PC180 USER MANUAL

CHEMICAL MANAGEMENT SYSTEM

Approvals: Class I, Division I, Groups C and D; Class I, Zone 0, Ex/AEx ia [ia] IIB

Modbus is a trademark of Modicon, Inc. | Manual content copyright © 2015 Extreme Telematics Corporation. All Rights Reserved.

Ver 3.1.2 10/07/15

The PC180 Chemical Management System (CMS) is an electronic control and monitoring system designed to augment chemical injection pumps found in oil and gas fields. This system helps reduce the amount of waste during the chemical injection process. The PC180 calculates and manages an optimal chemical injection cycle for the desired injection rate.

1 | Introduction 2

1.1 | Purpose 3
1.2 | Overview 3

2 | Installation 4

2.1 | Mounting 5
2.2 | Gas Connections 6
2.3 | Grounding 7
2.4 | Electrical Connections 8

3 | Controller Overview 12

3.1 | Start Up 13
3.2 | Display 13
3.3 | Keypad 14
3.4 | Home Screen 17
3.5 | Status Screens 18

4 | Controller Operation 20

4.1 | Battery Monitor 21
4.2 | Controller Configurations 22
4.3 | Digital Outputs 34

5 | Menu Reference 36

5.1 | Hot Key Menus 37
5.2 | Install Menu 40

6 | Modbus Communications 52

7 | Troubleshooting 54

8 | Support 56

8.1 | Software Upgrade 57
8.2 | Replacement Parts and Accessories 59
8.3 | Technical Support 60

9 | Acronyms 62

1 | Introduction

1.1 | Purpose

This manual is intended to provide all of the information required to set up and operate the PC180 Chemical Management System. It also covers basic troubleshooting techniques and support information.

Assumptions

The following assumptions have been made when writing this manual:

- The reader has some knowledge of the operation of a oil/gas well.
- A controller or installed simulator is available as a reference while reading this manual.

1.2 | Overview

The PC180 Chemical Management System is designed to control the amount of chemical being injected by a conventional chemical injection pump.

In addition, the controller can be accessed remotely using the provided Modbus compatible RS485 communications port.

2 | Installation

2.1 | Mounting

Each controller is supplied with a universal mounting bracket. This bracket is designed to keep the controller away from other surfaces so that the vent can be properly routed. As well, it provides a number of different mounting configurations to meet any application.

Mount the bracket to the desired surface securely and then attach the controller to the bracket. Studs have been pre-pressed into the four corners to make attaching the controller simple.

Figure 1 - Universal Mounting Bracket

Wall/Stud Mount

The universal mounting bracket includes nine holes that can be used for mounting to a wall or stud. To mount to a vertical stud, use three of the vertically aligned holes. For mounting to a horizontal stud, use one of the three horizontally aligned holes.

Pipe Mount

The long slots that run horizontally are intended for mounting to a vertical pipe, while the vertical slots are intended for mounting to a horizontal pipe. Use the appropriate set of slots to secure the mounting bracket with U-bolts and pipe clamps.

Valve Mount

Wider, shorter slots are provided along the bend to allow the bracket to be secured to a pneumatic valve. Remove 2 adjacent bolts from the top of the valve. Place the bracket over the holes and push the bolts through the bracket and valve, fastening them again.

2.2 | Gas Connections

Each solenoid has 3 different connections which must be connected properly in order for the controller to operate the valve.

Supply

The supply side of the solenoid can be identified by the "IN" marking that is stamped on the body. A 90 degree elbow has been pre-installed to make it easier to terminate in the field.

Clean supply gas must be supplied in order to operate the valve. The solenoid is designed to work up to 60 psi, but will operate at lower pressures.

Dual valve assemblies are constructed so that the supply ports of the two solenoids are facing towards each other and are attached with a tee. Although two separate solenoids will perform the same function, a single supply connection makes installation simpler.

Valve

The valve side of the solenoid can be identified by the "CYL" marking that is stamped on the body. A 90 degree elbow has been pre-installed to make it easier to terminate in the field.

Vent

The vent faces towards the back of the enclosure and is threaded so that the appropriate fittings can be attached. The vent should be routed according to the appropriate local regulations.

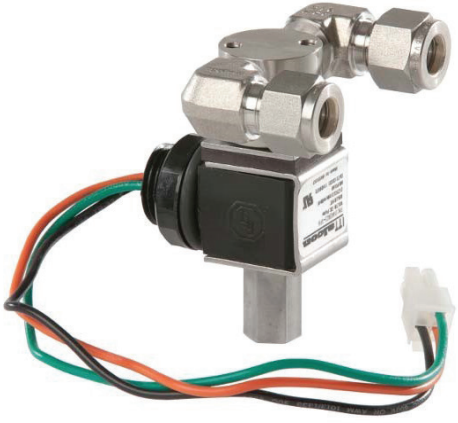

Figure 2 - Valve Solenoid

2.3 | Grounding

The controller is designed so that the circuit board is isolated from the enclosure and mounting hardware. This allows stray voltages to be routed away from the electronics through a ground point. If connected correctly, there is less chance of damage to the controller in the event of an electrical disruption.

A ground lug is provided on the bottom left corner of the enclosure. It is designed to fit up to 4 AWG wire. The enclosure should be grounded according to the appropriate local regulations.

2.4 | Electrical Connections

The following is an outline of the locations that devices can be wired to. All connected devices must meet the entity parameters found in the ET-12001-1012-0000 Control Drawing.

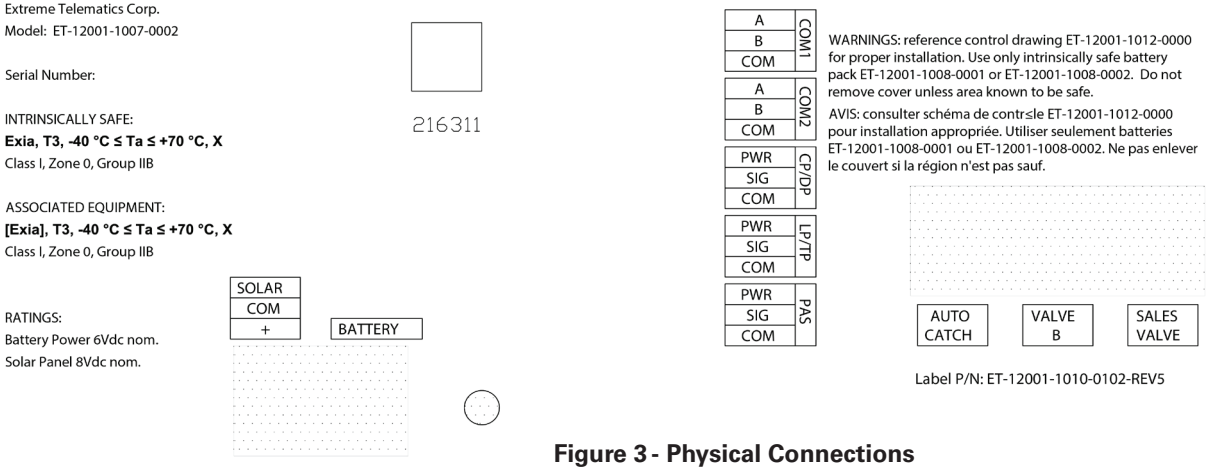

Figure 3 - Physical Connections

The PC180 has a maximum of 3 solenoids and has support for a Line Pressure (LP) and Modbus Communications (COM1).

The following table outlines all of the available connections.

Table 1 - Electrical Connections Summary

Location	*Devices To Connect*	*Ratings**	*Description*
Solar	Solar Panel		Use only a 1.1 W Profire Solar Panel.
Battery	6 V Battery		Use only a 6 V intrinsically safe Profire battery.
Sales Valve	Pump 1 Solenoid		Use only an intrinsically safe Profire approved solenoid.

Location	Devices To Connect	Ratings*	Description
Valve B	Pump 2 Solenoid		Use only an intrinsically safe Profire approved solenoid.
Auto Catch	Pump 3 Solenoid		Use only an intrinsically safe Profire approved solenoid.
PAS (Digital Input)	Pressure Switch		Connect a 2 wire switch to COM/SIG to use the Pump Pulse monitoring system.
LP (Analog 1 Input) DO1 (Digital 1 Output)	Pressure Switch/Sensor, Pump Pulse, Pump Output, Pump Pulse Alarm	SIG: Pressure Switch: 0V-6V Pressure Sensor: 0.5V-4.5V PWR: 5V, max 2.5mA**	Connect a 2 wire switch to COM/SIG or a 3 wire sensor to all three connections to use tank pressure features or connect a 2 wire switch COM/SIG to monitor Pump Pulses for Pump 2. Connect COM/PWR to use Digital Output 1
CP/DP (Analog 2 Input) DO2 (Digital 2 Output)	Pressure Switch/Sensor, Temperature Sensor, H2S Sensor, Pump Pulse, Pump Output, Pump Pulse Alarm	SIG: Pressure Switch: 0V-6V Pressure Sensor: 0.5V-4.5V Temp Sensor: 0.5V-4.5V H2S Sensor: 1V-5V PWR: 5V, max 2.5mA**	Connect a 2 wire switch to COM/SIG or a 3 wire sensor to all three connections to use line pressure features. Connect a 2 wire switch to COM/SIG to use the Aritificial Lift Injection Optimization. Connect a 3 wire temperature sensor to all three connections to use the Temperature optimization. Connect a 2 wire switch COM/SIG to monitor Pump Pulses for Pump 3. Connect a 2 wire H2S sensor to use H2S Injection Optimization.
COM 1	Differential RS485 device		Modbus slave connection / Upgrade Port.

* Control drawing entity parameters must be adhered to. In cases where this table and the control drawings are in conflict, the control drawing is to be considered as correct.

