

Variable Frequency Drive

311596K

EN

Motor drive control for Graco E-Flo[®] 4-Ball Piston Pumps. For professional use only.
Not approved for use in European explosive atmosphere locations.



Important Safety Instructions

Read all warnings and instructions in this manual.
Save these instructions.

Part No. 15J753, 200-240 Vac

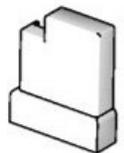
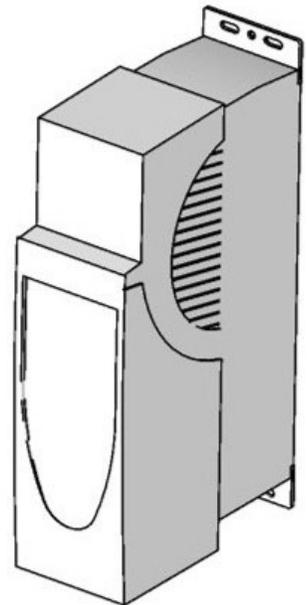
UNIDRIVE SP Digital AC Drive
208/230VAC, 5HP, SP2201

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.



ti9002a

Contents

| | | | |
|--|-----------|--|-----------|
| Warnings | 2 | Running the Pump | 21 |
| Models | 3 | Secure Disable | 21 |
| E-Flo 4-Ball Piston Pumps | 3 | Start/Stop Command | 22 |
| Pump Operational Limits | 3 | Flow Control | 23 |
| Related Graco Manuals | 3 | Diagnostics | 24 |
| Glossary of Terms | 3 | Drive Trip Codes and Diagnostic Procedures .. | 24 |
| Overview | 4 | Trips and Diagnostic Procedures | 24 |
| Variable Frequency Drive (VFD) Kits and Options | 5 | Resetting the System | 24 |
| Repair Kits | 5 | Computer Control and Monitoring | 27 |
| Options | 5 | Ethernet Upgrade Kit 15H885 | 27 |
| Controls and Indicators | 6 | E-Flo Software Update | 27 |
| Control Modes | 6 | Configure the Ethernet Card | 30 |
| Variable Frequency Drive (VFD) Keypad | 7 | Install the Computer Software | 31 |
| Setup | 8 | Connect the VFD to the PC | 31 |
| Ground the VFD | 8 | Run Screen | 33 |
| Navigating the Keypad | 8 | Advanced Options Screen | 35 |
| E-Flo Calibration | 9 | BPR Production Flow Screen | 36 |
| Calibrate and Autotune the Motor | 9 | Data Logging Screen | 39 |
| Factory Defaults | 12 | Power Monitor Screen | 40 |
| SMARTCARD Defaults | 12 | Pressure Transducer Calibration Procedure ... | 41 |
| Complete System Reload | 13 | System Electrical Diagrams | 42 |
| E-Flo Features | 14 | Parts | 45 |
| Back Pressure Regulator (BPR) Control | 15 | Mounting Hole Diagrams | 47 |
| Cycle Counter | 16 | Graco Standard Warranty | 48 |
| Flow Rate Monitoring | 16 | | |
| Pressure Monitoring | 16 | | |
| Operational Envelope Limit | 21 | | |

Warnings

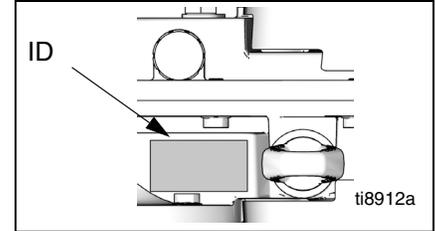
The following warnings are for the setup, use, grounding, maintenance, and repair of this equipment. The exclamation point symbol alerts you to a general warning and the hazard symbols refer to procedure-specific risks. When these symbols appear in the body of this manual, refer back to these Warnings. Product-specific hazard symbols and warnings not covered in this section may appear throughout the body of this manual where applicable.

|  WARNING | |
|--|---|
|   | <p>ELECTRIC SHOCK HAZARD Improper grounding, setup, or usage of the system can cause electric shock.</p> <ul style="list-style-type: none"> • 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 4-Ball Piston 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**), 2000 cc Maxlife lower (**6**), and no stand installed (**0**). To order replacement parts, see the Repair-Parts manual 311594.



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 | | Stand Option | |
| E (electric) | P (pump) | 0 | No motor | 0 | No circuit installed | 1 | 1000 cc Chromex | 0 | No stand installed |
| | | 1 | 230/400V, 5 HP, ATEX | 1 | Circuit installed | 2 | 1500 cc Chromex | 1 | Stand installed |
| | | 2 | 230/460V, 5 HP, UL/CSA | | | 3 | 2000 cc Chromex | | |
| | | 3 | 230/400V, 3 HP, ATEX | | | 4 | 1000 cc Maxlife | | |
| | | 4 | 230/460V, 3 HP, UL/CSA | | | 5 | 1500 cc Maxlife | | |
| | | | | | | 6 | 2000 cc Maxlife | | |
| | | | | | | 7 | 750 cc Chromex | | |
| | | | | | | 8 | 750 cc Maxlife | | |

Pump Operational Limits

See **Related Graco Manuals** below.

Related Graco Manuals

| Manual | Description |
|--------|-----------------------------|
| 311592 | E-Flo Installation Manual |
| 311593 | E-Flo Operation Manual |
| 311594 | E-Flo Repair-Parts Manual |
| 311606 | VFD/BPR Air Control Manual |
| 311608 | Power Module Manual |
| 311612 | Ethernet Upgrade Kit Manual |
| 3A0539 | 4-Ball Lowers |

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 24 |
| 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.

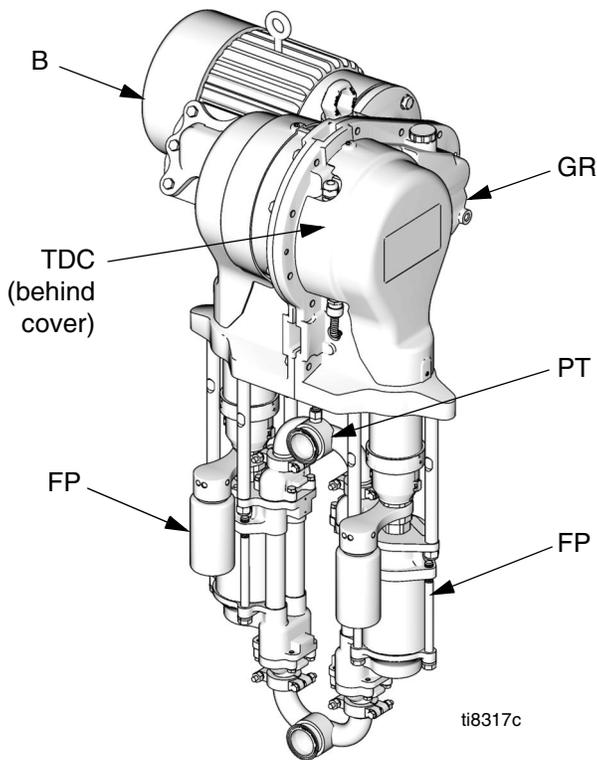


FIG. 1. Electric Circulation Pump

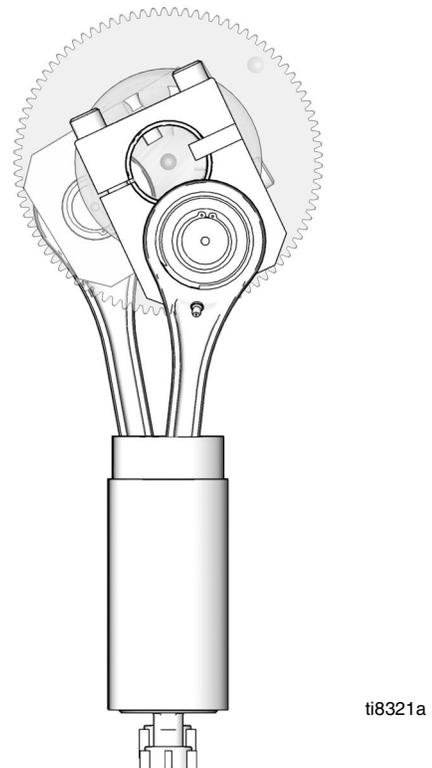


FIG. 2. Cutaway Showing Offset Stroke Positions

Variable Frequency Drive (VFD) Kits and Options

Kits and options can be ordered through your Graco Distributor.

Repair Kits

Sensor Circuit Kit P/N 15J755 - for use with CT VFD when using the Graco CAM software to manage pump output pressure. Kit includes the most current revision application software required for compatibility with latest pressure transducer circuit hardware.

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 24J305 - contains the circuit board and TDC, position, and pressure sensors necessary to utilize the Graco ACS module, taking advantage of flow control and pressure control mode delivered by Graco ACS software. See manual 311603.

Local I/O Box P/N 120373 (UL/CSA) or 120991 (ATEX) - allows the operator to control the E-Flo 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

| | | | | | | |
|---|---|---|--|--|--|--|
|  |  |  | | | | |
| <p>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.</p> | | | | | | |

Control Modes

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

- Locally
- Remotely (Keypad/Modbus)

The addition of a local control box allows the operator to control the E-Flo 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 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 (VFD terminal #28) is configured for this operation (see **System Electrical Diagrams**, page 42). Normally open position of the switch commands remote mode; closed position commands local mode.

NOTE: Common ground is available at VFD terminals #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 (see page 5).

More than 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 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. VFD terminal #27 is configured for this operation (see **System Electrical Diagrams**, page 42). Normally open position is Stop; closed position is Run.

NOTE: Common ground is available at VFD terminals #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 joystick 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.

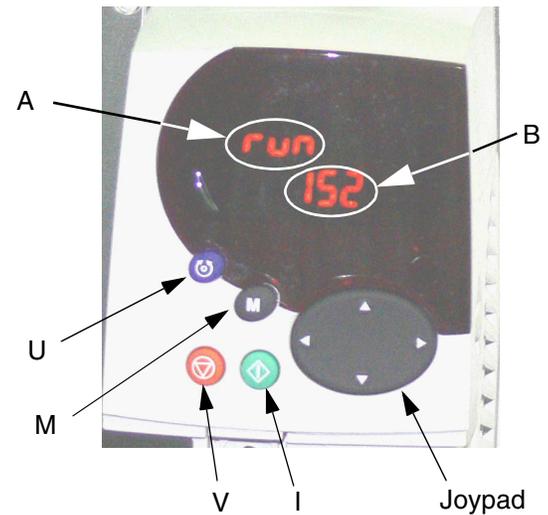


FIG. 3: Variable Frequency Drive Keypad

Setup

Ground the VFD



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:

- Pressing the Left and Right arrow keys will allow you to navigate between menus 0 and 22.
- Pressing the Up and Down arrow keys will allow you to navigate within the submenus.
- Press the Left or Right arrow keys until you reach menu 20 (Number 20.00 should be flashing on a screen).
- 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:

NOTE: 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.

- 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 **2000** (most right digit) should be flashing.
- Press the Left arrow key to navigate to the third digit from the right **200**. This will cause the digit to start flashing.
- Press the Up arrow key to scroll to number 5. This should cause number **2500** to display on a screen with number 5 still flashing.
- Press the Left arrow key to navigate to the next digit on the left. This will cause number '2' to start flashing (**2500**).
- Press the Down arrow key to change the number 2 to number 1. Number **1500** should be displayed on a screen with number 1 flashing.
- 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.
- 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).

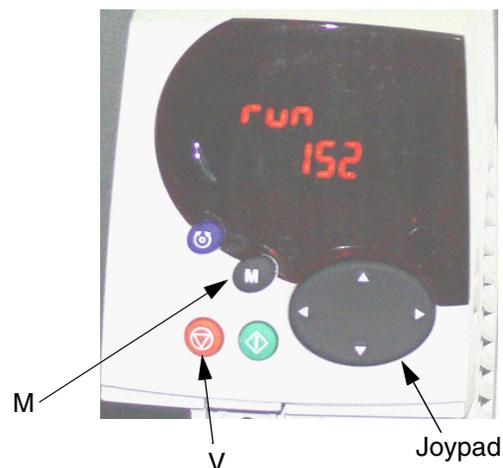


FIG. 4: Variable Frequency Drive Keypad

E-Flo Calibration

NOTICE

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

IMPORTANT: Before installing the motor it must be calibrated and autotuned. This allows the drive to have better control of the motor.

