.1 – Drive Assembly and Power Module Ratings (23XR Ratings)

Drive Assembly Number	Power Module Model Number	Frame Size	Inverter Carrier Freq.	Maximum Ambient Air Temp.	Maximum Inlet Refrig. Temp.	Maximum Input Amps	Maximum Output Amps
179615-903	LF200460AAR	3AA	4 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	405 420 440	405 420 440
179615-903	LF200460AAR	3AA	2 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	380 400 420	430 440 460
179615-943	LF200460BAR	3BA	4 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	506 506 520	420 420 440
179615-943	LF200460BAR	3BA	2 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	506 520 520	440 440 460
179615-904	LF200520BBR	3BB	4 or 2 kHz	122°F (50°C) 104°F (40°C)	115°F (46°C) 115°F (46°C)	506 520	520 520
179615-905	LF200608CCR	3CC	4 or 2 kHz	122°F (50°C)	115°F (46°C)	608	608

ROCKWELL LF1 & LF2

LiquiFlo II



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Table 2.2 – Drive Assembly and Power Module Ratings (19XV Ratings)

Drive Assembly Number	Power Module Model Number	Frame Size	Inverter Carrier Freq.	Maximum Ambient Air Temp.	Maximum Inlet Refrig. Temp.	Maximum Input Amps	Maximum Output Amps
180700-A03	LF200460AAR	3AA	4 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	405 420 440	405 420 440
180700-A03	LF200460AAR	3AA	2 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	380 400 420	430 440 460
180700-A43	LF200460BAR	3BA	4 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	506 520 520	420 420 440
180700-A43	LF200460BAR	3BA	2 kHz	122°F (50°C) 104°F (40°C) 104°F (40°C)	115°F (46°C) 115°F (46°C) 97°F (36°C)	506 520 520	440 440 460
180700-A05	LF200608CCR	3CC	4 or 2 kHz	122°F (50°C)	115°F (46°C)	608	608
181285-A07	LF201215CCR	4AA	4 or 2 kHz	122°F (50°C)	115°F (46°C)	900	900
181285-A09	LF201215CCR	4CC	4 or 2 kHz	122°F (50°C)	115°F (46°C)	1210	1210



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LiquiFlo II – Power Module

LF20 0608CC R

LF20 = LiquiFlo 2.0

Continuous Ampere Rating
and Frame Size

0460AA = 405 amps*, frame 3AA

0608CC = 608 amps, frame 3CC

0810AA = 810 amps, frame 4CC

1215CC = 1215 amps, frame 4CC

Cooling Method

R = refrigerant/water

* 460 A with refrigerant, 405 A with water as coolant

Drive Assembly ID Number	Power Module Model Number	Frame Size	Enclosure Rating	Input Power (KVA)	Input Voltage (V)	Input Current ¹ (Amps)	Output Current at 2 kHz ² (Amps)
180264-A03	LF200460AAR	Frame 3AA	NEMA 1	337	480 ±10%	405	405
180264-A06	LF200608CCR	Frame 3CC	NEMA 1	505	480 ±10%	608	608
180580-A07	LF201215CCR	Frame 4CC	NEMA 1	673	480 ±10%	810	810
180580-A09 ³	LF201215CCR	Frame 4CC	NEMA 1	1010	480 ±10%	1215	1215

¹460 A with refrigerant, 405 A with water as coolant.

²110% output current capability for one minute, 150% output current capability for 5 sec.

³No overload rating for 180580-A09. 100% output current capability.

ROCKWELL LF1 & LF2

LiquiFlo II – VFD Panel & Power Module Components



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ROCKWELL LF1 & LF2



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Panel Components -- Input Circuit breaker

Shunt trip controlled by VFD & the ICVC

Capable of protecting the circuit wiring making

Carrying and breaking currents under normal circuit conditions making

Carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short circuits

Standard is 65KAIC or 100KAIC is available



ROCKWELL LF1 & LF2



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Panel Components -- Input Filter Circuit

The LiquiFlo 2 drive uses an active rectifier to eliminate most of the harmonic distortion caused by conventional diode or SCR rectifiers.

The LCL (inductor and capacitor resistor and inductor) circuit is designed / tuned for the 4Khz. rectifier Carrier frequency

The active rectifier consists of a three-phase IGBT bridge and a filter between the bridge and the line.

The filter blocks the PWM carrier and its harmonics, allowing the active rectifier to control the line frequency input current.

Input reactors are 3% and 9% with a capacitor between each input phase. Works like power factor correction.

The Input current measured when inverter is not running is reactive current.



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Panel Components -- Pre-charge circuit

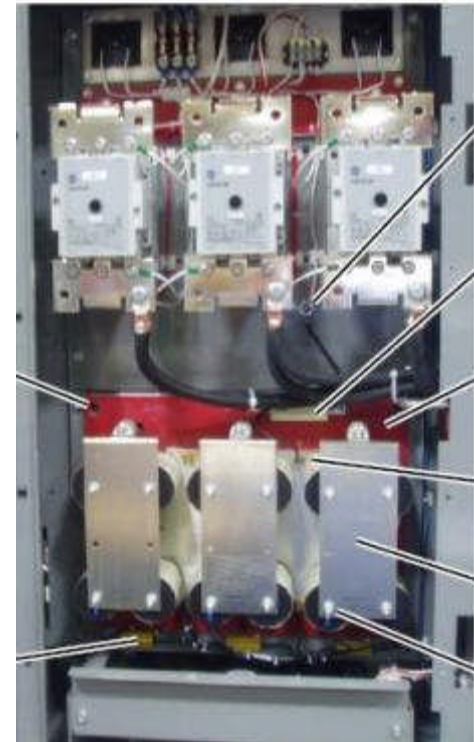
The pre-charge assembly consists of a three-phase relay and three power resistors.

The pre-charge resistors ramp the voltage to the DC Bus capacitors (about 20 amps) when power is applied. Pre-charge contactors close upon a start command bypassing the resistors. Pre-charge relay Auxiliary contacts initiate the drive run command.

When power is turned on, the bus charges to the peak of the AC line through the pre-charge resistors, and begins in an idle state.

Pre-charge limits inrush current during power up or a power dip or line loss and simplifies selection of branch circuit protection devices.

When pre-charge is complete, the parallel contacts are closed.



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LiquiFlo II –Panel Components



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15 Amp 2F1 & 2F2 fuses

Protects the input for the 3KVA Control Transformer.

3 KVA Control Transformer

Steps the input voltage down to control voltage, approximately 115vac. Control transformers are designed to reduce supply voltages to control circuits, providing greater safety to operators. These transformers also isolate the control circuits from power and lighting circuits. They are designed to accommodate the momentary current inrush caused when electromagnetic components are energized, without sacrificing secondary voltage stability.



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LiquiFlo II – Power Module

Power Module Contains

- Two separate control boards (Inverter and Rectifier)

- I/O boards

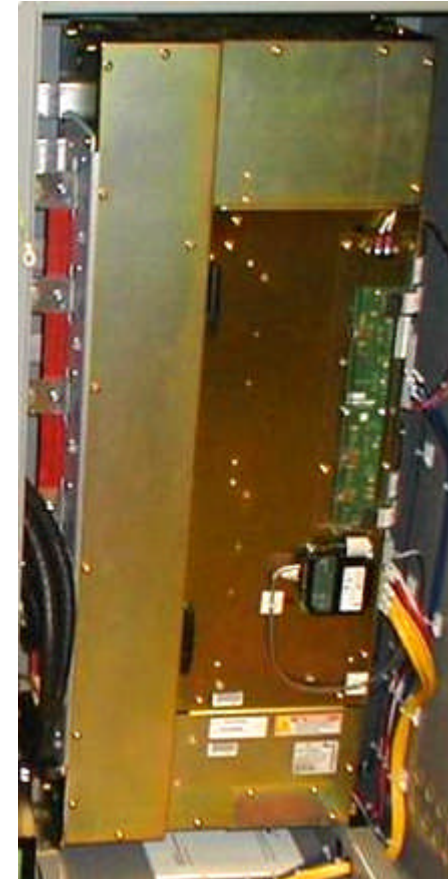
- Power boards

- Power structures

One power structure is used as an active Rectifier to regulate the DC Bus Voltage

Second power structure is used for traditional motor control

Communications between the control boards, and ICVC, (optional LCD OIM; Lap Top computer via an RECOMM 232 cable) through the DPI interface card.



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LiquiFlo II – Power Module



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Meter Kit (Optional)

Wired to the AC line I/O Board (0-10Vdc)

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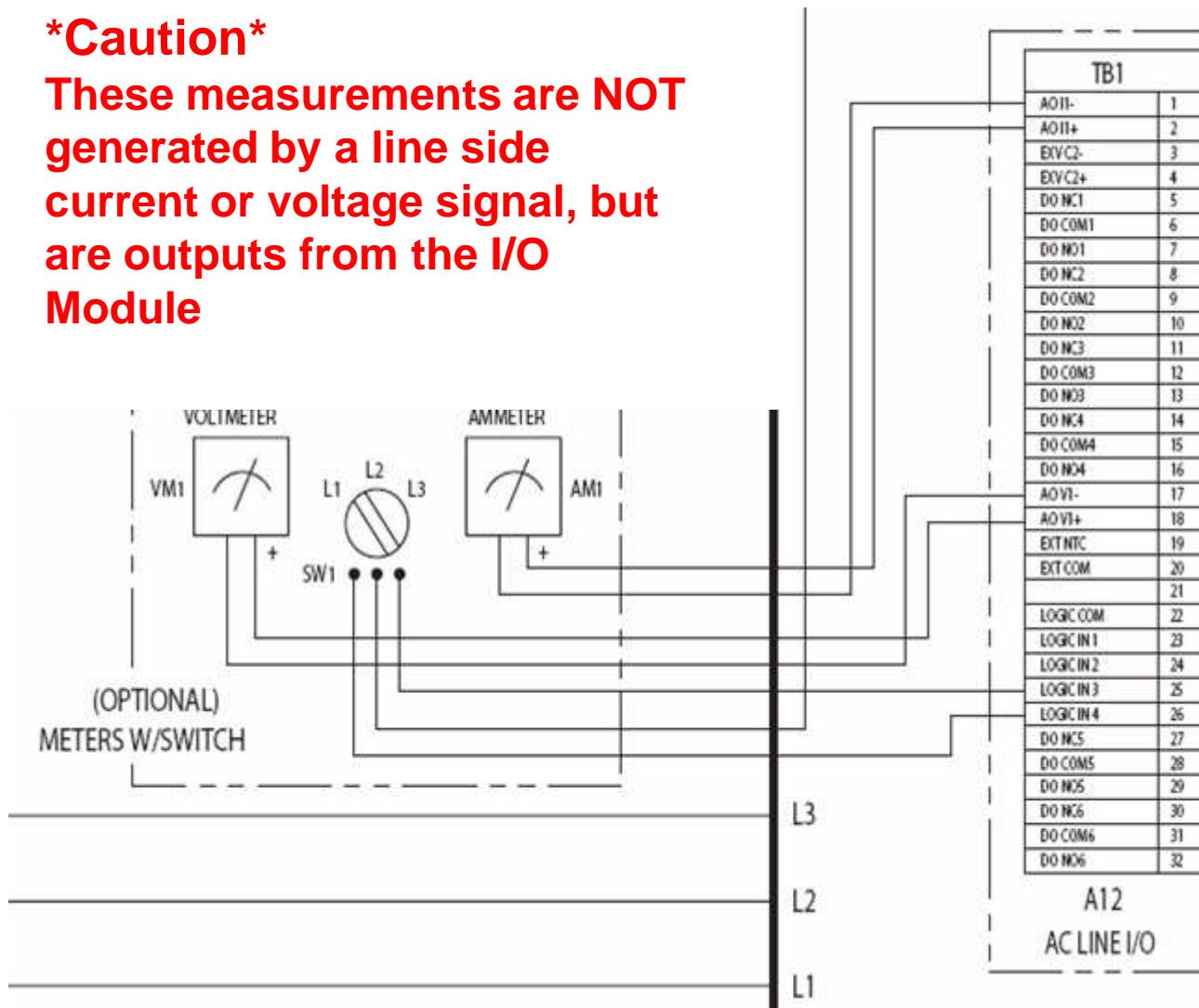


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LiquiFlo II – Meter Option Kit (Optional)

Caution

These measurements are NOT generated by a line side current or voltage signal, but are outputs from the I/O Module



Meter Kit

Two analog Voltmeter are used to display each input phase AC Voltage and Current. The phase being displayed is selectable by a selector switch.

The voltmeter and the selector switch is wired to the AC Line I/O board.

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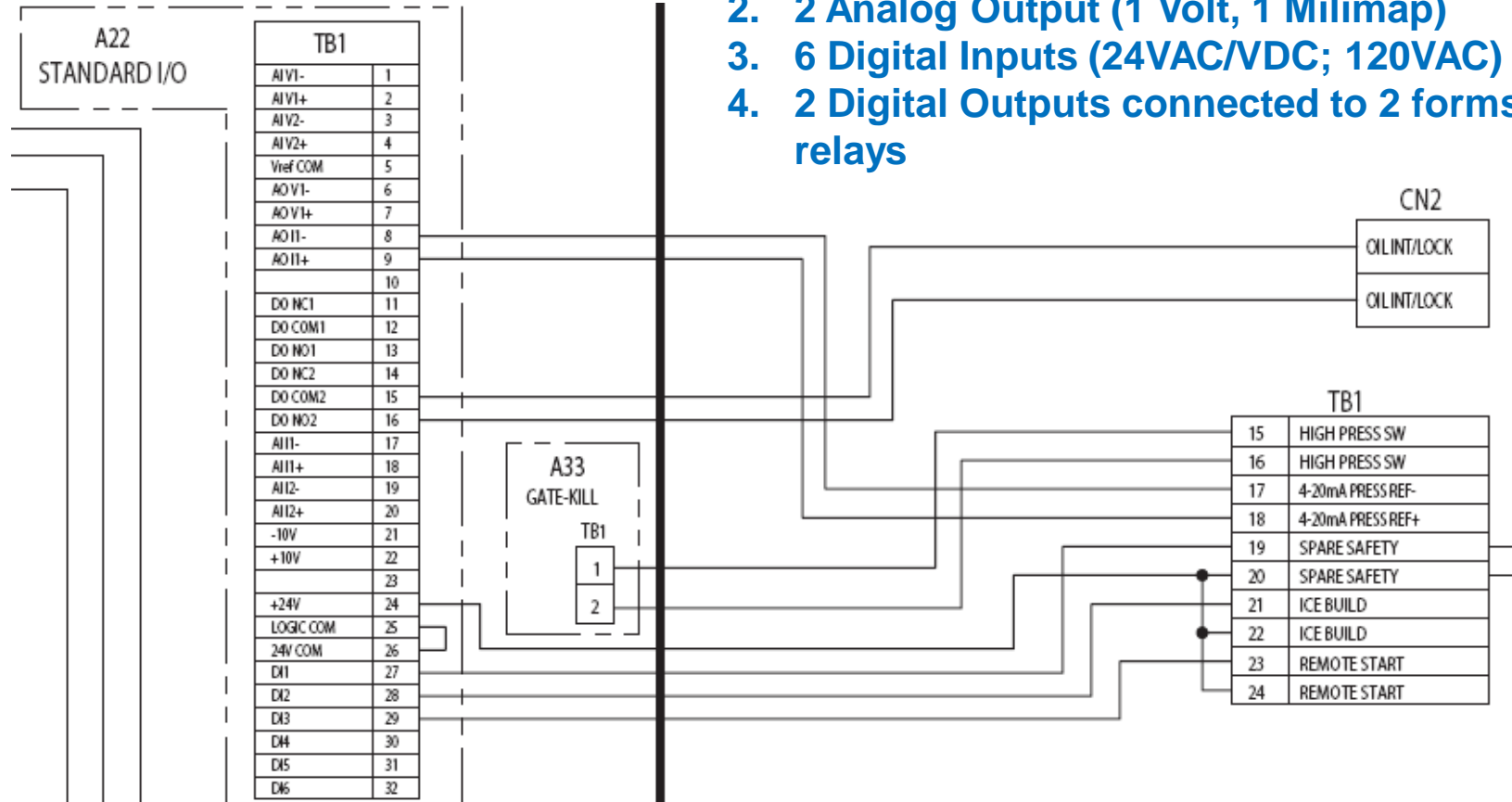


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LiquiFlo II – Standard I/O

The SIO board is a microcontroller based I/O subsystem. The Standard I/O board is connected to the Inverter Control Board. The I/O is configured through the Gateway and cannot be modified in the field.

1. 4 Analog Inputs (2Volt, 2 Miliamp)
2. 2 Analog Output (1 Volt, 1 Milimap)
3. 6 Digital Inputs (24VAC/VDC; 120VAC)
4. 2 Digital Outputs connected to 2 forms C relays



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LiquiFlo II – Power Module Components

AC Line I/O

I/O board attached to the Rectifier Control. The I/O are not configurable by the parameters.

Inverter Power Supply

Supplies power to the inverter section.

Inverter Power and IGBT gating Board

Hardware for gating the IGBT's

Inverter Control Assembly

Processor for the Inverter controls

Standard I/O "Optional"

I/O board connected to the Inverter regulator. I/O configurable via parameters.

DPI communication board

Platform for communications

Gate Kill thermostat connections

Hardwired into the IGBT gating power supply. The terminal must be closed to operate. Condenser High Pressure Switch.

AC Input and Output Current Sensors

Solid state device made by LEM.

IGBT (rectifier and inverter)

High Speed switch in the power circuit.

Bus Capacitors

Stores energy for the DC bus.

Bus balancing resistors

Keeps the voltage balanced from the midpoint to the plus and minus DC Bus.

Line Sync board

Primary function is to monitor the AC input and synchronize the IGBT control.

Rectifier Power Supply

Supplies power to the rectifier section.

Rectifier Power and IGBT gating PCB

Hardware for gating the IGBT's

Rectifier Control Assembly

Processor for the rectifier controls.

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LiquiFlo II – AC Line Sync



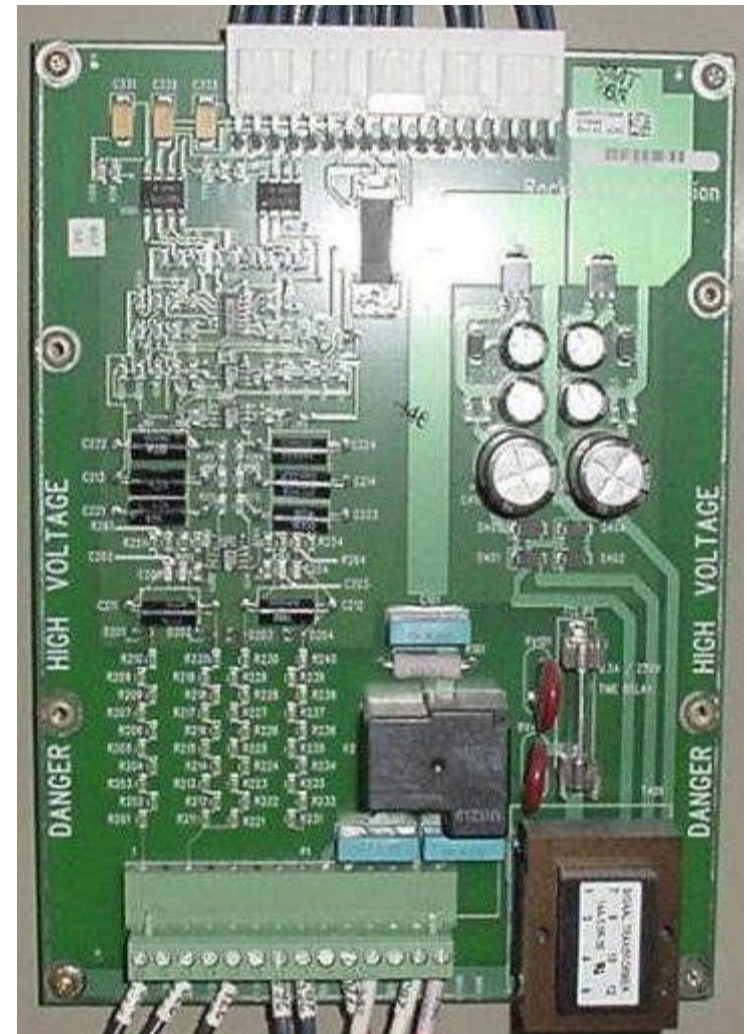
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The active rectifier commands a 3-phase voltage that is very close to the AC line.

Line sync (AC line phase synchronization) produces the phase angle & commanded frequency synchronized to the AC line. The small difference between the commanded voltage and the AC line results in current flowing from the AC line to the DC bus when motoring, or from the DC bus to the AC line when regenerating.

Two current regulators control the phase and magnitude of the commanded voltage. The reactive current is regulated to zero to maintain unity power factor.

The drive then has a leading power factor due to the input filter capacitor. The active current (in phase with the voltage) is regulated to maintain the desired bus voltage. Square wave signal tells us the peak of the AC line with only 1 analog input.



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LiquiFlo II – AC Line Sync Frame 3 only

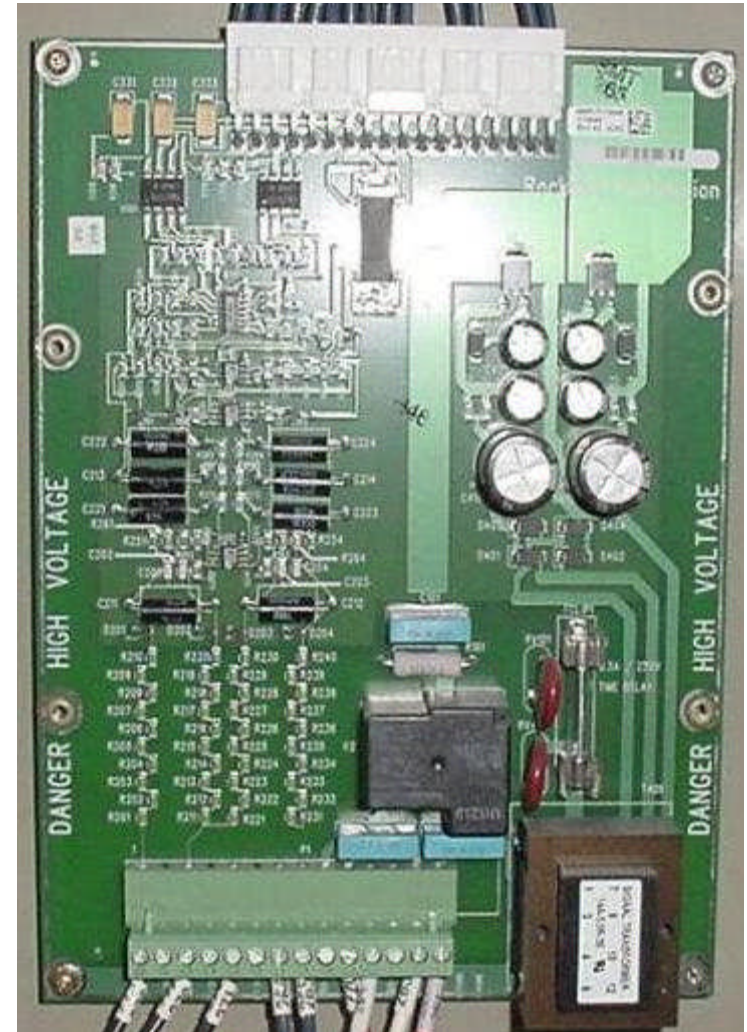


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The AC Line I/O board is connected to the Rectifier Control Board. The I/O is not configurable via parameters but configured in the firmware.

The analog inputs wired through J4 are used to read the 3 phase input AC Line Voltage and a square wave to synchronize the voltage output of the rectifier to the input line voltage from the Line Sync PCB.

There are 4 digital input (120VAC) and 6 Digital Outputs (5Amps at 120VAC).

