

# VFD Variable Frequency Drive

## Installation Guide



Tamas Hydronic Panels  
**VFD Variable Frequency Drive**  
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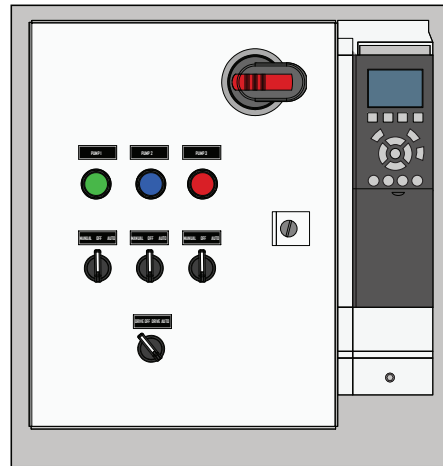
**This User Guide is Applicable to:**

**Variable Frequency Drive 208V Models**

- T-CP-2VLT3C208V* 3 Phase Variable Frequency Drive, (2) Horse Power, 208 Voltage
- T-CP-3VLT3C208V* 3 Phase Variable Frequency Drive, (3) Horse Power, 208 Voltage
- T-CP-4VLT3C208V* 3 Phase Variable Frequency Drive, (4) Horse Power, 208 Voltage
- T-CP-5VLT3C208V* 3 Phase Variable Frequency Drive, (5) Horse Power, 208 Voltage
- T-CP-7.5VLT3C208V* 3 Phase Variable Frequency Drive, (7.5) Horse Power, 208 Voltage
- T-CP-10VLT3C208V* 3 Phase Variable Frequency Drive, (10) Horse Power, 208 Voltage
- T-CP-15VLT3C208V* 3 Phase Variable Frequency Drive, (15) Horse Power, 208 Voltage

**Variable Frequency Drive 575V Models**

- T-CP-2VLT3C575* 3 Phase Variable Frequency Drive, (2) Horse Power, 575 Voltage
- T-CP-3VLT3C575* 3 Phase Variable Frequency Drive, (3) Horse Power, 575 Voltage
- T-CP-4VLT3C575* 3 Phase Variable Frequency Drive, (4) Horse Power, 575 Voltage
- T-CP-5VLT3C575* 3 Phase Variable Frequency Drive, (5) Horse Power, 575 Voltage
- T-CP-7.5VLT3C575* 3 Phase Variable Frequency Drive, (7.5) Horse Power, 575 Voltage
- T-CP-10VLT3C575* 3 Phase Variable Frequency Drive, (10) Horse Power, 575 Voltage
- T-CP-15VLT3C575* 3 Phase Variable Frequency Drive, (15) Horse Power, 575 Voltage



## Safety & Regulations

The VFD (Variable Frequency Drive) must be disconnected from the mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.

The [OFF/STOP] key on the control panel of the VFD does not disconnect the equipment from mains and is thus not to be used as a safety switch.

Do not remove the plugs for the motor and mains supply while the VFD is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.

Please note that the VFD has more voltage inputs than L1, L2, L3 when the DC-bus terminals or AUX24V option are used. Check that all voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.

The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the VFD is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.

While parameters are being changed, the motor

may start. Consequently, the stop key [OFF/STOP] must always be activated, following which data can be modified.