** PWR pins can provide up to 2.5 mA while still maintaining voltage within +/- 5%

Battery

Each controller is shipped with the battery disconnected to save the life of the battery and ensure that the product has enough energy to operate before requiring solar charge. Simply plug the pre-installed battery connector into the spot marked BATTERY. The connector is not field replaceable as it requires a special tool. The battery should be plugged in before connecting the solar panel.

Warning: Only Profire approved batteries can be used with this controller. Protective components must never be bypassed as it is unsafe to do so. Please refer to Replacement Parts and Accessories section for a full list of approved parts.

Solar Panel

The solar panel is optional, but will ensure that the battery is topped up and that operation of the controller is not interrupted due to a low battery condition.

1. Install the solar panel in a location where it will face the sun throughout the day.
2. Connect a pair of wires to the terminals on the solar panel.
3. Ensure that the battery is connected.
4. Connect the other end of the pair so that the minus (-) terminal on the solar panel is connected to the SOLAR COM input on the controller. Likewise, the plus (+) terminal on the solar panel must be connected to the SOLAR + input on the controller.

Figure 4 - Solar Panel

Warning: Only Profire approved solar panels can be used with this controller. Panels that operate at higher voltages or current are unsafe and cannot be used. Please refer to the Replacement Parts and Accessories section for a full list of approved parts.

Solenoids

Each solenoid is supplied with a pre-installed connector. The connector is not field replaceable as it requires a special tool.

Press each solenoid connector into either the Sales Valve, Valve B, or Auto Catch until you hear it click. Every solenoid is the same, so it does not matter which one is plugged into a particular socket.

Warning: Only Profire approved solenoids can be used with this controller. Using any other solenoid or extending the solenoid wires is unsafe. Please refer to the Replacement Parts and Accessories section for a full list of approved parts.

Transducer Inputs

Depending on the model, the controller comes with two or three inputs. These inputs are physically the same and support either two or three wire devices. Two wire devices only use the COM and SIG inputs, while three wire devices make use of the PWR output as well.

The PWR output will provide a regulated 5 V output that is used to power the attached device. This output is only turned on for a short duration while the sensor is being sampled, so measuring the power is not possible. If a digital output is enabled, the corresponding PWR pin is no longer available to power a transducer. As well, the SIG input is expecting to see an input of 0.5 – 4.5 V for pressure transducer types, which is translated to the appropriate value by the controller.

When Analog Input 2 is configured to use a temperature sensor, the input range of 0.5V- 4.5V is translated to-10°C- 30°C. When Analog Input 2 is configured to use an H2S sensor, the input range of 0.5V- 4.5V is translated to 0 to 10 ppm.

Whenever the input voltage goes outside of the expected range, the controller will display an up or down arrow to indicate and over-range/under-range condition. The system may not operate as expected when there is an over-range/under-range condition.

It is recommended that you only use transducer devices recommended by Profire Energy to ensure proper operation.

COM Ports

Each controller is equipped with one communications (COM) port. COM ports are designed to communicate with Modbus devices.

COM1 is disabled by default, but operates as a Modbus Slave when enabled. When enabled, all of the communication settings for this port are made visible and can be configured by the installer. In general, the communication settings must be configured to match the settings of the Modbus Master. This will allow the master to poll the controller as a slave to retrieve operational data.

As well, the master may also write data to the controller to change settings or to change the controller's state.

Please refer to your local regulations to determine if an intrinsic safety barrier is required. This typically is the case if the communications modem is located in a less hazardous area.

3 | Controller Overview

3.1 | Start Up

On power up, the controller is initialized by performing the following operations:

- Load all previously saved values
- Close all valves
- Turn on the display
- Set the display to show the current controller state as the latest device status information.

The controller automatically enters the Inject state when powering up and begins counting down.

3.2 | Display

A Vacuum Fluorescent Display (VFD) is provided which consists of 2 lines x 16 characters. Each character is a 5x7 dot matrix with a full underline bar. The display is partitioned into 2 areas with an unused column between them for spacing.

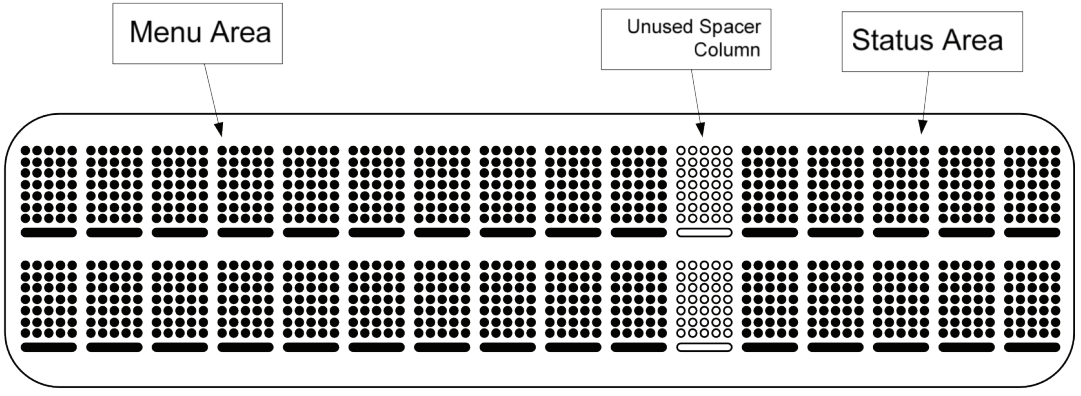

Figure 5 - Screen Layout

Menu Area

The content of the Menu Area (2 x 10 characters) shows the current state of the controller on start up. This area will change based on user keypad interaction. The current state information as well as the setup menu is available in this area.

Status Area

The Status Area (2 x 5 characters) constantly rotates through all enabled inputs and outputs. By default, this includes the battery voltage as well as the state of the Sales Valve. As other options are enabled on the controller, additional information becomes available in this same area. For example, Valve B will be displayed if it has been enabled. If pressure devices such as line pressure and tank pressure are enabled, their current value will also be displayed.

Automatic Shut Off

To conserve power, the display will automatically go to sleep if a key press has not been detected in the previous 30 seconds. This time can be modified by the user.

Automatic Log Out

If security is enabled, the active user will be automatically logged out if a key press has not been detected in the previous 10 minutes. This time can be modified by the user.

3.3 | Keypad

An integrated keypad is included which allows the user to change settings, navigate through history, and control injection rates.

The navigation and numeric keys are overlapped to provide both sets of functionality on fewer keys. The controller automatically knows what function to use based on the current controller display. When in the menus, the arrow keys are used. When editing a numeric screen, the same keys are interpreted as their numerical equivalent.

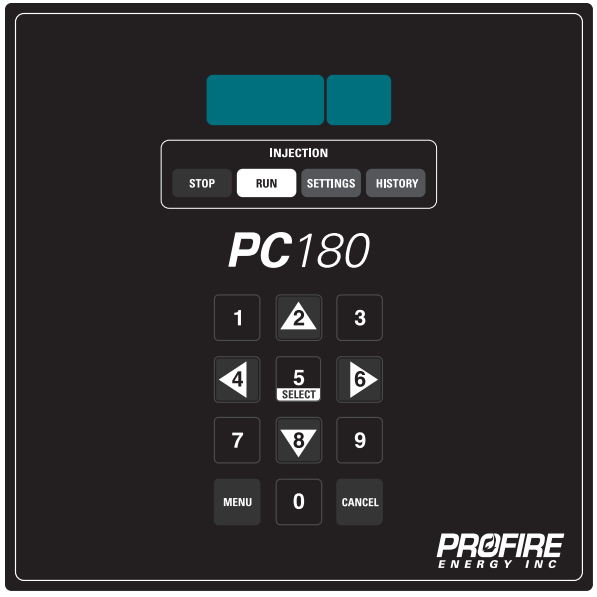

Figure 6 – Keypad Layout

Navigation Keys

The navigation keys are used to move through the menus in the controller and select items from lists.

- Select is used to enter a sub-menu, select a field to be edited, or save changes made while editing a field.
- Cancel is used to back up through the menu levels or to cancel editing a value.
- The arrow keys allow the user to move up/down and left/right in the menu. If the display is on a line that has a sub menu associated with it, pressing "Right" will enter the sub menu. Conversely, pressing the "Left" arrow will go back one level of menu depth. If a field can be edited the "Right" arrow will put the controller into edit mode. If a numeric value is being edited, the arrow keys will act as their numeric value instead.

Numeric Keys

The numeric keys are used to input new values for numeric fields. Examples include entering new pump rates, target rates and pressures. If a numeric field is not currently being edited, then the number keys are ignored.

Hot Keys

The hot keys are provided to take the user to special menus or provide instant action.

- Pressing stop will send the controller to the Inject Hold state, putting the controller in a perpetual state of injection. If the stop key is held down for 3 seconds, the controller will enter the Recycle Hold state, putting the controller in a perpetual state of recycle.
- Pressing run will start the Injection Management program, starting with the injection portion of the cycle.
- The settings key navigates to where pump rate, target rate, injection pressure and fine tune inputs are located.
- The history key navigates to a special menu that shows information about the recent operation of the Injection Management controller. This information is broken into cycle information, daily cycle and cycle log.
- The menu key navigates to the install menu, where the user is required to login. The default login is 000-0000. Once logged in, a number of sub menus are available.

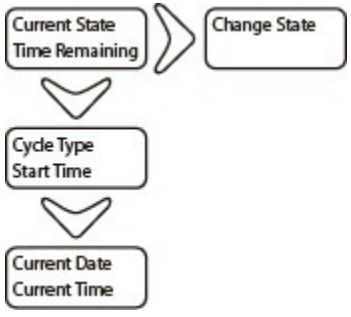

Figure 7 - Install Menu

See the Install Menu section for more detail.

