The PIT Boss II

The PIT Boss II Plus

Installation and Operations Manual

PREMIER INTEGRATED TECHNOLOGIES

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The PIT Boss II/The PIT Boss II Plus Installation and Operations Manual

Revision History

Revision	Date	Author	Changes
1.x.x	11/29/2010	MDS	Initial Version
1.4.x	4/17/2012	MDS	Update graphics and part numbers. Add an index. Bring the configurations further forward and push the menu reference back.
1.6.x	10/09/2013	MDS	Add in the ability to select units. Allow the digital outputs to be pulsed.
1.7.x	02/21/2014	MDS	Add in Arrival Guard Time. Correct Pressure Optimization combinations in table.
2.0.x	02/17/2016	MAB	Add in Plunger Velocity Sensor related screens Add Average and Surface Velocity to Cycle Log

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1 Introduction

1.1 Purpose

This manual is intended to provide all of the information required to set up and operate The PIT Boss II Plunger Lift Controller. As well, it covers basic troubleshooting techniques and support information.

1.2 Overview

The PIT Boss II Plunger Lift Controller is a versatile gas well controller that can be used in a number of different configurations. It can function as a simple intermitter or with a plunger and can optimize a well based on pressures or plunger arrival times. In addition, the controller can be accessed remotely using the provided Modbus compatible RS485 communications port.

1.3 Assumptions

The following assumptions have been made when writing this manual:

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

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.

Simply 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.

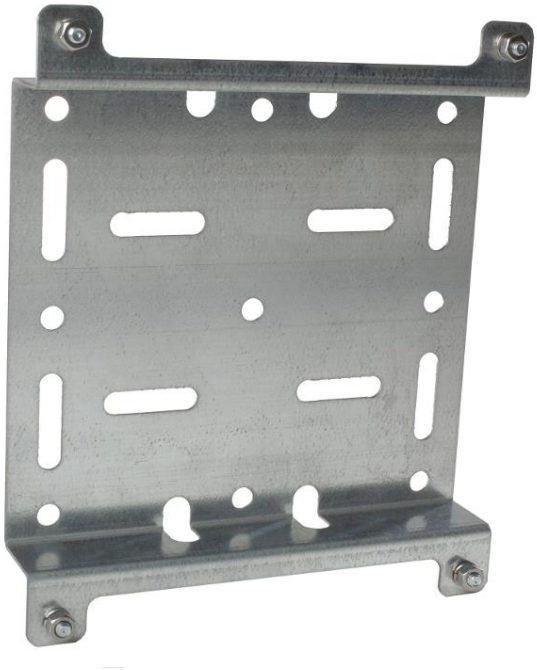


Figure 1 - Universal Mounting Bracket

2.1.1 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, simply use three of the vertically aligned holes. For mounting to a horizontal stud, use one of the three horizontally aligned holes.

2.1.2 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/pipe clamps.

2.1.3 Valve Mount

Wider, shorter slots are provided along the bend to allow the bracket to be secured to a pneumatic valve. Simply 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.

1.1 Gas Connections

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

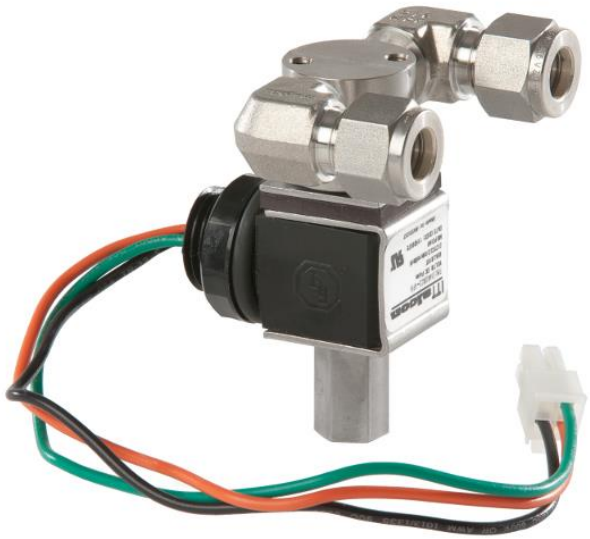


Figure 2 - Valve Solenoid

2.1.4 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.

2.1.5 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.

2.1.6 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.

1.2 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.

1.3 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.

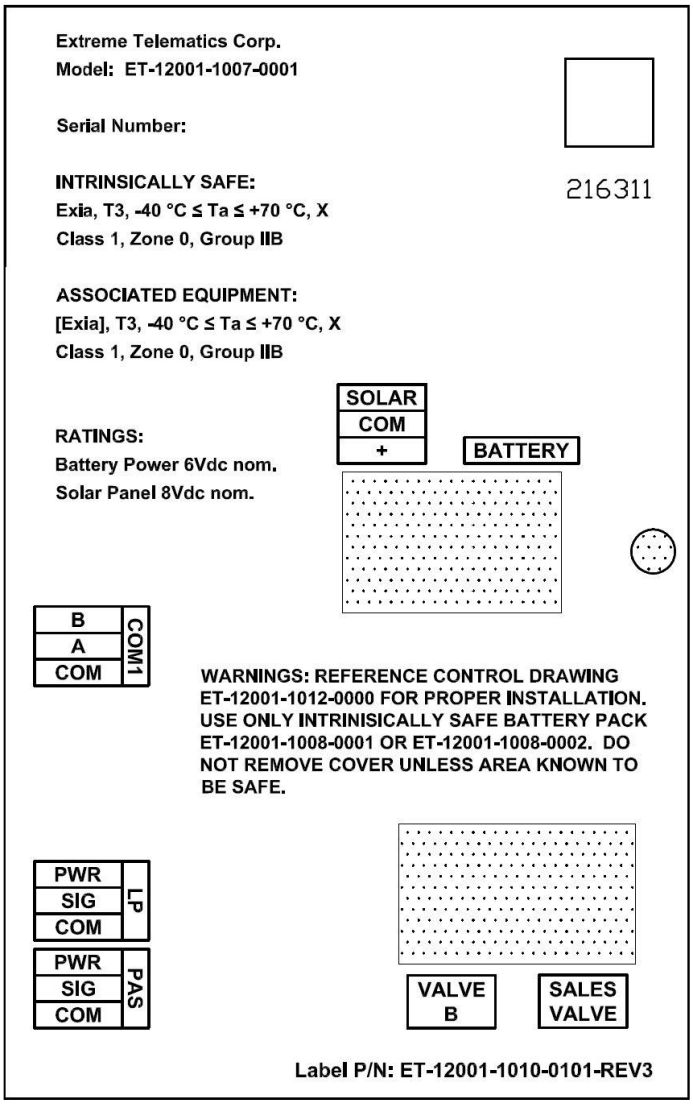


Figure 3 - PIT Boss II Physical Connections

The PIT Boss II model is limited to a maximum of 2 solenoids and has support for a Plunger Arrival Sensor (PAS), Line Pressure (LP), and Modbus Communications (COM1).

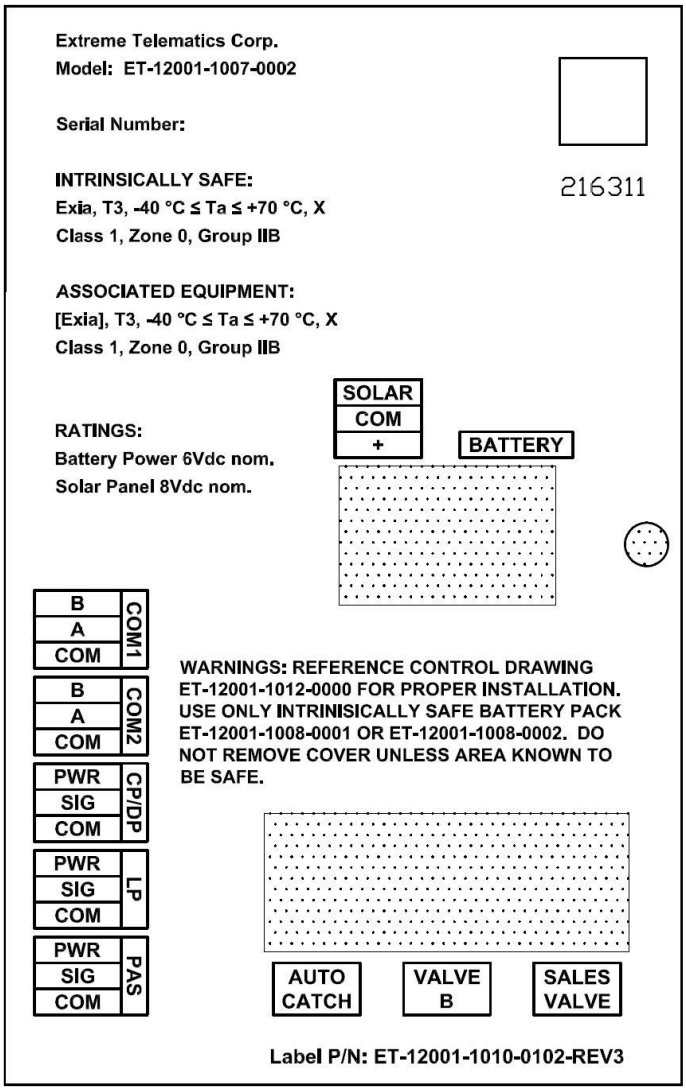


Figure 4 - PIT Boss II Plus Physical Connections

The PIT Boss II Plus has all of the same features as the PIT Boss II, but includes support for an additional solenoid (AUTO CATCH), Casing Pressure or Differential Pressure (CP/DP) and additional Modbus Communication features (COM2).

The following table outlines all of the available connections for both models of controllers.

Table 1 - Electrical Connections Summary

Location	Devices To Connect	Description
Solar	Solar Panel	Use only a 1.1 W ETC Solar Panel

Location	Devices To Connect	Description
Battery	6 V Battery	Use only a 6 V intrinsically safe ETC battery.
Sales Valve	Sales Valve Solenoid	Use only an intrinsically safe ETC approved solenoid.
Valve B	Valve B Solenoid	Use only an intrinsically safe ETC approved solenoid.
Auto Catch	Auto Catch Solenoid	Use only an intrinsically safe ETC approved solenoid.
PAS	Plunger Arrival Sensor	Connect signal and ground of a 2 or 3 wire plunger arrival sensor.
LP	Line Pressure Switch/Sensor	Connect a 2 wire switch to COM/SIG or a 3 wire sensor to all three connections to use line pressure features.
CP/DP	Casing Pressure/ Differential Pressure Switch/Sensor	Connect a 2 wire switch to COM/SIG or a 3 wire sensor to all three connections to use EITHER casing pressure OR differential pressure features.
COM 1	Differential RS485 device	Modbus slave connection Upgrade Port
COM 2	Differential RS485 device	Modbus master connection

2.1.7 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. 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 5 - Solar Panel

Warning: Only ETC 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 section 8.2 Replacement Parts and Accessories for a full list of approved parts.

2.1.8 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.

Warning: Only ETC approved batteries can be used with this controller. Protective components must never be bypassed as it is unsafe to do so. Please refer to section 8.2 Replacement Parts and Accessories for a full list of approved parts.

2.1.9 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 one of 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 ETC approved solenoids can be used with this controller. Using any other solenoid or extending the solenoid wires is unsafe. Please refer to section 8.2 Replacement Parts and Accessories for a full list of approved parts.

2.1.10 Plunger Arrival Sensor

The plunger arrival sensor connection has an unregulated power output that will be related to the battery voltage. As such, it cannot be used with any device that requires exactly 5V. It is recommended that an ETC Cyclops™ is used, but most 2 and 3 wire plunger arrival sensors are supported.

Figure 6 - ETC Cyclops™

If using a 3 wire plunger arrival sensor, connect power, signal and common to the appropriate connections on the terminal block. If using a 2 wire sensor, the power connection is omitted.

2.1.11 Pressure Inputs

Depending on the model, the controller comes with either one (Line) or two (Line and Casing /Differential) pressure 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. As well, the SIG input is expecting to see an input of 0.5 – 4.5 V, which is translated to the appropriate value by the controller.

It is recommended that you only use pressure devices recommended by ETC to ensure the proper operation.

2.1.12 COM Ports

Each controller is equipped with at least one communications (COM) port. Both 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.

COM2 functions as a Modbus Master and communicates with downstream devices. It can be used to retrieve pressure or flow readings, communicate with Modbus enabled plunger arrival sensors, or pass data through to a downstream controller.

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:

- Set the outputs to a known state
- Close all valves
- Load all previously saved values
- Turn on the display
- Set the display to show the current controller state.

The controller automatically enters the Close state when powering up.

4 User Interface

4.1 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 used to show the current state of the controller as well as a menu that allows for the controller settings to be modified.

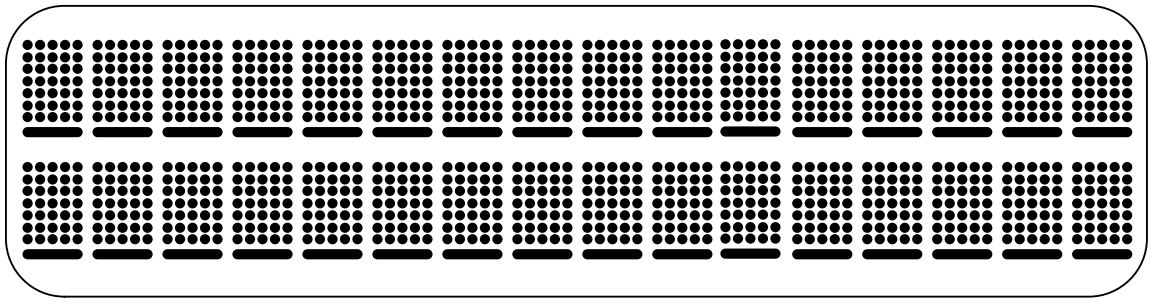


Figure 7 - Screen Layout

4.1.1 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.

