TUF Grinder™ Control Panel

Variable Frequency Drive for Grinder Pumps
User Manual

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⚠WARNINGS

Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

Failure to follow these precautions could result in serious injury or death. Keep these instructions with warranty after installation. This product must be installed in accordance with National Electrical Code, ANSI/NFPA 70 so as to prevent moisture from entering or accumulating within the controller housing.
See additional specifications on page 3 of this manual.

⚠WARNING

ELECTRICAL SHOCK HAZARD

Disconnect power to the panel and wait 10 minutes before removing any cover.
A qualified service person must install and service this product according to applicable codes and electrical schematics.

- Lethal voltages are still present inside the panel after power is disconnected. Wait 10 minutes to allow internal capacitors to fully discharge before attempting to connect or disconnect wiring or to service this equipment.
- Do not connect incoming power to motor terminals U, V, W. Doing so will result in irreversible damage to the drive.
- Do not connect power to this equipment if it has been damaged or has any missing parts.
- Verify that the incoming voltage supply matches the panel rating before applying power to the unit.
- The panel contains no serviceable parts, do not attempt to repair this equipment.
- The panel must be grounded at the grounding terminal according to N.E.C. Refer to the electrical connections page.
- Do not install in areas with: excessive or conductive dust, corrosive or flammable gas, excessive heat, regular impact shocks or excessive vibration.
- Do not install in areas where ambient temperature exceeds 40°C (104°F).

⚠WARNING

EXPLOSION OR FIRE HAZARD

Do not use this product with flammable liquids. Do not install in hazardous locations as defined by National Electrical Code, ANSI/NFPA 70.

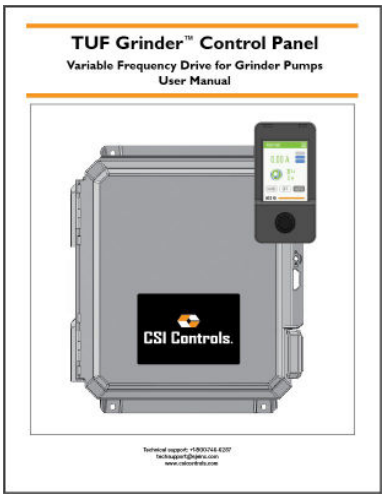
INCLUDED IN THE TUF GRINDER™ PANEL PACKAGE

1. TUF Grinder™ Panel VFD controller (Simplex, 2HP, 240VAC)
2. User manual
3. Schematic

Verify that all components are included and the TUF Grinder™ Panel model number is correct.

1

2



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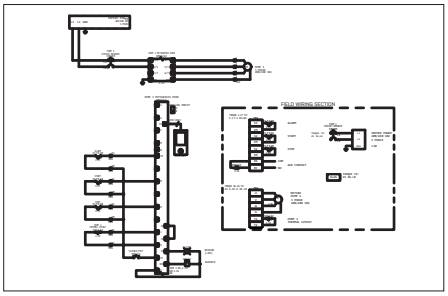
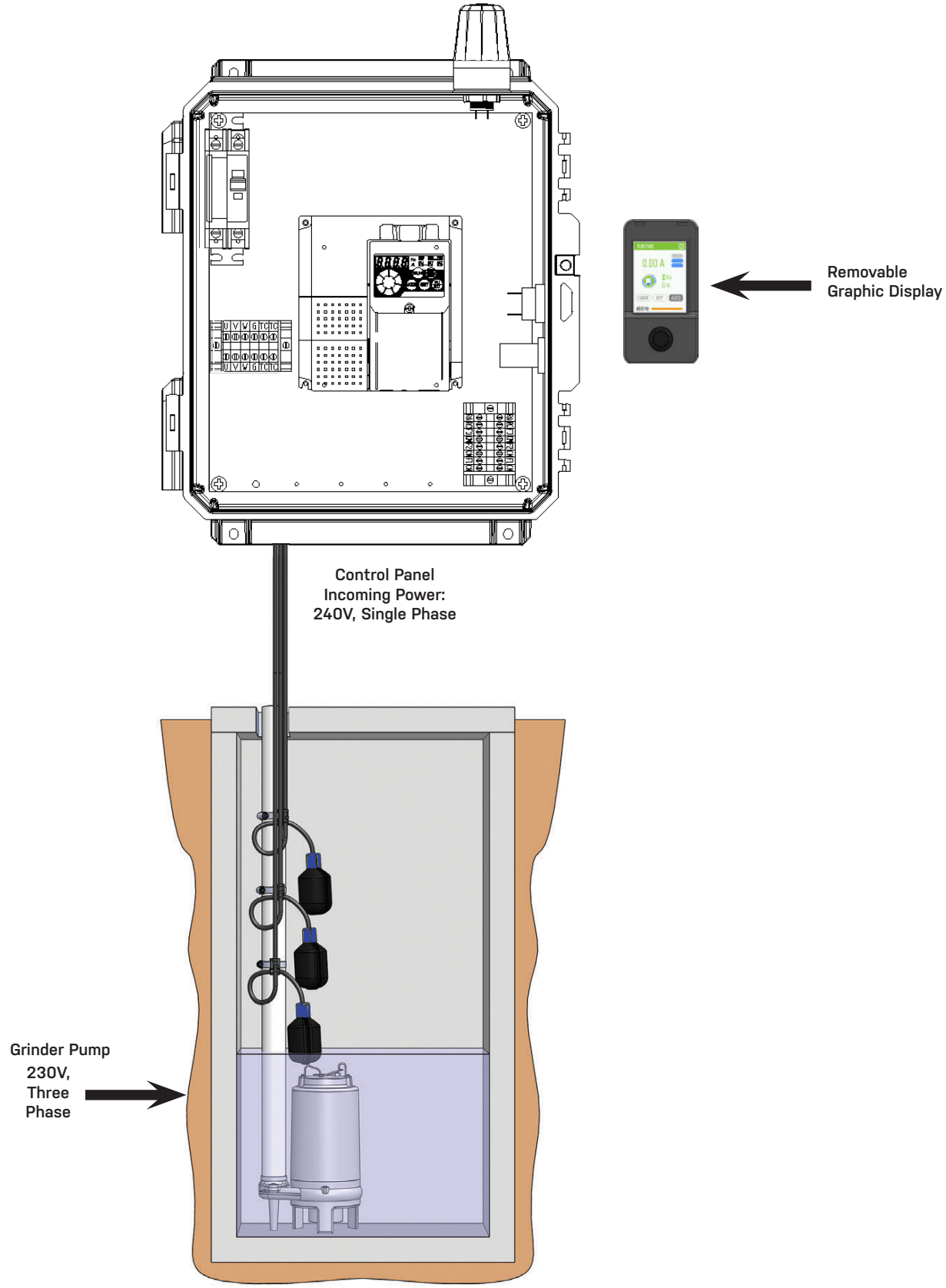


SYSTEM OVERVIEW

SIMPLEX 2HP, 240VAC

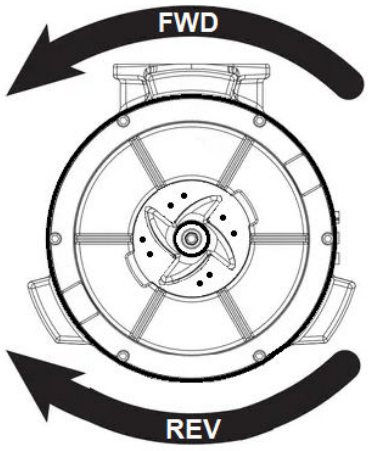


INTRODUCTION & SPECIFICATIONS

Congratulations and thank you for your purchase of the TUF Grinder™ Control Panel. This manual explains the features and operations of the controller which was designed to operate a grinder pump in wastewater application. The TUF Grinder™ Control Panel is designed to operate on 208-240VAC single phase power to control a 208-240VAC three phase sewage grinder pump in level control applications. Two or three control switches activate a Variable Frequency Drive (VFD) to turn the pump on and off as the level rises. If a high-level alarm condition occurs, it activates the audible/visual alarm system. The TUF Grinder™ can help reduce pump clogging by reversing the impeller rotation to clear debris. This is done momentarily on start, on stop, or when detecting high-amp conditions. The reverse operation is automatic and done repeatedly until the binding material has been shredded to a size that can pass through the pump. This control method reduces clogging and potential failure resulting from locked rotor. Manual Forward/Reverse operation is possible through the HMI.

