INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WELKER® ECOSYSTEM™ HYDROGEN INJECTION SYSTEM

WITH XL4 CONTROLLER

Part
BSYS301A0U002H043

DRAWING NUMBER
BSYS0160

MANUAL NUMBER
IOM-244

REVISION
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IMPORTANT SAFETY INFORMATION
READ ALL INSTRUCTIONS

Notes emphasize information and/or provide additional information to assist the user.

Caution messages appear before procedures that could result in damage to equipment if not observed.

Warning messages appear before procedures that could result in personal injury if not observed.

This manual is intended to be used as a basic installation and operation guide for the Welker® ECOsystem™ Hydrogen Injection System With XL4 Controller. For comprehensive instructions, please refer to the IOM Manuals for each individual component. A list of relevant component IOM Manuals is provided in Appendix A of this manual.

The information in this manual has been carefully checked for accuracy and is intended to be used as a guide for the installation, operation, and maintenance of the Welker® equipment described in this manual. Correct installation and operation, however, are the responsibility of the end user. Welker® reserves the right to make changes to this manual and all products in order to improve performance and reliability.

BEFORE YOU BEGIN

Read these instructions completely and carefully.

IMPORTANT – Save these instructions for local inspector's use.

IMPORTANT – Observe all governing codes and ordinances.

Note to Installer – Leave these instructions with the end user.

Note to End User – Keep these instructions for future reference.

Installation of this ECOsystem™ Hydrogen Injection System With XL4 Controller is of a mechanical and electrical nature.

Proper installation is the responsibility of the installer. Product failure due to improper installation is not covered under the warranty.

If you received a damaged Welker® ECOsystem™ Hydrogen Injection System With XL4 Controller, please contact a Welker® representative immediately.

Phone: 281.491.2331
Address: 13839 West Bellfort Street
Sugar Land, TX 77498

SECTION 1: PRODUCT INFORMATION

1.1 Introduction

We appreciate your business and your choice of Welker® products. The installation, operation, and maintenance liability for this equipment becomes that of the purchaser at the time of receipt. Reading the applicable *Installation, Operation, and Maintenance* (IOM) *Manuals* prior to installation and operation of this equipment is required for a full understanding of its application and performance prior to use.*

If you have any questions, please call Welker® at 1.281.491.2331.

**The following procedures have been written for use with standard Welker® parts and equipment. Assemblies that have been modified may have additional requirements and specifications that are not listed in this manual.*

1.2 Product Description

The Welker® *ECOsystem™ Hydrogen Injection System* is designed to infuse the customer pipeline proportional to flow with hydrogen. This skid-mounted automatic hydrogen injection system has three (3) primary components: the touch screen controller, the solenoid cabinet, and the hydrogen meter. Each primary component plays an integral role in the operation of the ECOsystem™ and can be customized to better suit each application.

The touch screen controller serves as the system's brain. It continuously receives feedback from the customer's gas flow meter and the hydrogen flow meter, allowing the system to respond to changing flow conditions. As pipeline conditions change, the controller increases or decreases the injection rate so that the ECOsystem™ continues infusing proportional to flow. On-site and remote troubleshooting and monitoring are made easier by time- and date-stamped audit data detailing system performance and alarm history.

The solenoid cabinet contains two (2) solenoids which control the flow of hydrogen into the pipeline. Having two (2) solenoids allows the ECOsystem™ to better respond to and accommodate varying flow rates and limits interruption to operation in the event of solenoid maintenance. To prolong the operational life of the regulator and solenoids, the Welker® F-9 Filter conditions the hydrogen supply. The hydrogen flow meter provides feedback to the controller to ensure the proper injection rate.

Welker® may custom design the ECOsystem™ Hydrogen Injection System With XL4 Controller to suit the particular application and specifications of each customer.

1.3 Safety Warning

Wherever hazardous gases or vapor-producing liquids are used, transported, or stored, the potential for an accidental leak exists. Continuous monitoring of these hazards is essential to ensure personnel safety.

1.4 Specifications

The specifications listed in this section are generalized for this equipment. Welker® can modify the equipment according to your company's needs. **Please note that the specifications may vary depending on the customization of your equipment.**

Table 1: ECOsystem™ Hydrogen Injection System Specifications	
Application	Hydrogen Gas Infusion
Electrical Connections	AC 120 V DC 24 V
Features	Solenoid Cabinet Touch Screen Controller With NEMA 4 Enclosure

Table 2: Solenoid Cabinet Specifications	
Tubing Size	**Low Flow:** ¼" (*0.6 cm*) **High Flow:** ⅜" (*0.9 cm*) **Variable Flow:** ¼" and ⅜" (*0.6 cm* and *0.9 cm*)
Features	Hydrogen Flow Meter Regulator for Hydrogen Supply Two (2) Two-Way Solenoid Valves Welker® F-9 Filter for Hydrogen Supply
Options	Nitrogen Tank: SA 110 ft^3 Three (3) Two-Way Solenoid Valves Heater, CP Multitherm 150 Watt Insulated Enclosure

1.5 Equipment Diagrams

Figure 1: ECOsystem™ Hydrogen Injection System Schematic

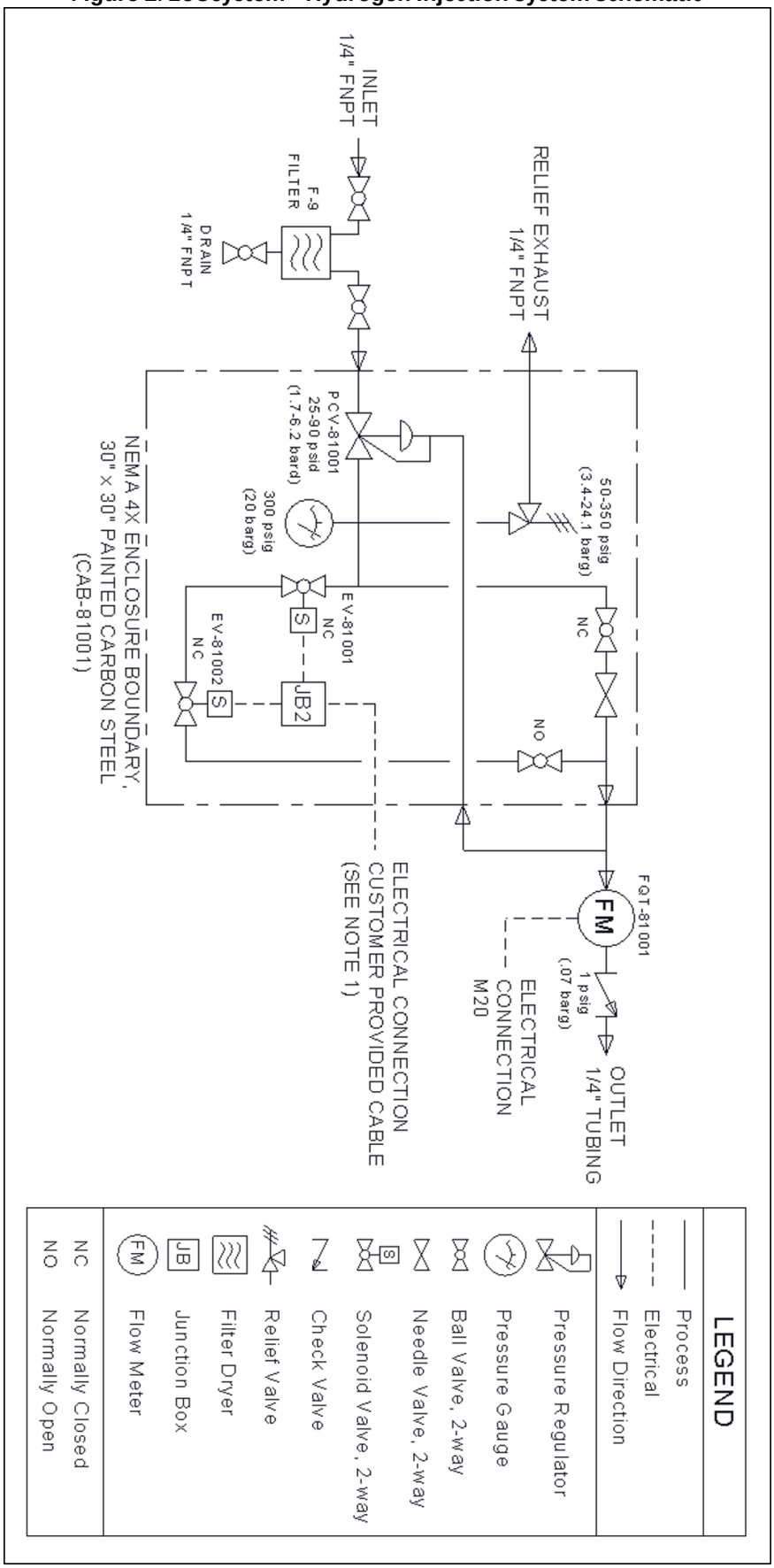
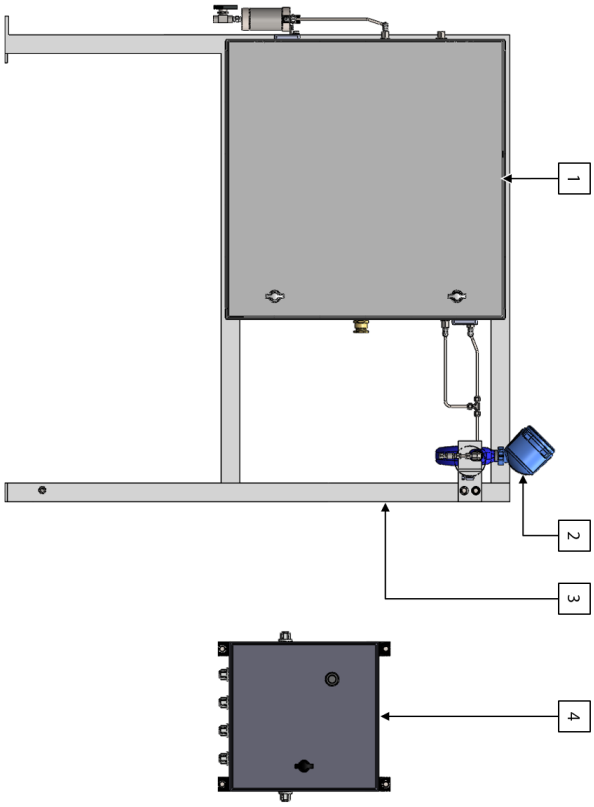
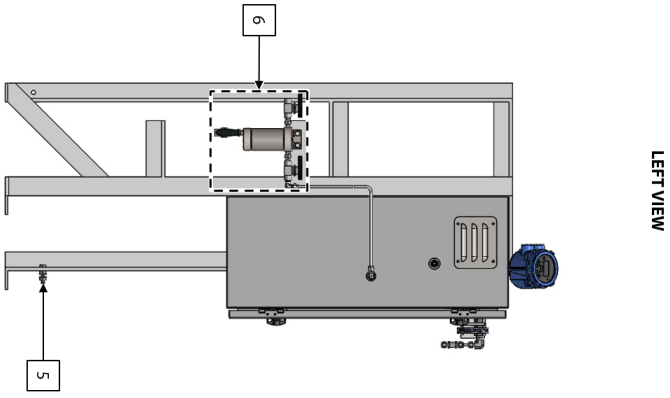