3.4 | Home Screen

As soon as the controller powers on, if the user presses stop/run, or if the user presses cancel to back out of the menus, the home screen will appear on the display. By default, this shows the current state of the controller and the time remaining until it switches state. As well, there are a number of screens available at this same level that show more detailed information.

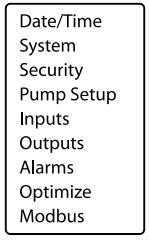

Figure 8 – Home Screen Structure

Scrolling down from the home screen will take you through a number of other screens. Information such as the cycle type, start time, and the current date/time are displayed here. Pressing select or the right arrow will take you to a screen that allows you to force the controller to change states.

Current State

This screen is shown by default when the controller is powered up. It shows the current part of the cycle that the controller and a timer that indicates when the state will change.

Cycle Information

This screen shows the information for the last cycle. This includes the type of cycle (OK, Low Battery, Operator, etc…) as well as the time that the cycle started.

Current Date/Time

This screen simply shows the current date and time. If this information is incorrect, the user must login and change the date and time in the Date/Time menu. The date and time is reset back to January 1, 2000 when the battery is disconnected.

Change State

The controller can be manually forced into the Inject or Recycle state by performing a manual state change. The controller will enter the selected state for a length of time (up to 200 days) set by the user in this screen. This will perform the same operation on all pumps. Once the timer expires, the controller will go back to Inject and resume normal operation.

3.5 | Status Screens

When active, the display will automatically update the status area on the right hand side of the display. The information shown is a summary of the current operation of the controller.

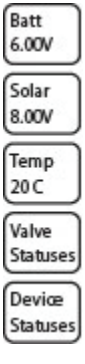

Figure 9 - Status Screens

Battery Status

This screen shows the current battery voltage with the solar charger disconnected so that it does not influence the reading. A battery level indicator is also shown in the top right hand corner to show how full the battery is. If the battery is currently being charged, a lightning bolt is shown instead of the battery indicator.

Solar Status

This shows the current voltage as seen on the solar panel input. The charger is disconnected during this reading so that it is not influenced by the battery.

Temperature Status

This shows the temperature used by the controller for any optimization. It can be the internal temperature sensor with an offset applied or a temperature written from an external Modbus master.

Valve Status

Each enabled valve is shown on these screens. The screen shows whether the valve is currently set to recycle (open) or inject (closed).

Device Statuses

If the tank or line pressure is enabled it is shown on this screen.

4 | Controller Operation

The controller configuration can be accessed in two different ways:

- Through the menu using the display and keypad
- Using Modbus over the RS485 communications port.

The PC180 Modbus Communications User's Guide discusses everything from physical connection to data format and access. As such, the Modbus communications interface will not be discussed further in this manual.

When the controller starts up, all valves are closed and the controller is put into the Inject state. The injection timer starts decrementing. Once this timer has expired, the controller decides what action to take based on the controller configuration.

4.1 | Battery Monitor

The controller samples the battery every 10 minutes, monitoring the voltage in order to prevent unpredictable valve operation. The battery voltage is reported as one of the following:

- Normal: The controller behaves normally. If 6 successive battery samples are below 5.5 V, the controller closes all valves and enters the Low state. A low battery alarm condition is recorded, which is reported in the history.
- Low: If 6 successive samples are above 6.0 V, the controller enters the Normal state. When entering the Normal state, the controller will restart to the Close state for a duration specified by the Close Time parameter.

During power on or reset, and before any valves are opened, the battery voltage is sampled. The Normal or Low state is entered based upon this sample.

Low Battery

The controller is designed to handle a number of failure conditions, most of which have already been discussed. If the controller senses that the battery is low, it will take action to ensure that the valve(s) are left in a known state. When a low battery condition has occurred, the controller will actuate the valve(s) and go into the Stopped state. The controller will remain in this state until the battery has recovered or an operator has intervened.

The state that the valve is placed in when a low battery condition occurs is based on the Low Battery Fail Mode parameter that is found in the Alarms menu.

4.2 | Controller Configurations

The following sections describe the various ways that the controller can be configured. The configuration may be changed by modifying the parameters that are available through the user interface screens outlined in the preceding sections.

Stopping the Controller

If you wish to stop the controller and hold the valves in a specific configuration for maintenance, during installation, or at any other time, pressing the stop button or pressing and holding the stop button for 3 consecutive seconds will send the controller to stop.

While stopped, the controller will count up to show how long the controller has been stopped for. Whenever stopped, all pumps will both be put into the same mode. If another configuration is required, each enabled valve can be toggled in the Menu>Outputs menu.

When you are ready to go back to normal operation, press the run button. This will ensure that all pumps start injecting and the controller returns to normal operation. As the controller operates, valves will be opened or closed as needed.

NOTE: Valves that had their state changed manually may not be in the right position since a valve is expected to be in a certain position when Inject or Recycle starts.

Stop Hold Inject: Enter the Stop Hold Inject state by pressing stop. All pumps will perpetually inject.

Stop Hold Recycle: Enter the Stop Hold Recycle state by pressing and holding stop for 3 consecutive seconds. All pumps will perpetually recycle.

Single Pump Injection

The controller is designed to control the chemical injection process for a single pump in the most basic configuration.

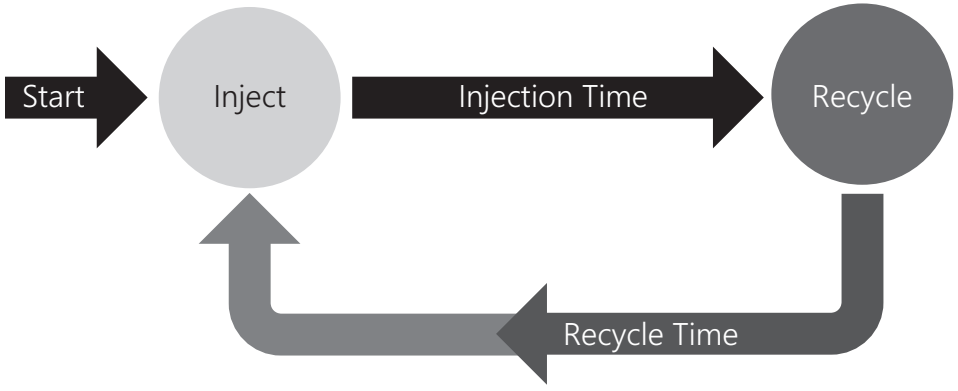

Figure 10 – Single Pump Injection

In this configuration, the valve is opened and closed based on internal calculations that are derived from the pump rate, target rate, pressure, cycle time, and fine tune time. The calculated Injection Time and Recycle Time are used to determine when to open and close the valve.

At the start of the cycle, the valve is closed and the Injection Time is started. When the Injection Time expires the controller moves to Recycle and the Recycle Time is started. Once this timer expires, the controller moves back to Inject and the valve is closed, restarting the cycle.

Multiple Pump Injection

When operating a second or third pump, the same cycle time is used for both pumps, but each valve is controlled independently so that they can each maintain a different desired rate.

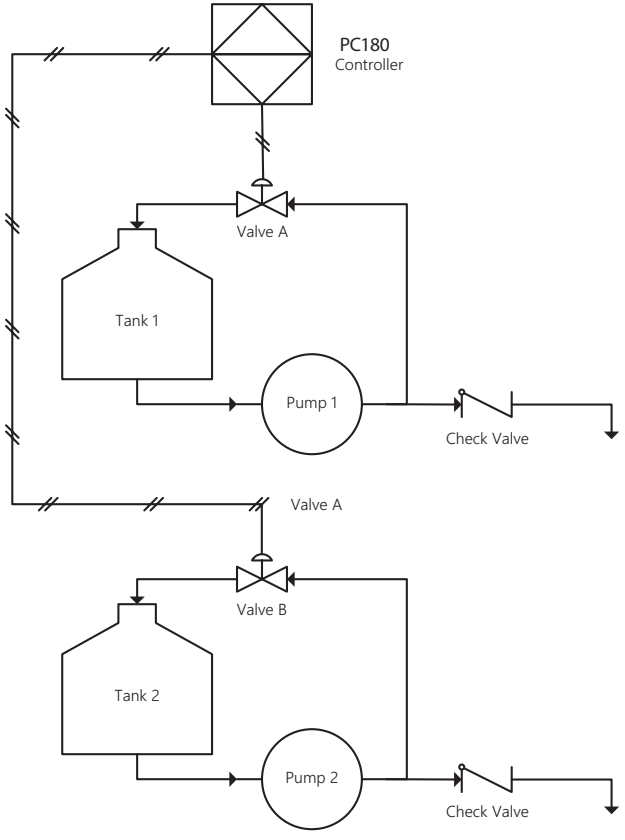

Figure 11 – Dual Pump Injection

As illustrated below for dual pump operation, both pumps are set to start injection at the same time, but they switch from inject to recycle independently. In this case, the injection time for pump 2 is less than that of pump 1.