4.1.2 Automatic Log Out

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.

4.2 Keypad

An integrated keypad is included which allows the user to change settings, navigate through statistics, and control the well. The following sections discuss the various keys that are available.

4.2.1 Numeric/Navigation Keys

The numeric keys as well as the enter key are used to navigate through the menus and to enter values.

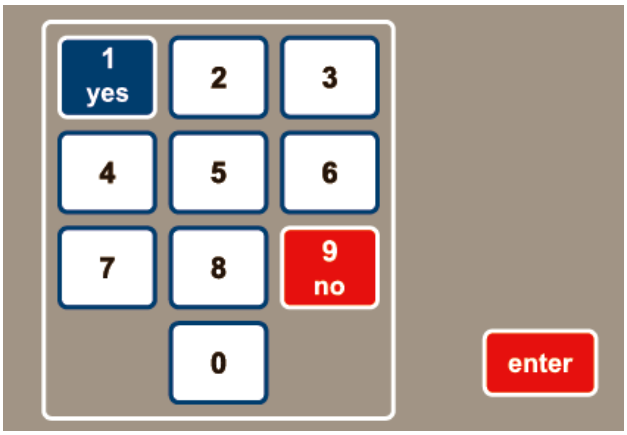


Figure 8 – Numeric/Navigation Keys

4.2.1.1 Yes/No

The *yes/no* keys are used to answer yes or no to a given configuration question. As well, the *yes* key is used to start editing a value. For example, if the user is currently in the Adjust Settings Menu and is viewing the *Close Time*, pressing *yes* will start editing the *Close Time*.

4.2.1.2 Numeric Keys

While in a menu (which is achieved by pressing *menu*), the numeric keys are used to select the sub menu to enter. As well, the numeric keys are used to enter values for timers and other numeric settings. If the user starts editing (by pressing *1*) a numeric value, the value will be blanked and the new value can be entered. Be aware that all blank spaces must be filled in. This means that any leading zeros must be entered.

4.2.1.3 Enter

The *enter* key is used to move downward through the menus. If the user is viewing a timer in the Adjust Settings menu, pressing *enter* will advance them to the next timer. If the desired setting is passed, re-enter the menu and press *enter* multiple times until the desired setting is displayed.

4.2.2 Hot Keys

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

Figure 9 - Hot Keys

4.2.2.1 Close

Pressing c*lose* will send the controller to the close state, closing all valves.

4.2.2.2 Open

Pressing o*pen* will send the controller to the open portion of the cycle. The action that is taken depends on the number of valves configured, how they are set to operate, and if there are any special checks required, such as casing and/or line pressure. The normal mode of operation is to go to Wait Arrival, which opens the Sales Valve and waits for a plunger arrival to occur.

4.2.2.3 Status

The *status* key sends the display back to the main status screen. This shows the current controller state as well as the time remaining in the current state.

4.2.2.4 History

The *history* key provides access to the history menu. This contains information about the number and type of cycles, production information and plunger statistics. More detail can be found in 5.2.9 History Menu.

4.2.2.5 Menu

The *menu* key provides access to the settings menu. This menu is the main area to setup all controller parameters. It has been broken up into a number of sub-menus that are indexed with a single digit number.

Figure 10 - Settings Menu

More detail can be found in 5.3 Main Menu (Menu Button).

4.3 Status Screens

A menu is provided that allows the user to view current controller information.

Figure 11 - Status Screens

Scrolling down (pressing enter) from the status screen that appears on startup will take you through the available status screens. Information such as the cycle type, start time, and the current date/time are displayed here.

4.3.1 Current State Screen

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

4.3.2 Cycle Information Screen

This screen shows the information for the last cycle. This includes the type of cycle (Ok, Fast Trip, Non Arrival, etc…) as well as the time that the cycle started.

4.3.3 Current Date/Time Screen

This screen simply shows the current date and time. If this information is incorrect, the user may 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.

4.3.4 Battery Status Screen

This screen shows the current battery voltage. It also shows an indicator representing the current level of the battery in the top right corner. If the battery is currently being charged, a lightning bolt symbol will be displayed.

4.3.5 Solar Status Screen

The current solar voltage is displayed. Although voltage may be present, the battery will not be charged under the following conditions:

- The solar voltage is below the battery voltage
- The battery is full

4.3.6 Valve Status Screen(s)

Each enabled valve is shown on these screens. The screen shows whether the valve is currently open or closed.

4.3.7 Device Status Screen(s)

There are several device screens, one for each input device. Each screen will show the name of the device and its current reading. Please be aware that this may not be updated as soon as a change is made. Enabling some devices may not take effect until the next cycle starts. This can be achieved by pressing open or repowering the controller. Information for each device is only shown if that device has been enabled.

4.3.8 Version/Serial Number

This screen shows controller information. The top line shows the firmware version running on the controller. The bottom line shows the serial number of the controller. This information is required to enable product features or to obtain support.

5 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.

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

5.1 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.

5.1.1 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.

5.2 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.

5.2.1 Intermitting

The controller is designed to act as a well intermitter in the most basic configuration. In this case, a plunger is not present in the well.

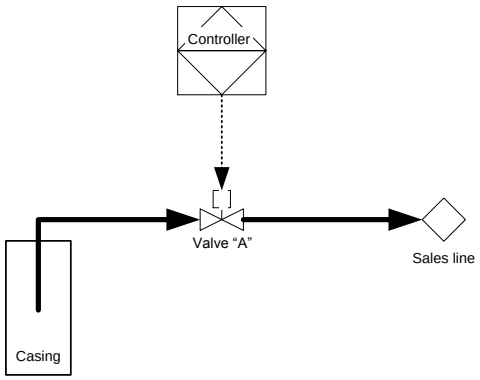


Figure 12 - Well Intermitting

In this configuration, Valve A is opened and closed based on a simple timer setup. The *Close* and *Afterflow Times* are used to determine when to open and close the well. The *Arrival Sensor Device Type* must be *Disabled* for the controller to act as a simple well intermitter.

At the start of the cycle, Valve A is closed and the *Close Time* is started. When the *Close Time* expires the controller moves to Afterflow and the *Afterflow Time* is started. Once this timer expires, the controller moves back to Close and the valve is closed, restarting the cycle.

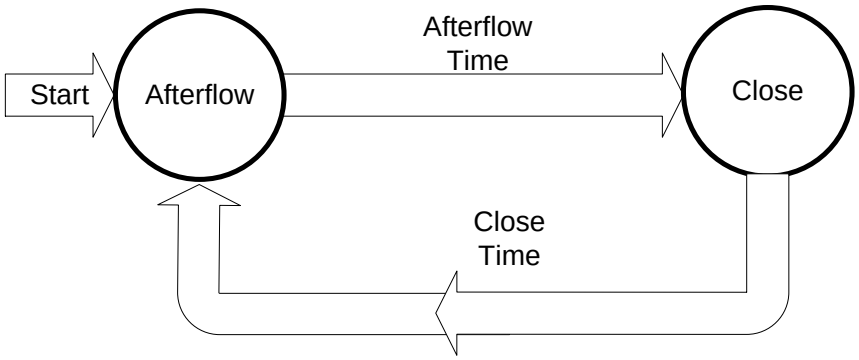


Figure 13 - Basic Controller States

5.2.2 Arrival Sensor Operation

The plunger lift controller is designed to operate primarily in the following plunger lift configuration:

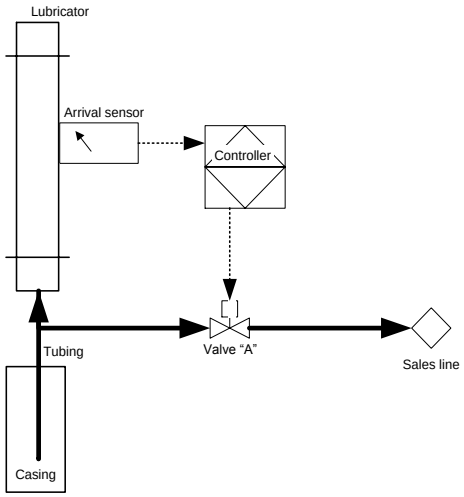


Figure 14 - Arrival Sensor Operation

In this application, a plunger travels between the bottom of the well tubing and the lubricator. The purpose of the plunger is to lift fluids which accumulate at the bottom of the well tubing. The lubricator acts as a trap for the plunger when it arrives at the surface and is fitted with an *Arrival Sensor*. The *Arrival Sensor* acts as a switch, closing its contacts as the plunger arrives.

When the valve is closed, the plunger falls to the bottom of the well tubing. After the expiry of the *Close Time*, Valve A is opened, and the pressure in the gas formation drives the plunger and any accumulated fluids to the top of the well tubing. As the plunger arrives, the controller transitions to Afterflow. On expiry of the *Afterflow Time*, Valve A is closed and the cycle repeats.

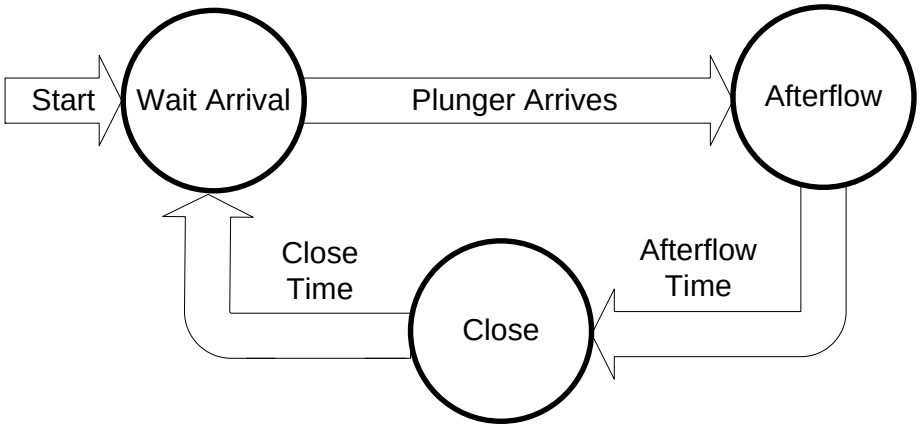


Figure 15 - Controller Operation with Arrival Sensor

5.2.2.1 Non-Arrival

If the plunger fails to arrive within the *Wait Arrival Time*, a non-arrival cycle is recorded. In this case, the controller returns to the Close portion of the cycle, skipping Afterflow. After a pre-determined number of *Non-Arrivals*, the controller will move into a Backup Close state, which will close the well for an extended period of time defined by *Backup Close Time*.

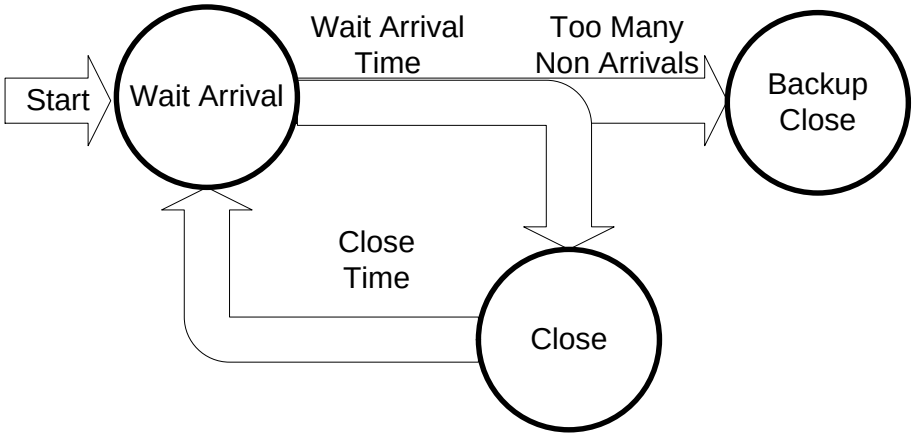


Figure 16 - Non-Arrival

5.2.2.2 Backup Close

If the number of consecutive non-arrivals reaches the *Non-Arrival Count*, the controller will move into Backup Close and the *Backup Close Time* will be started. The Backup Close Time is an extended period of close time that is used to create additional build-up prior to opening the well. If the plunger continues to not arrive within the *Wait Arrival Time*, the Backup Close will be executed each cycle and a Backup Fail will be declared. Once the *Backup Fail Count* is reached, the controller will shut in the well, advance to the Stopped state, and wait for operator intervention.