Figure 2: General Arrangement - Support Bracket and Controller Enclosure Diagram





No.	Description
1	Solenoid Cabinet (See *Figure 4*)
2	Flow Meter Sensor and Transmitter
3	Support Bracket
4	Controller Enclosure
5	Ground Lug
6	Welker F-9 Filter (See *Figures 6 & 7*)

Figure 3: ECOsystem™ Hydrogen Injection System Connections Diagram

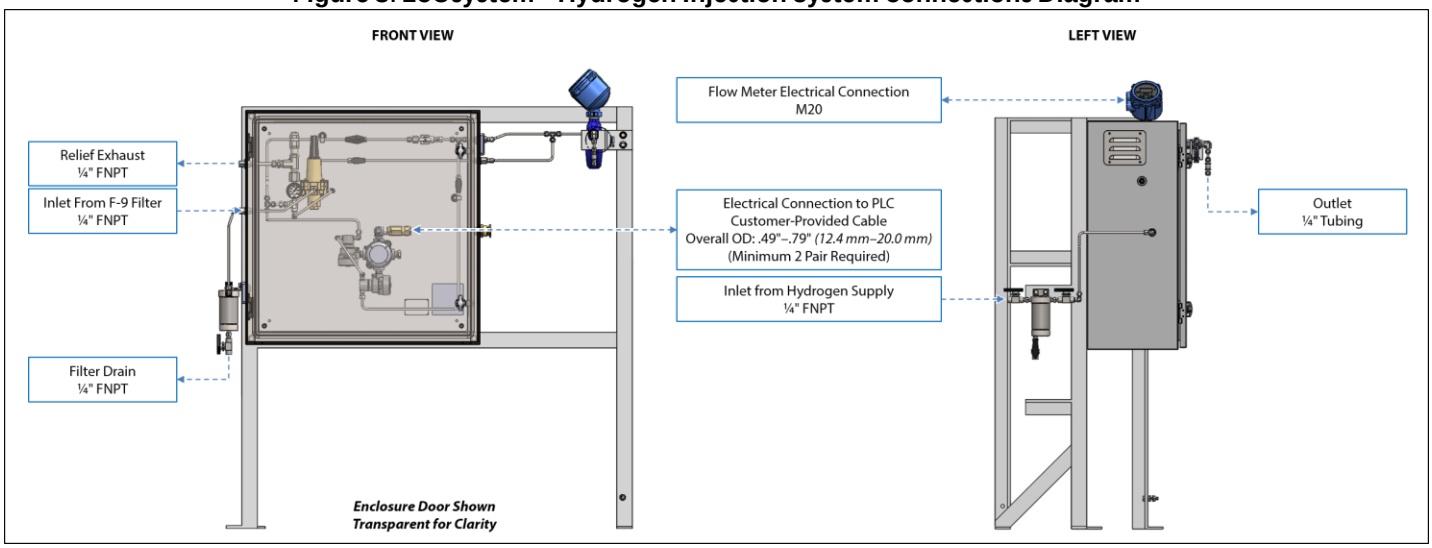
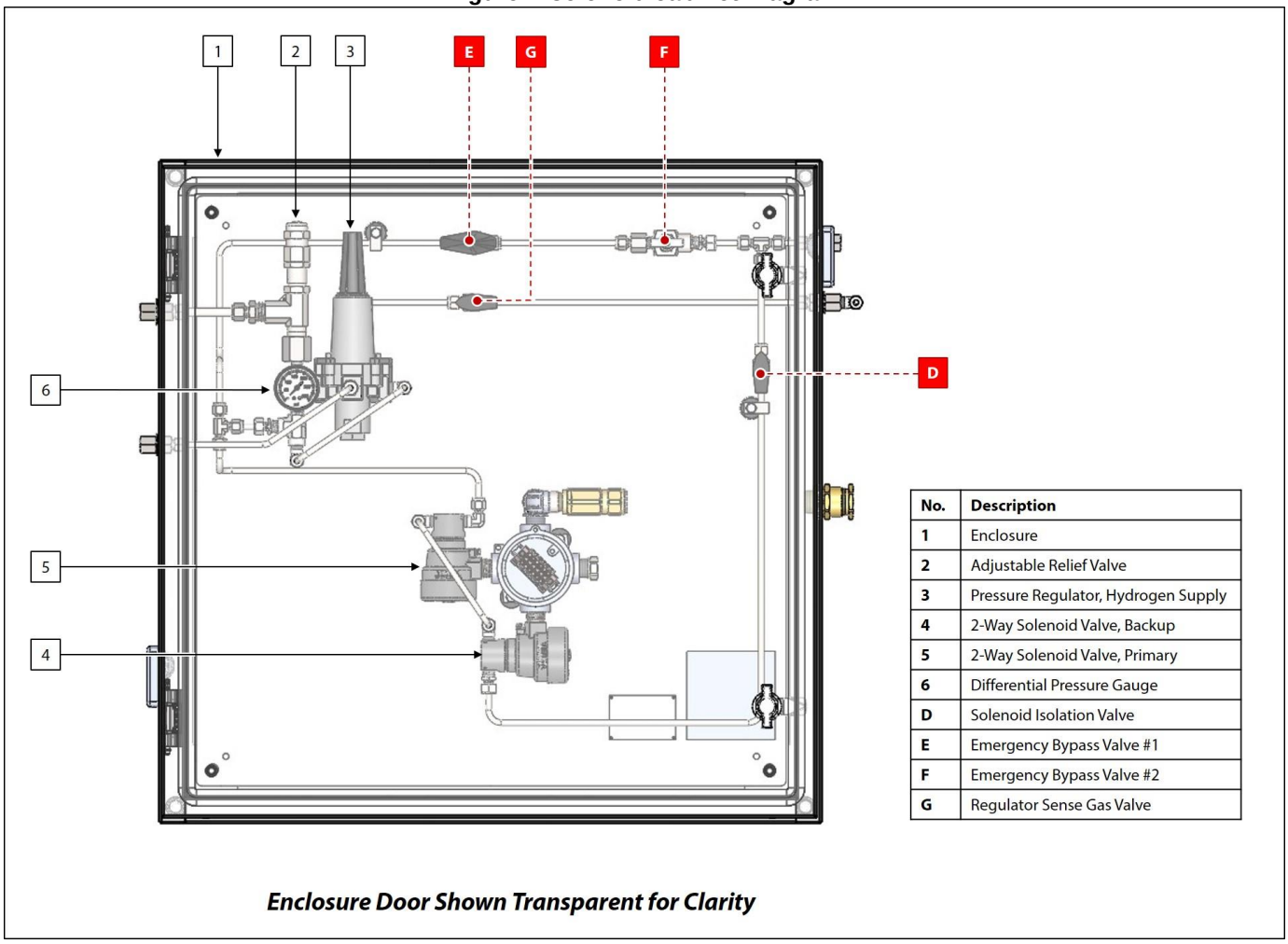
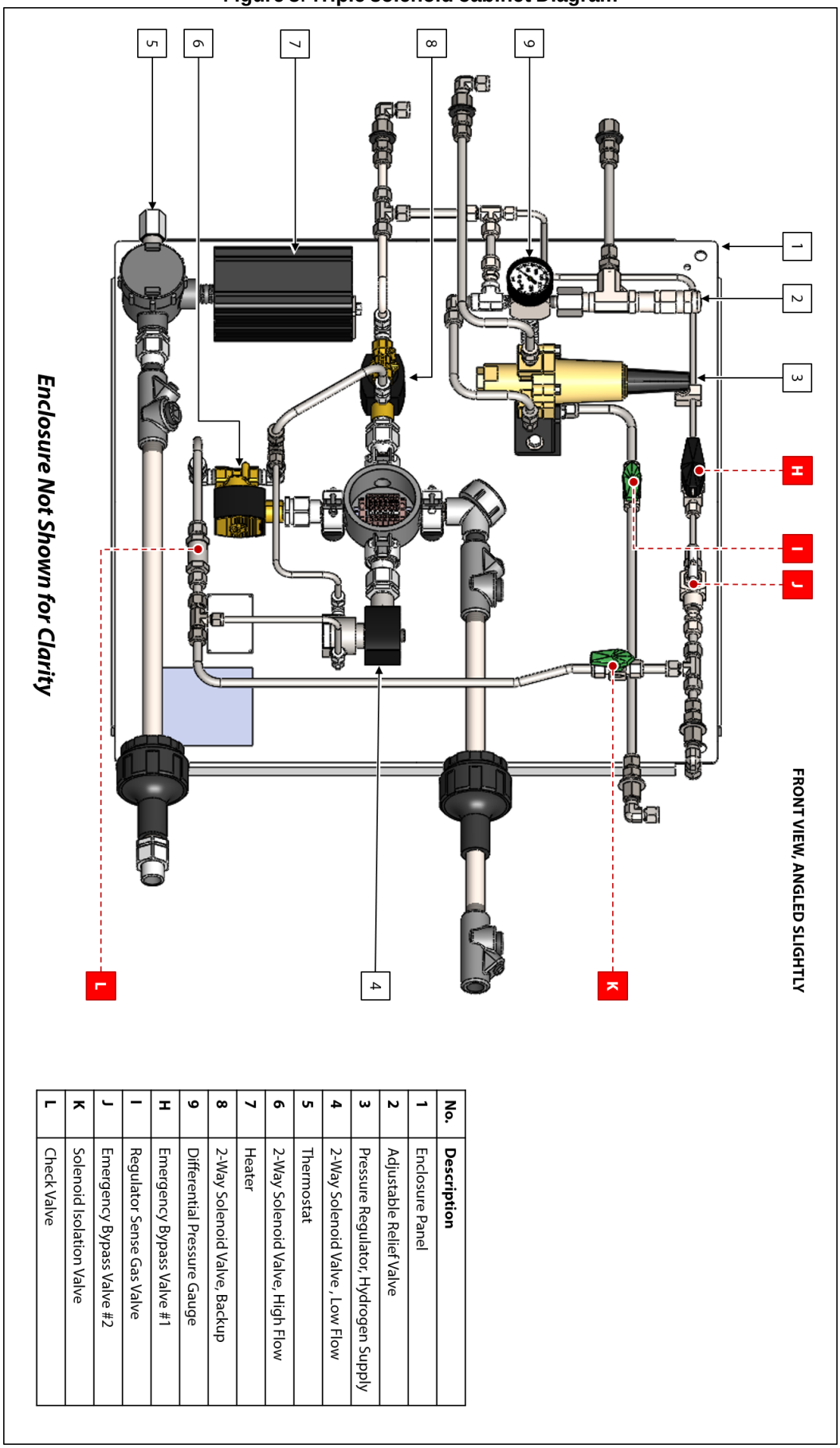


