

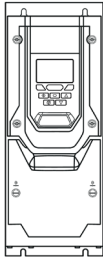


HAYWARD®

AC Variable Frequency Drive

Hayward Commercial Aquatics

Owner's Manual



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Certified to
NSF/ANSI Standard 50

421501P	620401P
520201P	620501P
520251P	620601P
620301P	

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IMPORTANT SAFETY INSTRUCTIONS

When using this electrical equipment, basic safety precautions should always be followed, including the following:

READ AND FOLLOW ALL INSTRUCTIONS

WARNING: Follow all applicable electrical codes.

WARNING: Turn off power at main source before making any electrical connections or servicing the unit.

WARNING: To reduce the risk of electric shock, injury or death disconnect unit from power supply.

WARNING: Follow the instructions or risk of serious injury or death could occur!



WARNING - Read and follow all instructions in this owner's manual and on the equipment. Failure to follow instructions can cause severe injury and/or death.



WARNING – Suction Entrapment Hazard Suction in suction outlets and/or suction outlet covers which are, damaged, broken, cracked, missing, or unsecured can cause severe injury and/or death due to the following entrapment hazards:



Hair Entrapment- Hair can become entangled in suction outlet cover.



Limb Entrapment- A limb inserted into an opening of a suction outlet sump or suction outlet cover that is damaged, broken, cracked, missing, or not securely attached can result in a mechanical bind or swelling of the limb.

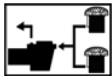


Body Suction Entrapment- A negative pressure applied to a large portion of the body or limbs can result in an entrapment.



Evisceration/ Disembowelment - A negative pressure applied directly to the intestines through an unprotected suction outlet sump or suction outlet cover which is, damaged, broken, cracked, missing, or unsecured can result in evisceration/ disembowelment.

Mechanical Entrapment- There is potential for jewelry, swimsuit, hair decorations, finger, toe or knuckle to be caught in an opening of a suction outlet cover resulting in mechanical entrapment.



WARNING - To Reduce the risk of Entrapment Hazards:

- When outlets are small enough to be blocked by a person, a minimum of two functioning suction outlets per pump must be installed. Suction outlets in the same plane (i.e. floor or wall), must be installed a minimum of three feet (3') [1 meter] apart, as measured from near point to near point.
- Dual suction fittings shall be placed in such locations and distances to avoid "dual blockage" by a user.
- Dual suction fittings shall not be located on seating areas or on the backrest for such seating areas.
- Never use Pool or Spa if any suction outlet component is damaged, broken, cracked, missing, or not securely attached.
- Replace damaged, broken, cracked, missing, or not securely attached suction outlet components immediately.
- Two or more suction outlets per pump installed in accordance with latest ASME, APSP Standards and CPSC guidelines, follow all National, State, and Local codes applicable.
- Installation of a vacuum release or vent system, which relieves entrapping suction, is recommended.

WARNING – Failure to remove pressure test plugs and/or plugs used in winterization of the pool/spa from the suction outlets can result in an increase potential for suction entrapment as described above.

WARNING – Failure to keep suction outlet components clear of debris, such as leaves, dirt, hair, paper and other material can result in an increase potential for suction entrapment as described above.



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WARNING – Suction outlet components have a finite life, the cover/grate should be inspected frequently and replaced at least every ten years or if found to be damaged, broken, cracked, missing, or not securely attached.

CAUTION – Components such as the filtration system, pumps and heater must be positioned so as to prevent their being used as means of access to the pool by young children. To reduce risk of injury, do not permit children to use or climb on this product. Closely supervise children at all times. Components such as the filtration system, pumps, and heaters must be positioned to prevent children from using them as a means of access to the pool.



