

# 24H372 ACS Module

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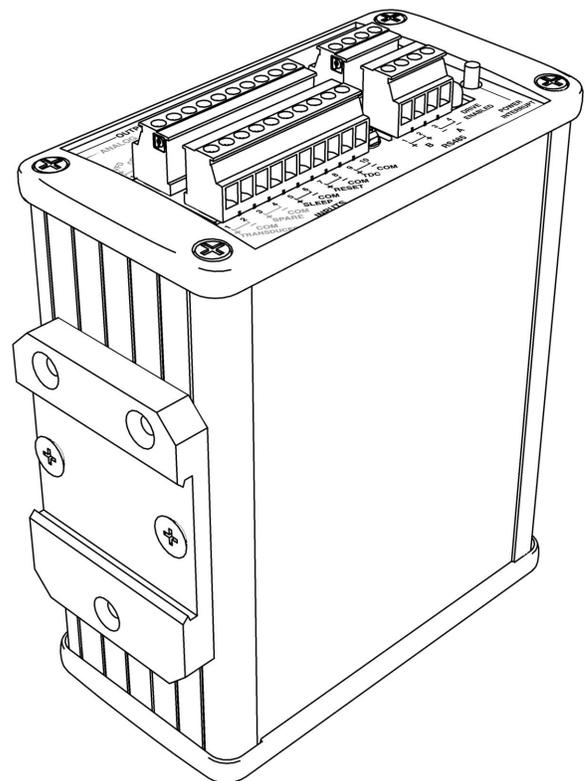
Advanced Motor Control System for Graco E-Flo<sup>®</sup> Electric Circulation Pumps. See page 4 for Required System Components. For professional use only.

Not approved for use in explosive atmospheres or hazardous locations.



### Important Safety Instructions

Read all warnings and instructions in this manual and in your E-Flo pump manuals. Save these instructions.



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# Related Manuals

<b>Manual</b>	<b>Description</b>
311592	E-Flo Installation Manual
311593	E-Flo Operation Manual
311594	E-Flo Repair-Parts Manual
311603	24J305 Sensor Circuit Option
311690	4-Ball Lowers with open wet-cup
3A0539	4-Ball Lowers with enclosed wet-cup

## 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.

 <b>WARNING</b>	
	<p><b>ELECTRIC SHOCK HAZARD</b></p> <p>This equipment must be grounded. Improper grounding, setup, or usage of the system can cause electric shock.</p> <ul style="list-style-type: none"> <li>• Turn off and disconnect power at main switch before disconnecting any cables and before servicing equipment.</li> <li>• Connect only to grounded power source.</li> <li>• All electrical wiring must be done by a qualified electrician and comply with all local codes and regulations.</li> </ul>

## Glossary of Terms

<b>Term</b>	<b>Description</b>
ACS	Advanced Control System
VFD	Variable Frequency Drive
TDC	Top Dead Center; measures position of pump drive
I/O	Input/output
PCB	Printed Circuit Board
Run	Set of commands enabling motor to run in designated direction
Stop	Set of commands authorizing motor to stop running

# Overview

## Required System Components

**NOTE:** The following components **must** be installed in every ACS system.

### 24J305 Sensor Circuit Kit for E-Flo Pump (Series D and later)

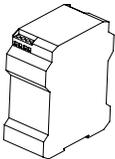
Verify that the 24J305 Sensor Circuit Kit is installed on your E-Flo Pump. If the pump does not have the sensor circuit, order Part No. 24J305. The kit contains the circuit board and TDC, position, and pressure sensors necessary to utilize the Graco ACS module, taking advantage of flow control and pressure control mode delivered by Graco ACS software. See manual 311603.

**For E-Flo Pumps Series C and earlier**, check with your local Graco Distributor for compatibility.

### 16D612 Power Module Assembly

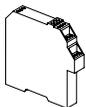
Transforms AC power to a 24 Vdc power supply for the pump sensor circuit. See manual 311608. This assembly includes the following required power supply and barriers, which are also available separately:

#### 121314 Power Supply (required) 24 Vdc, 2 A. DIN rail mount.



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#### 16A630 TDC and Position Sensor Barrier (2 channel) [required] 16A633 Transducer Barrier (1 channel) [required]



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## CAT5 Ethernet Cables

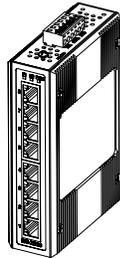
- 121994, 1 ft (0.305 m)
- 121998, 25 ft (7.6 m)
- 121999, 50 ft (15.2 m)
- 15V842, 100 ft (30.5 m)
- 15V843, 200 ft (61.0 m)

## Optional Components

Optional ACS components can be ordered through your Graco Distributor.

### 15V342 Ethernet Switch

Enables connection of ACS module to multiple network components through an Ethernet.



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### Local I/O Box

#### 120373 (UL/CSA) 120991 (ATEX)

Allows the operator to control the E-Flo locally at the pump when performing maintenance or troubleshooting. See page 12. Includes the following features:

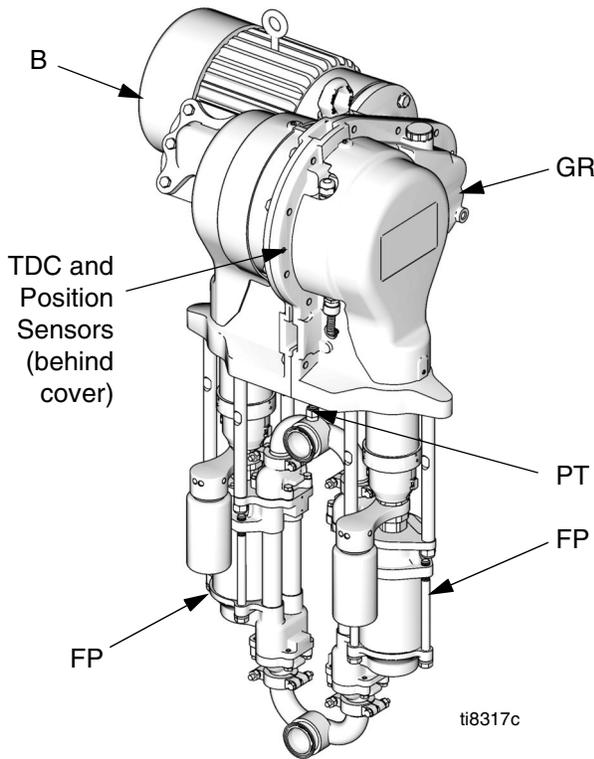
- secure disable switch
- start/stop switch
- fault reset

## E-Flo Pump Operational Overview

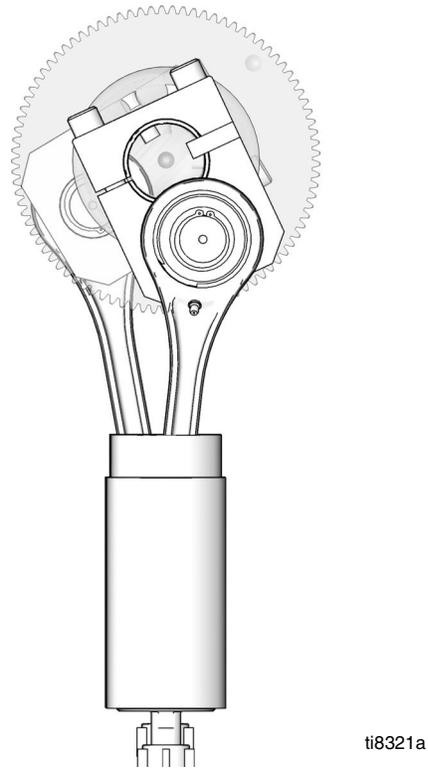
An electric motor (B) provides input to a 75:1 gear reducer (GR), which drives two fluid pumps (FP). See FIG. 1. The stroke positions of the two pumps are offset to achieve consistent flow from the pump assembly. See FIG. 2.

The optional sensor circuit includes a top dead center (TDC) sensor to measure motor speed, a position sensor (PS) to measure motor position, and a pressure transducer (PT) to measure fluid pressure at the pump outlet. The Graco ACS control module 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 electrical control module simulating the function of a 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 ACS module provides an analog drive signal to the VFD. Use one ACS module for each E-Flo pump. The ACS module can be controlled by a local control box mounted in the hazardous area, or via communication protocol (such as modbus).



**FIG. 1. Electric Circulation Pump**



**FIG. 2. Cutaway Showing Offset Stroke Positions**

# Installation

All electrical wiring must be completed by a qualified electrician and comply with all local codes and regulations.						

FIG. 3 shows the ACS panel. See FIG. 4, and FIG. 5 for schematic diagrams showing wiring connection points of all required and optional system components.

See FIG. 6 for a detailed schematic of VFD, Barrier, and Start/Stop connections.

## Inputs and Outputs

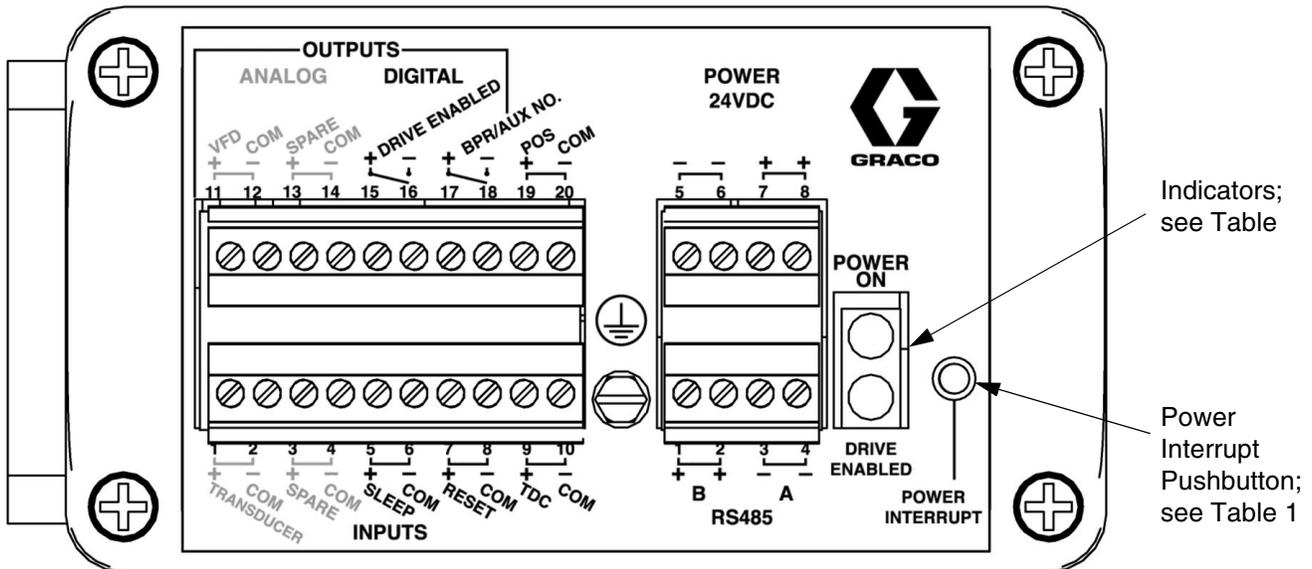
FIG. 3 shows the ACS Module input and output terminal block. See also FIG. 4, FIG. 5, and **System Diagnostic Indicators**, page 30.

## Indicators and Pushbutton

FIG. 3 shows the ACS Module indicators and POWER INTERRUPT pushbutton. See also FIG. 4 and FIG. 5.

**Table 1: ACS Module Indicators and Pushbutton**

Indicator or Button	Color	Condition
POWER ON indicator	Solid Green	The ACS is powered and the pump is running.
DRIVE ENABLED indicator	Solid Red	Turns on if the ACS is sending an analog drive command and the drive enabled relay is closed.
POWER INTERRUPT pushbutton	n/a	Press momentarily to interrupt power, for system reboot.  Power is restored when released.



**FIG. 3. ACS Module Indicators and Input/Output Terminals**

## Critical Item Checklist

- Wire according to FIG. 4 on page 8 and FIG. 5 on page 9.
- Use Belden 8777 cable or equivalent. It is important to use multiconductor cable with 3 individually shielded pairs.
- Ferrite (15D906) must be installed on pressure transducer wires.
- Do not place signal wires in the same conduit as AC Power wires. For example, the TDC/Position sensor wires should not share a conduit with the VFD wires.
- Use the following VFD configuration settings:
  - analog input scaling
  - 4 mA = 0 (zero) Hz
  - 20mA = 80 Hz
  - Acceleration rate = 1.0 second (for full range 0-80 Hz)
  - Deceleration rate = 0.5 second (for full range)-80 Hz)