Figure 4: Solenoid Cabinet Diagram



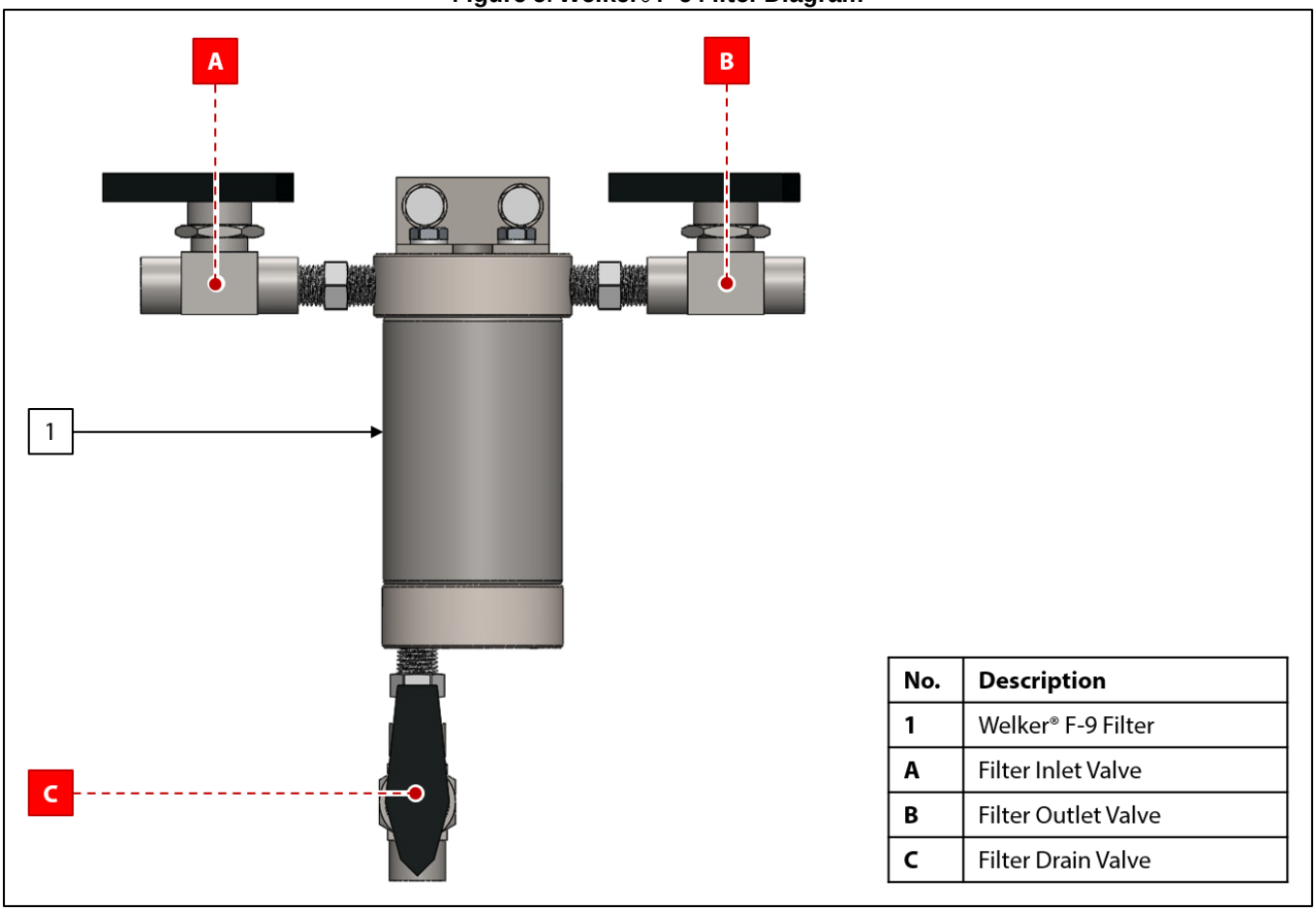
No.	Description
1	Enclosure
2	Adjustable Relief Valve
3	Pressure Regulator, Hydrogen Supply
4	2-Way Solenoid Valve, Backup
5	2-Way Solenoid Valve, Primary
6	Differential Pressure Gauge
D	Solenoid Isolation Valve
E	Emergency Bypass Valve #1
F	Emergency Bypass Valve #2
G	Regulator Sense Gas Valve

Figure 5: Triple Solenoid Cabinet Diagram



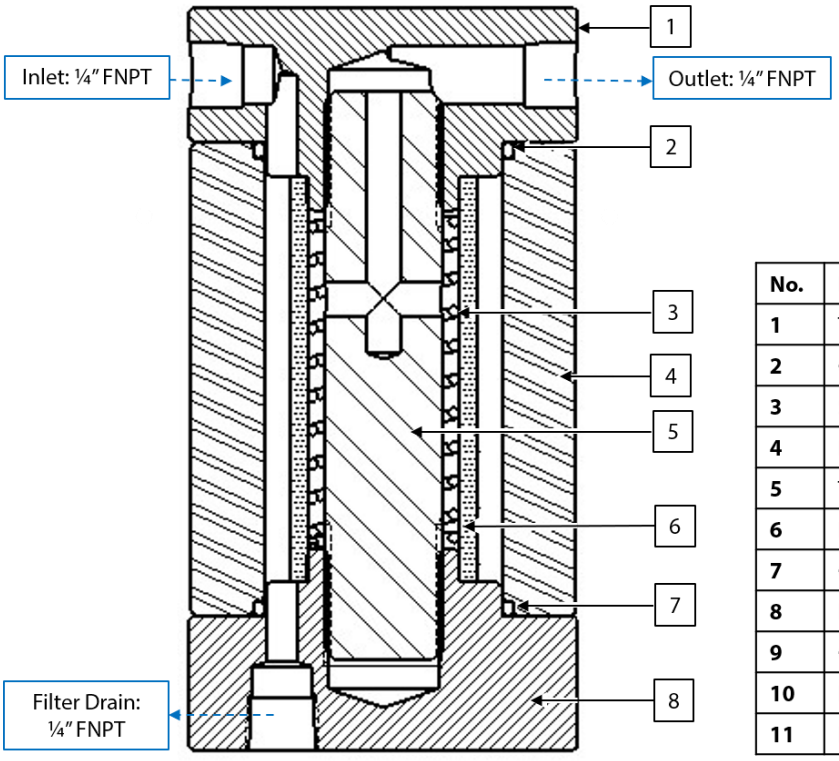
No.	Description
1	Enclosure Panel
2	Adjustable Relief Valve
3	Pressure Regulator, Hydrogen Supply
4	2-Way Solenoid Valve , Low Flow
5	Thermostat
6	2-Way Solenoid Valve, High Flow
7	Heater
8	2-Way Solenoid Valve, Backup
9	Differential Pressure Gauge
H	Emergency Bypass Valve #1
I	Regulator Sense Gas Valve
J	Emergency Bypass Valve #2
K	Solenoid Isolation Valve
L	Check Valve

