A Compact, Liquid-Cooled Variable Speed Drive for High Horsepower Applications

The Reliance Electric LiquiFlo™ AC drive combines high-performance variable speed drive technology with a patented liquid-cooling design in a compact, stand-alone solution for high-horsepower applications in even the most demanding environments.

PRIMARY APPLICATIONS

LiquiFlo drives can be used in any high horsepower (350 - 1000 HP at 460 VAC) applications where mounting space is at a premium and a cooling liquid is available. Primary application examples include:

- compressors
- extruders
- water/WWTP pumping
- petrochemicals
- power generation
- mining
- large chilled water pumps
- pelletizers
- electric vehicles
- pulp and paper

Challenging environments may have made it impossible to consider variable speed for some high horsepower applications in the past. With over 80% of the heat generated by LiquiFlo drives dissipated through the cooling liquid, they can be totally sealed to protect the sensitive electronics from even the harshest conditions.

In addition, applications in the 500 - 1000 HP range, traditionally controlled by costlier medium voltage drives, are ideal for LiquiFlo drives.

PRODUCT BENEFITS

Variable Speed Control for Maximum Efficiency

Variable speed control means varying motor speed to match load requirements. Here are a few of the many demonstrated advantages of variable speed control over fixed speed control in high horsepower applications:

- Reduced energy consumption. Uses only as much power as your process load requires. The energy portion of your utility charges will be reduced because of the improved efficiency of variable speed control during times of less than 100% load requirements. This means a faster payback for installing variable speed control. (Some utilities even offer rebates or other incentives for installing variable speed control.)
- Longer mechanical system life. Variable speed control brings the motor up to speed without the high starting current and torque caused by motor starters. This means less wear and tear on mechanical parts such as gears, belts and sheaves.
- Soft starters can reduce wear and tear on the mechanical system when starting, but they cannot vary motor speed over the motor's full range efficiently the way that variable speed drives can.
- Fewer mechanical components and less maintenance required. Variable speed control means fewer contactors, motor current transformers, overload relays and wiring. Fewer components that wear out means less work to maintain and less cost to replace.

Variable Speed Control with No Penalty in Cost or Size

Traditional fixed-speed motor starters and reduced voltage starters no longer have a size or cost advantage over variable speed control. LiquiFlo drives have a smaller footprint than both types of starters, as well as conventionally-cooled AC and DC drives. In fact, LiquiFlo drives have the industry's smallest HP/square inch footprint—60% smaller compared to air-cooled drives.

In addition to being as small as or smaller than most starters installed, LiquiFlo drives cost little more than a typical reduced voltage starter, with all the advantages of variable speed. Installing LiquiFlo drives means dramatic savings from the first day of operation.

Proven Control Technology Paired with Leading-Edge Cooling Design

The core of a LiquiFlo drive is the power section and regulator board of the flagship Reliance Electric GV3000/SE drive. The GV3000/SE drive power section and regulator were designed onto the patented LiquiFlo heatsink to optimize power device ratings as well as use of material. The GV3000/SE, a U.S.- designed drive that has sold over 65,000 units since its introduction in 1994, is a market leader due to its steady evolution in control schemes and ease of use.

The LiquiFlo drive is normally sold as a chassis. It can be mounted in optional NEMA 1, NEMA 12, or NEMA 4X/12 enclosures. Additional options, such as input fuses, disconnects, line reactors and controls can be configured with the LiquiFlo drive to meet specific application needs.

LiquiFlo AC Drives

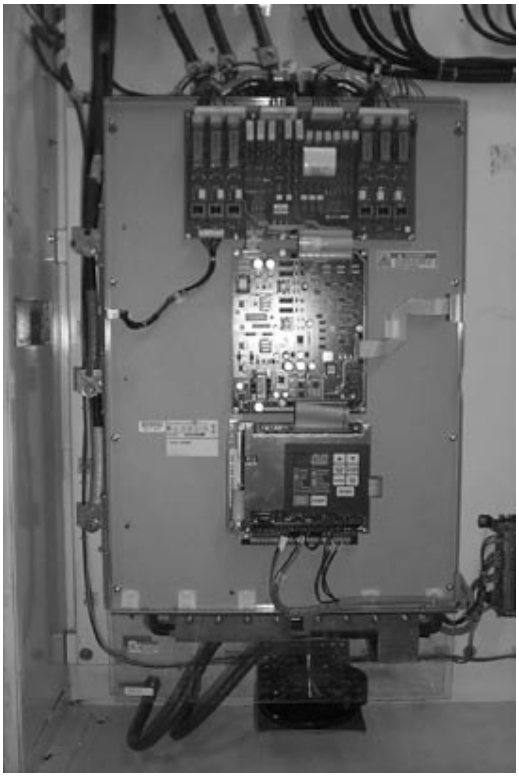
Liquid Cooling Design Features

LiquiFlo cooling technology is optimized for heat dissipation for each frame size and varies from a hermetically sealed aluminum casting with cooling passageways to a heatsink single-cast around copper tubing. By design, all major heat producing components, such as IGBTs and diodes, are mounted within the LiquiFlo heatsink itself, resulting in an extremely compact drive package. Virtually any available liquid which can be pumped through copper tubing can be used as the cooling medium. See the pressure, flow and temperature specifications for acceptable cooling liquids later in this document.

