FAMILY OWNED

AMERICAN PROUD™

CMDR PRO (TVS) Variable Frequency Drive

Application Guide

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FW2327
0625 Supersedes NEW

Motor Wire Sizing

Motor HP	Copper Wire Size (AWG)	Maximum Wire Lengths Connecting the Controller to The Main Circuit Box (Based On 3% Voltage Drop At 230V)								
		14	12	10	8	6	4	3	2	Circuit Breaker
1.5/2	Max. Length. (Ft.)		85*	140*	220	345	550	680	895	20 AMP
3				115*	180	285	455	560	740	25 AMP
5					115	185	290	360	470	40 AMP

* Wire with 90°C Insulation only.

If submersible pump type is chosen, the output of the drive is 3-phase. (If the option is available, 3-wire may be available for submersible pumps).

The power output terminals (for motor wire connections) are located on the lower right-hand side of the controller and are labeled RED, BLK, YEL and (⏚). To select the wire size refer to the pump owner's manual, NEC and local codes for proper wire size.

NOTE: Regardless of owner's manual, wire length should not exceed 1000 ft.

If the Commander Pro Controller is used with above ground motors the output is limited to 3-phase. To maximize motor life the cable length between the controller and the motor should be limited to a maximum length of 25 ft. Caution: Correct motor rotating needs to be verified to avoid pump and motor damage.

Pressure Tank Sizing

Minimum Pressure Tank Size (Total Capacity)		
Controller	**Pump Flow Rating less than 12 GPM**	**Pump Flow Rating 12 GPM or higher**
VS15/TVS15	4.6 Gal (132477)	4.6 Gal (132477)
VS20/TVS20	4.6 Gal (132477)	14 Gal (132661)
VS30/TVS30	14 Gal (132661)	14 Gal (132661)
TVS50	14 Gal (132661)	20 Gal (132662)

Pre-charge should be set at 70% of system operating pressure. See tank table above for minimum pressure tank size.

Generator Sizing

VFD	Pump Flow Rating less than 12 GPM
VS15/TVS15	4.8 kW
VS20/TVS20	8.0 kW
VS30/TVS30	10.0 kW

There are several technical issues that go into correct sizing of a generator for use with a VFD controller. Since the VFD is a "non-linear load", the generator needs to be oversized considerably for proper operation. Listed below is minimum recommended sizing of a generator for each drive rating if the VFD controller is the only load on the generator. Because of the variation in design of voltage controls used in generators, the generator manufacture should always be contacted to verify the correct sizing when used with a VFD controller.

For best results when used with a generator in the Advanced Features Menu the **Powered by Generator option needs to be set to "Yes"**.

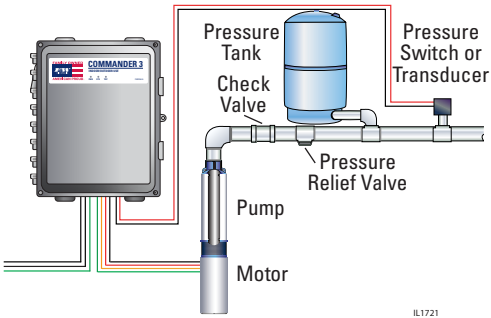
Controller Location Selection

The NEMA 3R controller is intended for indoor and outdoor use and for operation in ambient temperatures up to 125°F (50°C). The following recommendations will help in selection of the proper location of the unit:

1. A tank tee is recommended for mounting the tank, pressure switch/transducer, pressure gauge, and pressure relief valve at one junction. There should be no elbows between the tank and pressure switch/ transducer.
2. The unit should be mounted on a sturdy supporting structure such as a wall or supporting post.
3. The electronics inside the controller are air-cooled. As a result, there should be at least 6 inches of clearance on each side and below the unit to allow room for air flow.

Controller Location Selection Cont'd.

4. The controller should only be mounted with the wiring end oriented downward. If possible, for best cooling, the controller should not be placed in direct sunlight or other locations subject to extreme temperatures or humidity (mounting location should not be subjected to condensation).
5. Do not expose the drive to water spray greater than 30° from vertical.



Button Configuration

NOTE: Be sure your drive is installed and wired properly per the instruction manual before proceeding.

Key	Function
EDIT	Allows for changes to be made.
UP / DOWN	Scroll up or down to view change selections.
ENTER	Saves changes.
ESCAPE	Discard changes and/or return to the home screen.