WARNING – Hazardous Pressure Pool and spa water circulation systems operate under hazardous pressure during start up, normal operation, and after pump shut off. Stand clear of circulation system equipment during pump start up. Failure to follow safety and operation instructions could result in violent separation of the pump housing and cover, and/or filter housing and clamp due to pressure in the system, which could cause property damage, severe personal injury, or death. Before servicing pool and spa water circulation system, all system and pump controls must be in off position and filter manual air relief valve must be in open position. Before starting system pump, all system valves must be set in a position to allow system water to return back to the pool. Do not change filter control valve position while system pump is running. Before starting system pump, fully open filter manual air relief valve. Do not close filter manual air relief valve until a steady stream of water (not air or air and water) is discharged.



WARNING – Separation Hazard Failure to follow safety and operation instructions could result in violent separation of pump and/or filter components. Strainer cover must be properly secured to pump housing with strainer cover lock ring. Before servicing pool and spa circulation system, filters manual air relief valve must be in open position. Do not operate pool and spa circulation system if a system component is not assembled properly, damaged, or missing. Do not operate pool and spa circulation system unless filter manual air relief valve body is in locked position in filter upper body. Never operate or test the circulation system at more than 50 PSI. Do not purge the system with compressed air. Purging the system with compressed air can cause components to explode, with risk of severe injury or death to anyone nearby. Use only a low pressure (below 5 PSI), high volume blower when air purging the pump, filter, or piping.



WARNING – Risk of Electric Shock All electrical wiring MUST be in conformance with applicable local codes, regulations, and the National Electric Code (NEC). Hazardous voltage can shock, burn, and cause death or serious property damage. To reduce the risk of electric shock, do NOT use an extension cord to connect unit to electric supply. Provide a properly located electrical receptacle. Before working on any electrical equipment, turn off power supply to the equipment. To reduce the risk of electric shock replace damaged wiring immediately. Locate conduit to prevent abuse from lawn mowers, hedge trimmers and other equipment. Do NOT ground to a gas supply line.

WARNING – Risk of Electric Shock Failure to ground all electrical equipment can cause serious or fatal electrical shock hazard. Electrical ground all electrical equipment before connecting to electrical power supply.

WARNING – Risk of Electric Shock Failure to bond all electrical equipment to pool structure will increase risk for electrocution and could result in injury or death. To reduce the risk of electric shock, see installation instructions and consult a professional electrician on how to bond all electrical equipment. Also, contact a licensed electrician for information on local electrical codes for bonding requirements.

Notes to electrician: Use a solid copper conductor, size 8 or larger. Run a continuous wire from external bonding lug to reinforcing rod or mesh. Connect a No. 8 AWG (8.4 mm²) [No. 6 AWG (13.3 mm²) for Canada] solid copper bonding wire to the pressure wire connector provided on the electrical equipment and to all metal parts of swimming pool, spa, or hot tub, and metal piping (except gas piping), and conduit within 5 ft. (1.5 m) of inside walls of swimming pool, spa, or hot tub.

IMPORTANT - Reference NEC codes for all wiring standards including, but not limited to, grounding, bonding and other general wiring procedures.



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WARNING – Risk of Electric Shock The electrical equipment must be connected only to a supply circuit that is protected by a ground-fault circuit-interrupter (GFCI). Such a GFCI should be provided by the installer and should be tested on a routine basis. To test the GFCI, push the test button. The GFCI should interrupt power. Push reset button. Power should be restored. If the GFCI fails to operate in this manner, the GFCI is defective. If the GFCI interrupts power to the electrical equipment without the test button being pushed, a ground current is flowing, indicating the possibility of an electrical shock. Do not use this electrical equipment. Disconnect the electrical equipment and have the problem corrected by a qualified service representative before using.

CAUTION – HAYWARD® pumps are intended for use with permanently-installed pools and may be used with hot tubs and spas if so marked. Do not use with storable pools. A permanently-installed pool is constructed in or on the ground or in a building such that it cannot be readily disassembled for storage. A storable pool is constructed so that it is capable of being readily disassembled for storage and reassembled to its original integrity.