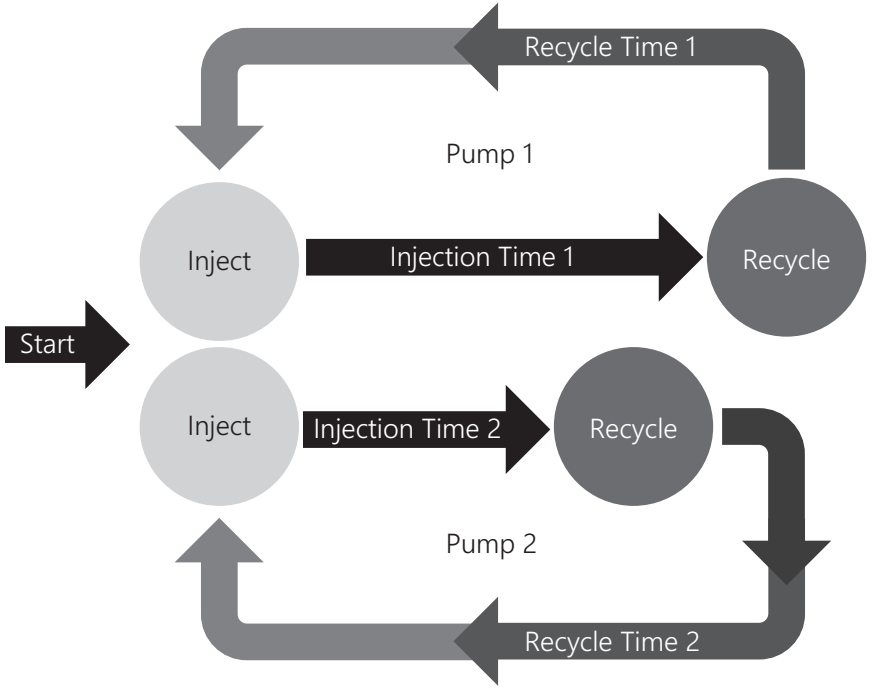

Figure 12 – Dual Pump Controller States

Perpetual Inject

Press the stop button and the controller will stop operation until the run button is pressed. The controller is configured to inject by default when the controller is stopped. The counter on the screen shows how long the controller has been stopped.

Perpetual Recycle

The controller can also be stopped in a perpetual state of recycle. To achieve this, press and hold the stop button for 3 seconds. The controller is still stopped and a counter on the screen indicates the time it has been stopped for, but the pump is set to perpetually recycle.

Pump Pulse Sensor (PPS)

A PPS switch is used to count each pump's pulses (the number of strokes each pump has made). When a switch is connected to the appropriate pumps PPS input the controller increments the count each time it detects a switch trip from the PPS. The controller counts each pump's pulses separately and the count is used to update the cycle log with the total number of pulses that occurred during each cycle. The controller also updates the daily logs with the total number of pulses that occurred.

Pump Pulse Sensor Alarm

The controller can monitor all pump pulse sensors and generate an alarm signal when any senor has not detect a pump pulse for a certain number of cycles. In an alarm condition the controller will continue to inject. This alarm can be configured in the Alarms menu.

Line Pressure

The well may be equipped with a line pressure switch or sensor. This device simply allows for the monitoring and reporting of line pressure so that it can be watched or trended to ensure that the pump is in fact pushing chemical into process.

High Line Pressure Alarm

When a line pressure switch is used the controller can monitor the state of the switch to determine if the pump is injecting chemicals. When the switch trips the controller will force the pump into the Recycle state. The controller will remain in the Recycle state until the switch resets. This alarm can be configured in the Alarms menu.

Tank Pressure

The well may be equipped with a tank pressure switch or sensor. This device simply allows for the monitoring and reporting of tank pressure so that it can be watched or trended.

Temperature Optimization

The PC180 has an advanced temperature optimization feature that will auto adjust the Target Rate for a given pump. This allows the pump rate to be automatically adjusted for chemicals such as Methanol that should be injected more regularly when the temperature drops or that can be cut back or turned off when the temperature rises. There are two different ways for the controller to access the temperature. In either case, the same algorithm is used.

Temperature Source

The temperature can be acquired from one of the following sources:

- the controller's internal temperature sensor
- from a SCADA host via a Modbus register
- a calibrated external temperature sensor connected to Analog Input 2

When the controller's internal temperature sensor is used an offset can be applied to this reading if the current reading does not accurately reflect the ambient temperature. The internal temperature sensor can have an offset that varies from controller to controller and does not account for heating inside the enclosure.

When the temperature is acquired from a Modbus register the SCADA host is responsible for populating the current temperature. The correct Modbus register to use can be found in the Modbus user manual. Alternatively using a calibrated external temperature sensor, the controller can measure the ambient temperature.

In any configuration, the resultant temperature is then used for the looking up the Target Rate in the Temperature Optimization.

Optimization Settings

The optimization settings for the temperature optimization are used to define a straight line. This straight line is then used to cross reference any temperature to a target injection rate. If the temperature falls outside the low and high points, the low and high target rates are used respectively. The target rate can never exceed the pump rate, nor can it be less than zero.

The following parameters show how to define the end points of this line that defines the relationship between Target Rate and Temperature.

- **Low Temperature:** The Low Temperature is the used to define a point at which the Low Temperature Target Rate is achieved.
- **Low Temperature Target Rate:** This rate will be achieved when the Low Temperature is reached.
- **High Temperature:** The High Temperature is used to define the point at which the High Temperature Target Rate is achieved.
- **High Temperature Target Rate:** This rate will be achieved when the High Temperature is reached.

Operation

The temperature optimization feature auto adjusts the target injection rate based on the current temperature each cycle. The high and low rate and high/low temperature settings are used to define a straight line. The current temperature reading is taken at the start of the cycle and the corresponding target rate is determined.The following example shows the case where there is an inverse relationship between Target Rate and Temperature. This would be used for a chemical such as Methanol where the Target Rate will decrease as the temperature rises.

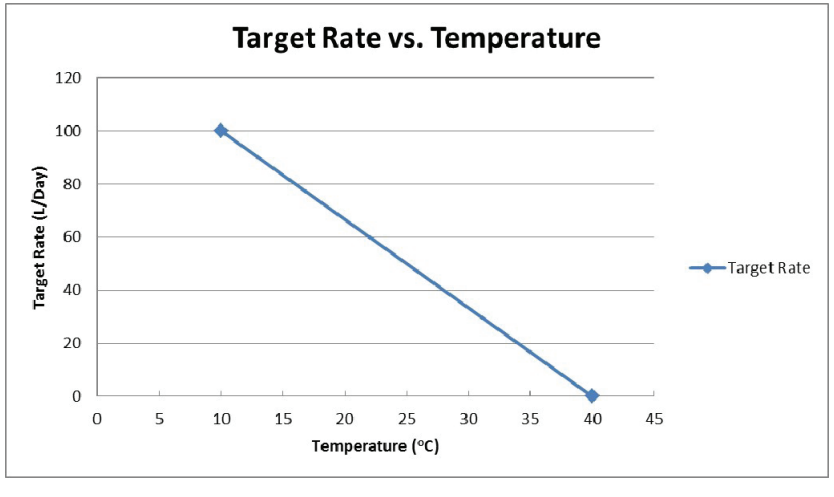

Figure 13 - Inversely Proportional Temperature Optimization

Of course, the opposite case may be desirable as well. By simply changing the relationship between Target Rate and Temperature, we can obtain a directly proportional relationship. This means that the Target Rate will increase as the Temperature increases. This is shown below.

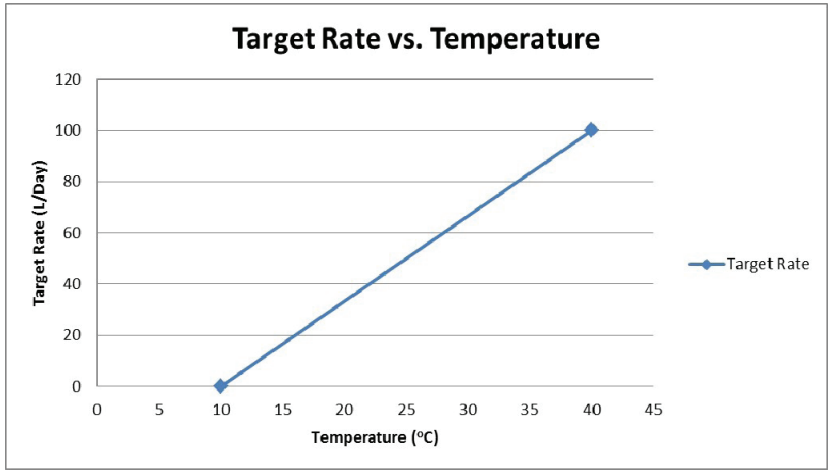

Figure 14 - Directly Proportional Temperature Optimization

Line Pressure Optimization

The PC180 has an advanced pressure optimization feature that will auto adjust the Target Rate for a given pump. This allows the pump rate to be automatically adjusted as the line pressure rises or falls. This optimization method is only available when Analog Input 2 is configured as a Line Pressure sensor.

Optimization Settings

The optimization settings for the line pressure optimization are used to define a straight line. This straight line is then used to cross reference any pressure to a target injection rate. If the pressure falls outside the low and high points, the low and high target rates are used respectively. The target rate can never exceed the pump rate, nor can it be less than zero. The following parameters show how to define the end points of this line that defines the relationship between Target Rate and Pressure.

- **Low Line Pressure:** The Low Line Pressure is the used to define a point at which the Low Line Pressure Target Rate is achieved.
- **Low Line Pressure Target Rate:** This rate will be achieved when the Low Line Pressure is reached.
- **High Line Pressure:** The High Line Pressure is used to define the point at which the High Line Pressure Target Rate is achieved.
- **High Line Pressure Target Rate:** This rate will be achieved when the High Line Pressure is reached.

Operation

The line pressure optimization feature auto adjusts the target injection rate based on the current line pressure each cycle. The high and low rate and high/low line pressure settings are used to define a straight line. The current line pressure reading is taken at the start of the cycle and the corresponding target rate is determined.

The following example shows the case where there is an inverse relationship between Target Rate and Line Pressure.

