Instructions

Variable Frequency Drive

311596 rev.A

Motor drive control for Graco E-Flo Plus Electric Circulation Pumps.

Important Safety Instructions
Read all warnings and instructions in this manual.
Save these instructions.

Part No. 15J753, 200-240 Vac
UNIDRIVE SP Digital AC Drive
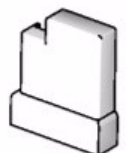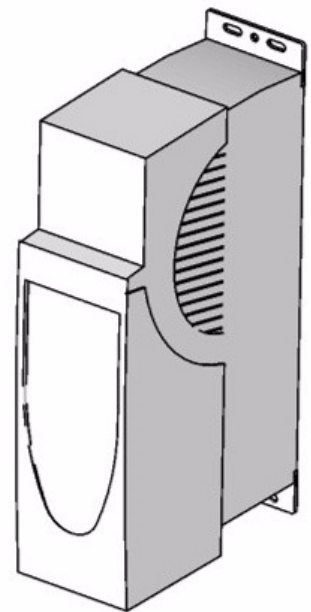208/230VAC, 5HP, SP2201

Part No. 15J754, 380-480 Vac
UNIDRIVE SP Digital AC Drive
460VAC, 5HP, SP1405

UNIDRIVE Information

Unidrives are manufactured by Control Techniques
Corporation. Read all warnings and instructions
from Control Techniques (provided on a CD)
before beginning the installation or operation of
this equipment.

Related Graco Manuals

Manual	Description
311592	E-Flo Plus Installation Manual
311593	E-Flo Plus Operation Manual
311594	E-Flo Plus Repair-Parts Manual
311606	VFD/BPR Air Control Manual
311608	Power Module Manual
311612	Ethernet Upgrade Kit Manual

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Contents

Warnings

The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbol refers to procedure-specific risk. Refer back to these warnings. Additional, product-specific warnings may be found throughout the body of this manual where applicable.

⚠ WARNING
ELECTRIC SHOCK HAZARD Improper grounding, setup, or usage of the system can cause electric shock. • Turn off and disconnect power at main switch before disconnecting any cables and before servicing equipment. • Connect only to grounded power source. • All electrical wiring must be done by a qualified electrician and comply with all local codes and regulations.

Models

E-Flo Plus Electric Circulation Pumps

Check your pump's identification plate (ID) for the 6-digit part number of your pump. Use the following matrix to define the construction of your pump, based on the six digits. For example, Pump Part No. **E P 2 1 6 0** represents electric power (**E**), pump (**P**), 230/460V motor (**2**), sensor circuit installed (**1**), and 2000 cc Maxlife lower (**6**). The last digit (**0**) is unassigned. To order replacement parts, see the Repair-Parts manual 311594.

ID

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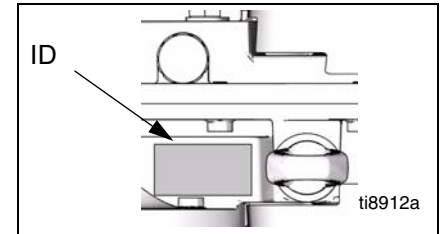
ID Plate, Viewed from Above

E	P	2		1		6		0
First Digit	**Second Digit**	**Third Digit**		**Fourth Digit**		**Fifth Digit**		**Sixth Digit**
Power Source	**Equipment Style**	**Motor**		**Sensor Circuit**		**Lower Size**		**Unassigned**
E (electric)	P (pump)	0	No motor	0	No circuit	1	1000 cc	0	None assigned
		1	230/400V ATEX	1	Circuit installed	2	1500 cc		
		2	230/460V UL/CSA			3	2000 cc		
						4	1000 cc Maxlife		
						5	1500 cc Maxlife		
						6	2000 cc Maxlife		

Pump Operational Limits

See **Related Graco Manuals** on the front cover.

Approvals

This equipment meets requirements of the following approval agencies:

⟨Ex⟩ II 2 G
II2G EExdIIA T3   CE

Glossary of Terms

Term	Description
VFD	Variable Frequency Drive
TDC	Top Dead Center; measures position of pump drive
I/O	Input/output
Trip	A condition which causes VFD to trip motor; see page 21
PCB	Printed Circuit Board
Pr	Parameter
Run	Set of commands enabling motor to run in designated direction
Stop	Set of commands authorizing motor to stop running

Overview

An electric motor (B) provides input to a 75:1 gear reducer (GR), which drives two fluid pumps (FP). See FIG. 1. The stroke positions of the two pumps are offset to achieve consistent flow from the pump assembly. See FIG. 2.

The optional sensor circuit includes a top dead center (TDC) sensor which assists software in measuring motor speed, and a pressure transducer (PT) with circuit board, which measures fluid pressure at the pump outlet. The Graco VFD software mimics the effect of a camshaft, constantly adjusting motor speed to keep steady fluid flow and achieve minimal pressure variation. The output shaft of the gearbox and the connecting rods experience the effect of the imaginary camshaft by speeding up when the pressure drops (pump lower is at a changeover) and slowing down when pressure increases (both lowers are pumping).

The VFD can be controlled by a local control box mounted in the hazardous area, via communication protocol (such as modbus), or directly from the keypad.
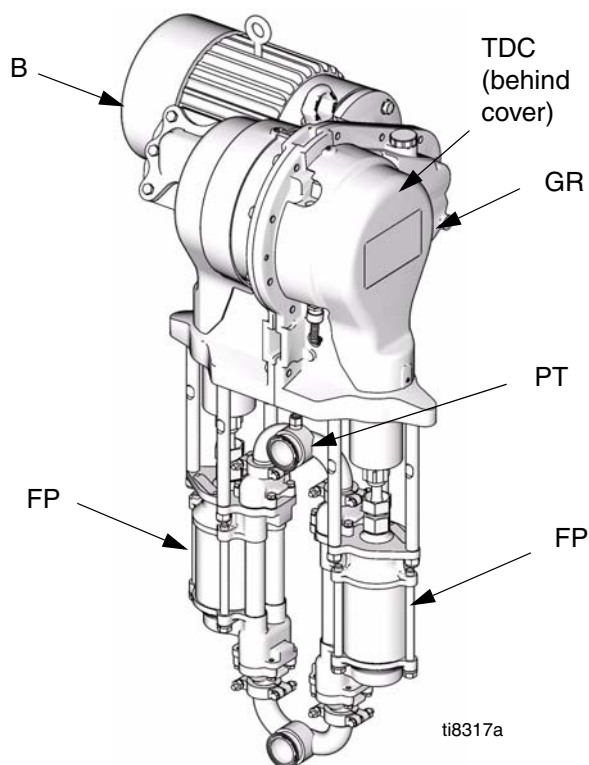
FIG. 1. E-Flo Plus Electric Circulation Pump
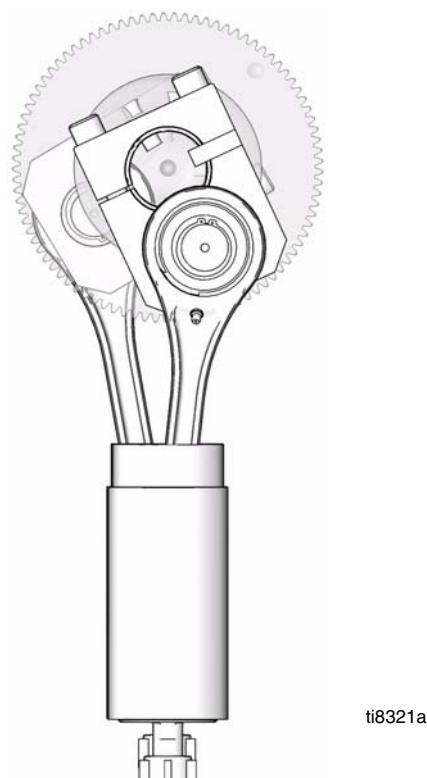
FIG. 2. Cutaway Showing Offset Stroke Positions

Variable Frequency Drive (VFD) Kits and Options

Kits and options can be ordered through your Graco Distributor.

Repair Kits

Transducer Kit P/N 15H876 - replaces the pressure sensor and its circuit board. Note that pressure sensor can be calibrated, and calibration procedure is included in this manual.

Circuit Board Kit P/N 15H879 - replaces the sensor circuit board.

Top Dead Center Sensor Kit P/N 15H877 - replaces top dead center (TDC) sensor.

Options

Ethernet Upgrade Kit P/N 15H885 - provides Ethernet module for the VFD. Ethernet cable is not included.

Circuit System Kit P/N 15J755 - contains PCB and sensors necessary to run Graco programmed VFD and take advantage of low flow and pressure fluctuations delivery by Graco software.

Local I/O Box P/N 120373 - allows the operator to control the E-Flo Plus locally at the pump when performing maintenance or troubleshooting. The local I/O box has the following features:

- secure disable switch
- run/stop switch
- local/remote switch
- jog/park switch
- trip reset

Power Module P/N 288036- supplies necessary hardware to interface with the pump's intrinsically safe (IS) circuitry. The hardware includes IS barriers, transformer, 24 VDC power supply, fuses and terminal blocks for connectivity.

RFI Filter Module for 230 VAC VFD: P/N 120365

RFI Filter Module for 480 VAC VFD: P/N: 120366

VFD 200/240V Control Kit: P/N 15J753

VFD 380/480V Control Kit: P/N 15J754

Controls and Indicators

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Two Variable Frequency Drives are available and are used for different voltages. Use the appropriate one for your system. See front cover for part number information.

Control Modes

There are two ways to control or monitor the E-Flo Plus Electric Circulation Pump.

• Locally

• Remotely (Keypad/Modbus)

The addition of a local control box (kit 120373) allows the operator to control the E-Flo Plus at the unit. See Available Options on page 5.

Starting, running, and stopping of the motor is controlled by the Sequencer, which has been programmed to comply with E-Flo Plus Local and Remote schemes. VFDs are normally installed in electrical enclosures, away from motors, which they control. Local mode refers to controls which are installed locally at the pump, or within sight of the pump. Remote mode refers to controls installed remotely, away from the pump.

Mode selection is performed by a hardware switch. Digital I/O #5 (Pin #28) is configured for this operation (see **System Electrical Diagrams**, page 36). Normally open position of the switch commands remote mode; closed position commands local mode.

✎ Common ground is available at VFD pins #1, 3, 11, 21, 23, and 30.

If Local mode of operation is an option for a given installation, use Graco Local I/O Explosion Proof Control Box (Graco P/N: 120373).

More then one command is required to be active for motor to operate. All of these are controlled by Graco software. Do not try to reconfigure VFD parameters to operate outside of the Graco design described in this manual. Doing so can cause system malfunction. Parameters are controlled by the program in the AppsLite module and will be reset back to E-Flo Plus defaults at next reset. Reset occurs during each power-up.

Run command refers to a set of commands, enabling motor to run in designated direction.

Stop command refers to a set of commands, authorizing motor to stop running.

Local Control Mode

When Local mode is selected, motor can only be started by a hardware switch. Pin #27 is configured for this operation (see **System Electrical Diagrams**, page 36). Normally open position is Stop; closed position is Run.

✎ Common ground is available at VFD pins #1, 3, 11, 21, 23, and 30.

Stop Command Via Keypad

To initiate the Stop command via the keypad, press the Stop/Reset (red) button on a keypad display.

Remote Control Mode

When remote control mode is selected, control commands can be directly entered into the VFD by means of a keypad or can be sent via modbus. Refer to SM Ethernet User Guide (Control Techniques) for more information on modbus control.

Variable Frequency Drive (VFD) Keypad

The VFD keypad consists of a display, four control buttons, and a joypad with four arrow keys. See FIG. 3.

VFD Display

The VFD display has two rows.

The upper row (A) displays either the drive status (run is shown) or the parameter being viewed, in the format XX.XX (for example, 20.05). In this manual, parameters are referred to as Pr (for example Pr 20.05).

The lower row (B) displays the parameter value (152 is shown) or a trip code.

Table 1 shows some examples of drive status codes. Refer to the User's Guide by Control Techniques for the full list.

Table 1: Drive Status Examples

Display Code	Definition
Auto tunE (flashes alternately)	Motor auto tune is in progress.
inh	VFD is inhibited and will not run because Secure Disable is engaged.
rdY	Motor is ready to run.
run	Motor is running.
triP	VFD has tripped. Trip code appears in lower display.
dEC	Decelerating - motor speed is ramping to zero following a stop command.

VFD Control Buttons

- Fwd/Rev (U): not active in this application.

- Stop/Reset (V)

- Start (I, green): not active in this application.

- Mode (M, black): used to change between the display modes - parameter view, parameter edit, status.

- Joypad: used to navigate the parameter structure and change parameter values. See page 8 for details.
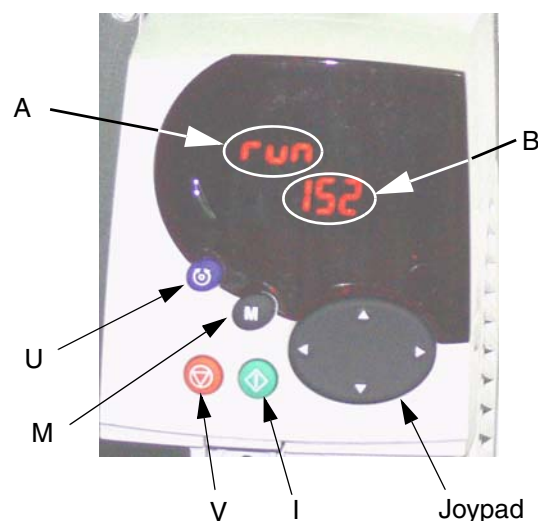
FIG. 3: Variable Frequency Drive Keypad

Setup

Ground the VFD

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The equipment must be grounded. Grounding reduces the risk of static and electric shock by providing an escape wire for the electrical current due to static build up or in the event of a short circuit. Ground the variable frequency drive through a proper connection to a power source. Refer to the Control Techniques manuals for grounding instructions.