- Single pipe in and out connection for easy mounting and maintenance
- Both pipe in and out connections are located for easy access and protection against accidental leakage
- Uses standard size 10, SAE 37º flare female fittings

Drive Features

- 3-Phase, 50/60 Hz, 380 - 460 VAC
- Digital regulator provides three types of variable speed control:
- V/Hz, closed-loop vector, and sensorless enhanced vector control
- Overload:
  - In vector mode: 150% overload of continuous amp rating for 5 seconds
  - In V/Hz mode: 110% continuous overload of continuous amp rating with no time limit
- PWM (Pulse-Width-Modulated) output for smooth AC waveforms
- GBT (insulated Gate Bi-Polar transistors) power technology
- Full power rating at 2 kHz carrier frequency
- Open chassis model rated for 55ºC operating temperature, NEMA 1 up to 40ºC
- Standard DC bus inductor (choke) for reduced line harmonics
- Standard 12-pulse input configuration for line harmonic attenuation (414 - 643 Amp units only), with 6-pulse available via jumper connections
- Wireless construction for increased reliability
- Expanded I/O for additional drive logic control—fault relays, run relays, preset speeds, and PI control
- RS-232 serial port for connecting to personal computer using optional CS3000 drive configuration and control software
- Optional network communication boards



In an enclosure

LIQUIFLO DRIVE POWER RATINGS

LiquiFlo Ratings

Model Numbers	Continuous Amp Rating	HP (kW) Rating at 460 V		Overload Capacity	
		V/Hz Mode	Vector Mode	V/Hz	Vector Mode
				110% Continuous	150% for 5 sec.
41L4060	414 Amps	350 (229)	350 (229)	455 Amps	621 Amps
50LW4060	500 Amps	400 (230)	400 (230)	550 Amps	750 Amps
64LW4060	643 Amps	500 (295)	500 (295)	707 Amps	964 Amps
120L4060	1200 Amps	1000 (750)	1000 (750)	1320 Amps	1800 Amps

ENVIRONMENTAL SPECIFICATIONS

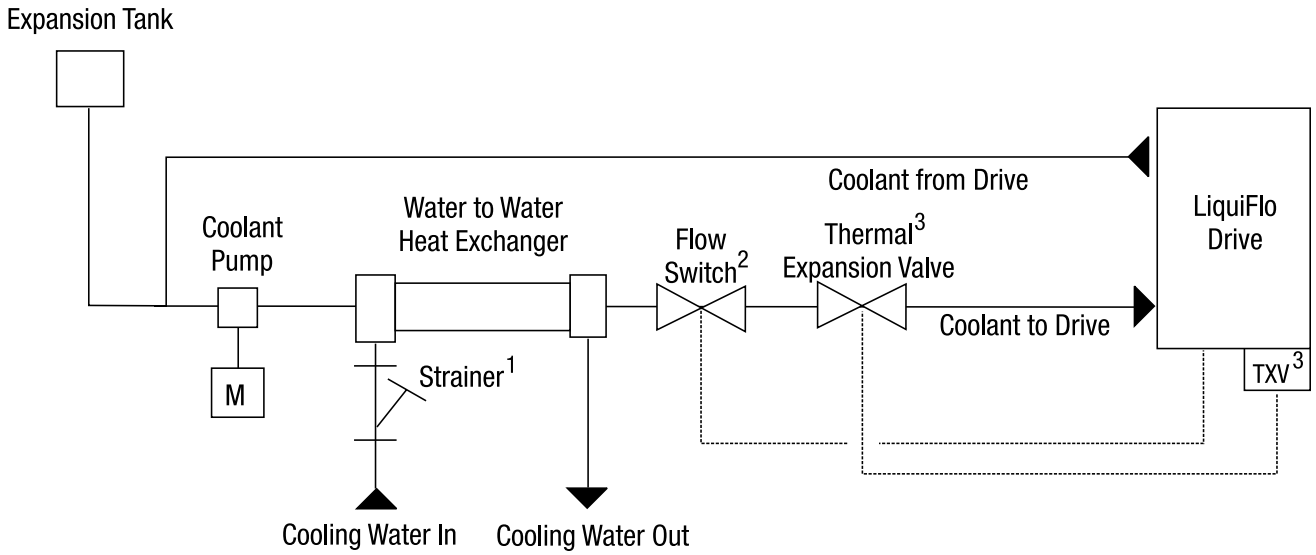
Condition	Specification
Operating Temperature Inside Cabinet (Ambient)	0° to +55°C (32° to 131°F)
Storage Temperature (Ambient)	-40° to 65° C (-40° to +149° F)
Humidity	5 to 95% (non-condensing)