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:

EP1XXX=> Pr **20.37** = 1

EP2XXX=> Pr **20.37** = 0

EP3XXX=> Pr **20.37** = 4

EP4XXX=> Pr **20.37** = 3

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.

IMPORTANT: Autotuning the motor is especially important if using a 3HP motor, or if a 5HP motor is used on a system with a low flow setting (corresponding frequency of less than 12 Hz).

4. Pr **5.27** controls the Slip Compensation feature. It is turned on by default for 3HP motors and turned off for 5HP motors. Turning this feature on will improve pressure performance for low flow settings (corresponding motor frequency of less than 12 Hz).
5. Continue with step **1. Pressure Sensor Calibration** on page 10.

Non-Graco Motors

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

NOTE: 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 **20.37** 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. **Enter Motor Rated Current.** Multiply motor rated current found on motor's identification plate by 10. Enter resulting value into Pr **20.12**.
4. Follow the instructions under **Autotune the Motor**, page 10.
5. Continue with step **1. Pressure Sensor Calibration** on page 10.

Autotune the Motor

IMPORTANT: Before installing the motor it must be calibrated and autotuned. This allows the drive to have better control of the motor.

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



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 22. Autotuning will begin.
5. When motor stops turning, check that Pr **5.10** (Power Factor) and Pr **5.17** (Stator Resistance) 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 1001, and press the red Stop/Reset button. The number 1001 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.

NOTICE

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. Select and set TDC and pressure transducer function (software level 5.00.00 and later only):
 - TDC: Pr **8.11**. Select On (enable) or Off (disable).
 - Pressure Transducer: Pr **7.13**. Select On (enable) or Off (disable).
 - Select Analog Signal Mode: Pr **7.11**. Typically 4-20tr.
- c. Enter calibration parameters Pr **20.34**, **20.35**, and **20.36**.
- d. Set Pr **20.16** to 0 to lock parameters, then set Pr **0.00** to 1001 to save parameters.

If pressure sensor is part of the system (EPX1XX → 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:

EPXX1X => Pr **20.03** = 1000

EPXX4X => Pr **20.03** = 1000

EPXX2X => Pr **20.03** = 1500

EPXX5X => Pr **20.03** = 1500

EPXX3X => Pr **20.03** = 2000

EPXX6X => Pr **20.03** = 2000

EPXX7X => Pr **20.03** = 750

EPXX8X => Pr **20.03** = 750

NOTE: If the pump lowers are changed to a different size after purchase, the plate information is no longer valid.

3. Unit Selection

Select measuring units in parameter Pr **20.15**. The default is English.

English => Pr **20.15 = 0**

Metric => Pr **20.15 = 1**

Measurement unit summary:

| Measurement | English | Metric |
|-------------|---------|--------|
| Pressure | psi | bar |
| Flow | gpm | lpm |

NOTE: The Keypad display does not show a decimal point. TABLE 2 provides resolution values for measurement setting parameters.

4. High Pressure Alarm Setting

The High Pressure Alarm setting is controlled by parameter Pr **20.09**. The default unit is English and default setting is 300 psi. Refer to TABLE 2 to determine maximum allowable setting for a given Lower size and units. The High Pressure Alarm (**#40**) becomes active when system pressure reaches the pressure setting in Pr **20.09**.

NOTE: For metric units, multiply the desired pressure by 10 and enter the result into the VFD. The last digit is a decimal.

5. 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**

NOTE: This feature is disabled by default.

6. Low Pressure Alarm Setting

The Low Pressure Alarm setting is controlled by parameter Pr **20.07**. The default unit is English and default setting is 150 psi. Refer to TABLE 2 to determine maximum allowable setting for a given Lower size and units. The Low Pressure Alarm (**#41**) becomes active if it is enabled (Pr **20.08 = 1**) and system pressure drops lower than the Low Pressure Alarm setting.

NOTE: For metric units, multiply the desired pressure by 10 and enter the result into the VFD. The last digit is a decimal.

NOTE: System pressure must first rise above the Low Pressure Alarm setting for the trip to start operating. This allows the system to build up to operating pressure without shutting down due to Low Pressure Alarms.

7. System Ramp Rate Selection

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

8. Speed Potentiometer Enable/Disable

Variable resistor (potentiometer) is used to control motor frequency. Refer to **Motor Speed Control**, page 23, for more information. Set Pr **20.38** to enable or disable the speed potentiometer. Disable is the default.

- 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 1001.
2. Press the red Stop/Reset button. The number 1001 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 (memory location #202).

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 System Specific Parameters (menu 20 parameters)

All of the E-Flo features are controlled by menu 20 parameters. VFDs are shipped with these parameters set to default values (refer to Table 2 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 Motor Specific Parameters

VFDs are shipped with all motor parameters defaulted to UL/CSA motor. It is essential for system performance that proper motor calibration parameters are entered into the VFD. See page 9 for more information.

NOTE: To restore factory defaults, set Pr **20.16** to **45**.

SMARTCARD Defaults

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

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. 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 1001, and press red Stop/Reset button to save the changes. Number 1001 will be automatically replaced by 0.
6. Disconnect power from the VFD, reinstall all modules, and reconnect power. Reset any faults associated with solutions modules (VFD may not recognize modules upon first power-up). Navigate to Pr **0.00**, set its value to 1001, and press red Stop/Reset button.

NOTE: Saving parameters will allow the VFD to retain information associated with solutions modules.

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 1001, and press red Stop/Reset button. Number 1001 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 Calibration**, beginning with **Calibrate and Autotune the Motor** on page 9 and continuing with steps **1-9** of the calibration procedure (pages **10-12**).

E-Flo Features

Drive Active (System ON) Output

VFD Relay output is available at VFD terminals 41 and 42. The output can be mapped to most of the parameters. The most common is Drive Active. This relay output will be closed when drive is active (there will be continuity between terminals 41 and 42). Pr **8.27** controls the relay source. In case Drive Active is a desired source, navigate to Pr **8.27** and set it to **10.02**.

NOTE: Pr **10.02** is a Drive Active indicator. See the Control Techniques manual for further information.

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)

750cc lowers: 1.0 gpm (3.8 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 (VFD terminal #29) is configured for the Jog mode (see **System Electrical Diagrams**, page 42). Normally open (N.O.) position of the switch disables jogging and closed position of the switch (VFD terminal #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 21 for details).

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

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/Flush 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)
- 750 cc lower: 12.2 gpm (46.2 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 (VFD terminal #26) is allocated for 24VDC, 0.5 W (maximum) solenoid.

Pr **20.18** enables and disables the solenoid output:

Pr **20.18** = 0: solenoid output disabled

Pr **20.18** = 1: solenoid output enabled

NOTE: See **System Electrical Diagrams** on page 42 and manual 311606 for wiring and installation details.

BPR Production/Sleep modes Graco E-Flo Control

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

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**.

Pr **20.26** resets to **0** automatically.

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 (English units) and Pr **20.17** displays number 125, the flow equals to 12.5 gpm (see TABLE 2).

Pump Displacement Volume

E-Flo Pump Volumes:

| Lower Size | Volume per Cycle (cc) | Volume per Cycle (Gal) |
|------------|-----------------------|------------------------|
| 2000cc | 4278 | 1.13 |
| 1500cc | 3070 | 0.81 |
| 1000cc | 2263 | 0.60 |
| 750 cc | 1537 | 0.41 |

Pressure Monitoring

Average Pressure

Pr **20.31** displays average cycle pressure. It is a running average of one full cycle. See TABLE 2 for more information.

NOTE: For metric units, the last digit is a decimal.

Pressure Deviation

Pr **20.32** displays pressure deviation measured over one full cycle. See TABLE 2 for more information.

NOTE: For metric units, the last digit is a decimal.

Table 2: E-Flo Calibration Parameters / Modbus Map

| Parameter ID | Function | English Units | | | | | | | Metric Units | | | | | | Default** | Load Defaults *** | | | |
|--------------|--|---------------|-------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------|-------------|-------------------|-------------------|-------------------|-----------------|-------------------|-------------------|-------------------|--------------|
| | | Units | Resolution* | Low Limit | | | High Limit | | | Units | Resolution* | Low Limit | | | | | High Limit | | |
| | | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 |
| 20.01 | Run Mode Selection | N/A | | | | | | | N/A | | | | | | 0 (Cam Mode) | Yes | | | |
| | 0 = Cam | | | | | | | | | | | | | | | | | | |
| | 1 = Constant Speed | | | | | | | | | | | | | | | | | | |
| | 2 = Jog | | | | | | | | | | | | | | | | | | |
| | 3 = Park | | | | | | | | | | | | | | | | | | |
| 20.02 | Ramp Rate Selection | GPM/MIN | 1 | 10 | | | 1000 | | | N/A | | | | | | 100 [GPM/MIN] | Yes | | |
| 20.03 | Lower Size Selection (750cc, 1000cc, 1500cc, 2000cc) | CC | N/A | 750 | | | 2000 | | | CC | N/A | 750 | | | 2000 | | | 2000cc | Yes |
| 20.04 | Local/Remote Control Indicator (Indicates position of the Local/Remote switch) | N/A | N/A | 0 (Local) | | | 1 (Remote) | | | N/A | N/A | 0 (Local) | | | 1 (Remote) | | | N/A | N/A |
| 20.05 | Flow Setting | GPM | 0.1 | | | | | | | LPM | 0.1 | | | | | | | N/A | No |
| | 750 cc Lowers | | | 1.0 | 1.6 | Customer specific | 9.7 | 8.1 | Customer specific | | | 3.8 | 6.1 | Customer specific | 36.7 | 30.7 | Customer specific | | |
| | 1000cc Lowers | | | 1.4 | 2.4 | | 14.3 | 11.9 | | | | 5.3 | 9.1 | | 54.1 | 45.0 | | | |
| | 1500cc Lowers | | | 1.9 | 3.2 | | 19.4 | 16.2 | | | | 7.2 | 12.1 | | 73.4 | 61.3 | | | |
| | 2000cc Lowers | | | 2.7 | 4.5 | | 27.1 | 22.6 | | | | 10.2 | 17.0 | | 102.6 | 85.6 | | | |
| | | | | | | | | | | | | | | | | | | | |
| 20.07 | Low Pressure Alarm Setting | PSI | 1 | | | | Pr 20.37 = 0, 1 | Pr 20.37 = 3, 4 | Pr 20.37 = 2 | Bar | 0.1 | | | | Pr 20.37 = 0, 1 | Pr 20.37 = 3, 4 | Pr 20.37 = 2 | 150 [PSI] | Yes |
| | 750cc Lowers | | | 0 | | | 500 | 460 | 500 | | | 0 | | | 34.5 | 31.7 | 34.5 | | |
| | 1000cc Lowers | | | | | | 460 | 460 | 460 | | | | | | 31.7 | 31.7 | 31.7 | | |
| | 1500cc Lowers | | | | | | 350 | 350 | 350 | | | | | | 24.1 | 24.1 | 24.1 | | |
| | 2000cc Lowers | | | | | | 300 | 300 | 300 | | | | | | 20.7 | 20.7 | 20.7 | | |
| 20.08 | Low Pressure Alarm Enable | N/A | N/A | 0 (Disable) | | | 1 (Enable) | | | N/A | N/A | 0 (Disable) | | | 1 (Enable) | | | 0 (Disable) | Yes |
| | 0 = Disable | | | | | | | | | | | | | | | | | | |
| | 1 = Enable | | | | | | | | | | | | | | | | | | |