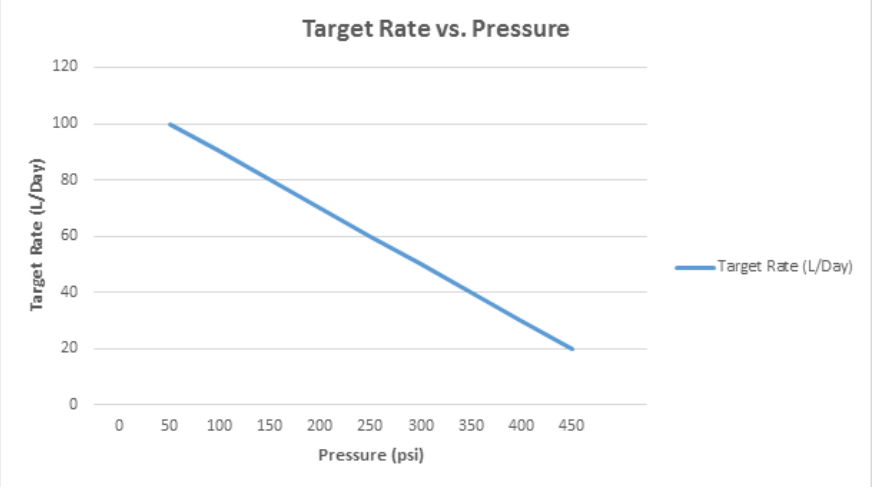

Figure 15 - Inversely Proportional Pressure Optimization

Of course, the opposite case may be desirable as well. By simply changing the relationship between Target Rate and Line Pressure, we can obtain a directly proportional relationship. This means that the Target Rate will increase as the Line Pressure increases. This is shown below.

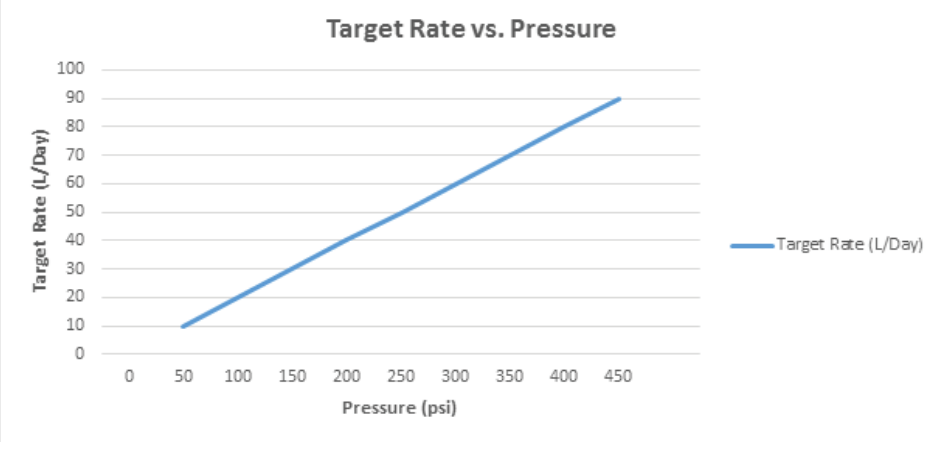

Figure 16 - Directly Proportional Pressure Optimization

Artificial Lift Optimization

The PC180 has an advanced optimization feature that will adjust the Target Rate in sync with an external Artificial Lift Controller operating a well. Using the CP-DP input on the PC180, a pressure switch can be used to signal when the well's production valve has been opened or closed. The PC180 will adjust the target rate for each pump according to the diagram below:

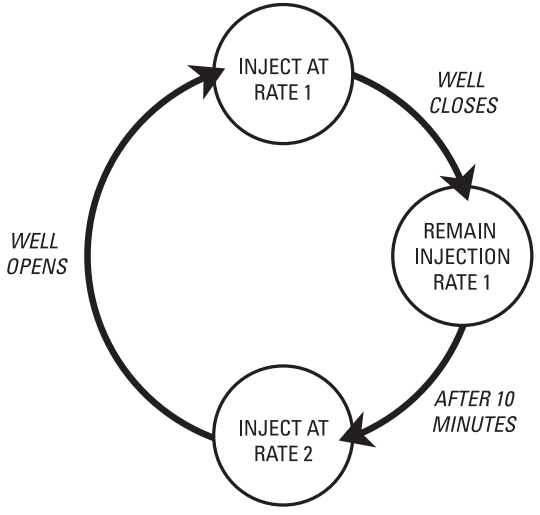

Figure 17 - Artificial Lift Optimization

The following parameters can be used to configure the PC180 in this mode. Each pump has its own set of parameters for injecting chemicals:

- **Production Rate (Rate 1):** The PC180 will adjust the Target Rate to this rate as soon as it detects the production valve has opened. It will continue at this rate for as long as the valve is open and for 10 minutes after it has closed.
- **Shut-In Rate (Rate 2):** The PC180 will adjust the Target Rate to this rate 10 minutes after it detects the well has been shut

in (i.e. the production valve has closed). The PC180 will continue to inject chemicals at this rate until the production valve is reopened.

H2S Injection Optimization

The PC180 has an advanced optimization feature that will adjust the target rate to achieve a minimal concentration of H2S. Using the Analog 2 Input, a H2S sensor can be used to measure the concentration of H2S. The PC180 will adjust the target rate for each pump according to the diagram below:

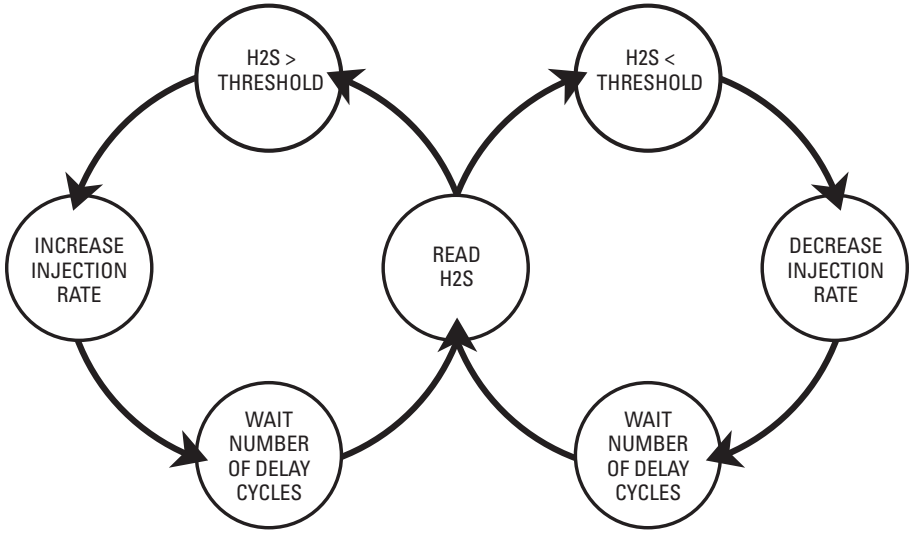

Figure 18 - H2S Injection Optimization

The following parameters can be used to configure the PC180 in this mode. Each pump has its own set of parameters for injecting chemicals:

- **H2S Threshold (applies to all pumps):** The H2S concentration that the PC180 will optimize injection to achieve.

- **Pump Increase Rate:** The PC180 will increase injection by this rate when the H2S concentration is above the H2S threshold.
- **Pump Increase Delay:** If the H2S concentration is above the threshold, the PC180 will wait the specified number of cycles before increasing injection.
- **Pump Decrease Rate:** The PC180 will decrease injection by this rate when the H2S concentration is below the H2S threshold.
- **Pump Decrease Delay:** If the H2S concentration is below the threshold, the PC180 will wait the specified number of cycles before decreasing injection.
- **Pump Injection Rate Limit:** The PC180 will not go below this injection rate when decreasing injection.

4.3 | Digital Outputs

The controller is equipped with 1 or 2 digital outputs based on the model that is being used. There are a number of different functions that can be achieved depending on how the outputs are configured. The following sections show some common configurations.

Mimic Valve

The digital outputs can mimic any valve that is enabled on the controller. If there is a valve, such as Pump 3 that you would like to mimic that is not available; first ensure that the Pump 3 is enabled.

Level

By default, the output is turned ON (5V) when a given value is opened. The output is turned OFF (0V) as soon as the valve is closed. This is useful when connecting to a relay. The relay is energized when the valve is open, allowing devices such as a electric valve to be powered. When the valve is closed, the power to the relay is removed, cutting power to the electric valve.

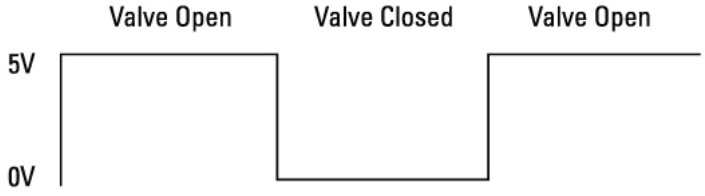

Figure 19 - Level Based Valve Output

Alarm

This feature is used to communicate with other systems when the controller has gone into an alarm state. If the controller stops operating because it has a low battery or another alarm condition has caused the internal state machine to shut the well in, the output will be turned to ON (5V). When the alarm condition is cleared and normal operation resume, the output will be turned OFF (0V).

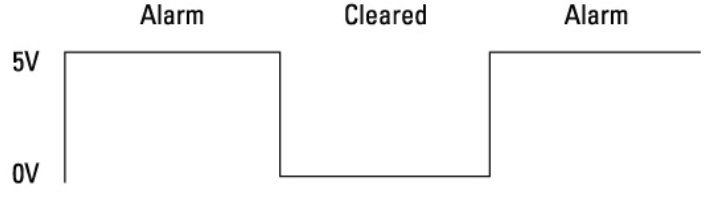

Figure 20 - Level Based Alarm Output

5 | Menu Reference

5.1 | Hot Key Menus

The following menus are available to the operator without logging in. Simply press the corresponding hot key to access the menus.