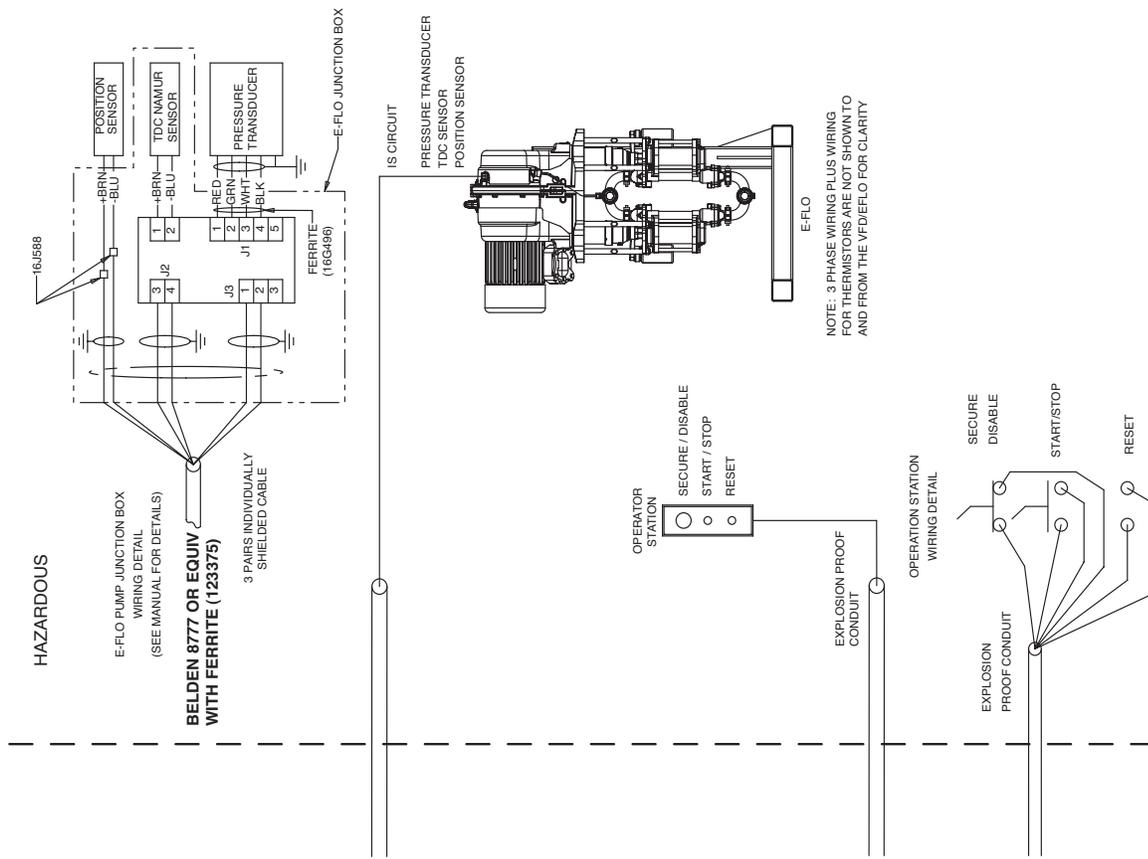


Fig. 5. System Schematic Diagram, Hazardous Area

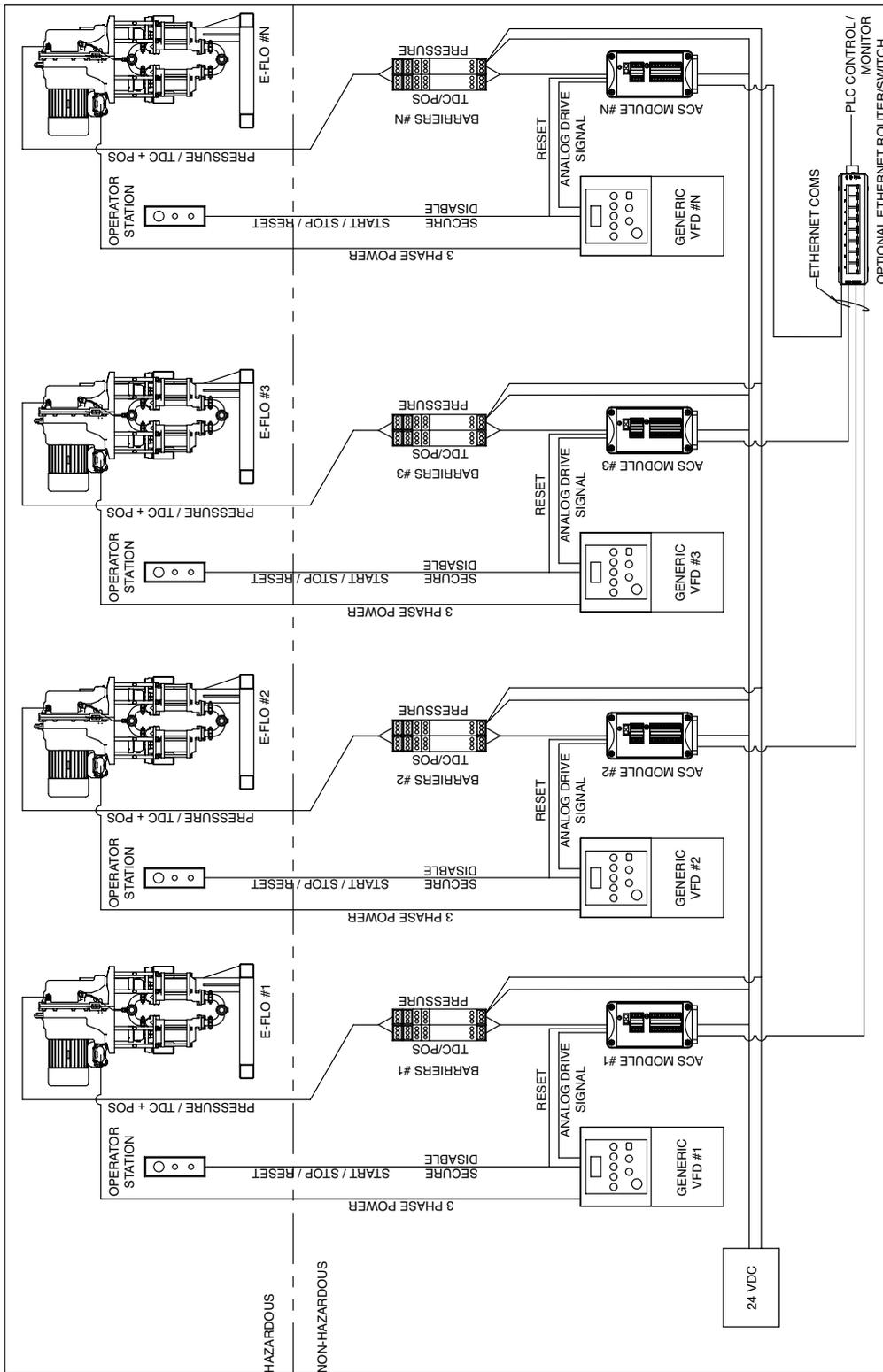


Fig. 6: Detailed Schematic, Connections to VFD

## Location

						
<p>This equipment is not for use in explosive atmospheres. Do not install equipment approved only for non-hazardous location in a hazardous area.</p>						

Install the ACS Module and components in a non-hazardous area.

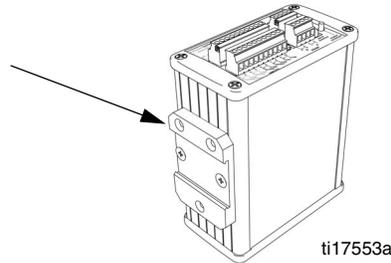
## Mounting

See **Dimensions**, page 43.

The ACS Module and associated components are designed to be mounted on a DIN rail inside of the motor control enclosure.

The ACS Module DIN rail bracket may be reversed if desired, to accommodate installation requirements. Remove the screws, turn the bracket 180°, and reattach.

DIN rail bracket may be reversed if desired.



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## Ground the ACS Control Module

						
<p>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 ACS Module through a proper connection to a power source.</p>						

## ACS Modbus Registers

Modbus Registers 401800 to 401828 are used for ACS system control and setup. See Table 2.

Table 2: ACS Modbus Registers 401800 to 401828

Register No.	Register Name	Description
401800	None	Not used.
401801	Model	Sets the pump model. Range of 1-4:  0 = Not used 1 = E-Flo 1500 2 = E-Flo 2000 3 = E-Flo 3000 4 = E-Flo 4000
401802	Units	0 = US GPM/PSI; 1 = Metric LPM/BAR
401803	ClrCtrFig	Clear the Cycle Counters:  1 = Clear Batch Total. 2 = Clear Grand Total.  This register is set to 0 by the ACS when done.
401804	CamMode	1 = Cam Mode enabled. Pump is compensated to provide constant flow.  0 = Constant speed mode. Motor will run at a constant speed.
401805	Modbus Baud Rate	0 = 19,200 (Default) 1 = 38,400 2 = 57,600  Changes take effect on next power up.
401806	AutoCAMoff	Determines how the ACS responds to a TDC or Position Sensor failure.  1 = Run at constant speed determined by Run or Sleep setpoint. 0 = Stop the pump.
401807	HipressLim	High Pressure Alarm Limit x 10; ie, 2500 = 250 psi.
401808	None	Not used.
401809	AuxOn	Aux Relay ON/OFF control.  1 = ON 0 = OFF
401810	LowPressLim	Low Pressure Alarm Limit x 10; ie, 400 = 40 psi.
401811	RemoteReset	1 = Reset the ACS to clear alarms. ACS will set to 0 when Reset is complete, and the pump will start.  The Reset pin is edge triggered; a low to high will reset the ACS. Short the Reset pin to Common, then release to reset.

Table 2: ACS Modbus Registers 401800 to 401828

Register No.	Register Name	Description
401812	PressAlrmEnable	0 = No alarms. 1 = High Pressure only. 2 = Low Pressure only. 3 = High and Low Pressure.
401813	Press_Mon	Indicates to the system that a transducer is present to read.  1 = Enable pressure transducer reads. 0 = Disable pressure transducer reads.
401814	SleepSetpt	Setpoint for Sleep Mode x 10 (GPM or LPM)
401815	RunSetpt	Setpoint for Run Mode x 10 (GPM or LPM)
401816	SleepEnable	1 = Sleep Mode is on. The Sleep Setpoint is used as the target flow rate. 0 = Sleep off. The Run Setpoint is used as the target flow rate.  Sleep can also be enable by the external AutoSleep input pin. Sleep Mode is enabled when either control is active.
401817	PressSetPt	Pressure Mode setpoint x 10. This is the target pressure for Pressure Control Mode.
401818	Cntrl_Mode	0 = Flow Control. Maintains a constant flow rate. Flow rate is either Sleep or Run Setpoint, depending on 1816_SleepEnable input.  1 = Pressure Control. Maintains a constant pressure defined by 401817_PressSetPt.
401820	AutoDecrement	1 = Enabled; automatically minimizes the flow rate in pressure mode, allowing the BPR to close. See <b>Auto Decrement</b> , page 27.
401821	RunStop	1 = Run 0 = Stop  Power up or Reset will set RunStop to 1.
401822	GaugePresH	High Gauge Pressure entered during calibration, PSI only
401823	GaugePresL	Low Gauge Pressure entered during calibration, PSI only
401824	ADmAHigh	High pressure CAL, Transducer current xx.x mA.
401825	ADmAHigh	Low pressure CAL, Transducer current xx.x mA.
401828	AutoXducerFail	Determines how the ACS responds to a pressure transducer failure.  1 = Run at constant flow rate determined by Run or Sleep setpoint. 0 = Stop the pump.

**Modbus Registers 401900 to 401950 provide ACS operation status information and are Read only. They must never be written to. See Table 3.**

**Table 3: ACS Modbus Registers 401900 to 401950**

Register No.	Register Name	Description
401900	None	Not used.
401901	CalcCPM	Pump cycles per minute x 100.
401902	GT_CyclesL	Grand Total cycles low word.
401903	GT_CyclesH	Grand Total cycles high word.  To calculate the Grand Total, use the following formula:  Grand Total = (10000 * GT_CyclesH) + GT_CyclesL.
401904	Batch_CyclesL	Batch Total cycles low word.
401905	Batch_CyclesH	Batch Total cycles high word.  To calculate the Batch Total, use the following formula:  Batch Total = (10000 * Batch_CyclesH) + Batch_CyclesL.
401906	AVG_Press	Average of last 5 pressure readings.
401907	Rev	SOFTWARE VERSION.
401908	EventFlag	Modbus Display only. 7 = Start Event. 8 = Stop Event.
401909	RunningFlag	1 = The motor is rotating. 0 = The motor is stopped.
401910	AutoSlpStat	Status of the AutoSleep input. 1 = the AutoSleep input is active (low).
401911	CalcFlow	Current flow rate x 100 in GPM or LPM.
401912	XducerValidFlg	1 = Pressure transducer is valid (> 2mA). 0 = Pressure transducer has failed (< 2mA).
401913 to 401919	None	Not used.
401920	ToothStat	Status of the Position Sensor. The motor must be rotating for the system to determine the validity of the position sensor.  1 = Valid; the ACS is receiving Position Sensor pulses. 0 = Failed; the ACS is not receiving Position Sensor pulses.
401921	PLC_ID	Modbus node number assigned to this ACS.
401922	ResetStat	Status of the ACS Reset input pin. 1 = the Reset pin is active (low).
401923	TDCStat	Status of the TDC (Top Dead Center) Sensor. The motor must be rotating for the system to determine the validity of the TDC Sensor.  1 = Valid; the ACS is receiving TDC Sensor pulses. 0 = Failed; the ACS is not receiving TDC Sensor pulses.

**Table 3: ACS Modbus Registers 401900 to 401950**

Register No.	Register Name	Description																														
401924	HeartBeat	Alternately set to 1 and 0 every second. This indicates that the ACS program is operating.																														
401925	DriveCmdHz	Current drive speed command x 10; ie, 0 to 800 = 0 to 80 Hz.																														
401926	Current_Alarm	<p>Represent the current alarm code.</p> <table border="1"> <thead> <tr> <th>Alarm Code No.</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0 = No alarm</td> <td>No current alarm/event.</td> </tr> <tr> <td>1 = OVERPRESS</td> <td>System stopped due to overpressure.</td> </tr> <tr> <td>2 = UNDERPRESS</td> <td>System stopped due to underpressure.</td> </tr> <tr> <td>3 = Xducer Fail</td> <td>Pressure Sensor failure, pump stops.</td> </tr> <tr> <td>4 = NO TDC/STALL</td> <td>TDC failure, pump stops.</td> </tr> <tr> <td>5 = MAXFLOW WARNING</td> <td>Attempted to drive &gt; 80 Hz.</td> </tr> <tr> <td>6 = AUTO CAM OFF-TDC</td> <td>TDC Sensor failure. Pump continues to run in constant speed mode. The CAM function is disabled.</td> </tr> <tr> <td>7 = START EVENT</td> <td>Logged only.</td> </tr> <tr> <td>8 = STOP EVENT</td> <td>Logged only.</td> </tr> <tr> <td>9 = AutoXducerFail</td> <td>Pressure Sensor failure. Pump continues to run without pressure monitoring.</td> </tr> <tr> <td>10 = MINFLOW</td> <td>Minimum Flow Warning, see page 30.</td> </tr> <tr> <td>11 = Position Error</td> <td>Position sensor failure, pump stops.</td> </tr> <tr> <td>12 = AUTO CAM OFF-Position</td> <td>Pump continues to run in constant speed mode. The CAM function is disabled.</td> </tr> <tr> <td>13 = AUTO CAM ACTIVATED</td> <td>CAM automatically reactivated, sensor signal found</td> </tr> </tbody> </table>	Alarm Code No.	Description	0 = No alarm	No current alarm/event.	1 = OVERPRESS	System stopped due to overpressure.	2 = UNDERPRESS	System stopped due to underpressure.	3 = Xducer Fail	Pressure Sensor failure, pump stops.	4 = NO TDC/STALL	TDC failure, pump stops.	5 = MAXFLOW WARNING	Attempted to drive > 80 Hz.	6 = AUTO CAM OFF-TDC	TDC Sensor failure. Pump continues to run in constant speed mode. The CAM function is disabled.	7 = START EVENT	Logged only.	8 = STOP EVENT	Logged only.	9 = AutoXducerFail	Pressure Sensor failure. Pump continues to run without pressure monitoring.	10 = MINFLOW	Minimum Flow Warning, see page 30.	11 = Position Error	Position sensor failure, pump stops.	12 = AUTO CAM OFF-Position	Pump continues to run in constant speed mode. The CAM function is disabled.	13 = AUTO CAM ACTIVATED	CAM automatically reactivated, sensor signal found
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401927	MaxFloFlg	Set when ACS attempts to drive the motor at more than 80 Hz. Cleared after two pump cycles.																														
401928	AuxOutStat	<p>Status of the AuxOut Relay.</p> <p>1 = Relay closed. 0 = Relay open.</p>																														
401929	DrvEnableRlyStat	<p>Status of the Drive Enable Relay.</p> <p>1 = Relay closed. 0 = Relay open.</p>																														
401930	MinFloFlg	1 = Minimum Flow Warning, see page 30.																														
401931	AnalogIN2	<p>Spare Input Pins 3 and 4:</p> <p>Value 0 - 4095 represents 0-20 mA current</p>																														
401932 to 401946	None	Not used.																														
401947	ID1	'A' Device ID																														
401948	ID2	'C' Device ID																														
401949	ID3	'S' Device ID																														

# ACS Control Mode

The ACS module provides an analog drive signal to the VFD.