Figure 6: Welker® F-9 Filter Diagram



No.	Description
1	Welker® F-9 Filter
A	Filter Inlet Valve
B	Filter Outlet Valve
C	Filter Drain Valve

Figure 7: Welker® F-9 Filter Drawing



No.	Description
1	Top Cap
2	O-ring
3	Spring
4	Body
5	Tie Bolt
6	Filter Element
7	O-ring
8	Base
9	Outlet: ¼" FNPT
10	Inlet: ¼" FNPT
11	Drain: ¼" FNPT

SECTION 2: INSTALLATION & OPERATION

2.1 Before You Begin

After unpacking the unit, check the equipment for compliance and any damage that may have occurred during shipment. Immediately contact a Welker® representative if you received damaged equipment.

When sealing fittings with PTFE tape, refer to the proper sealing instructions for the brand used.

The ECOsystem™ Hydrogen Injection System will ship skid-mounted and "hard-tube" connected with manufacturer-supplied fittings and hardware. However, the customer will need to supply some tubing and fittings in order to complete the installation of the system.

The hydrogen must be supplied to the ECOsystem™ Hydrogen Injection System at a pressure higher than the injection point.

All electrical connections must meet local and national electric codes, and excessive weight added to the conduit run must be supported.

2.2 Installation

Support Bracket

1. Mount the support bracket to a flat, level surface, such as a concrete slab.
2. Connect a grounding wire to the ground lug on the support bracket (*Figure 2*).

System Connections

3. Using customer-supplied ¼" tubing, connect from the outlet of the hydrogen supply source to the inlet of the Welker® F-9 Filter (*Figure 3*, *Figure 6*, and *Figure 7*).
4. Using customer-supplied ¼" tubing, connect from the relief exhaust outlet on the solenoid cabinet to an appropriate venting location (*Figure 3*).
5. Using customer-supplied ¼" tubing, connect from the hydrogen gas outlet to an unused valve on the natural gas pipeline (*Figure 3*).

Welker® recommends using stainless steel tubing for all natural gas process lines.

Electrical Connections

Turn OFF the electrical supply prior to making electrical connections.

6. Connect an appropriate customer-supplied electrical cable to the PLC (*Figure 3*). Refer to industry standards for appropriate electrical connections to interface with the PLC.

For systems used in hazardous locations, sealing compound is required to seal all fittings to restrict the passage of gases, vapors, or flames.

7. Connect the flow meter to the terminal block.

The PLC can accept analog or pulse input.

2.3 Start-Up Procedures

Hydrogen Gas Supply Regulator

1. As necessary, open any valves between the outlet on the hydrogen supply source and the F-9 inlet (*Figure 3*).
2. Open filter inlet valve A and filter outlet valve B (*Figure 6*).
3. Open the hydrogen supply source outlet to apply hydrogen gas to the solenoid cabinet and pressurize the hydrogen gas supply regulator (*Figure 4*).

The hydrogen supply regulator comes factory-set to the setting required to operate the solenoids.

4. Open regulator sense gas valve G (*Figure 4*).

Valve Configuration

5. Open solenoid isolation valve D (*Figure 4*).
6. If applicable, slowly open any valves between the ECOsystem™ Hydrogen Injection System and the pipeline.
7. Check for leaks and repair as necessary.

Controller Configuration

8. Verify that the customer setpoints have been set correctly by the manufacturer.

3.1 Understanding the Display

The touch screen controller is used to modify system parameters and view current system information and current alarm status.

The touch screen controller is a menu-driven system. The Home screen is the top screen in the menu tree (*Figure 8*).

Figure 8: Home Screen

Monitor
Takes you to the monitoring screens where you can view current information about the operation of the hydrogen injection system.

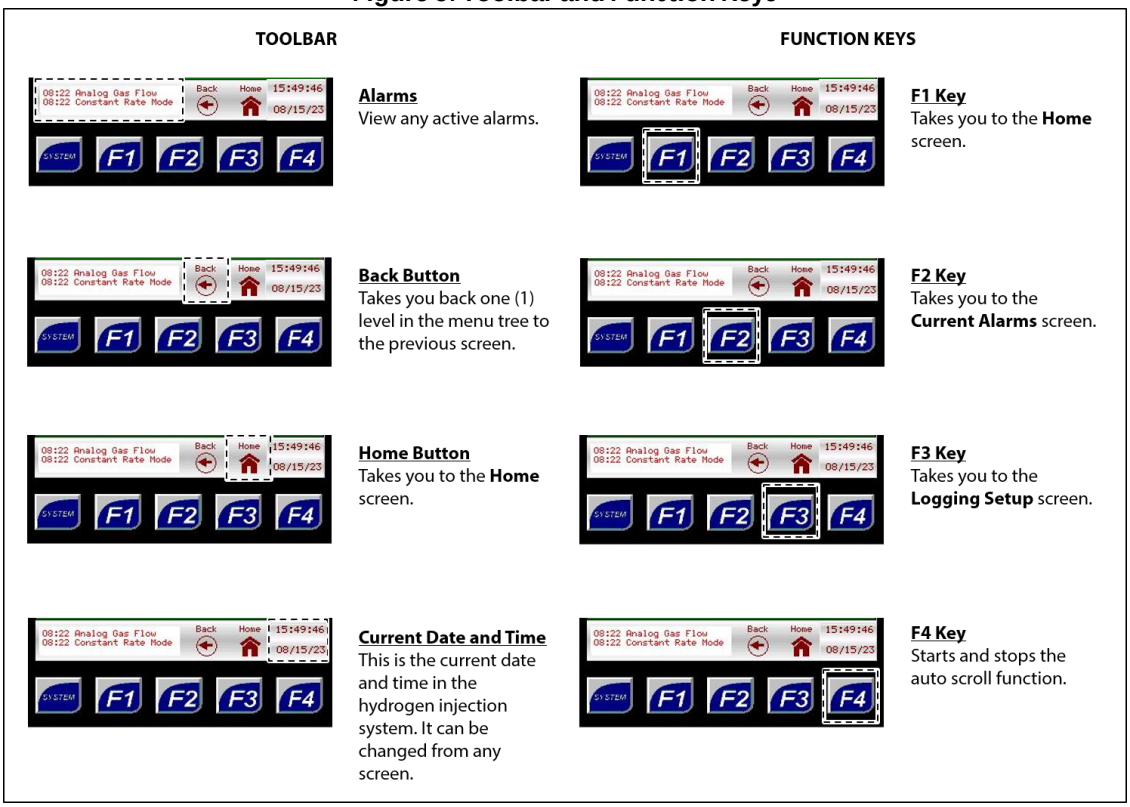
Setup
Takes you to the setup screens where you can change any setpoint values in the hydrogen injection system.

From the Home screen, the user can access three (3) types of screens:

- **Menu**—from this type of screen, the user can access submenus.
- **Informational**—from this type of screen, the user can monitor the hydrogen injection system and view current operating conditions. These screens have a **blue** background.
- **Setup**—from this type of screen, numeric and/or text values that affect the setup of the hydrogen injection system can be changed. These screens have a **red** background.

Navigating the Display

Figure 9: Toolbar and Function Keys



The toolbar appears on every screen except the Home screen.

If nothing on the screen is pressed for a certain amount of time, the sleep function will cause the backlight on the screen to turn off. To wake up the controller, press anywhere on the screen or press one of the function keys.

Viewing the Current Alarms

From any screen, press the F2 key to go to the Current Alarms screen (*Figure 10*).