| Parameter ID | Function | English Units | | | | | | Metric Units | | | | | | Default** | Load Defaults *** | | | | | | | | | | |
|--------------|---|---------------|-------------|-------------------|-------------------|--------------|-------------------|-------------------|--------------|-------|-------------|-------------------|-------------------|-----------|-------------------|-----------------|-------------------|-------------------|--------------|------|--|--|------|--|--|
| | | Units | Resolution* | Low Limit | | | High Limit | | | Units | Resolution* | Low Limit | | | | High Limit | | | | | | | | | |
| | | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | | | Pr 20.37 = 2 | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | | | | | | |
| 20.09 | High Pressure Alarm Setting | PSI | 1 | 0 | | | Pr 20.37 = 0, 1 | Pr 20.37 = 3, 4 | Pr 20.37 = 2 | Bar | 0.1 | 0 | | | Pr 20.37 = 0, 1 | Pr 20.37 = 3, 4 | Pr 20.37 = 2 | 300 [PSI] | Yes | | | | | | |
| | 750cc Lowers | | | | | | 500 | 460 | 500 | | | | | | 34.5 | 31.7 | 34.5 | | | | | | | | |
| | 1000cc Lowers | | | | | | 460 | 460 | 460 | | | | | | 31.7 | 31.7 | 31.7 | | | | | | | | |
| | 1500cc Lowers | | | | | | 350 | 350 | 350 | | | | | | 24.1 | 24.1 | 24.1 | | | | | | | | |
| | 2000cc Lowers | | | | | | 300 | 300 | 300 | | | | | | 20.7 | 20.7 | 20.7 | | | | | | | | |
| 20.12 | Motor Rated Current x 10; multiply motor rated current listed on a motor ID plate) by 10; for example, I=6.5A, Pr20.12 = 65 | [A] | 0.1 | 0 | | | 8.8 | | | [A] | 0.1 | 0 | | | 8.8 | | | N/A | No | | | | | | |
| | High Voltage Drive | | | | | | | | | | | | | | | | | | | 15.5 | | | 15.5 | | |
| | Low Voltage Drive | | | | | | | | | | | | | | | | | | | 0 | | | 0 | | |
| 20.15 | Unit Selection (0 = English, 1 = Metric) | N/A | N/A | N/A | | | | | | N/A | N/A | N/A | | | | | | 0 | Yes | | | | | | |
| 20.16 | Calibration (special parameter) | N/A | | | | | | | | | | | | | | | | 0 | N/A | | | | | | |
| | 1234 = Load Defaults (resets system related menu 20 parameters to Graco default settings) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 56 = Load Motor Defaults (resets motor related parameters to Graco default settings) | | | | | | | | | | | | | | | | | | | | | | | | |
| 20.17 | Flow Indicator | GPM | 0.1 | N/A | | | | | | LPM | 0.1 | N/A | | | | | | N/A | N/A | | | | | | |
| | | | | N/A | | | | | | | | N/A | | | | | | | | | | | | | |

| Parameter ID | Function | English Units | | | | | | | | Metric Units | | | | | | | | Default** | Load Defaults *** |
|--------------|---|---------------|-------------|-------------------|-------------------|--------------|-------------------|-------------------|--------------|--------------|-------------|-------------------|-------------------|--------------|-------------------|-------------------|--------------|-------------|-------------------|
| | | Units | Resolution* | Low Limit | | | High Limit | | | Units | Resolution* | Low Limit | | | High Limit | | | | |
| | | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | | |
| 20.18 | BPR Valve Solenoid Control 0 = Solenoid Disable 1 = Solenoid Enable | N/A | N/A | 0 (Disable) | | | 1 (Enable) | | | N/A | N/A | 0 (Disable) | | | 1 (Enable) | | | 0 (Disable) | Yes |
| 20.19 | Average Cycle Rate Indicator | CPM | 0.1 | N/A | | | N/A | | | CPM | 0.1 | N/A | | | N/A | | | N/A | No |
| 20.20 | Graco defined software version major | N/A | | | | | | | | | | | | | | N/A | No | | |
| 20.21 | Graco define software version minor | N/A | | | | | | | | | | | | | | N/A | No | | |
| 20.24 | Average Motor Current Indicator (divide by 10) | [A] | 0.1 | N/A | | | N/A | | | [A] | 0.1 | N/A | | | N/A | | | N/A | N/A |
| 20.25 | Run/Stop Command 0 = Stop 1 = Stop 2 = Run | N/A | N/A | 0 (Stop) | | | 2 (Run) | | | N/A | N/A | 0 (Stop) | | | 2 (Run) | | | 0 (Stop) | Yes |
| 20.26 | Reset Batch Cycle Counter 0 = Not Reset 1 = Reset | N/A | N/A | 0 (Not Reset) | | | 1 (Reset) | | | N/A | N/A | 0 (Not Reset) | | | 1 (Reset) | | | N/A | No |
| 20.27 | Grand Cycle Count - First 4 places - yyyy9999 | N/A | 1 | N/A | | | N/A | | | N/A | 1 | N/A | | | N/A | | | N/A | N/A |
| 20.28 | Grand Cycle Count - Next 4 places - 9999xxxx | N/A | 1 | N/A | | | N/A | | | N/A | 1 | N/A | | | N/A | | | N/A | N/A |
| 20.29 | Batch Cycle Count - First 4 places - yyyy9999 | N/A | 1 | N/A | | | N/A | | | N/A | 1 | N/A | | | N/A | | | N/A | N/A |
| 20.30 | Batch Cycle Count - Next 4 places - 9999xxxx | N/A | 1 | N/A | | | N/A | | | N/A | 1 | N/A | | | N/A | | | N/A | N/A |
| 20.31 | Average System Pressure Indicator | PSI | 1 | N/A | | | N/A | | | Bar | 0.1 | N/A | | | N/A | | | N/A | N/A |

| Parameter ID | Function | English Units | | | | | | | | Metric Units | | | | | | | | Default** | Load Defaults *** | | | | |
|-----------------------|--|---------------|-------------|-------------------|-------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------------------------|-------------|-------------------|--------------|--------------|-------------------|------------|-------------------|--------------|--------------|---------------------|-----|
| | | Units | Resolution* | Low Limit | | | | High Limit | | | | Units | Resolution* | Low Limit | | | | | | High Limit | | | |
| | | | | Pr 20.37 = 0 or 3 | Pr 20.37 = 1 or 4 | Pr 20.37 = 2 | Pr 20.37 = 3 | Pr 20.37 = 4 | Pr 20.37 = 2 | Pr 20.37 = 3 | Pr 20.37 = 4 | | | Pr 20.37 = 1 or 2 | Pr 20.37 = 3 | Pr 20.37 = 4 | Pr 20.37 = 1 or 2 | | | Pr 20.37 = 3 | Pr 20.37 = 4 | | |
| 20.32 | Pressure Range | PSI | 1 | N/A | | | | | | | | Bar | 0.1 | N/A | | | | | | | | N/A | N/A |
| 20.33 | Pressure Sensor Error Indicator (used for calibration) | N/A | 1 | N/A | | | | | | | | N/A | 1 | N/A | | | | | | | | N/A | N/A |
| 20.34 | Zero Point Calibration | N/A | 1 | 0 | | | | N/A | | | | N/A | 1 | 0 | | | | N/A | | | | N/A | N/A |
| 20.35 | System Calibration Pressure | PSI | 1 | 100 | | | | 500 | | | | Use English Units to calibrate | | | | | | | | N/A | N/A | | |
| 20.36 | High Point Calibration | N/A | 1 | 0 | | | | N/A | | | | N/A | 1 | 0 | | | | N/A | | | | N/A | N/A |
| 20.37 | Motor Select | N/A | 1 | 0 | | | | 4 | | | | N/A | 1 | 0 | | | | 1 | | | | 0 (5 H.P. UL Motor) | Yes |
| | 0 = 5 H.P. UL Motor | | | | | | | | | | | | | | | | | | | | | | |
| | 1 = 5 H.P. ATEX Motor | | | | | | | | | | | | | | | | | | | | | | |
| | 2 = Customer Motor | | | | | | | | | | | | | | | | | | | | | | |
| | 3 = 3 H.P. UL Motor | | | | | | | | | | | | | | | | | | | | | | |
| 4 = 3 H.P. ATEX Motor | | | | | | | | | | | | | | | | | | | | | | | |
| 20.38 | Analog Input Speed Control Enable | N/A | N/A | 0 (Disable) | | | | 1 (Enable) | | | | N/A | N/A | 0 (Disable) | | | | 1 (Enable) | | | | 0 (Disable) | Yes |
| | 0 = Disable | | | | | | | | | | | | | | | | | | | | | | |
| | 1 = Enable | | | | | | | | | | | | | | | | | | | | | | |
| 20.40 | Prime/Flush Enable (Special parameter, returns to Disable state once flushing is complete) | N/A | N/A | 0 (Disable) | | | | 1 (Enable) | | | | N/A | N/A | 0 (Disable) | | | | 1 (Enable) | | | | N/A | Yes |
| | 0 = Disable | | | | | | | | | | | | | | | | | | | | | | |
| | 1 = Enable | | | | | | | | | | | | | | | | | | | | | | |

* **Resolution:** Note that the Keypad display does not utilize a decimal point. Last digit of a variable with a resolution of 0.1 is a decimal. For example, flow indicator Pr 20.17 is showing a number 157, while English units are selected. Last digit 7 is a decimal, which means that the flow is **15.7** GPM.

** **Default:** All calibration parameters have a default setting. Drives are shipped out from Graco with all calibrations set to their defaults. Use Pr 20.16 to reload default.

*** **Load Defaults:** Yes indicates that a default value will be loaded if Load System Defaults is triggered (Pr 20.16 = 1234).

Operational Envelope Limit

Explosion-proof electric motors have constant torque and variable torque limits. E-Flo 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/CSA 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 for ATEX motors and 10:1 operation for UL/CSA motors. 5:1 dictates a frequency of 10 Hz minimum to 50 Hz maximum. 10:1 dictates a frequency of 6 Hz minimum to 60 Hz maximum.

See TABLE 2 for flow limits (Pr 20.05).

Pressure Limits

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. See TABLE 3 for system pressure limits.

Table 3: System Pressure Limits

| Lower Size (cc) | Graco Motor (Pr 20.37 = 0, 1, 3, or 4) | | Non-Graco Motor (Pr 20.37 = 2) | |
|-----------------|---|---|--------------------------------|------|
| | psi | bar | psi | bar |
| 2000 | 250 | 17.2 | 250 | 17.2 |
| 1500 | 330 | 22.8 | 330 | 22.8 |
| 1000 | 460 | 31.7 | 460 | 31.7 |
| 750 | 425 (if set to 3 or 4); 500 (if set to 0 or 1) | 29.3 (if set to 3 or 4); 34.5 (if set to 0 or 1) | 500 | 34.5 |

Running the Pump

NOTICE

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 (VFD terminal #31) is designed for positive logic input only. It should be connected to internal 24VDC power supply (VFD terminal #22). The SD is a fail-safe function; it enables the drive when 24VDC is connected to SD

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

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. Red Stop/Reset button on a keypad:

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 or 0.

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

Resistance of 0 ohms corresponds to zero flow. Increase in resistance causes 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 42).

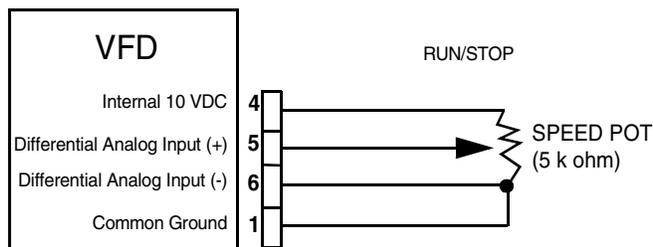


FIG. 5

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 (VFD terminal #28) is grounded (Common ground is available at VFD terminals #1, 3, 11, 21, 23, and 30).

Enter desired flow into Pr **20.05** as follows (example shown is in English units):

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).

NOTE: See TABLE 2 for flow limits.