COOLANT SPECIFICATIONS

Specifications	Model Number 41L4060	Model Numbers 50LW4060 and 64LW4060	Model Number 120L4060
Coolant Type	Clean water with no additives	Clean water with no additives	Potable water with approved corrosion inhibitor
Inlet Coolant Temperature Range	15° to 40° C (60° to 104° F)	15° to 40° C (60° to 104° F)	15° to 40° C (60° to 104° F)
Minimum Coolant Flow Rate at Full Load	7 gpm	5 gpm	8 gpm
Differential Coolant Pressure at Minimum Flow Rate	3 psi	34 psi	5 psi
Maximum Inlet Pressure	450 psi	450 psi	50 psi
Maximum Heat Load	16,000 BTU/hour	25,000 BTU/hour	40,000 BTU/hour

Refer to D-110 and D-111 for cooling loop opions and pricing

REQUIREMENTS FOR TYPICAL USER-SUPPLIED CIRCULATING LOOP WATER SYSTEM



1. Strainer used to capture contaminants, if required due to water source.
2. Optional flow switch used to protect against water loop failure. Could be wired into function loss input at drive.
3. Optional thermal expansion valve used to control flow based on heatsink temperature.

DRIVE DIMENSIONS

Model Number	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Dim. F	Dim. G	Weight
41L4060	18.69	31.52	14.06	15.63	28	1.53	0.79	275
	(475)	(800)	(357)	(397)	(711)	(39)	(20)	(125)
50LW4060	22.96	38.23	13.66	18.25	31	1.09	1	370
	(583)	(971)	(347)	(464)	(787)	(28)	(25)	(168)
64LW4060	22.96	38.23	13.66	18.25	31	1.09	1	375
	(583)	(971)	(347)	(464)	(787)	(28)	(25)	(170)
120L4060	39.75	49	14.16	33	47.25	1.09	1	850
	(1010)	(1245)	(360)	(838)	(1200)	(28)	(25)	(385)

inches (mm)

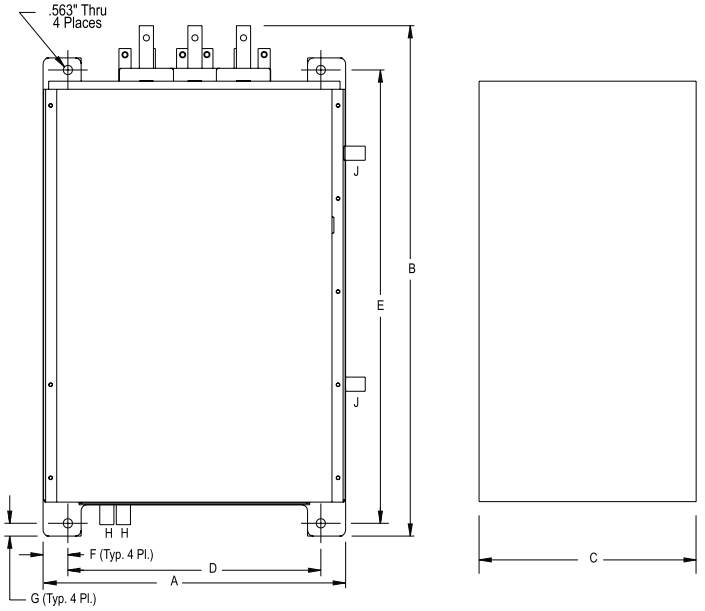
pounds (kg)

Coolant Connections

H = 50LW and 64LW cooling inlet and outlet
J = 41L cooling inlet and outlet
Both sizes SAE 37° flare female fittings