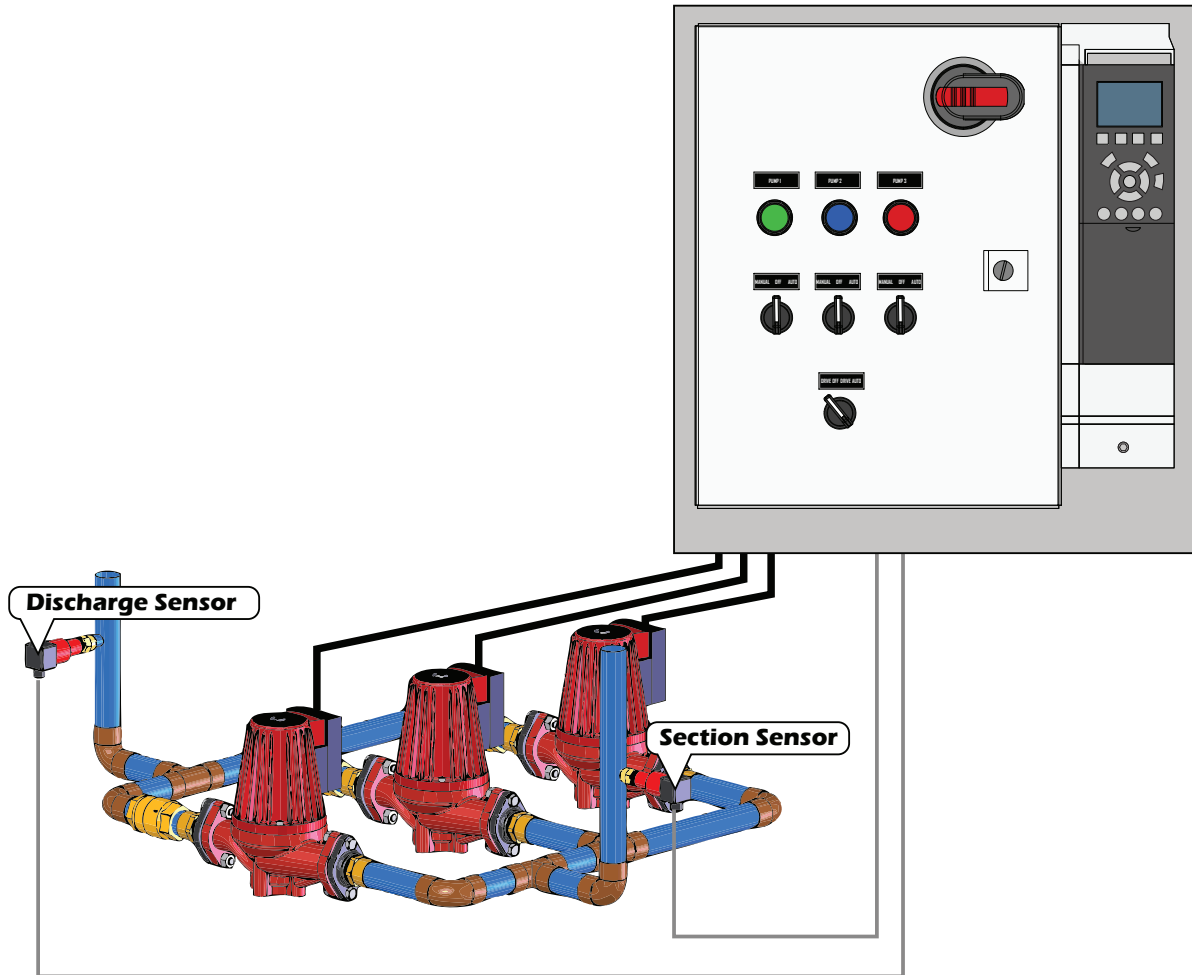
A stopped motor may start if a fault occurs in the electronics of the VFD, or if a temporary overload or a fault in the supply mains or the motor connection ceases.



**Electrostatic Precaution; Electro static discharge (ESD).** Many electronic components are sensitive to static electricity. Voltages so low that they cannot be felt, seen or heard, can reduce the life, affect performance, or completely destroy sensitive electronic components. When performing service, proper ESD equipment should be used to prevent possible damage from occurring.



**The VFD contains dangerous voltages when connected to mains voltage. After disconnecting from mains wait at least 15 minutes for VLT 8006-8062 before touching any electrical components. Also make sure that other voltage inputs have been disconnected, such as external 24VDC and load-sharing (linkage of DC intermediate circuit). Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the VLT may cause equipment failure, serious injury or death. Follow this manual and National Electrical Codes (NEC) and local safety codes.**



### Example A

This is an example of a three pump cascade heating and cooling application with two pressure transmitters calculating pressure differential between the desired pressure points.

## Description

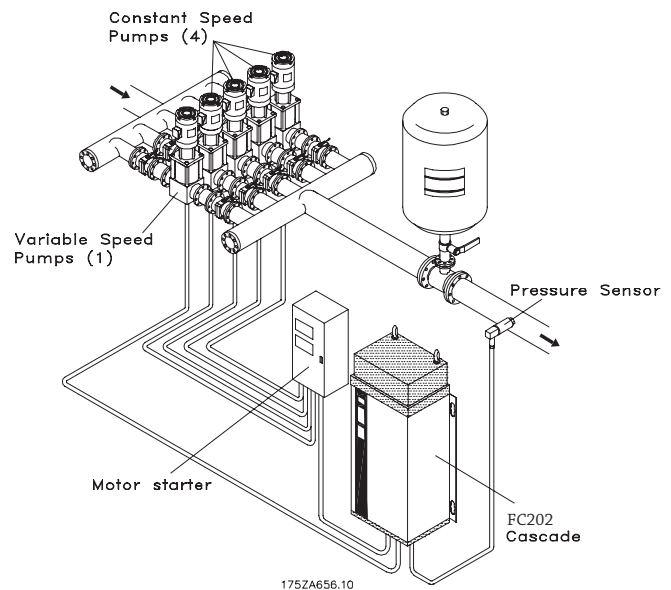
With the cascade controller option card, the VFD (Variable Frequency Drive) can automatically control up to five motors. Staging motors on or off is done cyclically, in accordance with operating hours. This function assures equal use over time and eliminates concern about starting a seldom used motor. The cascade controller includes four Form C relays having contacts rated 250V, 2A(non-inductive) that are used to control the motor contactors. The controller option card installs in the VFD control card cassette and can be ordered factory installed. The cascade controller is effective in applications where multiple motors are used to control a common flow, level or pressure involving pumps, fans, and blowers