GENERAL

- One Variable Frequency Drive grinder pump controller
- Forward and auto-reverse operation (De-Rag)
- Operates using two or three control float switches
- HMI - Rotary selector for menu navigation and editing settings
- HMI - High-Brightness 2.4" color graphic LCD display
- Alarm Test/Silence push button



PUMP CONTROL AND PROTECTION

- Pump run control/Fault status monitoring
- Pump speed (Hz) and Current (A) indication
- Pump motor overload protection
- High-level alarms/Pump run on high level
- Pump dry run alarm
- Pump run time/Cycle counter
- Max pump cycle run time limiter

ELECTRICAL SPECIFICATIONS

- Single Phase Input Models: 240VAC nominal (208-240VAC 50Hz/60Hz, single phase)
- Three Phase Input Models: 240VAC nominal (208-240VAC 50Hz/60Hz, three phase)
- Three Phase Input Models: 480VAC nominal (380-480VAC 50Hz/60Hz, three phase)
- Output 0-240VAC, three phase, 0-60Hz
- Output 0-480VAC, three phase, 0-60Hz
  Note: The output voltage cannot exceed the input voltage.

DEDICATED I/Os

- 4 Digital inputs (Dry contact only)
- 3 x float switch inputs: Stop/Start/High Level
- 1 x Pump Thermal cut off input
- 1 Relay output (N.O.) 240VAC, 0.3A Max

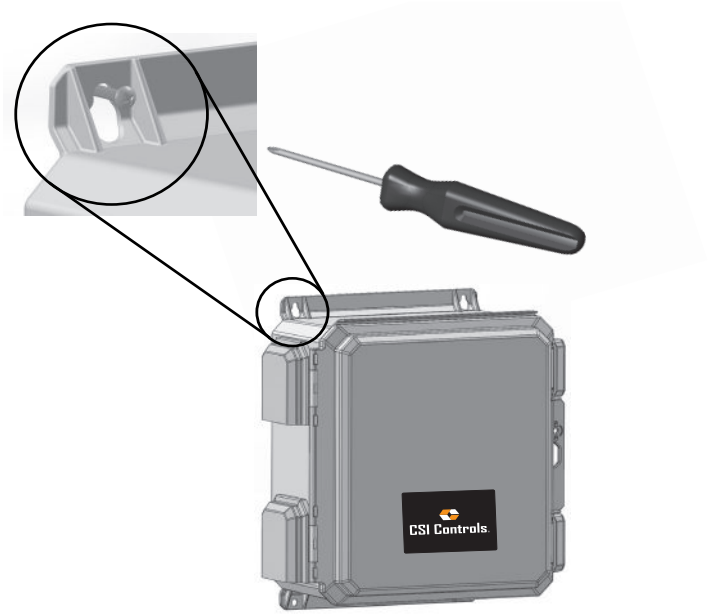
ENVIRONMENT

- Surrounding air temperature: 14°F to 104°F (-10°C to 40°C)
- Panel internal temperature: 14°F to 122°F (-10°C to 50°C)
- Storage temperature -4°F to 131°F (-20°C to 55°C)
- Altitude: Maximum of 3280 ft (1000m) above sea level
- Outdoor rated enclosure (UL Type 3R)

PART NUMBERS

Part Number	Panel Model	Simplex
1114632	TUFGS-240-1-11	TUF Grinder™ Simplex, 240V, 1PH Input, 3PH Output, 2HP, 11A
1114633	TUFGS-240-1-17.8	TUF Grinder™ Simplex, 240V, 1PH Input, 3PH Output, 3-5HP, 17.8A
1114634	TUFGS-240-1-28	TUF Grinder™ Simplex, 240V, 1PH Input, 3PH Output, 7.5HP, 28A
1114635	TUFGS-240-3-11	TUF Grinder™ Simplex, 240V, 3PH Input, 3PH Output, 2HP, 11A
1114636	TUFGS-240-3-16.5	TUF Grinder™ Simplex, 240V, 3PH Input, 3PH Output, 5HP, 16.5A
1114637	TUFGS-240-3-31.8	TUF Grinder™ Simplex, 240V, 3PH Input, 3PH Output, 7.5-10HP, 31.8A
		Duplex
1114638	TUFGD-240-1-11	TUF Grinder™ Duplex, 240V, 1PH Input, 3PH Output, 2HP, 11A
1114639	TUFGD-240-1-17.8	TUF Grinder™ Duplex, 240V, 1PH Input, 3PH Output, 3-5HP, 17.8A
1114640	TUFGD-240-3-11	TUF Grinder™ Duplex, 240V, 3PH Input, 3PH Output, 2HP, 11A
1114641	TUFGD-240-3-16.5	TUF Grinder™ Duplex, 240V, 3PH Input, 3PH Output, 5HP, 16.5A
1114642	TUFGD-240-3-31.8	TUF Grinder™ Duplex, 240V, 3PH Input, 3PH Output, 7.5-10HP, 31.8A

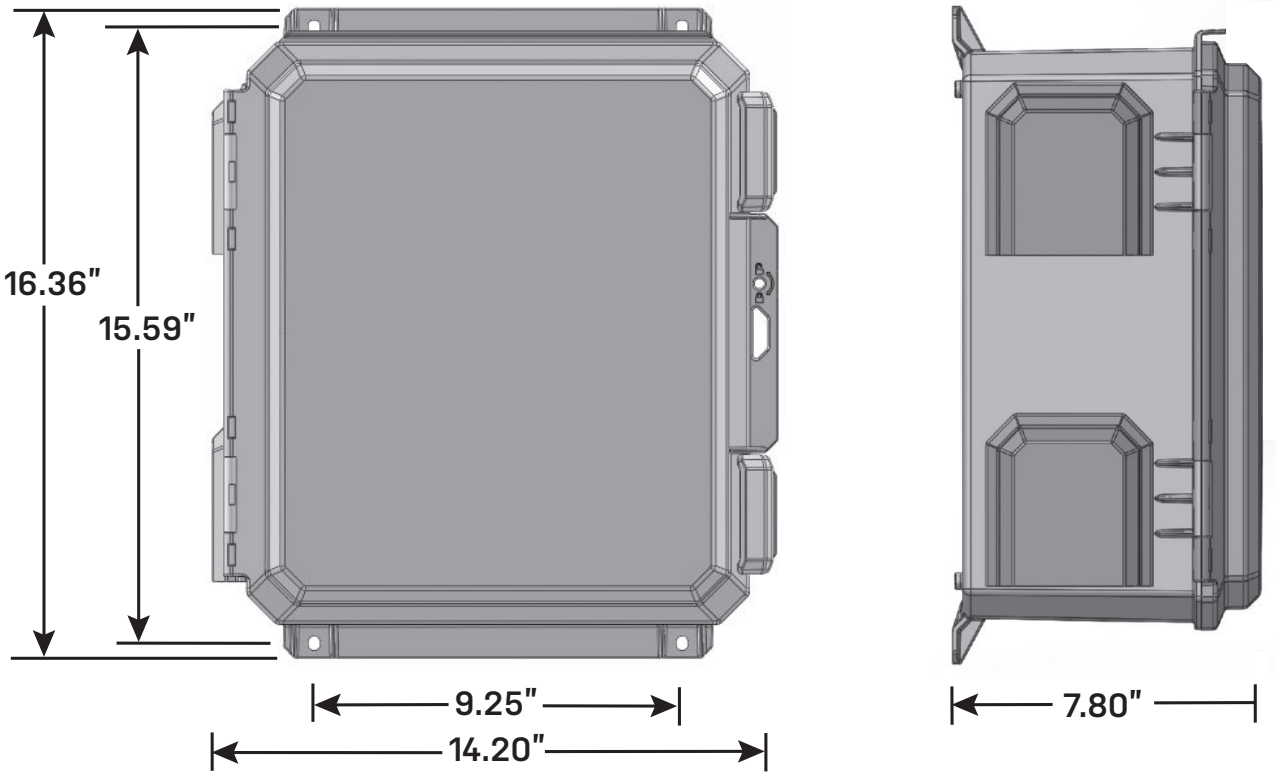
TUF GRINDER™ PANEL INSTALLATION & MOUNTING