Model Numbers

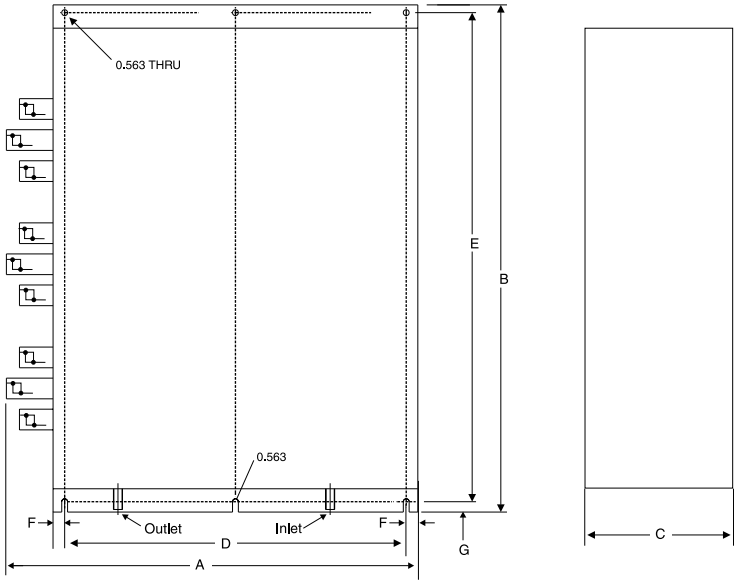
41L4060
50LW4060
64LW4060



Front View Side View

Model Numbers

120L4060



Front View Side View

RELIANCE ELECTRIC

PRICING

Continuous Amp Rating at 2 kHz	Drive Model Number	List[1]
414 Amps	41L4060	**$23,650**
500 Amps	50LW4060	**36,850**
643 Amps	64LW4060	**42,240**
1200 Amps	120L4060	**67,320**

(1) Contact your nearest Regional Drive Center for order entry and availability.

PANEL MOUNTING KITS

Use these kits to mount the LiquiFlo chassis drive in an enclosure. These kits include inlet and outlet extension hoses, cabling lugs for power connections, 6-pulse busbar jumpers and a DC bus inductor cooling fan with brackets (The DC bus inductor cooling fan is not included in kits 41L4060PM and 120L4060PM. The fan is included with the drive). (The 64L4060PM dies not include inlet and outlet tube assemblies.)

Drive Model Number	Panel Mounting Kit Model Number	List[1]
41L4060	41L4060PM	**$1,156**
50LW4060	64L4060PM	**1,240**
64LW4060	64L4060PM	**1,240**
120L4060	120L4060PM	**1,348**

- Stocked kits
- Available for field installation only

(1) Contact your nearest Regional Drive Center for order entry and availability.

INSTRUCTION MANUALS

Software: D2-3410
Hardware: D2-3411
Panel Mount Kit for Model Number 41L4060: D2-3460
Panel Mount Kits for Model Numbers 50LW4060 and 64LW4060: D2-3449
Panel Mount Kit for Model Number 120L4060: D2-3467

DISCOUNT: VS-1AC

A Compact High Horsepower VS AC Drive: Designed For Fan/Pump Applications

- **Liquid Cooled**
- **Cost Effective**
- **Fully Regenerative**
- **IEEE519 & CE Harmonic Limit Compliant**
- **Voltage Flexible**

The Reliance Electric LiquiFlo™ 2.0 AC drive is a PWM (Pulse-Width-Modulated), liquid-cooled drive that provides Sensorless vector and general purpose Volts-per-Hertz regulation for high-horsepower applications.

IEEE 519 – Line Harmonics

The LiquiFlo 2.0 AC drive features an active-rectifier with input filter allowing the drive to meet IEEE519 standards and CE standards for Europe for line harmonics.

Full Line Regeneration Capability

Full line regeneration capability produces a braking system by applying power back into the AC line.

Volts/Hertz & Sensorless Vector Control

LIQUIFLO 2.0 TECHNOLOGY

LiquiFlo 2.0 drives are built on the Reliance Electric SP600 AC drive regulator.

The LiquiFlo 2.0 drive is mounted in a NEMA 1 enclosure. Chiller options and water-to-water or water-to-air cooling options can be configured to meet specific application needs.

APPLICATION DATA

- Pulse width modulated (PWM): sensorless vector control V/Hz operation
- AC Line Voltage Variation: -10% to +10%
- Displacement Power Factor: +/- 0.99
- Line Frequency: 50/60 Hz (+/- 2 Hz)
- Motor Lead Lengths: 76 meters (250 feet) total
- Carrier Frequency: 2 kHz Standard (software-selectable)
- Current Limit Adjustment: 25% to 150% of drive rated amps for model numbers 180264-A03, 180264-A06, 180580-A07
- Current Limit Adjustment: 25% to 100% of drive rated amps for model numbers 180580-A09