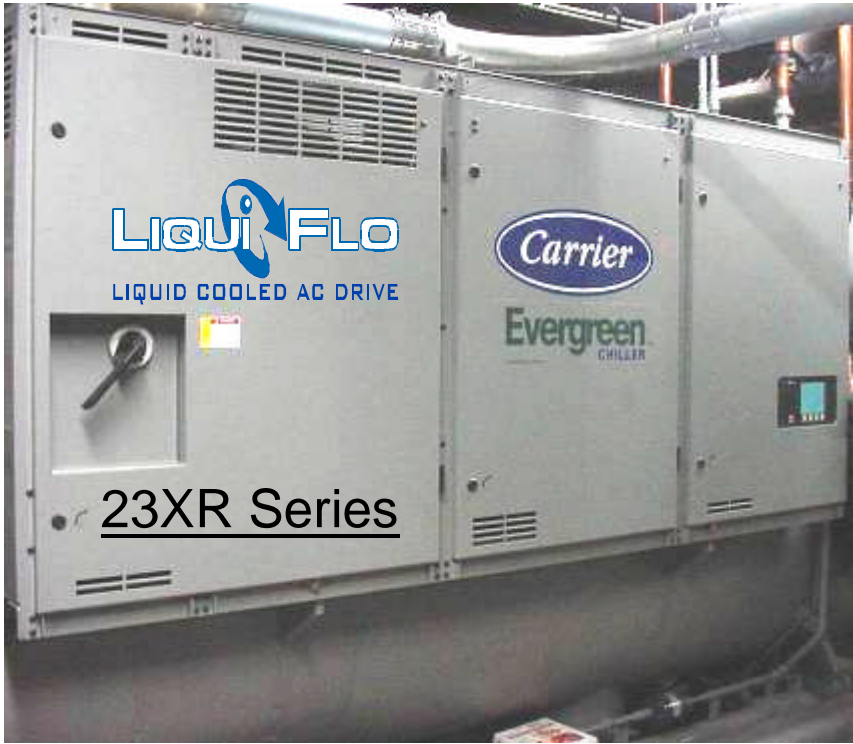


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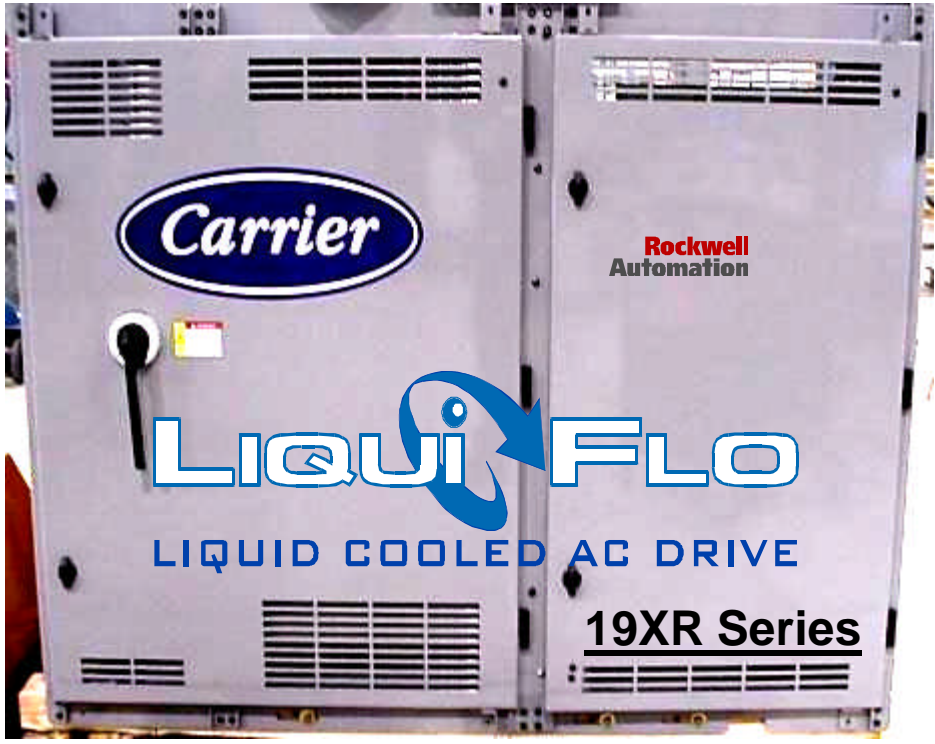
LiquiFlo II



Frame 3 LF2 23XR



Frame 3 LF2 19XR



ROCKWELL LF1 & LF2

LiquiFlo II – Frame 3 23XR Cabinet



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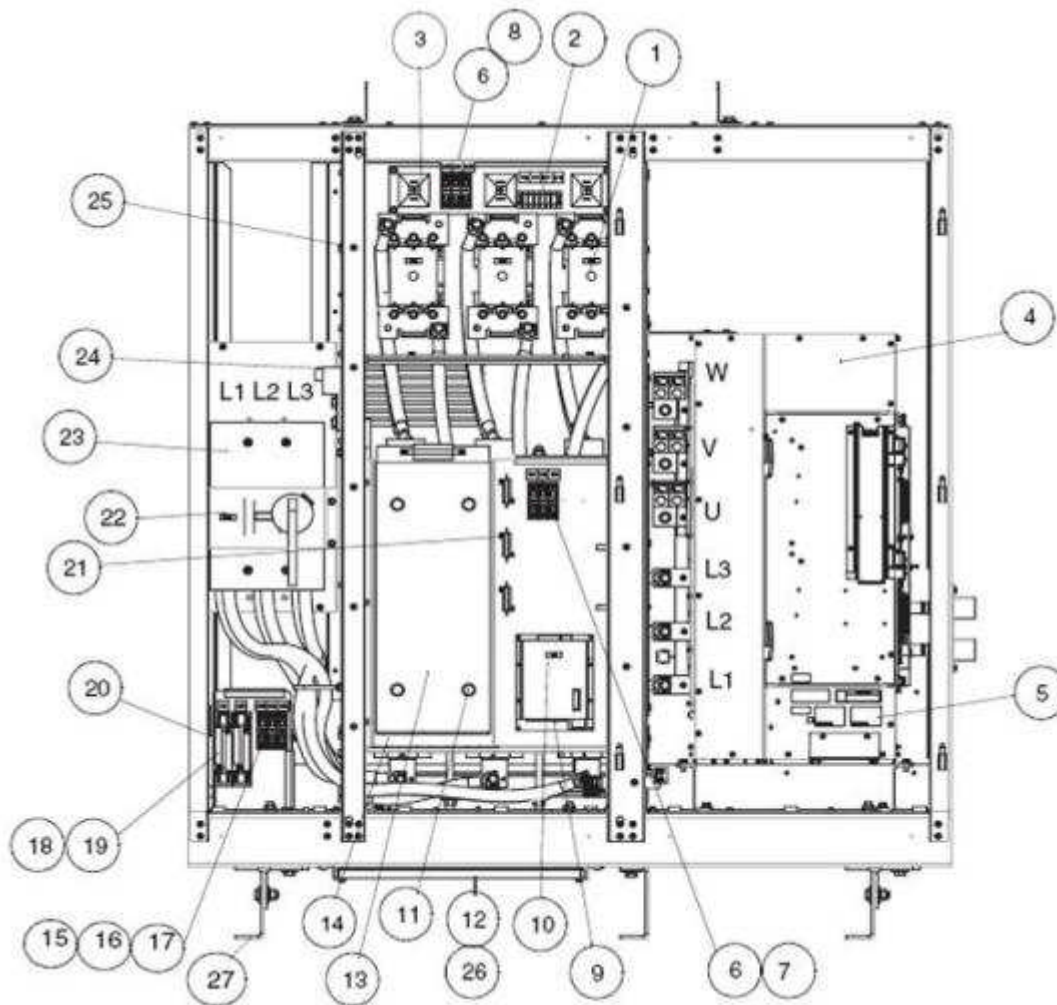


Figure 2.2 – Drive Input Components (Frame 3)

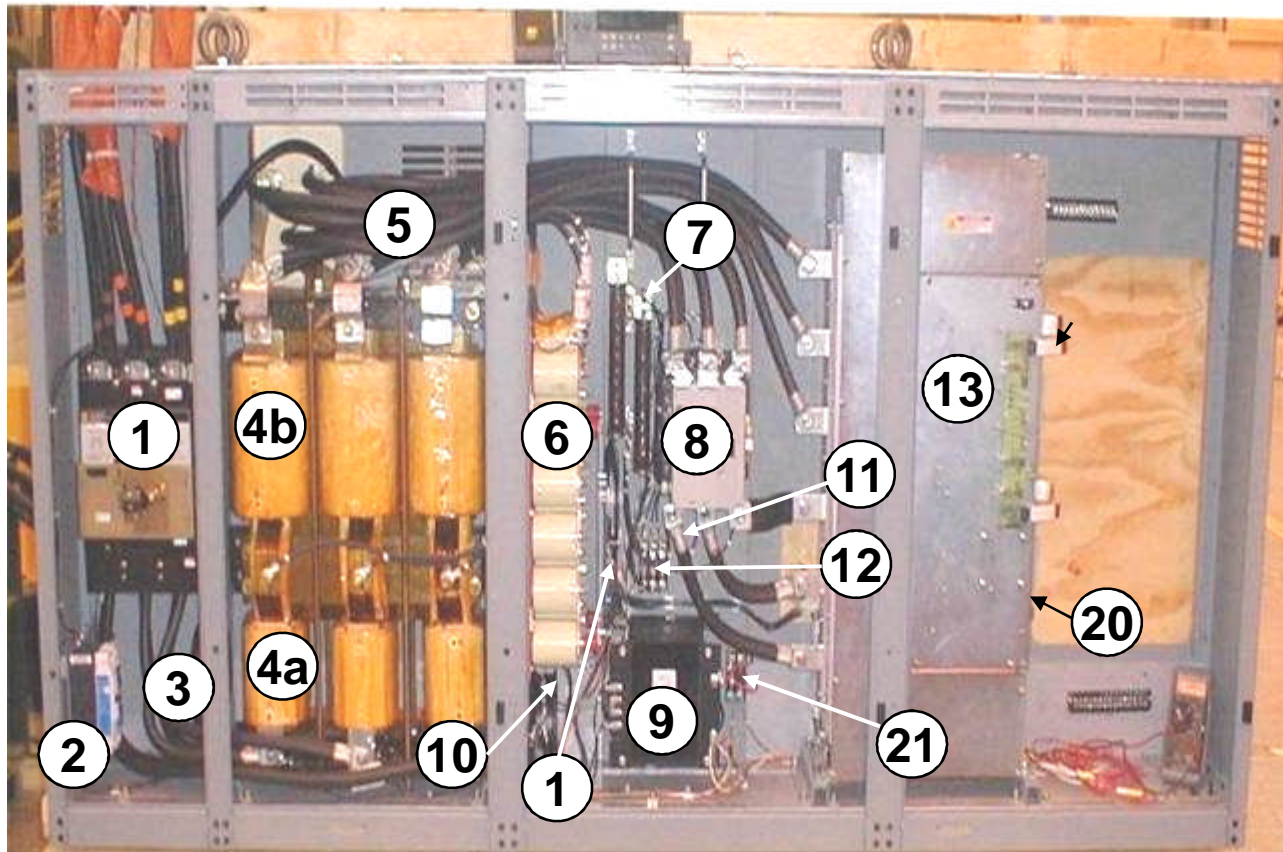
1. AC Contactor (3) with Surge Suppressor
2. Terminal Block, 6-Position
3. Precharge Resistors (3)
4. Power Module Assembly
5. Power Module Nameplate
6. Fuse Block, 30 A, 600 V, Class CC, 3-Line
7. Fuse, Class CC, 600 V, 1 A
8. Fuse, Class CC, 600 V, 20 A
9. Line Sync. PC Board Assembly
10. Line Sync. Board Cover
11. Plastic Knob
12. 115 V Fan, 6" dia. (2)
13. Capacitor Guard Panel
14. Capacitor Bank Assembly
15. Fuse Block, 30 A, 600 V, Class CC
16. Fuse, Class CC, 600 V, 5 A
17. Fuse, Class CC, 600 V, 25 A
18. Fuse Holder, 600 V, 30 A
19. Fuse, Class RK5, 600 V, 15 A
20. Transformer, 3 kVA
21. Resistor, 100 kOhm, 50 W
22. Operating Mechanism, Complete Kit
23. Main Input Circuit Breaker
24. Ground Lug, 2-600 MCM
25. 115 V Fan, 5" sq.
26. Air Filter
27. Floor Mounting Kit (3)

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LiquiFlo II – Frame 3 23XR Cabinet



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1. Input 65KAIC Circuit Breaker
2. Control XFMR 15 Amp Circuit Breaker
3. Inductor Cooling Fans
4. Inductor
 - a. Inductor 1
 - b. Inductor 2
5. Thermostat
6. Capacitor Bank
7. Precharge Resistor Assembly
8. Precharge AC Contactor
9. Control XFMR 3KVA
10. Input LCL FU 4,5,6
11. Precharge FU7,8,9
12. Line Sync. FU 1,2,3
13. Power Module Assembly
20. Optional Network Interface
21. CT Output FU 10,11A,11B

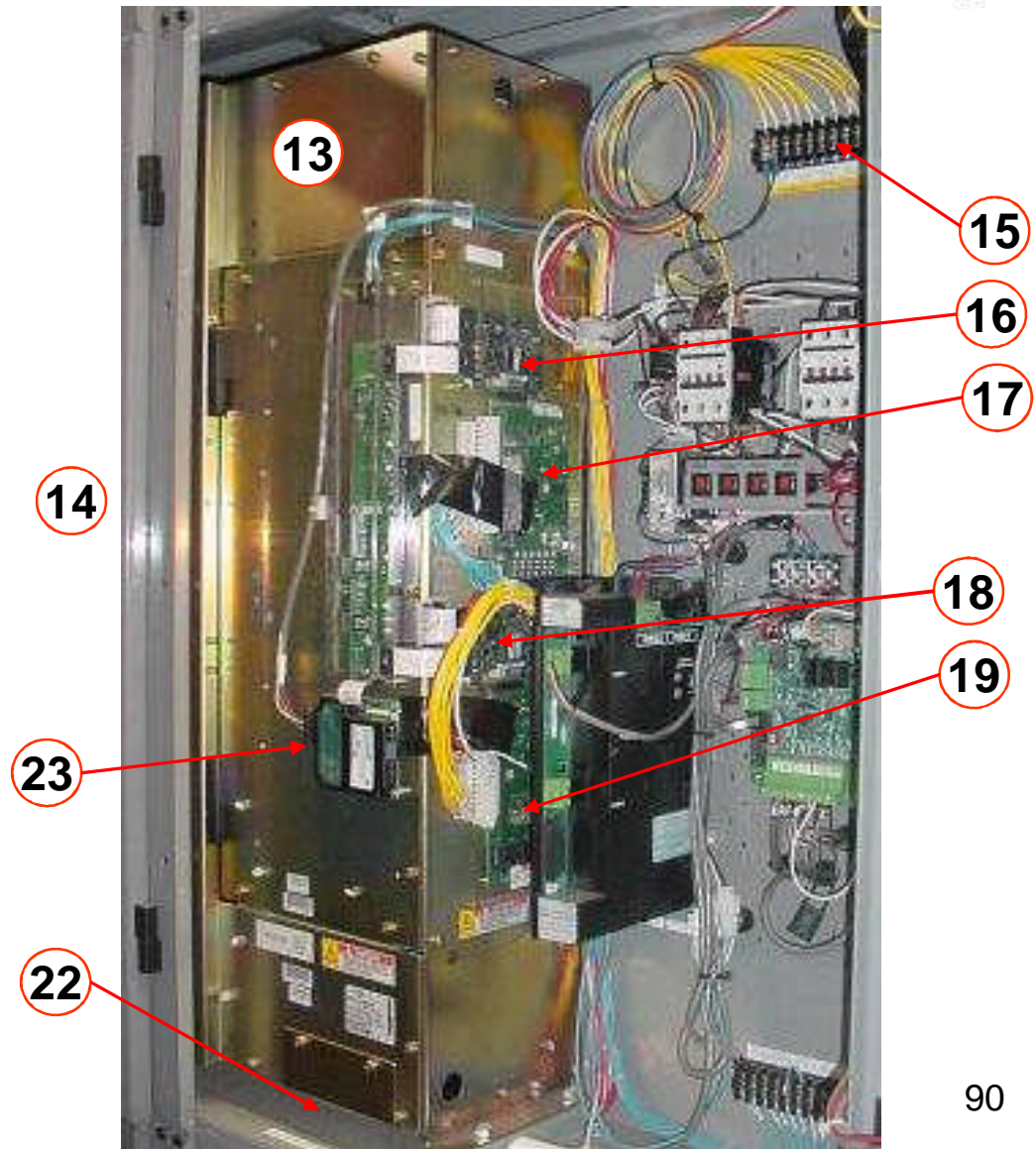
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LiquiFlo II – Frame 3 23XR Cabinet (Continue)



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- 13. Power module assembly
- 14. DPI Communication Board
- 15. Terminal Block assembly
- 16. Inverter Regulator Board
- 17. Inverter I/O Board
- 18. Inverter Regulator Board
- 19. Rectifier I/O Board
- 22. Power module fan
- 23. Gateway communication

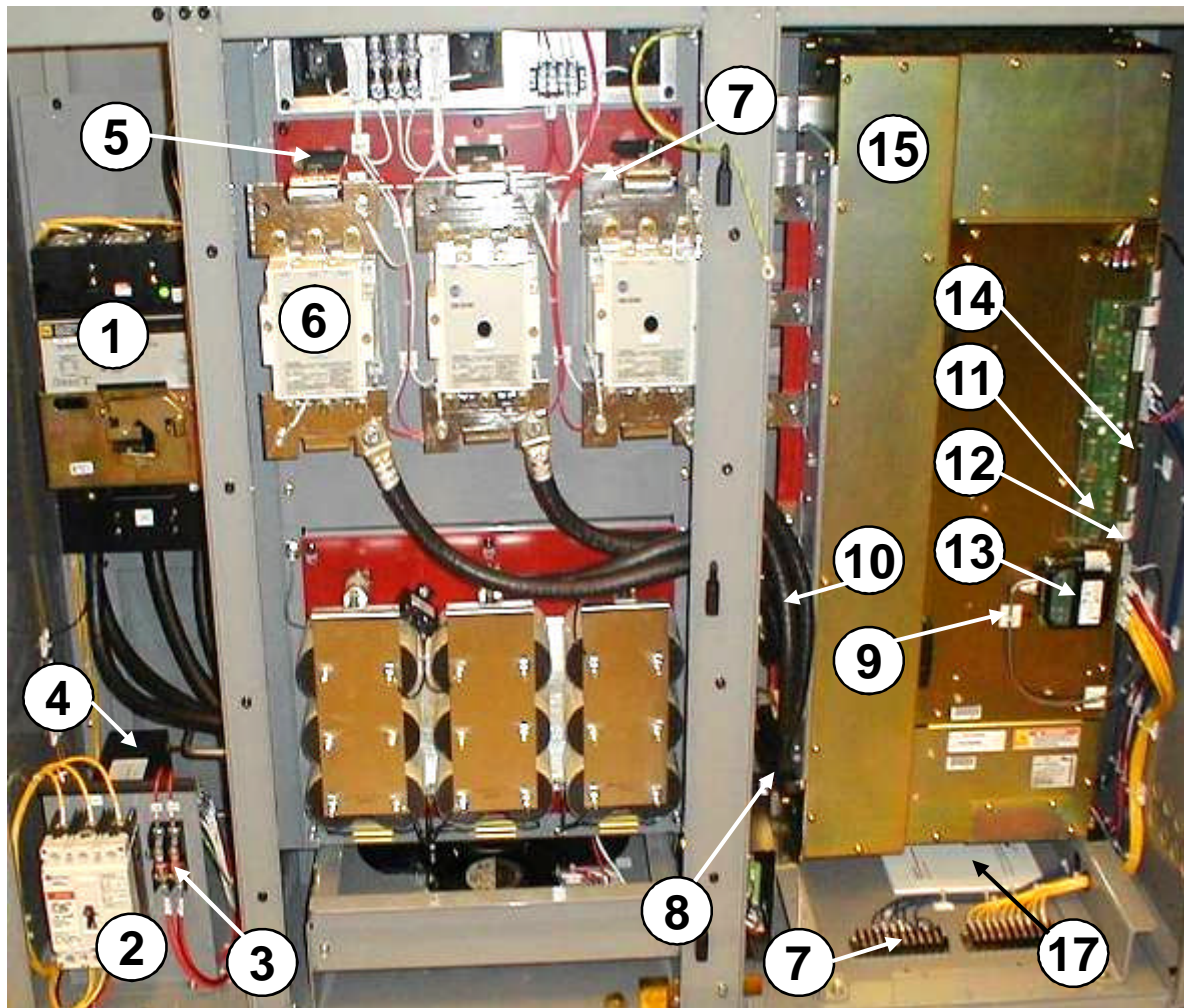


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LiquiFlo II – Frame 3 19XR Cabinet



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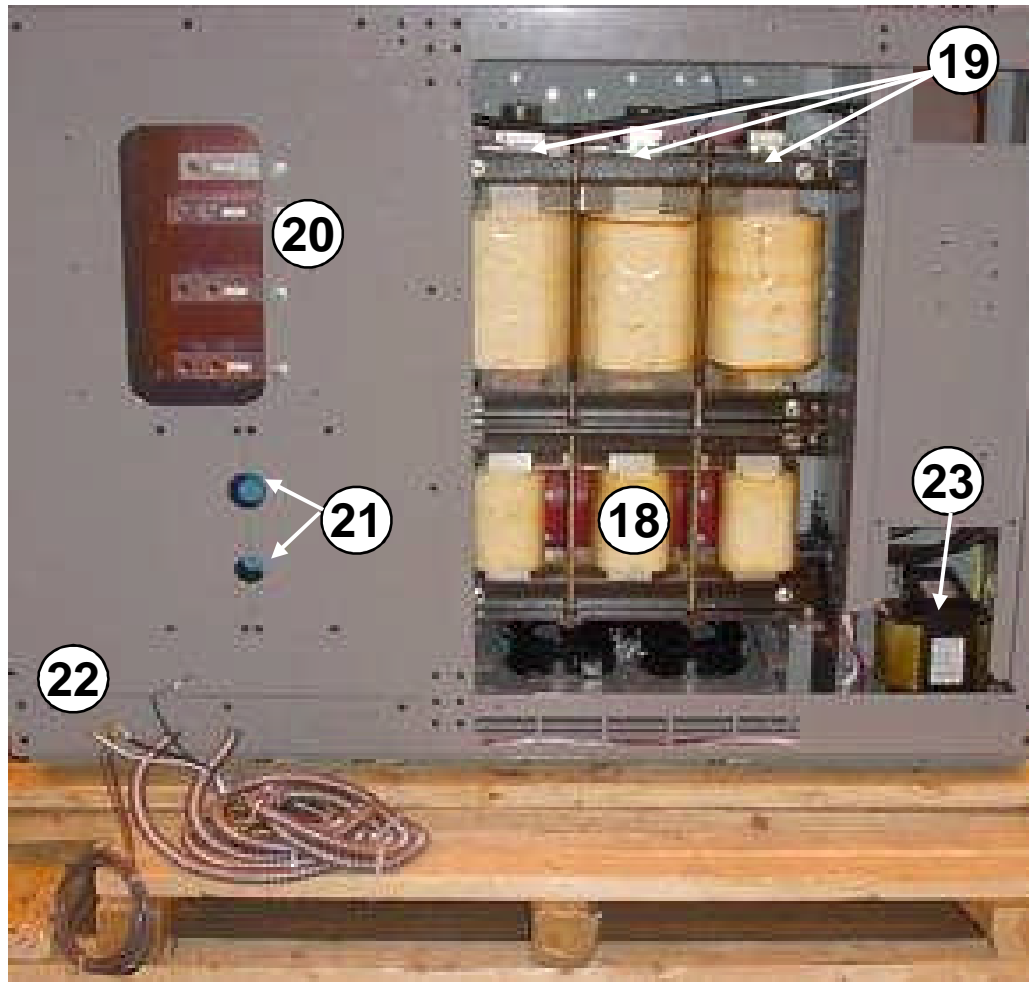
1. Input 65KAIC Circuit Breaker
2. Control XFMR 15 Amp Circuit Breaker
3. CT Output 10,11A,11B
4. Control XFMR 3KVA
5. Pre Charge Resistor Assembly
6. Pre Charge AC contactors (1 per phase)
7. Pre Charge FU 7,8,9
8. Line Sync
9. Gateway Communication
10. Line Sync FU 1,2,3
11. DPI Comm Interface Board
12. Rectifier Control AC Line I/O
13. Inverter Control Standard I/O
14. Inverter Regulator
15. Power Module Assembly
17. Inverter Power Module

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LiquiFlo II – Frame 3 19XR Cabinet (Continue)