## Cascade Control Principle

An important advantage to the cascade controller option is that it is based upon the VFDs advanced PID controller. This means that programming is done in selected units of measurement appropriate to the application and that the feedback and setpoints can be displayed. Unlike drives that base staging upon frequency, feedback allows precise control in response to actual system demand. The VFDs PID controller accommodates multiple feed back signals and multiple set points which allows regulating a system with different set point zones. In pumping applications, when a pressure feedback signal is not practical, the feedback signal may be taken near the pump by measuring flow. When the flow rate is low, the pressure needed is low. At increased flow, the pumps need to provide greater pressure to compensate for the increased pressure drop in the piping. The set point should be adjusted to match the flow in these cases. While difficult to accomplish with standard PID controllers, the cascade controller provides an easy solution. By programming one setpoint for minimum flow and the other for maximum flow, the VFD calculates intermediate setpoints based

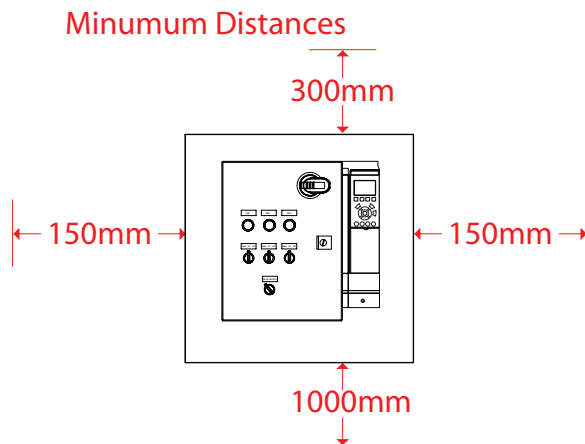
on the flow required. Cascade control operation depends on the general system design. Two operational modes are available:

1. Standard Cascade Control, with one speed controlled pump/fan and up to four fixed speed pumps/fans. Lead pump alternation makes it possible to average out the use of the pumps. This is done by cycling the lead pump in the system. Up to four pumps can be controlled this way.
2. Master/Slave Cascade Control has all pumps/ fans speed controlled through the Master drive.



### Installation Procedure

The control panel must be installed vertically. The VFD is cooled by means of air circulation. For the unit to be able to release its cooling air, the minimum distance over and below the unit must be as shown in the illustration below. To protect the unit from overheating, it must be ensured that the ambient temperature does not rise above the maximum temperature and 24-hour average can be seen from the General Technical Data. If the ambient temperature is in the range of 45°C-55°C, derating of the VFD will become relevant, see Derating for ambient temperature. The service life of the VFD will be reduced if derating for ambient temperature is not taken into account.