Navigating the Keypad

The Unidrive SP User Guide has a detailed explanation of the Keypad operation and contains navigation procedures. The following is an example and is not intended to explain in detail the complete operation of the Keypad. It is strongly recommended that the installer refer to the Unidrive SP User Guide (provided on a CD) for detailed instructions.

Calibration of lower size is chosen as an example to explain the operation of the Keypad display. Graco default setting for the lower size is 2000cc. In the following example, we will change the lower size to 1500cc.

Each parameter consists of a menu number and sub-menu number. Lower size calibration value is located in Pr **20.03**: **20** refers to Menu **20**; **03** refers to Submenu **03**.

1. Navigate to Pr 20.03:

    a. Pressing the Left and Right arrow keys will allow you to navigate between menus 0 and 22.

    b. Pressing the Up and Down arrow keys will allow you to navigate within the submenus.

    c. Press the Left or Right arrow keys until you reach menu 20 (Number 20.00 should be flashing on a screen).

    d. Press the Up or Down arrow keys until you reach submenu 3 (Number 20.03 should be flashing on a screen)

2. Alter the value of Pr 20.03:

    🖉 While number 20.03 is flashing on the upper row of the screen, number 2000 is displayed on the lower row of the screen, representing lower size of 2000cc.

    a. Press the (M) key once. This will cause the cursor to move to the bottom row of the display and the least significant digit of the number 200**0** (most right digit) should be flashing.

    b. Press the Left arrow key to navigate to the third digit from the right 2**0**00. This will cause the digit to start flashing.

    c. Press the Up arrow key to scroll to number 5. This should cause number 2**5**00 to display on a screen with number 5 still flashing.

    d. Press the Left arrow key to navigate to the next digit on the left. This will cause number '2' to start flashing (**2**500).

    e. Press the Down arrow key to change the number 2 to number 1. Number **1**500 should be displayed on a screen with number 1 flashing.

    f. Press the (M) key once to move cursor from the bottom row to the top row. This will cause number 20.03 on the top row to flash.

    g. This completes the procedure of changing a parameter value. In this case you have changed Pr **20.03** from 2000 to 1500 (number 1500 will show on lower row of display).

M

V

Joypad
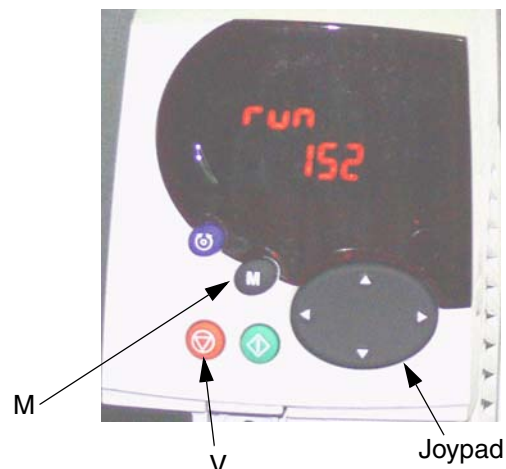
FIG. 4: Variable Frequency Drive Keypad

E-Flo Plus Calibration

CAUTION
The system must be calibrated before start-up. Failure to calibrate will result in malfunction, alarm trips, and decreased safety.

Calibrate and Autotune the Motor

CAUTION
Before installing the motor it must be calibrated and autotuned, to prevent degraded performance or shut-down due to unnecessary trips. First, identify if the motor was purchased from Graco: • For motors supplied by Graco, see **Graco Motors**, below. • For motors not supplied by Graco, see **Non-Graco Motors**, below.

Graco Motors

To calibrate and autotune motors purchased from Graco, perform the following steps:

1. **Motor Selection.** Parameter Pr **20.37** is reserved for the motor calibration information listed on the pump's identification plate. The value of Pr **20.37** is determined as follows:

   EP**1**XXX=> Pr **20.37** = **1**

   EP**2**XXX=> Pr **20.37 = 0**

2. **Load Graco Motor Defaults.** Navigate to Pr **20.16** and set its value to 56. At this time the specific Graco motor parameters will be loaded and the number 56 will be replaced by 0 automatically.

3. Follow the instructions under **Autotune the Motor**, page 10.

4. Continue with step **1. Pressure Sensor Calibration** on page 10.

Non-Graco Motors

✎ Graco does not support the use of the Graco VFD CAM mode on motors not supplied by Graco.

✎ Use only 1500 rpm or 1800 rpm rated motors.

To calibrate and autotune motors not purchased from Graco, perform the following steps:

1. **Motor Selection.** Set Pr **20.38** to 2 (non-Graco motor).

2. **Set Motor Parameters.** Navigate to menu #5. Refer to your motor's identification plate for necessary information.

   a. Pr **5.06** - Rated Frequency.

   b. Pr **5.07** - Motor Rated Current.

   c. Pr **5.08** - Rated Load RPM/Rated Speed.

   d. Pr **5.09** - Rated Voltage.

   e. Pr **5.10** - Rated Power Factor.

   f. Pr **5.11** - Number of Motor Pole Pairs (4 pole motor has 2 pairs).

3. **Turn Off Slip Compensation.** Set Pr **5.27** to 0.

4. **Enter Motor Rated Current.** Multiply motor rated current found on motor's identification plate by 10. Enter resulting value into Pr **20.12**.

5. Follow the instructions under **Autotune the Motor**, page 10.

6. Continue with step **1. Pressure Sensor Calibration** on page 10.

Autotune the Motor

Refer to the User's Guide by Control Techniques for complete autotuning instructions.

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The motor shaft will rotate during autotuning. Keep clear of moving parts.
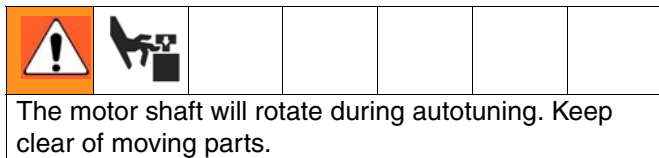
1. Decouple motor from gearbox. Secure motor to prevent it from jumping during autotuning.

2. Apply power to motor. Motor will rotate during autotuning. Keep clear of motor shaft and moving parts.

3. Navigate to Pr **5.12** and set its value to 2.

4. Apply Run command, see page 19. Autotuning will begin.

5. When motor stops turning, check that Pr **5.17** and Pr **5.24** are set to non-zero values. This indicates that the autotune was successful.

6. To save motor parameters, navigate to Pr **5.00**, set its value to 1000, and press the red Stop/Reset button. The number 1000 will automatically change to 0, indicating that the parameters have been saved.

1. Pressure Sensor Calibration

✏️ **IMPORTANT:** Pressure sensor information for your system is listed on the label attached to the pump gearbox circuit board cover.

CAUTION
Pressure sensor calibration information must be entered into the VFD. Failure to do so will result in Pressure Sensor Calibration Trip (**#50**), nuisance trips, or system malfunctions.

Pressure sensor information (Pr **20.34, 20.35, and 20.36) for your system must be keyed into the Variable Frequency Drive before system start-up.**

To prevent accidental change of pressure sensor calibration parameters, they are locked by Pr **20.16**. To enter calibration parameters, perform the following steps:

a. Set Pr **20.16** to 777, to unlock pressure sensor parameters.

b. Enter calibration parameters Pr **20.34**, **20.35**, and **20.36**.

c. Set Pr **20.16** to 0 to lock pressure sensor parameters.

If pressure sensor is part of the system (EPX**1**XX –> Fourth Digit = **1**), calibration information is printed on the label located on the circuit board cover. If the system was purchased without a Circuit System Kit (Graco P/N: 15J755) but one was installed later, affix the label (included with the kit) to the circuit board cover and enter calibration information into the VFD.

Calibration Parameters from the label:

Pr **20.34 –** Zero Calibration

Pr **20.35** – Calibration Pressure

Pr **20.36** – High Calibration

2. Pump Lower Size Selection

Parameter Pr **20.03** is reserved for the Lower size calibration information listed on the unit's identification plate:

EPXX**1**X => Pr **20.03** = 1000
EPXX**4**X => Pr **20.03** = 1000
EPXX**2**X => Pr **20.03** = 1500
EPXX**5**X => Pr **20.03** = 1500
EPXX**3**X => Pr **20.03** = 2000
EPXX**6**X => Pr **20.03** = 2000

3. High Pressure Alarm Setting

The High Pressure Alarm setting is controlled by parameter Pr **20.09.** The default setting is 300 psi. Refer to Menu 20 parameter table to determine maximum allowable setting for a given Lower size. The High Pressure Alarm (**#40**) becomes active when system pressure reaches the pressure setting in Pr **20.09**.

4. Low Pressure Alarm Enable/Disable

Low Pressure is an adjustable feature. Parameter Pr **20.08** is used to enable and disable the feature:

Low Pressure Alarm Enable => Pr **20.08** = **1**

Low Pressure Alarm Disable => Pr **20.08** = **0**

✎ This feature is disabled by default.

5. Low Pressure Alarm Setting

The Low Pressure Alarm setting is controlled by parameter Pr **20.07**. Default setting for the alarm is 150 psi. Refer to Menu 20 parameter table to determine maximum setting for a given Lower size. Low Pressure Alarm (**#41**) becomes active if it is enabled (Pr **20.08** = 1) and system pressure is lower than the Low Pressure Setting selected in Pr **20.07**.

6. System Ramp Rate Selection

Ramp rate controls the time it takes for the pump to reach the set flow rate and is measured in gallons per minute/minute (gpm/min). Note that a fast ramp rate may cause the pump to instantaneously build high pressure, causing system shutdown due to a High Pressure Trip (Alarm #40).

The Ramp Rate setting is controlled by parameter Pr **20.02.** Ramp rate range is 10 – 1000 gpm/min. Any number within this range can be selected. It is recommended that the default ramp rate be kept. The default setting is 100gpm/min.

7. Measuring Units

Select the desired units of flow measurement as follows:

Metric – liters per minute [lpm]=> Pr **20.15** = **1**

English – gallons per minute [gpm]=> Pr **20.15** = **0**

The Pr **20.15** selection affects only the flow measurement displayed in Pr **20.17**. It is not used by any system's functions.

8. Speed Potentiometer Enable/Disable

Speed potentiometer is a speed control option. Refer to **Motor Speed Control**, page 20, for more information. Set Pr **20.38** to enable or disable the speed potentiometer.

- Speed Potentiometer Enable=> Pr **20.38** = **1**

- Speed Potentiometer Disable=> Pr **20.38** = **0**

9. Saving Calibration

The last step in the calibration procedure is to save all calibration values.

a. Saving to the Drive/Program Module.

To ensure that all calibration values are permanently saved to the drive/program module:

1. Navigate to Pr **0.00** and set its value to 1000.

2. Press the red Stop/Reset button. The number 1000 will automatically change to 0, indicating that all parameters have been saved.

b. Saving to the SMARTCARD.

SMARTCARD is an excellent memory backup for system-specific parameter calibrations. If system parameters are mistakenly altered, using SMARTCARD can restore initial calibration.

1. Ensure that SMARTCARD is installed in the VFD. (VFD is shipped with SMARTCARD already installed and Graco defaults saved to memory location #101).

2. Navigate to Pr **0.00** and set its value to 4202.

3. Press the red Stop/Reset button. Small red dot on keypad display will start blinking, indicating that parameters are being saved.

4. When dot stops blinking, the save is completed.

Factory Defaults

E-Flo Plus System Specific Parameters (menu 20 parameters)

All of the E-Flo Plus features are controlled by menu 20 parameters. VFDs are shipped with these parameters set to default values (refer to Table 2 on page 16 for more information). Factory defaults can be loaded as follows:

1. Disable the drive through Secure Disable (if a Graco Local Control Box is used, press the red mushroom-type Secure Disable button).

2. Navigate to Pr **20.16** and set its value to **1234**. At this time the program defaults will be loaded and number 1234 will automatically be replaced by 0.

E-Flo Plus Motor Specific Parameters

VFDs are shipped with all motor parameters defaulted to a Graco UL motor. It is essential to check motor selection (page 9) and either:

• if Graco ATEX motor is used, reload motor defaults (see **Graco Motors**, page 9)

• if non-Graco motor is used, set all motor parameters (see **Non-Graco Motors**, page 9).

SMARTCARD Defaults

Default Graco parameter values for menus 0 through 22 are saved on SMARTCARD in location #101, as differences from the drive defaults (Code 4101); see the Control Techniques manual for further information. Use Code 6101 to load Graco defaults.

System-related Graco default parameters (menu 20) may be loaded by navigating to Pr **20.16** and setting its value to 1234. Note that Pr **20.16** will be automatically reset back to 0.

Complete System Reload

A complete system reload may be necessary because of an error in calibration or accidental parameter alteration.

1. Disconnect power to the VFD.

2. Remove all solutions modules from the VFD (AppsLite and Ethernet). Reconnect power.

3. Navigate to Pr **0.00** and set its value to 1244.

4. Press the red Stop/Reset button. Number 1244 will be automatically replaced by 0 as an indication that all VFD parameters are reset to defaults.