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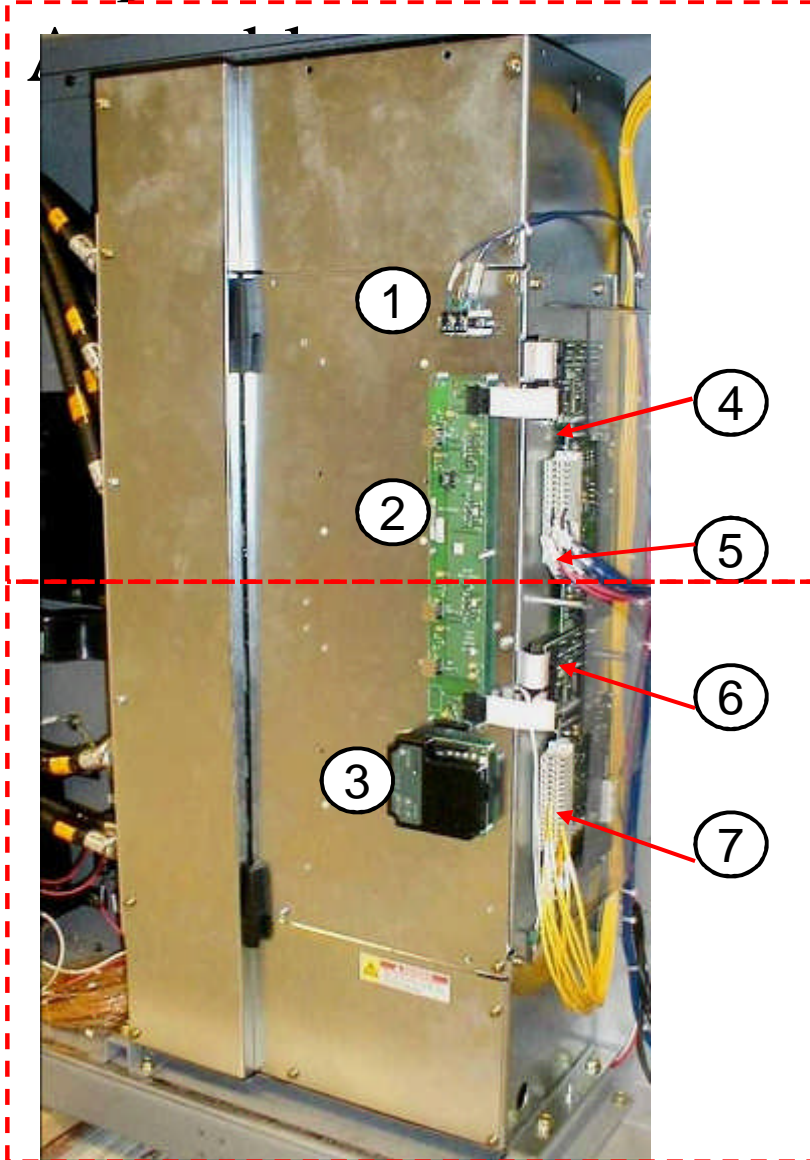
- 18. Input Filter Dual Wound Inductor
- 19. Terminations for input inductor thermostat
- 20. Motor Lead Connections
- 21. Refrigerant Connections
- 22. Control and Network Wiring Harness
- 23. Control XFMR 3 KVA

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LiquiFlo II – Frame 3 Power Module



Inverter Section

Rectifier Section

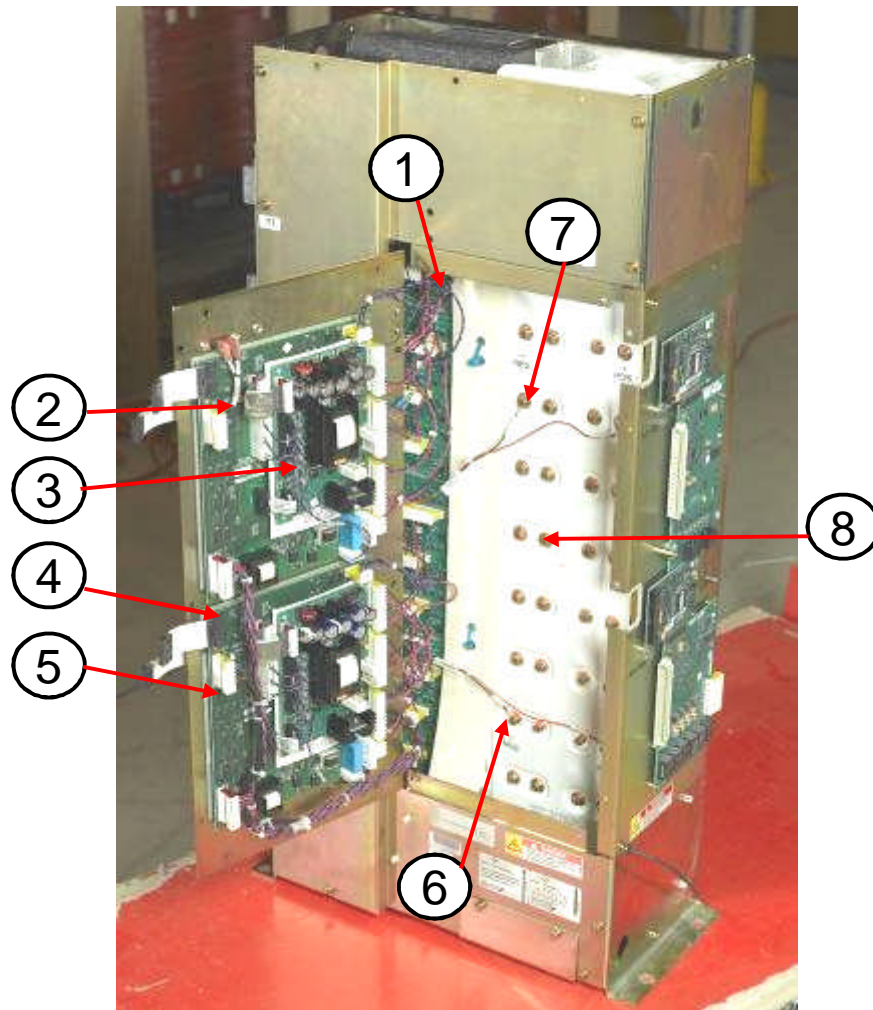
1. Gate Kill terminations
2. DPI Comm Interface Board
3. Carrier Recomm
4. Inverter Control
5. Standard I/O
6. Rectifier Control
7. AC Line I/O

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LiquiFlo II – Frame 3 Power Module



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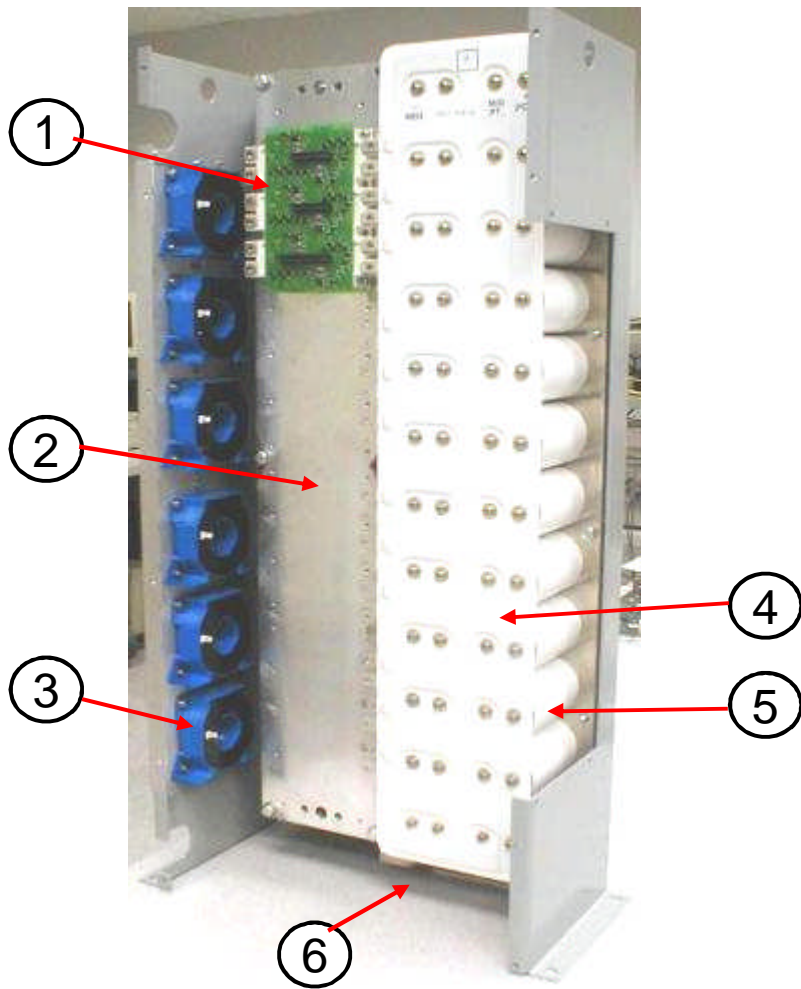
1. IGBT Modules
2. Inverter Power Board
3. Inverter 80 Watt Power Supply
4. Rectifier Power Board
5. Rectifier 80 watt Power Supply
6. Rectifier Power Board Supply From DC Bus
7. Inverter Power Board Supply from DC Bus
8. Laminated Low inductance DC Bus

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LiquiFlo II – Frame 3 Inside Power Module



1. IGBT Modules
2. Vacuumed brazed chill plate (connection back of chill plate)
3. Current Sensors (Total 6 – 3 input and output currents measured)
4. Laminated low inductance DC bus
5. DC Bus Caps

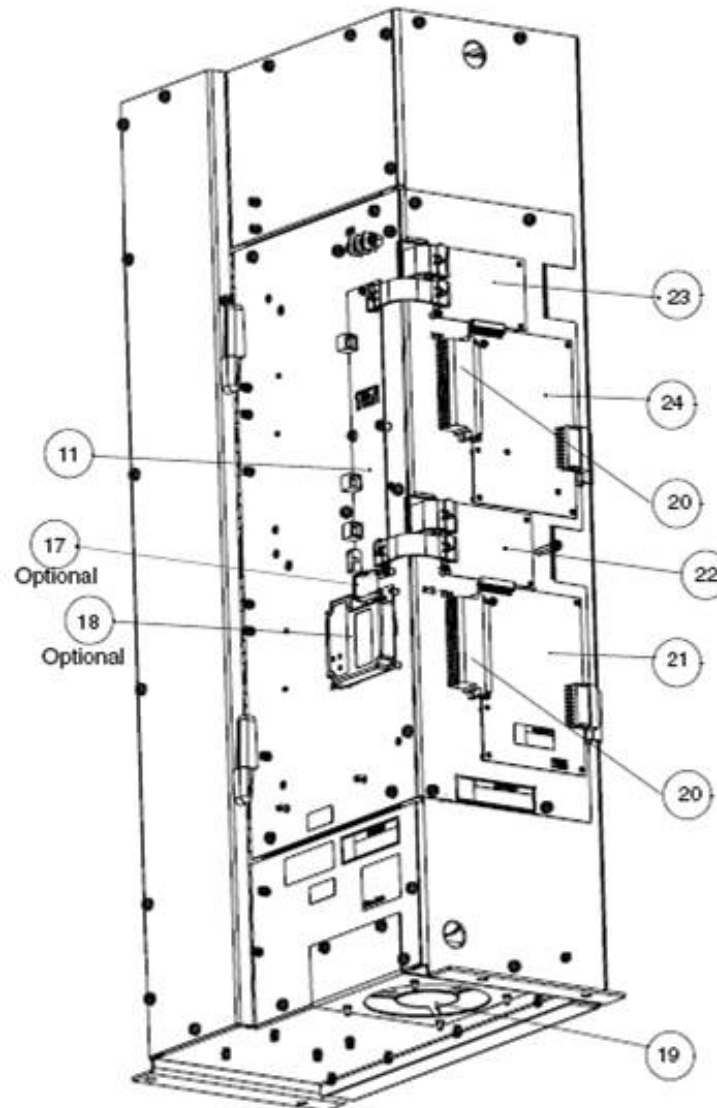


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LiquiFlo II – Power Module

1. Wire Harness Assembly, Power Supply, Logic (2)
2. Current Feedback Device, 1000 A (6)
3. Terminal Block, 2-Position
4. 80 W Power Supply Assembly (2)
5. Cable Assembly, 40-pin, 0.050 in Pitch, Flex Film (2)
6. Cable Assembly, 30-pin, 0.050 in Pitch, Flex Film (2)
7. Wire Harness Assembly, Power Supply, Upper Gate (2)
8. Inverter Power Interface Assembly
9. Wire Harness Assembly, Power Supply, Lower Gate (2)
10. Insulation Sheet (2)
11. Communications Interface Assembly
12. Rectifier Power Interface Assembly
13. Wire Harness Assembly, Gate Driver
14. Wire Harness Assembly, Current Feedback Device
15. Wire Harness Assembly, Line Sync.
16. Wire Harness Assembly, DC Bus Bleeder Resistors
17. Cable Assembly, 20-pin, 0.050 in Pitch, Flex Film (optional)
18. Communications Assembly (optional)
19. Internal Fan
20. Connector, Terminal Block, 32-pin
21. AC Line I/O Assembly
22. Rectifier Control Assembly
23. Inverter Control Assembly
24. Standard I/O Assembly
25. Wire Harness Assembly, Control Sync.



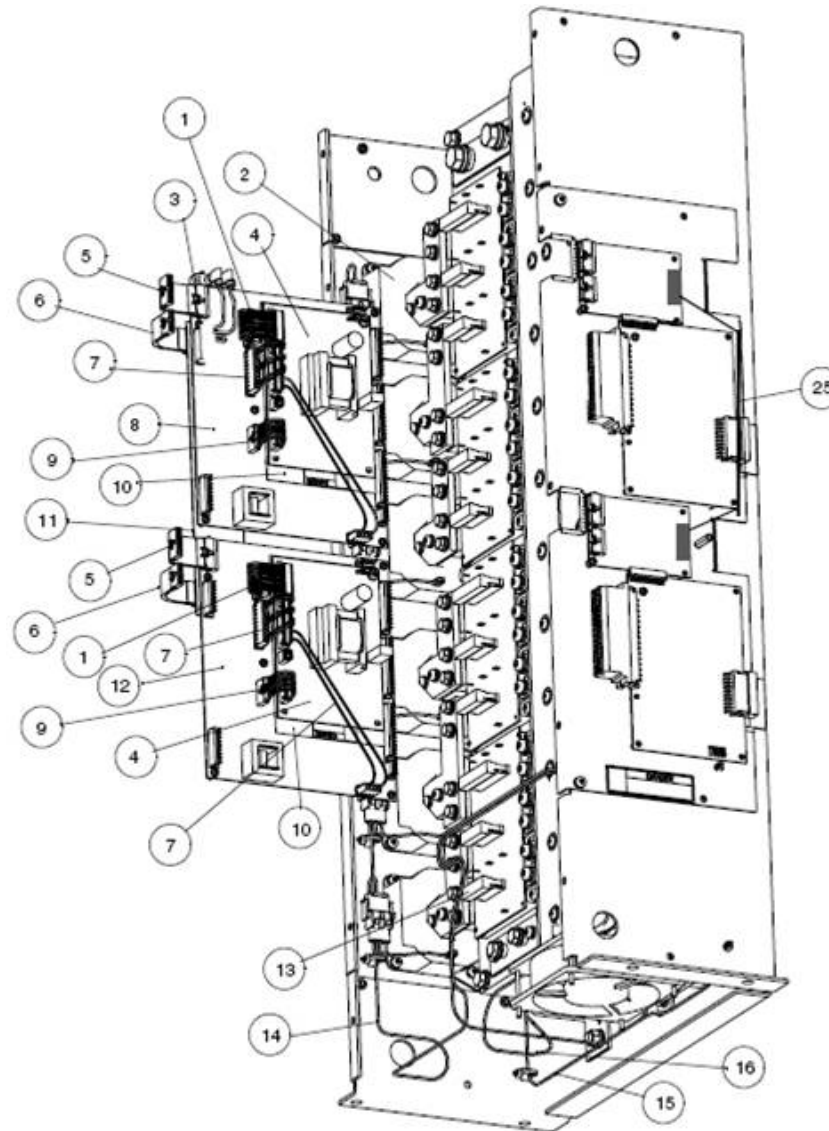
ROCKWELL LF1 & LF2

LiquiFlo II – Power Module Frame 3



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1. Wire Harness Assembly, Power Supply, Logic (2)
2. Current Feedback Device, 1000 A (6)
3. Terminal Block, 2-Position
4. 80 W Power Supply Assembly (2)
5. Cable Assembly, 40-pin, 0.050 in Pitch, Flex Film (2)
6. Cable Assembly, 30-pin, 0.050 in Pitch, Flex Film (2)
7. Wire Harness Assembly, Power Supply, Upper Gate (2)
8. Inverter Power Interface Assembly
9. Wire Harness Assembly, Power Supply, Lower Gate (2)
10. Insulation Sheet (2)
11. Communications Interface Assembly
12. Rectifier Power Interface Assembly
13. Wire Harness Assembly, Gate Driver
14. Wire Harness Assembly, Current Feedback Device
15. Wire Harness Assembly, Line Sync.
16. Wire Harness Assembly, DC Bus Bleeder Resistors
17. Cable Assembly, 20-pin, 0.050 in Pitch, Flex Film (optional)
18. Communications Assembly (optional)
19. Internal Fan
20. Connector, Terminal Block, 32-pin
21. AC Line I/O Assembly
22. Rectifier Control Assembly
23. Inverter Control Assembly
24. Standard I/O Assembly
25. Wire Harness Assembly, Control Sync.



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LiquiFlo II – Frame 4 19XR Cabinet



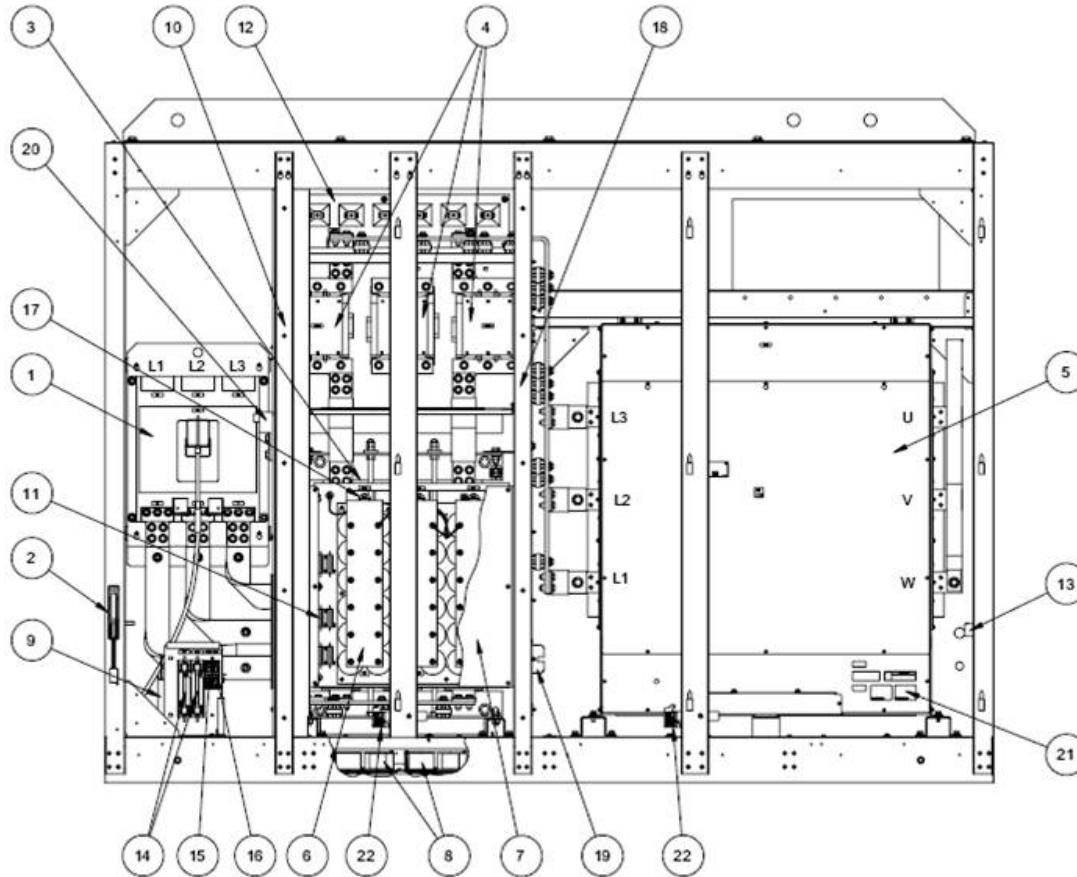
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LiquiFlo II – Frame 4 19XR Cabinet



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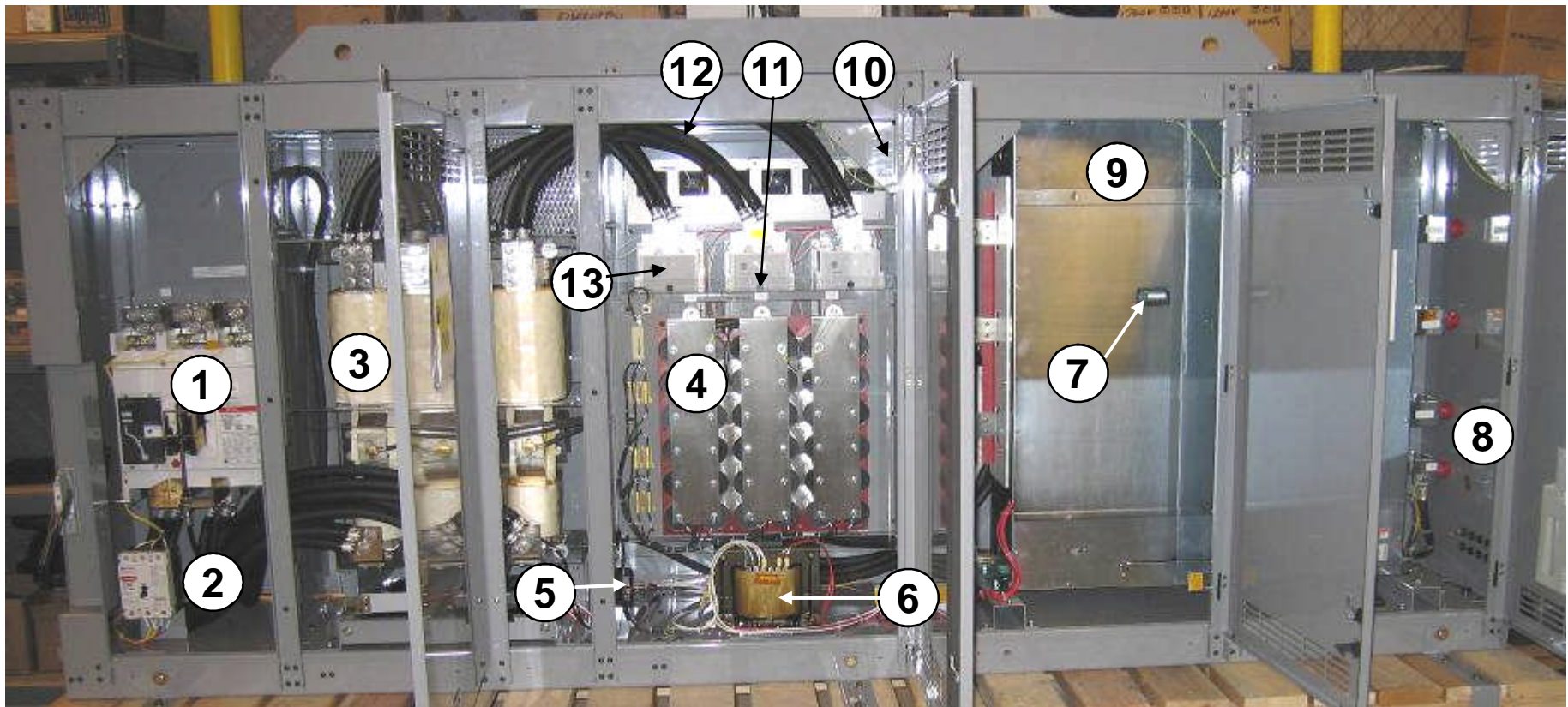
1. Circuit Breaker, 600V
2. Circuit Breaker Operating Mechanism
3. Inductor
4. AC Contactor
5. Power Module Assembly
6. Input Filter Capacitor Assembly
7. Input Filter Capacitor Guard Panel
8. Fans, 115VAC, Inductor (4)
9. Transformer, 3kVA
10. Fan, 115VAC, Contactor
11. Resistors, 100k Ohms, 50W
12. Precharge Resistors
13. Relay, Oil Pump & Control Power Terminals
14. Fuse, Class RK-5, 600V, 10A (2)
15. Fuse, Class CC, 600V, 25A (1)
16. Fuse, Class CC, 600V, 10A (1)
17. Fuse, Class T, 600V, 300A (3)
18. Fuse, Class CC, 600V, 20A (3)
19. Fuse, Class CC, 600V, 1A (3)
20. Ground Lug, 2-600 MCM
21. Nameplate, Power Module
22. Door Inter-lock (2)

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LiquiFlo II – Frame 4 19XR Cabinet



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1. Input 65 KAIC Circuit Breaker
2. Control XFMR 15 Amp Circuit Breaker
3. Input Filter Dual Wound Inductor
4. Input Filter Cap Bank