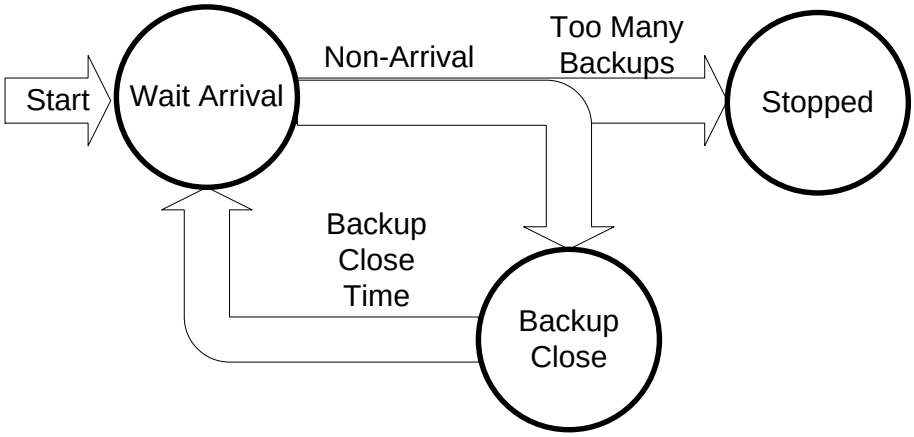


Figure 17 - Backup Close

5.2.2.3 Fast-Trip

If the plunger arrives within the *Fast-Trip Time*, a fast-trip, cycle is declared. This may occur if the plunger did not fall to the bottom of the well during the Close portion of the last cycle and the plunger returns to the surface dry. When a fast trip occurs, the controller proceeds to the Afterflow portion of the cycle. After a predetermined number of fast trip occurrences, the controller will move to the Stopped state and waits for operator intervention to protect the well.

Any arrivals in the first 10 seconds of the *Wait Arrival Time* are ignored. This delay helps to avoid a glitch from some arrival sensors that send out a signal when they are powered up. The controller only powers on the arrival sensor when expecting an arrival, which helps to reduce power consumption.

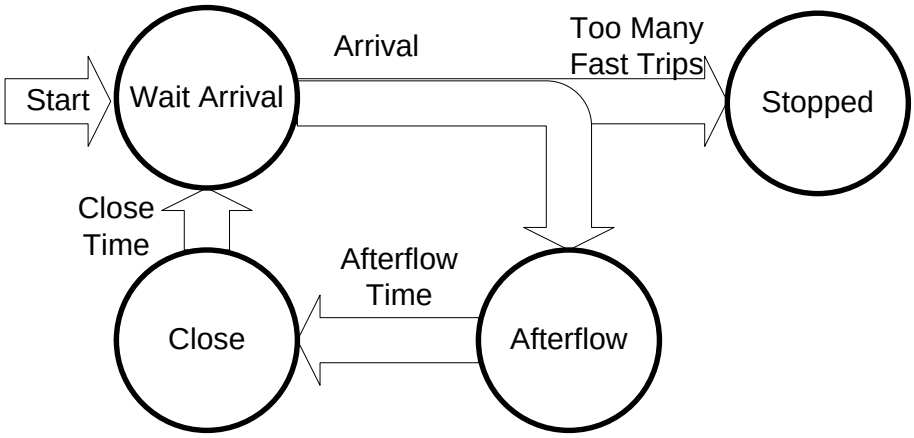


Figure 18 - Fast Trip

5.2.3 Line Pressure

The well may be equipped with a line pressure switch or sensor. This device is configured to be "tripped" when the pressure in the sales line exceeds a pre-determined threshold.

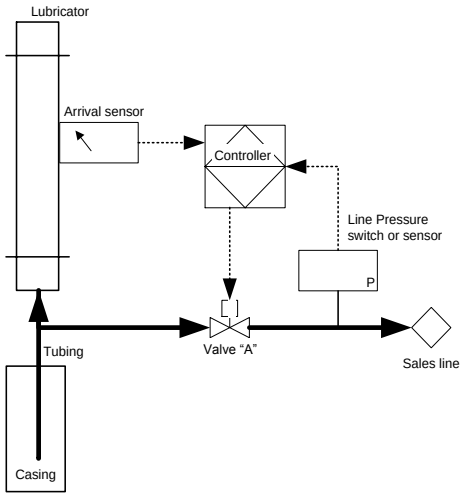


Figure 19 - Using Line Pressure

The controller monitors the state of the switch just before the Wait Arrival portion of the cycle. The cycle is delayed if the pressure is too high. It is also monitored during the Afterflow portion of the cycle. The well is shut-in if the pressure is high.

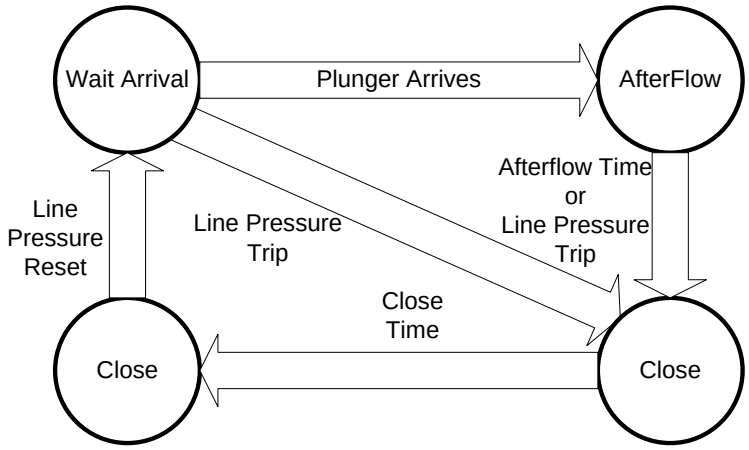


Figure 20 - Line Pressure Cycle

5.2.4 Pressure Optimization (The PIT Boss II Plus)

In addition to the line pressure switch/sensor, the well may be equipped with a casing pressure switch/sensor and/or a flow differential pressure switch/sensor.

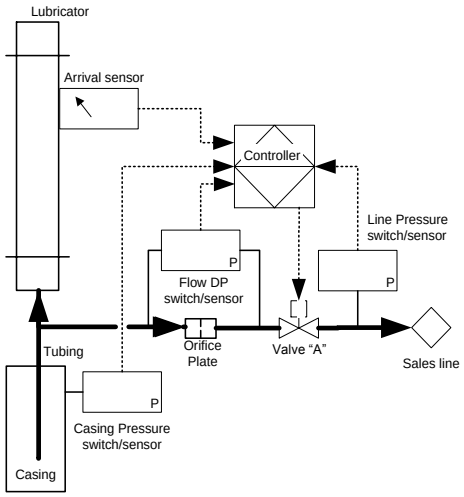


Figure 21 - Pressure Based Optimization

The following table describes the different optimization schemes that are used depending on the devices that are enabled.

Table 2 - Pressure Optimization Modes

Line Pressure	Casing Pressure	Flow DP	Optimization
disabled	disabled	disabled	none
disabled	disabled	switch	1
disabled	disabled	sensor	2
disabled	switch	disabled	3
disabled	sensor	disabled	4
switch	disabled	disabled	none
switch	disabled	switch	1
switch	disabled	sensor	2
switch	switch	disabled	3
switch	sensor	disabled	4, 6
sensor	disabled	disabled	none
sensor	disabled	switch	1

Line Pressure	Casing Pressure	Flow DP	Optimization
sensor	disabled	sensor	2, 5
sensor	switch	disabled	3
sensor	sensor	disabled	6, 7

1. Stay in Afterflow until the *Afterflow Time* expires AND: the *Max Open Time* expires or the Flow DP switch trips.
2. Stay in Afterflow until the *Afterflow Time* expires and: the *Max Open Time* expires or the Flow DP drops below an operator-entered threshold.
3. Monitor the Casing Pressure switch after the *Close Time* expires. Stay shut-in while the Casing Pressure switch is tripped.
4. Monitor the Casing Pressure sensor after the *Close Time* expires. Stay shut-in while the Casing Pressure is below an operator-entered set-point.
5. During Wait Arrival, Afterflow: Calculate the Flow Rate using a simplified orifice meter formula. Stay in Afterflow until the *Afterflow Time* expires. Stay in Afterflow until the *Max Open Time* expires or the Flow Rate drops below an operator-entered threshold. Calculate and save daily production volumes based on the calculated flow rate.
6. During Afterflow: Monitor the Casing Pressure.[1] Keep the well flowing until the *Afterflow Time* expires AND: the *Max Open Time* expires or the Casing Pressure falls below a set point (Absolute) or the rate of fall drops below a set point and a timer expires (Rate Drop). See diagram below. Other algorithms are also available to monitor Casing Pressure in the Afterflow portion of the cycle.
7. During Close: After the *Close* or *Backup Close Time* expires, monitor the Casing/Line differential pressure. Start a new cycle when the Casing/Line pressure difference exceeds an operator-entered threshold.

[1] Do not monitor Casing and Line pressure sensors within the *Arrival Guard* time of plunger arrival.

The following diagram illustrates the controller behaviour when using various extended flow devices.

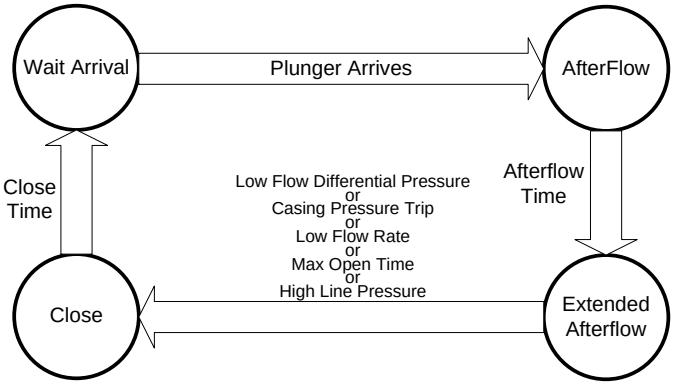


Figure 22 - Extended Afterflow Optimization

Please note that if an Extended Afterflow device trips during the Afterflow portion of the cycle, the Afterflow will be completed before terminating the flow and going back to Close. To specify a period of time where Extended Afterflow devices are allowed to settle out, configure the Arrival Guard Time.

5.2.4.1 Casing Pressure

Casing Pressure can be used on its own or in combination with Line Pressure. This section discusses how Casing Pressure can be used on its own. Some of the optimization schemes behave the same when Line Pressure is turned on, while others will cause the controller to switch to using Casing Line Differential Pressure. The following controller actions will only take place if a Casing Pressure device has been enabled.

5.2.4.1.1 Close

The Casing Pressure is not monitored until the end of the Close portion of the cycle. Once the *Close Time* or *Backup Close Time* has expired, the well will be held closed until the Casing Pressure device has been reset.

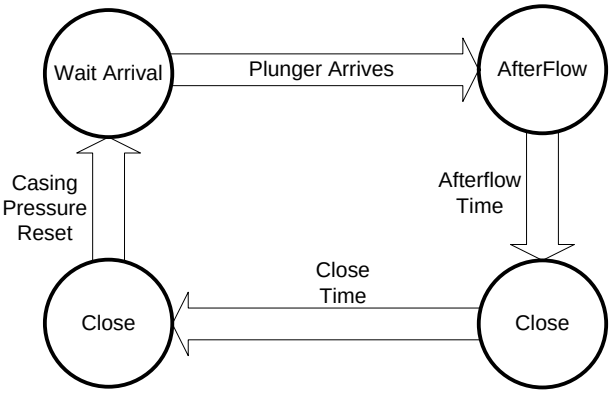


Figure 23 - Casing Pressure Close Cycle

If a switch is used, it must be in the reset position and must stay there for at least the *Close Casing Pressure Stable Time*. If the *Casing Pressure Device Type* is configured as a *sensor*, then the sensor value must exceed the *Close Casing Pressure Reset Point* and stay there for at least the *Close Casing Pressure Stable Time*.

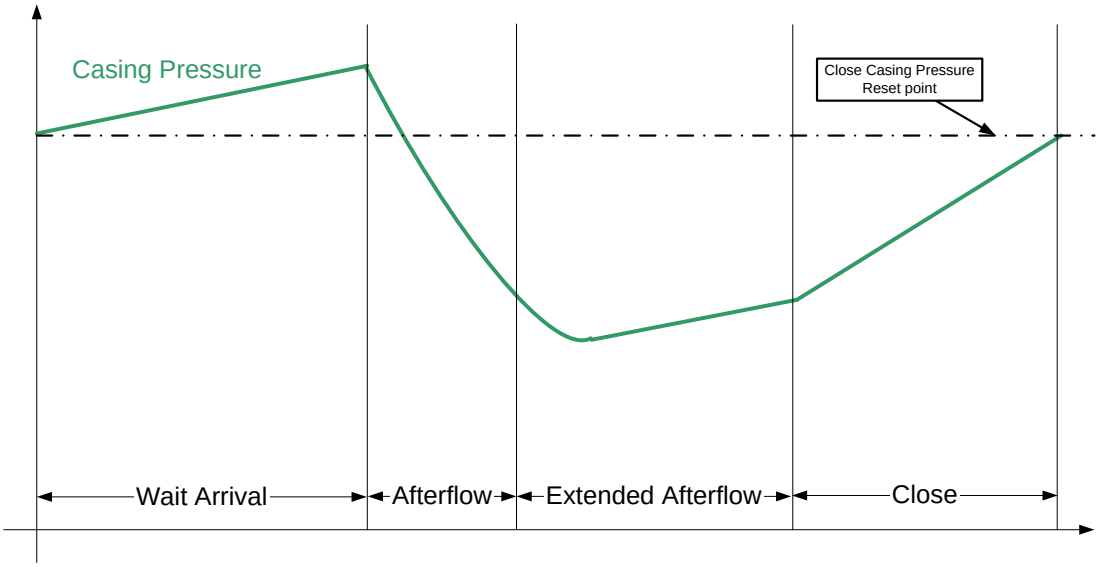


Figure 24 - Close Casing Pressure Reset Point

5.2.4.1.2 Afterflow/ Extended Afterflow

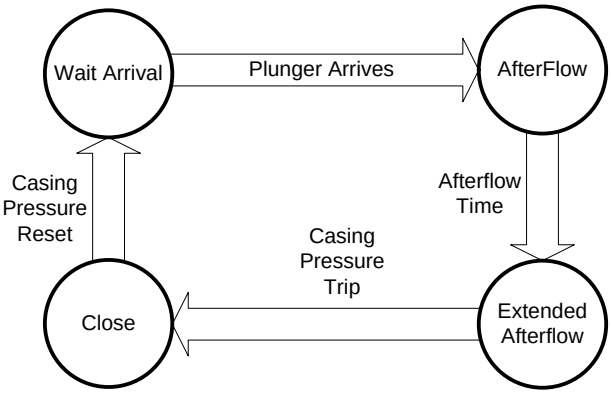


Figure 25 - Afterflow/Extended Afterflow Casing Pressure

During the Afterflow portion of the cycle, the Casing Pressure is monitored one of two different ways if the *Casing Pressure Device Type* has been configured as a *sensor*. If the Casing Pressure trips during Afterflow, the well is closed as soon as the *Afterflow Time* expires. If the Casing Pressure has not tripped by the end of the *Afterflow Time*, then the Casing Pressure will continue to be monitored during the Extended Afterflow portion of the cycle. A trip during the Extended Afterflow portion of the cycle will cause the well to be closed once the applicable

Stable Time has been met. The following sections describe the different Casing Pressure monitors that can be configured.