Figure 10: Current Alarms Screen

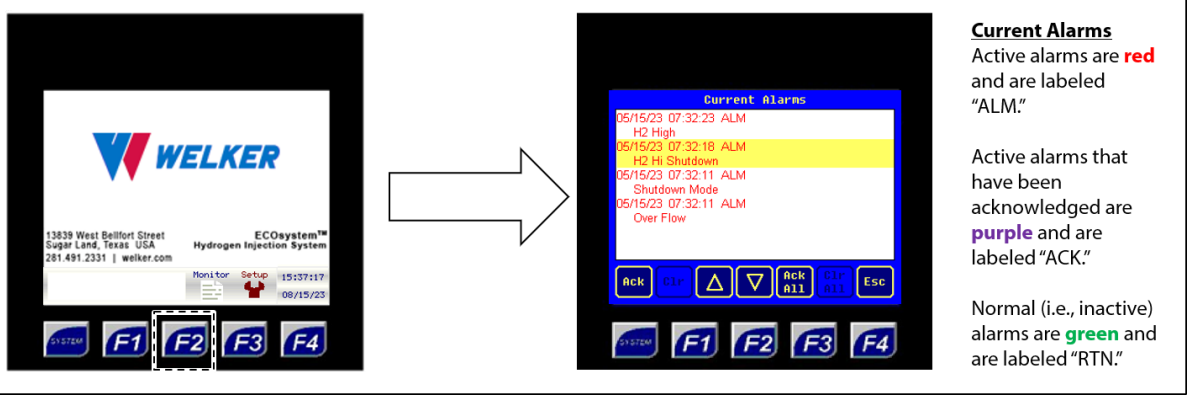


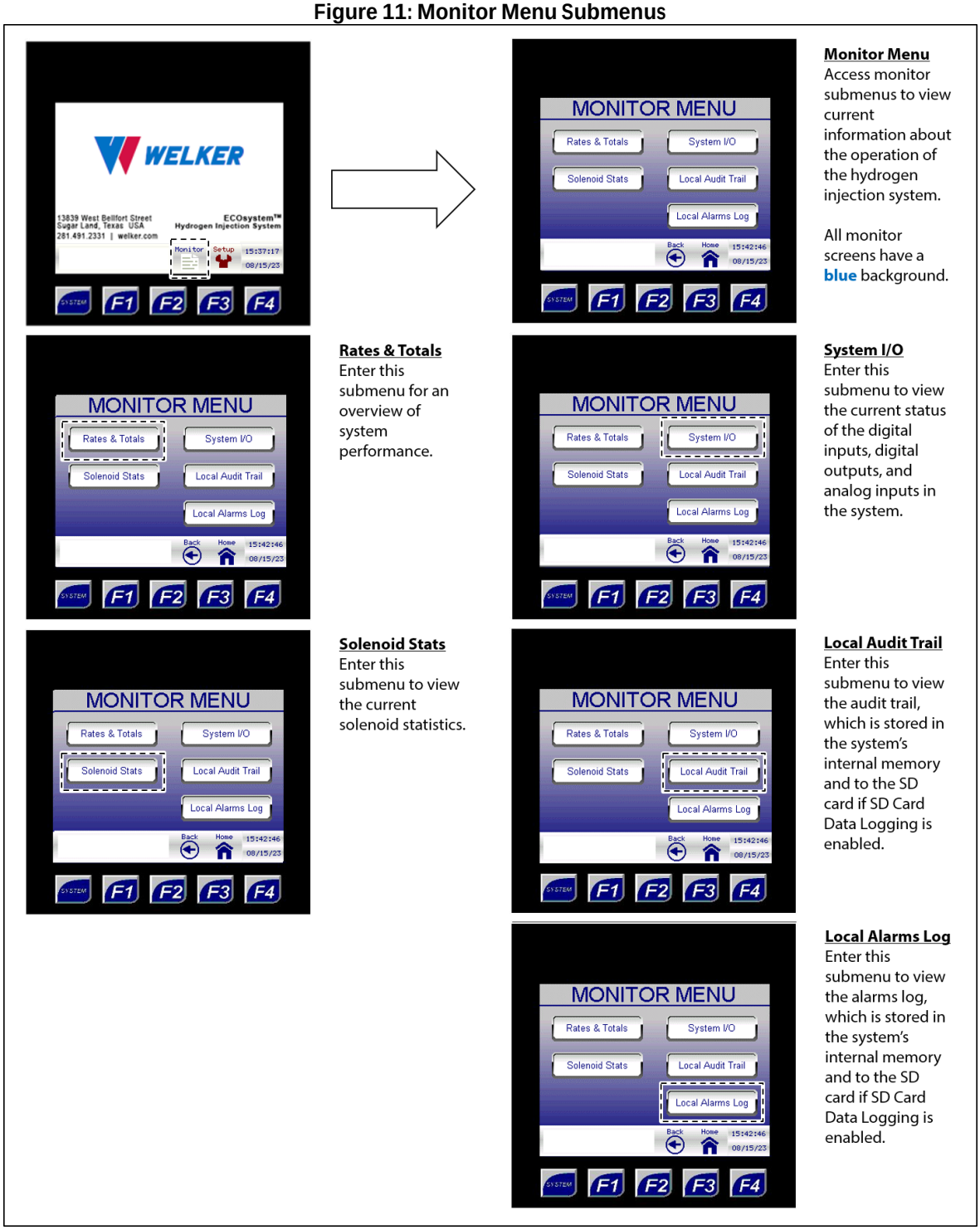
Table 3: Current Alarms	
Analog Gas Flow	Can only be active if Analog mode is selected. The controller will go into the selected fail mode when this alarm is active. Default setting is Shutdown. **NOTE:** If this alarm is active, verify that a 4–20 mA signal is being received from the flow meter.
Pulse Gas Flow	Can only be active if Pulse mode is selected. The controller will go into the selected fail mode when this alarm is active. **NOTE:** If this alarm is active, the pulse input cutoff time has expired. Verify that a pulse input is being received from the flow meter. If this alarm is active when the controller is receiving pulse input from the flow meter, Welker® recommends increasing the pulse input cutoff time to prevent the alarm from becoming active prematurely.
Constant Rate Mode	Can only be active if Constant Rate Mode is specified as the desired fail mode. The controller will enter this gas flow fail mode when there is a gas flow signal loss.
Shutdown Mode	Can only be active if Shutdown Mode is specified as the desired fail mode. The controller will enter this gas flow fail mode when there is a gas flow signal loss, Hydrogen Overflow alarm, Hydrogen Flow Meter signal failure, Hydrogen Shutdown alarm, or remote shutdown.
Fixed Mode	Can only be active if Fixed Mode is enabled and the Fixed Alarm Rate is set. **NOTE:** If this alarm is active, the Fixed Alarm Rate will be the assumed gas flow in the system and will override any other input parameters. The Fixed Rate Alarm will not clear until Fixed Mode is disabled.
Hydrogen Overflow	Active if the flow meter signals the controller indicating gas is passing through it even though the solenoid(s) should not be open. **NOTE:** If this alarm is active, it could be an indication that a solenoid is stuck open, and that the system is over-injecting or that the flow meter is stuck open.
Hydrogen No Flow	Active if the controller signals the solenoid to open but does not receive a signal from the flow meter confirming the solenoid has opened. **NOTE:** If this alarm is active, it could be an indication that the solenoid has failed closed or that the pressure differential across the system is not great enough to inject hydrogen.

3.2 Navigating the Monitor Menus

Through the Monitor menus, the user can access the Rates & Totals, Solenoid Stats, GC Inputs, System I/O, Local Audit Trail, and Local Alarms Log to view current information for the hydrogen injection system.

Monitor screens, which have a **blue** background, are informational screens: no values can be changed from these screens.

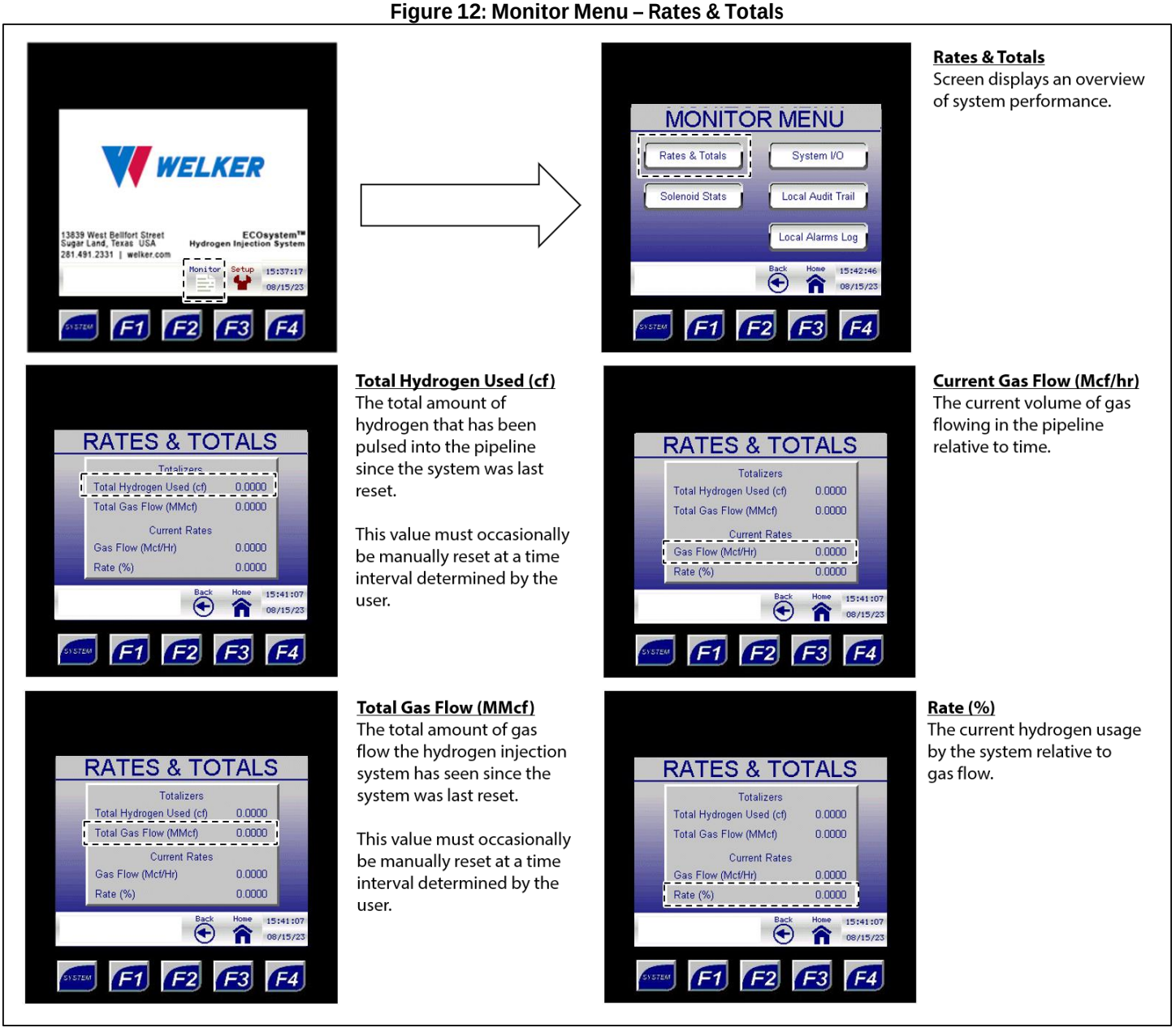
Figure 11: Monitor Menu Submenus



Rates & Totals

The Rates & Totals submenu provides the user with an overview of system performance.