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 (VFD terminal #28) is grounded (Common ground is available at VFD terminals #1, 3, 11, 21, 23, and 30).

Remote Mode

NOTE: In this mode the speed potentiometer mode has no effect even if 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 (VFD terminal #28) is floating.

Flow is controlled by the Pr **20.05**.

Multiply desired flow value by 10 (see **Local Mode** above and TABLE 2 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 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; 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 connected (normally closed switch is closed, indicating Drive Enable). It is therefore recommended to disable the drive by disconnecting the Secure Disable circuit (normally closed switch is open) before applying power to the motor.
- VFD/Apps module(s) reset is initiated while drive is enabled (Secure Disable circuit is connected). It is therefore recommended to disable the drive before performing system reset,

Refer to the Control Technique User Guides for trip codes which are not listed in TABLE 4.

Resetting the System

1. Stop the pump.
2. Disable the drive by disconnecting the Secure Disable circuit.
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 4: Trips and Diagnostic Procedures

| Trip Code | Trip Description | Diagnostic |
|-----------|---|--|
| 40 | High System Pressure (System pressure is higher than the allowed maximum) | <ol style="list-style-type: none"> 1. Check High Pressure Alarm setting (Pr 20.09). Verify that system desired operational pressure is lower than High Pressure Alarm setting. 2. Check for flow restrictions (closed valves, unexpected restrictions). 3. 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) | <ol style="list-style-type: none"> 1. Check Low Pressure Alarm setting (Pr 20.07). Verify that system desired operational pressure is higher than 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) | <ol style="list-style-type: none"> 1. Verify that output shaft is turning. 2. Check 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 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) | <ol style="list-style-type: none"> 1. Check motor calibration Pr 20.37 (UL/CSA. 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. |
| 44 | Operational Envelope (System has operated outside of operational window for the duration of 30 seconds) | <ol style="list-style-type: none"> 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 and to Operational Envelope Limit on page 21. 2. Check pressure sensor calibration. If sensor needs to be recalibrated follow instructions, page 41. |

Table 4: Trips and Diagnostic Procedures

| Trip Code | Trip Description | Diagnostic |
|------------------|--------------------------------|---|
| 45 | Motor Stalled | <p>This trip occurs when the motor is not able to develop torque, and therefore cannot put the pump into motion.</p> <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 1. Reset the system (see directions on page 24). 2. Cycle power. 3. Perform Complete System Reload, page 13. |
| 50 | Pressure Calibration | Enter proper pressure sensor calibration parameters, page 9. |
| Et | External Trip | Open Secure Disable circuit and reset the trip. |
| CL2 | Loss of Pressure Sensor | <ol style="list-style-type: none"> 1. Ensure that pressure sensor wiring is installed as shown in FIG. 29. 2. Ensure that pressure sensor shield is grounded. Use PCB terminal J3-3 as shown in FIG. 29. Do not ground the shield at both ends. 3. Check wiring and power to the barrier. 4. Check pressure transducer current (VFD terminal #7). The pressure transducer current range should be 4-20 mA. |

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 Software Update

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

Hardware

- CT COMM Cable

Software

- CT SOFT and Winflasher

Installation Instructions

1. Connect to Control Techniques website and download CT SOFT (<http://www.controltechniques.com>).

NOTE: CT SOFT is a free program, but must be registered with Control Techniques.

2. Download Winflasher III from the Control Techniques website.

3. Connect CT COMM Cable to RJ45 serial interface connector in the front of the VFD.

NOTE: If the Ethernet module is installed it must be disabled to allow serial communication.

4. Disable the Ethernet Module (if installed) as follows.
 - a. Navigate to Pr **16.37** and set its value to OFF.
 - b. Save all parameters: Navigate to Pr **0.00**, set its value to 1001 and press the red Stop/Reset button. Wait until number 1001 changes to 0 automatically as an indication that changes have been saved.
 - c. Cycle power to the VFD. This is necessary to activate serial communication after the Ethernet module has been disabled.
5. Update the software as follows:
 - a. Launch winflash.exe (Winflasher III program).

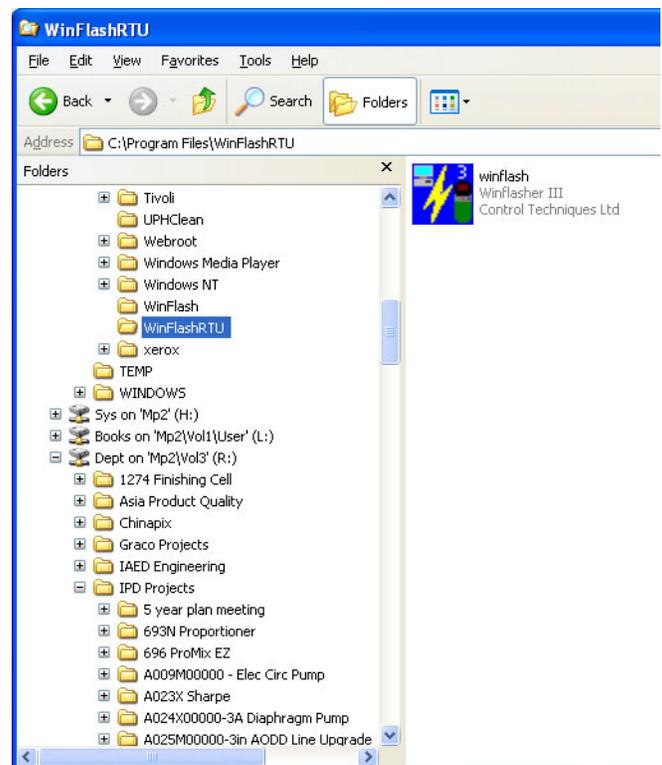


FIG. 6

- b. Read information in the Introduction window and select Next.



FIG. 7

- d. Browse for a Graco software file and select Next.

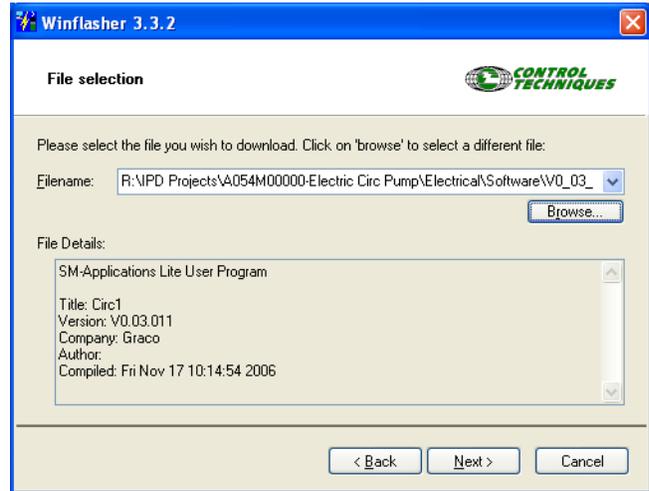


FIG. 9

- c. Choose “Download a compiled program” option and select Next.

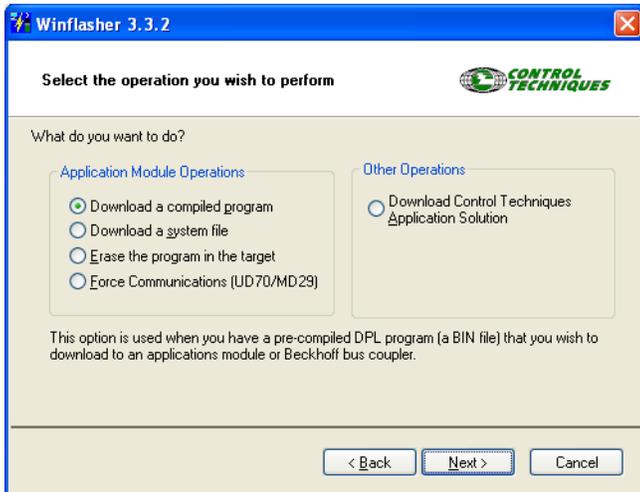


FIG. 8

- e. Select the method for downloading: In the “Select the method for downloading” window under “Connection Protocol”, select CT-RTU (Unidrive SP). Under “Settings” choose Slot 3. Ensure that the correct communication port is selected. Use the “Change Communications Settings” button to change the port assignment. Select Next.

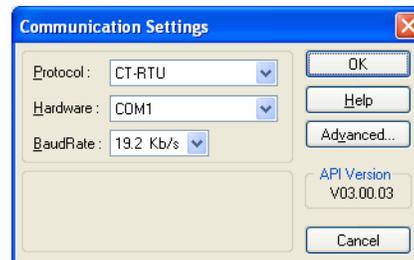
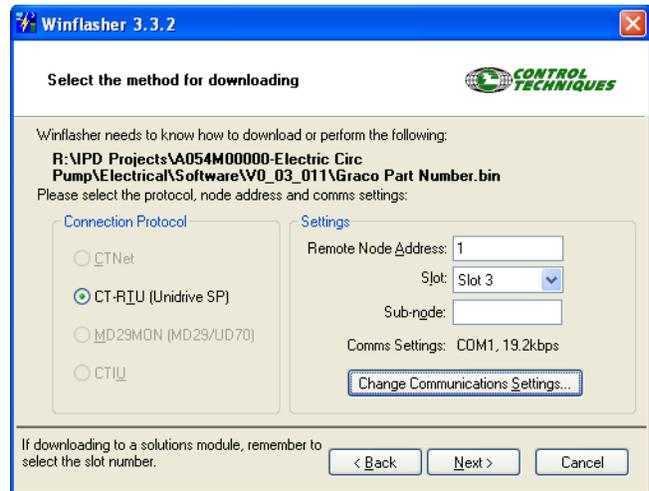


FIG. 10

- f. Read the Important Safety Warning and select Next.



FIG. 11

- h. Wait for download to finish. Do not disconnect power while downloading as it may cause damage to the equipment. When the download has ended, select Finish to exit the program.

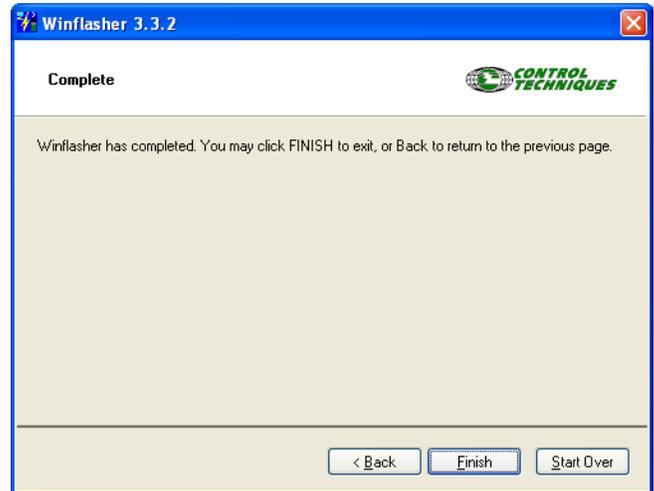


FIG. 13

- g. Press the red button to begin the download.