- **Run** command refers to an input command to the VFD, requesting the motor to run in designated direction.
- **Stop** command refers to an input command removed, requesting the motor to stop running.

The VFD drives the pump if the following conditions are met:

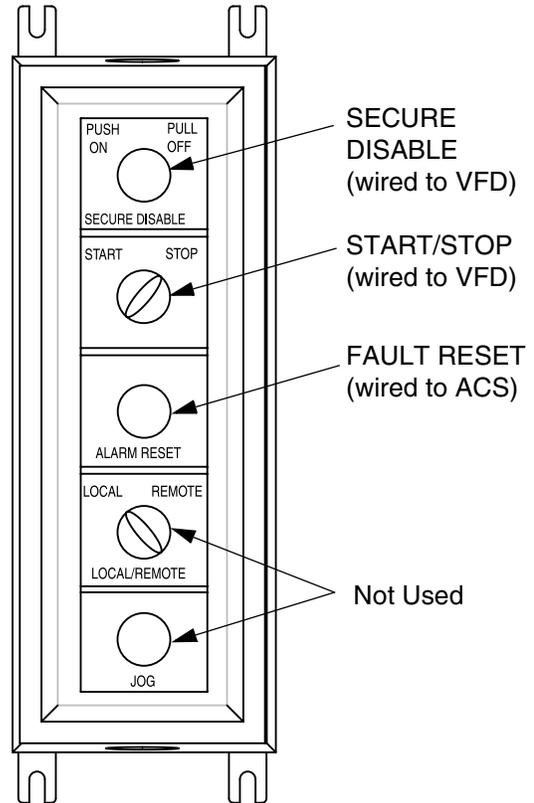
- SECURE/DISABLE switch is ON
- START/STOP switch is ON
- There are no VFD or ACS faults

**NOTE:** The local control box cannot make flow rate changes. Use automation (PC, VB software, or process controller) to change the flow rate.

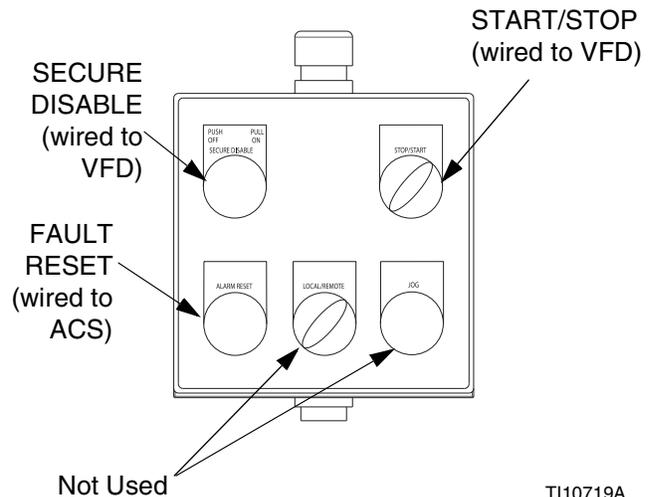
A control with interface must be used to select a drive speed.

**NOTE:** See the schematic diagrams on pages 8-10 for wiring details to complete the installation.

**120373 UL/CSA Control Box**



**120991 ATEX Control Box**



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**FIG. 7. Local Control Box**

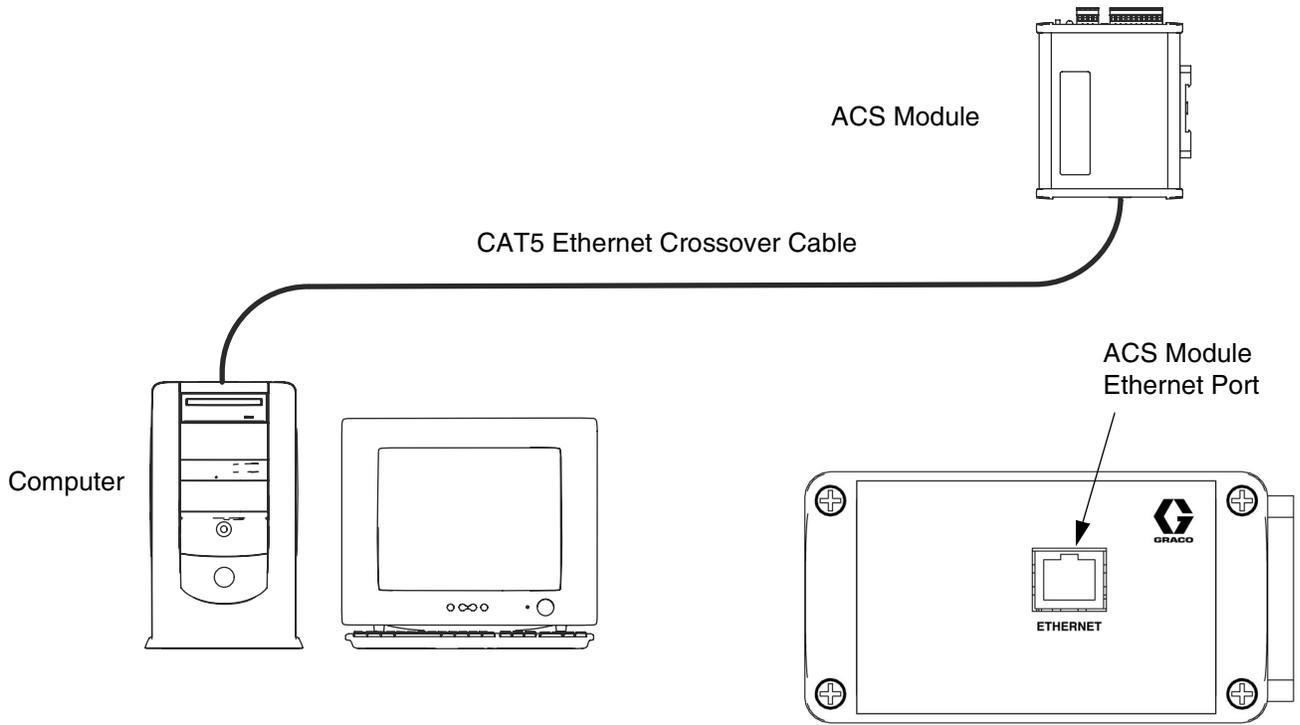
# Operation

## Set up a Static IP Address for the Computer

**NOTE:** Screen views in this manual are shown using Microsoft Windows XP.

**NOTE:** To run the program, Java Version 6 Update 10+ (Version 7 not compatible) must be loaded on your computer. This is a free download.

1. Before connecting your computer to the ACS, verify that Java Version 6 Update 10+ (Version 7 not compatible) is loaded on your computer. To verify, go to Java.com using your Internet browser and click on "Do I Have Java?" for further information.
2. After verifying that Java is loaded on the computer, connect the computer directly to the Ethernet Port on the bottom of the ACS module, using a CAT5 Ethernet crossover cable. See FIG. 8.



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**FIG. 8. Connect the Computer to the ACS Module**

3. Before running the software you must manually assign an IP address to your computer:

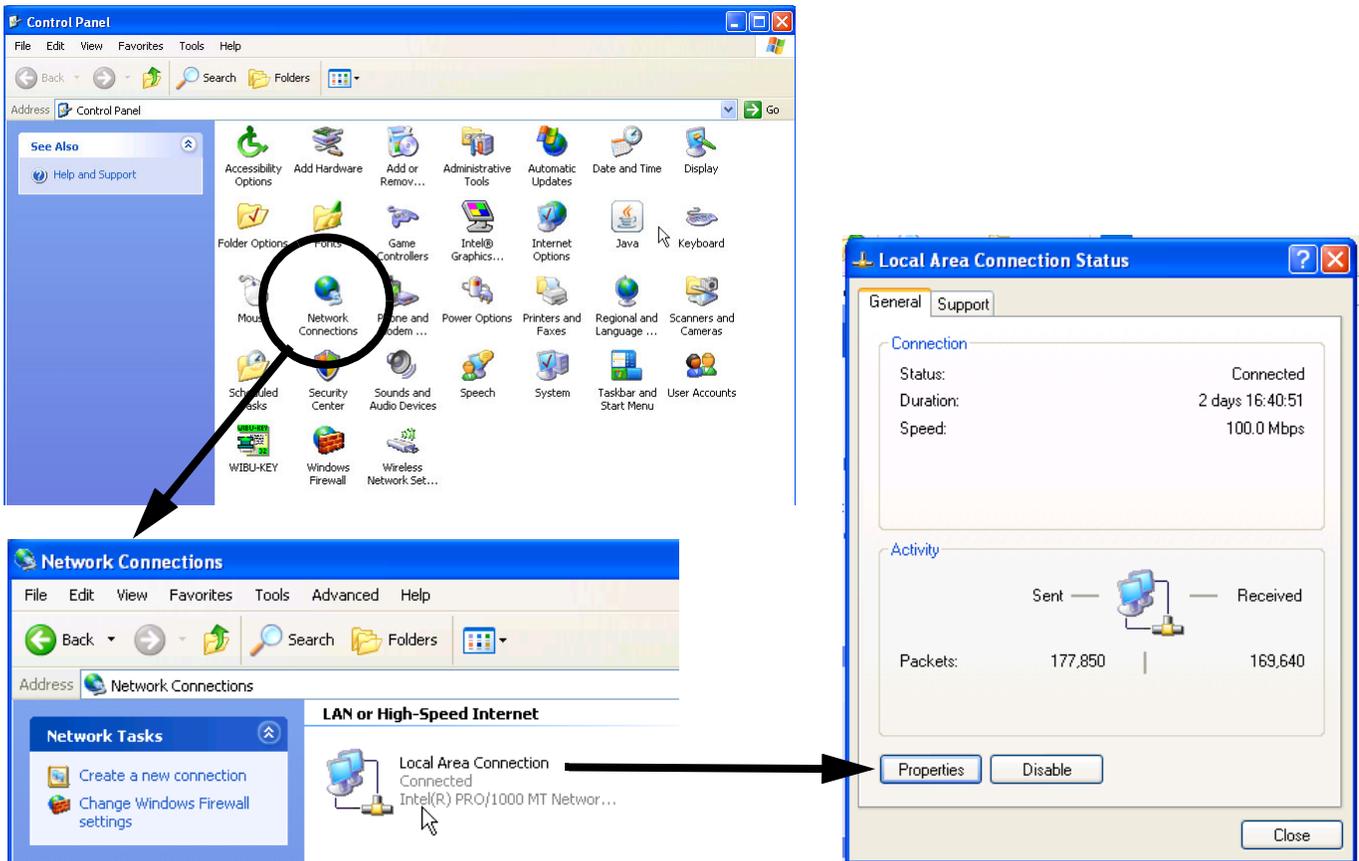
a. On your computer, click on the Start button



to open the menu, then click

on Control Panel

b. See FIG. 9. Double click on Network Connections. Double click on Local Area Connection to open the Local Area Connection Status window. Click on Properties to open the Local Area Connection Properties window. See FIG. 10.



**FIG. 9. Control Panel, Network Connections, and Local Area Connection Status Windows**

- c. In the Local Area Connection Properties window (FIG. 10), scroll to Internet Protocol (TCP/IP) and double click, to open the Internet Protocol (TCP/IP) Properties window (FIG. 11).

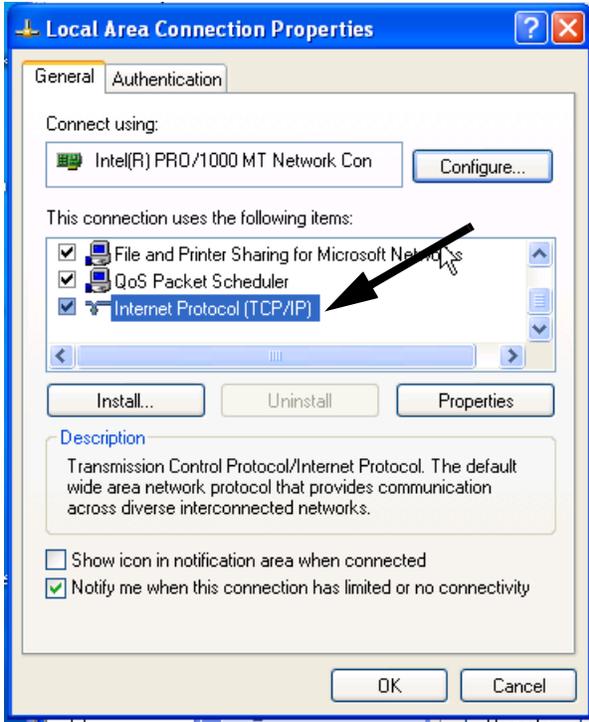


FIG. 10: Local Area Connection Properties Window

- d. See FIG. 11. Set to “Use the following IP address:”  
**NOTE:** The IP address being created in step e **must** be different from any other IP address used in the network.
- e. Type in the following 10 characters (including the dots):  
192.168.1.  
then type additional numbers (for example, 201)  
to create a unique IP address for the computer.