5.2.4.1.2.1 Absolute

This method simply looks for a drop in the Casing Pressure. Once the Casing Pressure drops below the *Afterflow Casing Pressure Trip Point* and stays there for at least the time defined by the *Afterflow Casing Pressure Stable Time*, the well will be shut in.

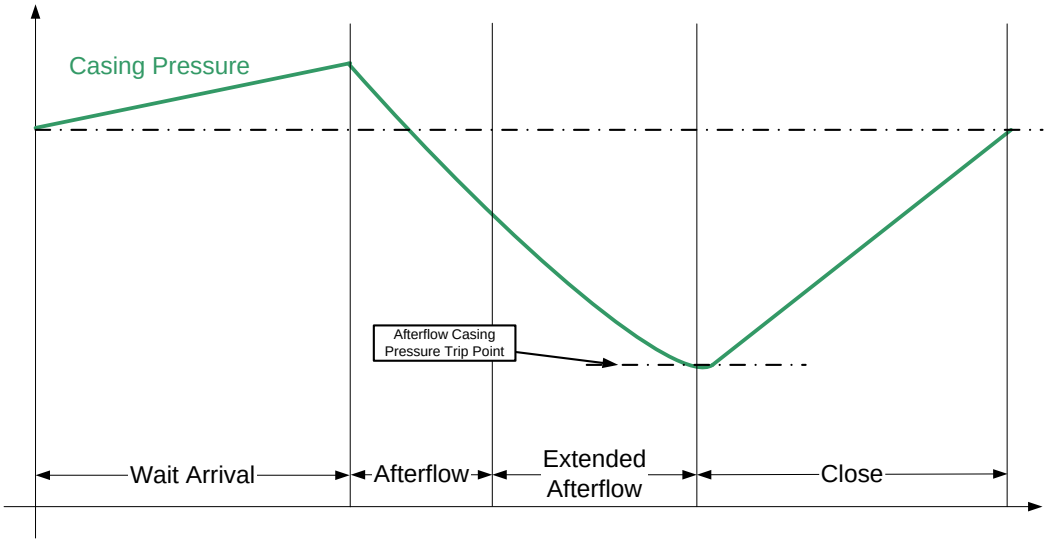


Figure 26 - Casing Pressure Absolute Method

5.2.4.2 Casing Line Differential Pressure

If a Casing Pressure Sensor and a Line Pressure Sensor are both enabled, Casing Line Differential Pressure will be used to determine when the controller can move from Close to Open. The difference will be taken between these two values and then compared to the *Close Casing Line Differential Pressure Reset Point*. Once the differential exceeds the reset point and stays above it for at least the *Close Casing Line Differential Pressure Stable Time*, the well will open. Please note that casing pressure alone is used when determining when to go from open to close.

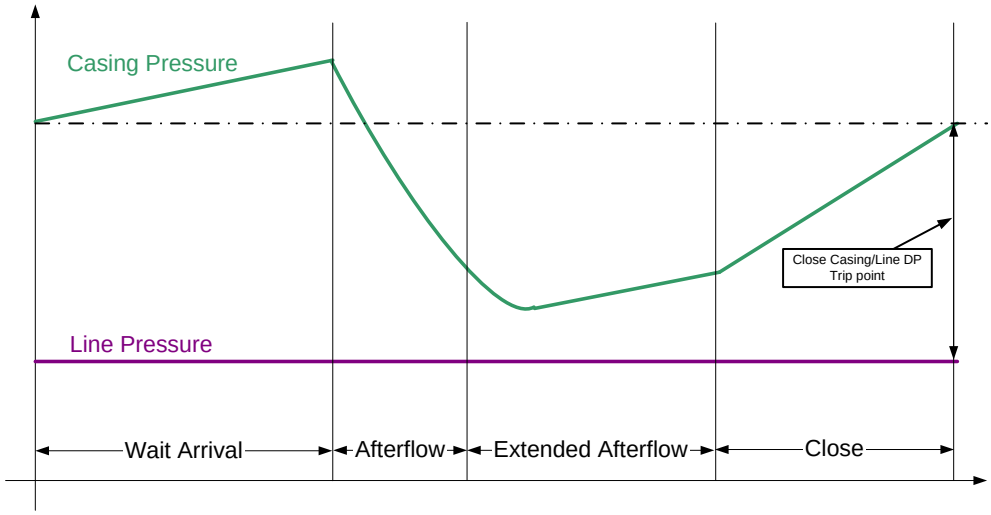


Figure 27 - Close Casing Line Differential Trip

5.2.4.3 Flow Differential Pressure

Flow Differential Pressure Device Type can be configured as either a switch or sensor. When it is configured as a switch, it will automatically drop out of Extended Afterflow when the switch trips. A trip indicates that the differential is below a trip point set externally. The differential is proportional to the flow. A drop in flow is represented as a drop in differential. As the well begins to water in, the differential will decrease.

When the *Flow Differential Pressure Device Type* is enabled as sensor, the controller will behave in the same manner. The difference is that the *Flow Differential Pressure Trip Point* and *Flow Differential Pressure Reset Point* must be configured to tell the controller when to shut in the well. If a Line Pressure sensor is used in conjunction with a Flow Differential Pressure Sensor, then a flow rate can be estimated. Please refer to the Flow Rate section below.

5.2.4.4 Flow Rate

When the Flow Rate is available, Afterflow Time of the controller is optimized. The well is shut-in when the Flow Rate drops below the *Flow Rate Trip Point* and remains there for at least the *Flow Rate Stable Time*.

The Flow Rate value is also used to provide an estimated daily production. The flow is summed over time and the resultant production numbers are shown in the daily logs, which can be viewed by pressing the History hot key and selecting the daily or total production menu.

The flow rate can be calculated if a Line Pressure sensor and a Flow Differential Pressure Sensor are used. This method will require a set of orifice plate parameters to be. A Meter Factor is derived from a look up table using the *Meter Run Size* and *Orifice Plate Size*. The *Gas Temperature* and *Gas Specific Gravity* are entered by the installer and are NOT updated real time. This calculation will provide an estimated flow that can be used for optimization. Please note that the production values that are derived from the calculation are not suitable for custody transfer.

5.2.5 Timer Based Optimization

Timer Based Optimization allows the well to be optimized based on the arrival time of the plunger, which is derived from the plunger velocity. The average[2] plunger arrival time is compared to a *Target Rise Time* and adjustments are made to the flow time or shut in time of the well in order to optimize the performance of the well. The objective of this optimization is to cause the plunger to arrive at the *Target Rise Time*.

Adjustments are made directly to the *Afterflow Time* and/or the *Close Time*. Each of these times are bounded by a minimum and maximum time to prevent the timers from going to zero or escalating beyond reasonable limits.

5.2.5.1 Optimization Modes

There are 3 different time optimization modes in the PIT Boss II. Each mode specifies whether the *Afterflow Time*, *Close Time*, or both times are manipulated.

5.2.5.1.1 Gas

This optimization mode will manipulate the *Afterflow Time* only. If the plunger arrives too soon (fast), the *Afterflow Time* is increased, allowing more production and additional fluids to accumulate. If the plunger arrives too late (slow), the *Afterflow time* is decreased, causing the plunger to make more frequent trips to remove fluids from the well.

5.2.5.1.2 Oil

This optimization mode will manipulate the *Close Time* only. If the plunger arrives too soon (fast), the *Close Time* is increased, reducing production while allowing additional fluids to accumulate. If the plunger arrives too late (slow), the *Close time* is decreased, causing the plunger to make more frequent trips to remove fluids from the well.

[2] The PIT Boss controller calculates a weighted average that consists of the last 3 arrival times (with the most recent time given double the weight) to obtain the arrival time used for optimization.

5.2.5.1.3 Oil Then Gas

This optimization mode will manipulate the *Close Time* first. Once there is no more room for the *Close Time* to adjust (i.e. We have reached the *Minimum Close Time* or *Maximum Close Time*), then the *Afterflow Time* is adjusted.

5.2.5.2 Optimization Adjustment Type

The aggressiveness of the adjustments is controlled by the *Optimization Adjustment Type*. This setting directly controls the magnitude of the adjustments that are made. Each adjustment type is described below.

5.2.5.2.1 Escalate

Escalate configures the adjustment so that is proportional to the amount of *Afterflow Time*. The larger the Afterflow Time is, the larger the adjustments that are made.

5.2.5.2.2 1:1

For every **one** minute the average arrival time is faster/slower than the *Target Time*, the controller adds/subtracts **one** minute of *Afterflow/Close Time*.

5.2.5.2.3 2:1

For every **one** minute the average arrival time is faster/slower than the *Target Time*, the controller adds/subtracts **two** minutes of *Afterflow/Close Time*.

5.2.5.2.4 3:1

For every **one** minute the average arrival time is faster/slower than the *Target Time*, the controller adds/subtracts **three** minutes of *Afterflow/Close Time*.

5.2.5.3 Backup to Afterflow

The Backup to Afterflow feature allows the Installer to specify how a Backup event impacts the *Afterflow Time* when using time optimization. On a backup, the *Afterflow Time* can be left at its current value, reduced to the *Minimum Afterflow Time*, or reduced by a percentage of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*.

5.2.5.3.1 Min Afterflow

The *Afterflow Time* is set to the *Minimum Afterflow Time*.

5.2.5.3.2 25%

The *Afterflow Time* is reduced by 25% of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*.

5.2.5.3.3 50%

The *Afterflow Time* is reduced by 50% of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*..

5.2.5.3.4 75%

The *Afterflow Time* is reduced by 75% of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*..

5.2.5.3.5 No Change

The *Afterflow Time* is not adjusted.

5.2.6 Dual Valve

The well may also be equipped with a second valve (Valve B). This valve may be installed in one of 3 configurations. These configurations are illustrated and described below.

5.2.6.1 Top Valve

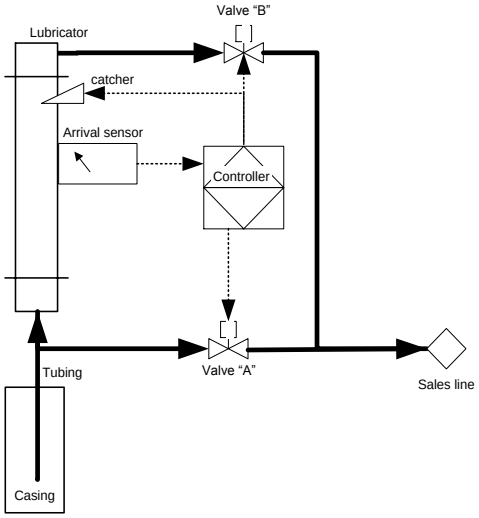


Figure 28 - Top Valve Well Configuration

Valve B must be set to *line: open A* in order to operate the controller in a Top Valve configuration.

During the Wait Arrival portion of the cycle, Valve B is open and Valve A is closed. The location of Valve B is such that the plunger will be driven fully into the lubricator upon arrival without requiring excessive (i.e. sub-optimal) velocity. A short time (*Afterflow Delay Time*) after the plunger arrival, Valve A is opened and Valve B is closed. The location of Valve A causes the Plunger to be held within the Lubricator while gas is flowing with sufficient pressure. In this configuration, the well may be equipped with an auto catch which is driven from the Valve B gas supply line.