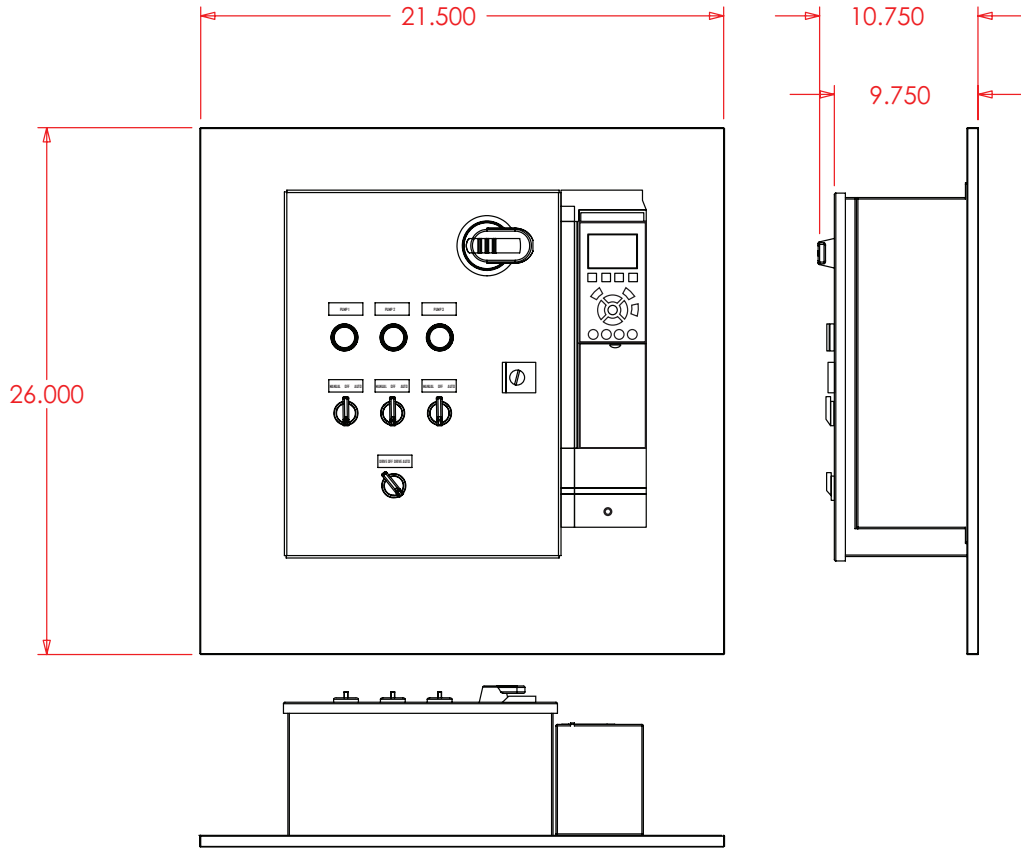
### Cables

Control cables and the filtered mains cable should be installed separate from the motor cables so as to avoid interference or coupling. Normally, a distance of 204mm (8in) will be sufficient, but it is recommended to keep the greatest possible distance wherever possible, especially where cables are installed in parallel over a substantial distance.

### EMC - Correct Electrical Installation








- Use only braided screened/armoured motor cables and braided screened/armoured control cables. The screen should provide a minimum coverage of 80%. The screen material must be metal, not limited to but typically copper, aluminium, steel or lead. There are no special requirements for the mains cable.
- Installations using rigid metal conduits are not required to use screened cable, but the motor cable must be installed in conduit separate from the control and mains cables. Full connection of the conduit from the drive to the motor is required. The EMC performance of flexible conduits varies a lot and information from the manufacturer must be obtained.
- Connect the screen/armour/conduit to earth at both ends for motor cables as well as for control cables. See also Earthing of braided screened/armoured control cables.
- Avoid terminating the screen/armour with twisted ends (pigtailed). Such a termination increases the high frequency impedance of the screen, which reduces its effectiveness at high frequencies. Use low impedance cable clamps or EMC cable glands instead.
- It is important to have good electrical contact between the mounting plate on which the VFD is installed and the metal chassis of the VFD unit.

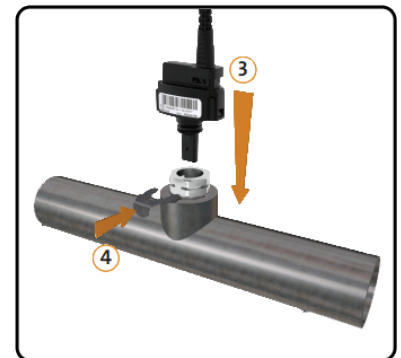
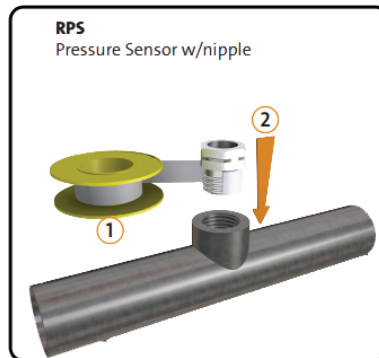
**Mechanical Dimensions**



**Pressure and Temperature Sensor Connections**

*Temperature Sensor is optional*

Pump Enable		
Supply Temperature Sensor		◀ Yellow
Return Temperature Sensor		◀ Yellow
Suction Pressure Sensor		◀ White
Discharge Pressure Sensor		◀ White
Sensor Ground -		◀ Green
Sensor Power +		◀ Brown



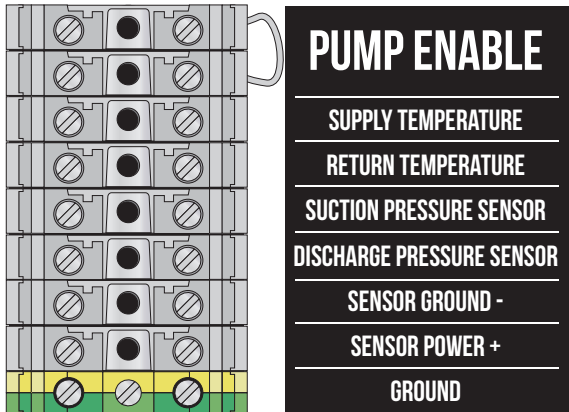
**Use shielded wire for sensor wiring.**

### System Start

The main disconnect on the control panel needs to be in the ON position.