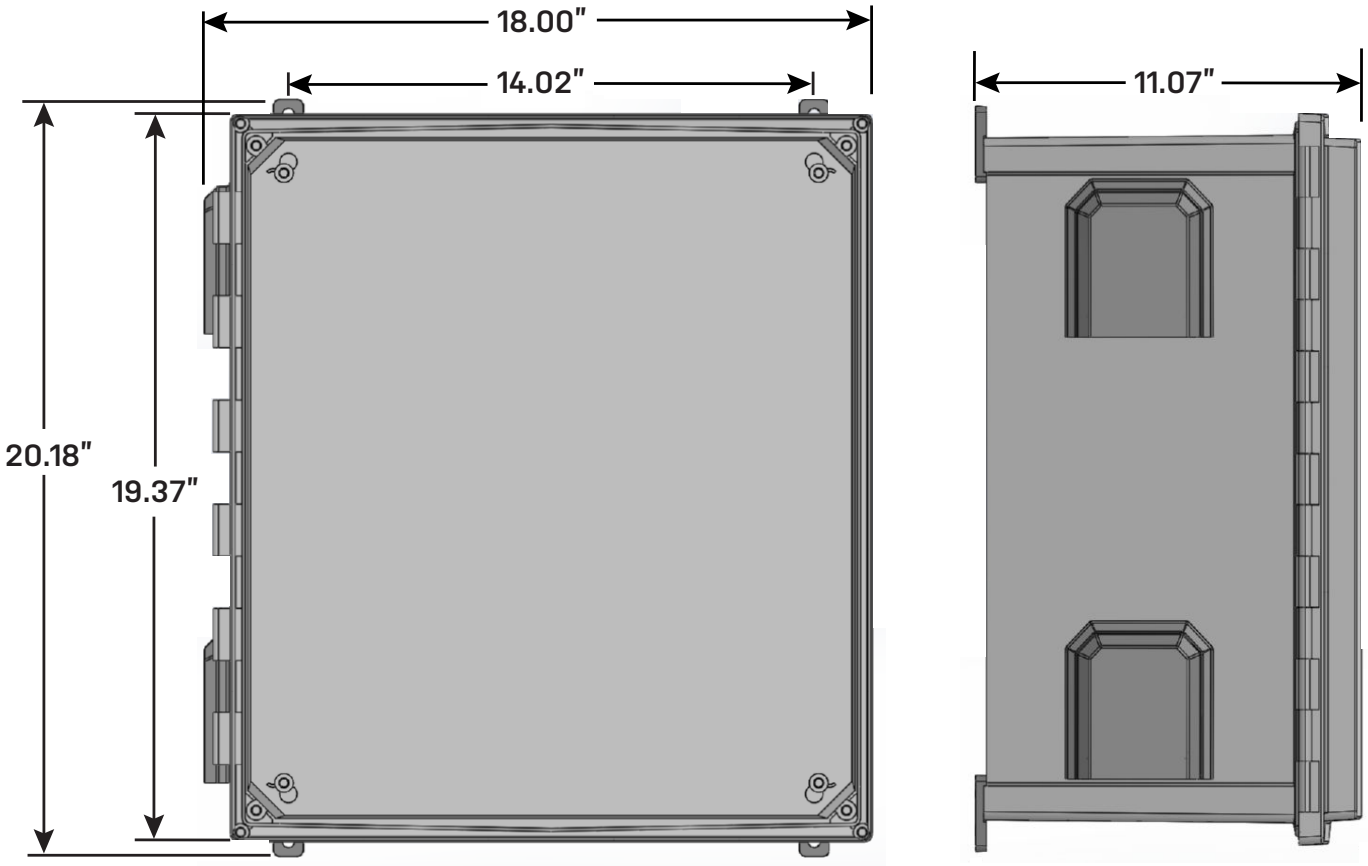
1. The TUF Grinder™ Control Panel is designed for outdoor installations.
2. The control panel can be wall or post mounted.
3. Mount vertically using four (4) screws.
4. Avoid locations with direct sunlight exposure.
5. Located near the wet well, keeping the motor cable as short as possible.
6. Seal offs are required for all conduits going to the tank.