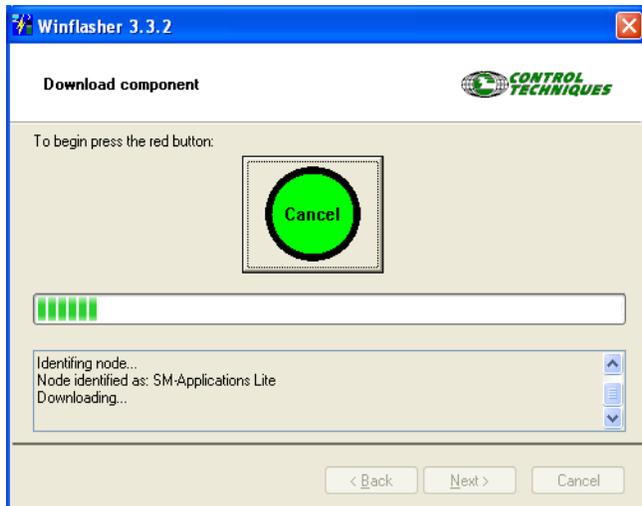
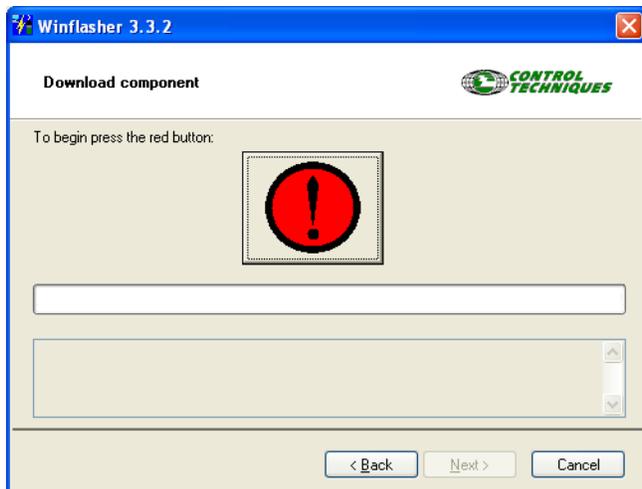


FIG. 12

NOTE: If the Ethernet module is used it must be re-enabled to allow serial communication.

6. Re-enable the Ethernet Module (if used) as follows.
 - a. Navigate to Pr **16.37** and set its value to ON.
 - b. Save all parameters: Navigate to Pr **0.00**, set its value to 1001 and press the red Stop/Reset button. Wait until number 1001 changes to 0 automatically as an indication that changes have been saved.

Configure the Ethernet Card

NOTE: 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. 14.

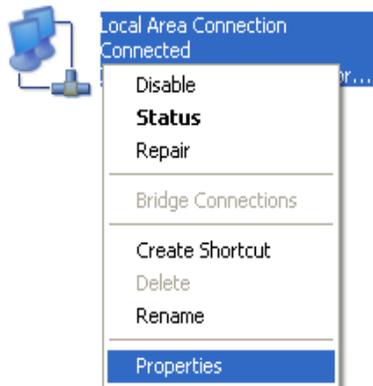


FIG. 14

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. 15.

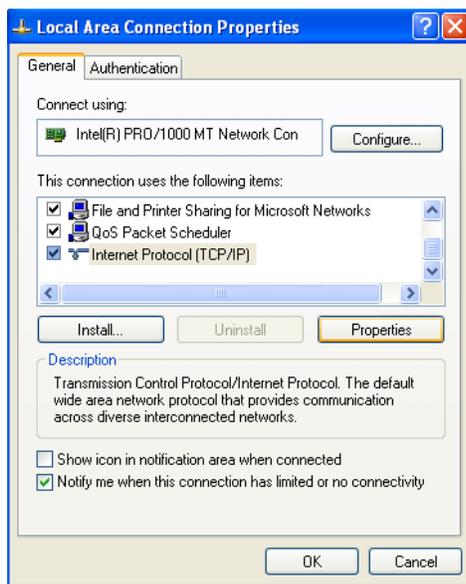


FIG. 15

5. See FIG. 16. 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.

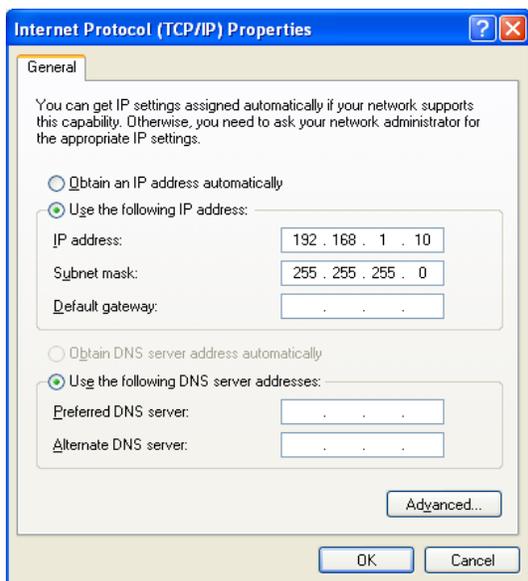


FIG. 16

6. Press OK.

NOTE: 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 from the Windows Start menu.

NOTE: 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. 17.

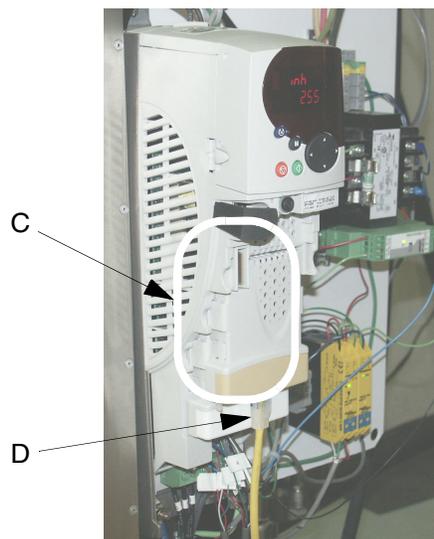


FIG. 17

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. 18.

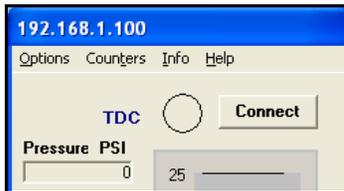
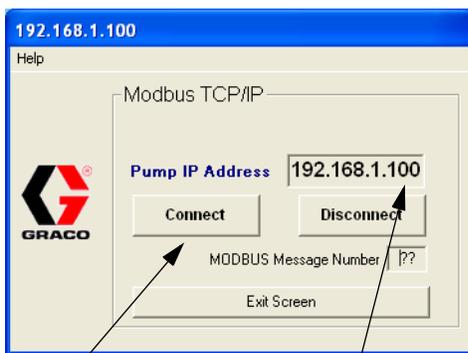


FIG. 18

3. Click CONNECT. See FIG. 19. The Run screen appears. See FIG. 22. 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. 20. Check the boxes next to each connected drive.



Press Button to Connect

Default Pump IP Address

FIG. 19. Network Address Setup Window

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 24, for instructions.

7. Repeat steps 2 and 3 for each additional IP address you selected in step 5 on page 31.

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.

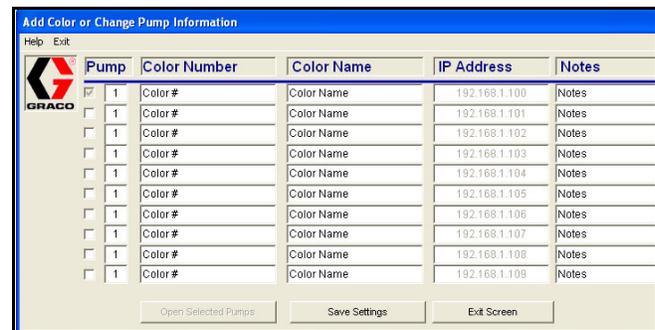


FIG. 20 Multiple VFD Connections

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

Run Screen

Speed Control

NOTE: 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. 22. The sliding scale on the Run screen sets the pump speed in units of flow.

NOTE: To change units of measure (English/Metric), select Options menu, then Advance Options screen (see page 35).

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. 22. 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 35.

Cycle Count - Displays total cycle count. Not resettable.

Control Buttons

See FIG. 22. 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.

NOTE: 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. 21) go to the Options pull-down menu. Select the **Advanced Options Screen** (page 35). From the Advanced Screen the **Data Logging Screen** (page 39), or **Power Monitor Screen** (page 40) can be selected.

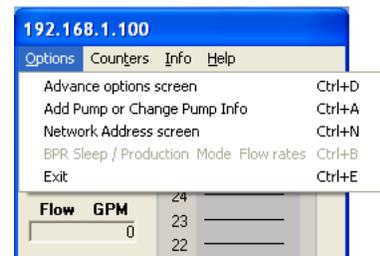


FIG. 21

Run Screen

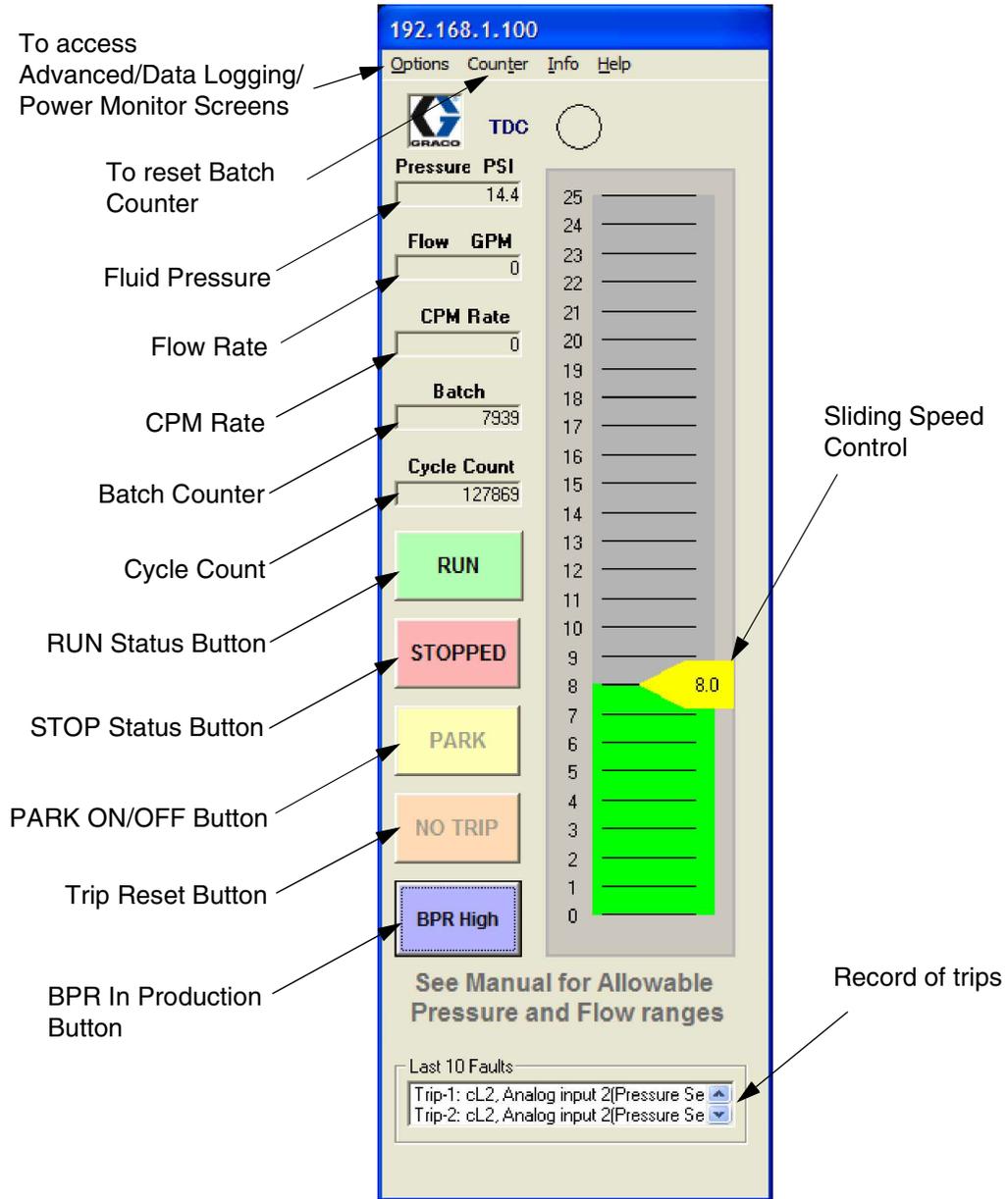


FIG. 22. Run Screen

Advanced Options Screen

The advanced screen allows user changes to operating parameters. This is only effective in the remote mode. See FIG. 24.

Units of Measure

Select desired units (English or Metric). See FIG. 24. 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 17, 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.

NOTE: System pressure must first rise above the Low Pressure Alarm setting for the trip to start operating. This allows the system to build up to operating pressure without shutting down due to Low Pressure Alarms.