- f. Type in the following Subnet mask:  
255.255.255.0

**NOTE:** To reconnect to the user network, change the setting back to “Obtain an IP Address Automatically.”

- g. Click on OK to accept the changes and close the Internet Protocol (TCP/IP) Properties window.
- h. Click on OK to close the Local Area Connection Properties window.
- i. Close the Local Area Connection Status window and Network Connections window.

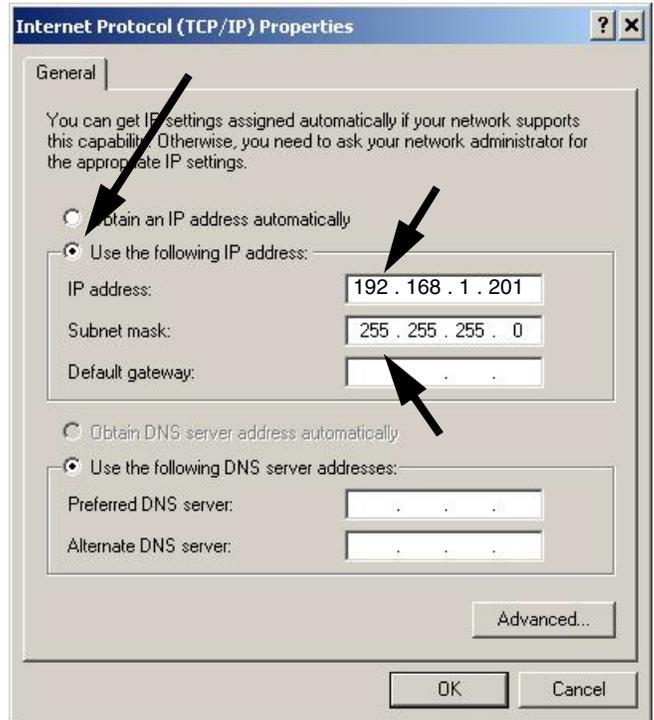


FIG. 11: Internet Protocol (TCP/IP) Window

**NOTE:** Verify that the wireless connection is turned off (disabled) before performing step 4.

4. In a web browser, enter: `http://192.168.1.5:9080`
5. Press Enter. The ACS Module Setup Screen appears. See FIG. 12.
6. Each ACS module is provided with a default IP address (192.168.1.5). The assigned ACS IP address **must** be different from any other IP address in the network. Only the last digit of the address is editable. Type a new number in the edit-

able field, then click **SET IP ADDRESS** to enter.

7. Set the Node ID number **only** if the ACS is connected to a Graco Gateway. The ID number must be unused by other ACS modules. Click on **GET ACS NODE #** to access the default Node ID number, which will then appear following **Device ID:**. Type a new number in the **Enter New ID** field, then click **SET NODE #** to enter.

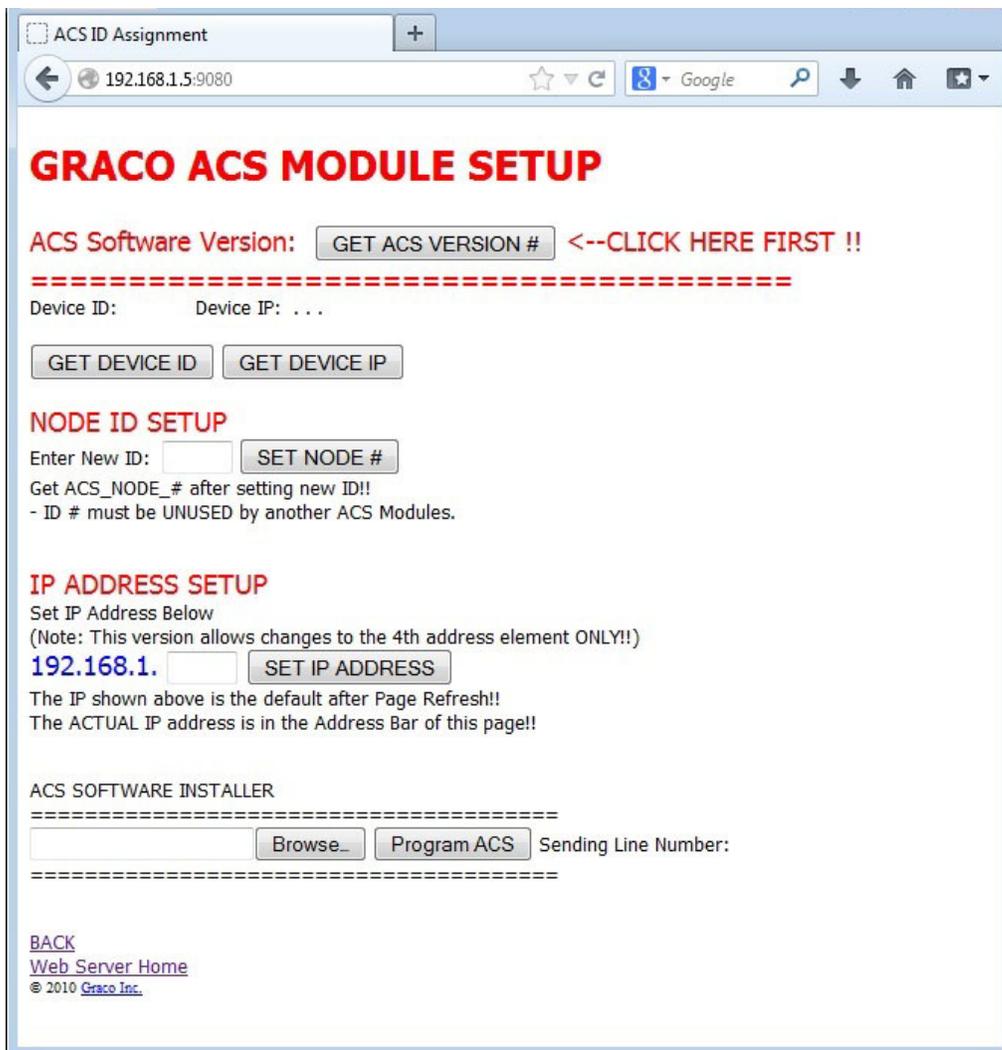


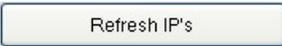
FIG. 12: ACS Module Setup Screen

## ACS System Status Screen

See FIG. 13. The System Status screen appears when the ACS Module is powered up. The screen displays the current conditions and status of up to 50 pumps (numbered 0-49) in the system.

Click on a Pump Name key to open the Run screen for that pump. FIG. 14 shows the Run screen.

If communication is interrupted due to a loose cable or broken wire, first correct the problem, then click on



to re-establish communication.

**NOTE:** The Visual Basic software program for the ACS Module is available as a free download from [www.graco.com/Finishing](http://www.graco.com/Finishing). Navigate to the E-Flo Pump product page for the download link.

**NOTE:** Open the program (Start>All Programs>GracoACS>GracoACS). The program will search for all pumps in the ACS system and populate the ACS System Status Screen. See FIG. 13.

**NOTE:** This program does not require the PC be configured with Static IP Address.

Click on a Pump Name key to open the Run screen for that pump (see page 23).

Configured through web browser, see page 20.

Pump Name	Flow	Pressure	Status	Configuration	IP Address	Node
Pump0	13.93	99.6	Running	E-Flo 4000	192.168.1.5	12
Pump1	0	0	Offline		192.168.1.6	
Pump2	0	0	Offline		192.168.1.7	
Pump3	0	0	Offline		192.168.1.8	
Pump4	0	0	Offline		192.168.1.9	
Pump5	0	0	Offline		192.168.1.10	
Pump6	0	0	Offline		192.168.1.11	
Pump7	0	0	Offline		192.168.1.12	
Pump8	0	0	Offline		192.168.1.13	
Pump9	0	0	Offline		192.168.1.14	
Pump10	0	0	Offline		192.168.1.15	
Pump11	0	0	Offline		192.168.1.16	
Pump12	0	0	Offline		192.168.1.17	
Pump13	0	0	Offline		192.168.1.18	
Pump14	0	0	Offline		192.168.1.19	
Pump15	0	0	Offline		192.168.1.20	
Pump16	0	0	Offline		192.168.1.21	
Pump17	0	0	Offline		192.168.1.22	
Pump18	0	0	Offline		192.168.1.23	
Pump19	0	0	Offline		192.168.1.24	
Pump20	0	0	Offline		192.168.1.25	

FIG. 13. ACS System Status Screen

## Run Screen

See FIG. 14. Use the Run screen to start or stop the pump, reset faults, access the Configuration or Alarm screen, view setpoints, and monitor the pump's operation by viewing performance data.

The Run screen displayed depends on which pump was selected on the **ACS System Status Screen**, page 21. Each Run screen applies only to the selected pump.

### Information Bar

The Run screen information bar displays the unique pump name, the ACS IP address, the date, and the time.

The Pump Name is not editable on the Run screen, but may be input on the Configuration screen. See page 24.

### Pump Performance Data

#### Pump Speed

The pump speed is displayed in cycles per minute (CPM).

#### Flow

The flow is expressed in gpm or lpm, as selected on the Configuration screen (see page 25).

#### Motor Command Hz

The speed command, in Motor VFD frequency (4-20mA scaled 0-80 Hz). This is not the frequency output by the VFD.

#### Fluid Pressure

The fluid pressure is displayed in psi or bar, as selected on the Configuration screen (see page 25).

### Pump Setpoints

#### Run Setpoint

The Run Setpoint is displayed, as set on the Configuration screen (see page 27).

#### Sleep Setpoint

The Sleep Setpoint is displayed, as set on the Configuration screen (see page 27).

### Pressure Setpoint

The Pressure Setpoint is displayed, as set on the Configuration screen (see page 26).

### Fault Status

The screen displays if there is a fault:

- None
- High Pressure
- Low Pressure
- Xducer (Transducer) Fail
- Pressure Sensor
- Auto Xducer Fail
- MIN FLOW Warning
- Position Error
- Auto Cam Off-Position
- Auto Cam Activated
- No TDC Signal
- Max Flow
- Auto Cam Off-TDC
- Start Event
- Stop Event

**NOTE:** See page 41 for alarm descriptions and troubleshooting.

Click on the Reset key to clear.

**NOTE:** The pump starts after a Reset.

### Run Button

Click on the Run key to start the pump.

### Stop Button

Click on the Stop key to stop the pump.

**NOTE:** The Run/Stop buttons function as enable/disable, active management is not necessary. This can be left in Run and the pump/motor controlled from a physical start/stop switch connected to VFD.

### Motor Status

The screen displays the status of the pump motor:

- Stopped - ACS module receiving position pulses
- Motor Running - ACS module not receiving position pulses.

### Config Button

Click on the Config key to open the Configuration screen. See page 24.

### Alarms Button

Click on the Alarms key to open the Alarms screen. See page 31.

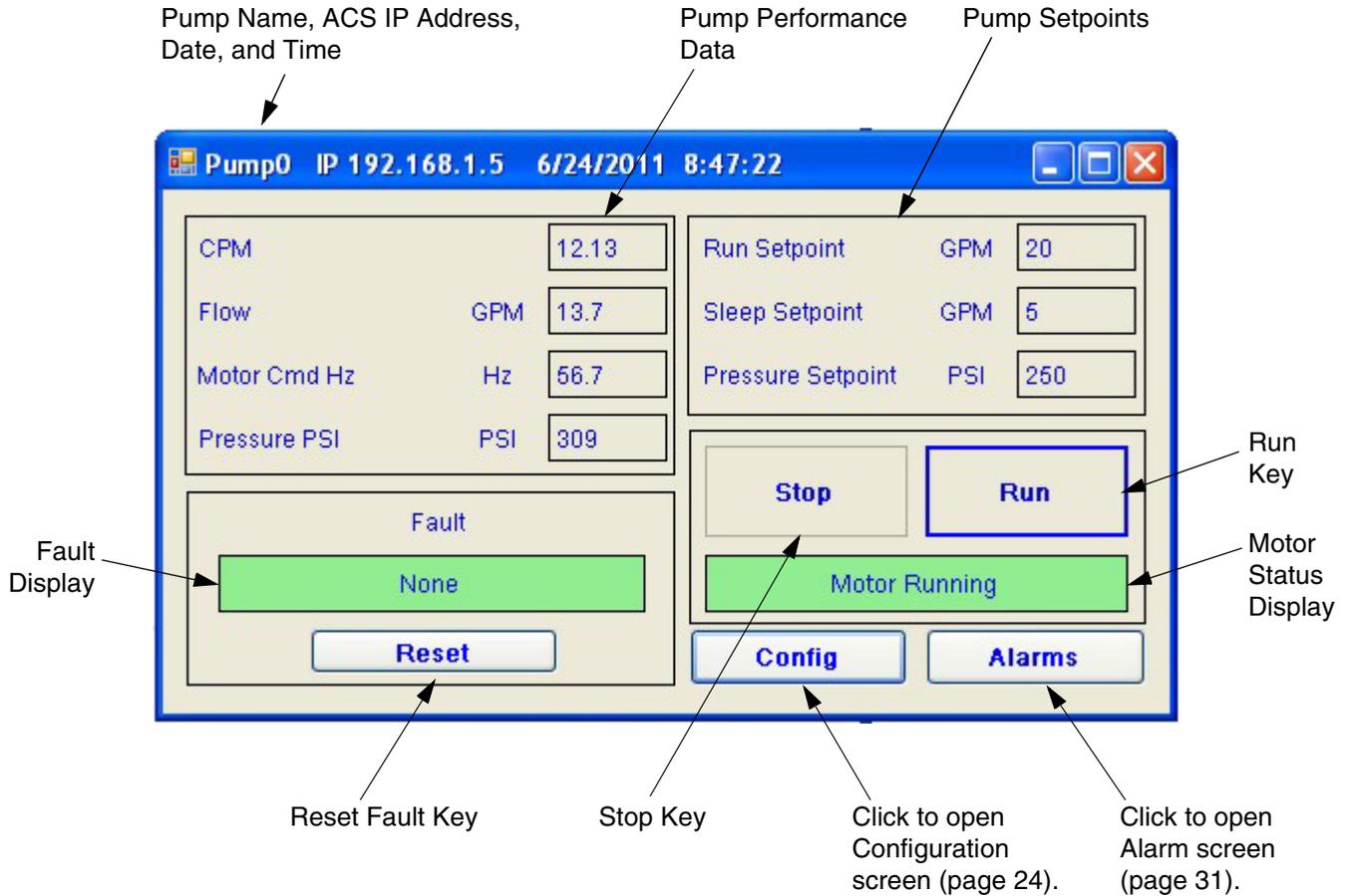


FIG. 14. Run Screen

# Configuration Screen

See FIG. 15. Use this screen to set the configuration for each pump.