Figure 12: Monitor Menu – Rates & Totals



Rates & Totals
Screen displays an overview of system performance.

Total Hydrogen Used (cf)
The total amount of hydrogen that has been pulsed into the pipeline since the system was last reset.

This value must occasionally be manually reset at a time interval determined by the user.

Current Gas Flow (Mcf/hr)
The current volume of gas flowing in the pipeline relative to time.

Total Gas Flow (MMcf)
The total amount of gas flow the hydrogen injection system has seen since the system was last reset.

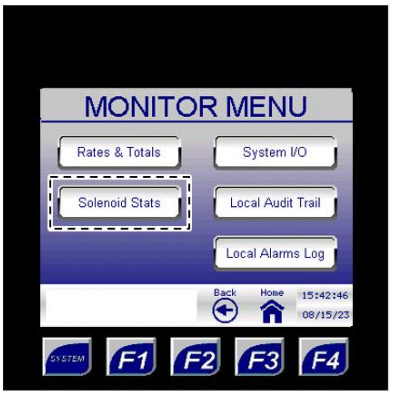
This value must occasionally be manually reset at a time interval determined by the user.

Rate (%)
The current hydrogen usage by the system relative to gas flow.

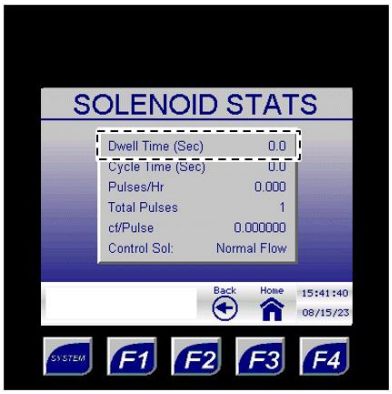
If the system status totals are used to track system performance, they should be periodically reset through the Controller Setup submenu (*Figure 19*). As the total values increase, they will begin to lose accuracy and will eventually stop accumulating.

Solenoid Stats

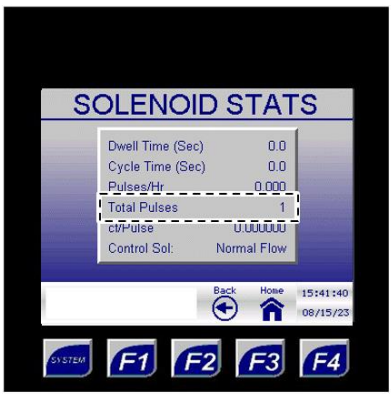
Figure 13: Monitor Menu – Solenoid Stats



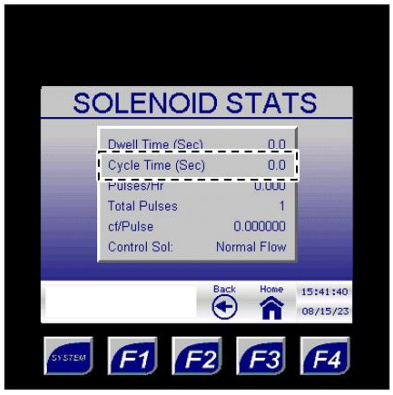
Solenoid Stats
Screen displays the current solenoid statistics.



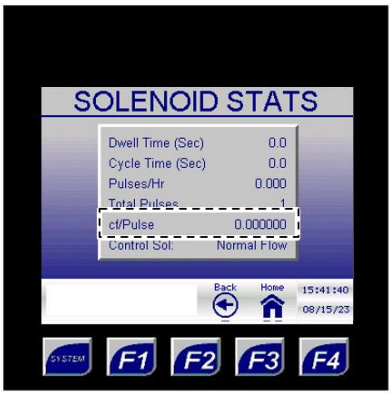
Dwell Time (Sec)
The dwell time is the length of time (in seconds) the solenoid remains open each time it opens.



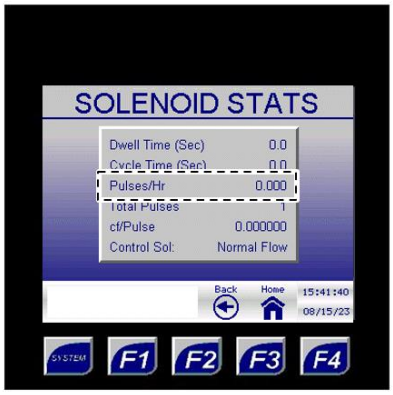
Total Pulses
The total number of times the solenoid has pulsed hydrogen into the pipeline.



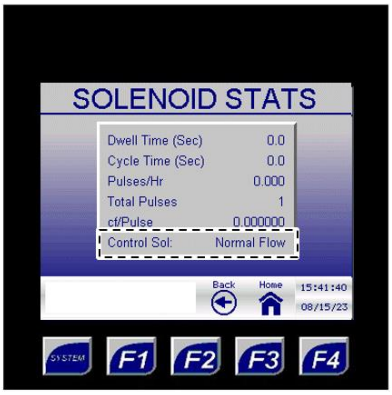
Cycle Time (Sec)
The cycle time is how frequently (in seconds) the solenoid is opening.



cf/Pulse
This is the volume of hydrogen pulsed into the pipeline every time the solenoid opens.



Pulses/Hr
Pulses per hour is the number of times the solenoid will open per hour given the current dwell and cycle times.



Control Sol:
This indicates which solenoid is currently operating.

System I/O

The System I/O submenu provides the user with an overview of the current status of digital inputs, digital outputs, and analog inputs in the system.