No. 1 Pump Switch must be in the auto position.

On the terminal block (inside the control box) contacts pump enable must be closed by an outside pump demand digital signal (close contact).



For automatic cascade operation pump No. 1 to 4 must be in the AUTO position.

### System Stop


There are two ways you can hand stop the control system:


#### Hand Stop

1. On the VFD keypad, press the hand stop button.
2. Pumps 1 to 4 must be in the AUTO position.

#### Automatic Stop

Disconnect digital pump demand input to terminal pump enable by remote device.

 **Please Note:** When pumps 1 to 4 are in the AUTO position and in the DRIVE ON position pumps 1 to 4 are NOT disconnected and may engage at any time.

 **When servicing the control panel the main disconnect switch must be in the OFF position. DO NOT attempt to run the control system with enclosure door open.**

### Changing Setups

Two different setups are available for controlling the system. The setup can be changed on the front control switch between Setup No. 1 and Setup No. 2. when the system is equipped with this feature.

#### Setup No. 1

- Optional pressure transmitters.
  - Pressure Transmitter 1
  - Pressure Transmitter 2

The system calculates the difference between the two.

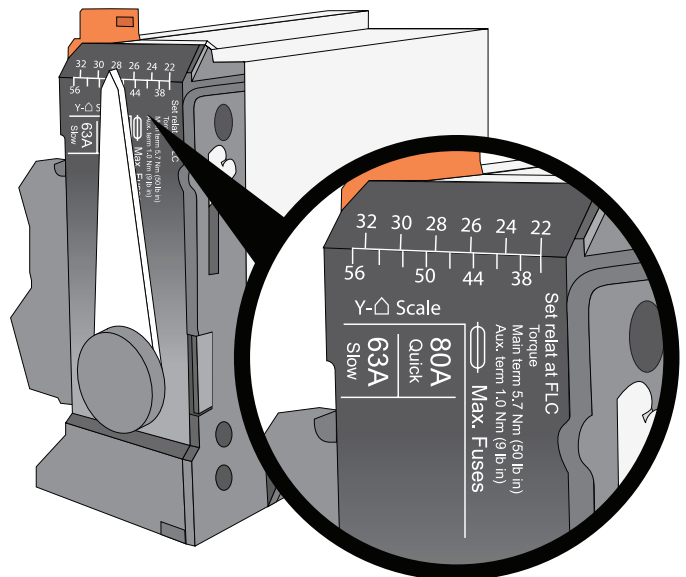
#### Setup No. 2

- Optional temperature transmitters.
  - Temperature Transmitter 1
  - Temperature Transmitter 2

The system calculates the difference between the two. (Setup No. 2 may also be equipped with a second set of pressure transmitters to achieve additional setpoints. Call factory for assistance.)

### Motor Overload Adjustment

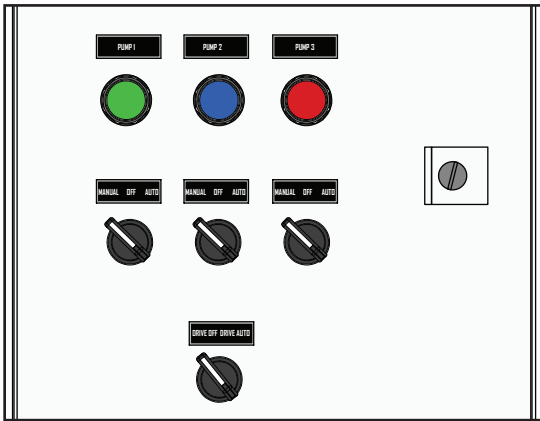
Please check your motor name plate for the highest amperage load.