The screenshot shows a web-based configuration interface for a pump. The window title is "Pump0 IP 192.168.1.5 9/2/2011 9:40:1". The interface is divided into several sections:

- Pump Parameters (see page 25):** Model (E-Flo 4000), Units (Metric), Control Mode (Flow), Pressure Setpoint (9.6 BAR), Pump Name (Pump0), Language (English).
- System Features (see page 27):** A list of checkboxes including Auto Decrement, Aux Relay On, CAM Mode (checked), Sensor Fault Override, Transducer Fault Override, Pressure Transducer Enable (checked), Sleep Enable, Run Setpoint (22.6 LPM), and Sleep Setpoint (11.3 LPM).
- Transducer Calibration (see page 28):** Cal High PSI (500), Cal Low PSI (0), Cal High mA (20.0), Cal Low mA (4.0), and a Set Clock button.
- Running Cycles:** Batch Total (314011) and Grand Total (563553) with Reset Batch and Reset GT buttons.
- Alarm Settings (see page 29):** Alarm Enable (BAR), Max Pressure (checked, 17.2), and Min Pressure (4.8).
- System Diagnostics (see page 30):** A vertical stack of buttons for Motor Running, ACS Heartbeat, Max Flow Warn, Min Flow Warn, Autosleep Input, Reset Input, TDC Sensor, Position Sensor, Aux Relay, Drive Enable Relay, and Transducer.
- Software Levels (see page 30):** ACS ID# (1), ACS Software Rev (4), and PC Software Rev (1.01.004).

Callouts with arrows point to these sections from the surrounding text:

- Pump Parameters (see page 25)
- System Features (see page 27)
- Run and Sleep Setpoints (see page 27)
- Reset Totals (see page 29)
- Alarm Settings (see page 29)
- Transducer Calibration (see page 28)
- Set the Clock (see page 28)
- System Diagnostics (see page 30)
- Software Levels (see page 30)

FIG. 15. Configuration Screen

## Set Pump Parameters

Model: E-Flo 4000  
 Units: English  
 Control Mode: Flow  
 Pressure Setpoint: 180 PSI  
 Pump Name: Pump0  
 Language: English

**FIG. 16. Pump Setup Fields**

### Select Pump Model

Click on the button to view the drop-down menu. Select the pump being controlled and monitored by the ACS module. See FIG. 17. The selection activates a flow rate setpoint range, based on the size of the pump selected.

**NOTE:** Changing the pump model will stop the pump.

Model: E-Flo 4000  
 Units: English  
 Control Mode: Flow  
 Pressure Setpoint: 180 PSI  
 Pump Name: Pump0  
 Language: English

**FIG. 17. Pump Model Drop-down Menu**

### Measurement Units

Click on the button to view the drop-down menu. Select the desired units of measure:

- US Units (gpm and psi)
- Metric Units (lpm and bar)

**NOTE:** Changing the measurement units will stop the pump.

Model: E-Flo 4000  
 Units: English  
 Control Mode: Flow  
 Pressure Setpoint: 180 PSI  
 Pump Name: Pump0  
 Language: English

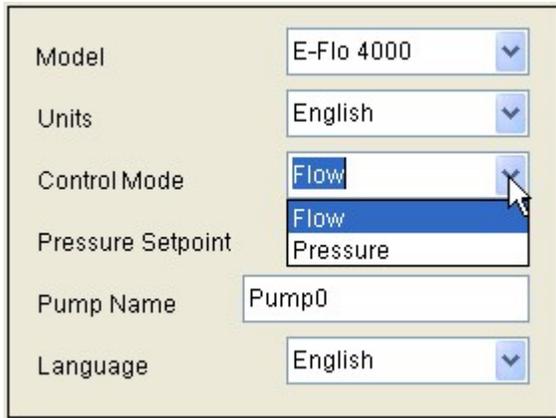
**FIG. 18. Units Drop-down Menu**

### Select Control Mode

Click on the  button to view the drop-down menu. Select the desired control mode:

- Flow (The pump will run at a constant flow rate)
- Pressure (This selection turns on Cam Mode and Pressure Transducer Enable, see page 27. The pump will make two revolutions before entering pressure control mode. The pump will vary speed/flow to maintain a constant pressure.)

**NOTE:** The Hz command will fluctuate in pressure mode or in flow mode if cam is enabled.



**FIG. 19. Control Mode Drop-down Menu**

### Select Pressure Setpoint

Click on the  button to raise or lower the setpoint, as desired.

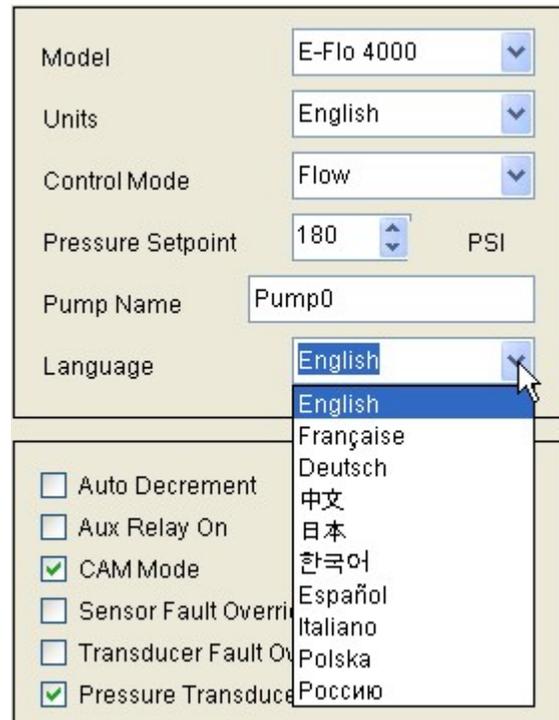
### Set Unique Pump Name

Input a unique name for each pump monitored by the ACS. The name may have up to 20 characters.

### Select Language

Click on the  button to view the drop-down menu. Select the desired language:

- English
- French
- German
- Chinese
- Japanese
- Korean
- Spanish
- Italian
- Polish
- Russian
- Swedish



**FIG. 20. Language Drop-down Menu**

## Select System Features

See FIG. 21.

### Auto Decrement

Auto Decrement helps extend pump life by operating the pump at the lowest speed necessary to maintain the selected pressure range. Auto Decrement is operable in pressure mode only. It reduces the flow rate incrementally by 1 Hz every 1 second until the Run Flow Setpoint is reached while still maintaining target pressure.

### Auxiliary Relay On

Enables peripherals such as a back pressure regulator.

### Cam Mode

Enables the Cam profile. If turned off, pressure mode is disabled.

### Sensor Fault Override

Check this box to allow the pump to continue to run if the TDC or Position sensors fail. The pump will run in flow mode.

### Transducer Fault Override

Under normal operation, the ACS will shut down the pump if the transducer fails. Selecting Transducer Fault Override bypasses that safeguard and allows the pump to continue to run. This selection cannot be made on this screen; it can only be selected through Modbus.

### Pressure Transducer Enable

Check this box if a pressure transducer is monitoring the pressure. This is automatically enabled if Pressure is selected as the Control Mode (see page 26).

<input type="checkbox"/>	Auto Decrement
<input type="checkbox"/>	Aux Relay On
<input checked="" type="checkbox"/>	CAM Mode
<input type="checkbox"/>	Sensor Fault Override
<input type="checkbox"/>	Transducer Fault Override
<input checked="" type="checkbox"/>	Pressure Transducer Enable

FIG. 21. System Features Menu

## Run and Sleep Setpoints

Check the Sleep Enable box to turn on the Sleep mode. Sleep mode will remain on until it is turned off.

Click on the button to raise or lower the setpoints, as desired. These values are expressed in gpm or lpm.

There are two setpoint fields:

- Run Setpoint sets the rate of the pump when it exits Sleep mode and enters Run mode.
- Sleep Setpoint sets the rate of the pump during Sleep mode.

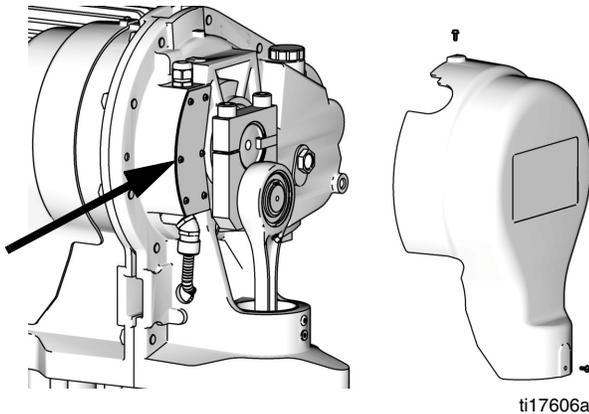
<input type="checkbox"/>	Sleep Enable	GPM
	Run Setpoint	11.1
	Sleep Setpoint	5.0

FIG. 22. Sleep Settings

### Calibrate the Transducer

**NOTE:** Only a 4-20 mA output transducer can be used with the ACS.

**NOTE:** Calibration values for a Graco transducer are listed on the label attached to the pump gearbox circuit board cover. See FIG. 23. For a non-Graco transducer, refer to the manufacturer's label or data sheet.



**FIG. 23. Calibration Label Location**

Enter the transducer calibration values where shown in FIG. 24, using the button to raise or lower the set-point, as desired.

After the values are entered, the ACS will perform the calibration.

Cal High PSI	<input type="text" value="500"/>
Cal Low PSI	<input type="text" value="0"/>
Cal High mA	<input type="text" value="20.0"/>
Cal Low mA	<input type="text" value="4.0"/>

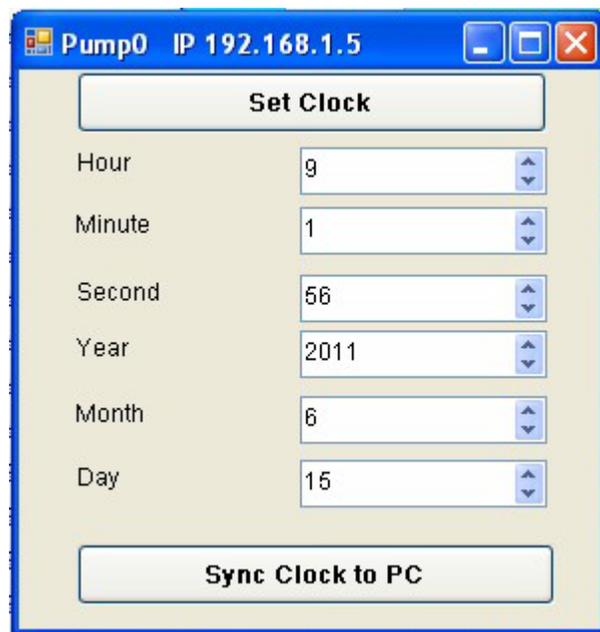
**FIG. 24. Calibration Values**

### Set the Clock

On the Configuration screen, click on

to access the clock screen (see FIG. 25). There are two methods to set the clock:

- To input the values yourself, use the buttons. Click on to enter.
- To synchronize the ACS clock with your PC, click on . All values will be loaded from the PC and the window will close.

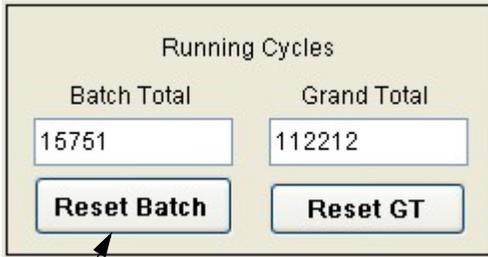


**FIG. 25. Set the Clock**

### Reset Totals

The screen displays the batch total and grand total cycles for each ACS module.

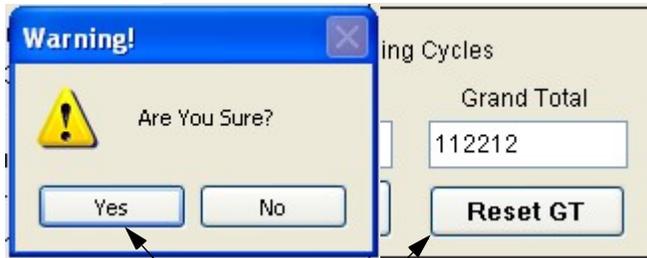
- To reset the batch total, click on **Reset Batch**.



Click to reset batch total

**FIG. 26. Reset Batch Total**

- To reset the grand total, click on **Reset GT**. You will be prompted to confirm the selection.

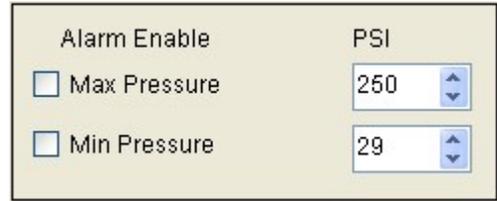


1. Click to reset grand total.
2. Click to confirm.

**FIG. 27. Reset Grand Total (GT)**

### Alarm Enable

There are two alarm pressure fields: Maximum Pressure and Minimum Pressure. Check the boxes to enable the alarms. Click on the buttons to raise or lower the pressure setpoints, as desired. These values are expressed in psi or bar.



**FIG. 28. Alarm Settings**

## System Diagnostic Indicators

See FIG. 29. The diagnostic indicators light under certain conditions, as detailed in the following paragraphs.

### Motor Running

Light is on steady when the motor is running.

### ACS Heartbeat

Light blinks when power is supplied to the ACS.

### Maximum Flow Warning

Lights if the maximum flow setpoint exceeds the pump's capability.

### Minimum Flow Warning

Lights if the flow rate in pressure mode is less than 80 percent of the Run Setpoint. The system reverts to flow mode at the Run Setpoint.

The system will return to pressure mode once the pressure has dropped back below 5% of the pressure setpoint for two cycles.

### Autosleep Input

Lights if a Sleep Enable input is received from the PLC. Closes the Auxiliary Relay.

### Reset Input

Lights if a Reset Fault input is received from the PLC.

### TDC Sensor

Status of the TDC (Top Dead Center) Sensor. The motor must be rotating for the system to detect the TDC Sensor.