ENCLOSURE DIMENSIONS

14”x12”x6” Enclosure

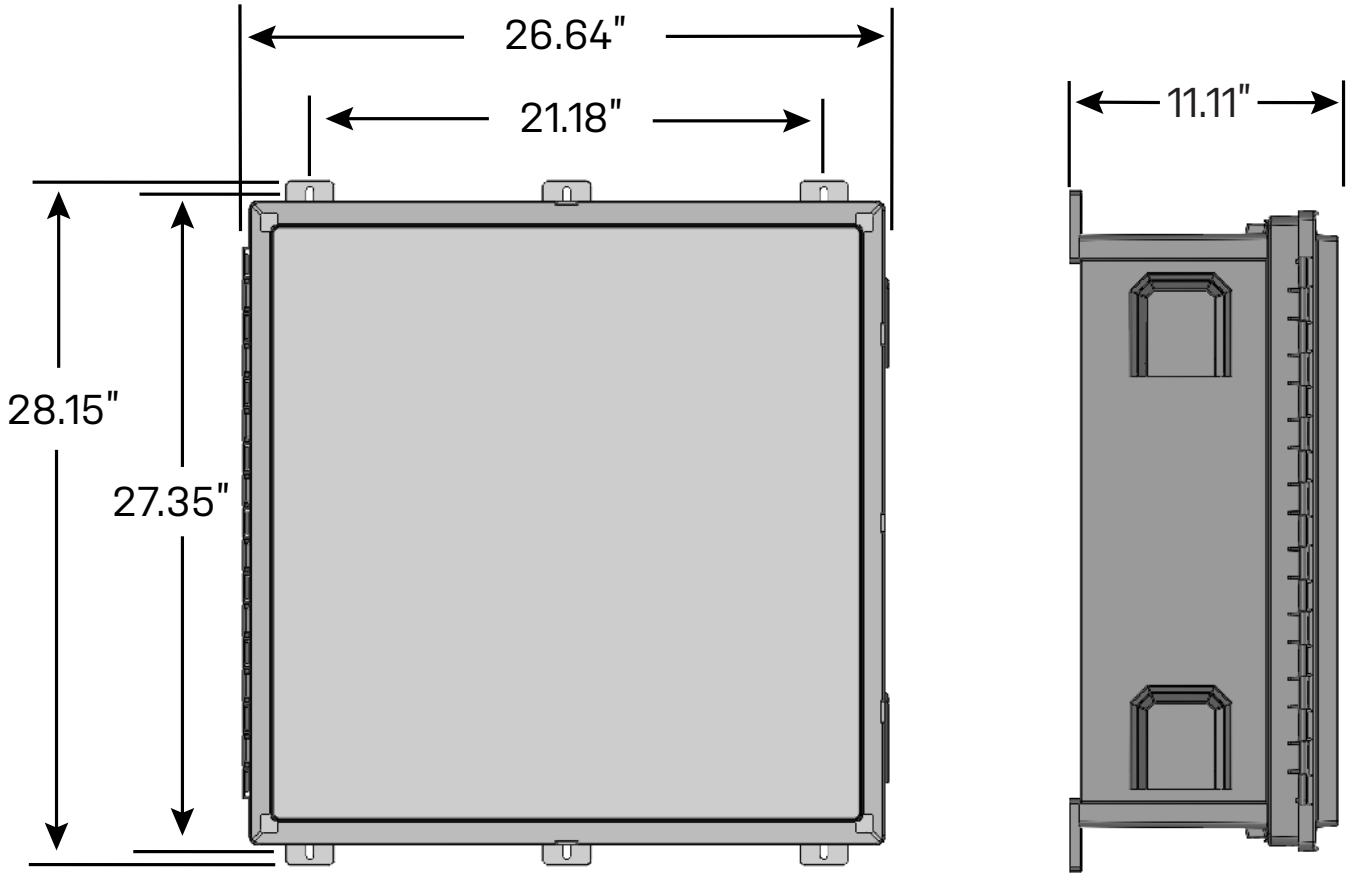


18”x16”x10” Enclosure

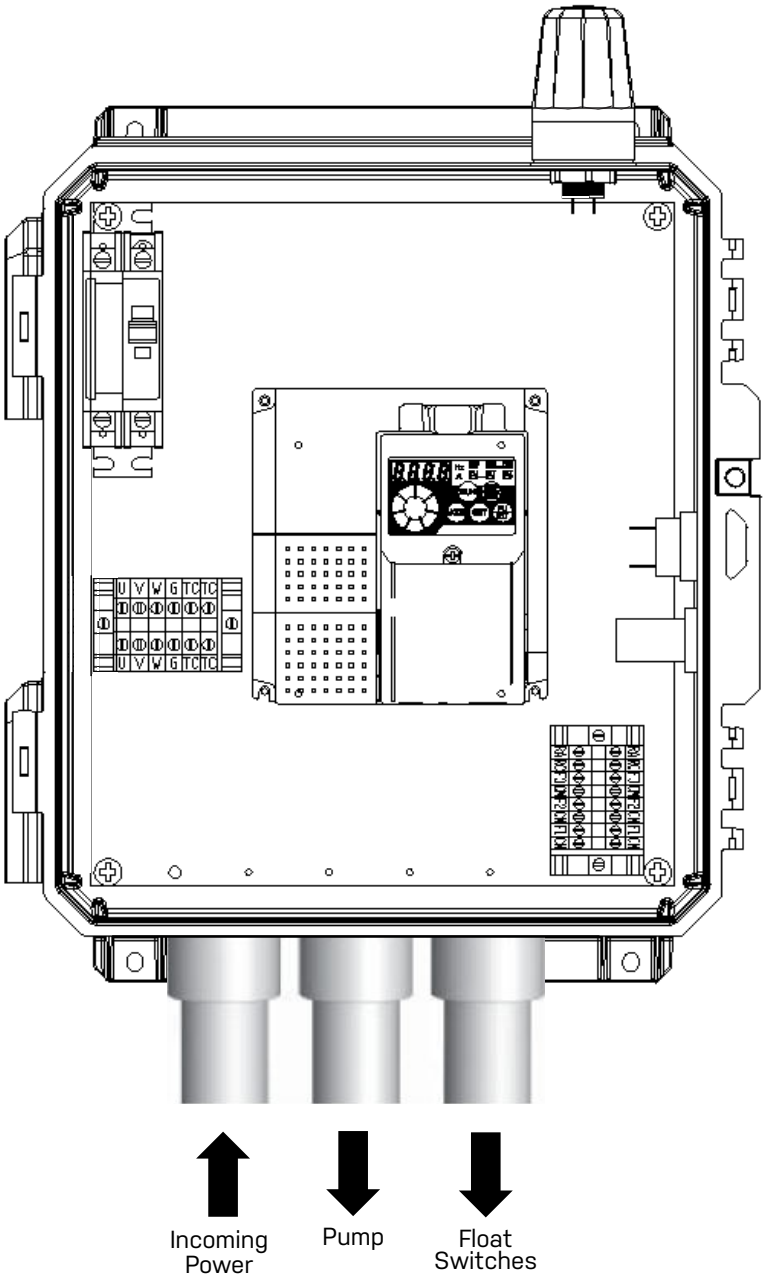


ENCLOSURE DIMENSIONS Cont.

24”x24”x10” Enclosure



CONDUITS



⚠ CAUTION!

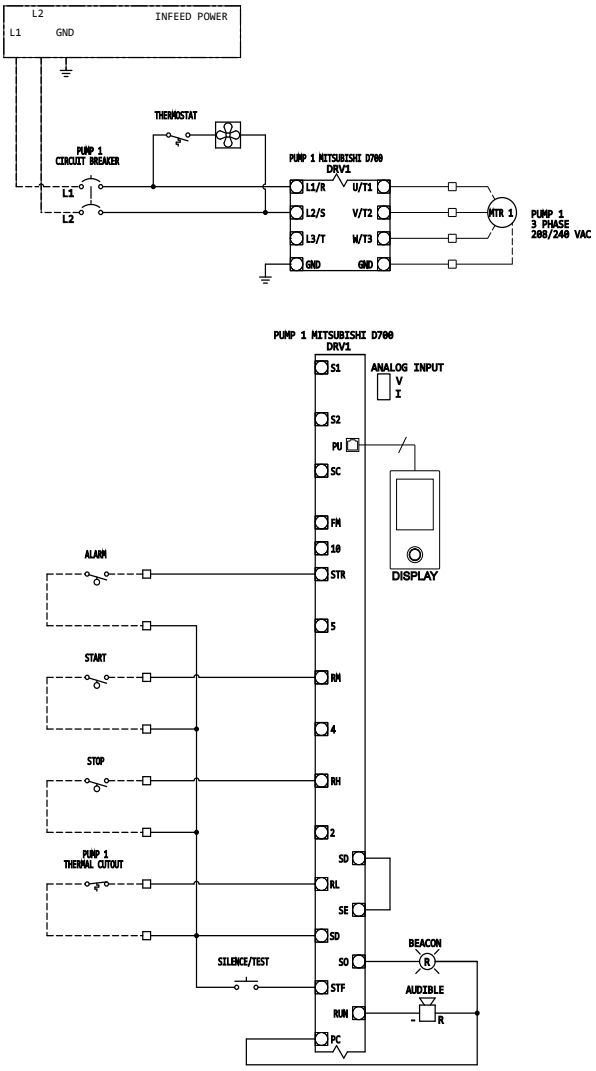
You must use conduit sealant to prevent moisture or gases from entering the panel.

Three (3) conduits are required. Do not run level sensor cables (float switches or level transducer) and motor cables in the same conduit. Use approved sealing compound to prevent sewage gases and moisture from entering the control panel.

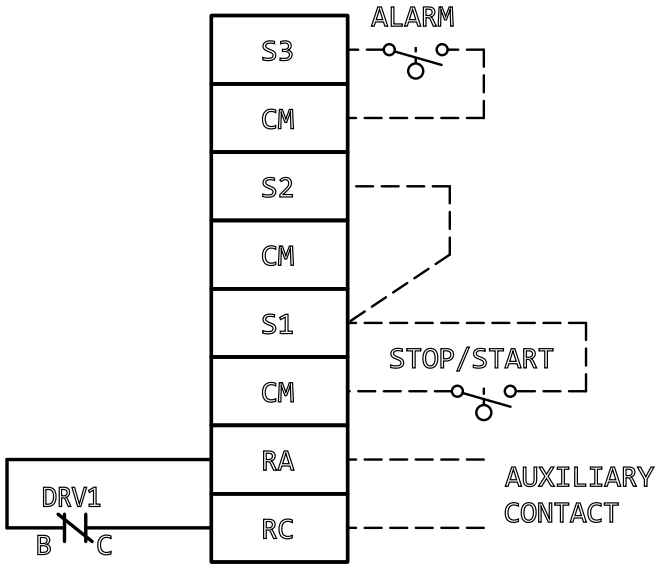
WIRING - SIMPLEX

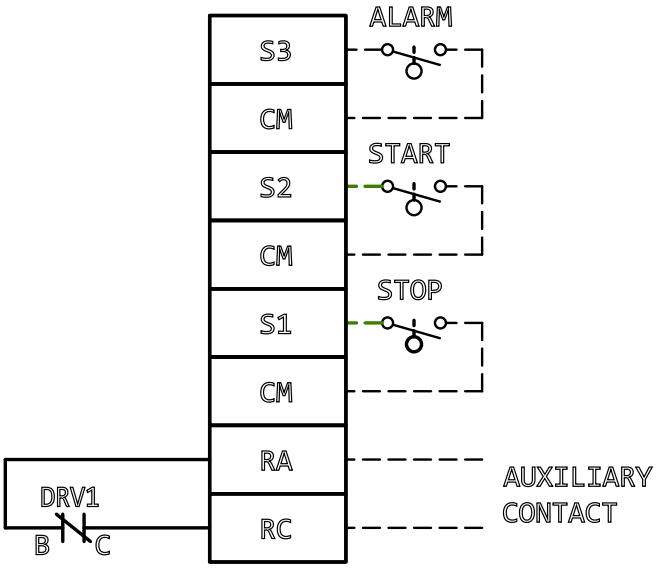
Sample Schematic Only

Refer to the schematic provided in the control panel for wiring and troubleshooting.