Figure 14: Monitor Menu – System I/O, 1 of 2

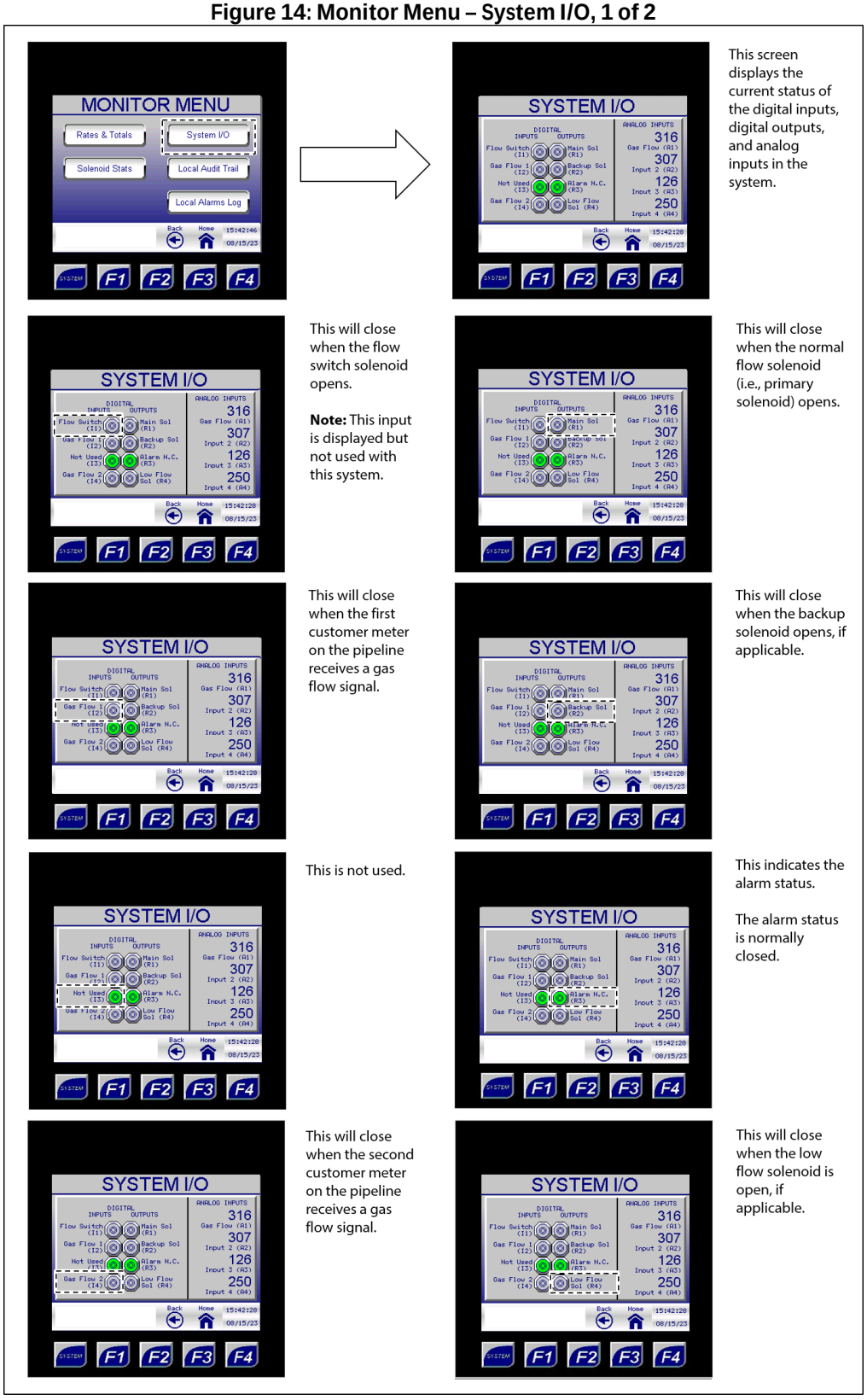
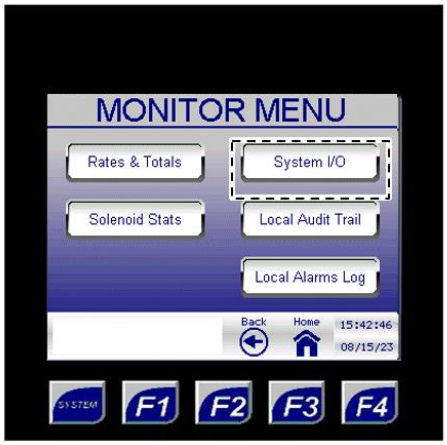
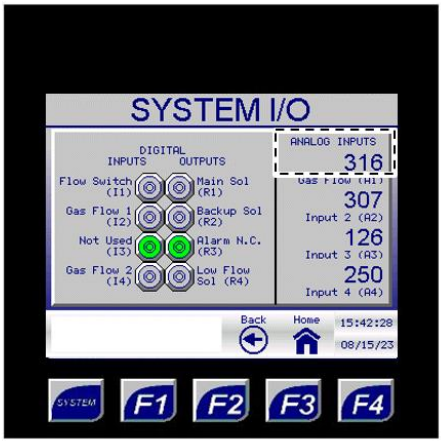
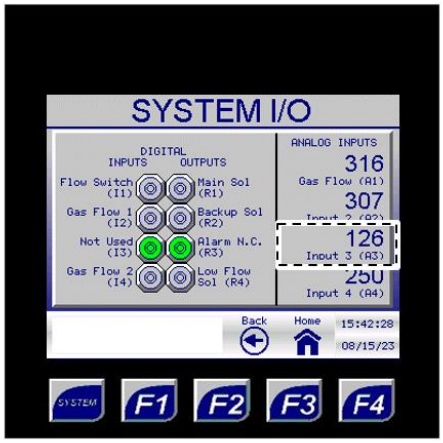


Figure 15: Monitor Menu – System I/O, 2 of 2

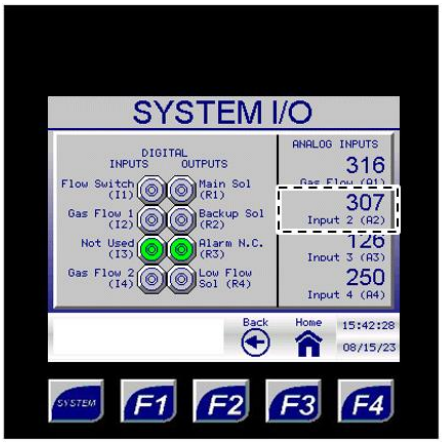




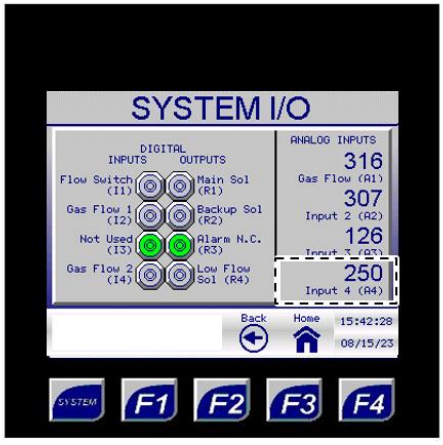
This analog signal is the raw count coming into the hydrogen injection system after the signal has been converted from milliamps. This value will vary according to the output from the customer gas flow meter.



Note: This input is displayed but not used with this system.



Note: This input is displayed but not used with this system.



Note: This analog signal is the raw count from the hydrogen flow meter.

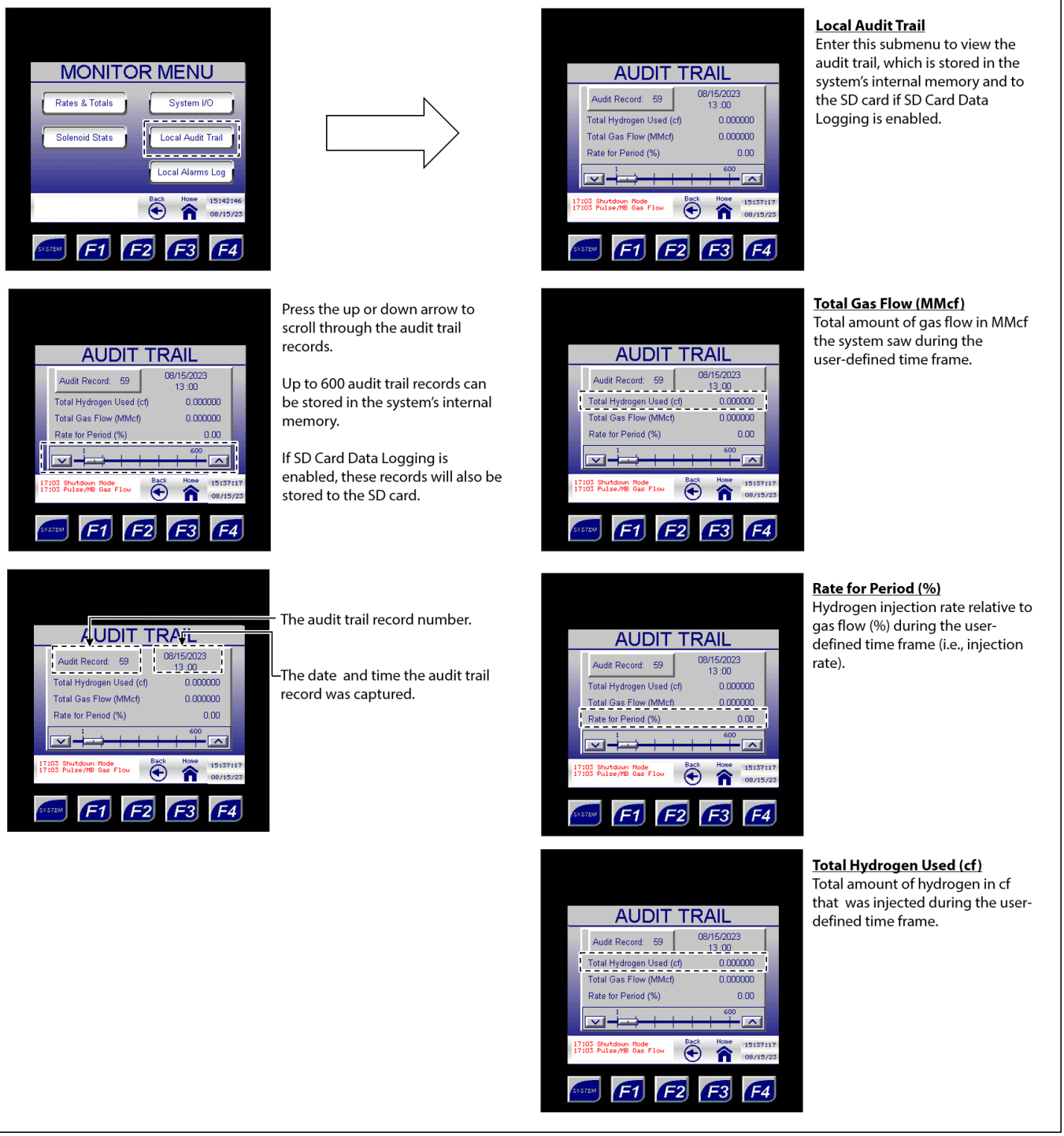
Analog Input Conversion	
Signal (mA)	**Raw Count**
4	6400
20	32000

Local Audit Trail

From the Local Audit Trail submenu, the user can access the audit trail records stored on internal memory. Up to 600 audit trail records can be stored and viewed.

If SD Card Data Logging is enabled, the audit trail records will also be stored on the installed micro-SD card. The micro-SD card is equipped with 8 GB of storage.