### Position Sensor

Status of the Position Sensor. The motor must be rotating for the system to detect the Position Sensor.

**NOTE:** TDC and position sensor indicators will both be lit when the motor is moving and the ACS module is receiving proper signals.

### Auxiliary Relay

Lights if Auxiliary Relay is turned on (page 27).

### Drive Enable Relay

Lights if Drive Enable Relay is turned on.

### Transducer

Lights if the system detects a pressure transducer is present.

### ACS ID#

Automatic input (Modbus node number). Not editable.

### ACS Software Revision

Automatic input. Not editable.

### PC Software Revision

Automatic input. Not editable.

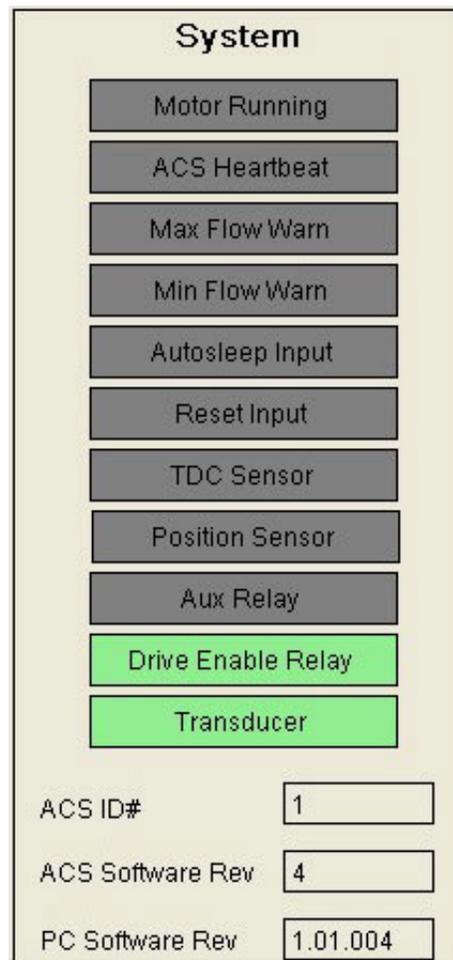


FIG. 29. System Diagnostic Indicators

# Alarms Screen

See FIG. 30. The Alarms screen logs the date, time, and description of each alarm.

See page 41 for descriptions and explanations of each alarm/warning.

Date MM/DD/YYYY	Time	Alarm Description
6/15/2011	8:53:39	Start Event
6/15/2011	8:52:36	Stop Event
6/15/2011	8:52:36	Xducer Fail
6/15/2011	8:50:20	Start Event
6/15/2011	8:50:19	Stop Event
6/15/2011	8:50:17	Start Event
6/15/2011	8:50:16	Stop Event
6/15/2011	8:50:14	Start Event
6/15/2011	8:50:13	Stop Event
6/15/2011	8:50:11	Start Event
6/15/2011	8:50:10	Stop Event
6/15/2011	8:50:7	Start Event
6/15/2011	8:50:5	Stop Event
6/15/2011	8:50:3	Start Event
6/15/2011	8:50:2	Stop Event
6/15/2011	8:50:0	Start Event
6/15/2011	8:49:59	Stop Event
6/15/2011	8:49:56	Start Event
6/15/2011	8:49:54	Stop Event
6/15/2011	8:49:52	Start Event
6/15/2011	8:49:52	Stop Event
6/15/2011	8:49:49	Start Event
6/15/2011	8:49:49	Stop Event
6/15/2011	8:49:47	Start Event

Click to refresh the screen.

**FIG. 30. ACS Alarms Screen**

# ACS Software Update

This process is required to load files to the Graco ACS module for an upgrade of the ACS application software. The process allows update of application software through the Ethernet port.

It is **critical** that the directions be followed in the correct order and with detail.

Required data and equipment:

- The Graco Firmware file will be loaded through the web browser. It will be 16J859G.CO5 (or a file of this format with a xxx.CO5 extension of a later version). This software is available at [www.graco.com](http://www.graco.com).
- Any PC/Laptop with an Ethernet port, and Mozilla Firefox web browser program preloaded (version 3.0 or higher). **Use only Mozilla Firefox.** Internet Explorer (IE) **will not** work properly.

1. Connect the ACS module Ethernet port to the PC/Laptop using an Ethernet cable.

**NOTE:** Some laptops will allow connections with or without a crossover cable. A standard Ethernet patch cord should work, but a crossover cable may be required depending on how your PC/Laptop is wired.

2. Set the Static IP Address on the PC/Laptop. Ensure the PC/Laptop network settings are configured for a static IP Address. The PC/Laptop should be set to the same network settings as the ACS module. The default ACS module IP is 192.168.1.5. Therefore set the static IP of the PC/Laptop to 192.168.1.XXX where XXX = 200 as an example. See FIG. 31.

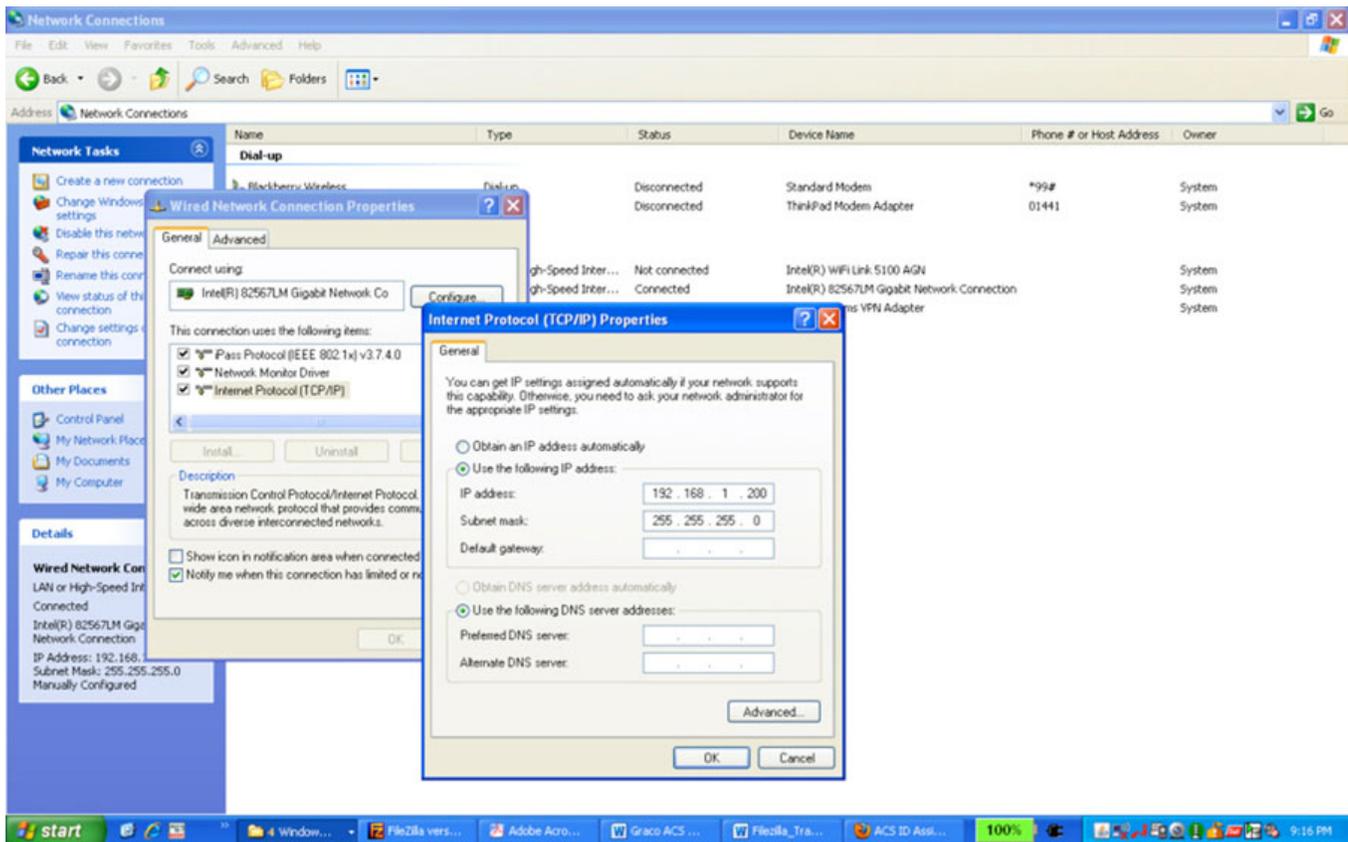


FIG. 31. Setting the Static IP Address on a PC or Laptop

- When the Digital Signature Verification window appears, click Run. Be sure that the “Always trust content from this publisher” box is **not** selected. See FIG. 32.

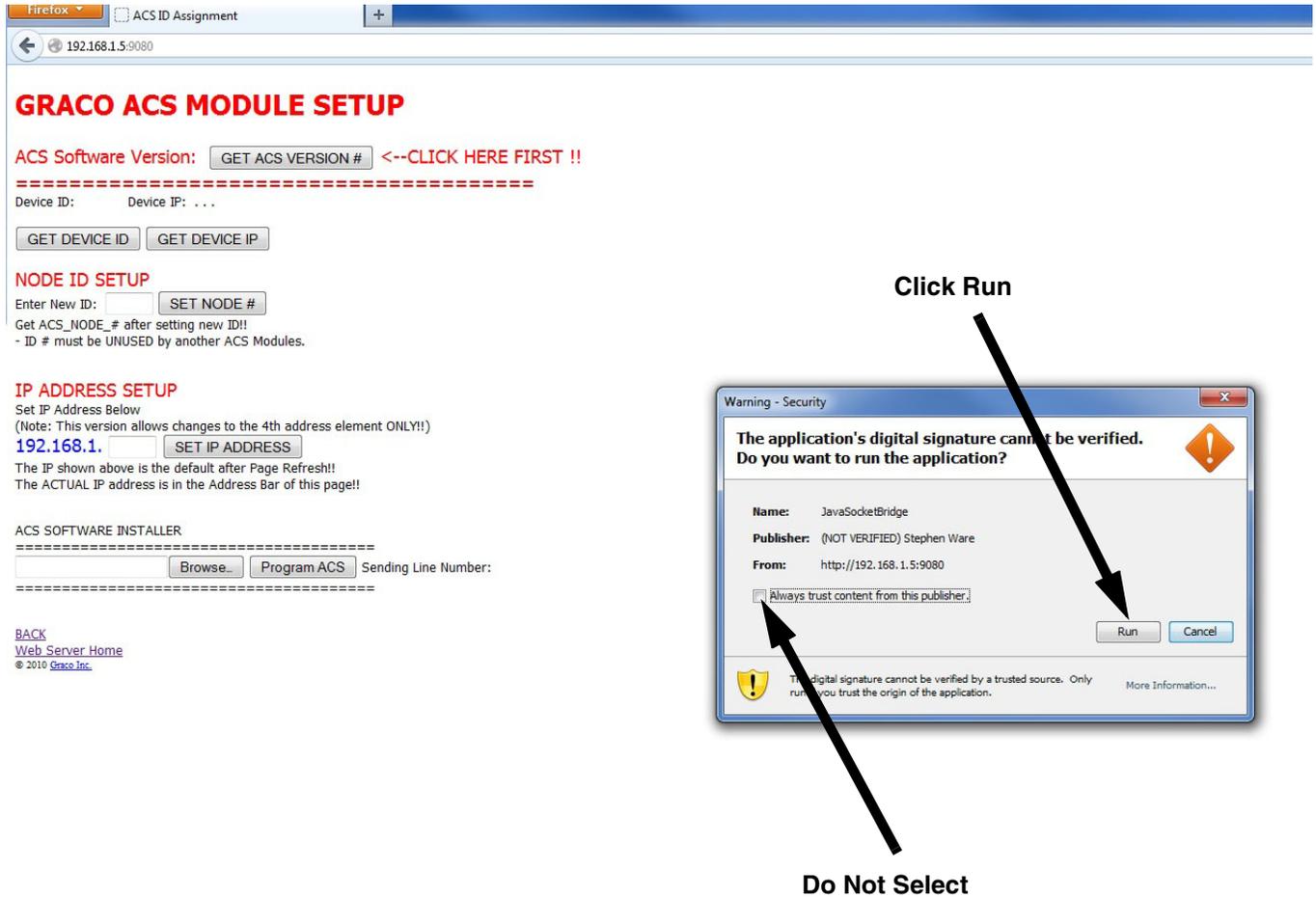
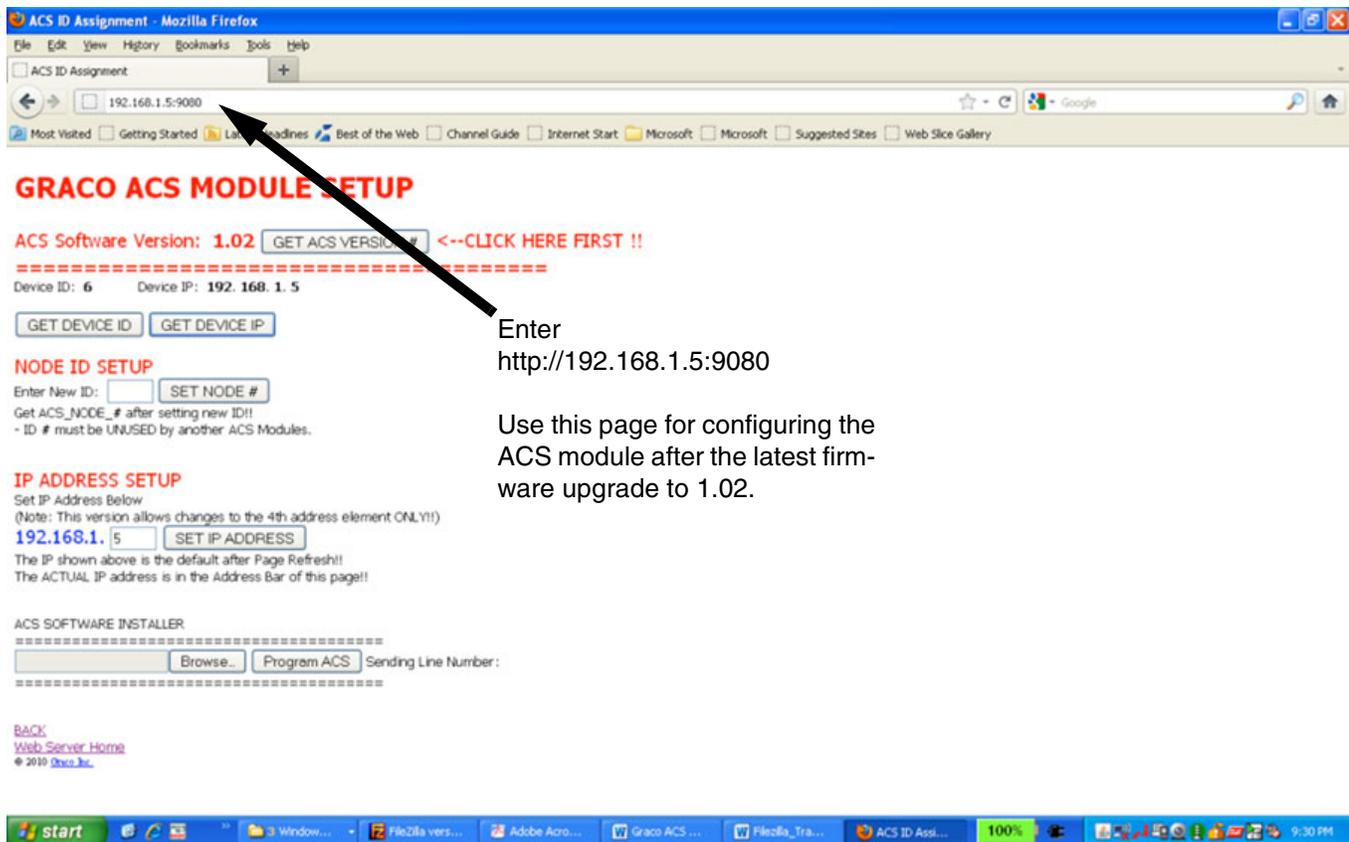