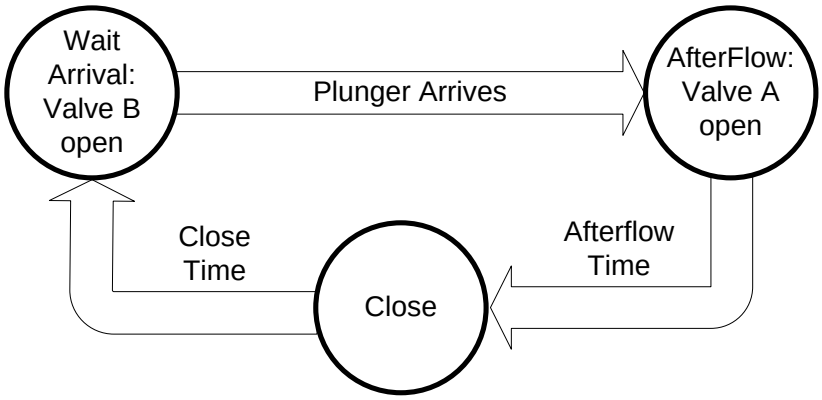


Figure 29 - Top Valve Operation

5.2.6.2 Flow Tee

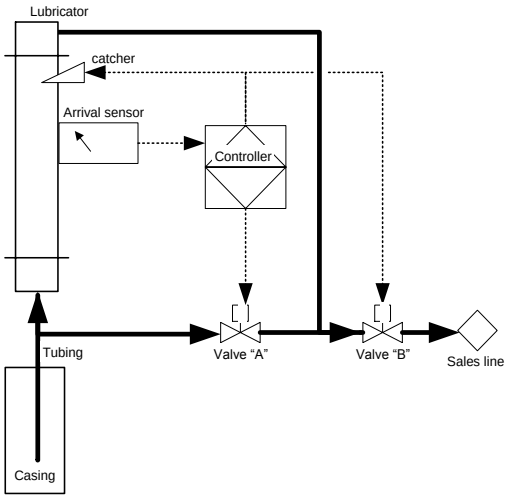


Figure 30 - Flow Tee Well Configuration

The Top Valve configuration has the disadvantage of requiring that a valve gas control line be installed between the separator shack and well-head. To avoid this, a Flow Tee configuration is often used. Operation is the same as for the *Top* valve except that, in the Afterflow portion of the cycle, both valves are left open.

To achieve this configuration, *Valve B* must be set to *line: open A&B*.

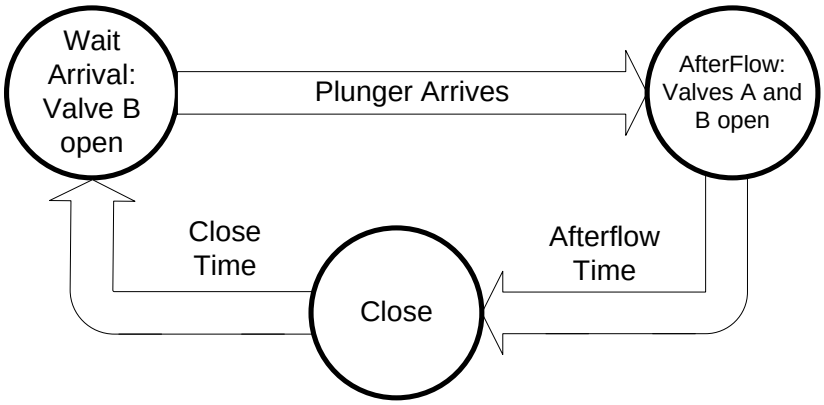


Figure 31 - Flow Tee Operation

5.2.6.3 Tank Valve

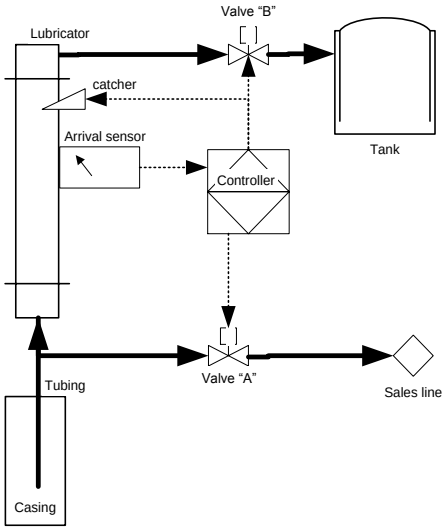
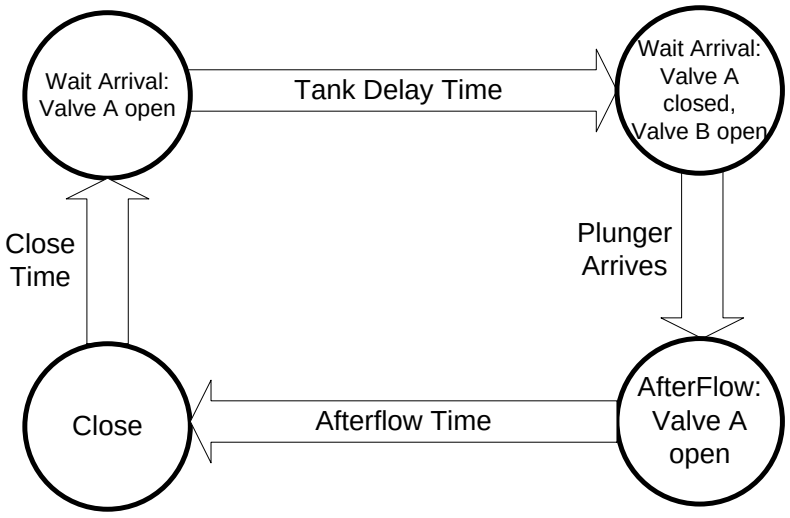


Figure 32 - Tank Valve Well Configuration

If Valve B is connected to a Tank, Valve A is opened at the start of the Wait Arrival portion of the cycle. If the plunger does not arrive within the *Tank Delay Time*, then the valves are toggled (i.e. simultaneously open Valve B and close Valve A). When the plunger arrives, the valves will be toggled again. The purpose of the tank is to assist in plunger lift by exerting less back pressure on the well tubing than that exerted from the sales line.

To achieve this configuration, *Valve B* must be set to *tank*.



5.2.7 Auto Catch (The PIT Boss II Plus)

The PIT Boss II Plus has the ability to run a pneumatic Auto Catch. By default, the Auto Catch is not used and a pulse will not be delivered. If you wish to use the Auto Catch, it must first be enabled.

5.2.7.1 Auto Catch Modes of Operation

The Auto Catch can be enabled to perform two different ways.

5.2.7.1.1 On Wait Arrival

The Auto Catch will be engaged as soon as the *Wait Arrival Time* is started.

5.2.7.1.2 On Arrival

The Auto Catch will be engaged as soon as the plunger arrival has been detected.

5.2.7.2 Catch Hold Time

The *Catch Hold Time* parameter tells the controller how long to hold the plunger at surface after the sales line has been closed. This can be disabled by setting this parameter to zero. If the value of this timer is non-zero, then a timer is started as soon as the sales line is closed. Once the timer expires, the Auto Catch will be released, allowing the plunger to fall.

5.2.8 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 then go into a 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.

2 Menu Reference

2.1 Hot Key Menus

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

5.2.9 History Menu

5.2.9.1.1 Daily Production

The controller maintains production statistics which are written to persistent memory when the current time-of-day passes the *Day Start* parameter. A total of 8 daily production logs can be stored. This consists of the current day, plus the previous 7 days. When the day crosses over, a new day starts, all days are shifted by one location, and the oldest day is removed. The following information is available in the Daily Production menu:

Table 3 – Daily Production 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.
Volume	This shows the total volume for the given day. This is represented as e^3m^3. This screen is only available when flow is being measured.
Open/Close Time	Displays the total time that the well has been open and the total time the well has been closed for the day.
Cycle Counts	There are a number of screens that are used to display all of the cycle types for the current day.
End of Log	This screen is a read only screen that signifies the end of the log.
Reset Time	This indicates the last time that the log was reset.
Reset Log	This resets the Daily Production History.
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.

5.2.9.1.2 Cycle Log

One cycle log entry is a history of a given cycle that the plunger went through. A cycle log entry is written at the end of a cycle, which is defined as the point when the controller finishes the

Close Time. Therefore, the controller will write the first cycle log entry after the controller starts and the initial *Close 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 in the cycle log:

Table 4 - Cycle Log Screens

Screen	Description
Cycles in Log	This indicates the number of cycles that exist in the 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: o Normal o Fast-trip o Non-Arrival o Max Open o Line Pressure Shut-In o Low Battery Shutdown o Operator Change o Start Up
Rise Duration	This value shows the time that it took the plunger to come to surface once the well was opened. This screen is not displayed if the arrival sensor has been disabled.
Afterflow Duration	This is the total *Afterflow Time* for this cycle. It is the total of *Afterflow* and *Extended Afterflow Time*.
Close Duration	This is the amount of *Close Time* for the given cycle. It may be longer than the specified *Close Time* if the well is held in close by devices such as line pressure or casing pressure.
Minimum Afterflow	This is the value of casing pressure that caused the well to go from open to close. This screen is only displayed if Pressure Based

Casing Pressure	Optimization is being used and the Casing Pressure device is configured as a sensor.
Avg Vel	This is the Average Velocity of the Plunger during the rise cycle
Srf Vel	This is the Surface Velocity of the Plunger as captured by the Plunger Velocity Sensor if enabled.
End of Log	This screen is a read only screen that signifies the end of the log.
Reset Time	This indicates the last time that the log was reset.
Reset Log	This resets the Cycle Log.

5.2.9.1.3 Total Production

The Total Production History provides a summary of the total production of the well. The total production is saved to persistent memory at the end of each cycle and is restored when the controller restarts after a power loss.

The following screens are available in the Total Production History:

Table 5 – Total Production Screens

Screen	**Description**
Volume	This shows the total volume produced. This is represented as e^3m^3.
Open/Close Time	Displays the total time that the well has been open and the total time the well has been.
Cycle Counts	There are a number of screens that are used to display all of the cycle types.
Reset Time	This indicates the last time that the log was reset.
Reset Log	This resets the Total Production History.

5.2.9.1.4 Plunger Statistics

The Plunger Statistics Log shows a number of key pieces of information about the plunger. This can be used to determine plunger wear and help the user to schedule maintenance.

The items available in this log are:

Table 6 – Plunger Statistics Log

Screen	Description
Distance Travelled	Indicates the distance in km that the plunger has travelled.
Arrivals	Displays the number of plunger arrivals since the last reset.
Reset Log	This resets the Plunger Statistics back to 0.

5.3 Main Menu (Menu Button)

By pressing menu on the keypad, the user will see a list of available menu items, which will automatically scroll. Each item is prefaced with a number. Press the number for the desired menu. Once a menu has been selected, pressing *enter* will scroll down through the available settings.

Please note that some menu items do not appear by default. Some are dependent on an operator/installer being logged in. Other menu items will not appear unless a particular feature has been enabled. The default login is 000-0000, but can be changed in the System Menu.

5.3.1 Adjust Settings Menu (Menu 1)

The Adjust Settings menu contains a list of timers and basic settings that control how long the well is open/closed, what constitutes a fast trip, and how long the controller waits for an arrival. The following is a list of the settings that are available in this menu:

Table 7 - Adjust Settings Menu Screens

Screen	Description	Default Value
Fast Trip Time	This time is used to indicate that the plunger did not likely fall to the bottom of the well, is hanging up on wax/hydrates, or that insufficient fluid is being brought up. The default value is based on a 730 m/minute travel speed. The well will be shut-in if a set number of consecutive fast trips have occurred. Not used if the *Plunger Arrival Sensor* is disabled.	0h01m22s

Screen	Description	Default Value
Target Rise Time	This is the time that the plunger is expected to arrive after the well has been opened. It is only used when running Timer Based Optimization. The controller will increase or decrease the *Afterflow Time* or *Close Time* in order to try and cause the plunger to arrive at the *Target Rise Time*. Not used if the *Plunger Arrival Sensor* or Timer Based Optimization is disabled.	0h04m41s
Wait Arrival Time	This time indicates the maximum amount of time that the controller should wait for the plunger to arrive. If the plunger does not arrive, the controller will go to either Close, Backup Close, or shut in the well. The action taken depends on the number of non-arrivals or backups that have previously occurred. The intent is to allow extra pressure to build in order to lift the plunger on the next cycle. The Wait Arrival Time may not be set to zero. Not used if the *Plunger Arrival Sensor* or Timer Based Optimization is disabled.	0h14m03s
Afterflow Time	The *Afterflow Time* defines the amount of flow time after the plunger arrives. This portion of the cycle is terminated when *Afterflow Time* expires. When "extended-afterflow"[3] devices are enabled, the controller will advance to Extended-Afterflow instead of Close if none of the devices have already tripped.	1h00m00s

[3] The "Extended-Afterflow" devices are:
- Casing Pressure Switch/Sensor
- Flow Differential Pressure Switch/Sensor
- Flow Switch/Sensor/Virtual

Screen	Description	Default Value
Max Open Time	This is the maximum time that a valve will remain open in a given cycle. If non-zero, must be greater than the Wait Arrival time. Not used if set to zero or if the *Plunger Arrival Sensor* is disabled or extended flow devices are not enabled.	999h59m59s
Close Time	This determines the normal duration of the Close portion of the cycle.	0h21m52s
Backup Close Time	This is an Extended period of close time that is used to create an additional build-up prior to opening the well. The *Backup Close Time* will only run after the set amount of non-arrivals. Not used if the *Plunger Arrival* is disabled.	0h54m41s
Fast Trip Count	The controller will shut in the well after "Fast Trip Count consecutive fast trips. Not used if this parameter is set to zero, the *Fast Trip Time* is set to 0 or if the *Plunger Arrival Sensor* is disabled.	3
Non-Arrival Count	The controller will move to Backup Close after "Non-Arrival Count" consecutive plunger non-arrivals. Not used if set to zero or if the *Plunger Arrival Sensor* is disabled.	3
Backup Fail Count	After the "Backup Fail Count" of consecutive backups is reached, the well will be shut in. Not used if set to zero or if the *Plunger Arrival Sensor* is disabled.	3
Display Level	Sets the screen brightness. Can be used to save power or adapt to different lighting conditions.	50%

Screen	Description	Default Value
Tank Delay Time	When Valve B is configured as a Tank Valve, this timer delays the opening of Valve B to allow the initial "gas cap" or "buildup" to go down the flow line prior to opening to tank. It must be less than the Wait Arrival Time. Not used if set to zero or if Valve B is disabled.	0h00m05s
Afterflow Delay Time	This timer delays the opening of the Sales Valve after the plunger arrives to ensure that the plunger is fully in the lubricator and to allow fluids to flush through the system. Not used unless Valve B is set as "line: open A" or "line: open A&B" and this time is set to non-zero	0h01m00s
Auto Catch Hold Time	This timer allows the installer to specify a set amount of time to hold the plunger in the Auto Catch once the well is closed. When this timer expires, the plunger will be released. This timer is only used if the Auto catch has been enabled and the value is non-zero. This feature is only supported on The PIT Boss II Plus.	disabled
Arrival Guard Time	This specifies a waiting period after the arrival of the plunger before we attach the pressure devices to ensure that their readings have stabilized.	0h00m05s

5.3.2 Set Date/Time Menu (Menu 2)

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 8 - Date/Time Menu Screens

Screen	Description	Default
Date	Allows the user to set the current date.	Jan 1, 2000

Screen	Description	Default
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. The PIT Boss II DST follows the post 2007 North American standard. The options are: 1. disabled 2. enabled	disabled

5.3.3 Alarms Menu (Menu 3)

The alarms menu allows parameters such as the number of Fast Trips or Non-Arrivals that can occur before the controller shuts the well in. There are also settings that determine if the well is shut in or opened when an alarm condition occurs.