5. Navigate to Pr **0.00,** set its value to 1000, and press red Stop/Reset button to save the changes. Number 1000 will be automatically replaced by 0.

6. Disconnect power from the VFD, reinstall all modules, and reconnect power.

7. Navigate to Pr **17.20** and set it to ON.

8. Navigate to Pr **17.21** and set it to ON.

9. Navigate to Pr **17.00,** set its value to 1000, and press red Stop/Reset button. Number 1000 will be automatically reset to 0 as an indication that changes have been saved.

10. Load system-specific calibration from the SMARTCARD (if saved at initial calibration).

    a. Graco defaults are loaded as differences from VFD defaults in memory location #101. Navigate to Pr **0.00**, set its value to 6101, and press red Stop/Reset button.

    b. Recommended memory location for customer calibration is #202. Navigate to Pr 0.00, set its value to 6202, and press red Stop/Reset button.

11. If SMARTCARD is not available or if initial calibration was not saved to SMARTCARD, perform the following steps:

    a. Load Graco system defaults - set Pr **20.16** to 1234.

    b. Repeat **E-Flo Plus Calibration**, beginning with **Calibrate and Autotune the Motor** on page 9 and continuing with steps **1-9** of the calibration procedure (pages **10-11**).

12. Reset program module (and Ethernet/communication modules) by navigating to Pr **0.00**, setting its value to 1070, and pressing the red Stop/Reset button on keypad display.

E-Flo Plus Features

Drive Active (System ON) Output

Drive Active Pr **10.02** is mapped to the VFD relay outputs available at terminals 41 and 42. The relay contacts are open when the motor is not running (Pr **10.02** = 0, which means the drive is inactive). The relay contacts are closed when the motor is running (Pr **10.02** = 1, which means the drive is active).

Jog Mode

Jog mode allows the user to run the pump at the slow speed and to stop it at a desired position. Note that park angle allows easy access to the stand-side lower. Jog mode can therefore be used to stop the pump at an angle which will allow easy access to the motor-side lower. Jog speed is equivalent to the following flow rates:

2000cc lowers: 2.7 gpm (10.2 lpm)

1500cc lowers: 1.9 gpm (7.3 lpm)

1000cc lowers: 1.4 gpm (5.4 lpm)

Jog Mode in Local Control

Hardware

Jog mode requires a momentary, normally open switch. Graco offers a control box with jog switch installed. If local control box is used and Local/Remote switch is set to Local, jog mode can be initiated by pressing momentary "Jog" switch. Digital I/O #6 (Pin #29) is configured for the Jog mode (see **System Electrical Diagrams**, page 36). Normally open (N.O.) position of the switch disables jogging and closed position of the switch (Pin #29 connected to common) enables jogging.

Operation

To initiate Jog mode, press and hold the jog button. Jog mode will stay active as long as the jog button is pressed. When the jog button is released, the system will stop.

Jog Mode - Keypad / Modbus Control

Parameter Pr **20.01** is allocated to control system modes. Jog mode is mode #2. In order to initiate jogging, navigate to Pr **20.01** and set its value to 2. At this time the system will enter the Jog mode.

When the pump has reached the desired position, stop the system using one of the following methods:

• Put the system in Park by setting Pr **20.01** to 3, or

• Initiate the Stop command by using the red Stop/Reset button or via Pr **20.25** (see **Running the Pump** on page 18 for details).

> **IMPORTANT:** Once system is stopped and jogging is no longer required, change Pr **20.01** back to 0.

Park Mode

Park mode allows you to park the pump in a position allowing easy access to stand-side lower.

Park Mode in Local Control

Jog button has a dual function – Jog and Park. To access the Park mode, press and release the switch in less than 1 second.

Park Mode – Keypad / Modbus Control

Parameter Pr **20.01** is allocated to control system modes. Park mode is mode #3. To initiate parking, navigate to parameter Pr **20.01** and set its value to 3. The system will enter the Park mode. See **Jog Mode** instructions.

Prime/Flush Mode

Prime mode allows system priming and flushing. Once enabled, it commands the pump to run at the following flow rates for 2 minutes:

2000cc lower: 33.8 gpm (128.4 lpm)

1500cc lower: 24.3 gpm (92.3 lpm)

1000cc lower: 17.9 gpm (68.0 lpm)

Parameter Pr **20.40** enables and disables the Prime/Flush mode.

Prime/Flush Enable => Pr **20.40** = 1 (Prime/Flush cycle will start).

Prime/Flush Disable => Pr **20.40** = 0.

Notes:

1. Run the Prime/Flush mode with minimum flow restriction.

2. Once Pr **20.40** is set to 1, the Prime/Flush cycle will start and run for 2 minutes, at which time the pump will stop. Pr **20.40** is automatically reset back to 0.

Back Pressure Regulator (BPR) Control

BPR Production/Sleep modes – Keypad / Modbus Control.

Digital I/O #3 (Pin #26) is allocated for 24VDC solenoid driven air valve. Low output (<5V) indicates that Sleep Mode is disabled. High output (>15V) indicates that Sleep Mode is enabled.

Pr **20.18** is a Sleep Mode control parameter with the following configuration:

Pr **20.18** = 0: Sleep Mode disabled

Pr **20.18** = 1: Sleep Mode enabled

Enabling the sleep mode will not change flow rate.

BPR Production/Sleep modes Graco E-Flo Plus Control

The E-Flo Plus program offers several BPR control features, which are not available using the Keypad. See **Computer Control and Monitoring**, page 24, for more information.

1. Automatic sleep mode flow setting.

2. Seven day timer.

Automatic sleep mode setting

1. Launch E-Flo Plus program.

2. In the Run screen press blue "BPR in Production Mode" button once. It will now show "BPR in Sleep Mode" message indicating that air valve is ON and the system is in sleep mode.

3. Use Flow Slider to select desired Sleep Mode flow. The Sleep Mode flow is now calibrated.

Seven-Day Timer setting

1. Launch E-Flo Plus program.

2. In the Run screen under Options select "Advance screen".

3. Select Auto / Setup option in BPR Mode section. This will launch BPR – Sleep Mode Timer Setup screen.

Make desired time and flow selections.

Cycle Counter

Two cycle counters are available: Grand Cycle counter and Batch Cycle counter. Batch Cycle counter is a resettable counter.

Grand Cycle Counter

Grand cycle counter is a non-resettable counter. First four digits (XXXX9999) of the counter are located in Pr **20.27**. Next four digits (9999XXXX) are located in parameter Pr **20.28**.

Batch Cycle Counter

Batch cycle counter is a resettable counter. First four digits (XXXX9999) of the counter are located in parameter Pr **20.29**. Next four digits (9999XXXX) are located in parameter Pr **20.30**.

Batch Cycle Counter reset

Parameter Pr **20.26** resets Batch Cycle Counter when set to **1**.

Flow Rate Monitoring

The average flow is displayed in Pr **20.17**. Pr **20.15** is a control parameter that allows the user to choose units for measuring flow. If Pr **20.15** is set to 0, then units are English and flow is displayed in gallons per minute (gpm). If Pr **20.15** is set to 1, then units are Metric and flow is displayed in liters per minute (lpm).

Pr **20.17** is an integer, and therefore it is not able to display decimal numbers. The last digit represents decimal number. For example, if Pr **20.15** is set to 0 and Pr **20.17** displays number 125, the flow equals to 12.5 gpm.

Pump Displacement Volume

E-Flo Plus Pump Volumes:

Lower Size	Volume per Cycle (cc)	Volume per Cycle (Gal)
2000cc	4278	1.13
1500cc	3070	0.81
1000cc	2263	0.60

Pressure Monitoring

Keypad/Modbus Control

Pr **20.31** displays average cycle pressure. It is measured over one full revolution of the output shaft.

Table 2: E-Flo Plus Calibration Parameters / Modbus Map

Pr ID	Function	Default	Low Limit	High Limit	Load Defaults**
20.01	Run mode selection (0 = Programmed Cam, 1 = Constant Speed, 2 = Jog, 3 = Park).	0 (PCAM mode***)	0	3	Yes
20.02	Ramp rate selection	100gpm/min (Calibration parameter)*	10	1000	Yes
20.03	Lower Size Selection (2000cc, 1500cc, 1000cc)	2000cc (Calibration parameter)	1000cc	2000cc	Yes
20.04	Local / Remote Control Selector	Controlled by a switch, Digital I/O #5; N.O. = REMOTE (1)			No
20.05	Remote Mode Flow Setting (gpm x 10).	0 (Calibration parameter). Multiply desired number by 10 (12.5gpm = 12.5 gpm x 10 = 125; enter 125)	2000cc = 45gpm (45); 1500cc = 32gpm (32); 1000cc = 24gpm (24)	2000cc = 22.6gpm (226); 1500cc = 1.62gpm (162); 1000cc = 12.0gpm (120)	No
20.07	Low Pressure Alarm Setting	150 psi (Calibration parameter)	0	2000cc = 300 psi; 1500cc = 350 psi; 1000cc = 460 psi	Yes
20.08	Low Pressure Alarm Enable (0 = Disable, 1 = Enable)	0 - Disabled (Calibration parameter)	0	1	Yes
20.09	High Pressure Alarm Setting	300 psi (Calibration Pr)	0	2000cc = 300 psi; 1500cc = 350 psi; 1000cc = 460 psi	Yes
20.12	Motor Current x 10	0 (Calibration parameter) Multiply motor rated current (listed on motor identification plate) by 10 (for example, I = 6.5A => 6.5 x 10 = 65)	0	200-240V application = 155 380-460V application = 88	No
20.15	Units (0 = English, 1 = Metric)	0 (Calibration parameter)	0	1	Yes
20.16	Calibration (Special parameter) When set to 1234, it will reset system related menu 20 parameters to Graco default settings. When set to 56, it will reset motor related parameters to Graco default settings. When set to 777, it will allow pressure sensor calibration.				

Table 2: E-Flo Plus Calibration Parameters / Modbus Map

20.17	Flow Indicator. If Pr 20.15 = 0, the flow is displayed in English units - gallons per minute [gpm], and if Pr 20.15 = 1, the flow is displayed in Metric units - liters per minute [lpm].	Indicator [gpm/lpm]			
20.18	BPR valve control (0 = Disable, 1 = Enable; controls digital I/O 3, 0 = 0V, 1 = 24V)	0 (Calibration Pr)	0	1	Yes
20.19	Average Cycle Rate Indicator	Indicator			
20.20	Graco defined software version major	Indicator			
20.21	Graco defined software version minor	Indicator			
20.24	Average Motor Current (A)	Indicator			
20.25	Keypad Run/Stop Command (0=Disable keypad run/stop control, 1=Motor Stop Command (same as Pr 6.42=193), 2=Motor Run Command (same as Pr 6.42=195)	0	0	2	Yes
20.26	Reset Batch Cycle Counter	0	0	1	No
20.27	Grand Cycle Count - First 4 places - yyyy9999	Indicator			
20.28	Grand Cycle Count - The next 4 places - 9999xxxx.	Indicator			
20.29	Batch Cycle Count - First 4 places - yyyy9999	Indicator			
20.30	Batch Cycle Counter - The next 4 places - 9999xxxx	Indicator			
20.31	Average Pressure [psi]	Indicator			
20.32	Pressure Range [psi]	Indicator			
20.33	Pressure Sensor Trip (used for calibration)	Indicator			
20.34	Low Calibration Point (refer to pressure calibration instructions, page 9)	X**** (Calibration parameter)	0	10000	No
20.35	System Calibration Pressure (250 - 280 psi)	X (Calibration parameter)	100	500	No
20.36	High Calibration Point (refer to sensor calibration instructions, page 9)	X (Calibration parameter)	0	10000	No
20.37	UL/ATEX Motor Select	0 (Calibration parameter)	0 (UL)	1 (ATEX)	Yes
20.38	Analog Speed Potentiometer Control (0 = Disable, 1 = Enable)	0 (Calibration parameter)	0	1	Yes
20.40	System Prime/Flush Enable - commands motor to run at 75Hz for 2 minutes (0=Disable/Stop, 1=Enable/Start)	0	0	1	No

* Calibration parameter – user calibration that gets saved. These parameters are not initialized to 0. For example, if Lower Size (Pr **20.03**) is calibrated to be 1500cc, this will be saved in a memory of AppsLite module. Pr **20.03** will then be initialized to 1500 at every system reset and start-up.

** Load Defaults: Yes indicates that a default value will be loaded if Load Defaults function is invoked.

*** Run mode is not a save parameter. Any changes to this parameter will only stay active until the drive is reset. The drive will default to Programmed Cam mode during the power-up cycle.

****Initial value is provided by Graco.

Operational Envelope Limit

Explosion-proof electric motors have constant torque and variable torque limits. E-Flo Plus system is a constant torque application, and therefore the motor's constant torque limits must not be violated. The system is available with two motors: the UL explosion-proof motor and the ATEX explosion-proof motor. To stay within the allowed torque, flow and pressure limits are installed.

Flow Limit

Speed command is limited to 5:1 operation, where minimum allowed frequency is 10Hz and maximum allowed frequency is 50Hz. Jog and Prime modes are exceptions because of the time limits imposed on these modes and because these modes are not continuous modes of operation.