Entering the Program Mode
Press and hold the EDIT and ENTER keys simultaneously for 3-5 seconds to access programming mode.

Entering the Fault Log
Press and hold the UP and DOWN keys simultaneously for 3-5 seconds to access the fault log.

1. Control Choice

At initial power-up, the drive will detect what control device is attached and will automatically set the control choice. If a switch or transducer is not hooked up, the drive will default to Switch as it's control choice.

For Pressure Transducer	
Set Transducer Range	50 – 300 PSI
Set Target Pressure	15 – (80% of transducer range)
*Set Over Pressure	4 – 20 PSI
Set Draw Down	2 – 25 PSI

*Sets the pressure increase in PSI over the setpoint that will cause the drive to turn off the output to the motor to prevent over pressurizing the plumbing system.

2. Maximum Motor Current

4" Submersible – 3-Phase (AMP)			
Manufacturer	**1.5 HP**	**2.0 HP**	**3.0 HP**
F&W	5.9	8.1	10.9
FE	5.9	8.1	10.9
Pentek	6.6	8.0	10.1
CentriPro	6.6	8.0	10.1
Grundfos	7.3	8.7	11.6

4" Submersible – 3-Wire, Single Phase (AMP)					
Manufacturer	**0.5 HP**	**0.75 HP**	**1.0 HP**	**1.5 HP**	**2.0 HP**
F&W	6.0	8.0	10.4	11.5	13.2
FE	6.0	8.0	9.8	11.5	13.2
Pentek	6.3	7.9	9.5	11.0	12.2
CentriPro	6.3	7.9	9.5	11.0	12.2
Grundfos	6.0	8.4	9.8	11.6	13.2

3. Maximum Frequency

Standby Drawdown	
Default Setting	**Optional**
80 Hz	50 – 80 Hz
Setting frequency determines the maximum motor speed. For matched HP rating of motor & pump end, set to 60 Hz. For pump end of half the HP rating of the motor (i.e. 3/4HP pump & 1.5 HP motor), set to 80 Hz.	

4. Pass Code Enable

Sets 5-digit pass code using Up/ Down keys
Pass code restricts parameters being changed by non-authorized individuals.

NOTE: If pass code lost, use default **46755**.

5. Underload Protection

Underload Protection provides pump protection from deadhead or dry well conditions.

Programmable options include: ON, OFF, and PRIME (off for 30 minutes to prime system).

5. Underload Protection Cont'd.

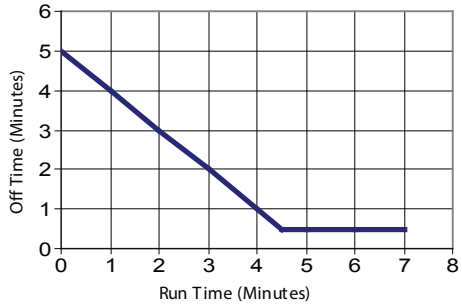
Default Underload Trip Point	
1.5 HP	3.9 A
2.0 HP	5.3 A
3.0 HP	6.5 A

If the motor current falls below this set point when drive has ramped to maximum frequency, the drive will trip on Underload Fault. Adjust down in increments of .2 if nuisance underload trip occurs.

Underload Off Time

Set to fixed time off before restarting in a range of **15 to 240 minutes** in increments of 15 minutes, or **12 or 24 hours** if desired. If set to OFF, underload time is variable by Intelligent Reset (see chart below).

"Intelligent Reset" Recovery Time Chart



6. Standby Sensitivity

The parameters for allowing the drive to go into standby mode at no/low flow.

NOTE: All three parameters must be met for standby to be initiated.

Default Standby Frequency
50 Hz
When the drive is running for 15 seconds below this frequency. and current is below the standby current, the drive will begin ramping the motor speed down and monitor system pressure to go into standby mode.

Standby Drawdown	
Default Setting	**Optional**
0.5 PSI	0.5 – 2.0 PSI
Increase the amount of pressure fluctuation allowed during the standby logic processing and still allow the drive to go into standby mode.	

Default Standby Current	
1.5 HP	3.3 A
2.0 HP	4.9 A
3.0 HP	6.3 A
When the drive is running for 15 seconds below this current and frequency is below the standby frequency, the drive will begin ramping the motor speed down and monitor system pressure to go into standby mode.	

7. Broken Pipe Mode

Turn On/Off broken pipe trip. When On, if the drive is running the pump continuously for the set time, the drive will trip out on “Broken Pipe”.