Flow Calibration

Lower Size: Select size of pump lowers (750cc, 1000cc, 1500cc, or 2000cc).

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).

CAM

- **CAM:** CAM is the default. This setting utilizes the E-Flo 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 5 on page 38 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)
- 750 cc lower: 12.2 gpm (46.2 lpm)

BPR Production Flow Screen

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

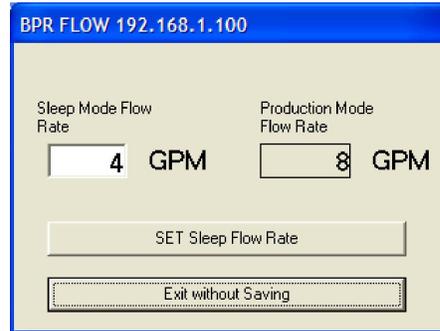


FIG. 23 BPR Production Flow Screen

Advanced Options Screen

Selecting the Auto/Setup displays the BPR Screen shown in FIG. 25.

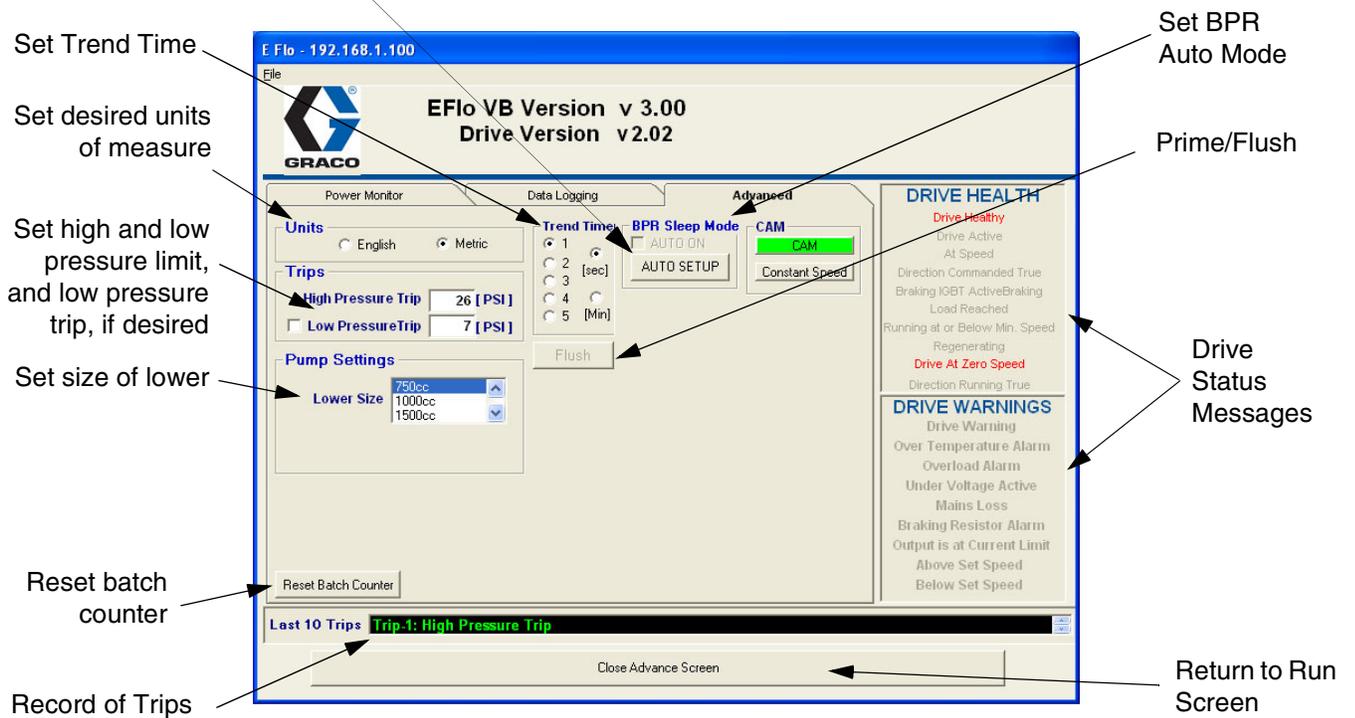


FIG. 24

BPR Timer Screen

Select Production Days

Select (De)Activation Times

Select Sleep Flow Rates

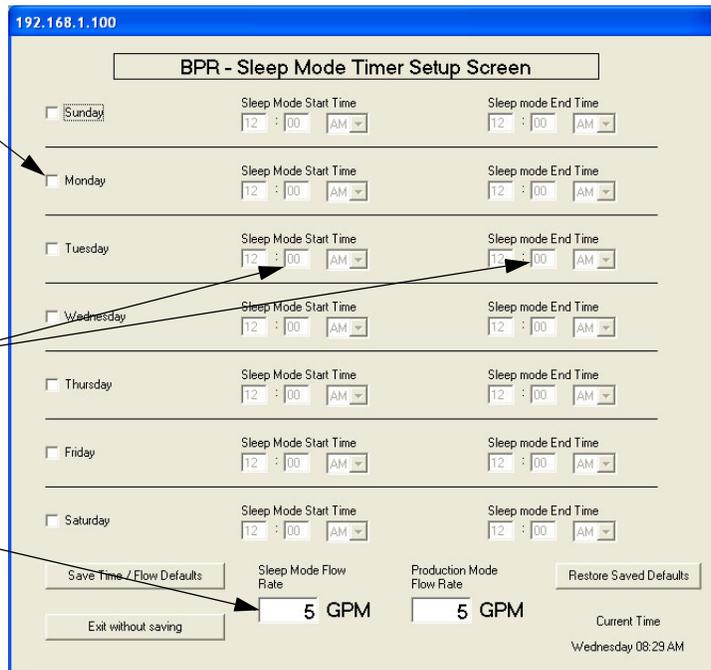


FIG. 25

Table 5: Drive Status Messages

| Message | Parameter ID | 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.

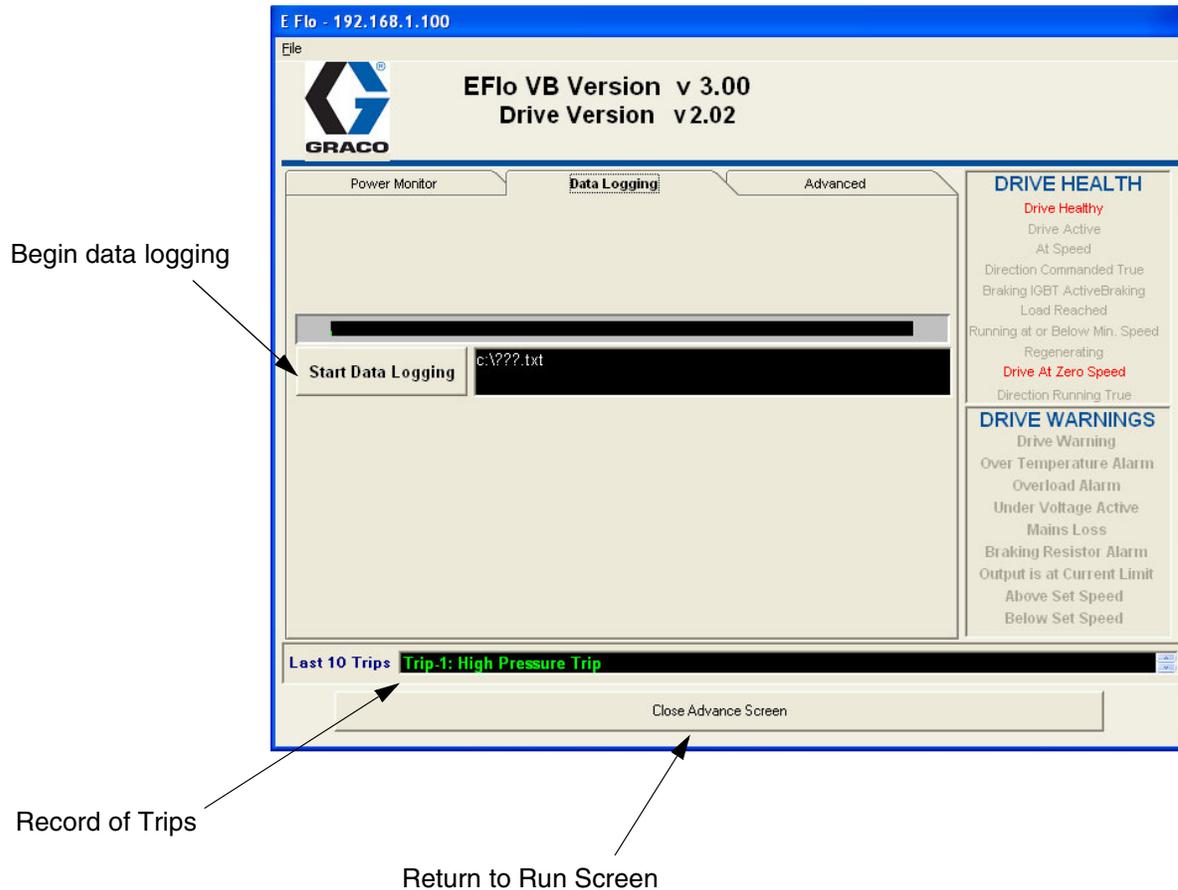


FIG. 26. Data Logging Screen

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.

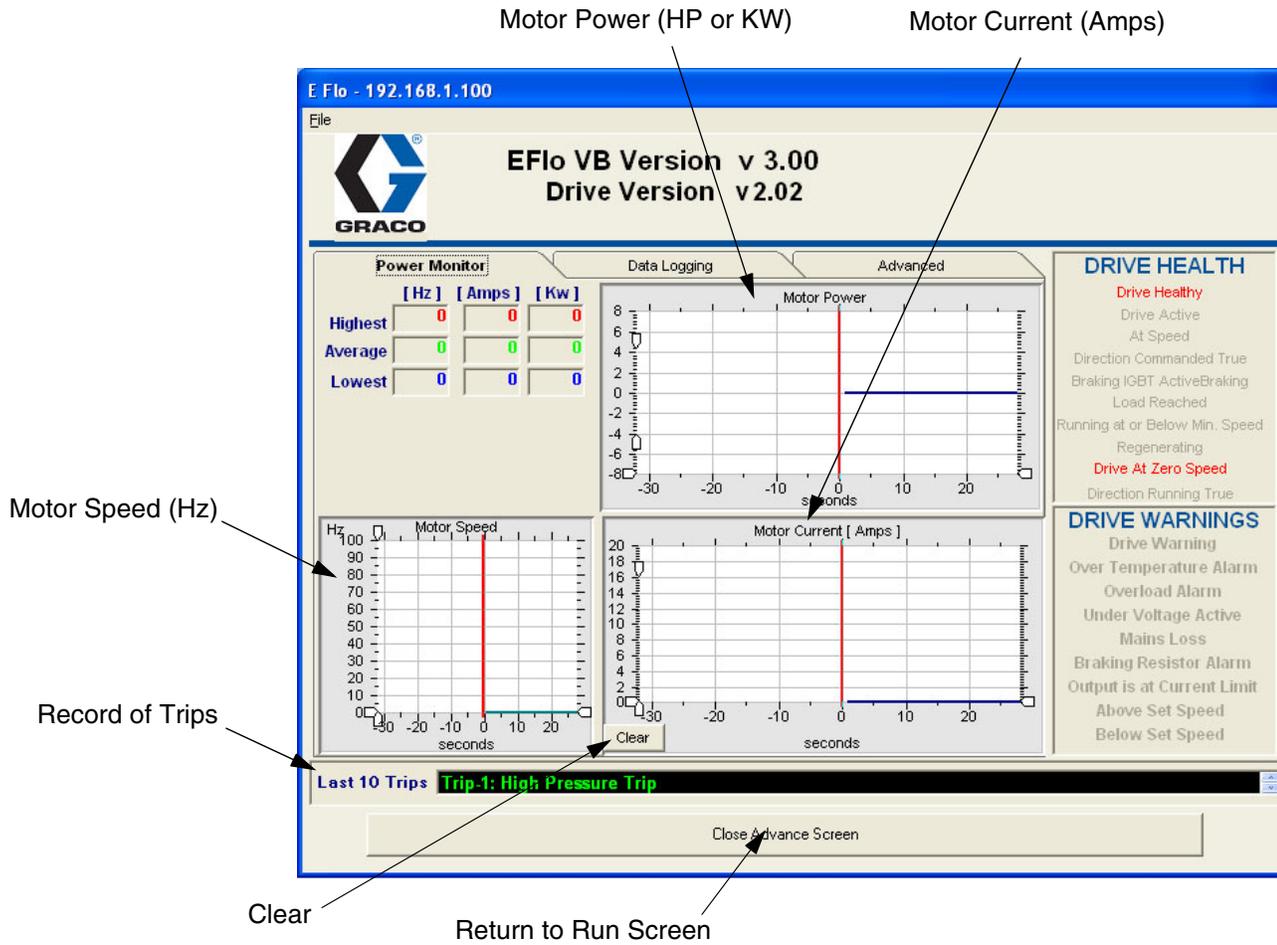


FIG. 27. Power Monitor Screen

Pressure Transducer Calibration Procedure

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

1. Ensure that the High Precision Pressure Transducer calibration is up to date.
2. Set Pr **20.16** 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.
5. Set Pr **20.16** to 0 to lock parameters, then set Pr **0.00** to 1001 to save 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.

| | | | | | | | |
|---|---|--|--|--|--|--|--|
|  |  | | | | | | |
| Do not exceed pressure rating of the system! If system is rated to a pressure lower than 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**.