Table 9 - Alarms Menu Screens

Screen	Description	Default
Fast Trip Count	The number of Fast Trips that occurred since the last alarm reset. This screen will not be displayed if there have been no fast trips.	0
Non-Arrival Count	The number of Non-Arrivals that occurred since the last alarm reset. This screen will not be displayed if there have been no non-arrivals.	0
Controller Reset	The number of controller resets that have occurred since the last alarm reset.	0
Reset Time	The time of the last alarm reset	N/A
Reset Alarms	Reset all current alarm counts.	N/A

5.3.4 Install Setup Menu (Menu 4)

The Install Setup Menu contains all of the settings that should be configured for a new controller install. All of the screens from the Adjust Settings Menu (Menu 1) and the Device Setup Menu (Menu 5) are available in this menu. This provides a convenient way of setting up the controller in a single pass.

Table 10 - Install Setup Menu Screens

Screen	Description	Default Value
New Install?	This allows the installer to reset the controller back to factory defaults and start from scratch. All statistics, logs, and alarms are cleared.	N/A
Stop Controller?	This allows the user to stop the controller and hold it in a known state while the controller is setup. This provides access to a number of screens that would not normally be available.	N/A
Stop Time	This is the time that the controller will be held in a stopped state. When this timer expires, the controller will resume normal operation.	20m00s
Plunger Depth	The depth that the plunger will have to fall once the well is closed. This is used to calculate the *Target Rise Time*.	1000 m
Optimization Mode	This is the type of optimization scheme that the controller will use: 1. manual – No optimization is performed (i.e. entered times are not modified) 2. gas – Change the *Afterflow Time* only 3. oil – Change the *Close Time* only 4. oil then gas – Change the *Close Time*, then change the *Afterflow Time*. 5. pressure – Use Line Pressure, Casing Pressure, Differential Pressure or Flow to optimize the well.	manual

Screen	Description	Default Value
Plunger Type	Specifies the plunger that is installed in the well. 1. conventional 2. freecycle 3. pacemaker	conventional
Optimization Adjustment Type	The aggressiveness of the timer optimization modes. 1. escalate – The amount of the adjustments is proportional to the amount of *Afterflow Time* The larger the *Afterflow Time*, the larger the adjustments. 2. 1:1 – For every minute the averaged[4] arrival time is faster/slower than the *Target Time*, the controller will add/subtract 1 minute of *Afterflow/Close Time* 3. 2:1 – For every minute the averaged arrival time is faster/slower than the *Target Time*, the controller will add/subtract 2 minutes of *Afterflow/Close Time* 4. 3:1 – For every minute the averaged arrival time is faster/slower than the *Target Time*, the controller will add/subtract 3 minutes of *Afterflow/Close Time*.	1:1

[4] The PIT Boss controller calculates a weighted average that consists of the last 3 arrival times (with the most recent time given double the weight) to obtain the arrival time used for optimization.

Screen	Description	Default Value
Plunger Arrival Sensor	Specifies the type of arrival sensor that is connected to the controller. PAS means a conventional 3-wire Plunger Arrival Sensor, Velocity means a Plunger Velocity Sensor 2. PAS 3. Velocity	PAS
FTrp Source	Fast Trip Source. This option allows selections between using the Average Velocity or the Surface Velocity when detecting a fast trip. See Fast Trip Time screen for a description fast trip. 1. Avg Vel 2. Srf Vel	Avg Vel
Optimize Src	Input source for optimization. This option allows selections between using the Average Velocity or the Surface Velocity as the input to the optimization algorithm. 1. Avg Vel 2. Srf Vel	Avg Vel
Sensor Delay Time	The delay time to wait after the well opens (Wait Arrival) to start accepting arrival signals. This setting is used with a pacemaker or freecycle plunger only.	disabled
Fast Trip Time	This time is used to indicate that the Plunger did not likely fall to the bottom of the well, is hanging up on wax/hydrates, or that insufficient fluid is being brought up. The default value is based on a 730 m/minute average rise velocity. The well will be shut-in if a set number of consecutive fast trips have occurred. Not used if the *Plunger Arrival Sensor* is disabled.	0h01m22s

Screen	Description	Default Value
Target Rise Time	This is the time that the plunger is expected to arrive after the well has been opened. It is only used when running Timer Based Optimization. The controller will increase or decrease the *Afterflow Time* or *Close Time* in order to try and cause the plunger to arrive at the *Target Rise Time*. Not used if the *Plunger Arrival Sensor* or Timer Based Optimization is disabled.	0h04m41s
Fast Trip Velocity	This velocity is used to indicate that the Plunger was travelling too fast when it arrived to the surface. The controller will use this value when Fast Trip Source is set to Surface Velocity	100 m/min
Wait Arrival Time	This time indicates the maximum amount of time that the controller should wait for the plunger to arrive. If the plunger does not arrive, the controller will go to either Close, Backup Close, or shut in the well. The action taken depends on the number of non-arrivals or backups that have previously occurred. The intent is to allow extra pressure to build in order to lift the plunger on the next cycle. The Wait Arrival Time may not be set to zero. Not used if the *Plunger Arrival Sensor* or Timer Based Optimization is *disabled*.	0h14m03s
Minimum Afterflow Time	Defines the minimum allowable *Afterflow Time*. When using Timer Based Optimization the *Afterflow Time* will never be allowed to drop below this time.	1h00m00s
Maximum Afterflow Time	Defines the maximum allowable *Afterflow Time*. When using Timer Based Optimization, the *Afterflow Time* will never be allowed to exceed this time.	24h00m00s

Screen	Description	Default Value
Afterflow Time	This defines the amount of flow time after the plunger arrives. This portion of the cycle is terminated when *Afterflow Time* expires. When "extended-afterflow"[5] devices are enabled, the controller will advance to Extended-Afterflow instead of Close if none of the devices have already tripped.	1h00m00s
Max Open Time	This is the maximum time that the well will remain open in a given cycle. If non-zero, must be greater than the *Wait Arrival Time*. The *Afterflow Time* or *Extended Afterflow Time* will be truncated if the *Max Open Time* expires. Not used if set to zero or if the *Plunger Arrival Sensor* is *disabled* or extended flow devices are not enabled.	999h59m59s
Minimum Close Time	Defines the minimum allowable *Close Time*. When using Timer Based Optimization, the *Close Time* will never be allowed to drop below this time.	0h21m52s
Maximum Close Time	Defines the maximum allowable *Close Time*. When using Timer Based Optimization, the *Close Time* will never be allowed to exceed this time.	2h00m00s
Close Time	This determines the normal duration of the Close portion of the cycle.	0h21m52s

[5] The "Extended-Afterflow" devices are:
- Casing Pressure Switch/Sensor
- Flow Differential Pressure Switch/Sensor
- Flow Switch/Sensor/Virtual

Screen	Description	Default Value
Backup Close Time	This is an Extended period of *Close Time* that is used to create an additional build-up prior to opening the well. The *Backup Close Time* will only run after the set amount of non-arrivals. Not used if the *Plunger Arrival Sensor* is *disabled*.	0h54m41s
Fast Trip Count	The controller will shut in the well after *Fast Trip Count* consecutive fast trips. Not used if this parameter is set to zero, the *Fast Trip Time* is set to 0 or if the *Plunger Arrival Sensor* is *disabled*.	3
Non-Arrival Count	The controller will move to Backup Close after *Non-Arrival Count* consecutive plunger non-arrivals. Not used if set to zero or if the *Plunger Arrival Sensor* is *disabled*.	3
Backup Fail Count	After the *Backup Fail Count* of consecutive backups is reached, the well will be shut in. Not used if set to zero or if the *Plunger Arrival Sensor* is *disabled*.	3

Screen	Description	Default Value
Backup To Afterflow	This determines how the *Afterflow Time* is adjusted when the controller goes to Backup Close. The options are: 1. Min Afterflow – The *Afterflow Time* is set to the *Minimum Afterflow Time*. 2. 25% - The *Afterflow Time* is reduced by 25% of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*. 3. 50% - The *Afterflow Time* is reduced by 50% of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*. 4. 75% - The *Afterflow Time* is reduced by 75% of the difference between the *Afterflow Time* and the *Minimum Afterflow Time*. 5. No Change – The Afterflow time is not adjusted.	Min Afterflow
Display Level	Sets the screen brightness. Can be used to save power or adapt to different lighting conditions.	50%
Sales Valve Test	This screen allows the installer to manually test the Sales Valve. The valve is toggled without changing the state of the controller. The controller must be stopped to test the valve in this manner.	N/A

Screen	Description	Default Value
Valve B	Selects how to use Valve B 1. disabled 2. line: open A 3. line: open A&B 4. tank See the 5.2.6 Dual Valve for more information on these configurations.	disabled
Valve B Test	This screen allows the installer to manually test Valve BThe valve is toggled without changing the state of the controller. The controller must be stopped to test the valve in this manner.	N/A
Tank Delay Time	When *Valve B* is configured as *tank*, this timer delays the opening of *Valve B* to allow the initial "gas cap" or "buildup" to go down the flow line prior to opening to tank. It must be less than the *Wait Arrival Time*. Not used if set to zero or if *Valve B* is *disabled*.	0h00m05s
Afterflow Delay Time	This timer delays the opening of Valve A after the plunger arrives to ensure that the plunger is fully in the lubricator and to allow fluids to flush through the system. Not used unless Valve B is set as "line: open A" or "line: open A&B" and this time is set to non-zero	0h01m00s

Screen	Description	Default Value
Auto Catch	Specifies when to activate the Auto Catch Valve. 1. disabled – Do not use the Auto Catch Valve 2. on wait arrival – Activate the Auto Catch Valve at the start of the *Wait Arrival Time*. 3. on arrival – Activate the Auto Catch after the plunger arrival has been detected. This feature is only supported on The PIT Boss II Plus.	disabled
Auto Catch Hold Time	This timer allows the installer to specify a set amount of time to hold the plunger in the Auto Catch once the well is closed. When this timer expires, the plunger will be released. This timer is only used if the Auto Catch has been enabled and the value is non-zero. This feature is only supported on The PIT Boss II Plus.	disabled
Line Pressure Device Type	Enables the use of a Line Pressure Switch or Sensor. 1. disabled – Device not installed or unused. 2. switch – Discrete Input Switch installed and enabled. 3. sensor – An analog Line Pressure Sensor is installed.	*disabled*
Line Pressure Range	When the *Line Pressure Device Type* is Analog, defines the range of the sensor.	500.0 psi
Line Pressure Value	This displays the current value of an attached line pressure device.	N/A
Wait Arrival Line Pressure	Determines if the Line Pressure is checked during the Wait Arrival portion of the cycle.	disabled

Screen	Description	Default Value
Wait Arrival Line Pressure Trip Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, above which, the well will be shut-in.	90.0 psi
Wait Arrival Line Pressure Reset Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, below which, a Line Pressure trip condition will be cleared.	85.0 psi
Wait Arrival Line Pressure Stable Time	When the *Line Pressure Device Type* is enabled, defines the time required for the line pressure to stabilize above the *Line Pressure Trip Point*, or below the *Line Pressure Reset Point*, in order to declare a trip or reset condition.	0h00m05s
Afterflow Line Pressure	Determines if the Line Pressure is checked during the Afterflow portion of the cycle.	disabled
Afterflow Line PressureTrip Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, above which, the well will be shut-in.	90.0 psi
Afterflow Line PressureReset Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, below which, a Line Pressure trip condition will be cleared.	85.0 psi
Afterflow Line PressureStable Time	When the *Line Pressure Device Type* is enabled, defines the time required for the line pressure to stabilize above the *Line Pressure Trip Point*, or below the *Line Pressure Reset Point*, in order to declare a trip or reset condition.	0h00m05s
Close Line Pressure	Determines if the Line Pressure is checked at the end of the Close portion of the cycle before allowing the well to open.	disabled
Close Line PressureTrip Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, above which, the well will remain shut-in.	90.0 psi