5. CT Output FU 10, 11A, 11B
6. Control XFMR 3KVA
7. Gateway & Status Light
8. Motor Output
9. Power Module Assembly

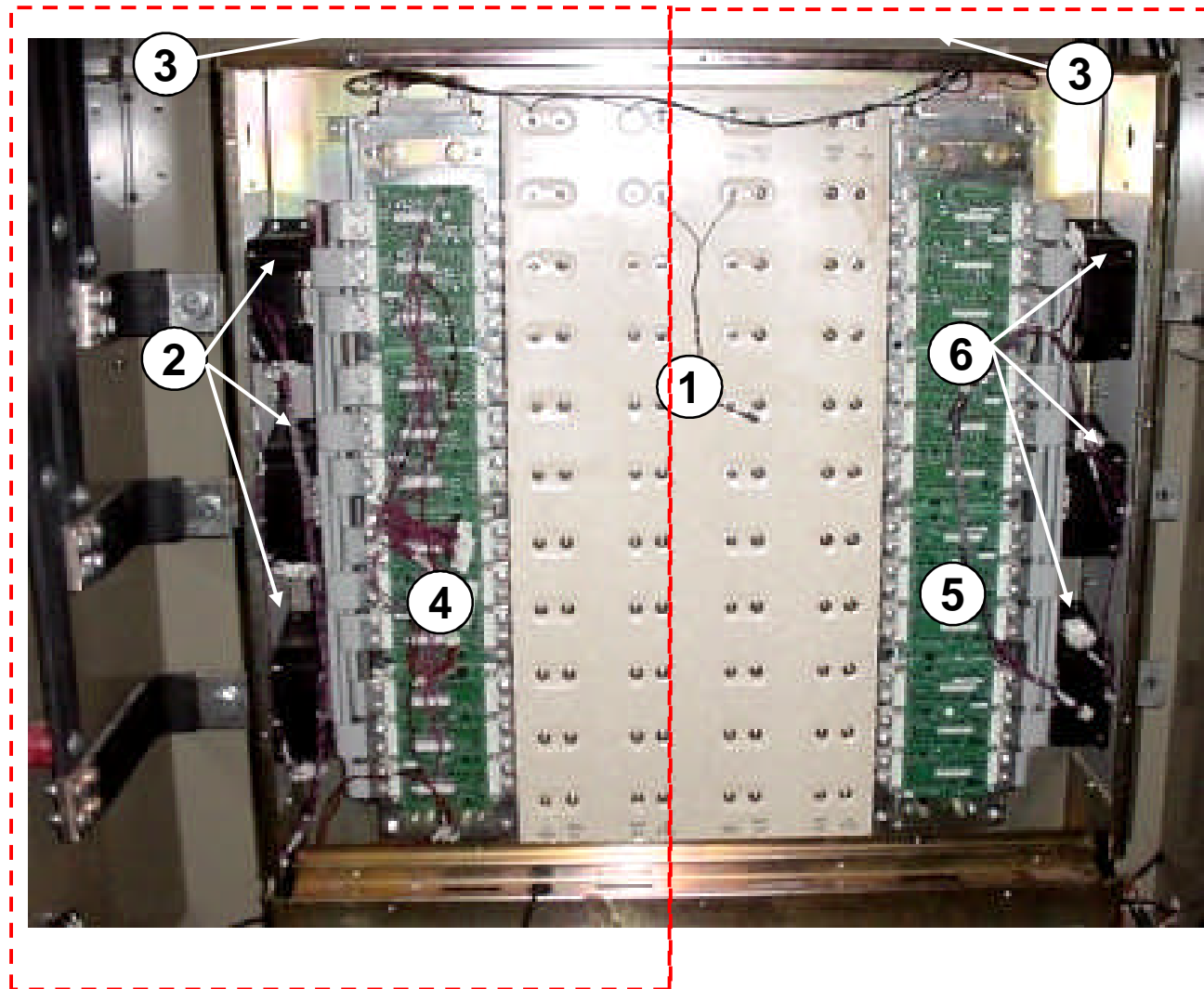
10. Pre charge FU 7,8,9
11. Input LCL FU 4,5,6
12. Pre charge Resistor Assembly
13. Pre charge AC Contactors One per phase

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LiquiFlo II – Frame 4 19XR Power Module



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Rectifier Section

Inverter Section

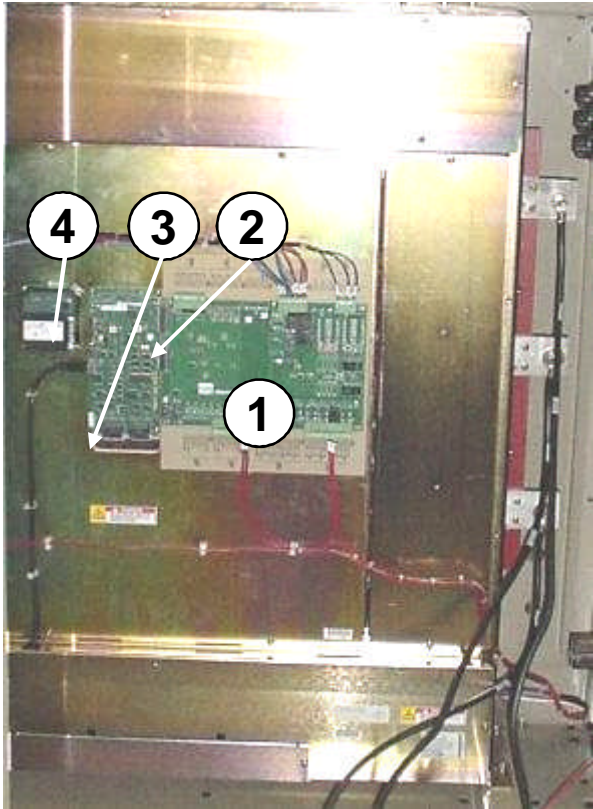
1. Laminated low inductance DC bus
2. Input Current Sensors (Total of 3)
3. Vacuumed brazed chill plate (Refrigerant connections on back of chill plate)
4. Rectifier IGBT Module (Total of 4 Modules) I
5. Inverter IGBT Module (Total of 4 Modules)
6. Output Current Sensors (Total of 3)

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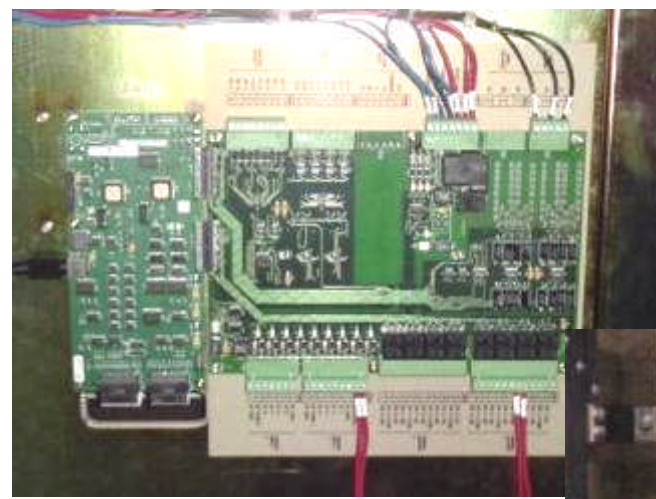


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LiquiFlo II – Frame 4 19XR Power Module

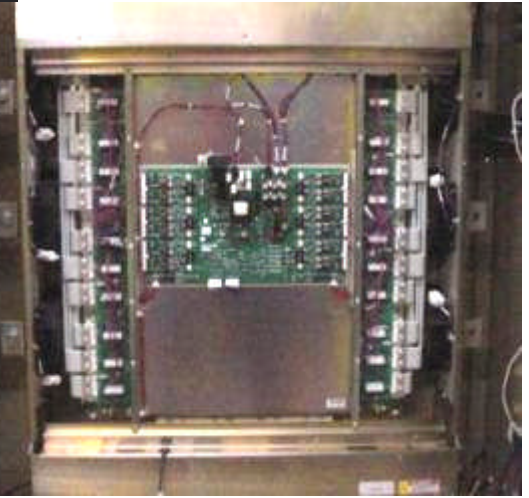


- 1. Combined I/O
- 2. Combined Rectifier/Inverter Regulator
- 3. DPI Comm Interface Connection
- 4. Gateway



Top Layer
View of Combined
Power Board & I/O

Second Layer
View of Combined
Power Board



Third Layer
View of DC Bus
Laminate & IGBT's &
Input and Output LEMS

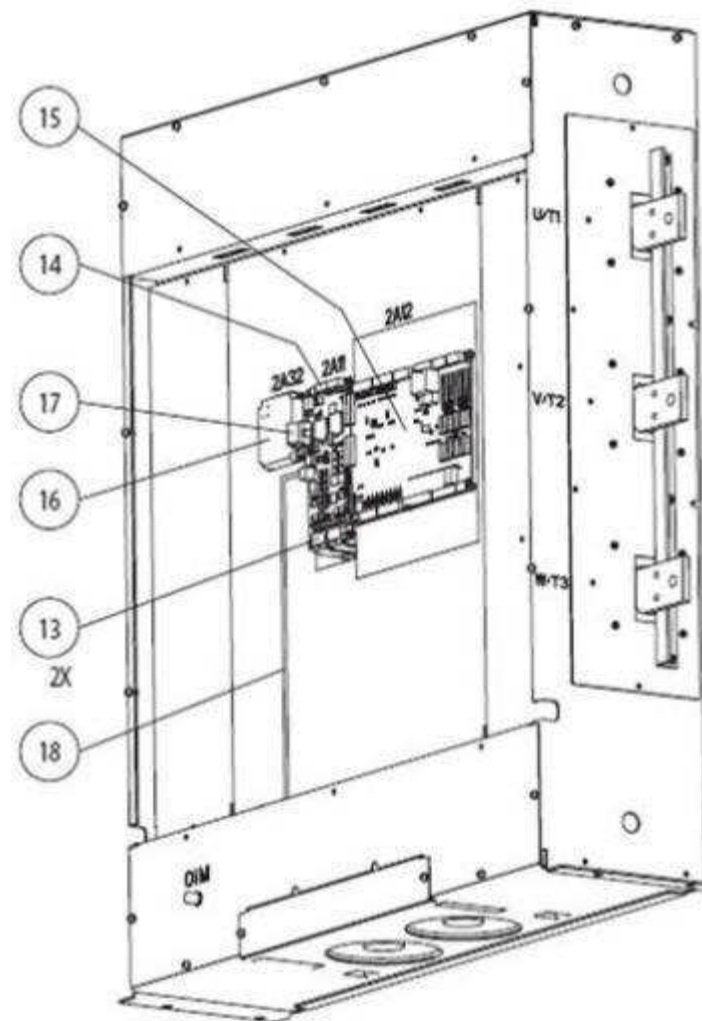
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LiquiFlo II – Power Module Frame 4



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1. Combined Power PCB Assembly, 810 Amps
Combined Power PCB Assembly, 1215 Amps
2. Wire Harness Assembly, Gate Driver
3. Internal Fan, 24 VDC
4. Internal Fan, 24 VDC
5. Wire Harness Assembly, Internal Fan
6. Wire Harness Assembly, DC Power
7. Wire Harness Assembly, DC Bus Resistors
8. Current Feedback Device, 2000A
9. Wire Harness Assembly, Current Feedback Device, Rectifier Side
10. Wire Harness Assembly, Current Feedback Device, Inverter Side
11. Wire Harness Assembly, RTD, Rectifier Side
12. Wire Harness Assembly, RTD, Inverter Side
13. Cable Assembly, 40-Pin
14. Combined Control PCB Assembly
15. Combined I/O PCB Assembly
16. RS-485 Communications Assembly
17. Cable Assembly, 20-Pin
18. Cable, Mini DIN, 8 Pos., Male/Male, 1 Meter Long



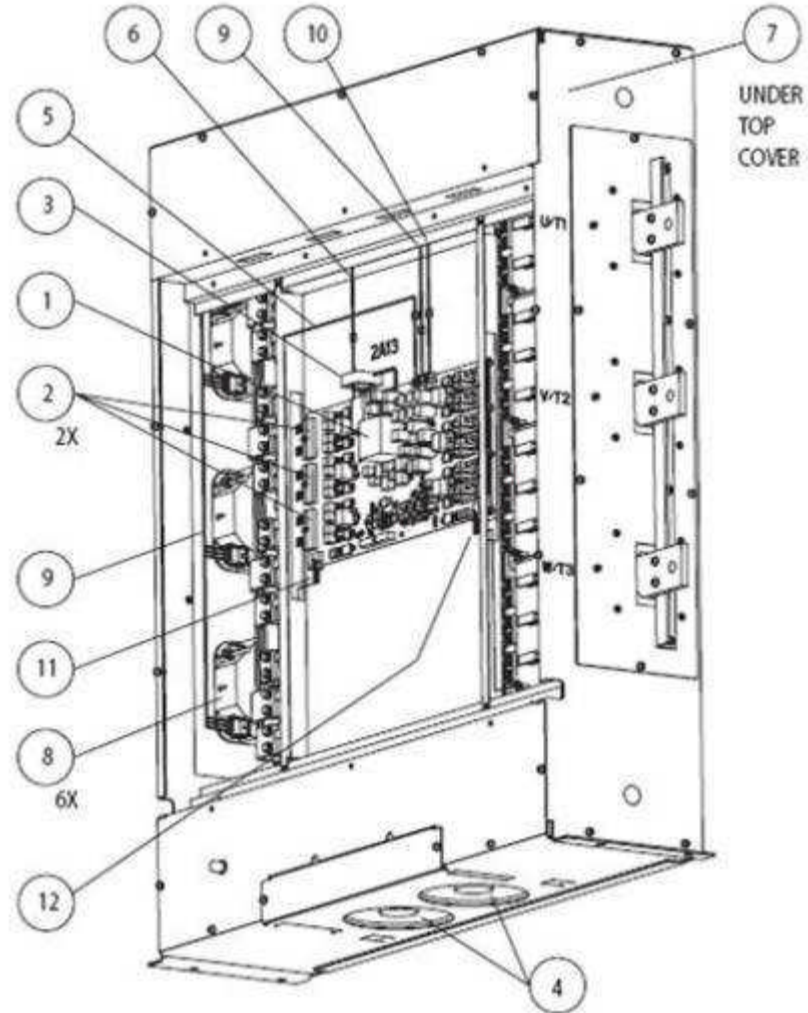
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LiquiFlo II – Power Module Frame 4



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1. Combined Power PCB Assembly, 810 Amps
Combined Power PCB Assembly, 1215 Amps
2. Wire Harness Assembly, Gate Driver
3. Internal Fan, 24 VDC
4. Internal Fan, 24 VDC
5. Wire Harness Assembly, Internal Fan
6. Wire Harness Assembly, DC Power
7. Wire Harness Assembly, DC Bus Resistors
8. Current Feedback Device, 2000A
9. Wire Harness Assembly, Current Feedback Device, Rectifier Side
10. Wire Harness Assembly, Current Feedback Device, Inverter Side
11. Wire Harness Assembly, RTD, Rectifier Side
12. Wire Harness Assembly, RTD, Inverter Side
13. Cable Assembly, 40-Pin
14. Combined Control PCB Assembly
15. Combined I/O PCB Assembly
16. RS-485 Communications Assembly
17. Cable Assembly, 20-Pin
18. Cable, Mini DIN, 8 Pos., Male/Male, 1 Meter Long



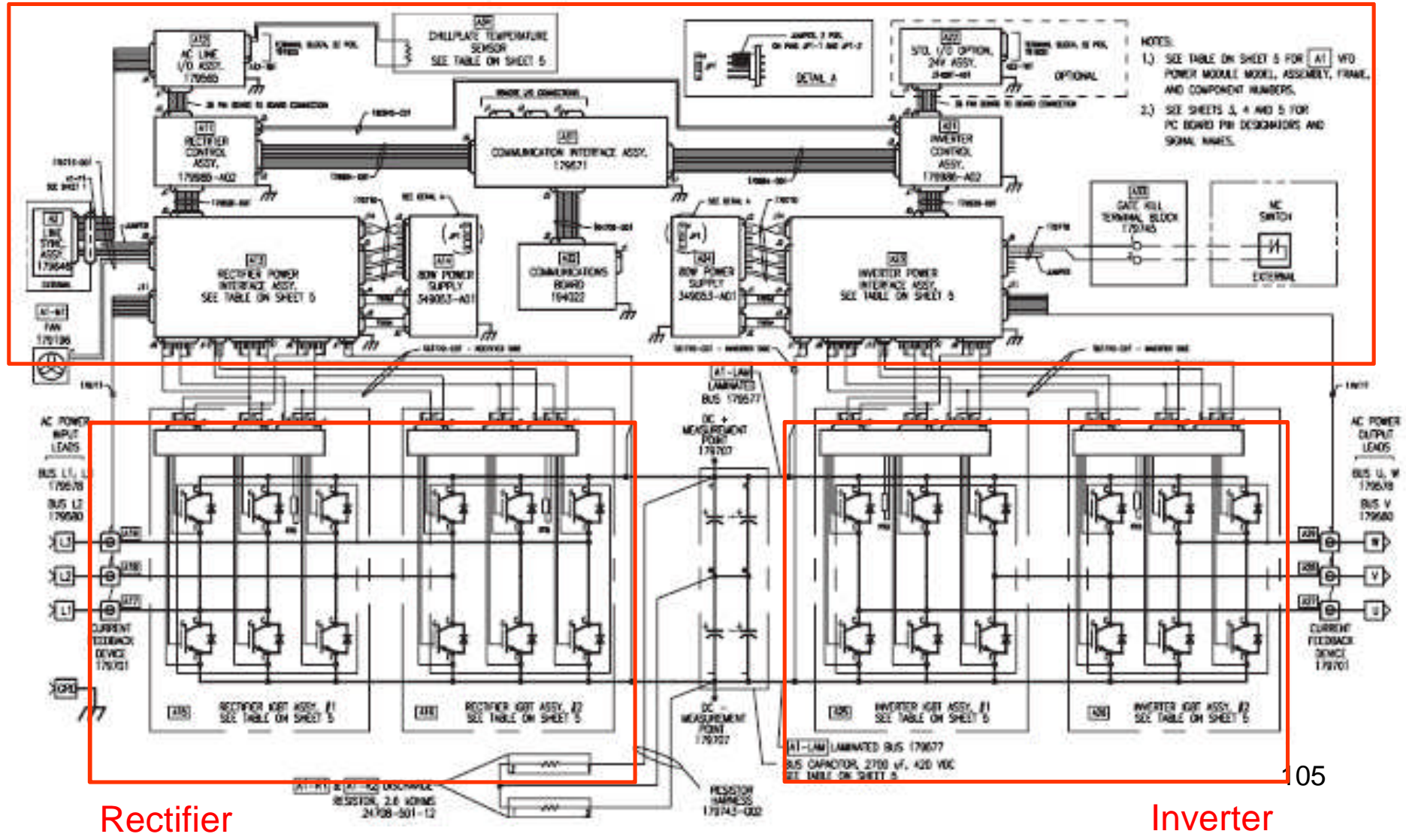
ROCKWELL LF1 & LF2



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LiquiFlo II – Frame 3 19 & 23XRV Wiring

Control Boards



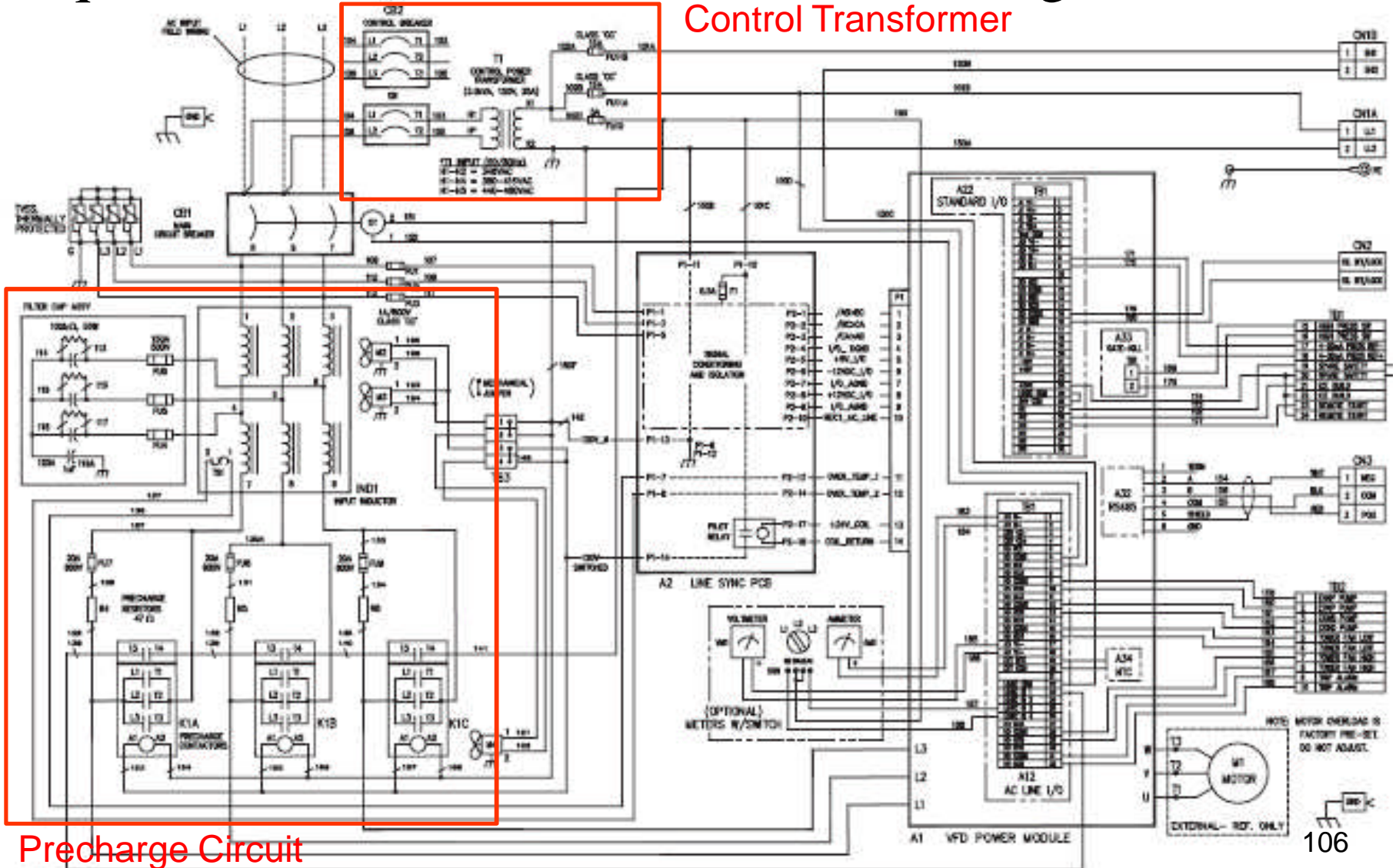
ROCKWELL LF1 & LF2



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LiquiFlo II – Frame 3 19 & 23XRV Wiring

Control Transformer



Precharge Circuit

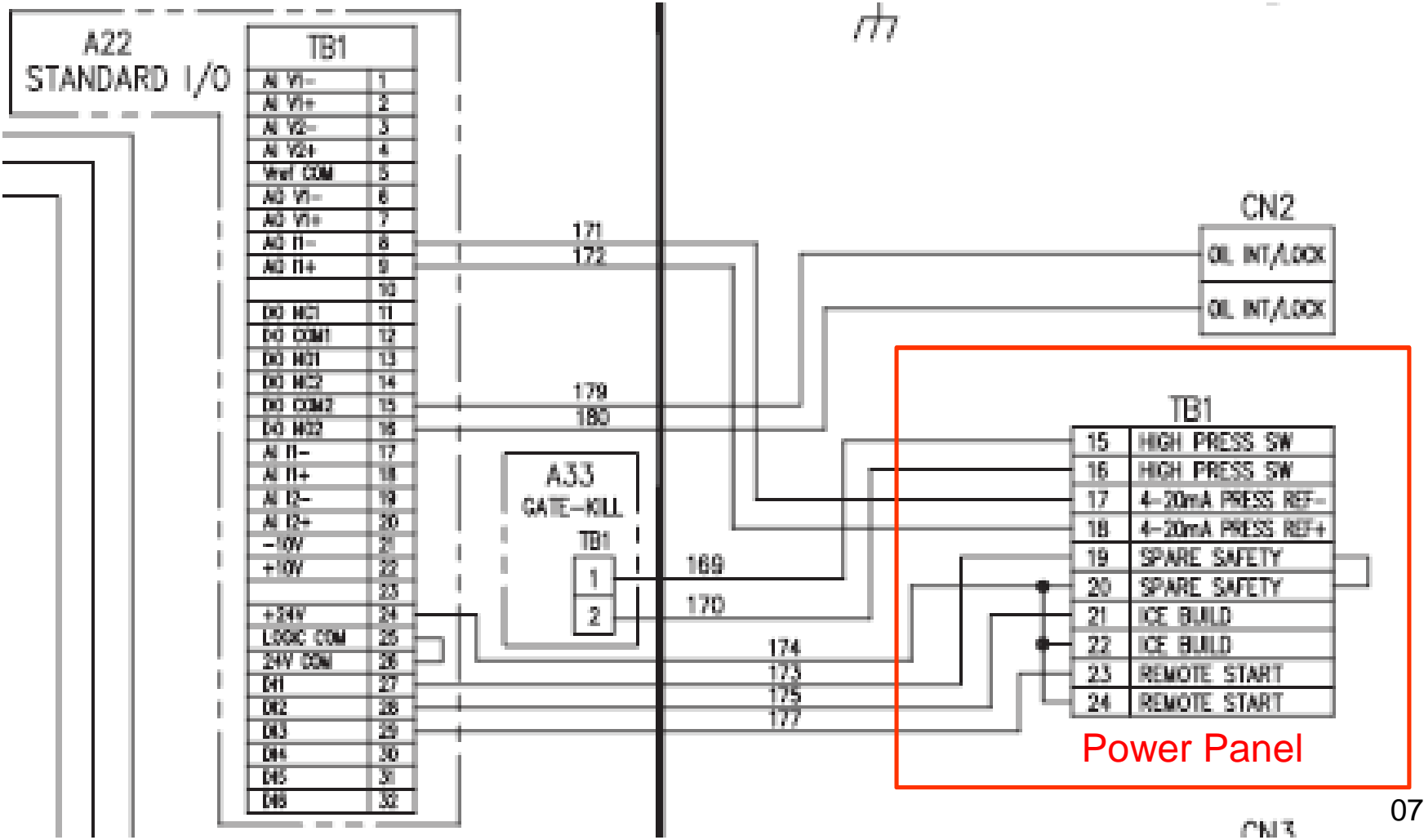
ROCKWELL LF1 & LF2



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LiquiFlo II – Frame 3 19 & 23XRV Wiring