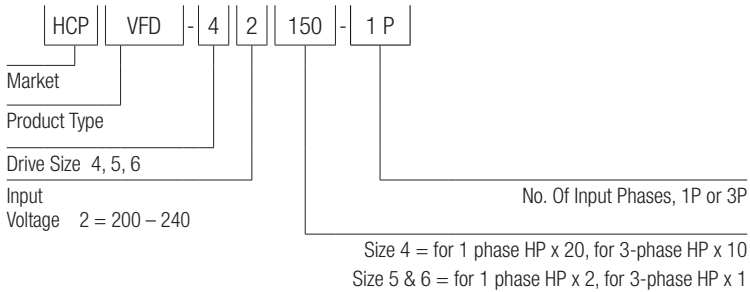
SAVE THESE INSTRUCTIONS

Before you Begin

Before installing the new Variable Frequency Drive (VFD), check that you've received the correct drive and that the motor type and specs are suitable for your installation.

Identifying the Drive by Model Number

Each drive can be identified by its model number, as shown below.



Single Phase Supply

Model	Motor HP
HCPVFD421501P	7.5
HCPVFD520201P	10
HCPVFD520251P	12.5
HCPVFD620301P	15
HCPVFD620401P	20
HCPVFD620501P	25
HCPVFD620601P	30

3- Phase Supply

Model	Motor HP
HCPVFD421501P	15
HCPVFD520201P	20
HCPVFD520251P	25
HCPVFD520251P	30
HCPVFD620401P	40
HCPVFD620501P	50
HCPVFD620601P	60



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Installation

Mounting Location

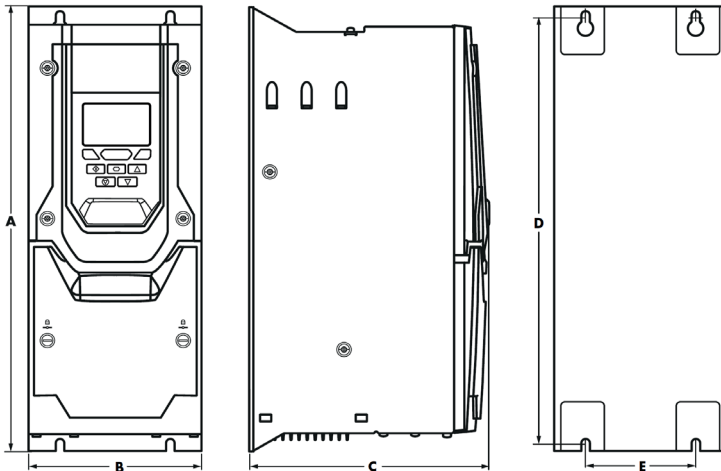
When preparing the mounting location, consider the following:

- The drive must be mounted in a vertical position only.
- Installation should be on a suitable flat, flame resistant surface, away from flammable material.
- Refer to Technical Data and ensure the chosen mounting location is within the drive specification.
- The mounting location should be free from vibration.
- Do not mount the drive in any area with excessive humidity, corrosive airborne chemicals or potentially dangerous dust particles.
- Avoid mounting close to high heat sources.
- The drive must not be mounted in direct sunlight. If necessary, install a suitable shade cover.
- The mounting location must be free from frost.
- Do not restrict the flow of air through the drive heatsink. The drive generates heat which must be naturally allowed to dissipate. Correct air clearance around the drive must be observed.
- If the location is subject to wide ambient temperature and air pressure variation, install a suitable pressure compensation valve in the drive gland plate.

NOTE: If the drive has been in storage for a period longer than 2 years, the DC link capacitors must be reformed. Refer to online documentation for further information.

Specifications

Refer to the diagram below and the table on page 5 for dimensions of the VFD. Refer to your model number for the Drive Size (page 3).