Broken Pipe Run Time	
Default Setting	**Optional**
24 Hours	30 mins. – 48 Hours
Define the time that the drive can run continuously before tripping on “Broken Pipe”.	

8. Advanced Features

Adjusting Locked Rotor Amps
With “Advanced Features” displayed on the drive screen press and hold ENTER, then press UP & DOWN.

Simultaneously release all three buttons and “Locked Rotor Trip Point” will be displayed. Use Up or Down buttons to adjust, pressing ENTER to confirm the change.

Continue pressing ENTER through the additional options. “Press START to continue” will be displayed. Press START to exit back to Main Menu, saving adjustments to “Locked Rotor Amps”.

8. Advanced Features Cont'd.

Feature	Description	Usage
Drive Parameters	View the current output Hz, Amps & heat sink temperature.	Used for diagnostic purposes.
Motor Type	Change setting for the type of pump motor.	This option is used to change the setting for the type of pump and motor the controller was set to use during the initial set-up menu.
Manual Run Mode	Sets pump to run without pressure switch. **Default: OFF**	Turn on a manual run condition at a set frequency for a defined amount of time.

Feature	Options	Description
External Control Mode Determines if the "Alarm In" contacts trips out the drive or just puts it in Standby Mode	Off **Default**	If Off and the contacts wired to the "Alarm In" terminal blocks are inverse of the "Alarm In" Relay settings, the drive trips out on "External Trip". This is used for protection like over pressure.
	On	If On and the contacts wired to the "Alarm In" terminal blocks close, the drive goes to Standby Mode. This is used for control like a timer contact for an irrigation system.
Powered by Generator	Yes	Sets the drive circuitry to expect power delivered from a gas driven generator.
	No **Default**	Not powered from a gas driven generator.
	Depending upon application a 5-10% pressure drop can be experienced when the drive is running the pump & motor at full speed.	

8. Advanced Features Cont'd.

Feature	Options	Usage
Alarm In Relay Sets "Alarm In" contact settings	Normally Open **(N/O)**	If set to "Normally Open", drive will operate normally when the contacts are open & trip (or go to Standby Mode) when contacts close.
	Normally Closed **(N/C)**	If set to "Normally Closed", drive will operate normally when the contacts are closed & trip (or go to Standby Mode) when contacts open.
	Example: An irrigation timer closes a contact to signal the drive to run, the Alarm In Relay setting should be set to NC (Normal Closed) for the drive to be active during the irrigation cycle.	
Drive Status Relay Sets "Alarm Out" contact settings	Normally Open **(N/O)**	
	Normally Closed **(N/C)**	
	The state of the relay changes when the drive trips. Typically, not for use in most residential applications.	

9. Reset to Factory Defaults

Resetting the drive back to factory defaults will clear any changes made to settings and result in the Initial Start-up Menu for the drive being displayed.

10. Control Settings

Setting	Description	Usage
Transducer Calibration	Used to calibrate transducer reading with external pressure gage within 20 – 80 PSI	Adjust value to match the pressure reading of the external pressure gauge & press enter.
PID Set Points Adjust Transducer feedback control parameters	Control PID P	100 – 5000 **Default: 400**
	Control PID D	1000 – 10000 **Default: 5000**
	Control PID Max	10 -50 **Default: 50**
Pipe Fill Mode	Set ON	When Pipe Fill mode is On, the drive will not trip on "Deadhead/ Low PSI" fault for set time. Set Pipe Fill Time: 1 – 15 minutes
	Set OFF **Default**	The drive is running under normal operation.

System Trip Codes

Fault	Possible Cause	Corrective Action
Drive Parameters	Shorted motor cables	Check motor wires and drop cable for shorts or bad connections.
	Shorted motor	Replace motor.
	Damaged Wire insulation	Use a megger to check drop cable for insulation damage.
	Internal hardware short	If motor is disconnected, and the fault is present when reset, replace drive.
Locked Rotor	Motor/pump misaligned	Verify pump is mounted flush on motor mounting flange.
	Bound pump	Check for debris in pump.
Transducer Found	Drive set for Switch control, but a transducer signal was detected	Change drive control choice from "Switch" to "Transducer" in the Control Choice menu.
Transducer Short	Drive has detected a short circuit between S1 & S2 terminals	Internal short of transducer. Replace transducer.
	Switch is hooked up between S1 & S2	Replace switch with transducer.