2000cc lowers:

Minimum Flow = 4.5 gpm (17.1 lpm)

Maximum Flow = 22.6 gpm (85.9 lpm)

1500cc lower:

Minimum Flow = 3.2 gpm (12.2 lpm)

Maximum Flow = 16.2 gpm (61.5 lpm)

1000cc lowers:

Minimum Flow = 2.4 gpm (9.1 lpm)

Maximum Flow = 11.9 gpm (45.2 lpm)

Pressure Limit

Operating pressure limits are unique to the pump lower sizes. If the system pressure is greater than the maximum allowed for a given pump lower size for longer than 30 seconds, system **Trip #44** will shut the system down. System pressure limits are as follows:

> 2000cc lower: 250 psi
>
> 1500cc lower: 330 psi
>
> 1000cc lower: 460 psi

Running the Pump

CAUTION
The drive has been programmed by Graco. **Do not** attempt to recalibrate the Sequencer or Motor Control as it can interfere with the Graco Program.

Secure Disable

According to Control Techniques Unidrive SP User Guide, "Secure Disable (SD) function provides a means for preventing the drive from generating torque in the motor, with very high level of integrity". This hardware function controls enable/disable state of the drive.

Secure Disable/Drive enable hardware input (pin #31) is designed for positive logic input only. It should be connected to internal 24VDC power supply (pin #22). The SD is a fail-safe function; it enables the drive when 24VDC is connected to SD hardware input and disables (inhibits) the drive when SD hardware input is open.

Pr **6.29** and Pr **8.09** can be used to monitor state of the Hardware enable input.

Local I/O Box (Graco P/N: 120373) provides a normally closed Secure Disable switch, which has a red mushroom button (press to latch, pull to unlock). When latched, switch opens SD circuit, therefore disabling (inhibiting) the drive. When unlocked, switch closes SD circuit, enabling the drive.

Start/Stop Command

Local Control Mode

When Local mode is selected, **Run** command can only be initiated by means of Run/Stop hardware switch – set Run/Stop switch to Run position.

Stop command can be initiated by one of the following:

1. Run/Stop switch:

   Set Run/Stop switch to Stop position.

2. Stop/Reset button:

   Press Stop/Reset (red) button on a VFD Keypad display. Note that if **Stop** command was initiated by pressing Stop/Reset button, one of the following two actions will restart the pump:

   a. Cycle the Run/Stop switch – Set it to Stop position and then to 'Run' position.

   b. Cycle Secure Disable circuit.

3. Secure Disable circuit:

   Disable the drive by disconnecting SD circuit. Note that if motor is stopped by means of SD circuit while Run/Stop switch was in Run position, the Run command will be reapplied once SD circuit is reconnected.

Remote Control Mode

When remote control mode is selected (Local/Remote switch is in Remote mode), Control Word is automatically enabled (Pr **6.43** = 1) and Run/Stop commands are controlled by the Control word (Pr **6.42**). Commands can be directly entered into the VFD by means of a Keypad or can be sent via Modbus. Refer to SM Ethernet User Guide (Control Techniques) for more information on Modbus control.

Control word (Pr **6.42**) commands:

Run command = 195

Stop command = 193

Refer to Unidrive SP User Guide for more information on system sequencer.

Keypad Control

Run command can be varied via Keypad only if Local/Remote switch is set to Remote.

To initiate **Run** command via Keypad, navigate to Pr **20.25** and set its value to 2.

Stop command can be initiated by one of the following:

1. Stop/Reset button:

   Press Stop/Reset (red) button on a VFD Keypad display. If Stop command was initiated by pressing Stop/Reset button, one of the following two actions will restart the pump:

   a. Set Pr **20.25** to 1 and then to 2.

   b. Cycle SD circuit.

2. Navigate to Pr **20.25** and set its value to 1.

✎ Pr **20.25** is an image of Pr **6.42**. Setting Pr **20.25** to 2 will cause Pr **6.42** to set to 195, and setting Pr **20.25** to 1 will cause Pr **6.42** to set to 193.

Modbus Control

Run command can be varied via Keypad only if Local/Remote switch is set to Remote.

VFD parameter Pr **6.42** can be varied via Modbus communication protocol.

Run Command => Pr **6.42** = **195**

Stop Command => Pr **6.42** = **193**

Note that Hardware Enable circuit cannot be triggered by software. It needs to be physically connected or disconnected.

One way to use Modbus is to open Ethernet module's webpage and get direct access to Pr **6.42**.

Flow Control

Motor Speed Control

Motor speed is set indirectly, by setting Pump Flow Rate, which is then translated to motor speed by Graco Software.

Motor Speed is set via Preset Reference 1. Refer to Unidrive SP User Guide, Menu 1: Frequency / Speed Reference Logic Diagram.

Local Mode – Keypad Flow Control

Resistance of 0 ohms corresponded to zero flow. Increase in resistance equals increase in flow. Use Pr **5.01** to monitor instantaneous speed of the motor (in Hz).

Hardware required – 5 k ohm Variable Resistor (Potentiometer). Refer to Control Technique Unidrive SP User Guide for more details on electrical installation (also see **System Electrical Diagrams**, page 36).
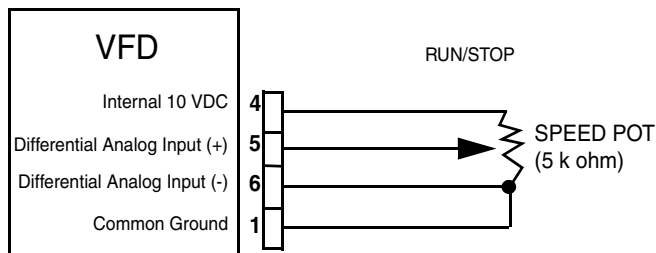

FIG. 5

If Speed Potentiometer is not installed, flow can be controlled directly from the Keypad. The following conditions must be true:

1. Speed Potentiometer Enable = Disable (Pr **20.38** = 0).

2. Control Mode = Local (Local/Remote switch in Local position; Digital I/O #5 (Pin #28) is grounded (Common ground is available at VFD pins #1, 3, 11, 21, 23, and 30).

Enter desired flow into Pr **20.05** as follows:

1. Determine desired flow (for example, 12 gallons per minute [gpm]).

2. Multiply desired flow by 10 (12gpm*10 = 120gpm).

3. Enter the result into parameter Pr **20.05** (enter number 120).

Speed Potentiometer control mode is available if the following conditions are valid:

1. Speed Potentiometer Enable = (Pr **20.38** = 1).

2. Control Mode = Local (Local/Remote switch in Local position; Digital I/O #5 (Pin #28) is grounded (Common ground is available at VFD pins #1, 3, 11, 21, 23, and 30).

Remote Mode

✎ The speed potentiometer mode has no effect even while enabled.

To have a remote control, the following condition must be true:

Control Mode = Remote (Local/Remote switch in Remote position; Digital I/O #5 (Pin #28) is floating.

Flow is controlled by the Pr **20.05**. Keypad or Modbus communication protocol can be used to alter value of Pr **20.05**.

Multiply desired flow value by 10 (see **Local Mode – Keypad Flow Control** above for more details).

Diagnostics

Drive Trip Codes and Diagnostic Procedures

Drive status and trips are located in Menu 10. Drive trips are stored in Pr **10.20** through Pr **10.29**. For more information on trip and diagnostic procedures refer to Control Technique Unidrive SP Advance User Guide.

Trips and Diagnostic Procedures

System trips with values in the range of #**40 – 50,** and trip **100** are E-Flo Plus specific.

Trips #**40 – 50** will cause the system to shutdown upon becoming active. Trip **100** is reserved for a system alarm reset.

An external trip is also configured specifically for E-Flo Plus; its trip code is **Et**. This trip becomes active if one of the following conditions is true:

- Power is applied to the motor while Secure Disable circuit is disconnected (normally closed switch is open). It is therefore recommended to connect Secure Disable circuit (normally closed switch is closed) before applying power to the motor.

- VFD/Apps module(s) reset is initiated while Secure Disable circuit is disconnected (normally closed switch is open). It is therefore recommended to connect Secure Disable circuit (normally closed switch is closed) before performing system reset,

The **CL2** trip becomes active if the pressure sensor signal is lost.

Refer to the Control Technique User Guides for trip codes which are not listed in TABLE 3.

Resetting the System

1. Stop the pump.

2. Enable the Secure Disable.

3. Navigate to Pr **0.00** and set its value to 1070. Press the red (reset) button. Note that the system will reset at this time. Value of Pr **0.00** will be reset back to 0 automatically.

Table 3: Trips and Diagnostic Procedures

Trip Code	Trip Description	Diagnostic
40	**High System Pressure** (System pressure is higher than the allowed maximum)	1. Check High Pressure Alarm setting (Pr **20.09**). Verify that system desired operational pressure is lower then High Pressure Alarm setting. 2. Check for flow restrictions (closed valves, unexpected restrictions). 3. Check fluid supply to the pump. 4. Check pump fluid section for proper operation (piston seals, ball checks). Refer to pump maintenance manual for additional information.
41	**Low System Pressure** (System pressure is lower than the allowed minimum)	1. Check Low Pressure Alarm setting (Pr **20.07**). Verify that system desired operational pressure is higher then Low Pressure Alarm setting. 2. Check fluid level. Low fluid level will cause system to run at low pressure. 3. Check fluid supply to the pump. 4. Check pump fluid section for proper operation (piston seals, ball checks). Refer to pump maintenance manual for additional information.
42	**No TDC** (Top Dead Center Sensor is not detected)	1. Verify that output shaft is turning. If trip is active, enable Secure Disable, reset the trip, and restart the pump to verify if it is running. 2. Verify all of the wiring. 3. Verify that sensor is operational. Remove PCB cover and monitor LED light on a top of the sensor. The light should be normally on and it should be turned off for only short period of time when top dead center is reached.
43	**High Motor Current** (Motor current has exceeded the maximum for the duration of 30 seconds)	1. Check motor calibration Pr **20.37** (UL. motor is 0 and ATEX motor is 1). 2. Check torque on both throat-packing nuts (see lower repair-parts manual 311690). 3. Flow/Pressure combination may be set too high for a given fluid/system. 4. Check ramp rate setting in Pr **20.02**. If ramp rate is set too high consider changing it to a lower setting.
44	**Operational Envelope** (System has operated outside of operational window for the duration of 30 seconds)	1. Check system pressure setting. Ensure that system pressure does not exceed the allowed operational envelope. Refer to Operation Manual 311593 for Motor Speed and Flow Charts. 2. Check pressure sensor calibration. If sensor needs to be recalibrated follow instructions, page 35.

Table 3: Trips and Diagnostic Procedures

45	**Motor Stalled**	This trip occurs when the motor is not able to develop torque, and therefore cannot put the pump into motion. 1. Relieve system pressure. 2. Check lowers, slider cylinders, and output shaft with connecting rods for visible damage. If no damage is visible, check for excessive heat which is a sign of friction. 3. Check motor wiring. 4. Disconnect lowers and try running just the motor and gearbox.
49	**Runtime Trip**	1. Reset the system (see directions on page 21). 2. Cycle power. 3. Perform **Complete System Reload**, page 12.
50	**Pressure Calibration**	Enter proper pressure sensor calibration parameter, page 9.
100	**Alarm Reset**	
Et	**External Trip**	Enable Secure Disable and reset the trip.
CL2	**Loss of Pressure Sensor**	1. Check wiring and power to the barrier. 2. Check pressure transducer current (pin #7). If current is less than 3 mA, replace the sensor.

Computer Control and Monitoring

To control or monitor the system using the supplied software with a computer (PC), the following components are required:

- Graco VFD, Part No. 15J753 or 15J754

- Ethernet Upgrade Kit 15H885

- Category 5 Ethernet Cable

To *control* the pump using a computer, the system must be in *remote* mode and the SECURE/DISABLE switch must be disabled.

To *monitor* the pump from a computer, the system must be in *local* mode.

Ethernet Upgrade Kit 15H885

The Ethernet Upgrade Kit includes a module which allows a computer to monitor/communicate with the VFD via Ethernet. See manual 311612 for installation instructions.

E-Flo Plus Software Update

The following components are required to update E-Flo Plus software:

- PC

- Control Techniques Communication Cable (PC-to-drive Communications Cable, RS232/RS485 converter with 9-pin D-shell and RJ45 connectors)

- Control Techniques CTNetAPI Installer

- Control Techniques WinFlash

Installation Instructions

1. Connect to Emerson website (www.emersonct.com).

2. Go to Support/Downloads and select Software.

3. Register as a user to gain access to the Software downloads.

4. Select Software.

5. Choose Unidrive SP option.

6. Download CTNetAPI Installer. Unzip and install the program.

7. Create a folder for the WinFlash program.

8. Download and save WinFlash zip file into the folder.

9. Extract winflash.exe from the zip file.

Software update instructions

1. Launch winflash.exe.

2. Read information in the Introduction window and select Next.

3. Choose Download a Compiled Program option and select Next.

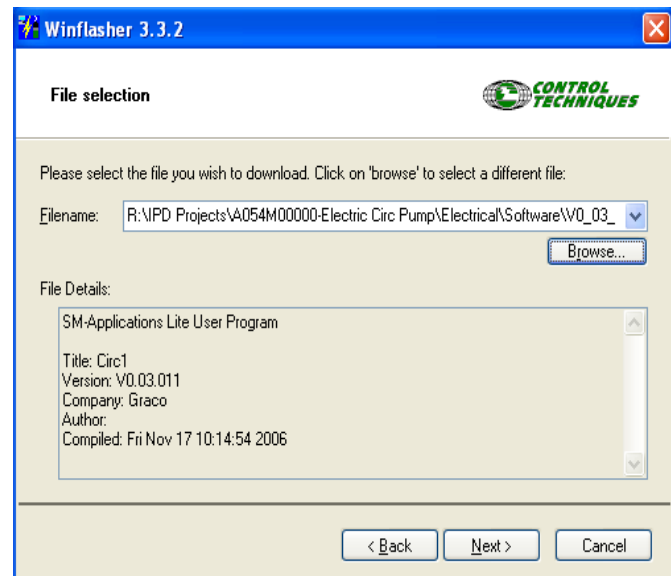4. Browse for a Graco software file and select Next. See FIG. 6.