Drive Size	A		B		C		D		E		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
4	450	17.72	171	6.73	252	9.92	428	16.85	110	4.33	11.5	25.4
5	540	21.26	235	9.25	270	10.63	520	20.47	175	6.89	23	50.7
6	865	34.06	330	12.99	332	13.07	840	33.07	200	7.87	55	121.2

Mounting Bolts		
Frame Size	Metric	UNF
4	M8	5/16
5	M8	5/16
6	M10	3/8

Tightening Torques			
	Frame Size	Required Torque	
Control Terminals	All	0.5 Nm	4.5 lb-in
	4	2 Nm	18 lb-in
Power Terminals	5	4 Nm	35.5 lb-in
	6	15 Nm	11 lb-ft

Wiring

Gland Plate and Lock Off

The use of a suitable gland system is required to maintain the appropriate IP / NEMA rating. Remove the gland plate at the bottom of the drive and drill holes for the appropriate sized cable gland fitting. Please take care when drilling to avoid leaving any particles within the product.

UL rated ingress protection ("Type") is only met when cables are installed using a UL recognized bushing or fitting for a flexible-conduit system which meets the required level of protection ("Type").

For conduit installations the conduit entry holes require standard opening to the required sizes specified per the NEC. Not intended for installation using rigid conduit system.

The power input cables should be dimensioned according to any local codes or regulations. Maximum dimensions are given in the Rating Tables section of this manual.

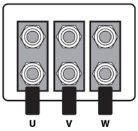
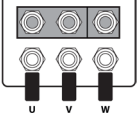
- For 1 phase supply, the mains power cables should be connected to L1/L, L2/N.
- For 3 phase supply, the mains power cables should be connected to L1, L2, and L3. Phase sequence is not important.

NOTE: The motor cable length should not exceed 300 feet (100 meters). If longer cable lengths are necessary, please contact Hayward for additional installation requirements.



Motor Terminal Box Connections

Most general purpose motors are wound for operation on dual voltage supplies. This is indicated on the nameplate of the motor. This operational voltage is normally selected when installing the motor by selecting either STAR or DELTA connection. STAR always gives the higher of the two voltage ratings.

Incoming Supply Voltage	Motor Nameplate Voltages	Connection	
208 / 230	230 / 460	Delta Δ	
Not normally used for these drives		Star λ	

Information for UL Compliance

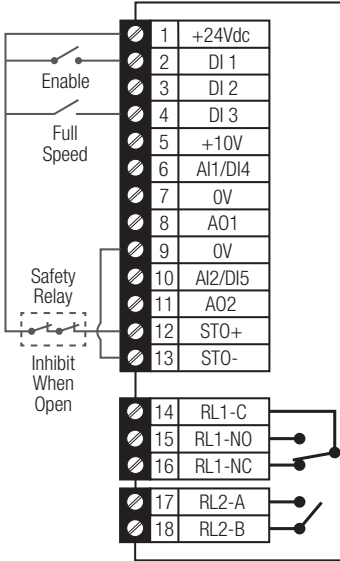
The drive is designed to meet the UL requirements. For an up-to-date list of UL compliant products, please refer to UL listing NMMS.E226333. Reference numbers are on the drive label. In order to ensure full compliance, the following must be fully observed.

Hayward Part Number	UL Listing
HCPVFD421501P	ODP-2-42150-3HF4N
HCPVFD520201P	ODP-2-52020-3HF4N
HCPVFD520251P	ODP-2-52025-3HF4N
HCPVFD620301P	ODP-2-62030-3HF4N
HCPVFD620401P	ODP-2-62040-3HF4N
HCPVFD620501P	ODP-2-62050-3HF4N
HCPVFD620601P	ODP-2-62060-3HF4N

Input Power Supply Requirements	
Supply Voltage	200 – 240 RMS Volts for 230 Volt rated units, + /- 10% variation allowed. 240 Volt RMS Maximum.
Frequency	50 – 60Hz + / - 5% Variation
Short Circuit Capacity	All drives are suitable for use on a circuit capable of delivering not more than 100kA maximum short-circuit Amperes symmetrical with the specified maximum supply voltage when protected by Class J fuses.
Mechanical Installation Requirements	
All drive units are intended for installation within controlled environments which meet the condition limits shown in the Environment section of this manual.	