A22 Standard I/O Wiring



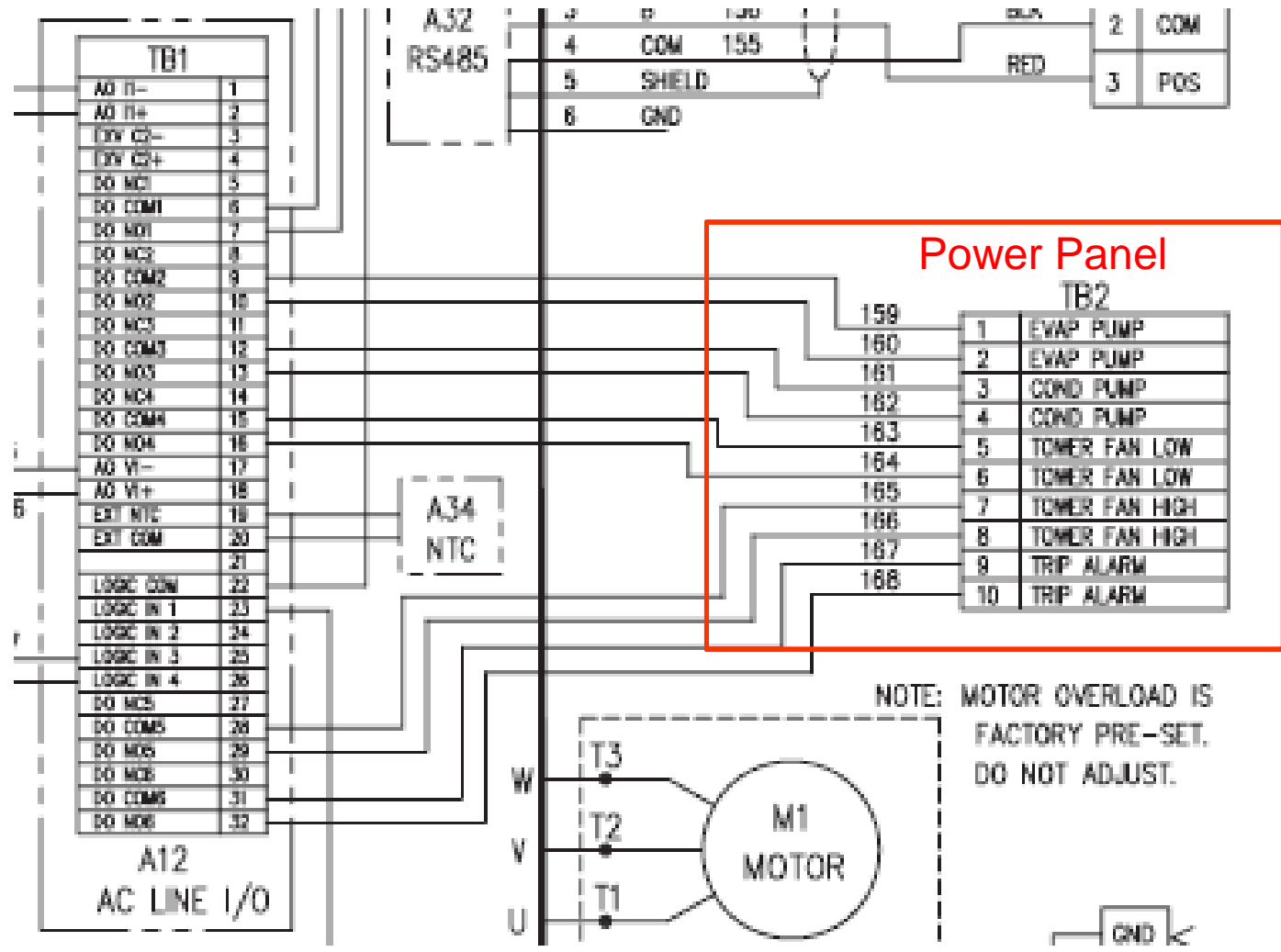
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LiquiFlo II – Frame 3 19 & 23XRV Wiring



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A12 Standard I/O Wiring





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LiquiFlo II – Frame 3 19/23 XRV Wiring

Board Wiring Rectifier



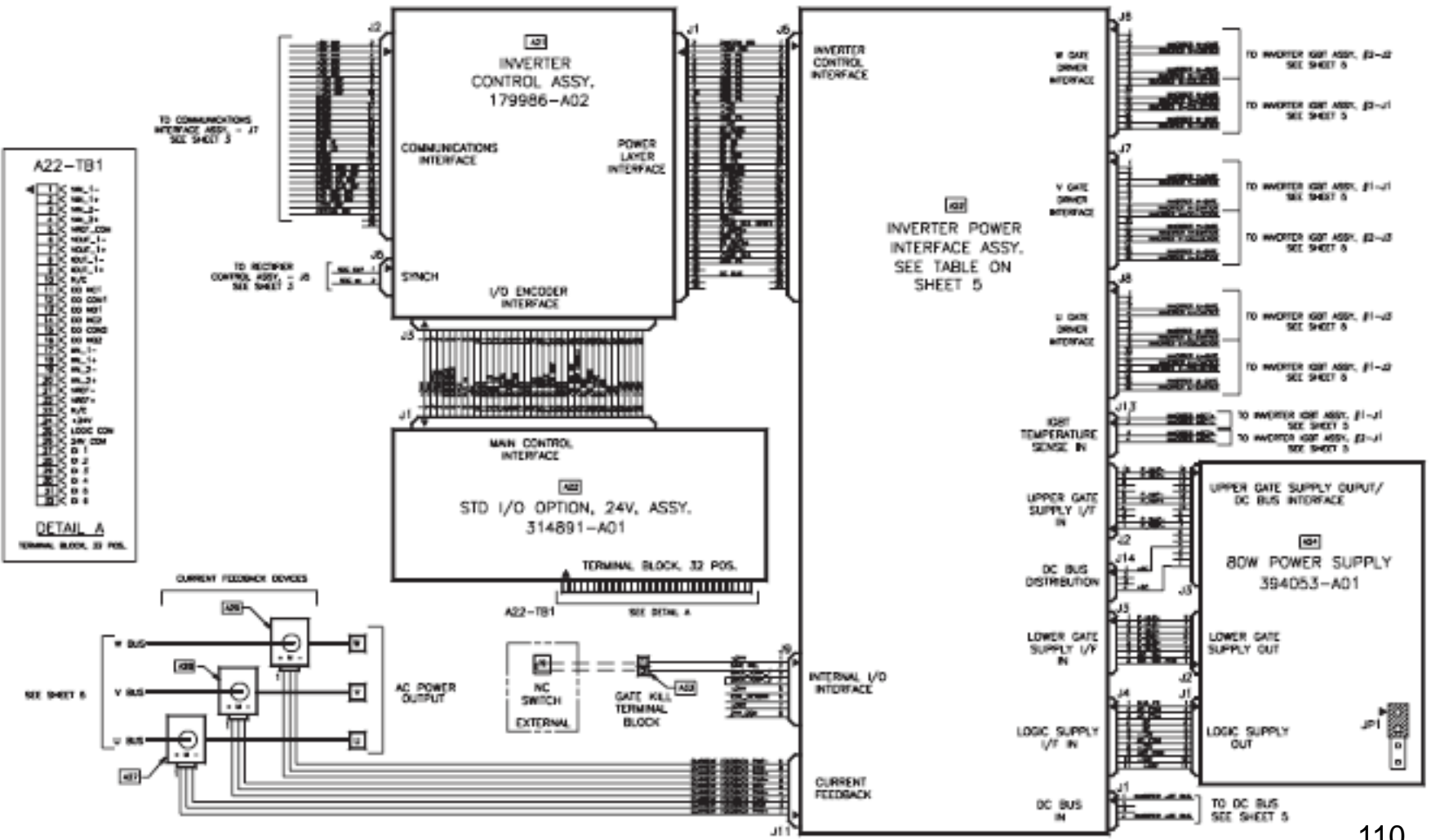


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LiquiFlo II – Frame 3 19/23 XRV Wiring

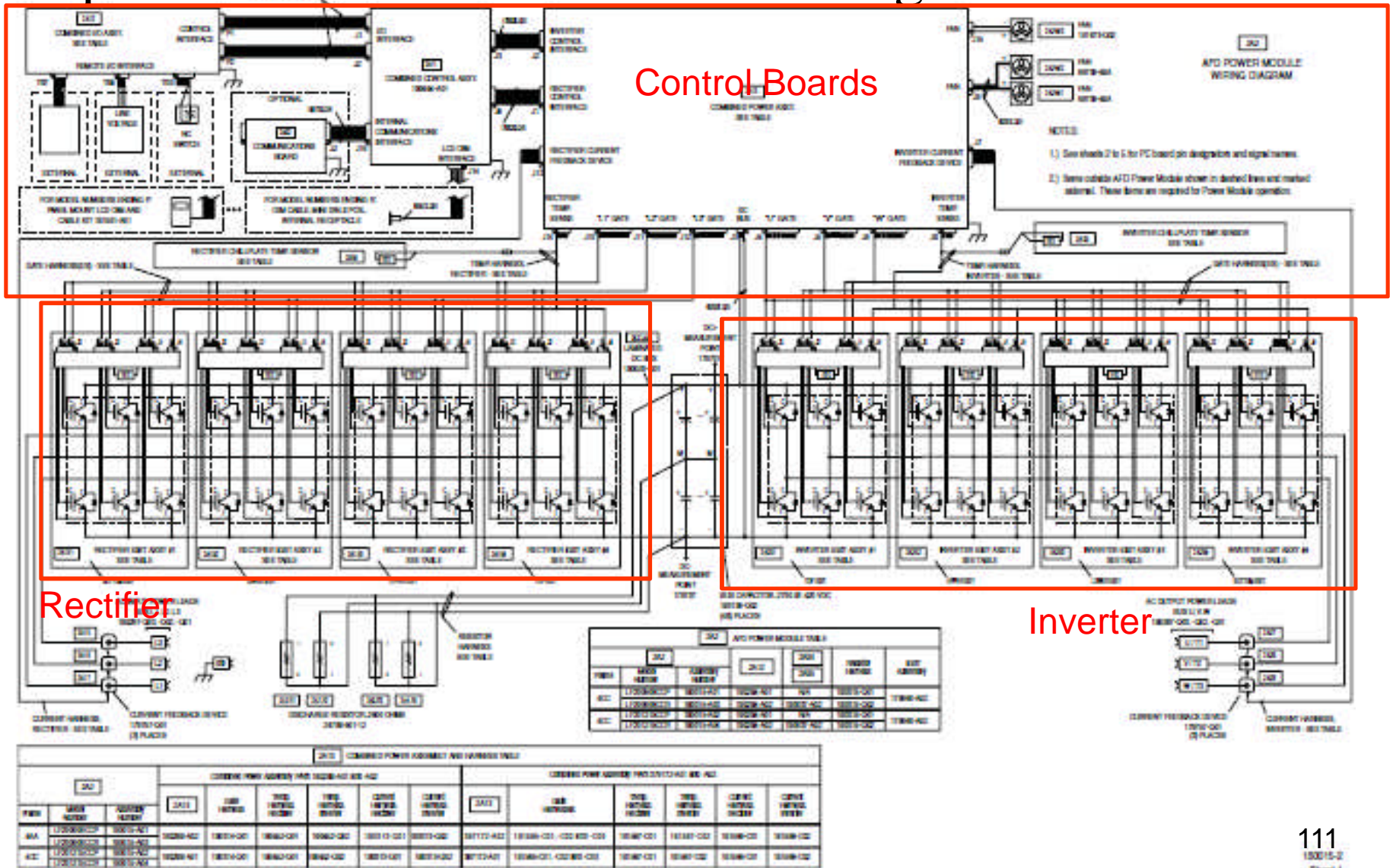
Board Wiring Inverter



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LiquiFlo II – Frame 4 19XRV Wiring

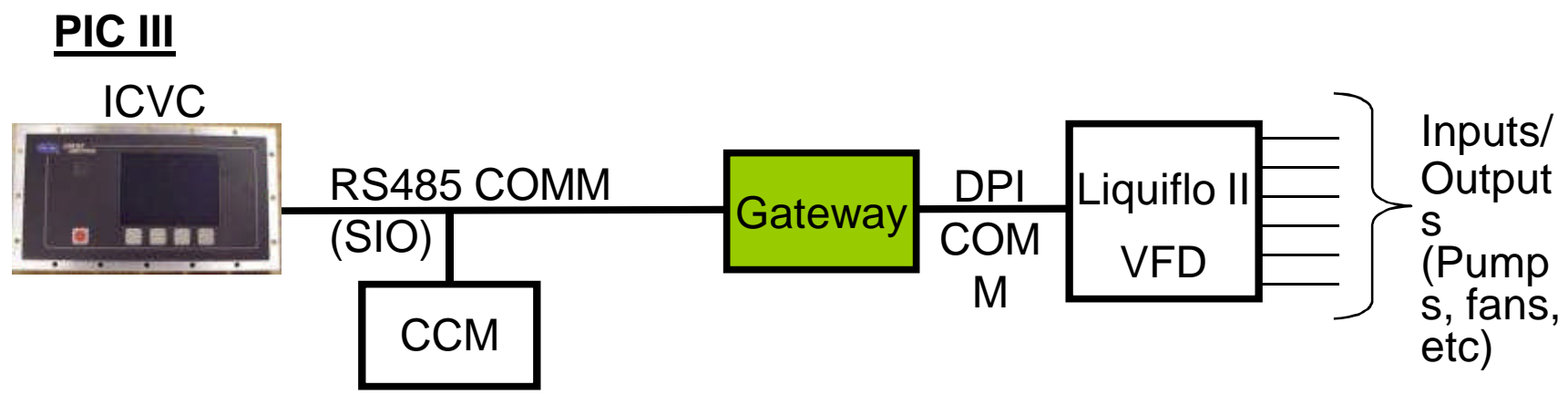
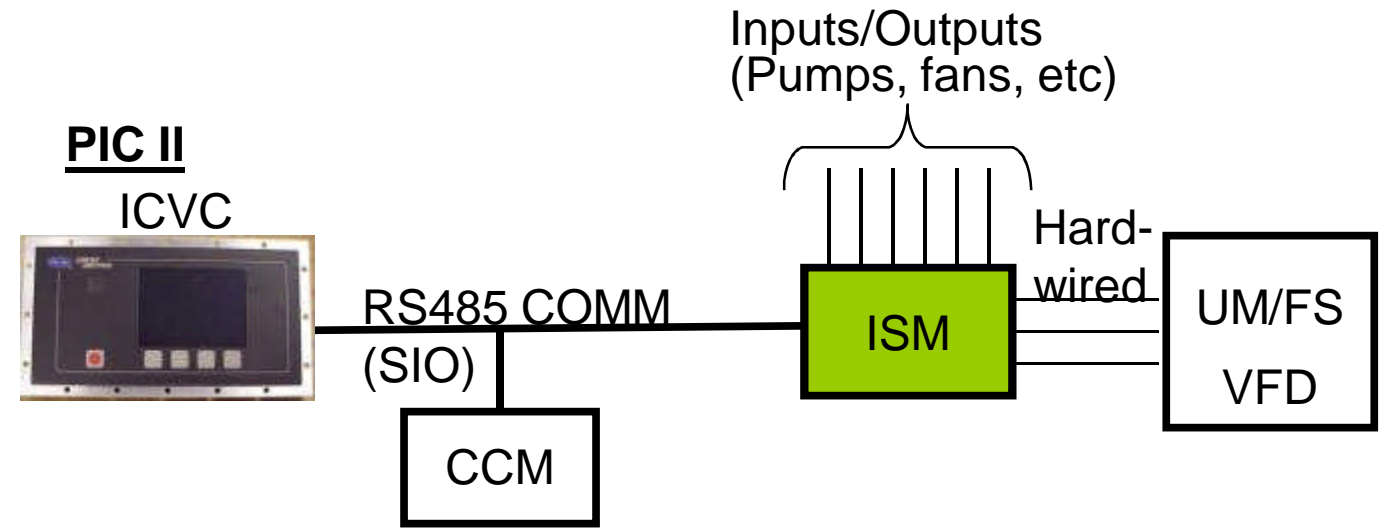


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LiquiFlo II – Controls Setup



DPI -- Drive Peripheral Interface

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LiquiFlo II – Control without ISM

Only one Circuit Breaker for both Control Power & Oil Heater and Compressor Oil Pump (CB2).

Oil Pump 2C Aux. Contact and HPS (Power Panel term. #17 & # 43) are wired directly to VFD Gate Kill Terminal Block (A33, TB-1) and prevents any Gate signal to the Inverter IGBT's when related contacts are open (Closed to Run).

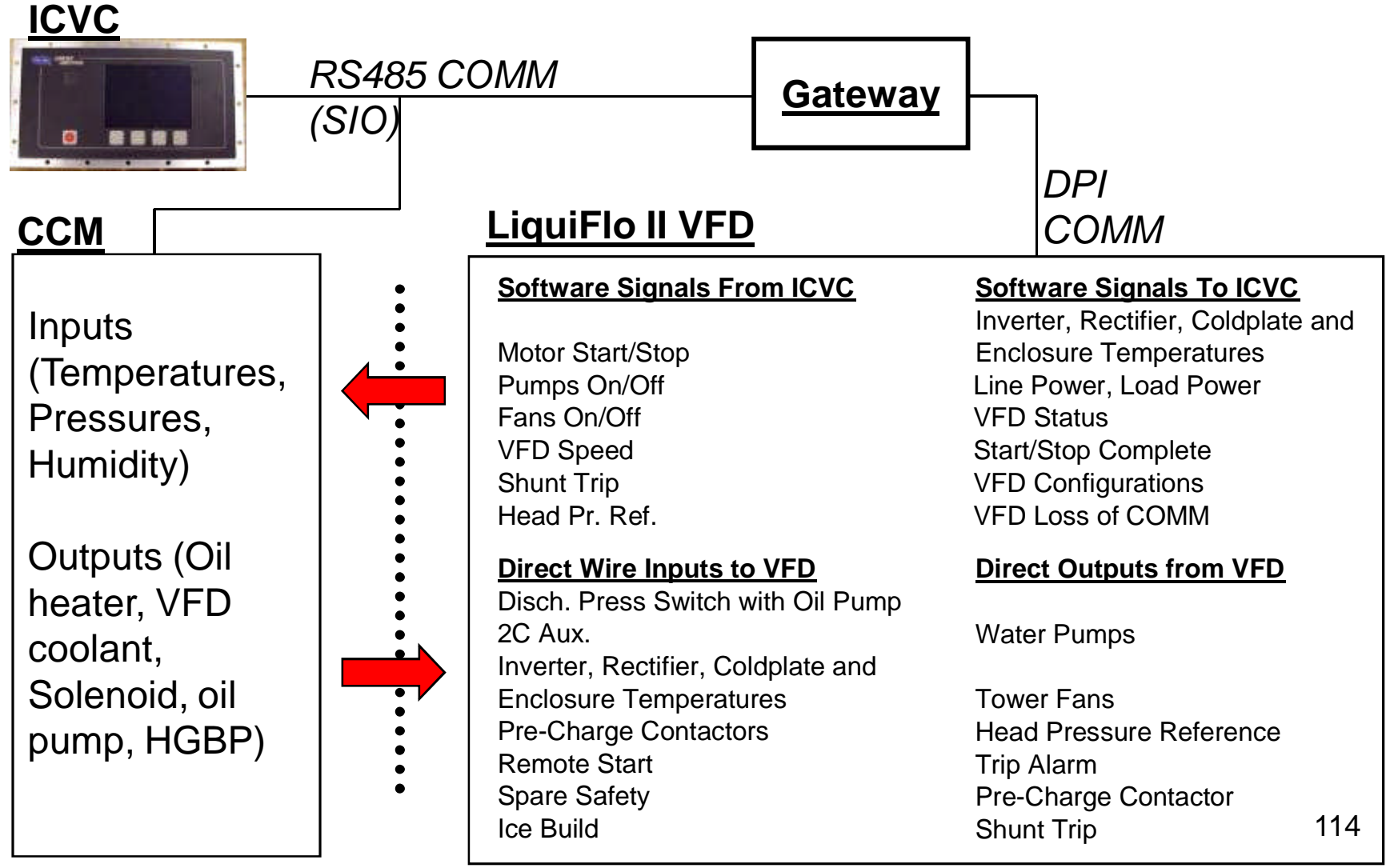
Oil Pump Contactor (Power Panel term. #50 & #51) is wired directly to VFD Standard I/O Board (Discrete N.O. Output, term. #15 & #16).

Output term. #5 on CCM Board is utilized to energize VFD Coolant Solenoid which replaces the VFD Coolant TXV.

Relative Humidity Sensor is located in ICVC Panel and wired to CCM (J3, term. #7 & #9 and J5, term. #6).

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LiquiFlo II – Controls Setup



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LiquiFlo II – Controls Setup



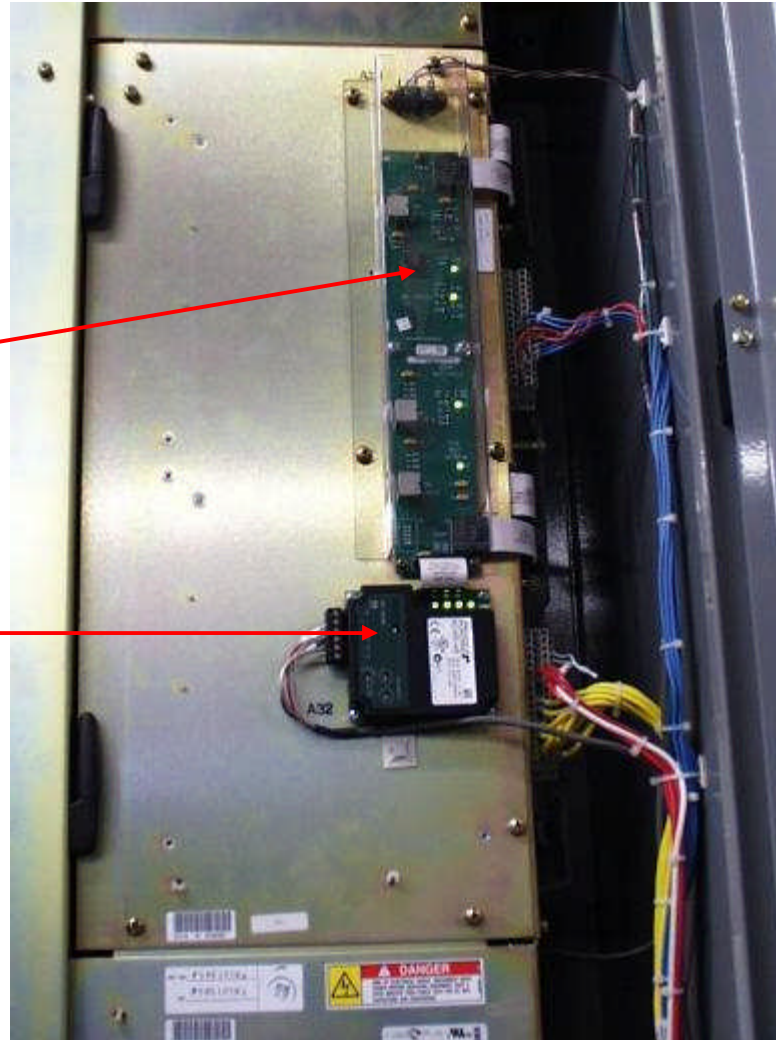
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DPI Board