FIG. 6

5. In the Select the method for downloading window, select Slot 3 and click on Change Communication Settings… tab. See FIG. 7.
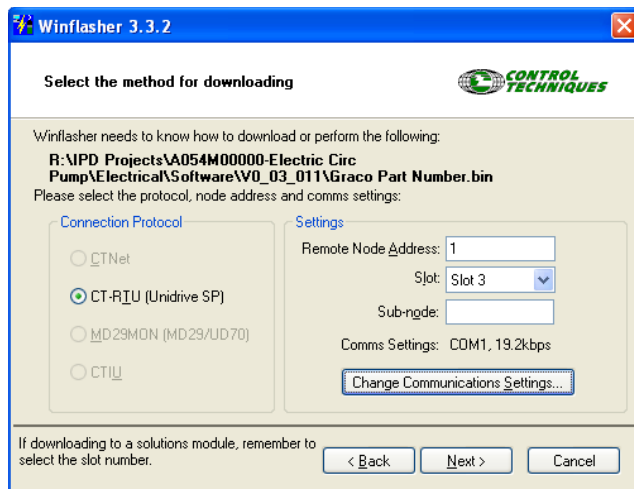

FIG. 7

6. Select the appropriate hardware communication port in the Communication Settings window and click OK button. See FIG. 8.
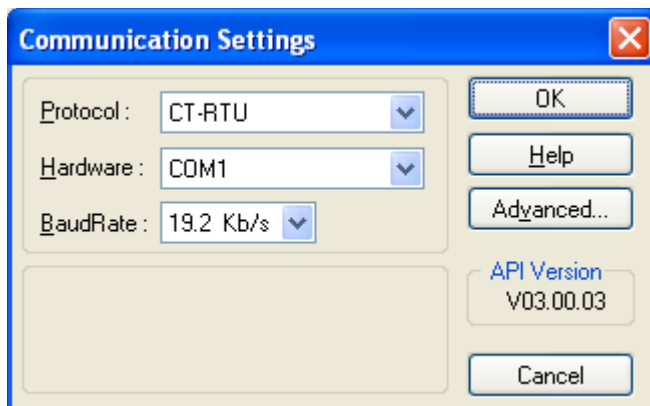

FIG. 8

7. Read the Important Safety Warning and select Next.

8. Begin the download. Once the download process has ended select Finish to exit the program.

Configure the Ethernet Card

To configure the Ethernet card for proper access manually set the IP address rather than allowing the PC to automatically do so. These procedures are written for a Windows XP operating system.

1. Go to Start>Control Panel.

2. Select Network Connections.

3. Select the icon for the network connection you will be using to communicate with the VFD, right click on the icon, and select properties. See FIG. 9.
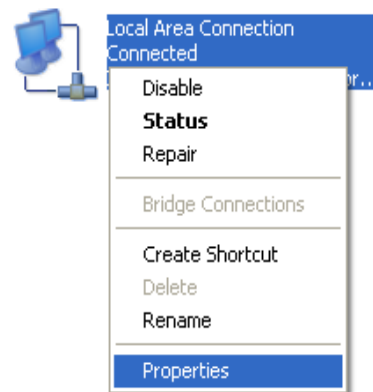

FIG. 9

4. The Local Area Connection Properties window will open. Select Internet Protocol from the listed options. Click on Properties. The Internet Protocol Properties window will appear. See FIG. 10.
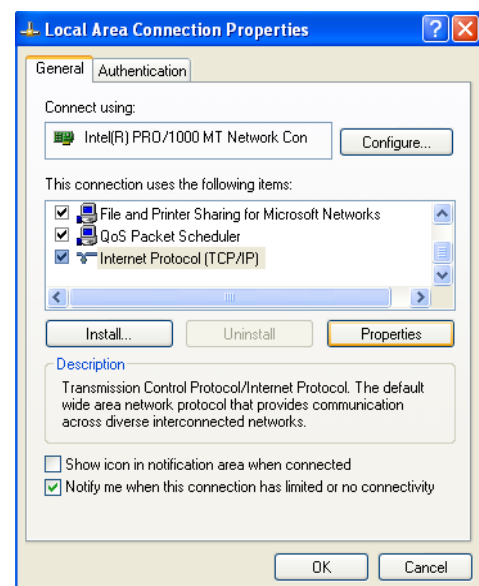

FIG. 10

5. See FIG. 11. Select "Use the following IP address."
    The default Pump IP address is 192.168.1.100.
    Enter a number which differs from the default
    address in only the last set of numbers, for example:
    192.168.1.10. This enables the computer to connect
    to the VFD. Set Subnet mask to 255.255.255.0.
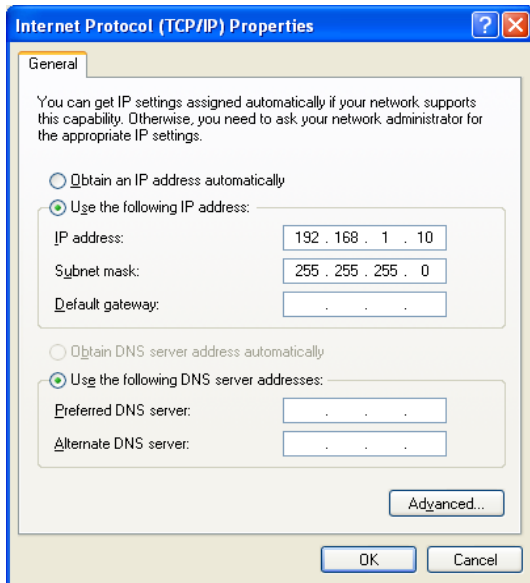
FIG. 11

6. Press OK.

✎ It may take 30-60 seconds for the computer to
locate the address and establish the connection.

Install the Computer Software

Load the supplied CD into your computer and follow the
software installation instructions as they appear on the
screen.

Once the installation is complete, select E-Flo Plus from
the Windows Start menu.

✎ Graco uses a Visual Basic program to display the
run screen on the computer. **This software and
program is not supported by Graco.**

Connect the VFD to the PC

Use a CAT 5 Ethernet Cable (D) to connect the VFD
Ethernet Module (C) to the PC. See FIG. 12.

FIG. 12

Connecting to Multiple VFDs

Connecting to multiple VFDs requires that each VFD must have an individual Ethernet upgrade kit. Furthermore, a router is probably necessary to allow one instance of the Visual Basic software to control all drives. The following steps describe the correct procedure to set up numerous connections:
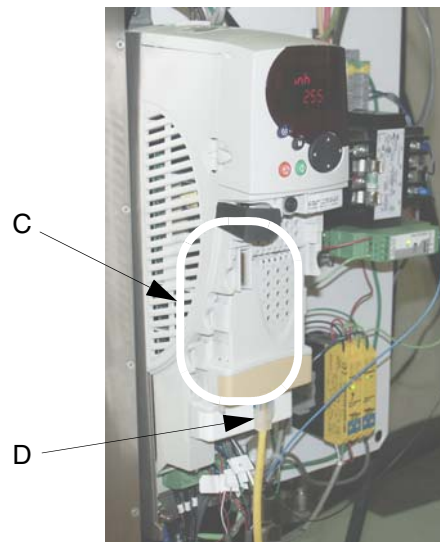
1. Connect an Ethernet cable from each module to the router and also from the router to PC.

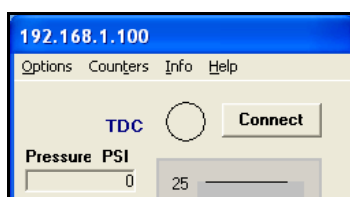2. Open the VB application and press Connect. See FIG. 13.

FIG. 13

3. Click CONNECT. See FIG. 14. The Run screen appears. See FIG. 17. The Network Setup window will close when connection is made.

4. In the main run window, go to Options>Add or Change Pump Info.

5. Enter the new pump information. See FIG. 15. Check the boxes next to each connected drive.
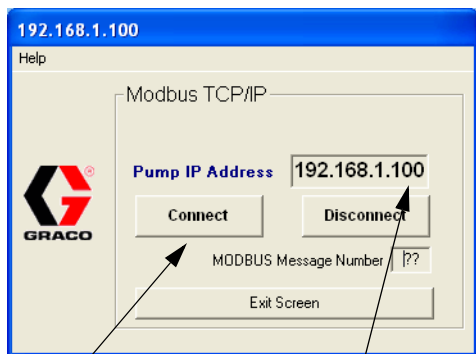
Press Button to Connect

Default Pump IP Address

FIG. 14. Network Address Setup Window

6. Select Save Settings and then select Open Selected Pumps.

Multiple run windows should now appear. To connect to each drive, the IP Address of each drive must be unique. To accomplish this, navigate to drive parameter #16.13 on each drive and increment this such that each pump contains a different value. For example:

Drive 1: Par. #16.13 = 100

Drive 2: Par. #16.13 = 101

Drive 3: Par. #16.13 = 102

Drive 4: Par. #16.13 = 103

After doing this on each drive, each drive must be reset. See **Resetting the System**, page 21, for instructions.

7. Repeat steps 2 and 3 for each additional IP address you selected in step 5 on page 26.

At this point, go to the software again, and press the Connect button on the main run window and then, in the Network Address Setup window, enter the new IP address.

FIG. 15 Multiple VFD Connections

Run Screen
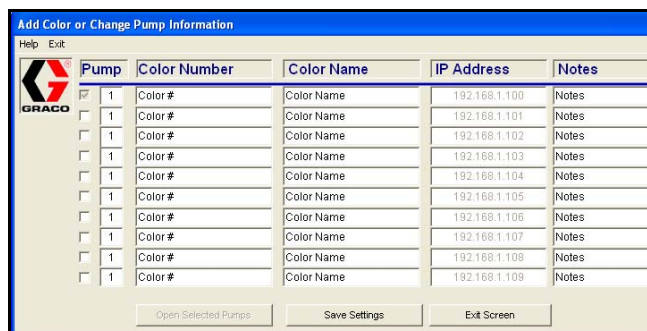
Speed Control

✎ Graco uses a Visual Basic program to display the run screen on the computer. **This software and program is not supported by Graco.**

See FIG. 17. The sliding scale on the Run screen sets the pump speed in units of flow.

✎ To change units of measure (English/Metric), select Options menu, then Advance Options screen (see page 30).

In *remote* mode, the slider is active and can be controlled on the computer. Select the slider with the cursor and move it to the desired value on the scale.

In *local* mode, the slider cannot be controlled on the computer. It will independently move up and down the scale, reflecting average flow as measured by the VFD.

Counters

See FIG. 17. The counters are active in both remote and local mode.

Pressure - Displays fluid pressure reading from pressure transducer.

Flow Rate - Displays flow per minute.

CPM Rate - Displays pump cycles per minute reading from TDC sensor.

Batch Counter - Displays batch cycle count. User resettable; see **Reset Batch Counter**, page 30.

Cycle Count - Displays total cycle count. Not resettable.

Control Buttons

See FIG. 17. In remote mode, the buttons are active and may be used to control the pump.

RUN and STOP Status Buttons

The status buttons operate as a toggle switch to run or stop the pump.

- To run the pump, press RUN. The button display will change to RUNNING, and the STOPPED button display will change to STOP.

- To stop the pump, press STOP. The button display will change to STOPPED, and the RUNNING button display will change to RUN.

PARK ON/OFF Button

- PARK ON sets the pumps to the park position.

- PARK OFF turns off the park feature and resumes normal operation.

Trip Reset Button

Trip button becomes enabled (active) when Secure Disable is pressed.

Press to reset the pump if a trip occurs.

BPR Button

- BPR IN PRODUCTION: use in normal production mode.

- BPR IN SLEEP: when no production.

✎ Set the speed (flow) to the desired level for sleep mode and the system will slow down when BPR OUT OF PRODUCTION button is pushed.

Access the Advanced Options Screens

From the Run screen (FIG. 16) go to the Options pull-down menu. Select the **Advanced Options Screen** (page 30). From the Advanced Screen the **Data Logging Screen** (page 33), or **Power Monitor Screen** (page 34) can be selected.

FIG. 16

Run Screen

To access
Advanced/Data Logging/
Power Monitor Screens

To reset Batch
Counter

Fluid Pressure

Flow Rate

CPM Rate

Batch Counter

Cycle Count

RUN Status Button

STOP Status Button

PARK ON/OFF Button

Trip Reset Button

BPR In Production
Button

Sliding Speed
Control

Record of trips

192.168.1.100

Options Counters Info Help

TDC ◯

Pressure PSI
141

Flow   GPM
0

CPM Rate
0

Batch
4032

Cycle Count
91115

RUN

STOPPED

PARK OFF

Trip Reset

**BPR in
Production
Mode**

25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5 5.0
4
3
2
1
0

**See Manual for Allowable
Pressure and Flow ranges**

Last 10 Faults
Trip-1: High Pressure Trip
Trip-2: Et, Secure Disable Button On

FIG**. 17. Run Screen**

Advanced Options Screen

The advanced screen allows user changes to operating parameters. This is only effective in the remote mode. See FIG. 19.