FIG. 32. Digital Signature Verification Window

4. Open Mozilla Firefox web browser. In the address bar enter: `http://192.168.1.5:9080`. See FIG. 33.

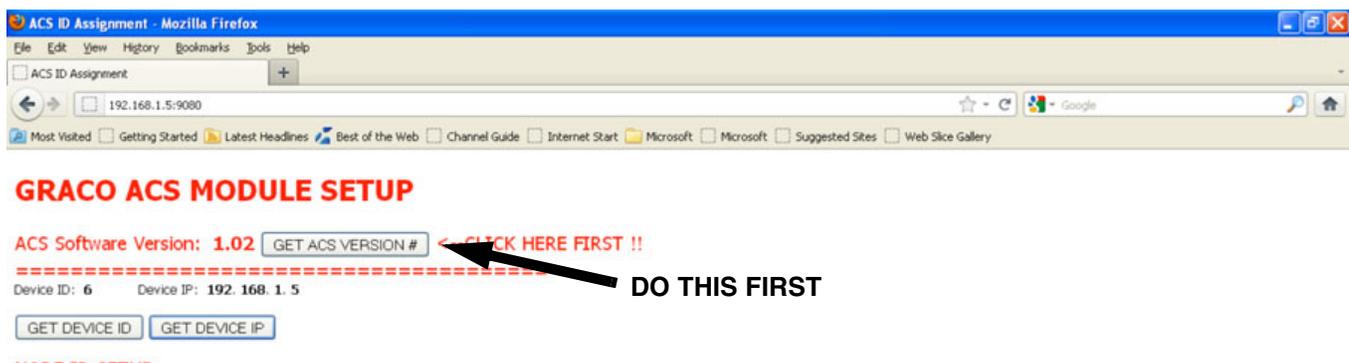


Enter  
`http://192.168.1.5:9080`

Use this page for configuring the ACS module after the latest firmware upgrade to 1.02.

FIG. 33. Standard ACS Module Setup Page

5. Click the **GET ACS VERSION #** button **first**. See FIG. 34.



DO THIS FIRST

FIG. 34. Get ACS Version # Button

6. Click the  button, then the  button. The Get Device ID and Get Device IP values **must** be populated on the page **before** installing the new ACS software. See FIG. 35.

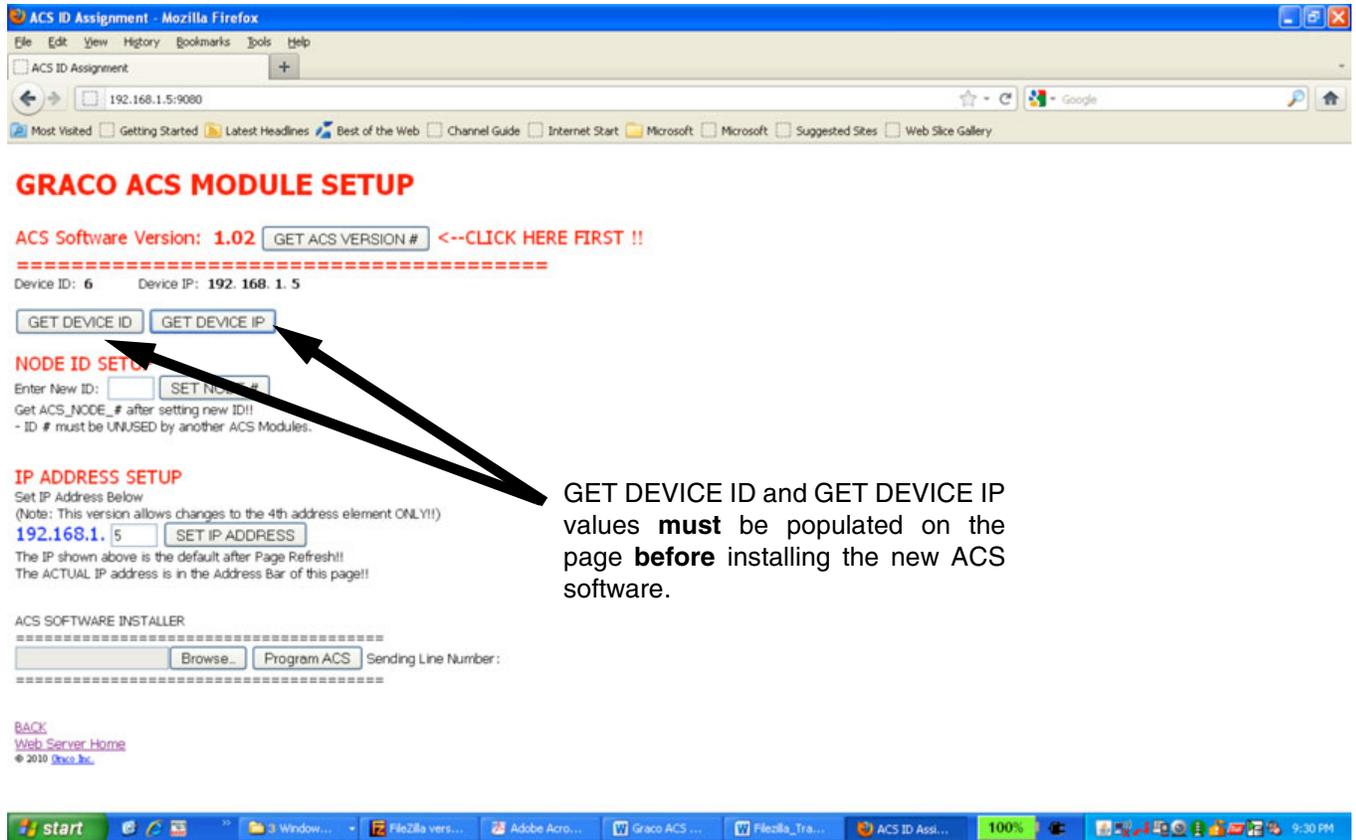


FIG. 35. Get Device ID and Get Device IP Buttons

- Click the **Browse...** button and navigate to the 16J859G.C05 (or later revision) file. Click the **Program ACS** button when the file link is loaded.

See FIG. 36.

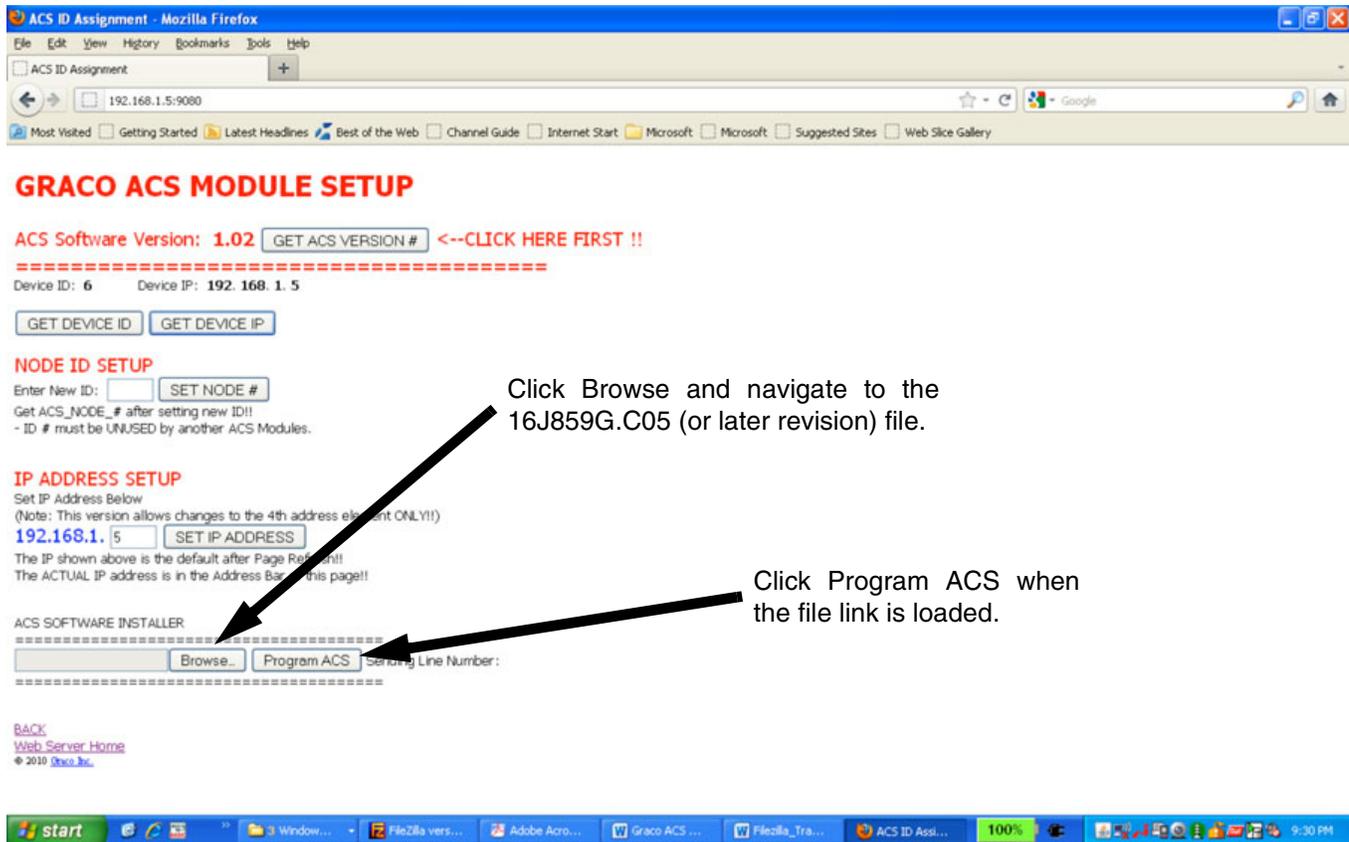


FIG. 36. Browse Button and Program ACS Button

- After performing steps 6 and 7, the screen will show window pop ups while the software is downloading to the ACS module. See FIG. 37.