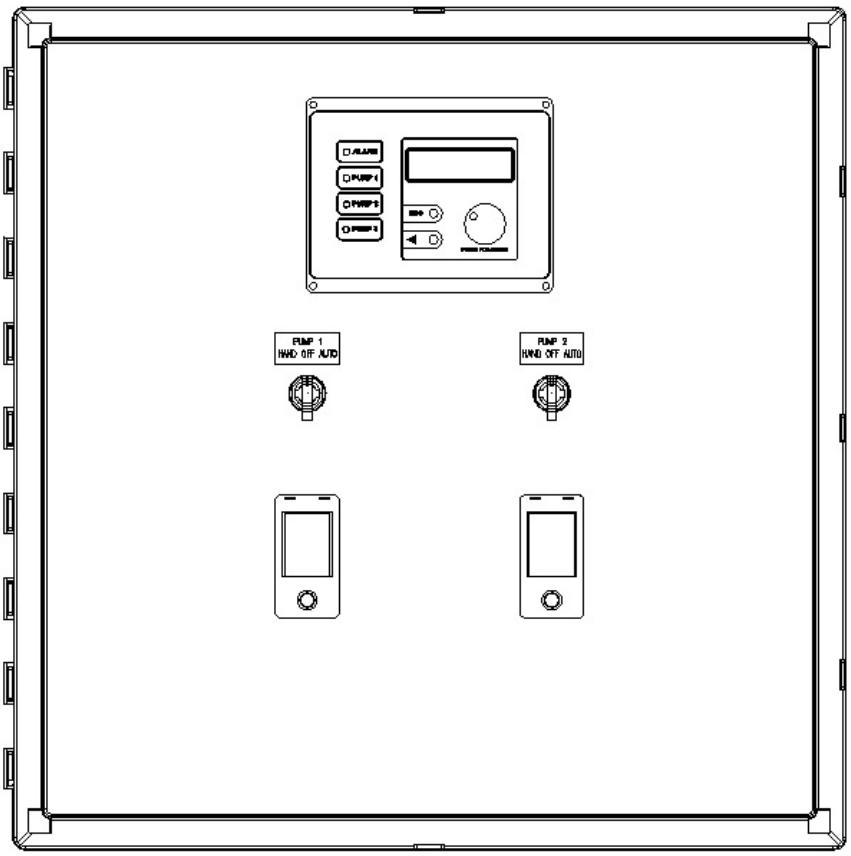


This control panel can operate with 2 or 3 float switches in AUTO mode.





WIRING - DUPLEX

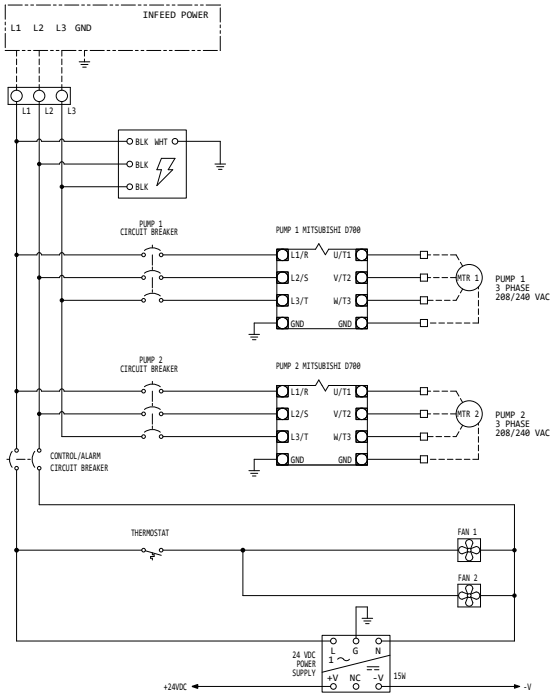


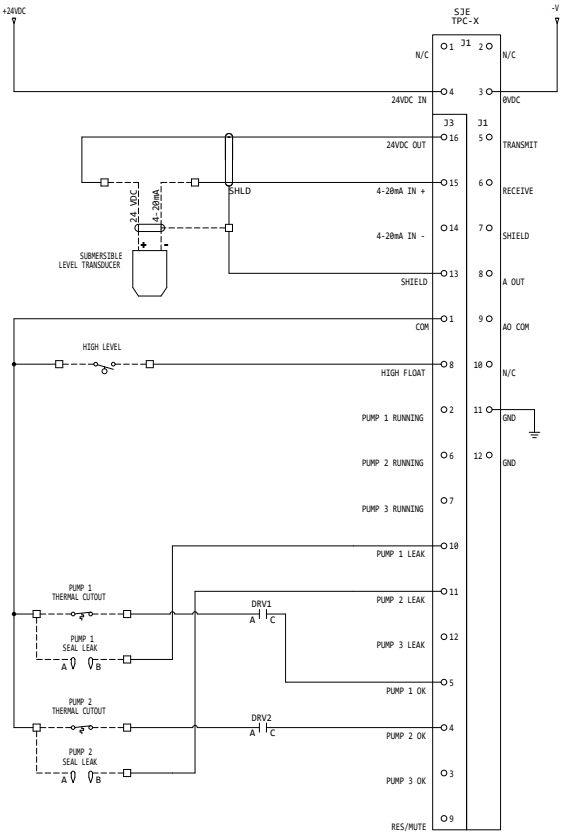
For duplex systems:

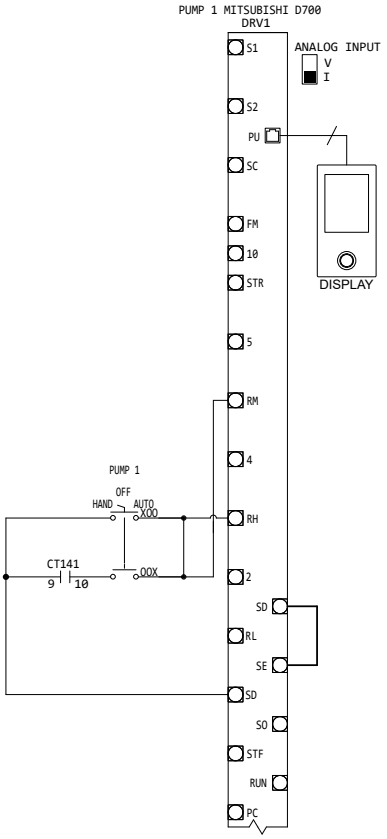
The pumps are called to run by the TPC-X controller instead of float switches. See the TPC-X user manual for level setup and operations. Review the wiring schematics provided with each control panel for connection details for level sensors, incoming power, and pump motor cables. The configuration for each TUF Grinder™ VFD unit in the panel is similar to the Simplex setup.

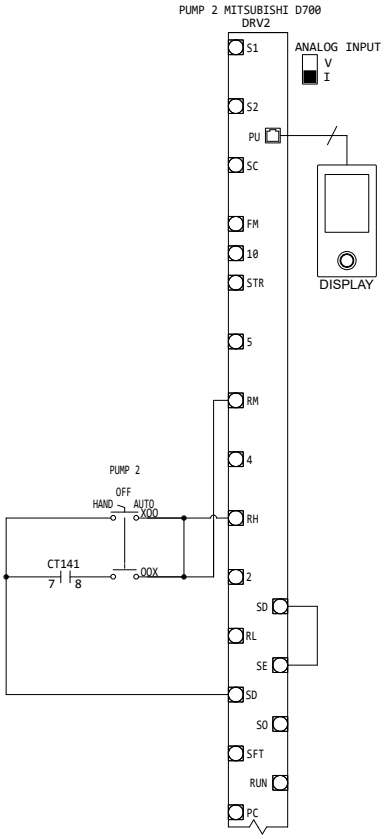
WIRING - DUPLEX

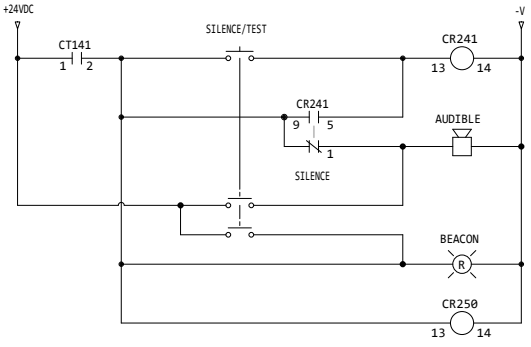
Sample Schematic Only
Refer to the schematic provided in the control panel for wiring and troubleshooting.