System Trip Codes

Fault	Possible Cause	Corrective Action
Transducer Open	Transducer lead not connected properly to transducer (or cut)	Check transducer lead connection and/or replace transducer lead wire.
	Loose connection on terminals S1 & S2	Check transducer lead connection at drive terminals S1 & S2.
	Transducer lead wire backwards at S1 & S2 terminals	Switch transducer leads at S1 & S2.
	Switch is hooked up between S1 & S2	Replace switch with transducer.
	Transducer failed as an open circuit	Replace transducer.
Underload	Underload sensitivity incorrect	Adjust underload sensitivity in Underload Protection menu.
	Over pumped/dry well	Wait for well to recover and automatic restart timer to time out.
	Blocked pump screen	Clear pump screen.
	Broken pump shaft	Replace pump shaft (or pump).
	Worn pump	Replace pump.
Under Voltage	Low line voltage	Check line voltage and confirm all connections are secure.
	Power was removed from drive	
Overheated	Excessive heating of Drive	Ambient temperature is above 125°F. Check for obstructed or inoperable fan Check for blocked vents.

System Trip Codes

Fault	Possible Cause	Corrective Action
Low PSI	Pipe has not filled	Reset pipe fill mode in Menu #10 Control Settings and increase fill time if necessary.
	Valve closed between pump & transducer	Confirm valves are open.
	Pressure transducer clogged	Check transducer port & clean.
	Damaged transducer	Replace transducer.
Overpressure	Water pressure measured 85% or higher of transducer range	System pressure can spike for rapidly closing valves. Drive will automatically reset and start running the motor when the drawdown pressure is reached and at least 10 seconds have passed since the trip occurred.
	Transducer lead wire backwards at S1 & S2 terminals	Switch transducer leads at S1 & S2.
	Transducer failed and producing a high-pressure signal	Replace Transducer.
Broken Pipe	Drive has been running without going into standby mode for set time	Check for broken or leaking pipe and repair as necessary.
	Application calls for long run time	Increase broken pipe run time in Advanced Feature menu.
External Trip	Contacts closed on “Alarm In” terminals	Check condition of switch wired into “Alarm In” terminals.

Problem Diagnosis Chart

Water flow rate is not as high as expected.

Possible Cause

1. Motor/Pump is running backwards
2. Pump capacity cannot supply the demand
3. Temperature in the controller is too high

   If the controller's heat exchanger becomes too hot, the controller will reduce the output frequency to the motor to lower the power consumption.

Excessive pressure fluctuations.

Possible Cause

1. Waterlogged tank
2. Pressure tank is too small for flow rating of the pump

Motor runs continuously with no flow demand.

Possible Cause

1. Standby sensitivity (Transducer Control) needs adjusted
2. Leak in the household or outdoor plumbing
3. Leak in the pit-less adapter

Problem Diagnosis Chart Cont'd.

Drive will not come out of standby mode.

Possible Cause

1. Bad pressure switch
2. Loose pressure switch wire connection or broken wire
3. Drive is in switch control mode and transducer is hooked up backwards

No water flow with motor pulling high current.

Possible Cause

1. Open connection between drive & motor or open motor winding
2. Damaged pump or motor

Commander Pro Series	Commander Pro 15 Series	Commander Pro 20 Series	Commander Pro 30 Series
Model Number	TVS15	TVS20	TVS30
Horsepower	Up to 1.5 HP Three Phase	Up to 2 HP Three Phase	Up to 3 HP Three Phase
Input Voltage	200 – 250 V Single Phase		
Input Frequency	60/50 Hz		
Input Amps (RMS)	11 Amps	19 Amps	23 Amps
Input Power (Idle)	35 Watts	65 Watts	65 Watts
Output Phase	3-wire Single Phase: up to 1-1/2 HP	3-wire Single Phase: up to 2 HP	
	Up to 1.5 HP Three Phase	Up to 2 HP Three Phase	Up to 3 HP Three Phase
Output Frequency	Variable (30 – 80 Hz) Three Phase, (30 - 60 Hz) 3 Wire Single Phase		
Pressure	25 – 80 PSI (preset to 50 PSI) all units		
Ambient Temp. Range	-20° C (-4° F) to 50° C (122° F)		

Groundwater Support Team
1-800-828-2313 • 1-280-599-8345 • GWTech@FlintandWalling

Flint & Walling, Inc. • 800-345-9422 • ***www.FlintandWalling.com***