Units of Measure

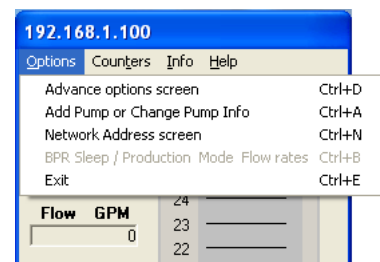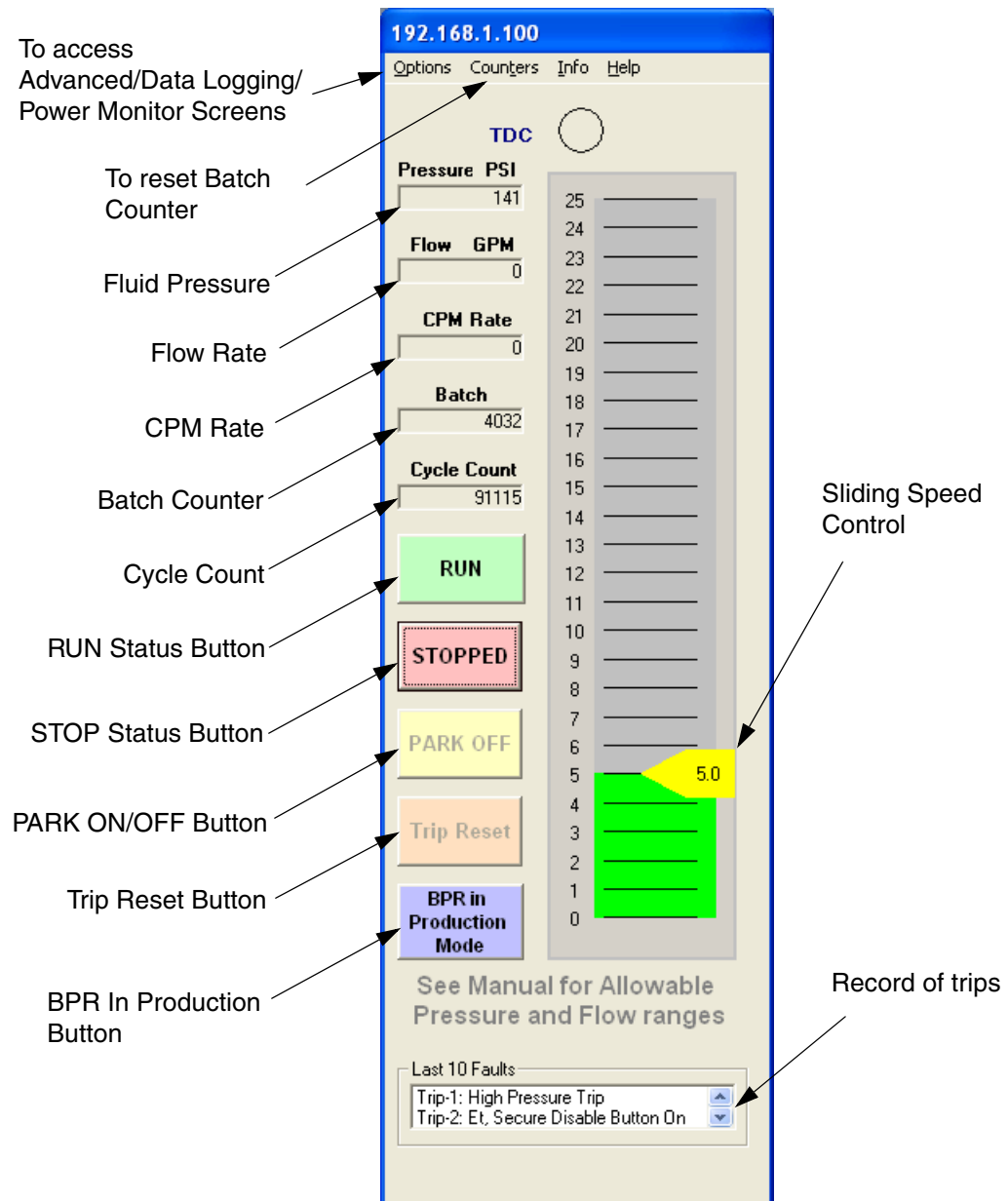Select desired units (English or Metric). See FIG. 21. Values on Run screen will change accordingly.

Trips

* **High Pressure Trip:** Default is 300 psi. If measured pressure is more than the set pressure, a high pressure trip will occur. See TABLE 2 on page 16, Pr **20.09**.

* **Low Pressure Trip:** The low pressure trip is an optional setting. To set, select the low pressure trip box and input the desired value. If measured pressure is less than the set pressure, a low pressure trip will occur.

✎ Pressure must surpass the low pressure trip value before the trip becomes active.

Flow Calibration

* **Lower Size:** Select size of pump lowers (1000cc, 1500cc, or 2000cc).

* **Flow Ramp Rate:** Default is 100 gpm. A higher rate will prevent pressure from building up too rapidly, which can cause nuisance high pressure trips.

Trend Timer

Trend timer is used for a timeline management for data logging. Set desired trend time (1 to 5 seconds) or (1 to 5 minutes).

BPR Mode

Select Manual or Auto/Setup, as applicable. If Auto/Setup is selected the BPR Timer Screen is displayed. See FIG. 20.

CAM

* **CAM:** CAM is the default. This setting utilizes the E-Flo Plus cam profile which eliminates pressure fluctuations by adjusting motor speed incrementally.

* **Constant Speed:** Sets motor to a constant speed, which negates the cam profile and may result in pressure fluctuations.

Reset Batch Counter

Press to reset batch counter on Run screen.

Drive Status Messages

There are two groups of drive status messages:

* Drive Health

* Drive Warning Messages

An active status message will turn red. See TABLE 4 on page 32 for additional information.

Prime/Flush

Prime/flush allows system priming and flushing. Once enabled, the pump will ramp up to the following flow rates for two minutes.

* 2000 cc lower: 33.8 gpm (128.4 lpm)

* 1500 cc lower: 24.3 gpm (92.3 lpm)

* 1000 cc lower: 17.9 gpm (68.0 lpm)

BPR Production Flow Screen

BPR Production Flow Screen is accessed from the options menu in main screen

FIG. 18 BPR Production Flow Screen

Advanced Options Screen

Selecting the Auto/Setup displays the BPR Screen shown in FIG. 20.

Set Trend Time

Set desired units of measure

Set BPR Mode

Prime/Flush

Set high and low pressure limit, and low pressure trip, if desired

Set size of lower

Drive Status Messages

Set flow ramp rate

Reset batch counter

Record of Trips

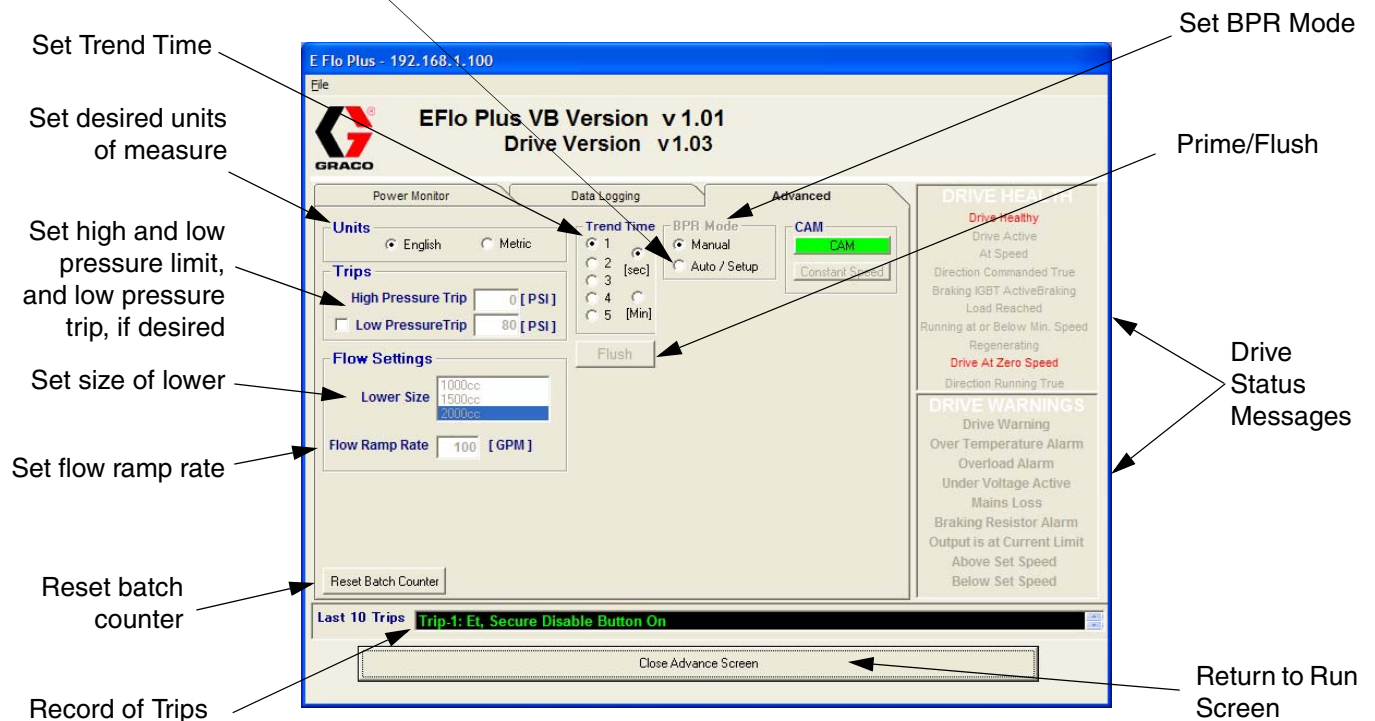Return to Run Screen

FIG. 19

BPR Timer Screen

Select Production Days

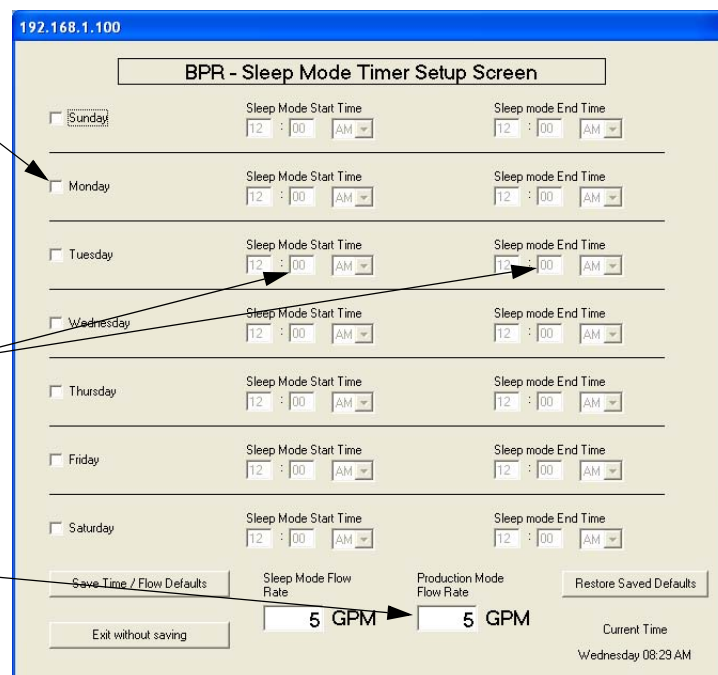Select (De)Activation Times

Select Production/Sleep Flow Rates

FIG. 20

Table 4: Drive Status Messages

Message	Submenu Address	Description
DRIVE HEALTH MESSAGES		
Drive Healthy	10.01	Drive is not tripped.
Drive Active	10.02	Drive is active.
At Speed	10.06	Motor is rotating.
Direction Commanded True	10.13	
Braking IGBT ActiveBraking	10.11	
Load Reached	10.08	
Running at or Below Min. Speed	10.04	
Regenerating	10.10	
Drive at Zero Speed	10.03	
Direction Running True	10.14	
DRIVE WARNINGS MESSAGES		
Drive Warning	10.19	There is an active drive alarm (10.18, 10.17, or 10.12).
Over Temperature Alarm	10.18	Motor overtemperature switch activated.
Overload Alarm	10.17	
Under Voltage Active	10.16	
Mains Loss	10.15	Loss of input power.
Braking Resistor Alarm	10.12	
Output is at Current Limit	10.09	
Above Set Speed	10.07	Unit is running faster than set speed range.
Below Set Speed	10.05	Unit is running slower than set speed range.

Data Logging Screen

The data logging screen records pressures, speed, time, and ranges.