OPTIONS

- Cooling Loop
- Water-to-Water
- Water-to-Air
- Chiller

PRODUCT FEATURES

IEEE 519 – Line Harmonics

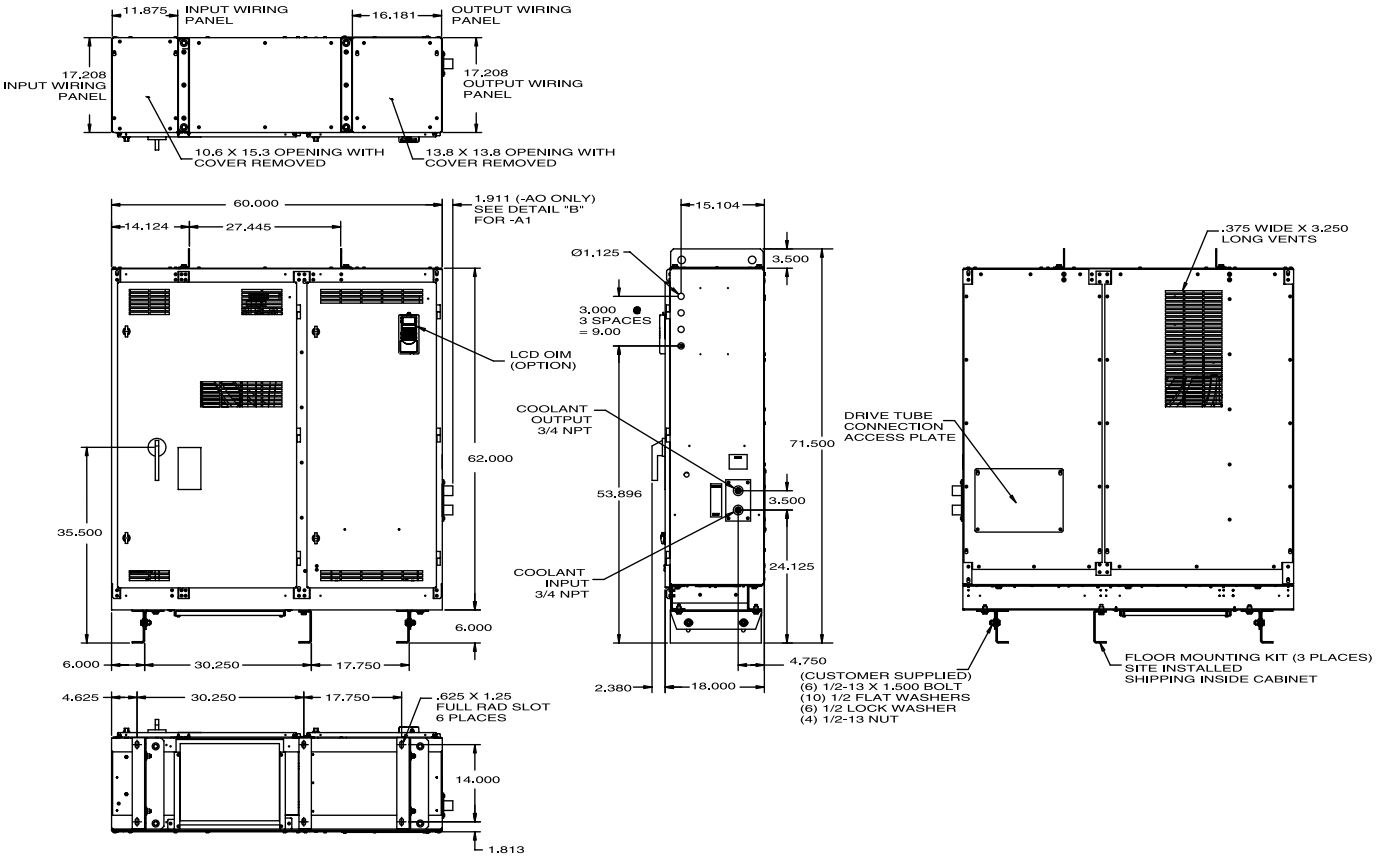
Benefits of Synchronous Rectifier front ends:

- Regenerative Power Flow: IGBT devices will allow power to flow into or out of the drives. This is extremely beneficial in that it allows an AC drive to absorb power from the application and put it back on the AC line at relatively the same efficiency level as when motoring. This one feature allows AC drives to be used in almost any application, which was previously solved with a DC drive.
- Full rated Voltage on the Motor for Wide Input Voltage Ranges: A synchronous rectifier can regulate the voltage level on the DC bus. The buck boost nature of the topology allows voltage levels on the DC bus to be higher than the peak of the AC line. During line sags, brownouts and other low voltage conditions the synchronous rectifier can maintain the DC bus at its rated voltage and thus provide full output voltage to the motor under almost all low line conditions. One very good example of this benefit is that the same drive and 480V motor can be used on a 380 Volt 50Hz line and a 480V 60Hz line and the motor will still operate at 480V and provide the same torque for both cases.
- Harmonics: The current waveforms produced by a synchronous rectifier are regulated to be sine waves. Thus, the current harmonics can be regulated to meet IEEE519 as well as the current CE standards for Europe with no additional modifications. Current harmonics are less than 5% while Voltage harmonics in the range of 0.5 to 2% are typical at the drive.
- Bus Over Voltages: Just as critical as it is to keep the DC bus above an acceptable voltage level, it is also possible to be too high. A synchronous rectifier will regulate the DC bus and lower the voltage if it rises above the desired set point. Repetitive line spikes will increase the DC bus voltage during the spike; however, the synchronous rectifier will reduce the level as soon as the spike has passed, thus preventing the ratcheting up of the DC bus voltage level with each spike. The LC filter formed by the rectifier and the DC bus capacitors will also limit the transient voltage excursions.
- Unity and/or Controlled Power Factor: The input line currents are regulated by the synchronous rectifier; therefore, a predetermined power factor can be set by the controls. This power factor is usually set to unity to maximize the unit's current draw; however, it is possible to dynamically change the power factor to meet the user's desire to have an improved plant power factor.