Settings Menu

The settings hot key navigates to a special menu that contains all of the settings that are used by the controller. These parameters are used to calculate the injection and recycle timers which in turn are used to control the opening or closing of the bypass valve. These settings give the installer/operator control over target injection rates. The following is a list of the settings that are available in this menu:

Table 2 - Settings Screens

Screen	*Description*	*Default Value*
Pump Rate1	This tells the controller what the current rate of the pump is set to.	2.0 L/day
Target Rate1	This is the target rate of injection that should be achieved.	1.0 L/day
Pressure1	This is the process pressure at the injection point. The pressure is used to compensate for the super compressibility of injection chemicals at different pressures.	5000 kPa
Fine Tune Time1	This time allows the operator to set some additional build time to fine tune the system.	0s
Pump Rate2	This tells the controller what the current rate of the second pump is set to. (This is only displayed if the second pump is enabled.)	2.0 L/day
Target Rate2	This is the target rate of injection that should be achieved. (This is only displayed if the second pump is enabled.)	1.0 L/day
Pressure2	This is the process pressure at the injection point. The pressure is used to compensate for the super compressibility of injection chemicals at different pressures. (This is only displayed if the second pump is enabled.)	5000 kPa
Fine Tune Time2	This time allows the operator to set some additional build time to fine tune the system. This is only displayed if the second pump is enabled.	0s
Pump Rate 3	This tells the controller what the current rate of the third pump is set to. (This is only displayed if the third pump is disabled.)	2.0 L/day

Screen	Description	Default Value
Target Rate 3	This is the target rate of injection that should be achieved. (This is only displayed if the third pump is enabled.)	1.0 L/day
Pressure 3	This is the process pressure at the injection point. The pressure is used to compensate for the super compressibility of injection chemicals at different pressures. (This is only displayed if the third pump is enabled.)	5000 kPa
Fine Tune Time 3	This time allows the operator to set some additional build time to fine tune the system. This is only displayed if the third pump is enabled.	0s

History Menu

Cycle Log

The cycle log is a history of each cycle that the controller goes through. A log entry is written at the end of a cycle, which is defined as the point when the controller finishes the Inject Time. Therefore, the controller will write the first cycle log entry after the controller starts and the initial Inject Time expires. Each log entry is stored in persistent memory so that it is maintained through any power disruptions. A maximum of 25 log entries will be saved. Once this limit is reached, new entries are written over top of the oldest entry.

The following information is saved for each cycle:

Table 3 - Cycle Log Screens

Screen	Description
Number of Cycles	The total number of cycles currently stored in the Cycle Log.
Cycle Type and Start Time	This screen shows the type of cycle that occurred as well as the date and time that the cycle started. The cycle type will be one of: Current Cycle,Normal,Low Battery Shutdown,Operator Change,Startup.
Recycle Duration1	This value shows the time that pump1 was recycling.
Inject Duration1	This value shows the time that pump1 was injecting.
Recycle Duration2	This value shows the time that pump2 was recycling.
Inject Duration2	This value shows the time that pump2 was injecting.

Screen	Description
Recycle Duration3	This value shows the time that pump3 was recycling.
Inject Duration3	This value shows the time that pump3 was injecting.
Pump Pulse1	The number of pump pulses detected for pump1 during the cycle.
Pump Pulse2	The number of pump pulses detected for pump2 during the cycle.
Pump Pulse3	The number of pump pulses detected for pump3 during the cycle.
Reset Log	This clears all of the cycle log data.

Daily

The controller maintains daily production statistics which are written to persistent memory when the current time-of-day passes the Day Start parameter. The following information is available in the Daily History menu:

Table 4 – Daily History Screens

Screen	Description
Date and Total Cycles	Shows the date for the given history record as well as the total number of cycles that occurred during that day.
Recycle/Inject 1	Displays the total time that the pump has been recycling and injecting for pump 1.
Recycle/Inject 2	Displays the total time that the pump has been recycling and injecting for pump 2.
Recycle/Inject 3	Displays the total time that the pump has been recycling and injecting for pump 3.
Pump Pulse 1 & 2	The total number of pump pulses detected for pumps 1 and 2.
Pump Pulse 3	The total number of pump pulses detected for pump 3.
OK and Start Cycles	The number of normal (OK) and startup cycles that completed for the day.
Operator Change & Low Battery Cycles	The number of cycles that occurred where the cycle was cut short by an operator pressing the run or stop buttons, and the number of cycles cut short by a low battery shutdown.
High Line Pressure and Artificial Lift Cycles	The numebr of cycles that occurred where the cycle was cut short by controller going into high line pressure recycle and the number of cycles cut short by a rate change due to artificial lift optimization.
Day Start	This defines the gas day cut off. When the controller passes this time each day, the history for the current day will stop and a new day will start.
Reset Log	This clears all of the daily log data.

5.2 | Install Menu

If security has been enabled, users must log in here in order to see the menus below. The install menu is entered by pressing the menu hot key. The default login is 000-0000, which can be changed in the security menu.

Date/Time

This menu allows the date and time to be configured. There is also a screen that allows daylight savings time to be enabled. The following is list of all of the available screens:

Table 5 - Date/Time Screens

Screen	*Description*	*Default*
Date	Allows the user to set the current date.	Jan 1, 2000
Day Confirm	This confirms the current day of the week when the date is set.	N/A
Time	Allows the user to set the current time. Please note that this is in 24 hr time (i.e. 1:00 pm is entered as 13:00).	00:00
DST Enable	If enabled, the controller will automatically adjust 2 times a year for daylight savings.	Disabled

System

The System menu provides information specific to the given controller. This includes information such as the serial number and firmware version. Features can be enabled, the display brightness can be adjusted, and the controller settings can be reset to factory defaults. If any errors have been reported by the controller, they can be found at the end of this menu. The following is a list of the available screens:

Table 6 - System Screens

Screen	*Description*	*Default*
Display Level	Sets the screen brightness. Can be used to save power or adapt to different lighting conditions.	50%
Display Auto Off	This sets the amount of time after the last key press that the display will stay on.	1m00s
Units	Set the controller to use imperial or metric units.	Metric
Serial Number	The serial number of the controller. This is required if features need to be enabled on the controller or it is to be returned for repair.	N/A
Software Version	This identifies the specific firmware version that is currently running on the controller. This is required if issues are reported to Profire. Please refer to the release notes for this version to see a list of known issues.	N/A
Hardware Version	Shows the current version of hardware. This is used to manage different generations of hardware. It also helps troubleshoot any future issues that may be linked to a specific version of hardware.	N/A
Restore Defaults	This will reset all controller settings back to the factory defaults. The user will be prompted to confirm this action before the settings are restored.	No
Error Log	This screen will only appear if a detectable error has occurred. Some errors will result in the controller restarting. This is the first place that should be checked if the controller is restarting itself.	N/A
Reset Error Log	If there are entries in the error log this screen will appear. It allows you to clear the error log. You will be prompted to confirm this action.	No

Security

The Security menu allows the currently logged in user to logout. Installers are able to view and change both the Operator and Installer login IDs.

Table 7 - Security Screens

Screen	*Description*	*Default*
Secure Login	Allows the installer to add security to the menu. If this is disabled, no login is requested and none of the following screens are displayed.	Disabled
Logout	This screen forces a log out. The screen will move back to the main status screen when the operator has logged out. The operator will be required to enter a password to regain entry to the Setup menu.	N/A
Auto Logout Time	The amount of time after the last key press that the user will remain logged in.	10m00s
Operator ID	This screen allows the Installer to set an Operator ID. This allows another user to have limited access to the Setup menu. This screen is only visible to a logged in Installer.	000-0000
Installer ID	This screen allows the Installer to change the current Installer ID. This screen is only visible to a logged in Installer. **Note: If the Installer and Operator IDs are configured to be the same number, the user will be logged in as the Installer when using this code.**	000-0000

Pump Setup

The Pump setup menu allows the installer to define some basic parameters of the controller set up if a custom application is required.

Table 8 – Pump Setup Screens

Screen	*Description*	*Default*
Pump Rate 1	This tells the controller what the current rate of the pump is set to.	0.5 G/day 2.0 L/day
Target Rate 1	This is the target rate of injection that should be achieved.	0.3 G/day 1.0 L/day
Pressure 1	This is the process pressure at the injection point. The pressure is used to compensate for the super compressibility of injection chemicals at different pressures.	725 psi 5000 kPa
Fine Tune Time 1	This time allows the operator to set some additional build time to fine tune the system	0s
Pump Rate 2	This tells the controller what the current rate of the second pump is set to. (This is only displayed if the second pump is enabled.)	0.5 G/day 2.0 L/day
Target Rate 2	This is the target rate of injection that should be achieved. (This is only displayed if the second pump is enabled.)	0.3 G/day 1.0 L/day
Pressure 2	This is the process pressure at the injection point. The pressure is used to compensate for the super compressibility of injection chemicals at different pressures. This is only displayed if the second pump is enabled.	725 psi 5000 kPa
Fine Tune Time 2	This time allows the operator to set some additional build time to fine tune the system. (This is only displayed if the second pump is enabled.)	0s
Pump Rate 3	This tells the controller what the current rate of the third pump is set to. (This is only displayed if the third pump is enabled.)	0.5 G/day 2.0 L/day
Target Rate 3	This is the target rate of injection that should be achieved. (This is only displayed if the third pump is enabled.)	0.3 G/day 1.0 L/day

Screen	Description	Default
Pressure 3	This is the process pressure at the injection point. The pressure is used to compensate for the super compressibility of injection chemicals at different pressures. (This is only displayed if the third pump is enabled.)	725 psi 5000 kPa
Fine Tune Time 3	This time allows the operator to set some additional build time to fine tune the system. (This is only displayed if the third pump is enabled.)	0s

Inputs

The inputs menu allows input devices such as a line pressure switch or sensor to be enabled and configured.