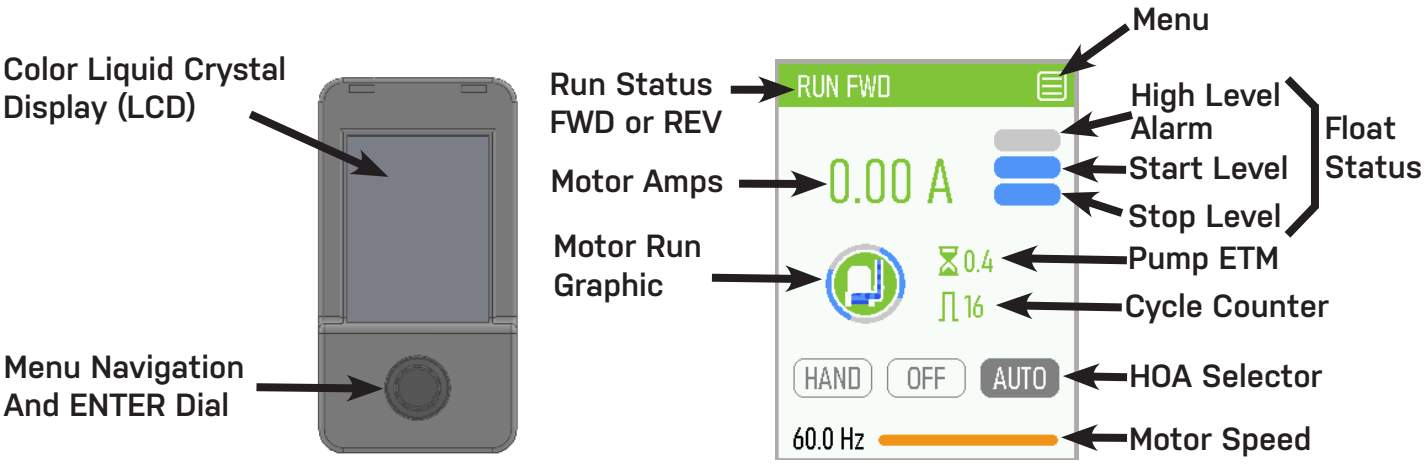


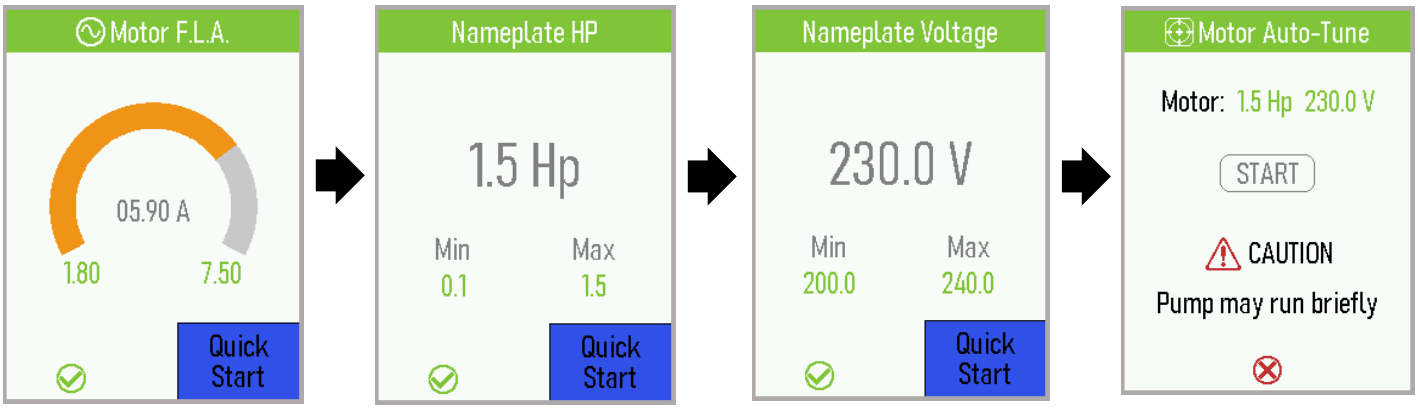






PROGRAMMING





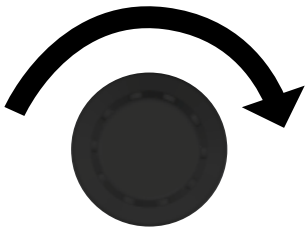
Power up the control panel after completing all the wiring. The "Quick Start" menu will open. Use the rotating button to enter following data:

- **Motor Full Load Amps (FLA):**
  Enter the motor Full Load Amps (FLA) as listed on the motor nameplate.
- **Motor Horsepower (HP):**
  Enter the motor HP value as listed on the motor nameplate.
- **Motor Voltage (V):**
  Enter the motor nameplate Voltage. This value cannot exceed the incoming voltage to the control panel.
- **Motor Auto-Tune:**
  Select START to perform Motor Auto-Tune.

  The VFD automatically measures and sets motor parameters for the most efficient operation and highest torque output. The pump must be connected for the Auto-tune to complete. The pump impeller may rotate briefly as part of this process. If motor leads are swapped to change rotation, run the auto-tune again from the Advanced Menu or reset to Factory Default for the Quick Start Menu to appear again.

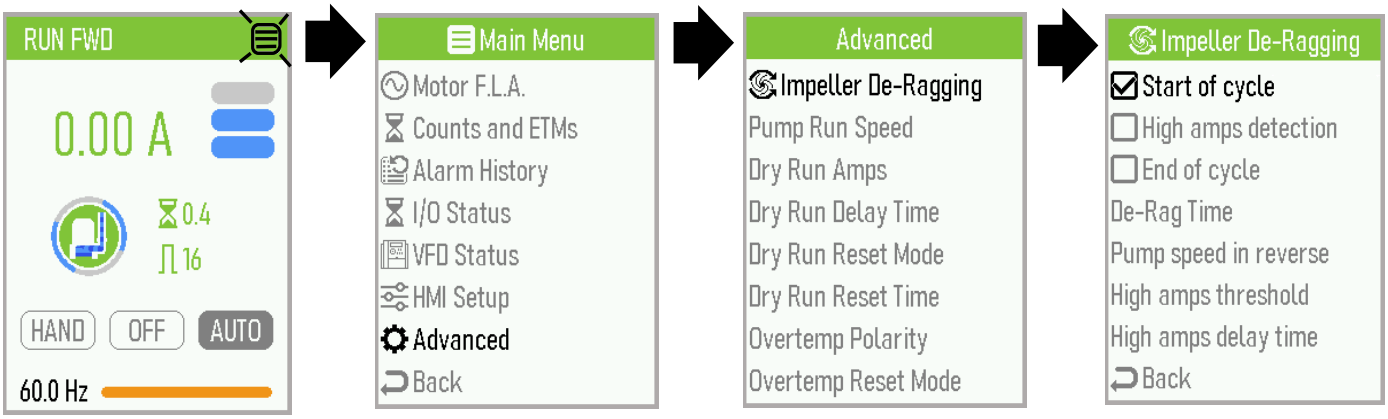
MENU NAVIGATION

Turn the rotary button to highlight HAND, OFF, or AUTO. Press the button to select.
Highlight the menu icon (top right corner) and press the button to enter the Main Menu.

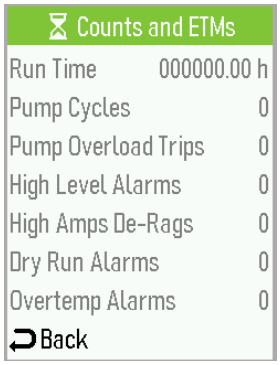


ROTATE

PRESS - ENTER



Counts and ETMs
- **Run Time** = Run time of the pump (Accumulated)
- **Pump Cycles** = Number of start cycles of the pump
- **Pump Overload Trips** = Number of Overload Trips
- **High Level Alarms** = Number of High-Level Alarms
- **High Amps De-Rags** = Number of De-Rags during the run (High Amps)
- **Dry Run Alarms** = Number of Dry Run Alarms
- **Overtemp Alarms** = Number of Overtemp alarms



Alarm History
View the history of the last 10 stored faults.

I/O Status
View the status of the TUF™ Grinder analog input, digital inputs, and alarm relay output.

VFD Status
View the TUF™ Grinder status. This includes output voltage, output current, output frequency, output power, and DC bus voltage.