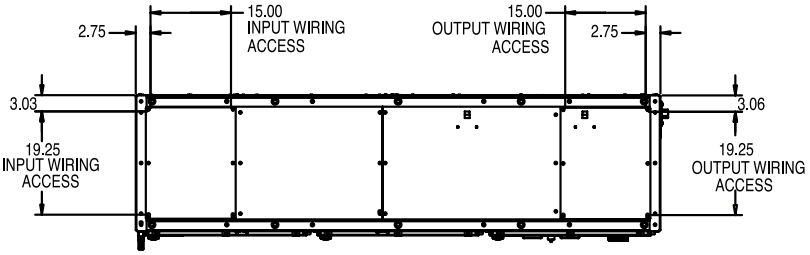
  Each of these benefits has varying degrees of importance to a user, but with a good synchronous rectifier the user always has the option to avoid issues and improve performance. With a fix front end, one's options are limited and there may be no solution for some problems that arise in the field.

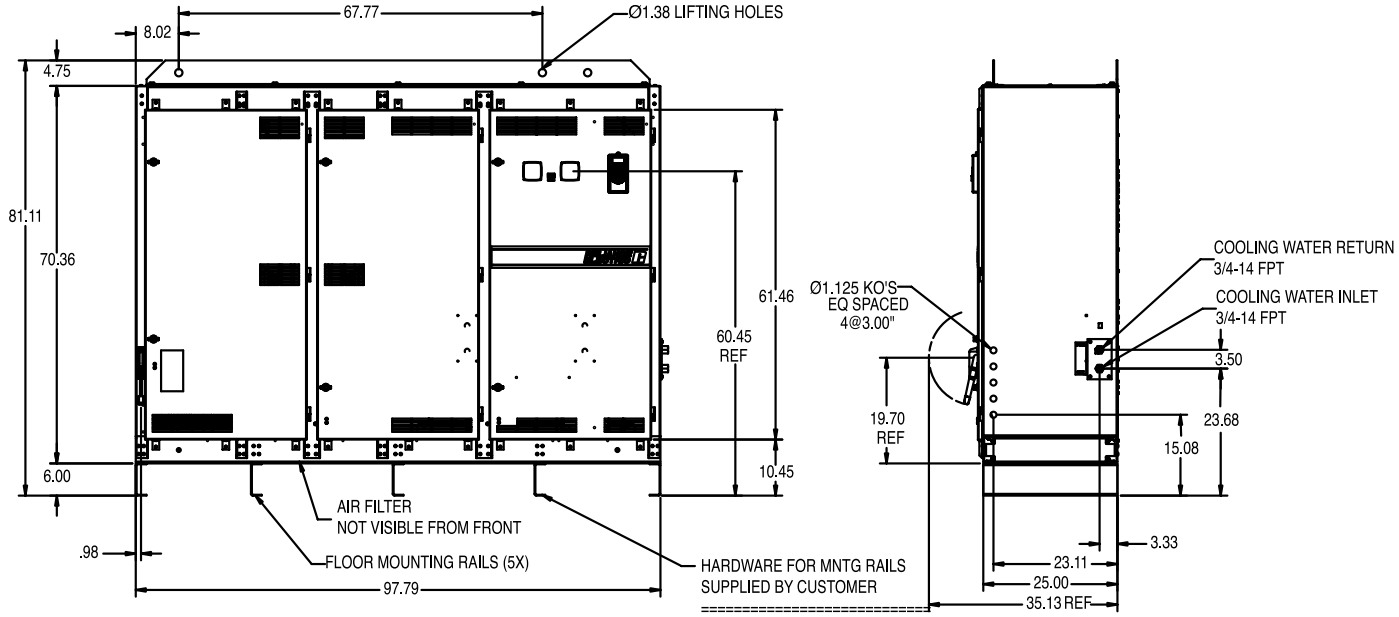
DIMENSIONS

180264-A03-600 and 180264-A06-600 Model Numbers



DIMENSIONS
180580-A07-600 and 180580-A09-600 Model Numbers





DRIVE CABINET ASSEMBLY OUTLINE
SHOWN AS FIELD INSTALLED

HARDWARE FOR MNTG RAILS
SUPPLIED BY CUSTOMER

1/2-13 HHCS X 1.50 LG (10X)
1/2" FENDER WASHER (20X)
1/2" SPLIT LOCK WASHER (10X)
1/2-13 HEX NUT (10X)