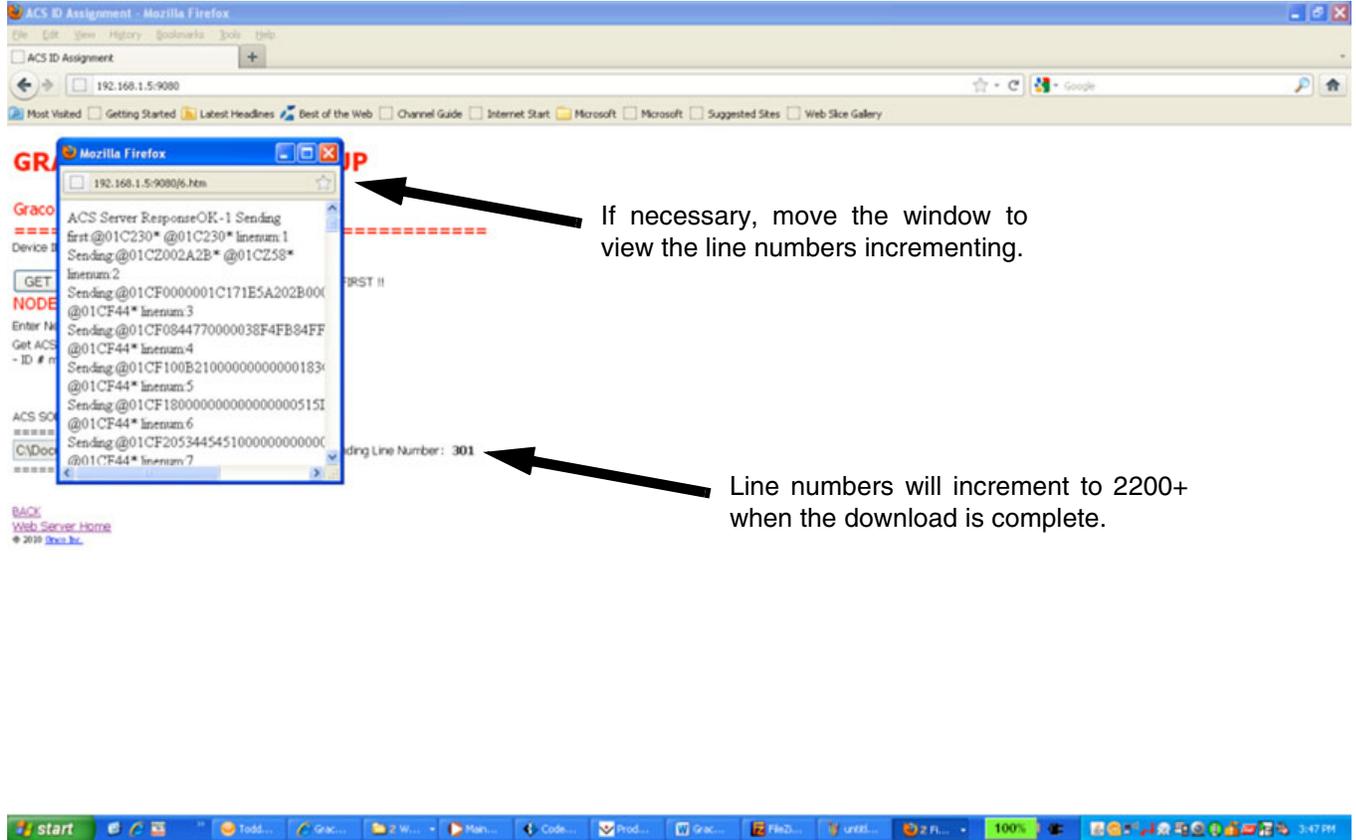
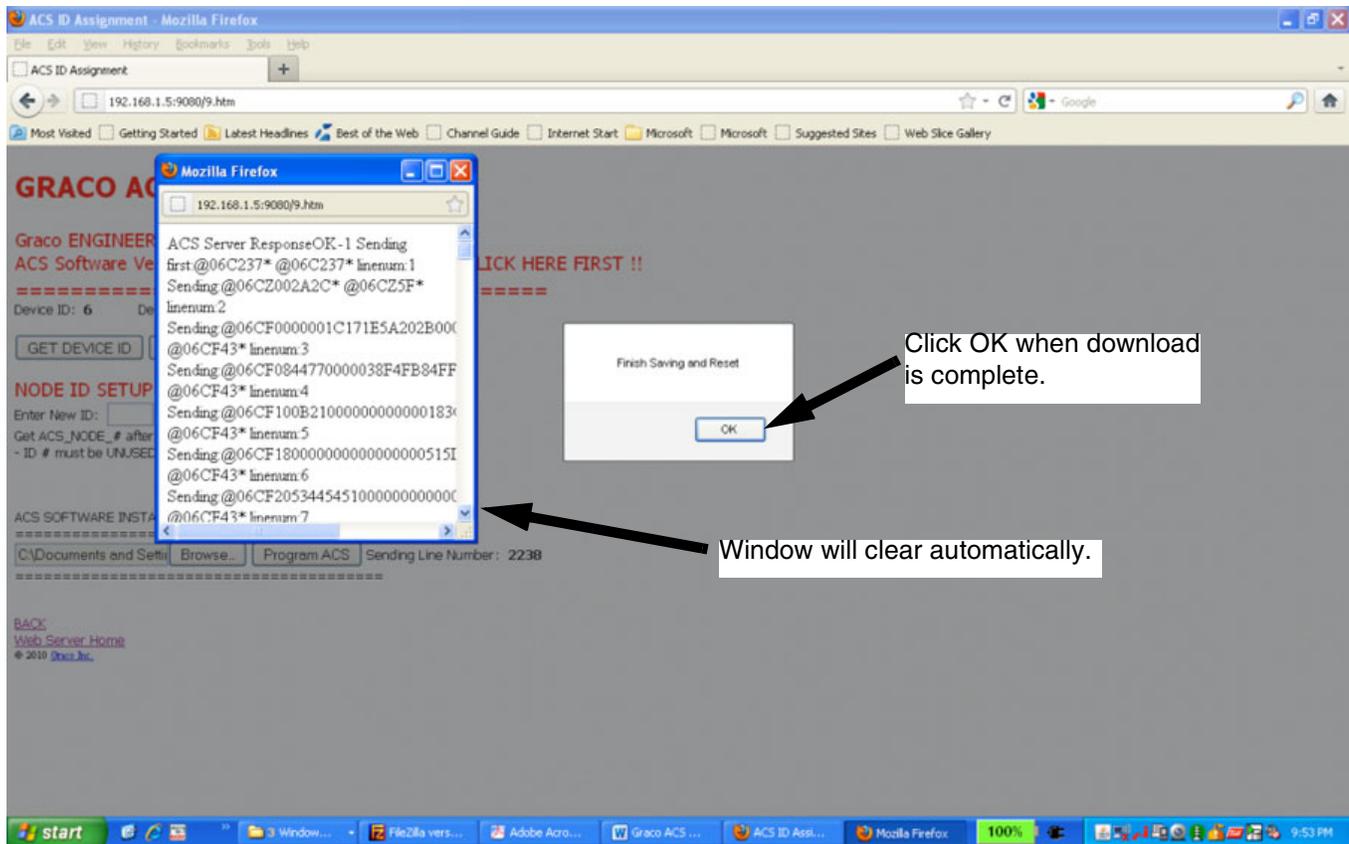


FIG. 37. Window Popup During Software Download

- Click OK when the download is complete. The popup window will clear automatically. See FIG. 37.



**FIG. 38. Click OK When Download is Complete**

**NOTE:** A new feature allows for setting of the default IP Address of "192.168.1.5" if you cannot remember the previous configured IP Address. To reset to the default IP Address:

- Power OFF the ACS Module.
- Activate the RESET INPUT (or short to ground/common) and HOLD.
- Power ON the ACS Module.
- Hold the RESET INPUT (pins 7-8 of input connector on ACS module) for 5 to 10 seconds, then remove the RESET INPUT (with power still applied).

- The IP Address has now been changed to 192.168.1.5, but the change will not take affect until power is cycled again.
- Cycle power to the ACS Module OFF then ON, to apply the change.

**NOTE:** The white power button on the ACS Module can be used to cycle power during this process. It is not necessary to unplug the 24 Vdc supply.

# ACS System Setup Checklist

## 1. Pressure Sensor Calibration

**NOTE:** Only a 4-20 mA output pressure transducer can be used with the ACS.

**NOTE:** Calibration values for a Graco transducer are listed on the label attached to the pump gearbox circuit board cover. See FIG. 23, page 28. For a non-Graco transducer, refer to the manufacturer's label or data sheet.

### NOTICE

Pressure sensor calibration information must be entered into the ACS control module. Failure to do so will result in Pressure Sensor Calibration Trip, nuisance trips, or system malfunctions.

## 2. Pump Lower Size Selection

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

## 3. Unit Selection

The defaults are psi and gpm.

**Table 4: Measurement Unit Summary**

Measurement	English	Metric
Pressure	psi	bar
Flow	gpm	lpm

## 4. User VFD Setup

**NOTE:** Each VFD brand will have varying setup parameters. ACS and E-Flo performance is optimized by the following key VFD settings:

- analog input scaling
- 4 mA = 0 (zero) Hz
- 20 mA = 80 Hz
- Acceleration rate = 1.0 sec (for full range 0-80 Hz)
- Deceleration rate = 0.5 sec (for full range 0-80 Hz)

**NOTE:** If the ACS is used with an E-Flo 1500 pump and a 3 HP motor, activating the VFD slip compensation feature may reduce motor heat and improve performance under certain conditions.

## 5. E-Flo Motor Specific Parameters

Verify that the parameters entered in the VFD match the motor parameters (rated voltage, maximum rated current limit, rated frequency, rated speed in rpm).

Other setting selections will be required to allow for the recognition of an analog speed command and motor ID match and limits.

Contact Graco for motor information and/or a list of locally supplied pre-approved motors.

# ACS Features

## Drive Active (System ON) Output

The output can be mapped to most of the parameters. The most common is Drive Enable. This relay output will be closed when ACS module is running. It is used as the Start or Run input to the VFD. It is **not** the Secure Disable input. See FIG. 4-FIG. 6 on pages 8-10 for further information.

## Back Pressure Regulator (BPR) Production/Sleep Modes

**NOTE:** See FIG. 4-FIG. 6 on pages 8-10 and manual 311606 for wiring and installation details.

## Flow Rate Monitoring

Table 5: E-Flo Pump Displacement 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

## 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 from Graco with two motors: the UL/CSA explosion-proof motor and the ATEX explosion-proof motor.

## Pressure Limits

If a pressure transducer is present, set the maximum pressure limits as shown in TABLE 6. See **Alarm Enable**, page 29.

Table 6: System Pressure Limits

E-Flo Model	Lower Size (cc)	Graco Motor		Non-Graco Motor	
		psi	bar	psi	bar
E-Flo 4000	2000	250	17	250	17
E-Flo 3000	1500	330	23	330	23
E-Flo 2000	1000	460	32	460	32
E-Flo 1500	750	425	29	500	35

# Diagnostic Procedures

The ACS module contains two diagnostic LEDs:

- **POWER ON:** Solid green when the ACS is powered and the pump is running.
- **DRIVE ENABLED:** ON (solid red) if the pump is stopped and the drive enabled relay is open. OFF if the pump is running and the drive enabled relay is closed.

**Table 7: Faults and Diagnostic Procedures**

Fault Description	Diagnostic
<b>High Pressure</b> (System pressure is higher than the entered high pressure trip point.)	<ol style="list-style-type: none"> <li>1. Check High Pressure Alarm setting. Verify that system desired operational pressure is lower than High Pressure Alarm setting.</li> <li>2. Check for flow restrictions (closed valves, unexpected restrictions).</li> <li>3. Check pump fluid section for proper operation (piston seals, ball checks). Refer to pump maintenance manual for additional information.</li> </ol>
<b>Low Pressure</b> (System pressure is lower than the entered low pressure trip point. This alarm is disabled for 1 minute after the pump starts to prevent premature alarms.)	<ol style="list-style-type: none"> <li>1. Check Low Pressure Alarm setting. Verify that system desired operational pressure is higher than Low Pressure Alarm setting.</li> <li>2. Check fluid level. Low fluid level will cause system to run at low pressure.</li> <li>3. Check fluid supply to the pump.</li> <li>4. Check pump fluid section for proper operation (piston seals, ball checks). Refer to pump maintenance manual for additional information.</li> </ol>
<b>Xducer Fail</b>	Loss of pressure transducer analog signal, cause by: <ul style="list-style-type: none"> <li>• wiring problem</li> <li>• pressure transducer failure</li> <li>• circuit board failure</li> <li>• EMF noise on the control cable</li> </ul>
<b>Max Flow</b> (The requested flow rate is beyond the pump's capability.)	Reduce the requested flow rate. (A 20 mA analog drive signal is the maximum.) <b>NOTE:</b> This trip is a Warning and will not shut off the pump.
<b>Min Flow</b> (The flow rate is too low for the Run Setpoint.)	Decrease the back pressure regulator pressure or increase the Pressure Setpoint. <b>NOTE:</b> This warning only occurs in pressure mode.
<b>Auto Cam Off (TDC/Position)</b>	Cam mode is not functional due to loss of TDC or position sensor signal (required for CAM operation). Verify wiring is shielded and installed correctly. See <b>Schematic Diagrams</b> , page 8.
<b>Start Event</b>	ACS has received a start command.
<b>Stop Event</b>	ACS has received a stop command.

Table 7: Faults and Diagnostic Procedures

Fault Description	Diagnostic
<p><b>No TDC Signal</b> (Top Dead Center Sensor is not detected, or motor is not able to develop torque, and therefore cannot put the pump into motion)</p>	<p><b>No TDC Signal:</b></p> <ol style="list-style-type: none"> <li>1. Verify that output shaft is turning.</li> <li>2. Check all of the wiring.</li> <li>3. Verify that sensor is operational. Remove PCB cover and monitor LED light on the 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.</li> </ol> <p><b>Stall:</b></p> <ol style="list-style-type: none"> <li>1. Relieve system pressure.</li> <li>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.</li> <li>3. Check the system control circuit wiring.</li> <li>4. Check that the motor is turning. If not, check motor wiring.</li> <li>5. Disconnect lowers and try running just the motor and gearbox.</li> </ol>
<p><b>No Position Sensor Signal</b> (Position Sensor is not detected, or motor is not able to develop torque, and therefore cannot put the pump into motion)</p>	<p><b>No Position Sensor Signal:</b></p> <ol style="list-style-type: none"> <li>1. Verify that output shaft is turning.</li> <li>2. Check all of the wiring.</li> <li>3. Verify that sensor is operational. Remove PCB cover and monitor LED light on the top of the sensor. The light should be normally on and it should be off for only short period of time when position is reached.</li> </ol> <p><b>Stall:</b></p> <ol style="list-style-type: none"> <li>1. Relieve system pressure.</li> <li>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.</li> <li>3. Check the system control circuit wiring.</li> <li>4. Check that the motor is turning. If not, check motor wiring.</li> <li>5. Disconnect lowers and try running just the motor and gearbox.</li> </ol>

# Technical Data

**Inputs**

- Power: ..... 20-30 Vdc, 200mA, reverse polarity protected
- Analog inputs: ..... 2 inputs for 4-20mA current loop sensing. Inputs protected from direct application of 24 Vdc.
- Digital inputs: ..... 4 inputs: TDC, Position Sensor, AutoSleep, and Reset. Digital inputs are 24V logic level NPN.

**Outputs**

- 4-20 mA loop:..... 2 channels, adjustable offset and span.
- Digital outputs:..... 2 open contact, normally open relay outputs, 24V, 1A, used for BPR control and Drive Enable.

**Communications** .....

1 Ethernet port and 1 RS485 port

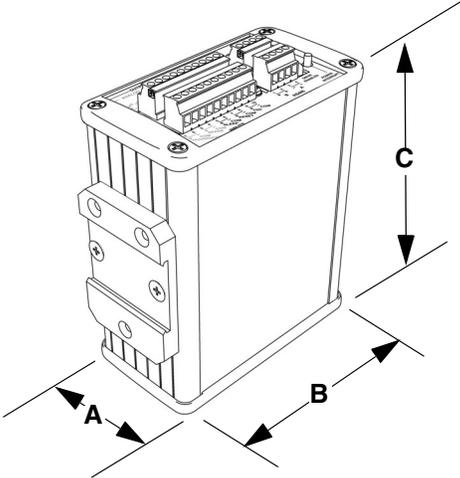
**Ambient Conditions**

- Operating temperature range..... 0-50°C (32-121°F)
- Operating humidity..... 10-90% relative humidity, non-condensing

# Dimensions

**ACS Module**

**NOTE:** Designed for DIN rail mounting.



ti17553a

Module	A	B	C	Weight
ACS	2.31 in. (59 mm)	4.49 in. (114 mm)	5.13 in. (130 mm)	1.1 lb (0.50 kg)

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Original instructions. This manual contains English. MM 3A0006

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