### Manual Operation

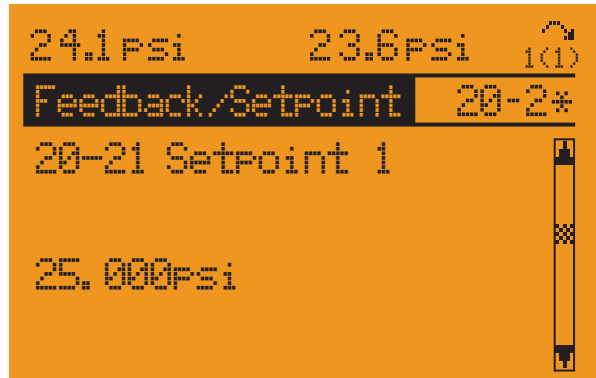
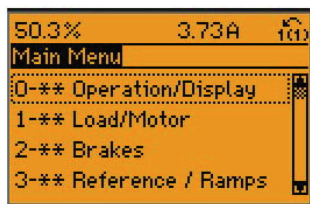
When the system needs to be operated manually, the VFD Drive switch needs to be in the **DRIVE OFF** position. The Pump #1-4 switches need to be set to **MANUAL** position for each desired manually controlled pump. When any of the Pump switches are switched to **MANUAL** position, the VFD Drive switch will automatically turn the drive off. Do not turn the pump #1-4 switches to off position when the VFD switch is turned on.



### Set Point Adjustment

Set point 1 is used in closed loop as the reference to compare the feedback values with. The set point can be offset with digital, analog or bus references. On the cascade control the valve calculates the difference between the two temperature and pressure transmitters. If the calculated value is below the setpoint the system speeds up and begins staging the pumps. If the calculated value is above the setpoint the system stops staging the pumps and slows down.

To change the setpoint push the Main Menu (Extended Menu) button, then using the left or right buttons navigate the menu to parameter group 20-\*\*. Using the up or down buttons, navigate to parameter 20-21 then press the Change Data button. Then use the up and down buttons to change the value to your desired setpoint. Lastly, press the OK button to apply the change.



Setpoint Adjustment Settings

### Pump Alteration

The Tamas Control panel is equipped with the Pump Alteration system to provide equal running time for all the controlled pumps including the Lead pump. In a configuration with only a single Drive, the Lead Pump is defined as the pump connected to the Drive.

More than one pump can be connected to the Drive through contactors controlled by the Master Drive's relays. Through normal staging and de-staging the cascade controller will alternate the Lead Pump to balancing running hours. It will also alternate the Lead Pump when starting the system or when exiting sleep mode\*. However, if the system demand stays below the maximum capacity of the Lead Pump for a long period of time without entering sleep mode\*, it will not alternate the pump. The time interval is adjusted to 72 hrs to alternate the lead pump.

The time interval can be adjusted at parameter 25-53



Alternation Settings

\* Sleep Mode is an optional programmable setting.

## 208V 3 Phase chart

	T-CP-2VLT3C2084	T-CP-3VLT3C2084	T-CP-4VLT3C2084	T-CP-5VLT3C2084	T-CP-7.5VLT3C2084	T-CP-10VLT3C2084	T-CP-15VLT3C2084
Output Current [A]	7.5 A 8.3	10.6 A 11.7	12.5 A 13.8	16.7 A 18.4	24.2 A 26.6	30.8 A 33.9	46.2 A 50.8
Output Power (240v)	2.70 kVa	3.82 kVa	4.50 kVa	6.00 kVa	8.7 kVa	11.1 kVa	16.6 kVa
Typical Shaft Output [kw]	1.5	2.2	3	3.7	5.5	7.5	11
Typical Shaft Output	2 HP	3 HP	4HP	5 HP	7.5 HP	10 HP	15 HP
Max Cable Cross-section [mm <sup>2</sup> ] (AWG)	[0.2-4]/(4-10)	[0.2-4]/(4-10)	[0.2-4]/(4-10)	[0.2-4]/(4-10)	[10]/(7)	[10]/(7)	[10]/(7)
Max Input Current [A]	6.8	9.5	11.3	15	22	28	42
Max Pre-Fuses [A]	20	20	32	32	63	63	63
Main Contactor	CI-9	CI-12	CI-16	CI-16	CI-30	CI-37	CI-50
Efficiency	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Weight IP 20 [Kg] (IBS)	4.9/10.8	4.9/10.8	6.6/14.55	6.6/14.55	12/26.46	12/26.46	12/26.46
Weight IP 55 [Kg] (IBS)	13.5/30	13.5/30	13.5/30	13.5/30	23/51	23/51	23/51
Power Loss at Max Load	82 W	116 W	155 W	185 W	269 W	310 W	447 W
Enclosure	NEMA 1	NEMA 1	NEMA 1	NEMA 1	NEMA 1	NEMA 1	NEMA 1
	<b>Contactors</b>						
	3 phase 2 HP 208V	3 phase 3 HP 208V	3 phase 4 HP 208V	3 phase 5 HP 208V	3 phase 7.5 HP 208V	3 phase 10 HP 208V	3 phase 15 HP 208V
Maximum load	25.88 Amp	36.57 Amp	43.13 Amp	57.62 Amp	83.49 Amp	106.26 Amp	159.39 Amp
Maximum Voltage	240 V	240 V	240 V	240 V	240 V	240 V	240 V
Overload Protection	TI-16	TI-16	TI-16	TI-30	TI-30	TI-80	TI-80
Current Range	6-9.2 A	8-12 A	11-16 A	15-20 A	24-32 A	22-32 A	42-63 A
Connection						Bus Bar	Bus Bar