Provide communication between Liquiflo II and other devices

Gateway

Translates protocols between ICVC, CCM & VFD

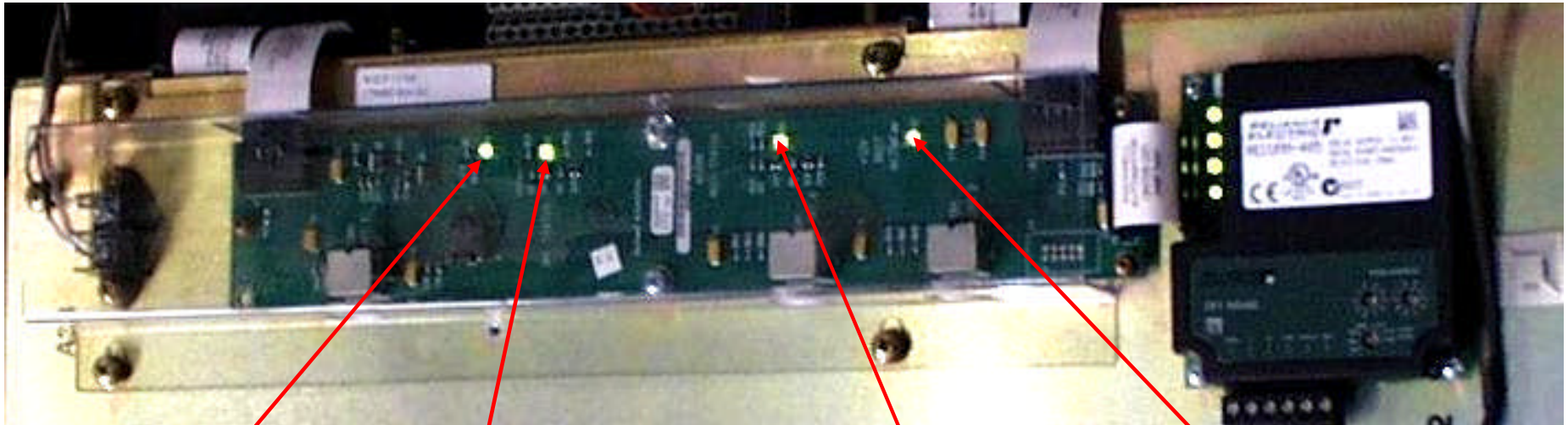


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LiquiFlo II – DPI Board



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Inverter +12V

Off = Green
Pre-lube/ Post-lube = Green
Operational = Green

Inverter Status

Off = Yellow
Flashing
Pre-lube/Post-lube = Yellow
Flashing
Operational = Green

Rectifier Status

Off = Yellow
Flashing
Pre-lube/Post-lube = Yellow
Flashing
Operational = Green

Rectifier +12V

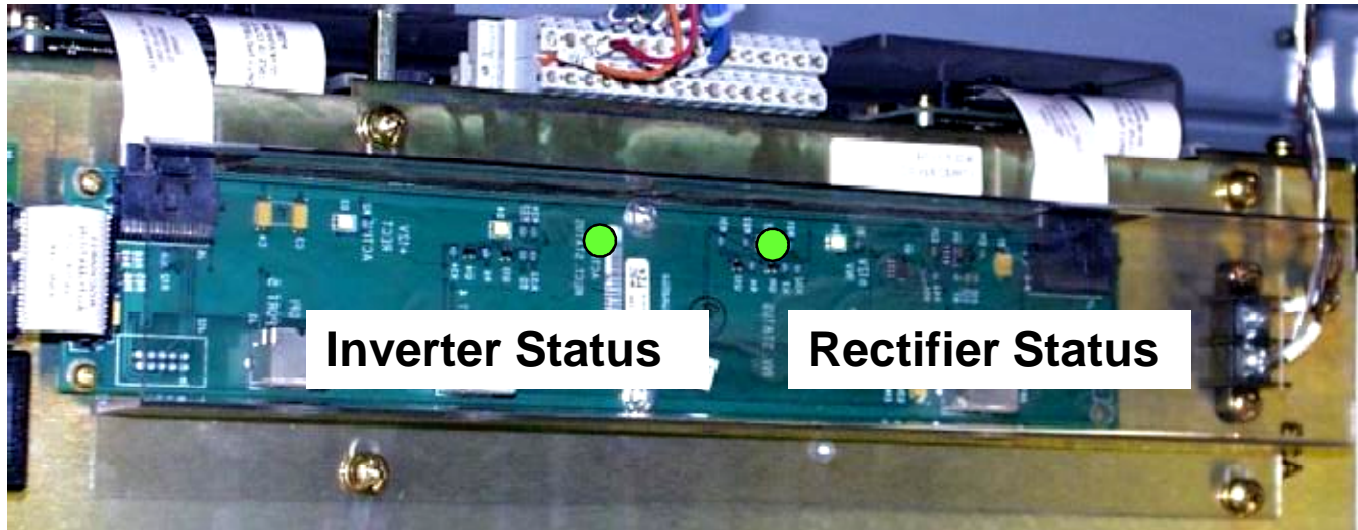
Off = Green
Pre-lube/Post-lube = Green
Operational = Green

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LiquiFlo II – DPI Board



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Green

Flashing - Drive ready, but not running, no faults and not communicating to processor

Steady - Drive running, no faults

Yellow

Flashing - Drive is not ready, check parameter 214 (start inhibits).

Steady - An alarm condition exists. Check parameter 211 (drive alarm 1) and 212 (drive alarm 2).

Red

Flashing - a fault has occurred.

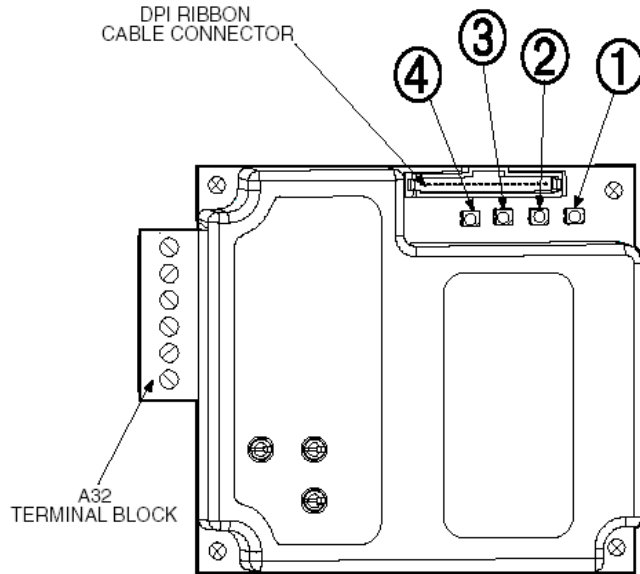
Steady - a non-reset-able fault has occurred.

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LiquiFlo II – Gateway



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NUMBER	STATUS INDICATOR	DESCRIPTION
1	DRIVE	DPI Connection Status
2	MS	Module Status
3	NET A	Serial Communication Status
4	NET B	Serial Communication Traffic Status

NOTE: If all status indicators are off, the Gateway is not receiving power.

Gateway Status LEDs — The RS485 VFD Gateway provides a communication link between the CCM and ICVC SIO bus to the VFD Drive Peripheral Interface (DPI) board. The SIO bus communicates with the Gateway through VFD connector A32. See Fig. 47.

The Gateway has four status indicators on the top side of the module.

DRIVE STATUS INDICATOR — The DRIVE status indicator is on the right side of the Gateway. See Table 19.

Fig. 47 — Gateway Status LEDs

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LiquiFlo II – VFD Cooling Control



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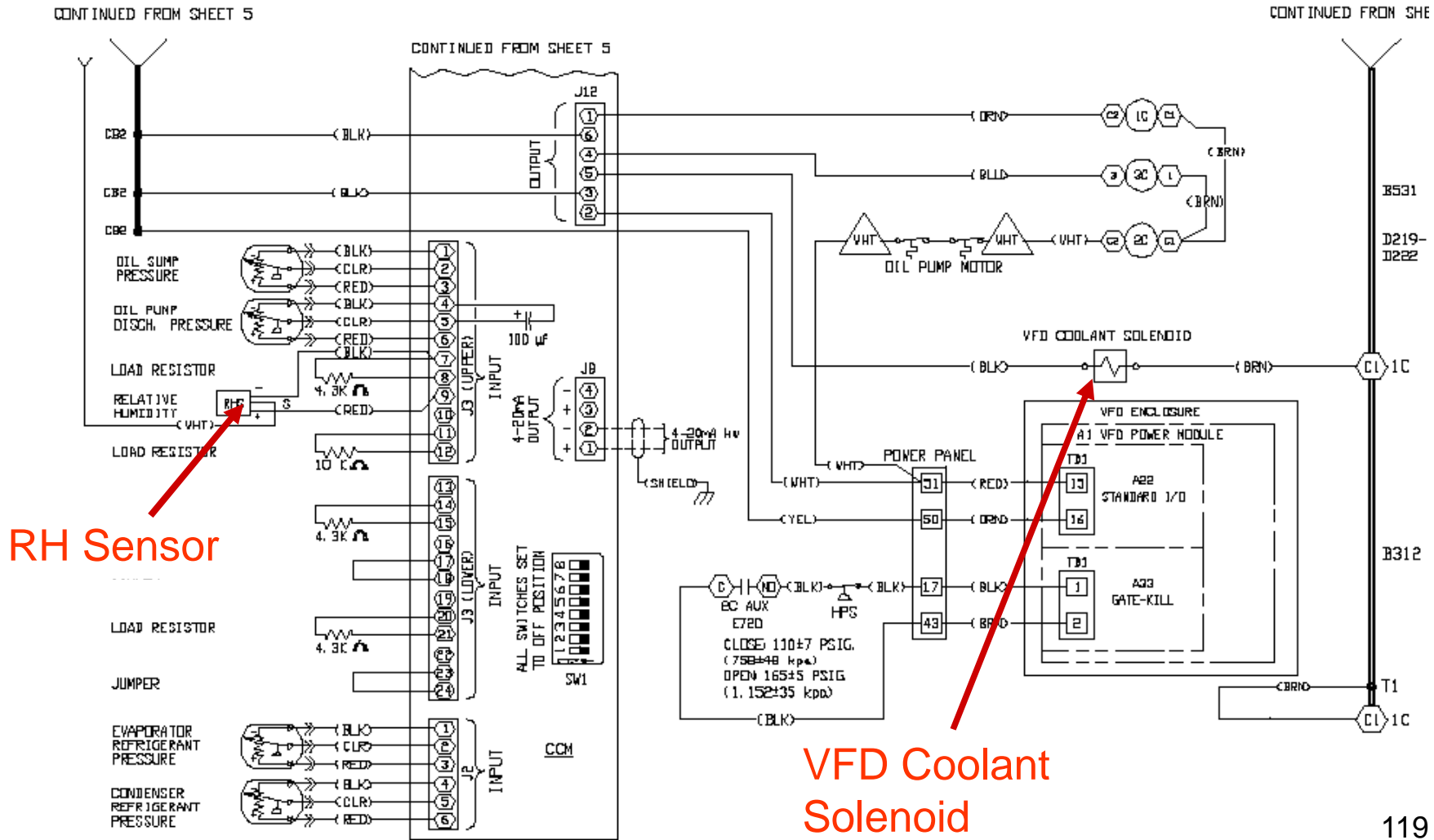


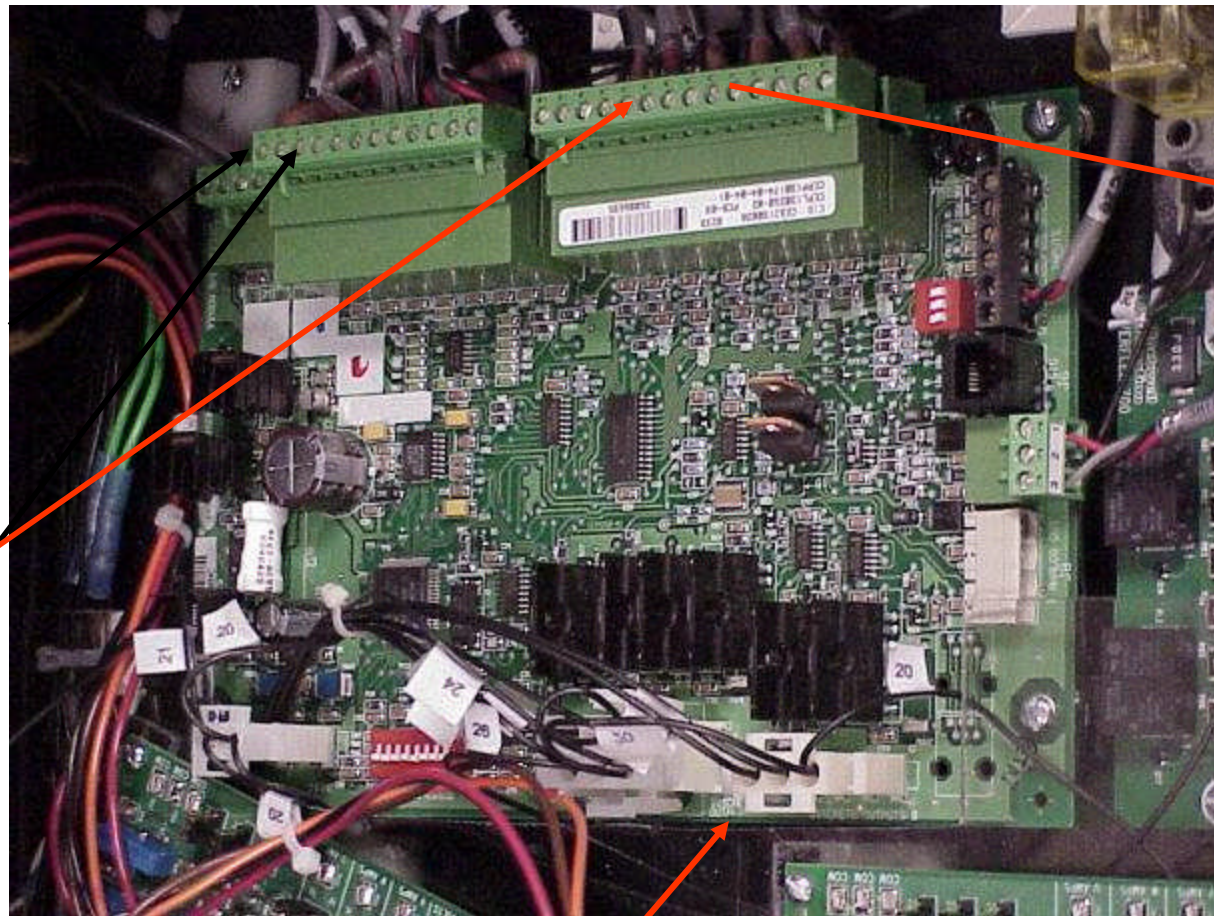
Fig. 51 — 19XRV Chiller Control Schematic (cont)

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LiquiFlo II – VFD Cooling Control



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Humidity
Sensor
Inputs

Evap
Sat'n
Temp

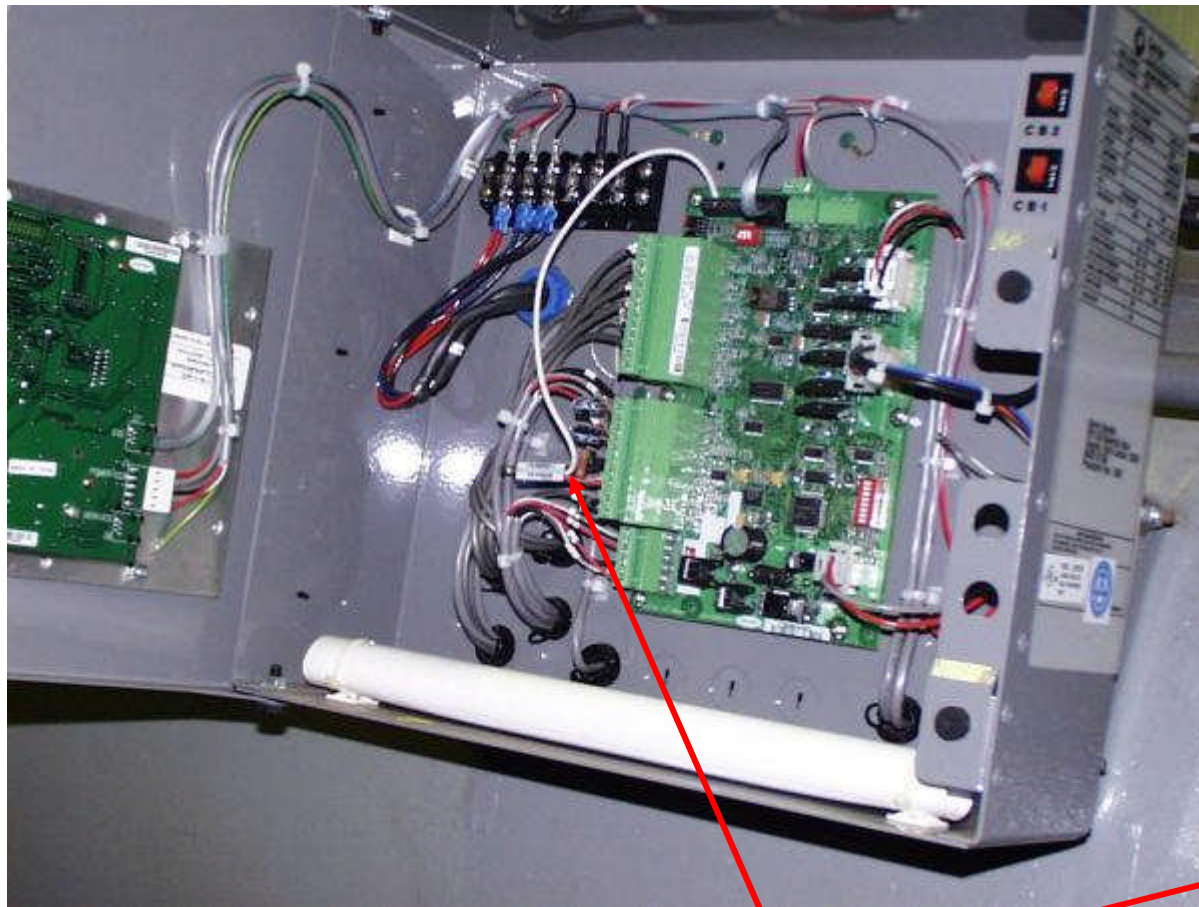
VFD Cooling Valve
Output)

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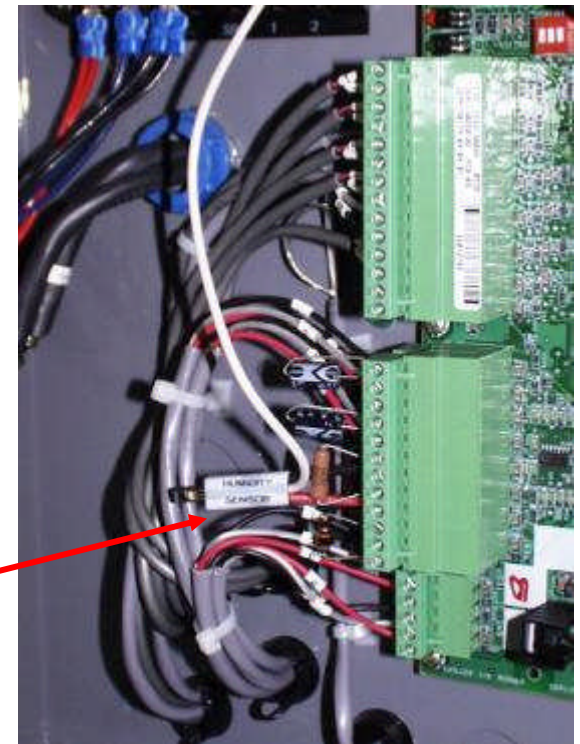
LiquiFlo II – VFD Cooling Control



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RH Sensor



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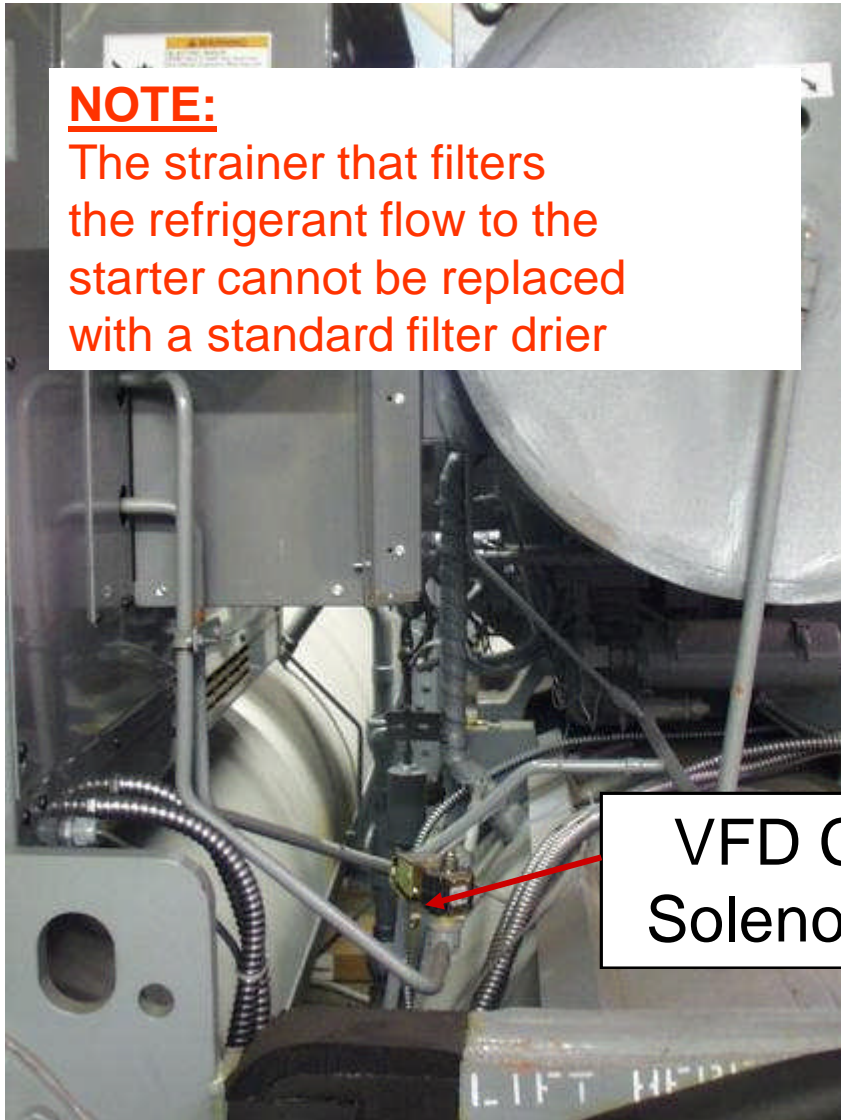


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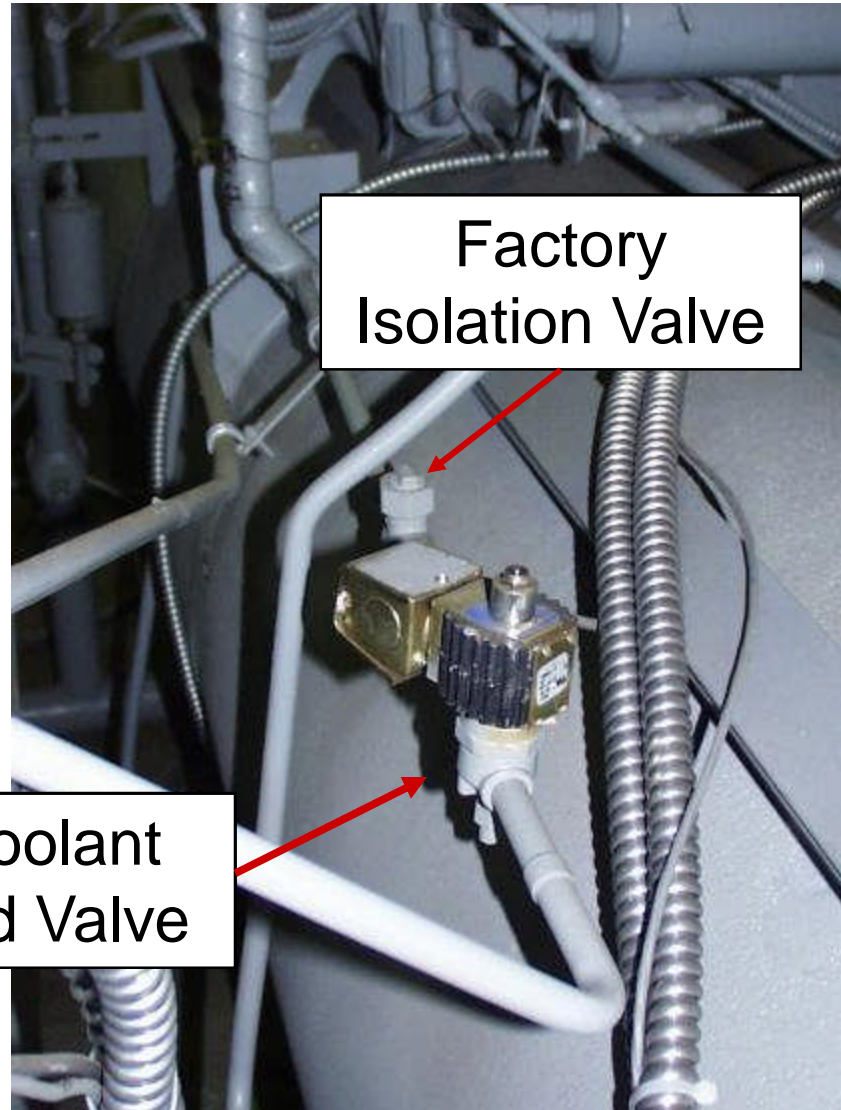
LiquiFlo II – VFD Cooling Control

NOTE:

The strainer that filters the refrigerant flow to the starter cannot be replaced with a standard filter drier



VFD Coolant Solenoid Valve



Factory Isolation Valve

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LiquiFlo II – Dew Point Prevention Alarm

VFD Dew Prevention (VFD Cooling) Control

Purpose

Maintain Coldplate temp above Dewpoint temp by de-energizing VFD solenoid 0 – 100% every 5 sec based on the greater % calculated for 1 or 2 below:

- 1) Cond ref temp is 1.5~3.5°F above Coldplate temp.
- 2) VFD Coldplate temp is 1~5°F above Dewpoint temp.