Screen	Description	Default Value
Close Line Pressure Reset Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, below which, a Line Pressure trip condition will be cleared.	85.0 psi
Close Line Pressure Stable Time	When the *Line Pressure Device Type* is enabled, defines the time required for the line pressure to stabilize above the *Line Pressure Trip Point*, or below the *Line Pressure Reset Point*, in order to declare a trip or reset condition.	0h00m05s
Differential Pressure Device Type	Enables the use of a Differential Pressure Switch or Sensor. 1. disabled – Device not installed or unused. 2. switch – Discrete Input Switch installed and enabled. 3. sensor – An analog Differential Pressure Sensor is installed. (Use low power Rosemount 1151 differential pressure transmitter unless the device is powered by another source.) This feature is only supported on The PIT Boss II Plus.	*disabled*
Differential Pressure Range	When the *Differential Pressure Device Type* is Analog, defines the range of sensor. This feature is only supported on The PIT Boss II Plus.	750.0 “WC
Differential Pressure Voltage	Defines the interface that is supported by the Flow Differential Pressure Device. 1. 0.8V – 3.2V 2. 1.0V – 5.0V This feature is only supported on The PIT Boss II Plus.	0.8V – 3.2V

Screen	Description	Default Value
Differential Pressure Value	This displays the current value of an attached Flow Differential Pressure device. This screen is not available if the *Differential Pressure Device Type* is disabled. This feature is only supported on The PIT Boss II Plus.	N/A
Differential Pressure Trip Point	When the *Differential Pressure Device Type* is *Analog*, this defines the pressure which will cause a trip condition to be reset. This screen is not available if the *Differential Pressure Device Type* is disabled or if *Differential Pressure Device Type* is set to *sensor* and the *Line Pressure Device Type* is also set to *sensor*. This feature is only supported on The PIT Boss II Plus.	20.0 “WC
Differential Pressure Reset Point	When *Differential Pressure Device Type* is *Analog*, this defines the pressure which will cause a trip condition to be reset. This screen is not available if the *Differential Pressure Device Type* is disabled or if *Differential Pressure Device Type* is set to *sensor* and the *Line Pressure Device Type* is also set to *sensor*. This feature is only supported on The PIT Boss II Plus.	22.0 “WC

Screen	Description	Default Value
Differential Pressure Stable Time	When the *Differential Pressure Device Type* is enabled, this defines the time required for the pressure to stabilize below the *Differential Pressure Trip Point*, or above the *Differential Pressure Reset Point*, in order to declare a trip or reset condition. This screen is not available if the *Differential Pressure Device Type* is disabled or if *Differential Pressure Device Type* is set to *sensor* and the *Line Pressure Device Type* is also set to *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Flow Rate Value	This displays the current value for Flow Rate. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Flow DP Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	N/A
Flow Rate Trip Point	This defines the rate above which the well will stay flowing. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	18.0 e3m3/d
Flow Rate Reset Point	This defines the rate which will cause a trip condition to be reset. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	19.0 e3m3/d

Screen	Description	Default Value
Flow Rate Stable Time	This defines the time required for the rate to stabilize below the trip point, or above the reset point, in order to declare a trip or reset condition. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Gas Temperature	When the *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the gas temperature used for flow rate calculations. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	60 °F
Gas Specific Gravity	When *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the specific gravity (relative to air) used for flow rate calculations. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	0.60

Screen	Description	Default Value
Meter Run Size	When the *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the meter run diameter used for flow rate calculations. Valid values are 2”, 3”, 4” This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	2”
Orifice Size	When *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the orifice diameter used for flow rate calculations. Valid Orifice Sizes are from 0.125” to 3.000”. The maximum for 3” Meter Run is 2.250” and the maximum for a 2” Meter Run is 1.375”. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	1.000”
Casing Pressure Device Type	Enables the use of a Casing Pressure Switch or Sensor. 1. disabled – Device not installed or unused. 2. switch – Discrete Input Switch installed and enabled. 3. sensor – An analog Casing Pressure Sensor is installed. This feature is only supported on The PIT Boss II Plus.	*disabled*

Screen	Description	Default Value
Casing Pressure Range	When the *Casing Pressure Device Type* is *sensor*, defines the range of sensor. This feature is only supported on The PIT Boss II Plus.	500.0 psi
Casing Pressure Value	This displays the current value of the Casing Pressure. This screen is only available if the *Casing Pressure Device Type* is enabled. This feature is only supported on The PIT Boss II Plus.	N/A
Afterflow Casing Pressure	This determines which algorithm to use for closing the well when the *Casing Pressure Device Type* is *enabled*. The options are: 1. *Disabled* 2. *Rate Drop (Future Feature)* 3. *Absolute* These optimization algorithms are discussed further in the 5.2.4.1 Casing Pressure section. This screen is only available if the *Casing Pressure Device Type* is not *disabled*. This feature is only supported on The PIT Boss II Plus.	disabled
Trip Delay Time	When using Rate Drop, this screen is used to define the time to wait to close in the well after a trip condition has occurred. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is Rate Drop. This feature is only supported on The PIT Boss II Plus.	2h00m00s

Screen	Description	Default Value
Afterflow Casing Pressure Trip Point	When using the Absolute method, this screen is used to define the casing pressure that has to be reached before a trip condition is declared. When using Rate Drop, this screen is used to define the casing pressure rate of change that has to be reached before a trip condition is declared. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is not disabled. This feature is only supported on The PIT Boss II Plus.	150.0 psi
Afterflow Casing Pressure Reset Point	When using the Absolute method, this screen is used to define the casing pressure that has to be reached before a reset condition is declared. When using the Rate Drop method, this screen is used to define the casing pressure rate of change that has to be reached before a reset condition is declared. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is not disabled. This feature is only supported on The PIT Boss II Plus.	155.0 psi
Afterflow Casing Pressure Stable Time	This defines the time required for the casing pressure to stabilize before a trip or reset condition is declared. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is not disabled. This feature is only supported on The PIT Boss II Plus.	0h00m05s

Screen	Description	Default Value
Close Casing Pressure	This screen defines whether the casing pressure is to be checked at the end of the Close cycle. If this is enabled, a low casing pressure will prevent the well from being opened. This screen is only visible when the *Casing Pressure Device Type* is not *disabled*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	disabled
Close Casing Pressure Trip Point	When the *Casing Pressure Device Type* is *sensor*, this defines the pressure below which the well will remain closed. This screen is only visible if the *Casing Pressure Device Type* is set as *sensor* and the *Close Casing Pressure* is *enabled*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	85.0 psi
Close Casing Pressure Reset Point	When the *Casing Pressure Device Type* is *sensor*, defines the above which the well will be opened. This screen is only visible if the *Close Casing Pressure Device Type* is set as *Absolute*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	90.0 psi

Screen	Description	Default Value
Close Casing Pressure Stable Time	When the *Casing Pressure Device Type* is *sensor*, this defines the time required for the pressure to stabilize below the *Close Casing Pressure Trip Point*, or above the *Close Casing Pressure Reset Point*, in order to declare a trip or reset condition. This screen is only visible if the *Close Casing Pressure Device Type* is set as *Absolute*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Close Casing Line Differential Pressure Trip Point	When the *Casing* and *Line Pressure Device Types* are both *sensor*, defines the pressure difference, below which the well will stay shut-in. This screen is only available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	25.0 psi
Close Casing Line Differential Pressure Reset Point	When the *Casing* and *Line Pressure Device Types* are both *sensor*, defines the pressure difference, above which the well will open. This screen is only available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	30.0 psi

Screen	Description	Default Value
Close Casing Line Differential Pressure Stable Time	When the *Casing* and *Line Pressure Device Types* are both *sensor*, defines the time required for the pressure difference to stabilize above the reset point, or below the trip point, in order to declare a trip or reset condition. This screen is only available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Arrival Guard Time	This specifies a waiting period after the arrival of the plunger before we attach the pressure devices to ensure that their readings have stabilized.	0h00m05s

5.3.5 Device Setup Menu (Menu 5)

The Device Setup Menu is a subset of the Install Setup Menu. The difference is that this menu shows only the screens that are specific to devices. The following are the available screens.

Table 11 - Device Setup Menu Screens

Screen	Description	Default Value
Stop Controller?	This allows the user to stop the controller and hold it in a known state while the controller is setup. This provides access to a number of screens that would not normally be available.	N/A
Stop Time	This is the time that the controller will be held in a stopped state. When this timer expires, the controller will resume normal operation.	20m00s

Screen	Description	Default Value
Plunger Arrival Sensor	Specifies the type of arrival sensor that is connected to the controller. 1. disabled 2. 2-wire 3. 3-wire	3-wire
Sales Valve Test	This screen allows the installer to test the Sales Valve. The valve is toggled without changing the state of the controller. The controller must be stopped to test the valve in this manner.	N/A
Valve B	Selects how to use Valve B 1. disabled 2. line: open A 3. line: open A&B 4. tank	disabled
Valve B Test	This screen allows the installer to test Valve B. The valve is toggled without changing the state of the controller. The controller must be stopped to test the valve in this manner.	N/A
Tank Delay Time	When *Valve B* is configured as *tank*, this timer delays the opening of *Valve B* to allow the initial "gas cap" or "buildup" to go down the flow line prior to opening to tank. It must be less than the *Wait Arrival Time*. Not used if set to zero or if *Valve B* is *disabled*.	0h00m05s

Screen	Description	Default Value
Afterflow Delay Time	This timer delays the opening of Valve A after the plunger arrives to ensure that the plunger is fully in the lubricator and to allow fluids to flush through the system. Not used unless Valve B is set as “line: open A” or “line: open A&B” and this time is set to non-zero	0h01m00s
Auto Catch	Specifies when to activate the Auto Catch Valve. 4. disabled – Do not use the Auto Catch Valve 5. on wait arrival – Activate the Auto Catch Valve at the start of the *Wait Arrival Time*. 6. on arrival – Activate the Auto Catch after the plunger arrival has been detected. This feature is only supported on The PIT Boss II Plus.	disabled
Auto Catch Hold Time	This timer allows the installer to specify a set amount of time to hold the plunger in the Auto Catch once the well is closed. When this timer expires, the plunger will be released. This timer is only used if the Auto Catch has been enabled and the value is non-zero. This feature is only supported on The PIT Boss II Plus.	disabled
Line Pressure Device Type	Enables the use of a Line Pressure Switch or Sensor. 4. disabled – Device not installed or unused. 5. switch – Discrete Input Switch installed and enabled. 6. sensor – An analog Line Pressure Sensor is installed.	*disabled*
Line Pressure Range	When the *Line Pressure Device Type* is Analog, defines the range of the sensor.	500.0 psi

Screen	Description	Default Value
Line Pressure Value	This displays the current value of an attached line pressure device.	N/A
Wait Arrival Line Pressure	Determines if the Line Pressure is checked during the Wait Arrival portion of the cycle.	disabled
Wait Arrival Line Pressure Trip Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, above which, the well will be shut-in.	90.0 psi
Wait Arrival Line Pressure Reset Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, below which, a Line Pressure trip condition will be cleared.	85.0 psi
Wait Arrival Line Pressure Stable Time	When the *Line Pressure Device Type* is enabled, defines the time required for the line pressure to stabilize above the *Line Pressure Trip Point*, or below the *Line Pressure Reset Point*, in order to declare a trip or reset condition.	0h00m05s
Afterflow Line Pressure	Determines if the Line Pressure is checked during the Afterflow portion of the cycle.	disabled
Afterflow Line Pressure Trip Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, above which, the well will be shut-in.	90.0 psi
Afterflow Line Pressure Reset Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, below which, a Line Pressure trip condition will be cleared.	85.0 psi
Afterflow Line Pressure Stable Time	When the *Line Pressure Device Type* is enabled, defines the time required for the line pressure to stabilize above the *Line Pressure Trip Point*, or below the *Line Pressure Reset Point*, in order to declare a trip or reset condition.	0h00m05s
Close Line Pressure	Determines if the Line Pressure is checked at the end of the Close portion of the cycle before allowing the well to open.	disabled

Screen	Description	Default Value
Close Line Pressure Trip Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, above which, the well will remain shut-in.	90.0 psi
Close Line Pressure Reset Point	When the *Line Pressure Device Type* is *Analog*, defines the pressure, below which, a Line Pressure trip condition will be cleared.	85.0 psi
Close Line Pressure Stable Time	When the *Line Pressure Device Type* is enabled, defines the time required for the line pressure to stabilize above the *Line Pressure Trip Point*, or below the *Line Pressure Reset Point*, in order to declare a trip or reset condition.	0h00m05s
Differential Pressure Device Type	Enables the use of a Differential Pressure Switch or Sensor. 4. disabled – Device not installed or unused. 5. switch – Discrete Input Switch installed and enabled. 6. sensor – An analog Differential Pressure Sensor is installed. (Use low power Rosemount 1151 differential pressure transmitter unless the device is powered by another source.) This feature is only supported on The PIT Boss II Plus.	*disabled*
Differential Pressure Range	When the *Differential Pressure Device Type* is Analog, defines the range of sensor. This feature is only supported on The PIT Boss II Plus.	750.0 “WC