## 575V 3 Phase chart

	T-CP-2VLT3C575	T-CP-3VLT3C575	T-CP-4VLT3C575	T-CP-5VLT3C575	T-CP-7.5VLT3C575	T-CP-10VLT3C575	T-CP-15VLT3C575
Output Current	2.7 A - 3 A	3.9 A - 4.3 A	4.9 A - 5.4 A	6.1 A - 6.6 A	9 A - 9.9 A	11 A - 12.1 A	18 A - 20 A
Output Power (575v)	2.70 kVa	3.9 kVa	4.9 kVa	6.1 kVa	9 kVa	11 kVa	17.9 kVa
Typical Shaft Output [kW]	1.5	2.2	3	4	5.5	7.5	11
Typical Shaft Output	2 HP	3 HP	4HP	5 HP	7.5 HP	10 HP	15 HP
Max Cable Cross Section [mm <sup>2</sup> ] (AWG)	[0.2-4]/(24-10)	[0.2-4]/(24-10)	[0.2-4]/(24-10)	[0.2-4]/(24-10)	[0.2-4]/(24-10)	[0.2-4]/(24-10)	[16]/(6)
Max Input Current [A]	2.7	4.1	5.2	5.8	8.6	10.4	17.2
Max Pre-Fuses [A]	10	20	20	20	32	32	40
Main Contactor	CI-6	CI-6	CI-6	CI-6	CI-9	CI-12	CI-15
Efficiency	0.97	0.97	0.97	0.97	0.97	0.97	0.98
Weight IP 20 [kg] (IBS)	6.5/14.33	6.5/14.33	6.5/14.33	6.5/14.33	6.6/14.55	6.6/14.55	12/26.46
Power Loss at Max Load [W]	65	92	122	145	195	261	225
Enclosure	NEMA 1	NEMA 1	NEMA 1	NEMA 1	NEMA 1	NEMA 1	NEMA 1
	<b>Contactors</b>						
	3 phase 2 HP 575 V	3 phase 3 HP 575 V	3 phase 4 HP 575 V	3 phase 5 HP 575 V	3 phase 7.5 HP 575 V	3 phase 10 HP 575 V	3 phase 15 HP 575 V
Maximum load	25.88 Amp	36.57 Amp	43.13 Amp	57.62 Amp	83.49 Amp	106.26 Amp	159.39 Amp
Maximum Voltage	575 V	575 V	575 V	575 V	575 V	575 V	575 V
Overload Protection	TI-16	TI-16	TI-16	TI-30	TI-30	TI-80	TI-80
Current Range	6-9.2 A	8-12 A	11-16 A	15-20 A	24-32 A	22-32 A	42-63 A
Connection						Bus Bar	Bus Bar



# Tamas Hydronic Panels VFD Variable Frequency Drive Warranty

## Limited Warranty

Tamas Hydronic Systems Inc. warrants each of its products to be free from defects in workmanship and materials under normal use and service for a period of 24 months from date of purchase from a Tamas Hydronic Systems inc. authorized Dealer.

If the product proves to be defective within the applicable warranty period, Tamas Hydronic Systems inc. on its sole discretion will repair or replace said product. Replacement product may be new or refurbished of equivalent or better specifications, relative to the defective product. Replacement product need not be of identical design or model. Any repair or replacement product pursuant to this warranty shall be warranted for not less than 90 days from date of such repair, irrespective of any earlier expiration of original warranty period. When Tamas Hydronic Systems Inc. Provides replacement, the defective product becomes the property of Tamas Hydronic Systems Inc.

Warranty Service, within the applicable warranty period, may be obtained by contacting your nearest Tamas Hydronics Systems inc. office via the original Authorized Agent and requesting a Return Material Authorization Number (RMA #). Proof of purchase in the form a dated invoice/receipt must be provided to expedite the issuance of a Factory RMA.