Output = 100% if:

Coldplate temp > 100°F or > Dewpoint + 5°F, or:

Condenser refrigerant temp > 100°F or > Dewpoint + 3.5°F

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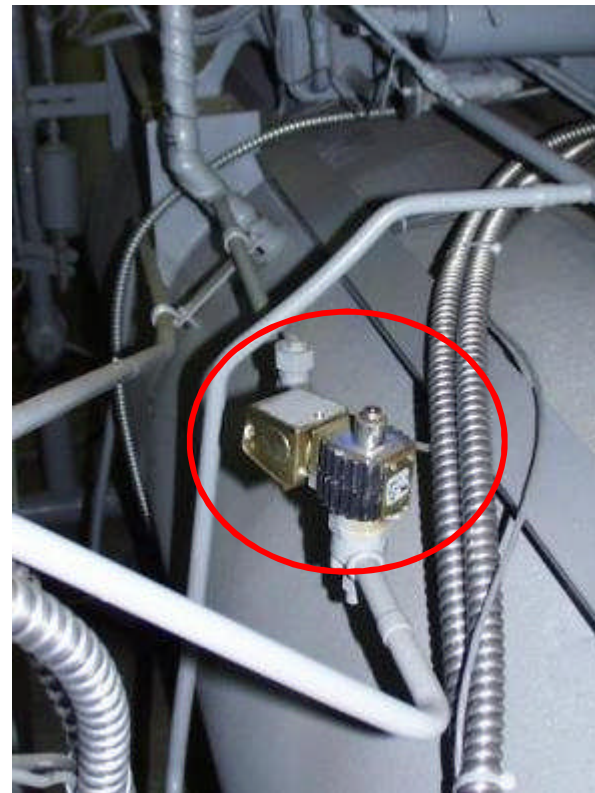
Features -- Configuration Changes

Newer LF2 drives will come with Orifice or Solenoid valve on cooling line, but not both

If solenoid valve is installed but not wired, perform wiring in the field to CCM as previously discussed



OR



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VFD Config Screen


DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Motor Nameplate Voltage	346-480	VOLTS	motor_nv	460
Compressor 100% Speed	45.0-62.0	Hz	comp_100	60.0
Line Freq=60 Hz? (No=50)	0/1	NO/YES	line_frq	YES
* Rated Line Voltage	346-480	VOLTS	vfd_volt	460
* Rated Line Amps	10-1500	AMPS	vfd_amps	200
* Rated Line Kilowatts	0-7200	kW	vfd_rlkw	100
* Motor Rated Load KW	0-7200	kW	mot_rlkw	100
* Motor Rated Load Amps	10-1500	AMPS	mot_rla	200
Motor Nameplate Amps	10-1500	AMPS	motorni	100
Motor Nameplate RPM	1500-3600		motorpm	3456
Motor Nameplate KW	0-5600	kW	motorkw	100
Inverter PWM Frequency (0=4 k Hz, 1=2 k Hz)	0/1		pwm_freq	0
Skip Frequency 1	0.0-102.0	Hz	skipfrq1	102.0
Skip Frequency 2	0.0-102.0	Hz	skipfrq2	102.0
Skip Frequency 3	0.0-102.0	Hz	skipfrq3	102.0
Skip Frequency Band	0.0-102.0	Hz	skipband	0.0
Line Voltage % Imbalance	1-10	%	v_unbal	10
Line Volt Imbalance Time	1-10	SEC	v_time	10
Line Current % Imbalance	5-40	%	lineim_i	40
Line Current Imbal Time	1-10	SEC	lineim_t	10
Motor Current % Imbalance	5-40	%	motim_i	40
Motor Current Imbal Time	1-10	SEC	motim_t	10
Increase Ramp Time	5-60	SEC	ramp_inc	30
Decrease Ramp Time	5-60	SEC	ramp_dec	30
Single Cycle Dropout	0/1	DSABLE/ENABLE	cydrop	DSABLE

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VFD Config Information

 Carrier <small>A United Technologies Company</small>	
MODEL NUMBER	
SERIAL NUMBER	
MACHINE NAMEPLATE SUPPLY DATA	
VOLTS/PHASE/HERTZ	
LOCKED ROTOR AMPS	
OVERLOAD TRIP AMPS	
MAX FUSE/CIRCUIT BREAKER SIZE	
MIN SUPPLY CIRCUIT CAPACITY	
MACHINE ELECTRICAL DATA	
MOTOR NAMEPLATE VOLTAGE	
COMPRESSOR 100% SPEED	
RATED LINE VOLTAGE	
RATED LINE AMPS	
RATED LINE KILOWATTS	
MOTOR RATED LOAD KW	
MOTOR RATED LOAD AMPS	
MOTOR NAMEPLATE AMPS	
MOTOR NAMEPLATE RPM	
MOTOR NAMEPLATE KW	
INVERTER PWM FREQUENCY	

Confirm that the following parameters in the VFD_CONF screen match the values on the Internal Machine Electrical Data Nameplate:

- Compressor 100% Speed — Compressor speed required to run at chiller design point.
- Rated Line Voltage — Nominal line voltage selected for the job site.
- Rated Line Amps — Line current required for the chiller to run at the design point.
- Rated Line Kilowatts — Line power required for the chiller to run at the design point.
- Motor Rated Load kW — Power consumed by the motor when running at the chiller design point.
- Motor Rated Load Amps — Motor current required for the chiller to run at the design point.
- Motor Nameplate Amps — Motor nameplate full load amps.
- Motor Nameplate RPM — Rated speed of the motor when running at motor nameplate rated frequency, rated current, and rated voltage.
- Motor Nameplate kW — Motor nameplate rated power.
- Inverter PWM Frequency — Sets the carrier frequency for the pulse width modulation output.

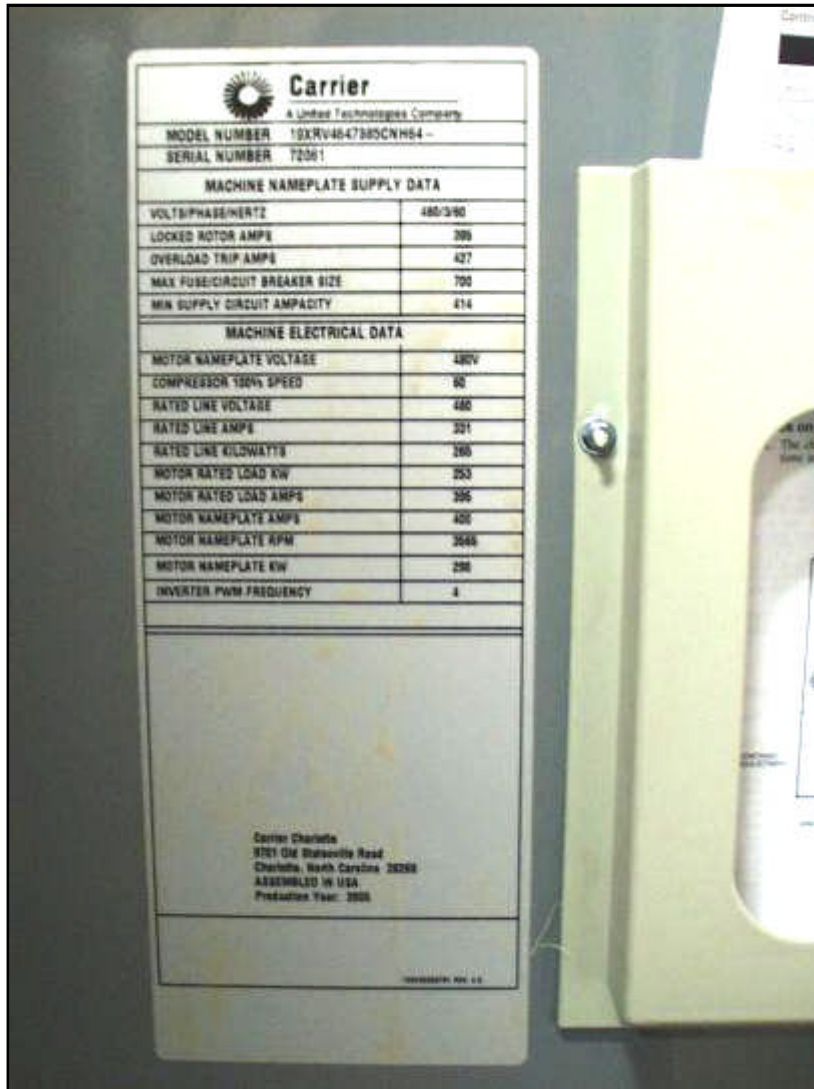
Note: Inverter PWM Frequency is 4 kHz, therefore parameter should equal "0".

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VFD Config Information



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Electrical data for CONFIG
Screen parameter

Nameplate on VFD Panel or
side of ICVC panel

Part # 19XV05008701

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Programming VFD config PIC III



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```

19XRV_II  VFD_CONF  VFD CONFIG
Motor Nameplate Voltage 480 V
Compressor 100% Speed 60.0 H
Line Freq=60 Hz? (No=50) Yes
Rated Line Voltage 480 V
Rated Line Amps 331 A
Rated Line Kilowatts 265 kW
Motor Rated Load kW 253 kW
Motor Rated Load Amps 395 A
Motor Nameplate Amps 400 A
Motor Nameplate RPM 3565
NEXT PREVIOUS SELECT
    
```

```

Chiller
Chiller Model ..... 19XRV4547374KFH64
Starter / VFD ..... VFD - Unit Mounted (Active Rectifier)
Refrigerant Type ..... R-134a
Cooler
Size ..... 45
Waterbox Type ..... Nozzle-in-Head, 150 psi
Passes ..... 2
Nozzle Arrangement ..... D
Tubing ..... Super E3 (SUPE3), .028 in, Copper
Fluid Type ..... Fresh Water
Fouling Factor (hr-ft2-°F)/BTU ..... 0.00010
Compressor
Size ..... 374
Flow Controls
Float Valve Size ..... 5
Flasc Orifice ..... 26
    
```

Output Type	Full Load	Part Load	Par
Percent Load	100.00	90.00	80.0
Chiller Capacity	490.0 Tons	441.0 Tons	392
Chiller Input kW	299.7 kW	260.4 kW	244
Chiller Input Power	0.6115 kW/Ton	0.5905 kW/Ton	0.62
Chiller COP	5.8	6.0	5.6
Isolation Valve	Installed	Installed	Inst
Cooler			
Entering Temp.	51.76 °F	50.79 °F	49.6
Leaving Temp.	42.00 °F	42.00 °F	42.0
Flow Rate	1200.0 gpm	1200.0 gpm	120
Pressure Drop	32.2 ft wg	32.3 ft wg	32.4

ROCKWELL LF1 & LF2

Programming VFD config PIC III



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```

19XRV_II  VFD_CONF  VFD CONFIG SELECT
Motor Nameplate Voltage 480 Volts
Compressor 100% Speed 60.0 Hz
Line Freq=60 Hz? (No=50) Yes
Rated Line Voltage 480 Volts
Rated Line Amps 331 AMPS
Rated Line Kilowatts 265 kW
Motor Rated Load KW 253 kW
Motor Rated Load Amps 395 AMPS
Motor Nameplate Amps 400 AMPS
Motor Nameplate RPM 3565
NEXT PREVIOUS SELECT EXIT
    
```

Motor		
Motor Nameplate KW	318.1	31
Motor Input Power	289.5 kW	24
Motor Input Voltage	475.74	46
Motor Nameplate Amps	440.7	44
Motor Rated Load Amps	429.5	38
Motor OLTA	464	
Motor LRDA	3200	
Motor Power Factor	0.8180	0.8
Motor Speed Ratio	0.99112	0.9
Motor Nameplate RPM	3563	35
Motor RPM	3531	34
Motor Efficiency	0.9613	0.9
VFD Loss	8.71 kW	9.6
VFD Efficiency	0.9716	0.9
VFD Power Factor	0.990	0.9
Chiller Rated Line Amps	375.0	32
Chiller Inrush Amps	375	
Max Fuse/CB Amps	800	
Min Circuit Ampacity	469	

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Programming VFD config PIC III



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```

19XR PIC3 VFD_CONF VFD CONFIG SELECT
Motor Nameplate KW 387 kW
Inverter PWM Frequency 0
(0=4 kHz, 1=2 kHz)
Skip Frequency 1 102.0 Hz
Skip Frequency 2 102.0 Hz
Skip Frequency 3 102.0 Hz
Skip Frequency Band 0.0 Hz
Line Voltage % Imbalance 10 %
Line Volt Imbalance Time 10 sec
Line Current % Imbalance 40 %
NEXT PREVIOUS SELECT EXIT
    
```

Motor		
Motor Nameplate KW	318.1	31
Motor Input Power	289.5 kW	24
Motor Input Voltage	475.74	46
Motor Nameplate Amps	440.7	44
Motor Rated Load Amps	429.5	38
Motor OLTA	464	
Motor LRDA	3200	
Motor Power Factor	0.8180	0.8
Motor Speed Ratio	0.99112	0.9
Motor Nameplate RPM	3563	35
Motor RPM	3531	34
Motor Efficiency	0.9613	0.9
VFD Loss	8.71 kW	9.6
VFD Efficiency	0.9716	0.9
VFD Power Factor	0.990	0.9
Chiller Rated Line Amps	375.0	32
Chiller Inrush Amps	375	
Max Fuse/CB Amps	800	
Min Circuit Ampacity	469	

Note: For LFII, Inverter PWM Frequency is 4 kHz, therefore parameter should equal "0".

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Programming VFD config PIC III



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```

19XRV_II  VFD_CONF  VFD CONFIG SELECT
Motor Nameplate Voltage      480 Volts
Compressor 100% Speed        60.0 Hz
Line Freq=60 Hz? (No=50)    Yes
Rated Line Voltage           480 Volts
Rated Line Amps               331 AMPS
Rated Line Kilowatts          265 kW
Motor Rated Load KW           253 kW
Motor Rated Load Amps        395 AMPS
Motor Nameplate Amps          400 AMPS
Motor Nameplate RPM           3565
NEXT      PREVIOUS  SELECT  EXIT
    
```

Motor		
Motor Nameplate KW	318.1	31
Motor Input Power	289.5 kW	24
Motor Input Voltage	475.74	46
Motor Nameplate Amps	440.7	44
Motor Rated Load Amps	429.5	38
Motor OLTA	464	
Motor LRDA	3200	
Motor Power Factor	0.8180	0.8
Motor Speed Ratio	0.99112	0.9
Motor Nameplate RPM	3563	35
Motor RPM	3531	34
Motor Efficiency	0.9613	0.9
VFD Loss	8.71 kW	9.6
VFD Efficiency	0.9716	0.9
VFD Power Factor	0.990	0.9
Chiller Rated Line Amps	375.0	32
Chiller Inrush Amps	375	
Max Fuse/CB Amps	800	
Min Circuit Ampacity	469	

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Other new features

Shunt Trip Breaker

No shunt trip on low evaporator pressure because liquiflo II would not have ability to energize the pumps for freeze protection.

ICVC -- Shunt Trip only if motor amps is sensed STOP MODE

VFD -- Shunt Trip only if ground fault is detected

ICVC Communication Loss between ICVC and VFD

Motor shuts down

Condenser and chilled water pump keeps running

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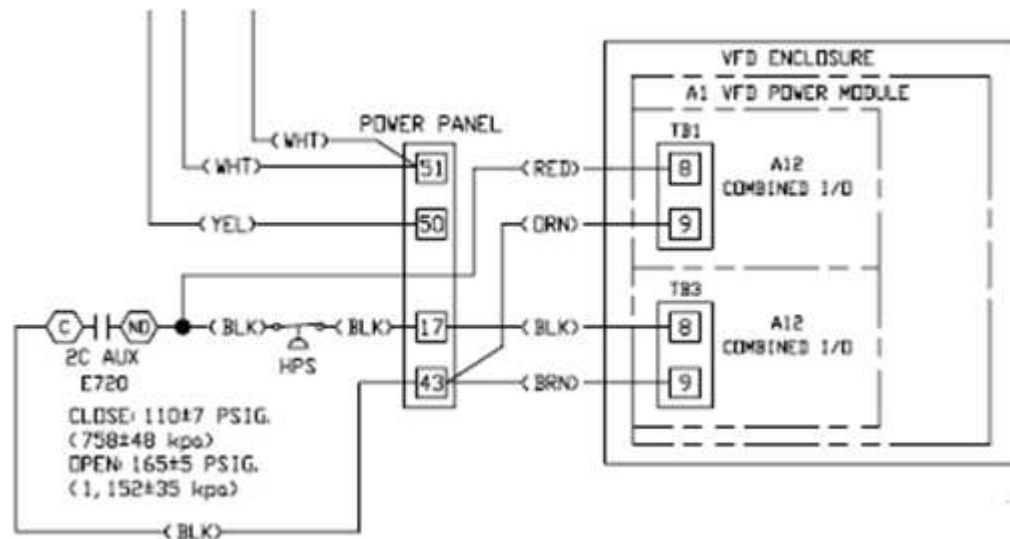
Liquiflo II START Sequence

Wiring change gate kill circuit maintains a closed circuit when the oil pump is off

The Gate Kill is monitored 24/7, so when the oil pump is off, and 2C aux is open, the VFD is in alarm. After oil pump starts, ICVC sends a VFD RESET signal to the VFD to clear the gate kill alarm. If the gate kill is OK, it then allows the pre-charge contactors to pull in.

If we don't get a pre-charge contactor to pull in after oil pump is pulled in, we can assume that the gate kill is still open.

The VFD checks the GATE KILL circuit again TB1 on A-33 Card (tied into the Power Panel terminals 43 and 17). Oil pump 2C aux contact and the Hi Pressure switch are wired in series.



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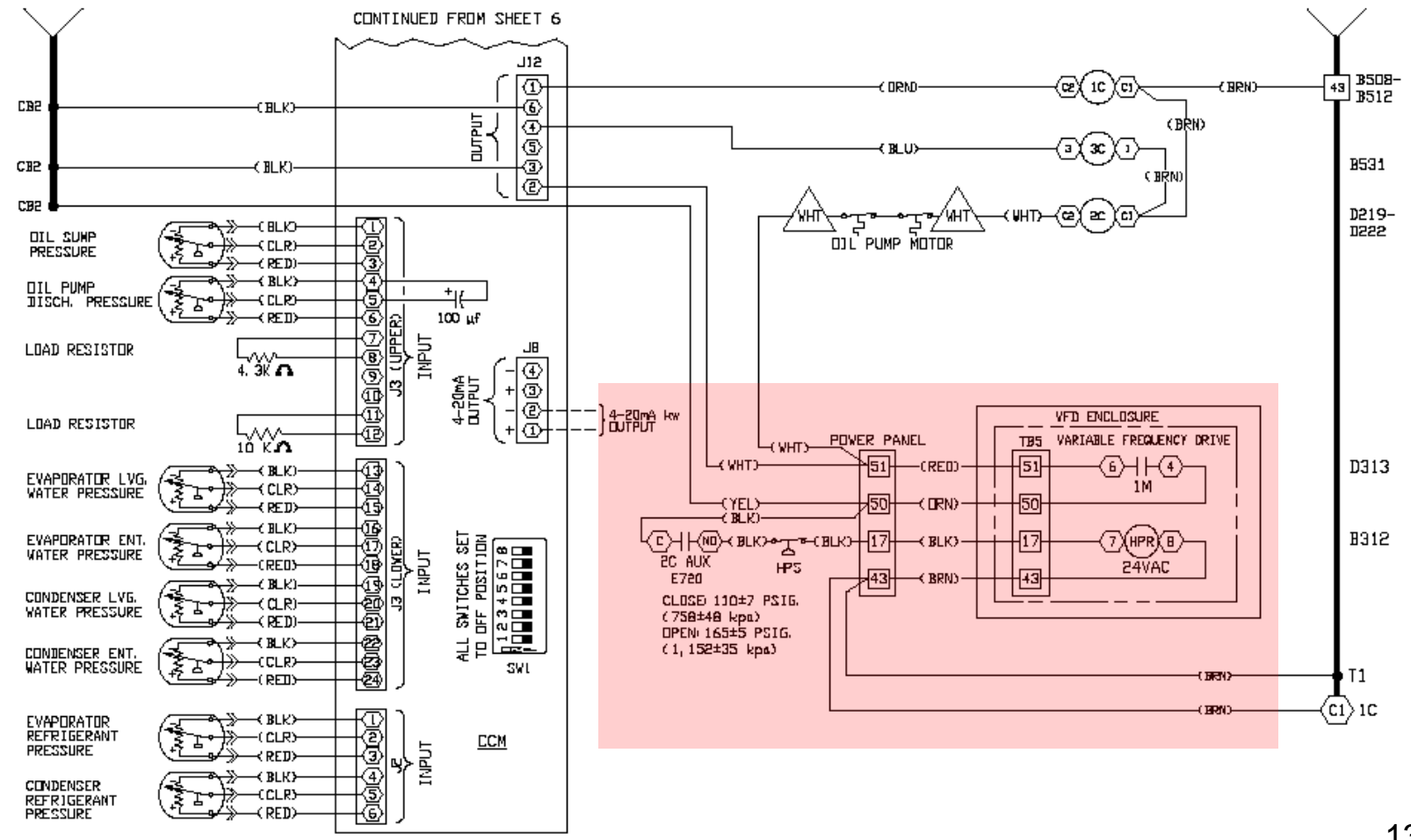
LiquiFlo II – PIC II with HPR safety circuit



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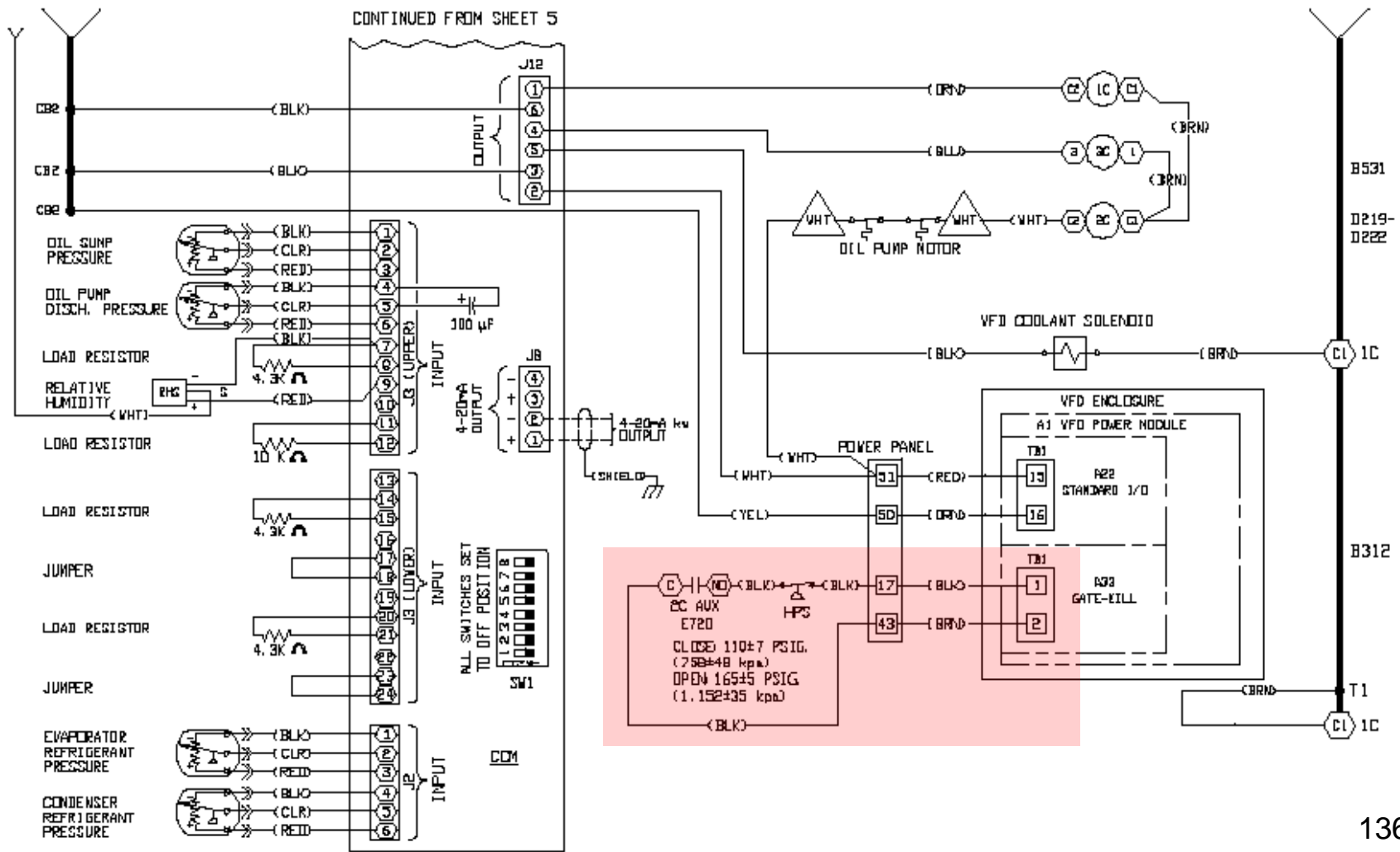
LiquiFlo II – PIC III with Gatekill