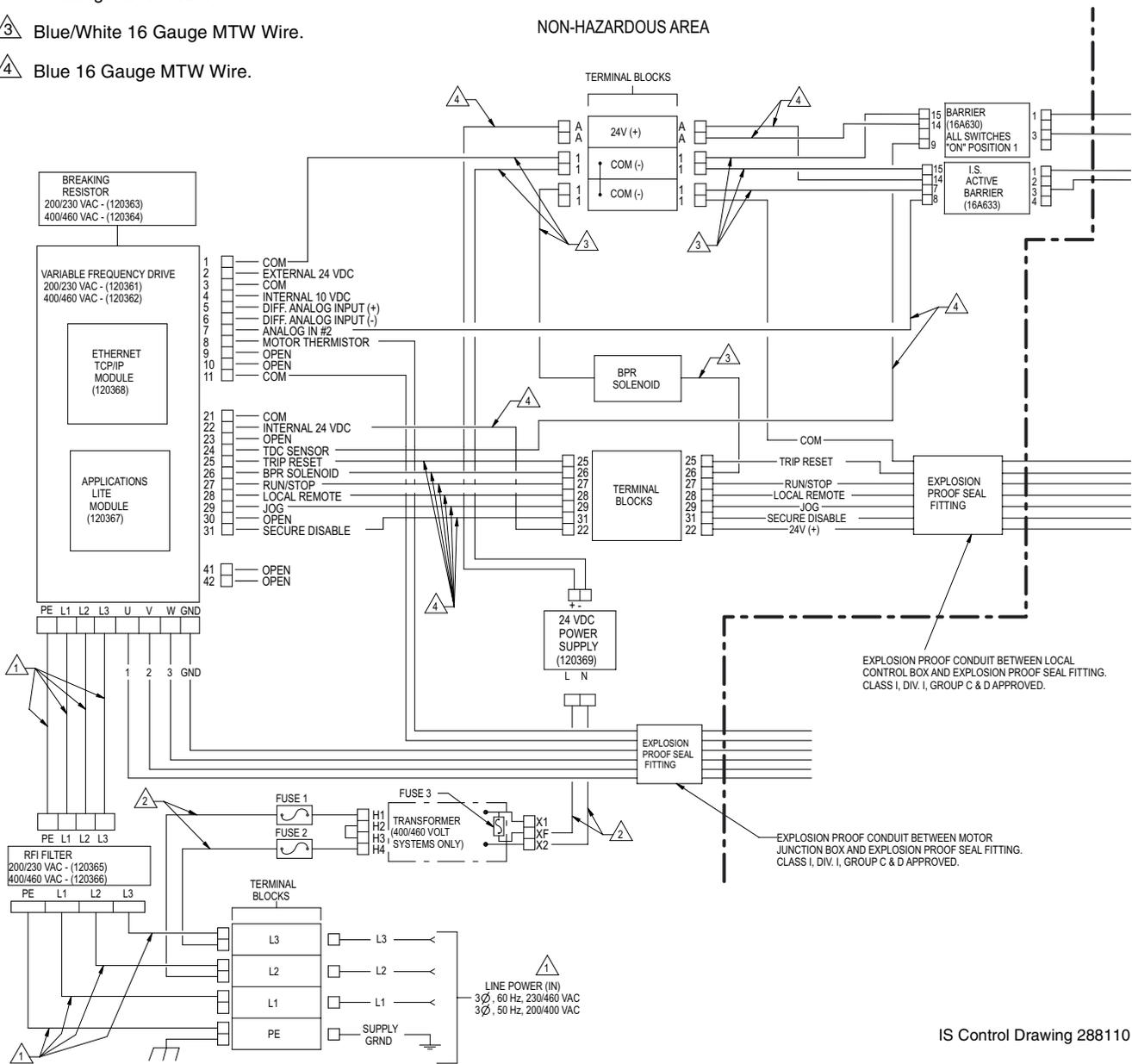
System Electrical Diagrams

FIG. 28 shows components which must be installed in a non-hazardous location.

FIG. 29 shows components approved for installation in a hazardous location, and FIG. 30 shows detail views of hazardous location components.

NON-HAZARDOUS AREA

- 1 12 Gauge Alpha Wire P/N V16012/equiv.
- 2 16 Gauge MTW Wire.
- 3 Blue/White 16 Gauge MTW Wire.
- 4 Blue 16 Gauge MTW Wire.



IS Control Drawing 288110

Fig. 28: System Wiring Schematic, Non-Hazardous Location Only

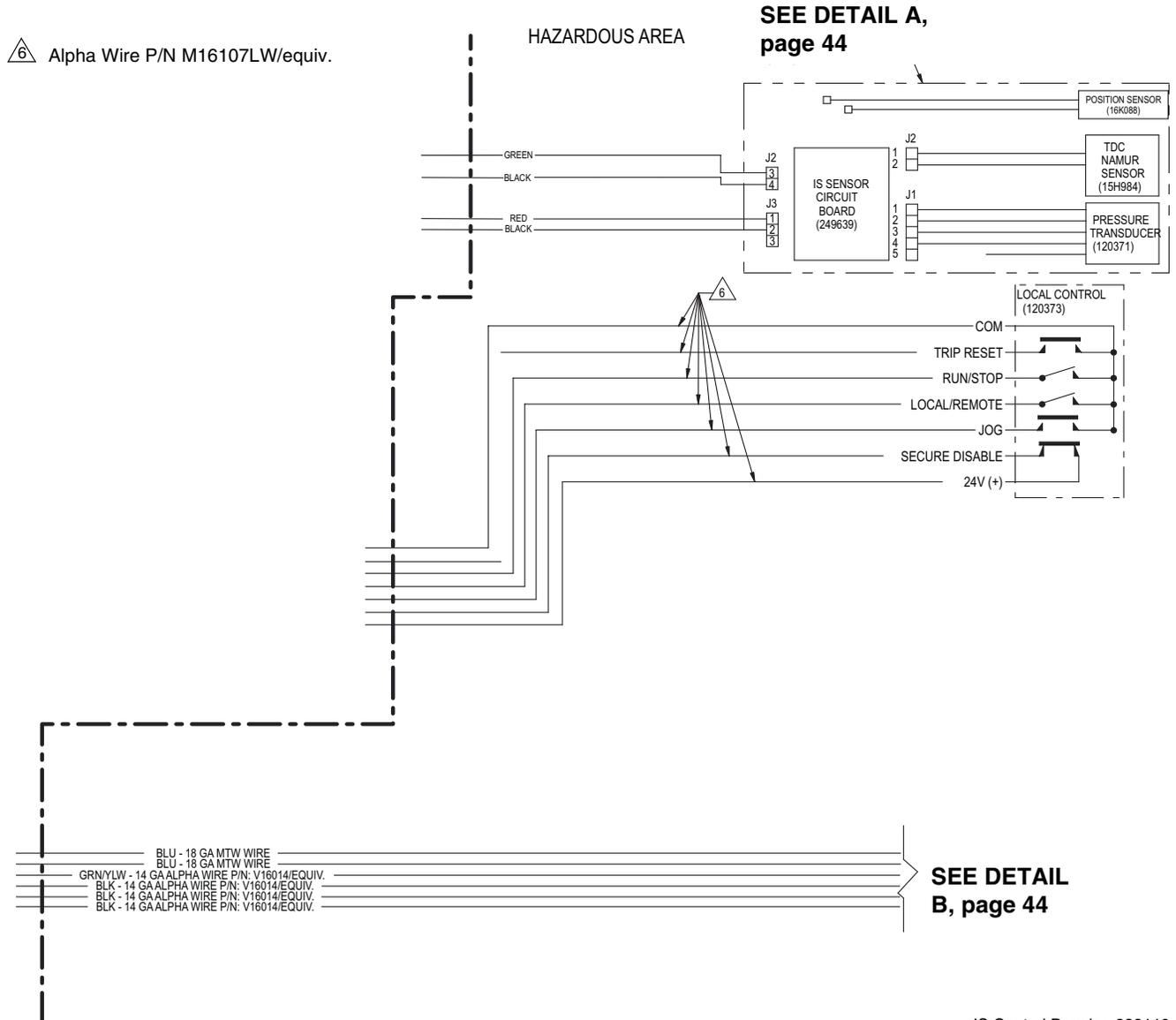
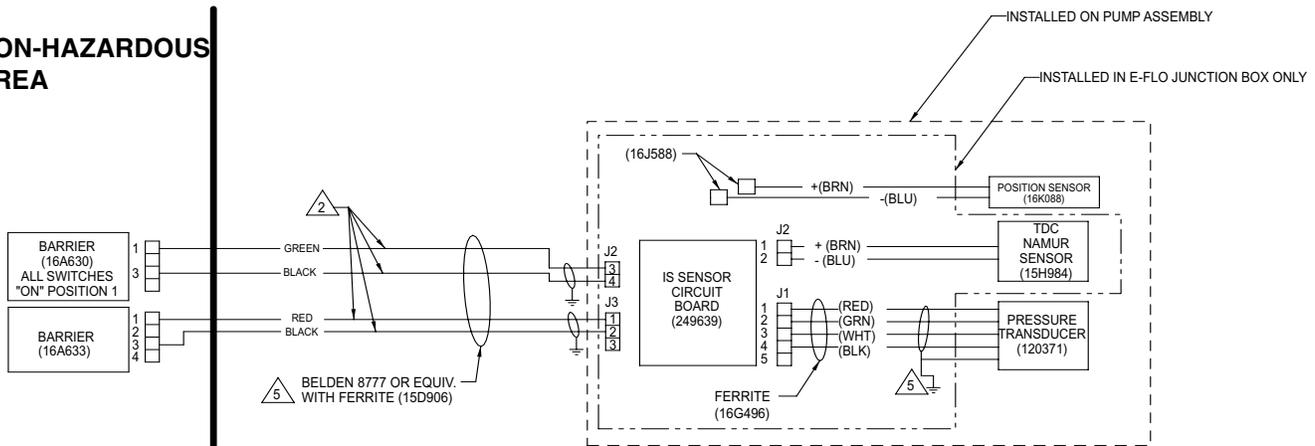