1. Press Start Data Logging button.

2. Default filename is LogFile.CSV. Enter the desired filename.

3. Pressing Start Data Logging will begin logging, and indicator will start moving.

4. Press Stop Data Logging to complete and close file.

Begin data logging

Record of Trips

Return to Run Screen

FIG. 21. Data Logging Screen

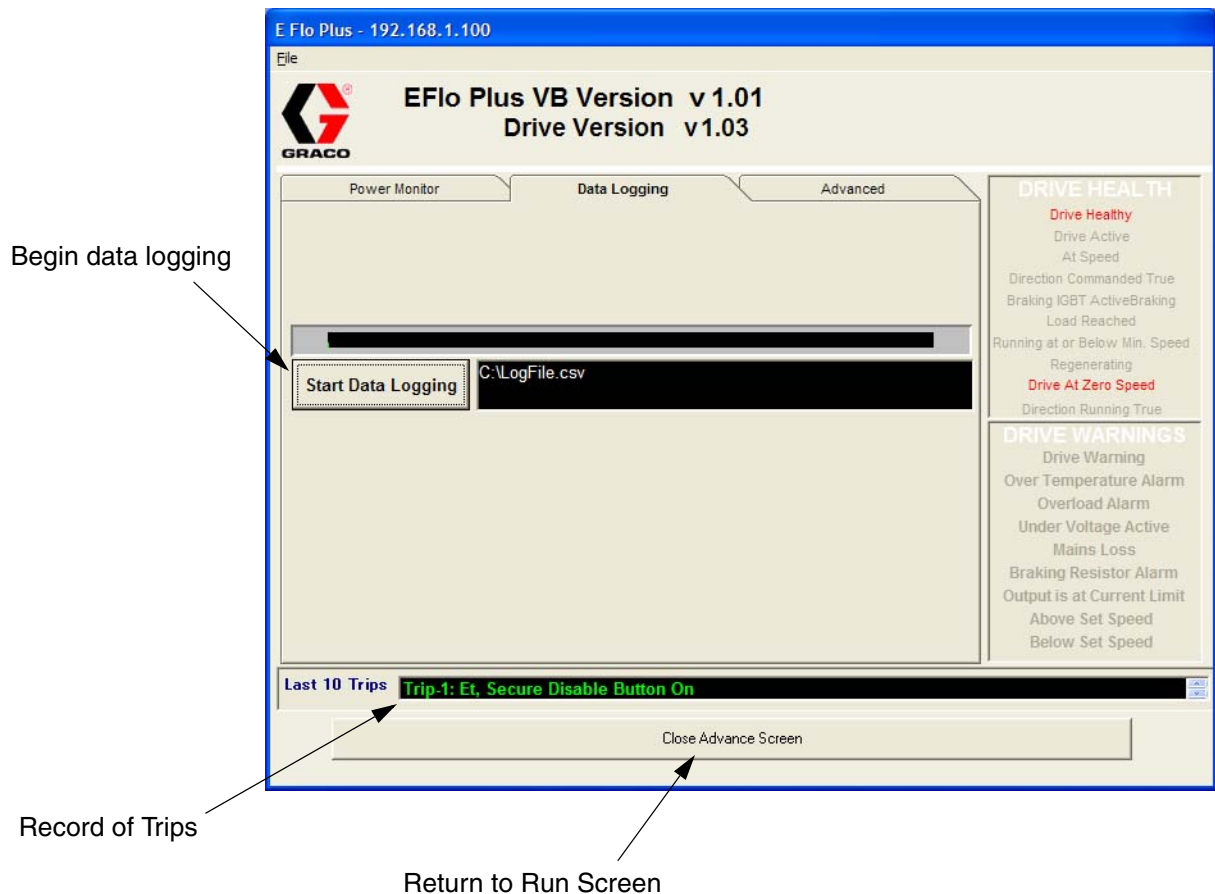# Power Monitor Screen

The Power Monitor screen displays motor status in Hz, Amps, and horsepower.

To zoom in on the graphs, select one of the sliders on an axis and slide it toward the other on the same axis.

Press Clear button to restart graph information.

Motor Power (HP or KW)   Motor Current (Amps)

Motor Speed (Hz)

Record of Trips
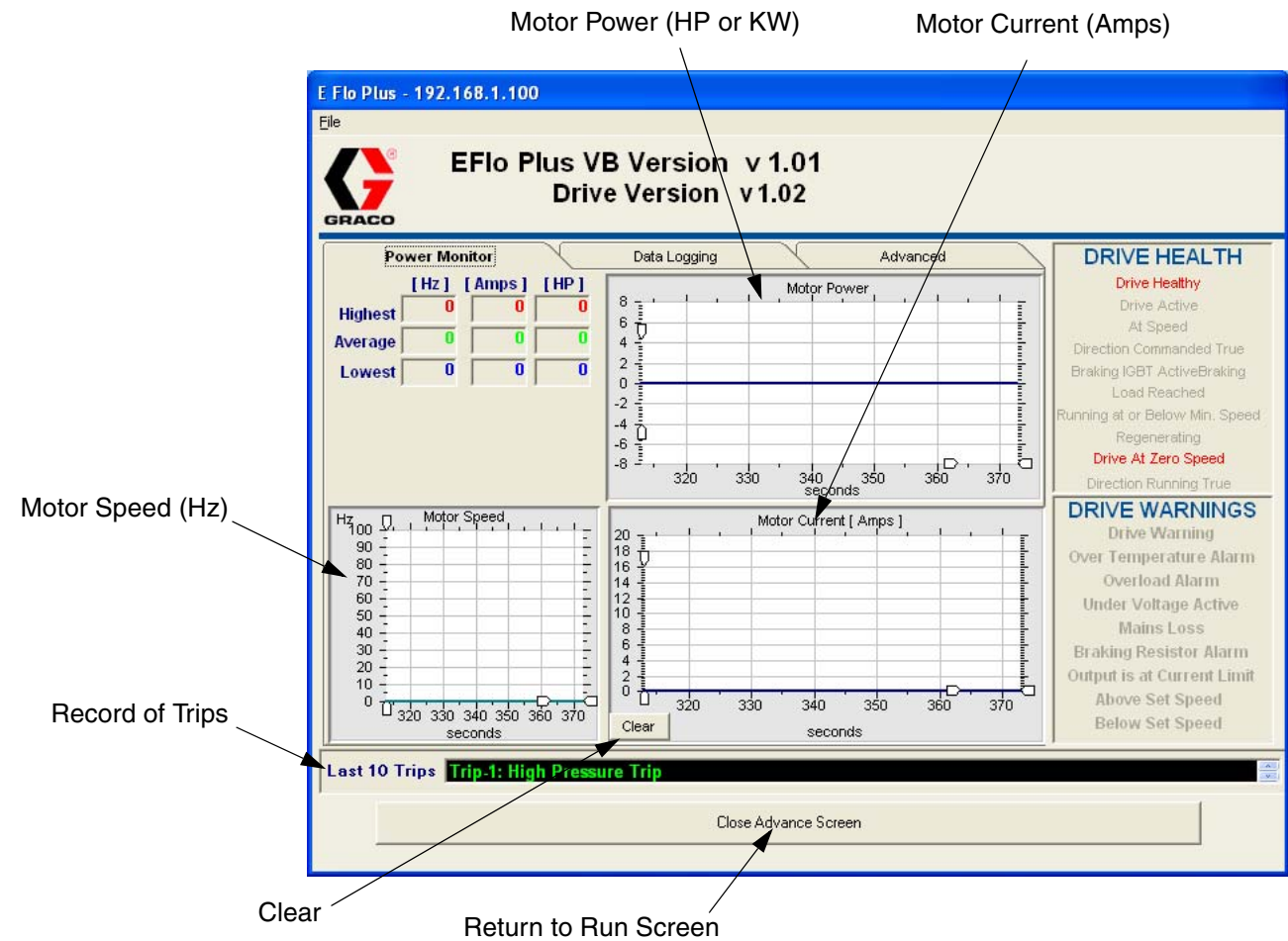
Clear

Return to Run Screen

FIG. 22. Power Monitor Screen

Pressure Transducer Calibration Procedure

E-Flo Plus pressure sensor must be calibrated against an instrument grade High Precision Pressure Transducer, which should be installed near the E-Flo Plus pressure sensor.

1. Ensure that the High Precision Pressure Transducer calibration is up to date.

2. Set Pr **20.11** to 777, to unlock pressure sensor parameters.

3. Calibrate Low Pressure Point as follows:

   a. Ensure that system is not pressurized. Calibration instrument pressure reading should be 0 psi.

   b. Use Keypad to navigate to Pr **20.33**; monitor its reading for 5 – 10 seconds to determine its average value. Make a record of it.

   c. Navigate to Pr **20.34** and enter the recorded average value of Pr **20.33**.

4. Calibrate the High Pressure Point as follows:

   a. Pressurize the system to 250 – 275 psi.

⚠	◬				
Do not exceed pressure rating of the system! If system is rated to a pressure lower then 250 psi, use maximum allowable rated pressure. Refer to Operation Manual 311593.					

   b. Keep the system pressurized and ensure that pressure does not fluctuate.

   c. Take a pressure reading from the calibration instrument and make a record of it.

   d. Navigate to Pr **20.35** and enter the recorded system pressure.

   e. Navigate to Pr **20.33**; monitor its reading for 5-10 seconds to determine its average value. Make a record of it.

   f. Navigate to Pr **20.36** and enter the recorded value of Pr **20.33**.

5. Set Pr **20.11** to 0 to lock pressure sensor parameters.

6. Verify pressure calibration.

   a. Relieve system pressure.

   b. Navigate to Pr **20.31** and verify that its reading is within the range of 0-3 psi.

   c. Pressurize the system to about 100 psi. Verify that reading of Pr **20.31** is within +/- 2.5 psi of the system pressure.

   d. Pressurize system to about 250 psi. Verify that reading of Pr **20.31** is within +/- 2.5 psi of the system pressure.

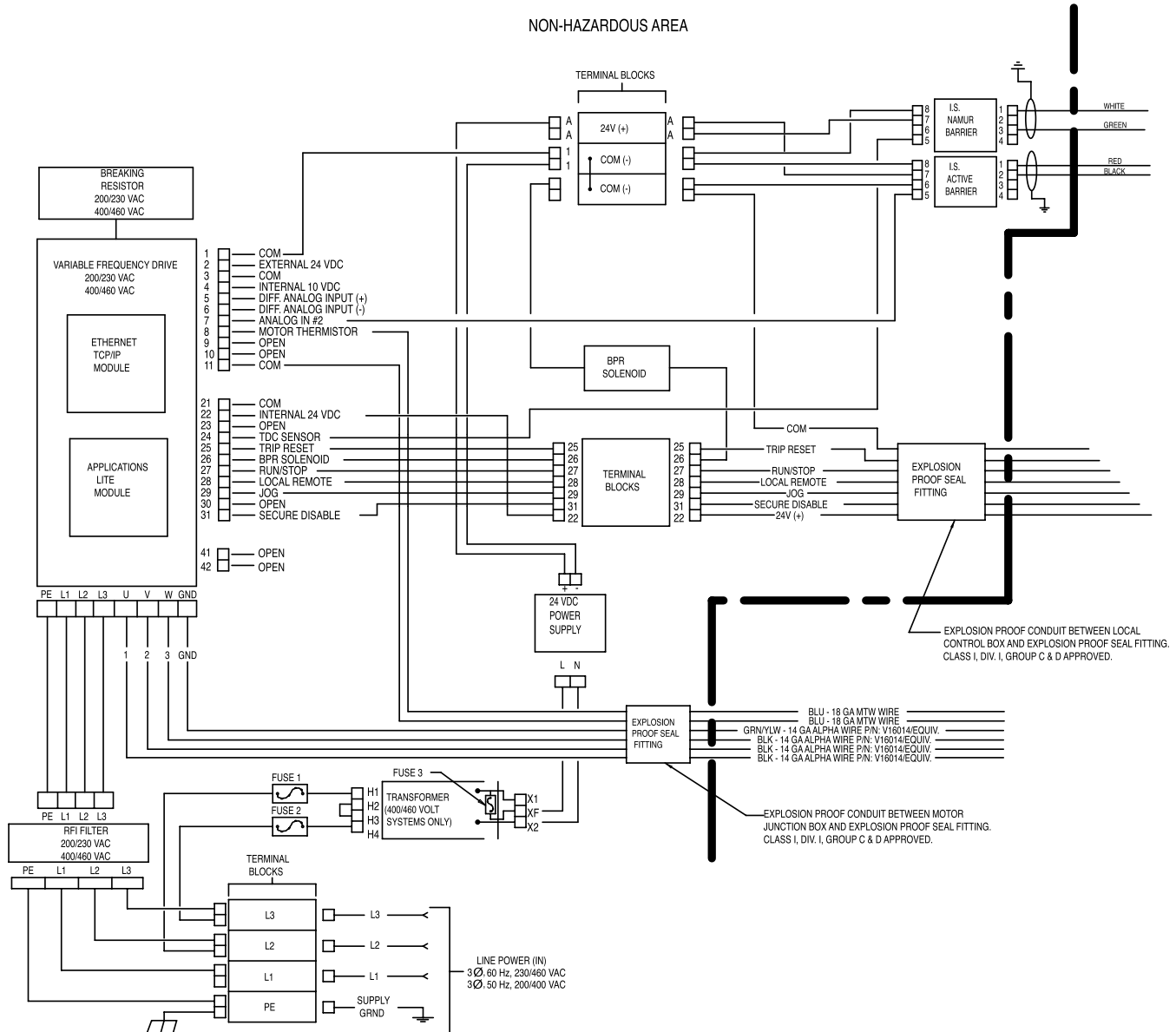# System Electrical Diagrams

FIG. 23 shows components which must be installed in a non-hazardous location.

FIG. 24 shows components approved for installation in a hazardous location.