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CONTINUED FROM SHEET 5

CONTINUED FROM SHEET 5



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Liquiflo II START Sequence

A START command initiated by the Operator, time schedule or remote contacts at the ICVC

Via the SIO BUS, the ICVC checks the VFD for any faults, if there are none, a normal startup proceeds

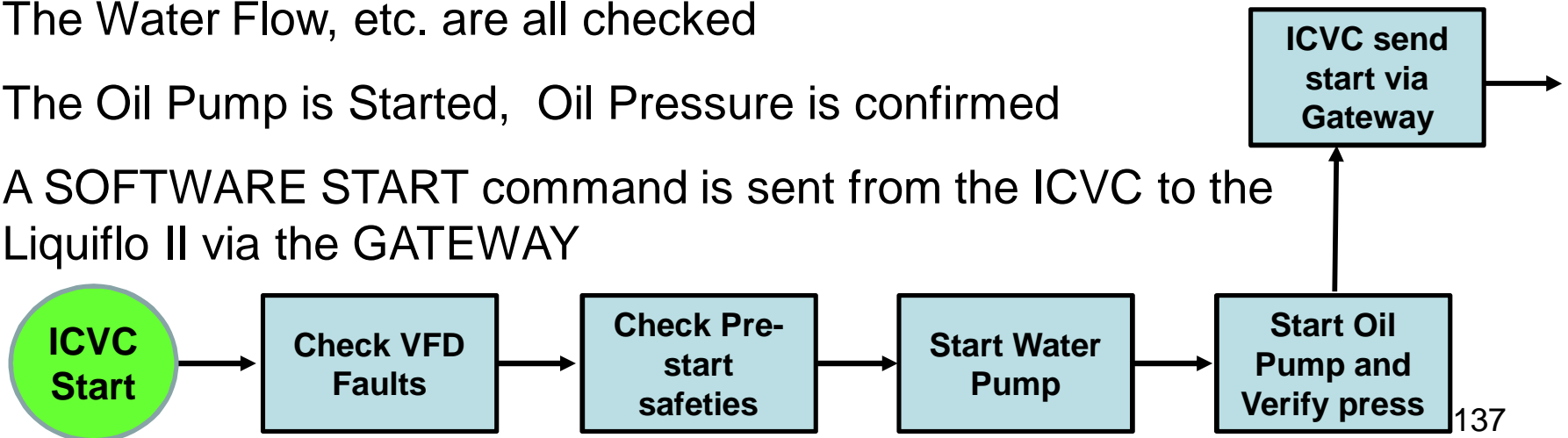
The Starts Counter, Pre-start Alerts , etc. are all checked

The LFII will start the Water Pumps as per our standard startup sequence

The Water Flow, etc. are all checked

The Oil Pump is Started, Oil Pressure is confirmed

A SOFTWARE START command is sent from the ICVC to the Liquiflo II via the GATEWAY



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Liquiflo II START Sequence

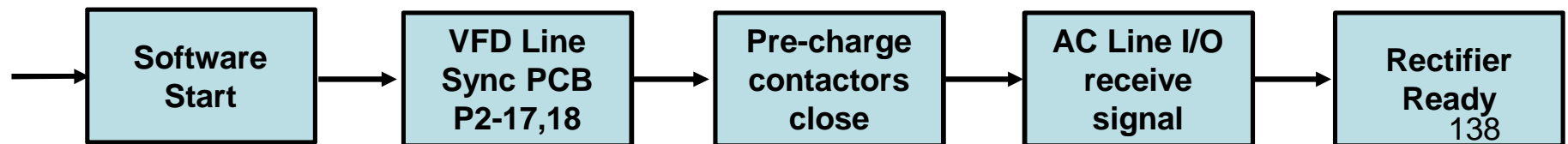
The VFD then closes a 24Volt Pilot Relay via Terminals 13 and 14 on plug P1 on the Power Module.

The Pilot Relay NO contacts then send 115VAC via wire 227B to TB3 inside the enclosure to CLOSE the three Pre-Charge Contactors, and at the same time to TB4 inside the enclosure to start the three VFD fans.

The VFD looks for confirmation that the pre-charge contactors have closed via the Logic In1 terminal 23 on TB1 of the A12 AC Line I/O card. This is fed 115 VAC from wire 227A, then through 3 sets of NO contacts that are in series .

The Rectifier section is then ready.

The Inverter is then turned on and applies power to the motor.



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Liquiflo II START Sequence

The VFD sends a signal back to the ICVC via the Gateway that the start has been successful. It also closes a run contact to ensure the oil pump contactor is energized.

The LFII also receives a software signal as to the Target Speed Command.

The following signals are transmitted between the ICVC and VFD

- Target and Actual speed

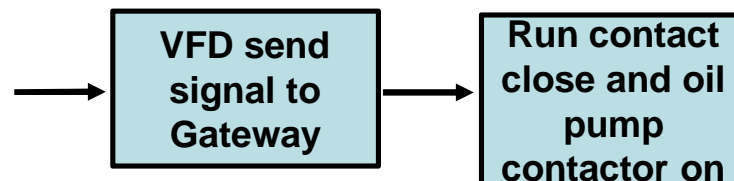
- Line Volts and Amps

- Load Volts and Amps

- Frequency

There is no need to calibrate speed or amp signals.

The VFD and the ICVC continue to communicate via the Gateway



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Liquiflo II STOP Sequence

VFD gets a Signal from the ICVC to Stop the machine via the Gateway.

VFD stops sending power to the motor.

When the VFD senses no amps, it de-energizes the Pilot Relay

Pilot Relay causes

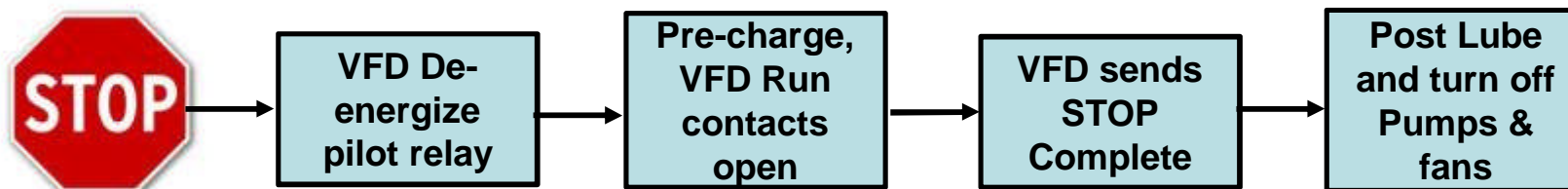
Pre-charge contactors to open

VFD Run contacts to open

The LFII sends a STOP COMPLETE software signal to the ICVC

The ICVC then initiates the POST-LUBE cycle.

After the POST LUBE cycle, the ICVC sends a command to the LFII to shut down the Water Pumps and Tower Fans.



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Manual



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19XRV
Hermetic Centrifugal Liquid Chillers
with PIC III Controls
50/60 Hz
HFC-134a

Start-Up, Operation, and Maintenance Instructions

SAFETY CONSIDERATIONS

Centrifugal liquid chillers are designed to provide safe and reliable service when operated within design specifications. When operating this equipment, use good judgment and safety precautions to avoid damage to equipment and property or injury to personnel.

Be sure you understand and follow the procedures and safety precautions contained in the chiller instructions as well as those listed in this guide.

⚠ DANGER

DO NOT VENT refrigerant relief valves within a building. Outlet from rupture disc or relief valve must be vented outdoors in accordance with the latest edition of ANSI/ASHRAE 15 (American National Standards Institute/American Society of Heating, Refrigeration, and Air Conditioning Engineers). The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation.

PROVIDE adequate ventilation in accordance with ANSI/ASHRAE 15, especially for enclosed and low overhead spaces. Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Misuse can be fatal. Vapor is heavier than air and reduces the amount of oxygen available for breathing. Product causes eye and skin irritation. Decomposition products are hazardous.

DO NOT USE OXYGEN to purge lines or to pressurize a chiller for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.

NEVER EXCEED specified test pressures. VERIFY the allowable test pressure by checking the instruction literature and the design pressures on the equipment nameplate.

DO NOT USE air for leak testing. Use only refrigerant or dry nitrogen.

DO NOT VALVE OFF any safety device.

BE SURE that all pressure relief devices are properly installed and functioning before operating any chiller.

THERE IS A RISK OF INJURY OR DEATH by electrocution. High voltage may be present on the motor leads even though the motor is not running. Open the power supply disconnect before touching motor leads or terminals.

⚠ WARNING

DO NOT WELD OR FLAMM CUT any refrigerant line or vessel until all refrigerant (liquid and vapor) has been removed from chiller. Traces of vapor should be displaced with dry air or nitrogen and the work area should be well ventilated. Refrigerant in contact with an open flame produces toxic gases.

DO NOT USE eyebolts or eyebolt holes to rig chiller sections or the entire assembly.

DO NOT work on high-voltage equipment unless you are a qualified electrician.

DO NOT WORK ON electrical components, including control panels, switches, starters, or oil heater until you are sure ALL POWER IS OFF and no residual voltage can leak from capacitors or solid-state components.

LOCK OPEN AND TAG electrical circuits during servicing. IF WORK IS INTERRUPTED, confirm that all circuits are deenergized before resuming work.

AVOID SPILLING liquid refrigerant on skin or getting it into the eyes. USE SAFETY GOGGLES. Wash any spills from the skin with

soap and water. If liquid refrigerant enters the eyes, IMMEDIATELY FLUSH EYES with water and consult a physician.

NEVER APPLY an open flame or live steam to a refrigerant cylinder. Dangerous over pressure can result. When it is necessary to heat refrigerant, use only warm (110 F [43 C]) water.

DO NOT REUSE disposable (nonreturnable) cylinders or attempt to refill them. It is DANGEROUS AND ILLEGAL. When cylinder is emptied, evacuate remaining gas pressure, loosen the collar and unscrew and discard the valve stem. DO NOT INCINERATE.

CHECK THE REFRIGERANT TYPE before adding refrigerant to the chiller. The introduction of the wrong refrigerant can cause damage or malfunction to this chiller.

Operation of this equipment with refrigerants other than those cited herein should comply with ANSI/ASHRAE 15 (latest edition). Contact Carrier for further information on use of this chiller with other refrigerants.

DO NOT ATTEMPT TO REMOVE fittings, covers, etc., while chiller is under pressure or while chiller is running. Be sure pressure is at 0 psig (0 kPa) before breaking any refrigerant connection.

CAREFULLY INSPECT all relief devices, rupture discs, and other relief devices AT LEAST ONCE A YEAR. If chiller operates in a corrosive atmosphere, inspect the devices at more frequent intervals. DO NOT ATTEMPT TO REPAIR OR RECONDITION any relief device when corrosion or build-up of foreign material (rust, dirt, scale, etc.) is found within the valve body or mechanism. Replace the device.

DO NOT install relief devices in series or backward.

USE CARE when working near or in line with a compressed spring. Sudden release of the spring can cause it and objects in its path to act as projectiles.

⚠ CAUTION

DO NOT STEP on refrigerant lines. Broken lines can whip about and release refrigerant, causing personal injury.

DO NOT climb over a chiller. Use platform, catwalk, or staging. Follow safe practices when using ladders.

USE MECHANICAL EQUIPMENT (crane, hoist, etc.) to lift or move inspection covers or other heavy components. Even if components are light, use mechanical equipment when there is a risk of slipping or losing your balance.

BE AWARE that certain automatic start arrangements CAN ENGAGE THE STARTER, TOWER FAN, OR PUMPS. Open the disconnect ahead of the starter, tower fans, or pumps.

USE only repair or replacement parts that meet the code requirements of the original equipment.

DO NOT VENT OR DRAIN waterboxes containing industrial brines, liquid, gases, or semisolids without the permission of your process control group.

DO NOT LOOSEN waterbox cover bolts until the waterbox has been completely drained.

DO NOT LOOSEN a packing gland nut before checking that the nut has a positive thread engagement.

PERIODICALLY INSPECT all valves, fittings, and piping for corrosion, rust, leaks, or damage.

PROVIDE A DRAIN connection in the vent line near each pressure relief device to prevent a build-up of condensate or rain water.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

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Tab 5a

Manual # 19XRV-5SS

ROCKWELL LF1 & LF2

Alarms/Alerts

19XRV-5SS

Includes related Alarm/Alert Codes (pgs. 91~100)



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Table 16 — Alarm and Alert Messages (cont)

I. CHILLER PROTECTIVE LIMIT FAULTS (cont)

ICVC FAULT STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
209	PROTECTIVE LIMIT	COOL OVERRIDE STOP	209—COOL Emergency/Override Stop.	COOL has signaled the chiller to stop. This fault must be manually reset from the default screen of the ICVC.
202	PROTECTIVE LIMIT	INVALID VFD CONFIG	202—Line Frequency (VALUE) Exceeded Configuration Range.	LINE FREQUENCY is (POWER) Upper, must be maintained between 45-62 Hz. LINE FREQ (LOWER) is set to NO (50 Hz). LINE FREQUENCY must be maintained between 45-62 Hz. LINE FREQ (LOWER) is set to YES (60 Hz). Check JC ALMHPR Gate Kill circuit.
203	PROTECTIVE LIMIT	INVALID VFD CONFIG	203—Compressor 100% Speed Config Range: 90-112 Hz; 60 Hz/55-62.	COMPRESSOR 100% SPEED in VFD_CONF screen must be set between 45-62 Hz. LINE FREQ (LOWER) is set to NO (50 Hz). COMPRESSOR 100% SPEED must be set between 45-62 Hz. LINE FREQ (LOWER) is set to YES (60 Hz).
204	VFD GATEWAY	COMPATIBILITY CONFLICT	204—VFD Gateway Compatibility Conflict. Check VFD VFD Versions.	VFD Gateway and VFD software versions are not compatible. Call Carrier Service.
205	VFD GATEWAY	COMPATIBILITY CONFLICT	205—VFD Gateway Compatibility Conflict. Check VFD ICVC Versions.	VFD Gateway and ICVC software versions are not compatible. Call Carrier Service.
206	PROTECTIVE LIMIT	INVERTER OVERCURRENT	206—Inverter Overcurrent Fault. Check VFD Status.	Check for high entering water temperature or low condenser water flow. Check current settings in VFD_CONF screen.

TLIMIT is shown on the ICVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. (VALUE) is the actual pressure, temperature, voltage, etc., at which the control tripped.

J. CHILLER ALERTS

ICVC FAULT STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
140	SENSOR ALERT	LEAVING COND WATER TEMP	140—Sensor Fault. Check Leaving Cond Water Sensor.	Check sensor resistance or voltage drop. Check for proper wiring.
141	SENSOR ALERT	ENTERING COND WATER TEMP	141—Sensor Fault. Check Entering Cond Water Sensor.	Check sensor resistance or voltage drop. Check for proper wiring.
142	LOW OR PRESSURE ALERT	CHECK OIL FILTER	142—Low Oil Pressure Alert. Check Oil Filter.	Check for partially or closed shut-off valves. Check oil flow and power supply. Check oil level. Check for foaming oil at start-up. Check transducer wires and accuracy.
143	AUTORESTART PENDING	LINE CURRENT IMBALANCE	143—Line Current Imbalance. Check VFD Fault History for Values.	Single phase has been detected in any phase. Chiller automatically restarting.
144	AUTORESTART PENDING	LINE VOLTAGE DROP OUT	144—Single Cycle Line Voltage Dropout.	A drop in line voltage has been detected within 2 voltage cycles. Chiller automatically restarting if Auto Restart is enabled in (SETUP) screen.
145	AUTORESTART PENDING	HIGH LINE VOLTAGE	145—High In-rush Line Voltage (VALUE).	Check phase to phase and phase to ground line power.
146	AUTORESTART PENDING	LOW LINE VOLTAGE	146—Low In-rush Line Voltage (VALUE).	Check phase to phase and phase to ground line power.
147	AUTORESTART PENDING	VFD MODULE RESET	147—VFD Module Power-On Reset When Running.	VFD Module has detected a hardware fault due to electrical noise, power loss or software and has reset. Chiller automatically restarting. Check for power loss and sources of electromagnetic interference.
148	AUTORESTART PENDING	POWER LOSS	148—Control Power Loss When Running.	Check 24 vac control power supply to ICVC.
149	MACHINE ALERT	HIGH COND WATER FLOW	149—High Flow: Condenser Water Delta P (VALUE) Exceeded Limit of (LIMIT).	COND H FLOW ALARM (DP) is disabled and CONDENSER WATER DELTA P has exceeded configured limit. Check FLOW DELTA P (DISPLAY) and COND H FLOW DEL. P LIMIT in (SETUP) screen. Check optional condenser water pressure transducer wiring and accuracy. Confirm that 5 V reference signal is available between COM J3-19 and J3-21 and J3-22 and J3-24. Check for disconnected, grounded, or shorted wiring. If pressure transducers are not installed, check for presence of restrictors and jumper COM terminals J3-19 through J3-24. See Chiller Controls Schematic if flow switches are used.
150	SENSOR ALERT	HIGH BEARING TEMPERATURE	150—Comp Thrust Brg Temp (VALUE) exceeded limit of (LIMIT).	Check sensor resistance or voltage drop. Check for proper wiring. Check for partially closed service valves. Check oil cooler TXV. Check oil level and oil temperature.

TLIMIT is shown on the ICVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. (VALUE) is the actual pressure, temperature, voltage, etc., at which the control tripped.

Table 16 — Alarm and Alert Messages (cont)

J. CHILLER ALERTS (cont)

ICVC FAULT STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
151	CONDENSER PRESSURE ALERT	PUMP RELAY ENERGIZED	151—High Condensing Pressure (VALUE). Pump Energized to Reduce Pressure.	Check sensor wiring and accuracy. Check condenser flow and water temperature. Check for fouled tubes. This alarm is not caused by the High Pressure Switch.
152	RECYCLE ALERT	EXCESSIVE RECYCLE STARTS	152—Excessive recycle starts.	Chiller load is too low to keep compressor on line and there has been more than 5 starts in 4 hours. Increase chiller load, adjust hot gas bypass, increase RECYCLE RESTART DELTA T from (SETUP) screen.
153	NO MESSAGE ALERT	no message, ALERT only	153—Lag/Lag Disabled-Config. Multiple Chiller Address.	Repl chiller address configuration in Lag/Lag screen. Both chillers require a different address.
154	POTENTIAL FREEZE-UP	COND PRESS/TEMP TOO LOW	154—Condenser freeze up prevention.	The condenser pressure transducer is reading a message that could freeze the condenser tubes. Check for condenser refrigerant leaks. Check fluid temperature. Check sensor wiring and accuracy. Place the chiller in PUMPDOWN mode if the vessel is evacuated.
155	OPTION SENSOR FAULT	REMOTE RESET SENSOR	155—Sensor Fault/Option Disabled. Remote Reset Sensor.	Check sensor resistance or voltage drop. Check for proper wiring to COM connector J4.
156	OPTION SENSOR FAULT	AUTO CHILLED WATER RESET	156—Sensor Fault/Option Disabled. Auto Chilled Water Reset.	Check sensor resistance or voltage drop. Check for proper wiring to COM connector J5.
157	OPTION SENSOR FAULT	AUTO DEMAND LIMIT INPUT	157—Sensor Fault/Option Disabled. Auto Demand Limit Input.	Check sensor resistance or voltage drop. Check for proper wiring to COM connector J5.
158	SENSOR ALERT	SPARE TEMPERATURE #1	158—Spare Temperature 1 (VALUE) exceeded limit of (LIMIT).	Check sensor resistance or voltage drop. Check for proper wiring to COM connector J4. Check Spare Temp #1 Limit in (SETUP) screen.
159	SENSOR ALERT	SPARE TEMPERATURE #2	159—Spare Temperature 2 (VALUE) exceeded limit of (LIMIT).	Check sensor resistance or voltage drop. Check for proper wiring to COM connector J4. Check Spare Temp #2 Limit in (SETUP) screen.
161	LOSS OF COMMUNICATION	WITH WSM	161—WSM Cool Source — Loss of Communication.	Check settings in WSM/EFM screen. Check COOL Communications link with WSM (Water System Manager) Module. Check Supervisory Part of WSM.
162	SENSOR ALERT	EVAPORATOR APPROACH	162—Evaporator Approach (VALUE) Exceeded Limit of (LIMIT).	Check that refrigerant charge level is adequate, water/ice drain plate (exists) are passing, evaporator tubes are not fouled and that oil reclaim system is working. Check sensor resistance or voltage drop. Check Evap Approach Alert setting in (SETUP) screen.
163	SENSOR ALERT	CONDENSER APPROACH	163—Condenser Approach (VALUE) Exceeded Limit of (LIMIT).	Check sensor resistance or voltage drop. Check for proper wiring. Check Cond Approach Alert setting in (SETUP) screen. Check for noncondensable gas in the condenser. Check that the condenser tubes are not fouled.
164	VFD SPEED ALERT	LOW VFD SPEED	164—Actual VFD Speed exceeded limit of target VFD Speed -10%.	Actual VFD Speed on COMPRESS screen must be at least 90% of target VFD Speed.
166	AUTORESTART PENDING	LOW DC BUS VOLTAGE	166—Low DC Bus Voltage (VALUE) Exceeded Limit of (LIMIT).	Verify phase to phase and phase to ground line voltage.
166	AUTORESTART PENDING	HIGH DC BUS VOLTAGE	166—High DC Bus Voltage (VALUE) Exceeded Limit of (LIMIT).	Verify phase to phase and phase to ground line voltage. Monitor AC line for high in-rush voltage conditions.
167	SYSTEM ALERT	HIGH DISCHARGE TEMP	167—Comp Discharge Temp (VALUE) exceeded limit of (LIMIT).	Check sensor resistance or voltage drop. Check for proper wiring. Check for excessive starts. Check Comp Discharge Alert setting in (SETUP) screen.
168	SENSOR ALERT	HUMIDITY SENSOR INPUT	168—Sensor Fault. Check Humidity Sensor Input Sensor.	Check humidity sensor wiring on COM connector J3 and J4. Call Carrier Service if it must be in "OFF" position. Check Humidity Sensor Input in Control Test.

TLIMIT is shown on the ICVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. (VALUE) is the actual pressure, temperature, voltage, etc., at which the control tripped.

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VFD Fault Code Description

VFD Fault Code, Type, Description, Action and ICVC Fault State (pages 101-104)

Table 17 — Fault Code Descriptions and Corrective Actions

Fault Type indicates if the fault is:
 1 — Auto-resettable
 2 — Non-resettable
 3 — User-configurable
 4 — Normal Fault

VFD FAULT CODE	FAULT TYPE	DESCRIPTION	ACTION	ICVC FAULT STATE
2	Auxiliary Input 1	Input is open.	Check remote wiring.	206
3	Power Loss 1, 3	DC bus voltage remained below 85% of nominal for longer than Power Loss Time (185). Enable/disable with Fault Config 1 (238).	Monitor the incoming AC line for low voltage or line power interruption.	215
4	UnderVoltage 1, 3	DC bus voltage fell below the minimum value of 407V DC at 400/480V input Enable/disable with Fault Config 1 (233).	Monitor the incoming AC line for low voltage or power interruption.	215
5	OverVoltage 1	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.	205
7	Motor Overload 1, 3	Internal electronic overload trip. Enable/disable with Fault Config 1 (238).	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by Motor NP FLA (42).	217
8	Invtr Base Temp 1	Base temperature exceeded limit.	Check for proper temperature and flow rate of coolant.	219
9	Invtr IGBT Temp 1	Output transistors have exceeded their maximum operating temperature.	Check for proper temperature and flow rate of coolant.	219
12	HW OverCurrent 1	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.	286

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VFD Fault Code



VFD Fault code can be found in 2 locations in ICVC

1. Status → VFD_STAT → VFD Fault Code
2. Service → Control Algorithm status → VFD History → VFD Fault Code

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VFD Fault Code



VFD Firmware numbers for Gateway, Inverter, Rectifier
can be found on Status → VFD_STAT →

VFD Gateway Version #

VFD Inverter Version #

VFD Rectifier Version #

Last 3 items on the screen

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LFII common fault

VFD Fault: F13 Ground Fault and/or F216 Rctfr Gnd Fault

If the power module detects excessive ground current, it will protect itself, the power cables, and/or the motor by tripping on a ground fault condition. The ground current trip at 7% of drive rated current in a 100micro second time interval.

Troubleshooting

Check proper grounding

Meg Motor

Check Moisture in the Panel

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LFII common fault

VFD Fault: F8 Invtr Base Temp or F9 Invtr IGBT Temp, Rectifier F217 Rctfr Base

This fault indicates that the temperature feedback has exceeded its specified limits.

Troubleshooting

Check cooling line to ensure that there is refrigerant flow

There must be at least 15psi between Evaporator and Condenser pressure to ensure flow of refrigerant

Possible bad temp sensor

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LFII common fault

VFD Fault: Code 107 at ICVC

This fault is seen after combined power board replacement

Troubleshooting

Connect to drive and clear fault using RECOMM and VS Utilities

CCS-SOP-7-SWI00030A