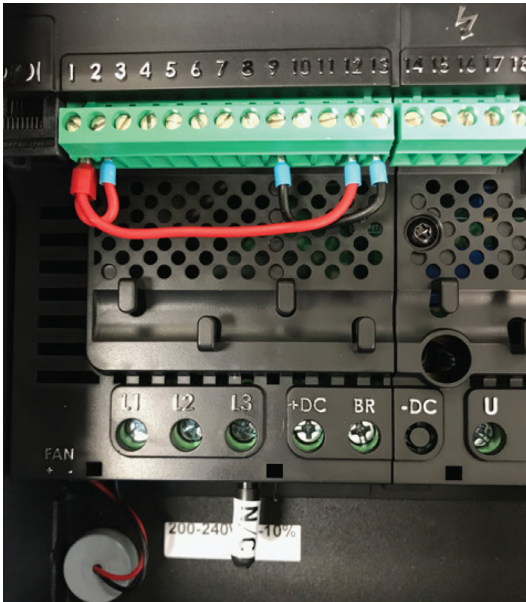


Control Terminal Connections



Key		
1	+24V	24 Volt DC Input / Output
2	DI 1	Closed: Keypad Enable
3	DI 2	Unused
4	DI 3	Closed: Full Speed
5	+10V	+10 Volt DC Output
6	AI1/DI4	Analog Input 1 / Digital Input 4
7	0V	0 Volt Common
8	AO1	Analog Output 1
9	0V	0 Volt Common
10	AI2/DI5	Analog Input 2 / Digital Input 5
11	AO2	Analog Output 2
12	STO+	STO + 24VDC Connection
13	STO-	STO 0 Volt Connection
14	RL1-C	Relay Output 1 Common
15	RL1-NO	Relay Output 1 Normally Open
16	RL1-NC	Relay Output 2 Normally Closed
17	RL2-A	Relay Output 2
18	RL2-B	Relay Output 2

Drive Control Terminals





Drive Functions

1. Connect terminals 1 to 2. This enables the drive when powered up.
2. Press the "Start" button on the keypad to run at the drive preset minimum speed (default, 36 Hz). This speed can be adjusted using the "Minimum Speed" setting at parameter P1-02. Take care to keep the pump speed above the minimum required to prime the pump so that it cannot run dry. The run speed can be raised and lowered using the UP and DOWN keys on the keypad. This speed setting will be memorized if the drive is stopped or the power turned off. If the drive is powered off, you will need to press "Start" button to restart.
3. Press "Stop" or disconnect the connection between terminals 1 and 2 to coast to stop.
4. When in the "Run" mode, connect terminal 1 to terminal 4 to run at the maximum set speed. This can be adjusted by changing the "Maximum Speed" setting at parameter P1-01.

NOTES:

1. The maximum speed should never be set greater than the rated speed shown on the motor nameplate.
2. Always refer to the pump and motor manuals before setting up and starting the drive.

Drive Set Up

Before setting up the drive, check and note the supply voltage and the motor nameplate data:

Supply Volts: _____

Supply Phases: _____

Motor Nameplate Data:

Model #: _____

Motor Type: Standard Induction / PMAC / Sync Reluctance

Horsepower: _____

(KW: _____)

Base Speed: _____ RPM

Base Volts: _____ volts, 3-phase

Base Frequency: _____ Hz

Operation

Before starting the VFD, ensure that all connections have been made properly and are secure.

Keypad and Display

The drive is configured and its operation monitored via the keypad and display. Refer to the table below for basic operation.

	START	When in keypad mode, used to start a stopped drive or to reverse the direction of rotation if bi-directional keypad mode is enabled.
	UP	Used to increase speed in real-time mode or to increase parameter values in parameter edit mode.
	DOWN	Used to decrease speed in real-time mode or to decrease parameter values in parameter edit mode.
	NAVIGATE	Used to display real-time information, to access and exit parameter edit mode and to store parameter changes.
	RESET /STOP	Used to reset a tripped drive.