1/2 X 3" LAG SCREW (10X)
1/2" FENDER WASHER (10X)
1/2" ANCHOR (10X)

LiquiFlo 2.0 Drive Power Ratings

Drive Assembly Number 460 VAC Input No Options	Input Power (KVA)	Input Voltage (V)	Input Current (Amps)	Output Current at 2 kHz (Amps)
180264-A03-600	337	460 ± 10%	405	405
180264-A06-600	515	460 ± 10%	608	608
180580-A07-600	673	460 ± 10%	810	810
180580-A09-600*	1010	460 ± 10%	1215	1215

- 110% output current capability for one minute, 150% output current capability for 5 sec. for model numbers 180264-A03, 180264-A06, 180580-A07
- 100% Continuous Capability with no Overload Capability for model number 180580-A09
- Input Voltage Rating (346 - 480 VAC @ 50 or 60 Hz.) with 460 VAC Output. If input voltage lower than 460 VAC is applied, then the continuous current rating must be lowered by the same percentage as the voltage.

  Continuous Current = [(Actual AC Input / 460 VAC) * Input Current Rating.

Environmental Specifications

Condition	Specification
Operating Temperature (inside NEMA 1 enclosure)	0° C to +55° C (1) (32° to 131° F)
Ambient Temperature (outside NEMA 1 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)

(1) With typical heat rise inside a cabinet, 40° C ambient outside usually results in 55° C inside.

Coolant Specifications and Pricing

Specification	405 Amps	608 Amps	810 Amps	1215 Amps
Coolant Type:		25% Ethylene Glycol (WEG) (% by weight)		
Inlet Coolant Temperature Range	5-40° C	5-40° C	5-40° C	5-40° C
Minimum Coolant Flow Rate at Full Load	7 GPM	7 GPM	15 GPM	15 GPM
Maximum Inlet Pressure	180 PSI	180 PSI	180 PSI	180 PSI
Maximum Heat Load	6000 Watts	9000 Watts	12,000 Watts	18,000 Watts

Base Model Number	180624-A03	180264-A06	180580-A07	180580-A09
Req. BTU	20,490	30,735	40,980	61,470
Flow GPM @ PSI	7gpm @ 50psi	7 gpm @ 50psi	15gpm @ 50 psi	15 gpm @ 50 psi
Chill Plate Max. PSI	180	180	180	180

Model Number Configuration Example: 180264-A03-6AA

Sample Model Number	Base Number	AC Input Voltage Selection	Option Selection
180264-A03-6AA	180264-A03-	6	AA

180264-A03 = LF2 405 Amps; 6 = 460VAC / 60Hz.; AA = 3 Phase Input Meter
Refer to the table below for appropriate Voltage and option codes.

PRICING

Standard Drives - LiquiFlo 2.0 AC Drives: 460 VAC

How to Order: Select base model number, voltage and option selections from chart below. Contact your local distributor or fax order to Reliance Electric at (864) 284-5075. For assistance call Reliance Electric at (864) 297-4800 and request Inside Sales.

Base Drive Model Number	180264-A03-***	180264-A06-***	180580-A07-***	180580-A09-***	Comments
Amp Rating	405	608	810	1215	
FLA @ 2kHz					
Base Drive List	**$41,085**	**$59,955**	**$83,622**	**$98,650**	
Standard Devices:					
Nema 1 Enclosure	Standard	Standard	Standard	Standard	
Door Mounted LCD OIM	Standard	Standard	Standard	Standard	
Control Transformer: 460:120 VAC, 3KVA	Standard	Standard	Standard	Standard	
65KAIC Circuit Breaker	Standard	Standard	Standard	Standard	
IEEE519 & CE Harmonic Limit Compliant	Standard	Standard	Standard	Standard	
Input Line Reactor	Standard	Standard	Standard	Standard	
Input Voltage Selection:	**Replace First * with your voltage selection Option Code Number**				**Option Code:**
460-480VAC, 60Hz.	Standard	Standard	Standard	Standard	"6"
346VAC, 50Hz.	(2)	(2)	(2)	(2)	"8"
380-415VAC, 50Hz.	(2)	(2)	(2)	(2)	"3"
Options:	**Replace Second & Third * with the two letter Option Code**				**Option Code:**
1. 3PH Input Metering	824	824	824	824	"AA"
2. 100KAIC Circuit Breaker	800	1600	3200	4800	"BA"
3. CE Touch – LVD	900	900	1000	1000	"CA"
Option 1 + 2	1624	2424	4024	5624	"KA"
Option 1 + 3	1724	1724	1824	1824	"LA"
Option 2 + 3	1700	2400	4200	5800	"TA"
Option 1 + 2 + 3	2524	3324	5024	6624	"ZB"
No Options	0	0	0	0	"00"
Network Communication Module	(1)	(1)	(1)	(1)	Order Separate