HMI Setup
Used to configure the display's color theme, as well as set up the password protection.

Advanced
Used to set advanced functions.

PARAMETERS

Setting	Min.	Max.	Units	Default	Description
Enter Password	00-00	99-99		00-00	Only displays if a password is required.
Motor F.L.A.	Rated Amps x 0.25	Rated Amps x 1.5	A	Rated Amps x 0.5	Set the nameplate motor Full Load Amps (FLA)
Counts and ETMs					
Alarm History					
I/O Status					
VFD Status					
HMI Setup Menu					
Color Theme	Blue/Dark, Green/Dark			Green/Dark	The color palette used for the display.
Password Setup	00-00	99-99		00-00	Will not display if the user has not yet entered the correct password. 00-00 will disable password protection.
Advanced Menu					
Impeller De-Ragging					Opens the De-Ragging Function menu (See below)
- When to De-Rag				Start of Cycle	Start of cycle / High amps detection / End of cycle
- De-Rag Time	1	999	sec	5 sec	Operation time in reverse
- Pump speed in reverse	30.00	60.00	Hz	60.00 Hz	Operation frequency in reverse
- High amps threshold	Rated Amps x 0.25	Rated Amps x 1.5	A	Rated Amps x 0.5	Detection threshold when "High amps detection" selected.
- High amps delay time	1	999	sec	2 sec	Amps must hold above threshold for longer than this delay time
Pump Run Speed	30.00	60.00	Hz	60.00 Hz	Forward run Frequency. Reduce speed to reduce flow rate.
Dry Run Amps	0.00	Motor F.L.A.	A	0.00	0.00A = Dry Run Disabled
Dry Run Delay Time	0	999	sec	20	Amps must hold lower than Dry Run Amps for longer than this delay time.
Dry Run Reset Mode	Auto Reset	Manual Reset		Auto Reset	
Dry Run Reset Time	0.1	9.9	hr	1.0	
Overtemp Polarity	N-C	N-O		N-C	Normally closed will cause a trip on open circuit.
Overtemp Reset Mode	Auto Reset	Manual Reset		Auto Reset	Will reset automatically after Overtemp Reset Time is done.
Overtemp Reset Time	0	999	min	0	Delay before resetting Overtemp fault (after fault signal has returned to normal).
Max Cycle Run Time	0	999	min	20	Max time pump will be allowed to run continuously; 0 = disabled.
Motor Voltage	200.0	480.0	V	---.-	Motor nameplate Voltage. Cannot be greater than the measured incoming voltage to the control panel.
Acceleration	0.0	300.0	sec	2.0	Acceleration time from 0-60Hz on start.
Reversing Pump	Normal	Reversing		Normal	Alternates pump direction (FWD/REV) each cycle (auto-reversing grinder).
HAND Run Time	0	999	min	5	The timer will stop the pump when operating in Manual. 0 = no timeout (Continuously Run).
Carrier Frequency	0.7	10	kHz	2	
Motor Auto-Tune					
- Nameplate HP	0.1	400.0	Hp	2.0	
- Nameplate Voltage	200.0	240.0	V	230	
Factory Reset					Will reset all parameters to factory default.

PARAMETER DESCRIPTIONS

BASIC SETTINGS

- **Enter Password**
  If password protection has been enabled in the Password Setup menu, the user must enter the correct password to be allowed to change any settings. Once entered correctly, the settings are "unlocked" and may be edited. After no inputs from the user for 5 minutes, these settings will become "locked" until the correct password is entered once again. When a password is set up, the user will only be able to view settings on the HMI but cannot change them, unless they first enter the correct password in the Enter Password menu.
- **Motor FLA (Full Load Amps)**
  The VFD's electronic overload will signal an overload fault and protect the motor from damage in the event of an overload condition. Set the Motor FLA setting to the motor nameplate.

HMI SETUP

- **Password Setup**
  Set Password Setup to any 4-digit password 00-01 through 99-99 to enable this password protection. Be sure this is a password you will remember or write the password down in a secure location for your future reference. Set Password Setup to 00-00 to disable password protection. Note: When password protection is enabled, this setting will not be accessible until the user enters the correct password in the Enter Password setting.
- **Color Theme**
  This adjusts the colors used in the HMI display screens.

ADVANCED MENU

Impeller De-Ragging:

This function reverses the rotation of the motor to eject debris that can potentially clog the pump.

- **Select when to run the De-ragging function** (all three can be selected)
  - **Start of Cycle**: Will run the de-ragging function before a run cycle (Start float turns ON). This is the default mode. Note: if the VFD trips on overload, it will reset automatically after 10 seconds and re-start in the reverse direction.
  - **End of Cycle**: Will run the de-ragging function at the end of the run cycle (Stop float turns OFF)
  - **High amps detection:** Will run the de-ragging function during a run cycle if High Amps are detected.
- **De-rag Time:** Default = 5 Seconds
  The length of time that the motor will spin in reverse.
- **Pump speed in reverse:** Default = 60Hz
  Determines how fast the pump will go in reverse.
- **High amps threshold:** Default = 10.0A
- **High amps delay time:** Default = 2 sec
  High amps detection can be used to initiate the de-rag function while the pump is running. The High amps threshold must be set at a value which is above normal pumping operation. The High amps delay time is set to ensure that binding is occurring and not normal grinding.
  Process:
  Record the amps on the main display when the pump is running normally.
  Set the **High amps threshold** value 1A or 2A above this value.
  Set the **High amps delay time** at 2 seconds. Increase if de-ragging occurs during normal operation. Note: An overload trip may occur before the de-ragging function is triggered if this delay time is too long.
  Test the pump operation. Adjust the 2 parameters above as needed.

Pump Run Speed (30-60Hz). Default = 60Hz

Speed at which the pump will run after acceleration. In some applications it is possible to run at less than 60Hz. Keep in mind that a lower speed will reduce the discharge flow and head and will increase the pump cycle time. A small reduction in Hz (rpm) will greatly reduce the power consumption (lower motor current) as suggested by the affinity laws: $P_1/P_2 = (n_1/n_2)^3$

Dry Run Protection:

- **Dry Run Amps** (0.0A-FLA). Default = 0.0A.

  The Dry Run alarm will activate when all three of the following conditions persist:

  1) The pump is running at the Pump Run Speed.
  2) The pump current is below the Dry Run Amps setting.
  3) The Dry Run Delay Time is done.

  This alarm will stop the pump, and can be reset manually or automatically, depending on the Dry Run Reset Mode setting. While the above three conditions are true, a Dry Run warning will be displayed on screen, showing a timer counting down to the Dry Run Alarm trip. Set Dry Run Amps to 0.00 to disable Dry Run detection (Default). Ensure that the Dry Run Amps value is less than running during high head conditions which will reduce the flow and reduce the motor amps.
- **Dry Run Delay Time** (0-999 seconds). Default = 20 sec

  Delay before stopping the pump on a Dry Run Alarm.
- **Dry Run Reset Mode** (Auto-Reset, Manual-Reset). Default = Auto-Reset

  If Dry Run Reset Mode is set to Auto-Reset, once a Dry Run Alarm is active, a countdown timer will begin according to the Dry Run Reset Time setting. After that timer reaches zero, the Dry Run alarm will be cleared, and the pump will be allowed to run again. If Dry Run Reset Mode is set to Manual Reset, then the user must reset a Dry Run Alarm manually through the main screen.
- **Dry Run Reset Time** (0.1-9.9 hours). Default = 1.0 h

  Delay before automatically re-starting the pump after a Dry Run Alarm. Valid for Auto-Reset mode only.

Overtemp:

- **Overtemp Polarity:** Normally Open or Normally Closed. Normally closed will cause a trip on open circuit.
- **Overtemp Reset Mode:** Auto or Manual. In Auto, the Over-temp fault will reset automatically when the input signal is back to normal, and the reset time is done.
- **Overtemp Reset Time:** Reset timer.

Max Cycle Runtime: (0-999 minutes). Default = 20 minutes

If a pump runs in AUTO continuously for longer than the amount of time set here, the pump will stop, and the alarm beacon will begin flashing; no audible alarm will occur. This Max Cycle Runtime fault will only occur when the Stop Float is ON, and the Start and High Level floats are both OFF. If the Start float or High Level float turn ON, then the pump will turn back on, even though the Max Cycle Runtime fault message will remain on the screen. This fault will reset when a normal pumping cycle ends with the Stop float turning OFF, or when the user resets it on the main screen. Setting Max Cycle Runtime to 0 minutes will disable this fault detection.