FIG. 29: System Wiring Schematic, Hazardous Location

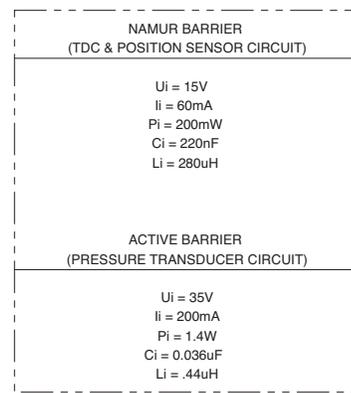
DETAIL A

**HAZARDOUS (CLASSIFIED) LOCATION
CLASS I, 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)**

**NON-HAZARDOUS
AREA**



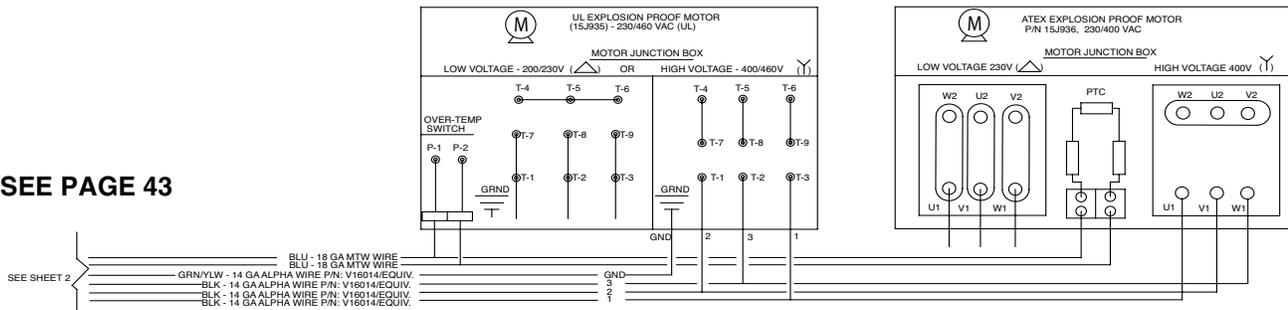
- 1 The installation must meet the requirements of the National Electric Code, Canadian Electrical Code Part I, Article 504, NFPA 70, and ANSI/ISA 12.06.01.
- 2 Individually shielded cables needed to ensure separation of sensor and transducer circuits.
- 3 The voltage (V_{max} or U_i), current (I_{max} or I_i), and power (P_i) must be equal to or greater than the voltage (V_{oc} , U_o , or V_t), current (I_{sc} , I_o , or I_t), and power (P_o or P_t) levels, which can be delivered by the associated apparatus. In addition, the maximum unprotected capacitance (C_i) and inductance (L_i) of the intrinsically safe apparatus, including interconnecting wiring, must be less than the capacitance (C_a) and inductance (L_a) which can be safely connected to the associated apparatus.
- 5 Land shield drain and foil to conductive strain relief.



DETAIL B

HAZARDOUS AREA

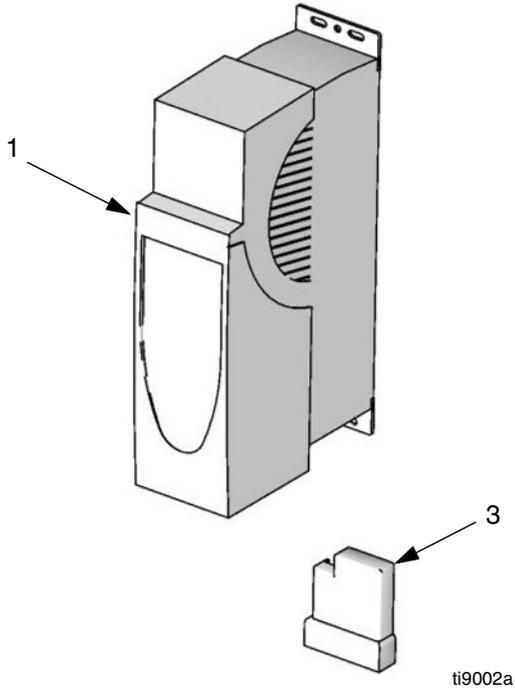
SEE PAGE 43



IS Control Drawing 288110

Fig. 30: System Wiring Schematic, Hazardous Location Detail Views

Parts



| 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

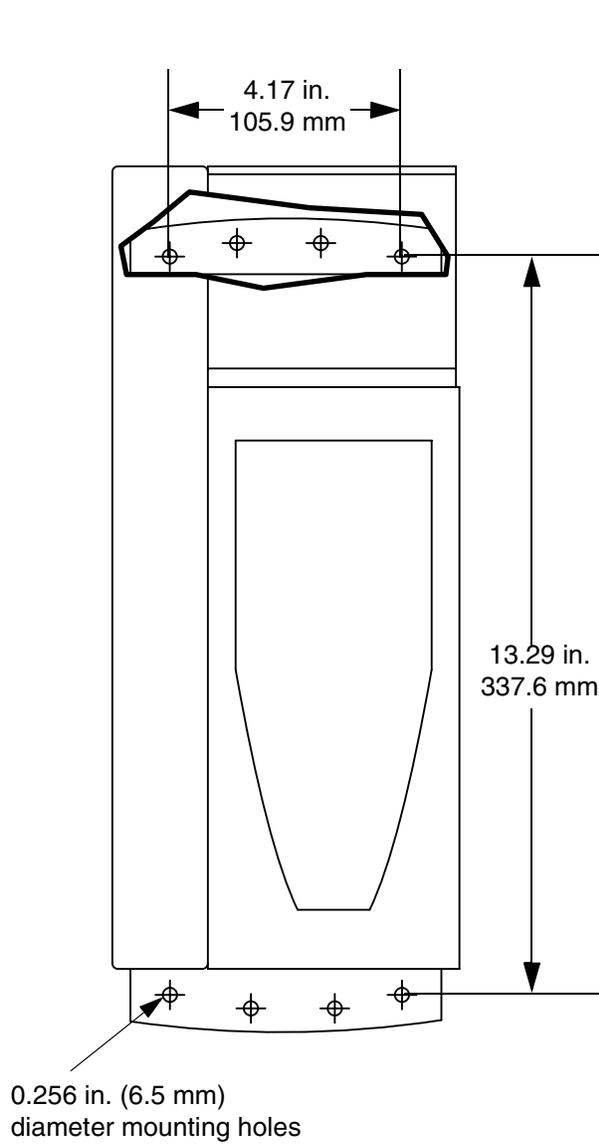


FIG. 31. 230V VFD Mounting Holes

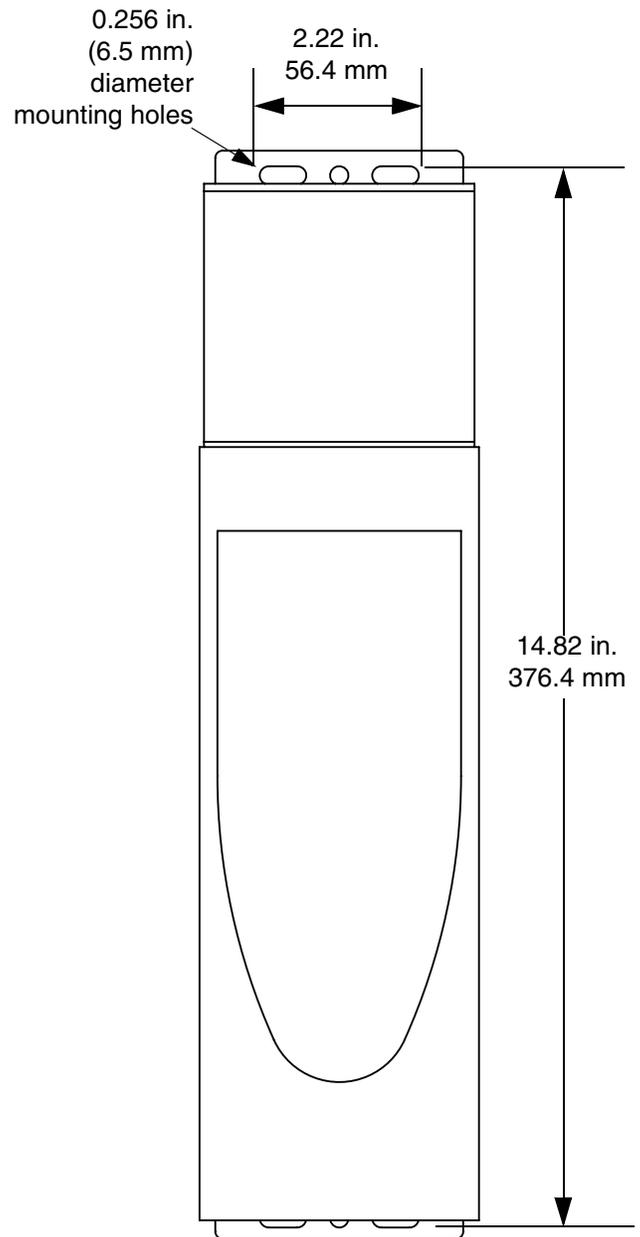


FIG. 32. 460V VFD Mounting Holes

Graco Standard Warranty

Graco warrants all equipment referenced in this document which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco's written recommendations.

This warranty does not cover, and Graco shall not be liable for general wear and tear, or any malfunction, damage or wear caused by faulty installation, misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-Graco component parts. Nor shall Graco be liable for malfunction, damage or wear caused by the incompatibility of Graco equipment with structures, accessories, equipment or materials not supplied by Graco, or the improper design, manufacture, installation, operation or maintenance of structures, accessories, equipment or materials not supplied by Graco.

This warranty is conditioned upon the prepaid return of the equipment claimed to be defective to an authorized Graco distributor for verification of the claimed defect. If the claimed defect is verified, Graco will repair or replace free of charge any defective parts. The equipment will be returned to the original purchaser transportation prepaid. If inspection of the equipment does not disclose any defect in material or workmanship, repairs will be made at a reasonable charge, which charges may include the costs of parts, labor, and transportation.

THIS WARRANTY IS EXCLUSIVE, AND IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

Graco's sole obligation and buyer's sole remedy for any breach of warranty shall be as set forth above. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available. Any action for breach of warranty must be brought within two (2) years of the date of sale.

GRACO MAKES NO WARRANTY, AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, IN CONNECTION WITH ACCESSORIES, EQUIPMENT, MATERIALS OR COMPONENTS SOLD BUT NOT MANUFACTURED BY GRACO. These items sold, but not manufactured by Graco (such as electric motors, switches, hose, etc.), are subject to the warranty, if any, of their manufacturer. Graco will provide purchaser with reasonable assistance in making any claim for breach of these warranties.

In no event will Graco be liable for indirect, incidental, special or consequential damages resulting from Graco supplying equipment hereunder, or the furnishing, performance, or use of any products or other goods sold hereto, whether due to a breach of contract, breach of warranty, the negligence of Graco, or otherwise.

FOR GRACO CANADA CUSTOMERS

The Parties acknowledge that they have required that the present document, as well as all documents, notices and legal proceedings entered into, given or instituted pursuant hereto or relating directly or indirectly hereto, be drawn up in English. Les parties reconnaissent avoir convenu que la rédaction du présente document sera en Anglais, ainsi que tous documents, avis et procédures judiciaires exécutés, donnés ou intentés, à la suite de ou en rapport, directement ou indirectement, avec les procédures concernées.

Graco Information

For the latest information about Graco products, visit www.graco.com.

For patent information, see www.graco.com/patents.

TO PLACE AN ORDER, contact your Graco distributor or call to identify the nearest distributor.

Phone: 612-623-6921 **or Toll Free:** 1-800-328-0211 **Fax:** 612-378-3505

All written and visual data contained in this document reflects the latest product information available at the time of publication. Graco reserves the right to make changes at any time without notice.

Original instructions. This manual contains English. MM 311596

Graco Headquarters: Minneapolis

International Offices: Belgium, China, Japan, Korea

GRACO INC. AND SUBSIDIARIES • P.O. BOX 1441 • MINNEAPOLIS MN 55440-1441 • USA

Copyright 2007 Graco Inc. All Graco manufacturing locations are registered to ISO 9001.

www.graco.com

Revision K, January, 2014