1 Refer to page D-39 for Network Options and pricing.

2 No Additional Charge for Optional Input Voltage rating, but it must be specified at order entry.

INSTRUCTION MANUAL

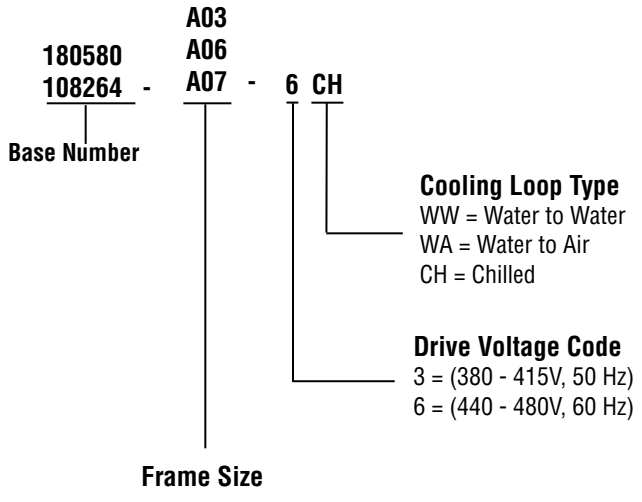
User Manual: D2-3518-1

DISCOUNT: VS-1AC

LiquiFlo Cooling Loop Specifications/Selection

LF1.0 Base Model Number	41L4060 414 Amps	50LW4060 500 Amps	64LW4060 643 Amps	120L4060 1200 Amps
Req. BTU	16,000	25,000	25,000	40,000
Minimum Coolant Flow Rate at Full Load @ PSI	7GPM @3 psi	5 GPM @34 psi	5 GPM @34 psi	8 GPM @ 5 psi
Chill Plate Max. PSI	180	180	180	50
LF2.0 Base Model Number	**180624-A03 405 Amps**	**180264-A06 608 Amps**	**180580-A07 810 Amps**	**180580-A09 1215 Amps**
Inner Loop Coolant Type:	25% Ethylene Glycol (WEG) (% by weight)			
Req. BTU	20,490	30,735	40,980	61,470
Minimum Coolant Flow Rate at Full Load @PSI	7 GPM @35PSI	7 GPM @ PSI	15 GPM @ 35PSI	15 GPM @ PSI
Chill Plate Max. PSI	180 PSI	180 PSI	180 PSI	180 PSI
Maximum Heat Load	6000 Watts	9000 Watts	12,000 Watts	18,000 Watts
Water to Water Heat Exchanger				
Inlet Coolant Temperature Range	5-40° C	5-40° C	5-40° C	5-40° C
Max. Ambient	104 deg. F	104 deg. F	104 deg. F	104 deg. F
180264-A06-6WW	YES	YES	YES - (64LW4060)	
180580-A09-6WW			YES - (180580-A07)	YES
Water to Air Heat Exchanger				
Max. Ambient	90 deg. F	90 deg. F	90 deg. F	90 deg. F
180264-A06-6WA	Yes			
180580-A07-6WA		Yes		
180580-A09-6WA			Yes	Yes
Chiller				
Max. Ambient	104 deg. F	104 deg. F	104 deg. F	104 deg. F
180264-A03-6CH	Yes			
180264-A06-6CH		Yes		
180580-A09-6CH			Yes	Yes

Cooling Loop Part Number



Cooling Loop Pricing

WATER TO WATER

Part Number	List
180264-A06-6WW	$8,617
180264-A06-3WW	8,746
180580-A09-6WW	9,212
180580-A09-3WW	9,350

WATER TO AIR

Part Number	List
180264-A06-6WA	$10,940
180264-A06-3WA	11,159
180580-A07-6WA	11,740
180580-A07-3WA	11,975
180580-A09-6WA	15,260
180580-A09-3WA	15,565

CHILLED

Part Number	List
180264-A03-6CH	$15,030
180264-A03-3CH	15,180
180264-A06-6CH	16,910
180264-A06-3CH	17,079
180580-A09-6CH	20,015
180580-A09-3CH	20,215

ACCESSORIES

Description	Part Number	List
5Gal. PreMix	LF-WW5GAL	$252
5Gal.100% glycol	LF-WW-5GAL-100	352
Hose Kit 10Ft.	LF-WW-HOSE-10	646

DISCOUNT: VS-1AC