Table 9 - Inputs Screens

Screen	Description	Default
Digital Input	Selects the device that is attached to the digital input. Available device selections are: • Disabled: No input device is connected . • Pump Pulse 1: Turns on counting of pump pulses for pump 1.	Disabled
Analog 1 Input	• Selects the device that is attached to the analog 1 input. Available device selections are: Disabled: No input device is connected. • Pump Pulse 2: Turns on counting of pump pulses for pump 2. • Tank Pressure Switch: Turns on monitoring of tank switch state. • Tank Pressure Sensor: Turn on monitoring of tank pressure sensor.	Disabled
Analog 2 Input	Selects the device that is attached to the analog 2 input. Available device selections are: • Disabled: No input device is connected. • Line Temperature: Turns on monitoring of a line temperature sensor on this input. This sensor value can be used for temperature based rate optimization. • Pump Pulse 3: Turns on counting of pump pulses for pump 3. • Artificial Lift Switch: Enables monitoring of a switch used for artificial lift based rate optimization. A switch trip indicates the well is shut in. A reset indicates the well is flowing. *Line Pressure Switch: Turn on monitoring of a line switch. • Line Pressure Sensor: Turns on monitoring of a line sensor. The sensor value can be used for line pressure based rate optimization. • H2S Sensor: Enables monitoring of an H2S sensor. The sensor value can be used for H2S injection optimization.	Disabled

Screen	Description	Default
Temperature Source	Selects the source used for the temperature based optimizations: • Internal: Temperature from the sensor internal to the controller is used. • Modbus: The temperature is read from the Modbus holding register. • Line temperature: The temperature will be read from the line temperature sensor on analog 2. This selection is only available when the analog 2 input is enabled as a line temperature sensor.	Internal
Temperature Offset	This is an offset that is applied to the internal temperature reading. This is required if the factory calibration of the temperature sensor was not completed.	0 F 0 C
Pump Pulse 1 Switch Polarity	Configures the type of pump pulse 1 switch to use. The controller can detect a Tank Pressure trip on a close or open of a switch.	Normally Open (Detects on a switch close)
Tank Pressure Range	When the Tank Pressure Device Type is sensor, defines the range of the sensor.	5.0 psi 34.475 kPa
Line Pressure Range	When the Line Pressure Device Type is sensor, defines the range of the sensor.	500.0 psi 3447.5 kPa
H2S Sensor Range	When Analog 2 Input is configured as an H2S sensor, this defines the range of the sensor.	10.0 ppm
Sensor Scan Time	Defines the rate at which all sensors are read.	00m01s
Switch Scan Time	Defines the rate at which all switches are read.	00m01s

Outputs

The Outputs menu allows the installer to configure the behavior of Valve B which enables the dual pump capability.

Table 10 - Outputs Screens

Screen	*Description*	*Default*
Pump 2 Type	Allows a 2nd pump to be enabled.	Disabled
Pump 2 State	Shows the current state of the valve. The user can also manually override the valve position.	N/A
Pump 3 Type	Allows a 3rd pump to be enabled.	Disabled
Pump 3 State	Shows the current state of the valve. The user can also manually override the valve position.	N/A
DO1 CFG	Sets the operation of the LP input to a digital output.	Disabled
DO1 Signal	Configures the behaviour of the digital output.	Alarm On
DO2 Type	Sets the operation of the CP/DP input as a digital output.	Disabled
DO2 Signal	Configures the behaviour of the digital output.	Alarm On

Alarms

These settings determine the behavior of the controller when an alarm condition occurs.

Table 11 | Alarms Screens

Screen	*Description*	*Default*
Low Battery Fail Mode	This screen allows the user to configure the behaviour of the controller for this type of failure. The user can decide to have the controller fail Closed or Open.	Closed/Inject
High Line Pressure Recycle	When a line pressure switch is connected to the analog 2 input, this screen allows high line pressure recycle to be enabled. All pumps will go into recycle when the line pressure switch has tripped, indicating a high line pressure state.	Disabled
Pump Pulse Sensor Alarm	This screen allows the user to configure the controller to generate an alarm if any pump pulse sensor does not detect pump pulses.	Disabled
Pump Pulse Alarm Period	Number of cycles.	5

Optimize

These settings are used to configure Temperature, Line Pressure, Artificial Lift Optimization, and H2S Optimization.

Table 12 - Optimize Screens

Screen	*Description*	*Default*
Artificial Lift Optimization	Allows Artificial Lift Optimization to be enabled for all pumps.	Disabled
Pump 1 Rate 1	Target rate for Pump 1 when the production valve is opened.	0.3 G/day 1.0 L/day
Pump 1 Rate 2	Target rate for Pump 1 when the production valve is closed	0.4 G/day 1.5 L/day
Pump 2 Rate 1	Target rate for Pump 2 when the production valve is opened.	0.3 G/day 1.0 L/day
Pump 2 Rate 2	Target rate for Pump 2 when the production valve is closed	0.4 G/day 1.5 L/day
Pump 3 Rate 1	Target rate for Pump 3 when the production valve is opened.	0.3 G/day 1.0 L/day
Pump 3 Rate 2	Target rate for Pump 3 when the production valve is closed	0.4 G/day 1.5 L/day
H2S Optimization	Allows H2S Optimization to be enabled for all pumps.	Disabled
H2S Threshold	Defines the H2S threshold to use for H2S Optimization.	0.1ppm
Optimization Type 1	Allows the optimization type for Pump1 to be selected. Available selections are: disabled, temperature, line pressure, or H2S concentration.	Disabled
Low Temperature 1	The low temperature to use the min/max target injection rate for Pump 1.	32 F 0 C
Low Line Pressure 1	The low line pressure to use the min/max target rate for Pump 1.	0 psi 0 kPa
Low Target Rate 1	The Target Rate to use when the line pressure or temperature (depending on the optimization type) is at or below the low pressure or temperature setting for Pump 1.	0.5 G/day 2.0 L/day
High Temperature 1	The high temperature to use the min/max target injection rate for Pump 1.	68 F 40 C

Screen	Description	Default
High Line Pressure 1	The high line pressure to use the min/max target rate for Pump 1.	200 psi 1379 kPa
High Target Rate 1	The Target Rate to use when the line pressure or temperature (depending on the optimization type) is at or below the high pressure or temperature setting for Pump 1.	0.3 G/day 1.0 L/day
Pump 1 H2S Increase Rate	Injection increase rate when above H2S threshold	0.5 L/day 0.1 gal/day
Pump 1 H2S Increase Delay	Number of cycles to wait before next injection rate increase.	1 cycle
Pump 1 H2S Decrease Rate	Target injection decrease rate when below H2S threshold.	0.5 L/day 0.1 gal/day
Pump 1 H2S Decrease Delay	Number of cycles to wait before next injection rate decrease.	1 cycle
Pump 1 H2S Injection Rate Limit	Target Rate limit when decreasing injection.	0 L/day 0 gal/day
Optimization Type 2	Allows the optimization type for Pump2 to be selected. Available selections are: disabled, temperature, line pressure, or H2S concentration.	Disabled
Low Temperature 2	The low temperature to use the min/max target injection rate for Pump 2.	32 F 0 C
Low Line Pressure 2	The low line pressure to use the min/max target rate for Pump 2.	0 psi 0 kPa
Low Target Rate 2	The Target Rate to use when the line pressure or temperature (depending on the optimization type) is at or below the low pressure or temperature setting for Pump 2.	0.5 G/day 2.0 L/day
High Temperature 2	The high temperature to use the min/max target injection rate for Pump 2.	68 F 40 C
High Line Pressure 2	The high line pressure to use the min/max target rate for Pump 2.	200 psi 1379 kPa
High Target Rate 2	The Target Rate to use when the line pressure or temperature (depending on the optimization type) is at or below the high pressure or temperature setting for Pump 2.	0.3 G/day 1.0 L/day
Pump 2 H2S Increase Rate	Injection increase rate when above H2S threshold.	0.5 L/day 0.1 gal/day
Pump 2 H2S Increase Delay	Number of cycles to wait before next injection rate increase.	1 cycle

Screen	Description	Default
Pump 2 H2S Decrease Rate	Target injection decrease rate when below H2S threshold.	0.5 L/day 0.1 gal/day
Pump 2 H2S Decrease Delay	Number of cycles to wait before next injection rate decrease.	1 cycle
Pump 2 H2S Injection Rate Limit	Target Rate limit when decreasing injection	0 L/day 0 gal/day
Optimization Type 3	Allows the optimization type for Pump3 to be selected. Available selections are: disabled, temperature, line pressure, or H2S concentration.	Disabled
Low Temperature 3	The low temperature to use the min/max target injection rate for Pump 3.	32 F 0 C
Low Line Pressure 3	The low line pressure to use the min/max target rate for Pump 3.	0 psi 0 kPa
Low Target Rate 3	The Target Rate to use when the line pressure or temperature (depending on the optimization type) is at or below the low pressure or temperature setting for Pump 3.	0.5 G/day 2.0 L/day
High Temperature 3	The high temperature to use the min/max target injection rate for Pump 3.	68 F 40 C
High Line Pressure 3	The high line pressure to use the min/max target rate for Pump 3.	200 psi 1379 kPa
High Target Rate 3	The Target Rate to use when the line pressure or temperature (depending on the optimization type) is at or below the high pressure or temperature setting for Pump 3.	0.3 G/day 1.0 L/day
Pump 3 H2S Increase Rate	Injection increase rate when above H2S threshold.	0.5 L/day 0.1 gal/day
Pump 3 H2S Increase Delay	Number of cycles to wait before next injection rate increase.	1 cycle
Pump 3 H2S Decrease Rate	Target injection decrease rate when below H2S threshold.	0.5 L/day 0.1 gal/day
Pump 3 H2S Decrease Delay	Number of cycles to wait before next injection rate decrease.	1 cycle
Pump 3 H2S Injection Rate Limit	Target Rate limit when decreasing injection	0 L/day 0 gal/day

Modbus

The Modbus menu will only appear if the Modbus feature has been enabled on the controller. This feature allows data to be retrieved by a SCADA host remotely. This menu contains all of the settings that are available for Modbus communications. These settings must match the settings that are used in the SCADA host.