Keypad and Display Layout

Control Keypad provides access to the drive parameters, and also allows control of the drive when Keypad Mode is selected in P1-12.

IP20, IP55 & IP66 models keypad with TFT display

Main Displayed Parameter
Shows the drive status or the value of whichever of the selectable parameters is currently being shown on the main display.

Operating Information
Provides a real time display of key operating information, e.g. output current and power.

Quick Help Button
Provides access to short description of the displayed messages.

F1 Button
Not used.

Start Button
When in Hand mode, used to start the drive.

Stop / Reset Button
Used to reset a tripped drive. When in Keypad mode, used to Stop the drive.

P2 **01**
STOP

37kW **400V** **3Ph**

F1 **F2**

Drive Address
Not used.

Navigate Button
Used to display real-time information, to access and exit parameter edit mode, and to store parameter changes.

F2 Button
Not used.

Up Button
Used to increase speed in Real-Time mode or to increase parameter values in Parameter Edit mode.

Down Button
Used to decrease speed in Real-Time mode or to decrease parameter values in Parameter Edit mode.

Operating Displays

Inhibit / STO Active		Drive Stopped			Drive Running Output Frequency Display		Drive Running Output Current Display		Drive Running Motor Power Display		Drive Running Motor Speed Display		
P2	01	P2	01	Output Frequency	01	Motor Current	01	Motor Power	01	Motor Speed	01		
INHIBIT		STOP			23.7Hz		15.3A		6.9kW		718rpm		
15kW	400V	3Ph	15kW	400V	3Ph	15.3A	6.9kW	6.9kW	23.7Hz	23.7Hz	15.3A	23.7Hz	15.3A
Drive Inhibited. The STO connections are not made.		Drive Stopped / Disabled.			Drive is enabled / running. Display shows the output frequency (Hz). Press the Navigate key to select alternate displays.		Press the Navigate key for < 1 second. The display will show the motor current (Amps).		Press the Navigate key for < 1 second. The display will show the motor power (kW).		If P1-10 > 0, pressing the Navigate key for < 1 second will display the motor speed (RPM).		



Changing Parameters

Stop	P2 01 P1-01	P2 01 P1-08	P2 01 30.0A↕	P2 01 P1-08	P2 01 Stop
15kW 400V 3Ph	50.0Hz	30.0A	P1-08 130.0 13.0	30.0A	15kW 400V 3Ph
Press and hold the Navigate key > 2 seconds.	Use the up and down keys to select the required parameter. Drives with TFT display will show the present parameter value on the lower line of the display.	Press the Navigate key for < 1 second.	Adjust the value using the Up and Down keys. Drives with TFT display will show the maximum and minimum possible settings on the lower line of the display.	Press for < 1 second to return to the parameter menu.	Press for > 2 seconds to return to the operating display.

Available Parameters

The parameters available are shown in the table below.

Par.	Description	Min	Max	Default	Units
P-01	Maximum Frequency/Speed Limit	P-02	500.0	50.0 (60.0)	Hz/RPM
P-02	Minimum Frequency/Speed Limit	0.0	P-01	36.0	Hz/RPM
P-03	Acceleration Ramp Time	0.00	600.0	5.0	s
P-04	Deceleration Ramp Time	0.00	600.0	5.0	s
P-07	Motor Rated Voltage/Back EMF at rated speed (PM/BLDC)	0	250/ 500	230/460	V
P-08	Motor Rated Current	Drive Rating Dependent			A
P-09	Motor Rated Frequency	10	500	60	Hz
P-10	Motor Rated Speed	0	30000	0	RPM
P-11	Low Frequency Torque Boost	0.0	Drive Dependent		%