- **Motor Voltage:** Set the Motor Voltage setting to the voltage rating found on the motor nameplate. This value must not exceed the voltage of the incoming power. If the Motor Voltage has never been set, it will display as, "---.-V" and the output pump voltage will match the incoming supply voltage.
- **Acceleration:** Set the Acceleration time to the rate at which the output frequency will accelerate from 0Hz to 60Hz. Example: If the pump is required to accelerate from stop to 30Hz in 1 second, the Acceleration time should be set to 2 seconds. If it is too quick, it may cause the pump to trip on overload or over-current.
- **Reversing Pump:** Normal or Reversing. Normal is the default mode. The pump will only reverse to de-rag. In reversing mode, the pump alternates pump direction (FWD/REV) after each cycle. The "Reversing" mode is only to be used with auto-reversing grinders designed to pump and cut in both directions.
- **HAND Run Time:** When in HAND, the pump will run for the number of minutes set in HAND Run Time if the user does not switch back to OFF or AUTO before that. The pump will stop when the HAND Run Time is done, at which point the controller will switch back to OFF mode. Set to 0 minutes to disable this protective function, allowing the pump to run in HAND mode indefinitely.
- **Carrier Frequency:** This is the PWM switching frequency for the VFD inverter output.
- **Motor Auto-Tune:**
  Enter the motor Nameplate HP & Voltage.
  The pump must be connected for the Auto-tune to complete. The pump impeller may rotate briefly as part of this process. If motor leads are swapped to change rotation, run the auto-tune again from the Advanced Menu or reset to Factory Default for the Quick Start Menu to appear again. This function will allow the VFD to automatically measure motor parameters and adjust the control method to become more accurate, efficient, and deliver higher torque. It is important to run the auto-tune successfully on any grinder pump application for optimum performance.

Auto-Tune Results and Actions

Result	Text Displayed	Action to Take
Success		Exit Menu and check for proper operation.
--	Tuning in progress	Wait for Auto-Tune to complete.
Failed	(Forced End)	Retry Auto-Tune.
Failed	(Inverter Protection)	Check Motor S.F. Amps, Motor Voltage and Motor Hp settings and retry Auto-Tune.
Failed	(Current Limit)	Check Motor Wiring.
Failed	(75% Output Voltage)	Check for a fluctuation of the power supply voltage.
Failed	(Motor Not Connected)	Check the motor wiring. Check Motor S.F. Amps, Motor Voltage, and Motor HP settings and retry Auto-Tune.

- **Factory Reset**
  This will reset all user settings, counts, and VFD parameters to their factory defualt values. The user must select "Confirm" when prompted "Are You Sure?" for the factory reset to be performed.

TUNING & TROUBLESHOOTING GUIDE

- **Testing & tuning the system:**
  To optimize the system, it is necessary to test run the pump and record the Hz & Amps. All are visible on the main screen of the display. Adjustments can then be made to optimize the system performance.
- **Rotation:**
  Ensure that the pump is operating in correct rotation during normal operation. It should only reverse rotation during a de-rag sequence. Note: Most pumps will still operate when spinning in the wrong direction but will do so inefficiently and the amp draw may be higher than normal. Please contact the pump manufacturer for indication of incorrect rotation. In the case of incorrect rotation, turn the power OFF, wait 10 minutes, then swap any two motor leads around to change the rotation. Run the Auto-Tune again on power up and ensure that the pump is running correctly.
- **Clogging:**
  If the pump is clogging frequently, check the following:
  1. Check motor rotation.
  2. Run the Auto-Tune again (this will ensure that the motor delivers the maximum torque).
  3. Check for large debris in the tank.
  4. Made adjustments to the De-ragging function: "Start of Cycle", "End of Cycle", "High amps detection".

  Manual De-ragging: If the pump is locked up and unable to free itself using the automatic de-ragging sequence, you can try to manually de-rag the pump by running it in HAND mode for short bursts of 3-5 sec in alternating directions. Allow the motor to cool off for 30 minutes after 10 attempts to run in HAND.
- **Dry Run:**
  The Dry Run alarm will activate when all three of the following conditions persist:
  1. The pump is running at Pump Run Speed.
  2. The pump current is below the Dry Run Amps setting.
  3. The Dry Run Delay Time is done.

  If there is nuisance tripping of this alarm, please check the following:
  - Decrease the Dry Run Amps value and verify that it trips only when the pump is running dry.
  - Increase the Dry Run Delay Time to ignore short anomalies in the system.
  - Check that the amps do not drop below the "Dry Run Amp" value during high head conditions which will reduce the flow.
  - You may opt to disable the Dry Run function and use the "Max Cycle Run Time" alarm function instead.
- **Motor Overloading**
  If the control panel is tripping on overload during normal operation, ensure that the overload current is set correctly. The controller will auto-reset an overload trip up to 5 times before finally stopping and require a manual reset. Do not exceed the Full Load Amps (FLA) value listed on the motor nameplate as it could result in motor damage. If the motor amps exceed the FLA value or the VFD capacity during normal operation:
  - Check motor rotation.
  - Run the Auto-Tune
  - Reduce the motor Run Speed from 60Hz to 57Hz. Ensure that pump performance is acceptable at lower speed. There will be a small reduction in the pump flow rate. Adjust the speed up or down as needed. Lower the "Pump speed in reverse" value, if necessary (although not typically an issue due to the short run time in reverse.)

ERROR MESSAGES

	MAIN DISPLAY MESSAGE	DESCRIPTION OF FAULT ALARM
SYSTEM FAULTS	HMI Communication Lost	Loss of Communications between VFD and Display
	Motor Overtemp	Motor Over Temperature Fault. The over-temp input switch embedded in the motor windings opens on high temperature (typical configuration). Ensure the input is configured correctly.
	Float Failure	Float switches out of sequence. The float most likely to be failed or stuck will have a red flashing outline.
	High Level Alarm	High level float switch input is ON (CM/S3). The pump will run when this float is up.
	Dry Run (flashing)	Pump Amps low / VFD full speed--Impending shut down (timer counting down).
	Dry Run	Run Dry Fault (Auto-Reset timer counting down or Manual Reset required).
	Max Cycle Runtime	Pump Cycle time exceeded the allowable time (Auto-Reset or Manual Reset). See Parameter for more details.
VFD FAULTS	Over-current During Accel	E. OC1 Overcurrent Trip During Acceleration*
	Over-current (Const Speed)	E. OC2 Overcurrent Trip During Constant Speed*
	Over-current During Decel	E. OC3 Overcurrent Trip During Deceleration*
	Over-voltage 1	E. OV1 Regenerative Overvoltage
	Over-voltage 2	E. OV2 Regenerative Overvoltage
	Over-voltage 3	E. OV3 Regenerative Overvoltage Trip
	VFD Overload Trip	E. THT Inverter Overload Trip
	Motor Overload Trip	E. THM Motor Overload Trip
	VFD Overheat	E. FIN Overheat
	Stall Prevention	E. OLT Stall Prevention
	Ground Fault	E. GF Output Side Earth (ground)
	Output Phase Loss	E. LF Output Phase Loss
	Inrush Current Limit	E. IOH Inrush Current Limit Circuit
	Invalid Analog Input	E. AIE Analog Input Fault
	VFD EEPROM Fault	E. PE Parameter Storage Device Fault
	Fault Retry Exceeded	E. RET Retry Count Excess
	VFD CPU Fault	E. 5/E CPU fault
	Output Amps Detection	E. CDO Output Current Detection Value Exceeded
	Input Phase Loss	E. ILF Input Phase Loss
	Brake Transistor Alarm	E. BE Brake Transistor Alarm Detection
	External Thermal Overload	E. OHT External Thermal Relay Operation
	External Thermistor Trip	E. PTC Thermistor Operation
	Disconnected PU	E. PUE PU Disconnection
	Safety Circuit Fault	E. SAF Safety Circuit Fault

* If an OC1, OC2, or OC3 fault occurs frequently, a motor Auto-Tune can often remedy this. The Auto-Tune function can be found in the Advanced menu.

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