Table 13 | Modbus Menus

Screen	*Description*	*Default*
Modbus Port	Sets whether the Modbus port is active or not on. It is disabled by default to save power.	Disabled
Station Address	Defines the Modbus station. Valid values are 1 to 247. This setting must match the settings on your Modbus master.	1
Protocol	The specific Modbus protocol that is use. This can be set to either RTU or ASCII. This setting must match the settings on your Modbus master.	RTU
Baud Rate	The speed of the serial port. This setting must match the settings on your Modbus master.	9600
Data Bits	Sets the number of data bits in each character. This setting must match the settings on your Modbus master.	8
Parity	The parity of the character. This setting must match the settings on your Modbus master.	None
Stop Bits	The number of stop bits per character. This setting must match the settings on your Modbus master.	1
Time Format	Specifies how time and dates are represented in the Modbus registers. Seconds format will utilize one or more registers to show elapsed seconds. H:M:S format allocates separate registers for Hours, Minutes, and Seconds. Please refer to the Modbus Communications User's Guide for more details.	Seconds

6 | Modbus Communications

The controller is equipped with an RS-485 port which is designed primarily to provide communications to a SCADA system. This port provides most of the functions available from the front panel user interface using the Modbus protocol. The PC180 Modbus Communication Manual discusses the physical connections, communications settings, and the available registers.

7 | Troubleshooting

The following outlines a number of common issues that may be encountered.

Table 14 - Troubleshooting Guide

Issue	*Cause*	*Resolution*
The display won't come on when the battery is plugged in.	The fuse is blown on the battery	Return to Profire Energy to be repaired. To avoid this issue, make sure to avoid shorting the battery connections.
	Battery is unplugged or there is a loose connection	Plug in the battery and check all connections.
	Battery is dead	Charge the battery as per the directions on the side of the battery. If it does not hold a charge, contact Profire Energy to purchase a new battery.
	Software has been erased	Reprogram the software using the software upgrade procedure.
Pressing a button does not produce the desired response.	A key is stuck on the keypad	The keypad will need to be replaced. Please call Profire Energy to arrange for the controller to be repaired.
	The main core of the controller has been shocked	The controller core must be replaced. Please call Profire Energy to arrange for the controller to be repaired. To avoid this, always transport the controller board in a static protection bag and avoid touching any exposed connections along the back of the controller without appropriate grounding.
Cannot Log in to the Setup Menu	You have forgotten your operator/ installer ID	If the Operator ID has been forgotten, use the Installer ID. If the Installer ID has been forgotten, Profire Energy can generate a new ID on a per controller basis.
Controller is sitting in the stopped state	The battery is low	Replace the battery and ensure that the solar panel is connected and positioned correctly.

8 | Support

8.1 | Software Upgrade

On occasion, software upgrades are made available. These releases will contain new features as well as resolutions to issues found in the product. The release notes describe the changes that are available in each release. The new software can be downloaded through the communications port whether the Modbus option is enabled or not.

It is recommended that the controller be removed from the well before the upgrade is performed as the valve operation cannot be trusted during the upgrade.

Prerequisites

The following equipment is required to upgrade the controller:

- Battery
- Laptop with a USB port
- USB to RS485 converter
- Latest firmware file.

Setup

1. Ensure that the USB to RS485 adapter is configured in 2 wire mode.

2. Wire the RDA(-) to COM1 A and RDB(+) to COM1 B. The GND can be wired to the unlabeled connection on COM1 between A and B, but is not necessary.

3. Plug adapter into an available USB port.

4. Install the drivers that were provided with the USB to RS485 converter.

Upgrade Procedure

1. Hold the menu button down
2. Plug the battery into the controller
3. Release the menu button
4. If the controller does not enter the upgrade program, the previous software that was installed may not include this program. Please contact Profire.
5. Follow the prompts on the screen to erase the current firmware. To abort the upgrade process at this point, unplug the battery.
    - When prompted to do so, download the firmware
    - Open Vision
    - Browse to the latest file provided by Profire Energy.
    - Select the appropriate COM port from the drop down list.
    - Click the Connect button
    - Select Download
6. The display on the controller should change to show the status of the download and a progress bar should appear on the screen, showing how much code has been downloaded.
7. When the download is complete, the controller should start normally.

Upgrade Errors

During the download of a firmware image, errors may occasionally occur. If this does happen, simply repeat the procedure again, making sure to erase the current firmware. If an error occurs multiple times in a row, contact Profire Energy.

The following is a list of errors that may be seen:

Err 1 – Invalid file format. The Bootloader found information in the serial stream that did not match the expected format. This could be a transmission error or an error with the file.

Err 2 – Dropped Characters. While parsing the incoming stream, extra characters were detected. This typically means that some data was lost.

Err 3 – Character Buffer Overrun. Incoming characters were lost because the controller was too busy processing to service the incoming data. Please contact Profire if this occurs.

Err 4 – Flash Buffer Over Run. This means that there is a back log saving to the controller. Please contact Profire if this occurs.

Err 5 – Character Buffer Under Run. The controller was expecting to parse more incoming characters, but there are none available. Please contact Profire if this occurs.

8.2 | Replacement Parts and Accessories

Several replacement parts or accessories are available for purchase. These items are listed in the table below with their associated part numbers. Please contact Profire for the current price list.

Table 15 - Available Replacement Parts and Accessories

Part Number	*Name*	*Description*
ET-00000-0000-0247	1.1 W Solar Panel	6V, 1.1W CSA Class 1 Div 2 Intrinsically safe solar panel
ET-12001-1008-0001	5 Ah Replacement Battery	CSA approved replacement battery with intrinsically safe protection.
ET-12001-1008-0002	8 Ah Replacement Battery	CSA approved replacement battery with intrinsically safe protection.
ET-12000-1011-0001	Single Valve Assembly, 3/8" tubing, AMP-DUAC connector	Includes a pneumatic valve solenoid, 2 3/8" NPT elbows, an O Ring, Nylon Lock Nut and connector.
ET-12000-1011-0002	Dual Valve Assembly, 3/8" tubing, AMP-DUAC connector	Includes 2 pneumatic valve solenoids, 2 3/8" NPT elbows, a Tee, a 3/8" NPT connector, 2 O Rings, 2 Nylon Lock Nuts, and connectors.
ET-00000-0000-0230	Valve Solenoid Core	Includes the plastic molded solenoid core and wires
ET-00000-0000-0231	Valve Piston and Spring	Includes the internal valve piston and attached spring assembly

Part Number	Name	Description
ET-12000-1009-0003	Battery Bracket	Replacement bracket used to retain either battery.
ET-00000-0000-0235	2 Pin Connector	2 Pin Weidmuller connector
ET-00000-0000-0236	3 Pin Connector	3 Pin Weidmuller connector
ET-00000-0000-0060	1/2" Liquid Tight Knockout Seal	NEMA rated plug to prevent water and dust from entering unused holes.

8.3 | Technical Support

Contacting Support

Support is available from Profire Energy.

Web

Please visit our website at http://www.profireenergy.com

Phone

Profire Energy support can be contacted via phone at our office in Spruce Grove, AB at 1-780-960-5278.

Identifying the Issue

Please take the time to identify the issue that is being experienced. Many issues can be resolved by simply upgrading the controller to the latest software. If the issue still persists, please try and determine if there is an issue with the software or hardware. Here are some common indications of each type of issue:

Hardware

- Battery is not charging
- Some display pixels do not power up
- The controller display does not come up and the controller does not draw any current
- A key is stuck

Firmware

- The controller restarts itself (goes back to close at an incorrect time)
- There are entries in the error log (Located in the System menu)
- Controller behaviour is erratic
- The same issue happens across multiple controllers

Reporting Software Issues

We strive to provide the best software possible that is free of defects. As with any controller, there may be issues. When issues do arise, please do the following:

- Copy down any errors that are found in the error log
- Note the controller configuration
- Note what was being done on the controller when the issue occurred
- Note the serial number and version number of the controller that experienced the issue
- Detail instructions on how to repeat the issue if possible

Repair Process

Please contact Profire Energy and arrange to have the controller repaired. Please be ready to explain the issues that are being experienced. A detailed account of the problem will be required so that the issue can be addressed in a timely fashion. Returned controllers will take approximately 4 – 6 weeks to be diagnosed and repaired.

9 | Acronyms

Acronyms	*Phrase*
ADC	Analog-to-Digital Converter
AI	Analog Input
CVC	Configurable Valve Controller
DAC	Digital-to-Analog Converter
DI	Digital Input
DO	Digital Output
ESD	Emergency Shut Down
N/C	Normally Closed
N/O	Normally Open
PAS	Pump Actuations Sensor
PSI	Pounds per Square Inch
R	Read Permission
RTU	Remote Terminal Unit
R/W	Read/Write Permission
SCADA	Supervisory Control And Data Acquisition
V	Volts
VFD	Vacuum Fluorescent Display
VI	Virtual Input

www.profireenergy.com

© 2014 PROFIRE