Technical Data

Operational ambient temperature range

IP55, NEMA 12 drives:	-20 ... 40°C (frost and condensation free)
Storage Temperature:	-40 ... 60°C
Maximum Altitude:	2000m. Derate above 1000m: 1% / 100m
Maximum Humidity:	95%, non-condensing



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Ratings Table

For applications with Single phase, 208 - 230 volts supply & 3-phase, 230 volts motors

Frame Size	kW	HP	Input Current (Amps)	Fuse/MCB (Type B)		Maximum Cable Size		Output Current A	Model
				Non UL	UL	mm	AWG		
4	5.5	7.5	50.1	63	70	16	5	23	HCPVFD421501P
5	7.5	10	63.9	80	80	35	2	30	HCPVFD520201P
5	9	12.5	74	100	90	35	2	36	HCPVFD520251P
6	11	15	99.1	125	125	150	300MCM	45	HCPVFD620301P
6	15	20	121	160	150	150	300MCM	55	HCPVFD620401P
6	18	25	159.7	200	200	150	300MCM	75	HCPVFD620501P
6	22	30	163.4	200	200	150	300MCM	90	HCPVFD620601P

For applications with 3-phase, 208 - 230 volts supply & 3-phase, 230 volts motors

Frame Size	kW	HP	Input Current (Amps)	Fuse/MCB (Type B)		Maximum Cable Size		Output Current A	Model
				Non UL	UL	mm	AWG		
4	11	15	50.1	63	70	16	5	46	HCPVFD421501P
5	15	20	63.9	80	80	35	2	61	HCPVFD520201P
5	18.5	25	74.0	100	90	35	2	72	HCPVFD520251P
6	22	30	99.1	125	125	150	300MCM	90	HCPVFD620301P
6	30	40	121.0	160	150	150	300MCM	110	HCPVFD620401P
6	37	50	159.7	200	200	150	300MCM	150	HCPVFD620501P
6	45	60	163.4	200	200	150	300MCM	180	HCPVFD620601P



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Troubleshooting

Fault Code Messages

Fault Code	No.	Description
Ol-b	01	Brake channel over current
OL-br	02	Brake resistor overload
O-I	03	Output Over Current
I_t-trP	04	Motor Thermal Overload (I2t)
O-volt	06	Over voltage on DC bus
U-volt	07	Under voltage on DC bus
O-t	08	Heatsink over temperature
U-t	09	Under temperature
U-deF	10	Reset drive to defaults
E-trip	11	External trip
FLt-dc	13	DC bus ripple too high
P-LOSS	14	Input phase loss trip
h0-I	15	Output Over Current
th-Flt	16	Faulty thermistor on heatsink
dAtA-F	17	Internal memory fault (IO)
4-20 F	18	4-20mA Signal Lost
dAtA-E	19	Internal memory fault (DSP)
F-Ptc	21	Motor PTC thermistor trip
FAn-F	22	Cooling Fan Fault (IP66 only)
O-heat	23	Drive internal temperature too high
OUt-F	26	Output Fault

NOTE: Following an over current or overload trip (3, 4, 5, 15), the drive may not be reset until the reset time delay has elapsed to prevent damage to the drive.



Resetting the Drive Following a Trip

The drive has many protection features, designed to protect both the drive and motor from accidental damage. When any of these protection features are activated, the drive will trip, and display a fault message. The fault messages are listed on the previous page. When a trip occurs, after the cause of the trip has been investigated and rectified, the user can reset the trip in one of the following ways:

1. Press the keypad Stop key.
2. Power off the drive completely, then power on again

User Parameter Reset

P2	01	P2	01	P2	01
Stop		U-Def		Stop	
P1-08 ↑30.0 ↓3.0		30.0a		15kW 400V 3Ph	
Press and hold the Up, Down, and Stop keys for > 2 seconds.		The display shows U-Def. Briefly press the Stop key.		The display returns to Stop. All parameters are reset to Factory defaults.	



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For further information or consumer
technical support, visit our website at
www.hayward.com



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