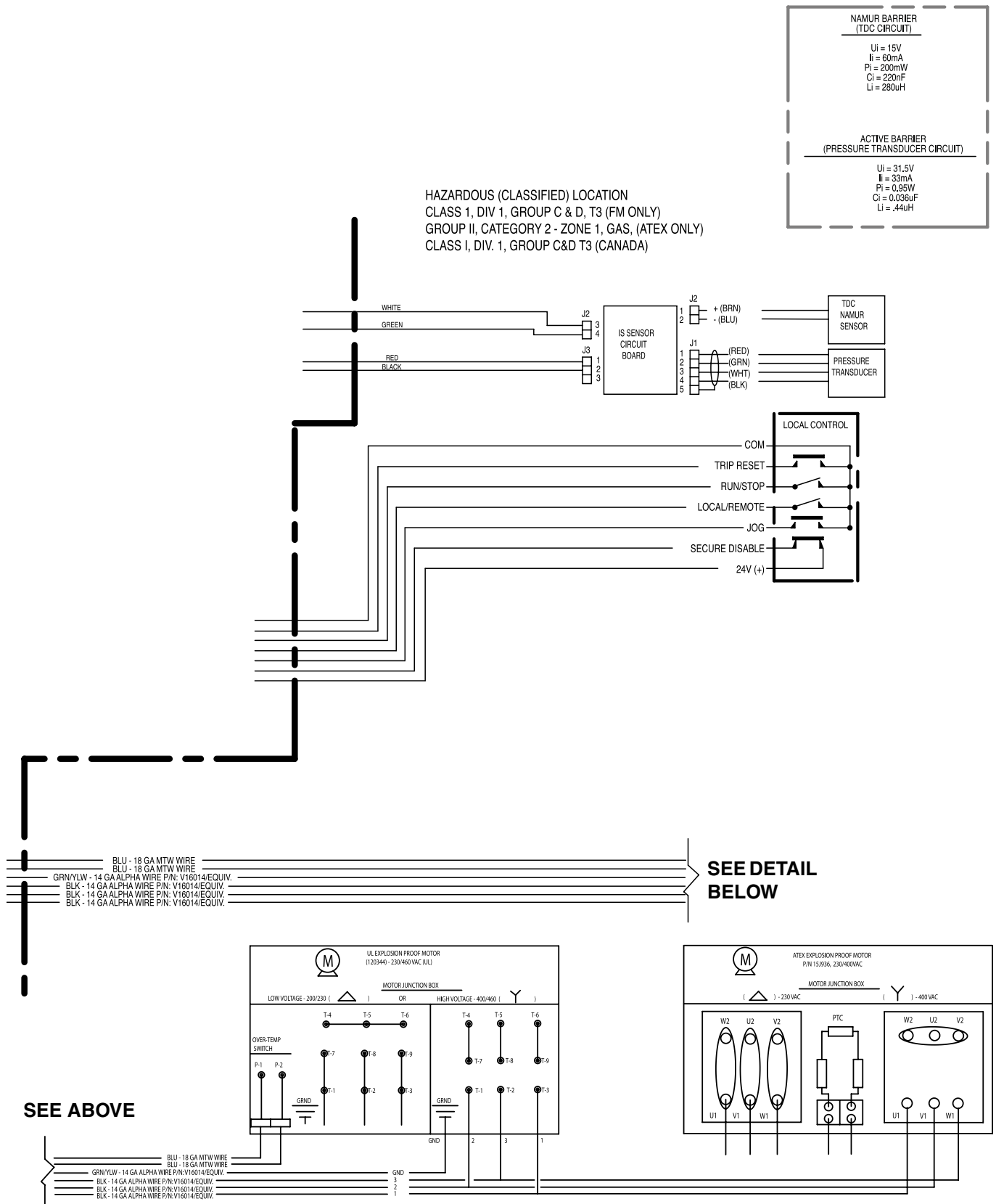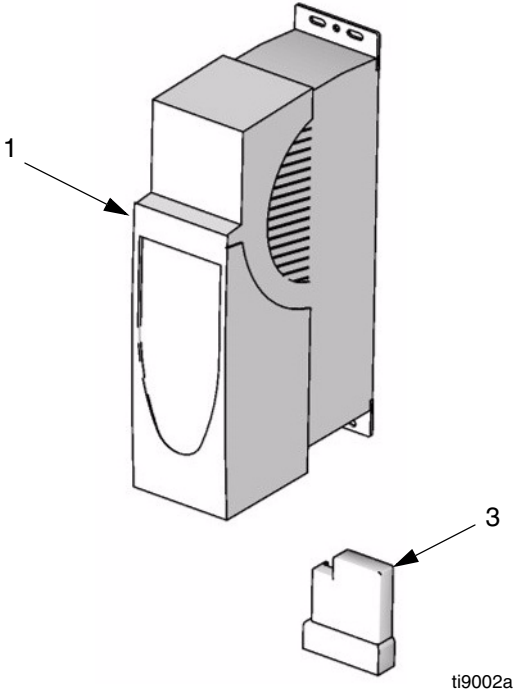FIG. 23: System Wiring Schematic, Non-Hazardous Location Only

NAMUR BARRIER
(TDC CIRCUIT)

Ui = 15V
Ii = 60mA
Pi = 200mW
Ci = 220nF
Li = 280uH

ACTIVE BARRIER
(PRESSURE TRANSDUCER CIRCUIT)

Ui = 31.5V
Ii = 33mA
Pi = 0.95W
Ci = 0.036uF
Li = .44uH

HAZARDOUS (CLASSIFIED) LOCATION
CLASS 1, DIV 1, GROUP C & D, T3 (FM ONLY)
GROUP II, CATEGORY 2 - ZONE 1, GAS, (ATEX ONLY)
CLASS I, DIV. 1, GROUP C&D T3 (CANADA)

WHITE

GREEN

J2
3
4

IS SENSOR
CIRCUIT
BOARD

J2
1
2

+ (BRN)
- (BLU)

TDC
NAMUR
SENSOR

RED
BLACK

J3
1
2
3

J1
1
2
3
4
5

(RED)
(GRN)
(WHT)
(BLK)

PRESSURE
TRANSDUCER

LOCAL CONTROL

COM
TRIP RESET
RUN/STOP
LOCAL/REMOTE
JOG
SECURE DISABLE
24V (+)

SEE DETAIL
BELOW

BLU - 18 GA MTW WIRE
BLU - 18 GA MTW WIRE
GRN/YLW - 14 GA ALPHA WIRE P/N: V16014/EQUIV.
BLK - 14 GA ALPHA WIRE P/N: V16014/EQUIV.
BLK - 14 GA ALPHA WIRE P/N: V16014/EQUIV.
BLK - 14 GA ALPHA WIRE P/N: V16014/EQUIV.

UL EXPLOSION PROOF MOTOR
(120344) - 230/460 VAC (UL)

MOTOR JUNCTION BOX

LOW VOLTAGE - 200/230 (△)   OR   HIGH VOLTAGE - 400/460 (Y)

OVER-TEMP
SWITCH

T-4   T-5   T-6   T-4   T-5   T-6

P-1   P-2

T-7   T-8   T-9   T-7   T-8   T-9

T-1   T-2   T-3   T-1   T-2   T-3

GRND   GRND

GND   2   3   1

ATEX EXPLOSION PROOF MOTOR
P/N 15J936, 230/400VAC

MOTOR JUNCTION BOX

(△) - 230 VAC   (Y) - 400 VAC

W2   U2   V2   PTC   W2   U2   V2

U1   V1   W1   U1   V1   W1

SEE ABOVE

BLU - 18 GA MTW WIRE
BLU - 18 GA MTW WIRE
GRN/YLW - 14 GA ALPHA WIRE P/N:V16014/EQUIV.
BLK - 14 GA ALPHA WIRE P/N:V16014/EQUIV.
BLK - 14 GA ALPHA WIRE P/N:V16014/EQUIV.
BLK - 14 GA ALPHA WIRE P/N:V16014/EQUIV.

GND
3
2
1

FIG. 24: System Wiring Schematic, Hazardous Location

Parts

ti9002a

Ref. No.	Part No.	Description	Qty
1	120361	CONTROL, variable frequency, 200-240 Vac	1
	120362	CONTROL, variable frequency, 380-480 Vac	1
2	120363	RESISTOR, braking; 37.5 ohms; 100W; for 200-240 Vac VFD; not shown	1
	120364	RESISTOR, braking; 75 ohms; 50W; for 380-480 Vac VFD; not shown	1
3	120367	MODULE, VFD applications	1

Mounting Hole Diagrams

4.17 in.
105.9 mm

13.29 in.
337.6 mm

0.256 in. (6.5 mm)
diameter mounting holes
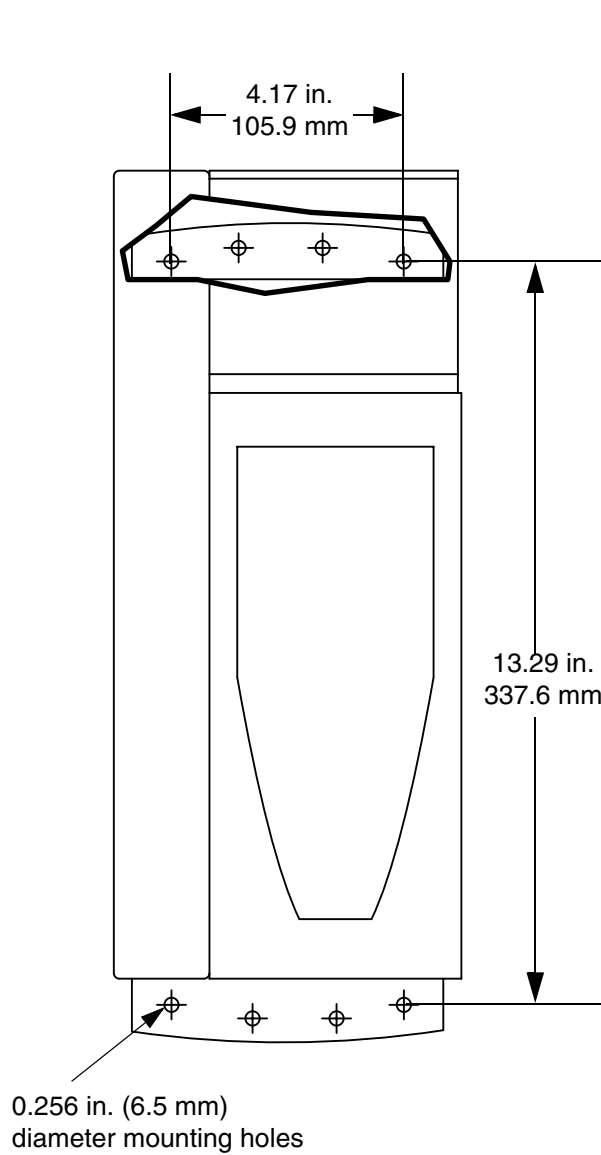
FIG. 25. 230V VFD Mounting Holes

0.256 in.
(6.5 mm)
diameter
mounting holes

2.22 in.
56.4 mm

14.82 in.
376.4 mm
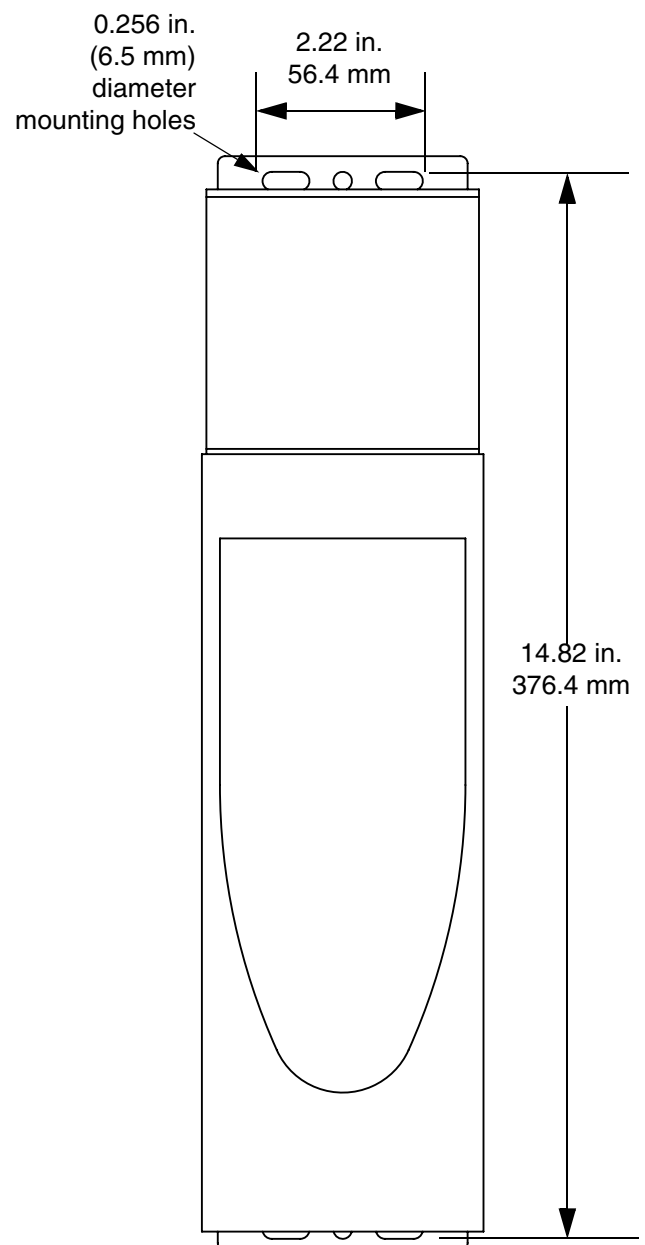
FIG. 26. 460V VFD Mounting Holes

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