After an RMA number has been issued, the defective product must be packaged securely in the original or other suitable shipping package to ensure that it will not be damaged in transit. The RMA number must be visible on the outside of the package and a copy included inside the package. The package must be mailed or otherwise shipped back to Tamas Hydronic Systems Inc. with all costs of mailing/shipping/insurance prepaid by the warranty claimant.

Any package/s returned to Tamas Hydronic Systems Inc. without an approved and visible RMA number will be rejected and shipped back to purchaser at purchaser's expense. Tamas Hydronic Systems Inc. Reserves the right, if deemed necessary, to charge a reasonable levy for costs incurred, additional to mailing or shipping costs.

## Limitation of Warranties

If the Tamas Hydronic Systems Inc. product does not operate as warranted above the purchasers sole remedy shall be, at Tamas Hydronic Systems Inc.' s option, repair or replacement. The foregoing warranties and remedies are exclusive and in lieu of all other warranties, expressed or implied, either in fact or by operation of law, statutory or otherwise, including warranties of merchantability and fitness for a particular purpose/application. Tamas Hydronic Systems Inc. neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale, installation maintenance or use of Tamas Hydronic Systems Inc. products.

Tamas Hydronic Systems Inc. shall not be liable under this warranty; if its testing and examination discloses that the alleged defect in the product does not exist or was caused by the purchasers or third persons misuse, neglect, improper installation or testing, unauthorized attempts to repair or any other cause beyond the range of intended use, or by accident, fire, lightning or other hazard.

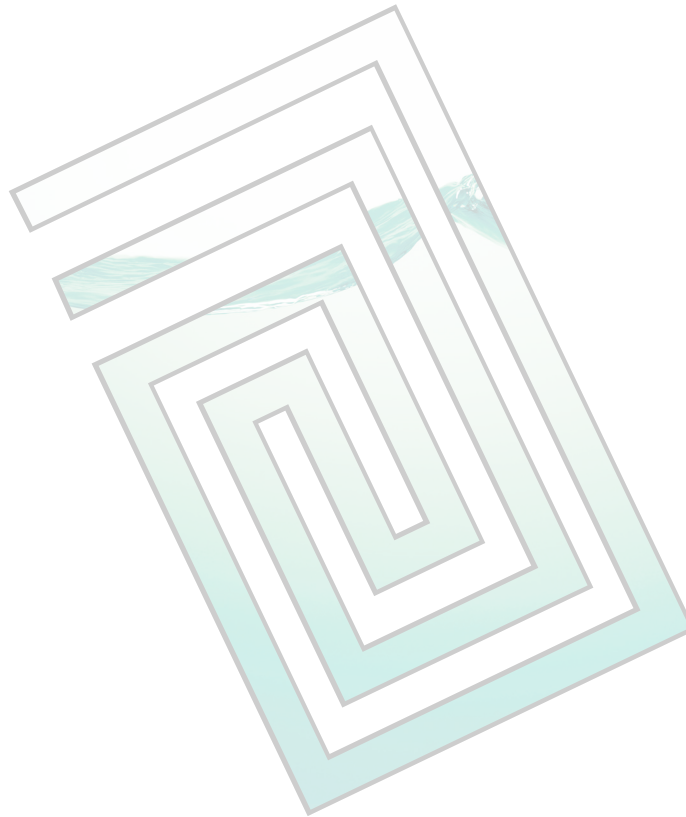
## Limitation of Liability

In no event will Tamas Hydronic Systems Inc. be liable for any damages, including loss of data, loss of profits, costs of cover or other incidental, consequential or indirect damages arising out of the installation, maintenance, commissioning, performance, failure or interruption of a Tamas Hydronic Systems Inc. product, however caused and on any theory of liability. This limitation will apply even if Tamas Hydronic Systems Inc. has been advised of the possibility of such damage.

## Local Law

This limited warranty statement gives the purchaser specific legal rights. The purchaser may also have other rights which vary from state to state in the United States, from Province to Province in Canada and from Country to Country elsewhere in the world.

To the extent this Limited Warranty Statement is inconsistent with local law, this statement shall be deemed modified to be consistent with such local law. Under such local law, certain disclaimers and limitations of this statement may not apply to the purchaser. For example, some states in the United States, as well as some governments outside the United States (including Canadian Provinces), may: Preclude the disclaimers and limitations in this statement from limiting the statutory rights of a consumer (e.g. United Kingdom); Otherwise restrict the ability of a manufacturer to enforce such disclaimers or limitations; or Grant the purchaser additional warranty rights which the manufacturer cannot disclaim, or not allow limitations on the duration of implied warranties.



**Custom, Reliable Hydronic Systems**

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