Screen	Description	Default Value
Differential Pressure Voltage	Defines the interface that is supported by the Flow Differential Pressure Device. 3. 0.8V – 3.2V 4. 1.0V – 5.0V This feature is only supported on The PIT Boss II Plus.	0.8V – 3.2V
Differential Pressure Value	This displays the current value of an attached Flow Differential Pressure device. This screen is not available if the *Differential Pressure Device Type* is disabled. This feature is only supported on The PIT Boss II Plus.	N/A
Differential PressureTrip Point	When the *Differential Pressure Device Type* is *Analog*, this defines the pressure which will cause a trip condition to be reset. This screen is not available if the *Differential Pressure Device Type* is disabled or if *Differential Pressure Device Type* is set to *sensor* and the *Line Pressure Device Type* is also set to *sensor*. This feature is only supported on The PIT Boss II Plus.	20.0 “WC
Differential Pressure Reset Point	When *Differential Pressure Device Type* is *Analog*, this defines the pressure which will cause a trip condition to be reset. This screen is not available if the *Differential Pressure Device Type* is disabled or if *Differential Pressure Device Type* is set to *sensor* and the *Line Pressure Device Type* is also set to *sensor*. This feature is only supported on The PIT Boss II Plus.	22.0 “WC

Screen	Description	Default Value
Differential PressureStable Time	When the *Differential Pressure Device Type* is enabled, this defines the time required for the pressure to stabilize below the *Differential Pressure Trip Point*, or above the *Differential Pressure Reset Point*, in order to declare a trip or reset condition. This screen is not available if the *Differential Pressure Device Type* is disabled or if *Differential Pressure Device Type* is set to *sensor* and the *Line Pressure Device Type* is also set to *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Flow Rate Value	This displays the current value for Flow Rate. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Flow DP Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	N/A
Flow Rate Trip Point	This defines the rate above which the well will stay flowing. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	18.0 e3m3/d
Flow Rate Reset Point	This defines the rate which will cause a trip condition to be reset. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	19.0 e3m3/d

Screen	Description	Default Value
Flow Rate Stable Time	This defines the time required for the rate to stabilize below the trip point, or above the reset point, in order to declare a trip or reset condition. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Gas Temperature	When the *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the gas temperature used for flow rate calculations. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	60 °F
Gas Specific Gravity	When *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the specific gravity (relative to air) used for flow rate calculations. This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	0.60

Screen	Description	Default Value
Meter Run Size	When the *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the meter run diameter used for flow rate calculations. Valid values are 2", 3", 4" This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	2"
Orifice Size	When *Differential Pressure Device Type* and the *Line Pressure Device Type* are both *Sensor*, defines the orifice diameter used for flow rate calculations. Valid Orifice Sizes are from 0.125" to 3.000". The maximum for 3" Meter Run is 2.250" and the maximum for a 2" Meter Run is 1.375". This screen is only available if the *Line Pressure Device Type* is set to *sensor* and the *Differential Pressure Device Type* is set to *sensor*. This feature is only supported on The PIT Boss II Plus.	1.000"
Casing Pressure Device Type	Enables the use of a Casing Pressure Switch or Sensor. 4. disabled – Device not installed or unused. 5. switch – Discrete Input Switch installed and enabled. 6. sensor – An analog Casing Pressure Sensor is installed. This feature is only supported on The PIT Boss II Plus.	*disabled*

Screen	Description	Default Value
Casing Pressure Range	When the *Casing Pressure Device Type* is *sensor*, defines the range of sensor. This feature is only supported on The PIT Boss II Plus.	500.0 psi
Casing Pressure Value	This displays the current value of the Casing Pressure. This screen is only available if the *Casing Pressure Device Type* is enabled. This feature is only supported on The PIT Boss II Plus.	N/A
Afterflow Casing Pressure	This determines which algorithm to use for closing the well when the *Casing Pressure Device Type* is *enabled*. The options are: 4. *Disabled* 5. *Rate Drop (Not valid for casing pressure switch)* 6. *Absolute* These optimization algorithms are discussed further in the 5.2.4.1 Casing Pressure section. This screen is only available if the *Casing Pressure Device Type* is not *disabled*. This feature is only supported on The PIT Boss II Plus.	disabled
Trip Delay Time	When using Rate Drop, this screen is used to define the time to wait to close in the well after a trip condition has occurred. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is Rate Drop. This feature is only supported on The PIT Boss II Plus.	2h00m00s

Screen	Description	Default Value
Afterflow Casing Pressure Trip Point	When using the Absolute method, this screen is used to define the casing pressure that has to be reached before a trip condition is declared. When using Rate Drop, this screen is used to define the casing pressure rate of change that has to be reached before a trip condition is declared. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is not disabled. This feature is only supported on The PIT Boss II Plus.	150.0 psi
Afterflow Casing Pressure Reset Point	When using the Absolute method, this screen is used to define the casing pressure that has to be reached before a reset condition is declared. When using the Rate Drop method, this screen is used to define the casing pressure rate of change that has to be reached before a reset condition is declared. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is not disabled. This feature is only supported on The PIT Boss II Plus.	155.0 psi
Afterflow Casing Pressure Stable Time	This defines the time required for the casing pressure to stabilize before a trip or reset condition is declared. This screen is only visible when the *Casing Pressure Device Type* is *sensor* and Afterflow Casing Pressure is not disabled. This feature is only supported on The PIT Boss II Plus.	0h00m05s

Screen	Description	Default Value
Close Casing Pressure	This screen defines whether the casing pressure is to be checked at the end of the Close cycle. If this is enabled, a low casing pressure will prevent the well from being opened. This screen is only visible when the *Casing Pressure Device Type* is not *disabled*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	disabled
Close Casing Pressure Trip Point	When the *Casing Pressure Device Type* is *sensor*, this defines the pressure below which the well will remain closed. This screen is only visible if the *Casing Pressure Device Type* is set as *sensor* and the *Close Casing Pressure* is *enabled*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	85.0 psi
Close Casing Pressure Reset Point	When the *Casing Pressure Device Type* is *sensor*, defines the above which the well will be opened. This screen is only visible if the *Close Casing Pressure Device Type* is set as *Absolute*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	90.0 psi

Screen	Description	Default Value
Close Casing Pressure Stable Time	When the *Casing Pressure Device Type* is *sensor*, this defines the time required for the pressure to stabilize below the *Close Casing Pressure Trip Point*, or above the *Close Casing Pressure Reset Point*, in order to declare a trip or reset condition. This screen is only visible if the *Close Casing Pressure Device Type* is set as *Absolute*. This screen is also not available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s
Close Casing Line Differential Pressure Trip Point	When the *Casing* and *Line Pressure Device Types* are both *sensor*, defines the pressure difference, below which the well will stay shut-in. This screen is only available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	25.0 psi
Close Casing Line Differential Pressure Reset Point	When the *Casing* and *Line Pressure Device Types* are both *sensor*, defines the pressure difference, above which the well will open. This screen is only available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	30.0 psi

Screen	Description	Default Value
Close Casing Line Differential Pressure Stable Time	When the *Casing* and *Line Pressure Device Types* are both *sensor*, defines the time required for the pressure difference to stabilize above the reset point, or below the trip point, in order to declare a trip or reset condition. This screen is only available if both the *Line Pressure Device Type* and the *Casing Pressure Device Type* are *sensor*. This feature is only supported on The PIT Boss II Plus.	0h00m05s

5.3.6 Outputs Menu (Menu 6)

The Outputs menu allows the installer to certain connections to act as outputs. If the line pressure and/or casing pressure features are not used, their power outputs can be configured to act as output such as mimicking an available valve or signaling an alarm condition.

Table 12 - Outputs Menu Screens

Screen	Description	Default
DO1-LP Power	Sets the operation to use the LP Power connection for.	Default (Power a LP sensor)
DO1 Signal	Sets what type of output signal is desired: Level – High signal when open and low when closed Pulse Open – Pulse high for a set time on open Pulse Close – Pulse high for a set time on close	Level
DO1 Time	Specify the time to pulse the output for.	1000 ms
DO2-CP/DP Power	Sets the operation to use the CP/DP Power connection for. This screen is only available on The PIT Boss II Plus.	Default (Power a CP/DP Sensor)

DO2 Signal	Sets what type of output signal is desired: Level – High signal when open and low when closed Pulse Open – Pulse high for a set time on open Pulse Close – Pulse high for a set time on close	Level
DO2 Time	Specify the time to pulse the output for.	1000 ms

5.3.7 System Menu (Menu 7)

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 13 - System Menu Screens

Screen	Description	Default
Display Level	Sets the screen brightness. Can be used to save power or adapt to different lighting conditions.	50%
Auto Off	This is the amount of time that the screen will stay on after the last key press.	30s
Units	Set whether to display values in metric or imperial units.	metric
Restore Factory 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.	N/A
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
Firmware Version	This identifies the specific firmware version that is currently running on the controller. This is required if issues are reported to ETC. Please refer to the release notes for this version to see a list of known issues.	N/A

Screen	Description	Default
Hardware Version	Specifies the version of hardware.	N/A
Timer Based Optimization Option	This feature allows the controller to optimize the afterflow or close times based on the arrival time of the plunger. This only applies to The PIT Boss II. Timer Optimization is always available on The PIT Boss II Plus.	Disabled
Fast Trip Limitation	Used to prevent the number of fast trips from being disabled. Also ensures that the fast trip time cannot be set too low. Once set, this screen disappears so it cannot be disabled.	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	Specifies the time after the last key press to log out the current user automatically.	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
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

Screen	Description	Default
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

5.3.8 Modbus Menu (Menu 8)

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 14 - Modbus Menu Screens

Screen	Description	Default
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

Screen	Description	Default
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

5.3.9 Hold Valves (Menu 9)

This item is different from all other menu items. Instead of loading a sub menu, it changes the state of the controller. It will hold the controller in a stopped state with the valve either being held open or closed. The valve position is determined by the current valve state when this menu item is selected. For example, if the controller is currently open and Hold Valves is selected, the controller will be stopped with the valve open.

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 Modbus Communications User's Guide 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 15 - 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 ETC to be repaired. To avoid this issue, make sure to avoid shorting the battery connections.

Issue	Cause	Resolution
	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 ETC 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 ETC 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 ETC 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 some of the menus	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, ETC can generate a new ID on a per controller basis.
Cannot access some of the devices (i.e. Flow DP, Casing	You are using the PIT Boss II	Pressure Optimization is only available on the PIT Boss II Plus

Issue	Cause	Resolution
Pressure, etc…)	The *Optimization Mode* is not set to Pressure Optimization.	Change the Optimization Mode to Pressure Optimization.
Timer Optimization adjustments are too large	The algorithm is setup to be too aggressive.	Try using a less aggressive *Optimization Adjustment Type.*
Timer Optimization takes too long to adjust to the right value	The algorithm is not setup to be aggressive enough.	Try using a more aggressive *Optimization Adjustment Type.*
Auto Catch does not appear in the menus	You are using The PIT Boss II	The Auto Catch functionality is only available on The PIT Boss II Plus.
Fast Trips do not shut in the well	Fast Trips are disabled	Set the Fast Trips in the Alarms menu to something other than disabled.
	The number of consecutive Fast Trips has not been reached.	The controller will continue in to Afterflow when a Fast Trip occurs. The well is only shut in after the number of consecutive Fast Trips has been reached. This is specified in the *Fast Trip Count* screen.
Non-Arrivals do not shut in the well	Non-Arrivals are disabled	Set the Non-Arrivals in the Alarms menu to something other than disabled.
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.
	Too many fast trips have occurred	Correct the issue with the well and set the controller to resume normal operation.
	Too many backups have occurred	Correct the issue with the well and set the controller to resume normal operation.

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.

8.1.1 Prerequisites

The following equipment is required to upgrade the controller:

- Battery
- Laptop with a USB port
- USB to RS485 converter
- Latest Firmware file from Extreme Telematics Corp.

8.1.2 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

8.1.3 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 ETC.
5. Follow the prompts on the screen to erase the current firmware. To abort the upgrade process at this point, unplug the battery.
6. When prompted to do so, download the firmware

a. Open ETC Vision

b. Select the appropriate COM port from the drop down list.

c. Click the Connect button

d. Browse to the latest ETC file that was provided by Extreme Telematics Corp.

e. Select Download

7. 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.

8. When the download is complete, the controller should start normally.

8.1.4 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 Extreme Telematics Corp.

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 ETC if this occurs.
- **Err 4 – Flash Buffer Over Run.** This means that there is a back log saving to the controller. Please contact ETC 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 ETC 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 sales for the current price list.

Table 16 - 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-12000-1008-0002	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 connector.
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
ET-12000-1009-0003	Battery Bracket	Replacement bracket used to retain either battery.
ET-11000-1019-0000	ETC Cyclops IS Plunger Arrival Sensor	Use with the plunger lift controller to detect a plunger arrival.
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

8.3.1 Contacting Support

Support is available through ***Premier Integrated Technologies (PIT)*** field offices or through our main office in Red Deer. Authorized representatives from PIT can contact us in the following ways:

8.3.1.1 Web

Please visit our website at http://www.premiertech.ca.

8.3.1.2 Phone

Phone: (403) 887-1200

Toll Free: (866) 443-5656

Fax: (403) 887-3583

8.3.2 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:

8.3.2.1 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

8.3.2.2 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

8.3.3 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

8.3.4 Repair Process

Repairs should be handled through ***Premier Integrated Technologies***. They will 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 addressed in a timely fashion. Returned controllers will take approximately 4 – 6 weeks to be diagnosed and resolved.

9 Acronyms

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	**Plunger Arrival 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**

10 Index