Figure 16: Monitor Menu – Local Audit Trail

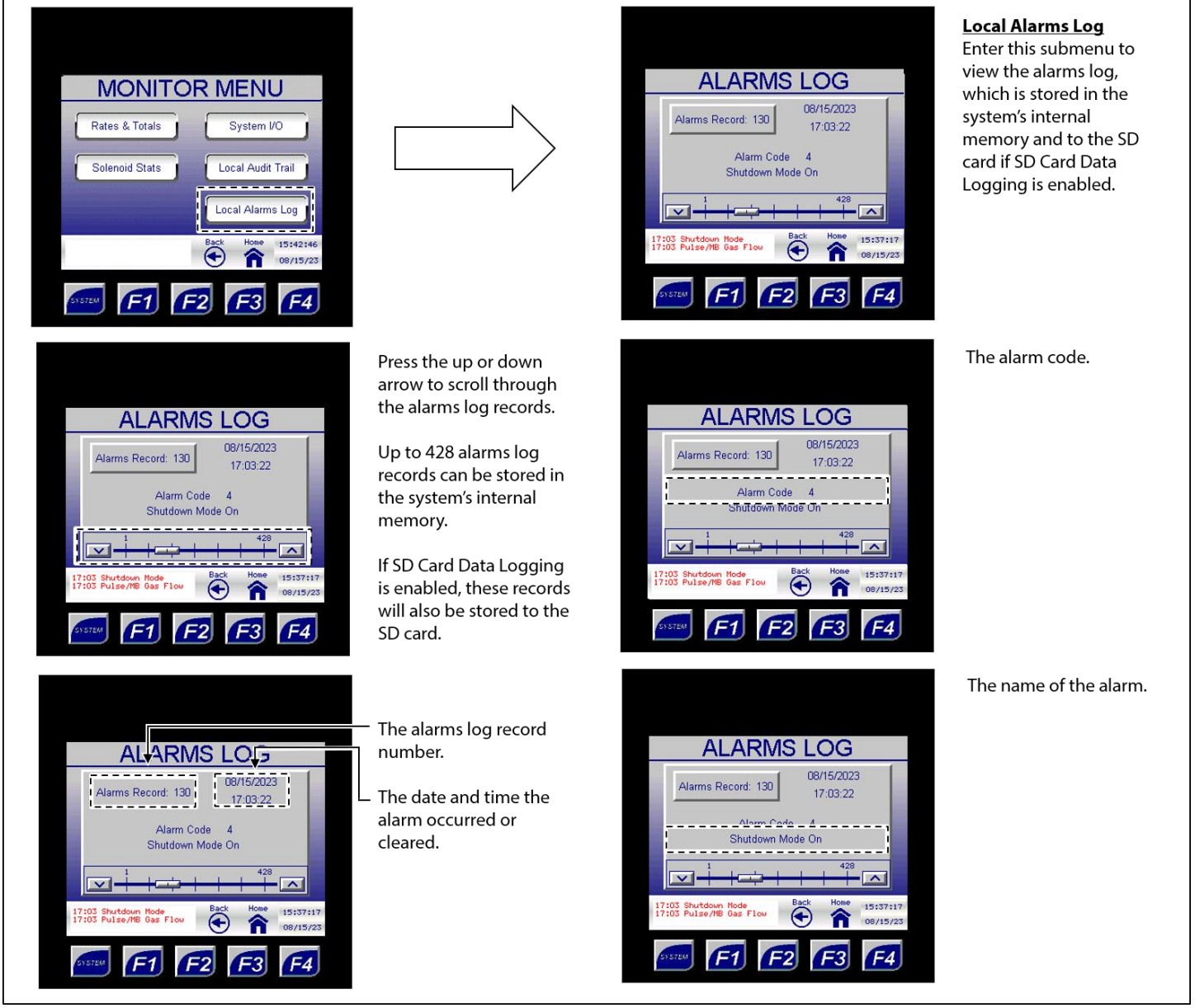


Local Alarms Log

From the Local Alarms Log submenu, the user can access the alarms log stored on internal memory. Up to 428 logged alarms can be stored and viewed.

If SD Card Data Logging is enabled, the logged alarms will also be stored on the installed micro-SD card. The micro-SD card is equipped with 8 GB of storage.

Figure 17: Monitor Menu – Local Alarms Log



3.3 Navigating the Setup Menus

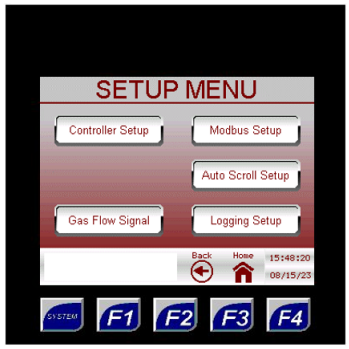
Through the Setup menu, the user can access the Controller Setup, GC Setup, Gas Flow Signal, Modbus Setup, Auto Scroll Setup, and Logging Setup and change numeric and/or text values that alter the parameters and features of the hydrogen injection system.

Changing numeric and/or text values in the Setup submenus will alter how the system operates.

Figure 18: Setup Menu Submenus

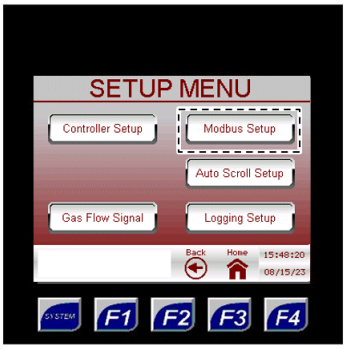
Password Login
When the Setup button is touched, the Password Login screen appears. Enter a password to access the Setup Menu. Default password is 2331. To change or disable the password, access the Auto Scroll Setup screen.

See *Figure 33.*

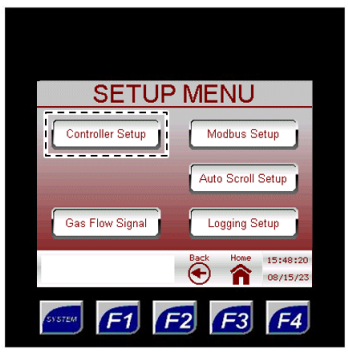


Setup Menu
Access setup submenus to change setpoint values in the hydrogen injection system.

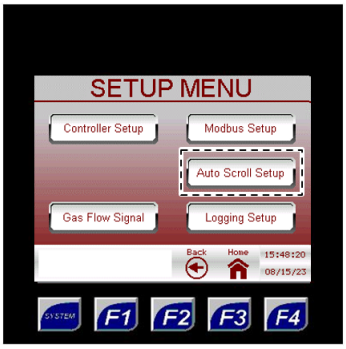
All setup screens have a **red** background.



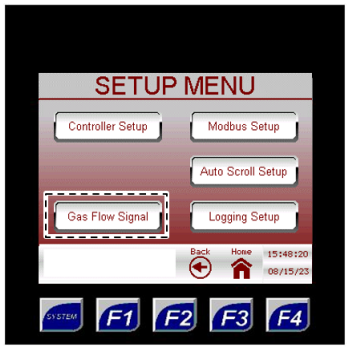
Modbus Setup
If the Modbus input method is used, enter this submenu to configure the Modbus input and view the current status of the Modbus.



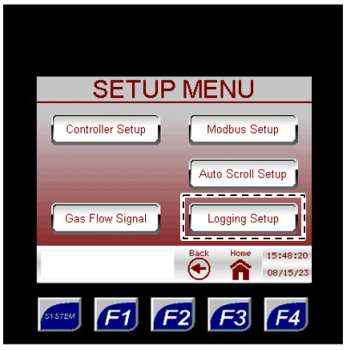
Controller Setup
Enter this submenu to configure the operation of the hydrogen injection system.



Auto Scroll Setup
Enter this submenu to customize screen operation.



Gas Flow Signal
Enter this submenu to set the parameters for the gas flow signal and set the fail mode.



Logging Setup
Enter this submenu to enable or disable data logging to the SD card and monitor the status of the SD card.

Changing Values on Setup Screens

Numeric Values

1. To change a numeric value, press on the value to be changed. A keypad will appear on the screen.
2. Type the new value using the keypad.
3. Once the new numeric value has been entered, press ENTER to save the changes.

If the new value entered is outside the range of allowable values, the value will revert to the previous value once ENTER is pressed. The keypad will stay active, allowing another value to be entered.

Text Values

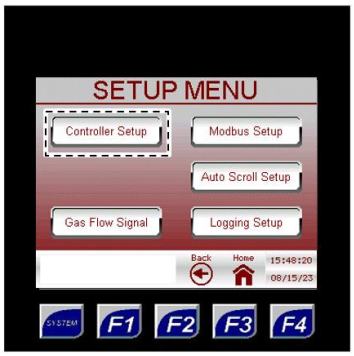
4. To change a text value, press on the value to be changed. A dropdown menu will appear on the screen.
5. Scroll through the value's options using the arrow keys in the dropdown menu.
6. Highlight the desired text value, and then press ENTER to save the changes.

If a mistake is made while entering the new value or if the value does not need to be changed, press the Home button to discard the changes and return to the Home screen.

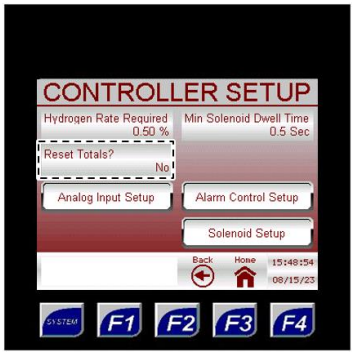
Controller Setup

Through the Controller Setup submenu, the user can set the general parameters for the hydrogen injection system.

Figure 19: Setup Menu – Controller Setup

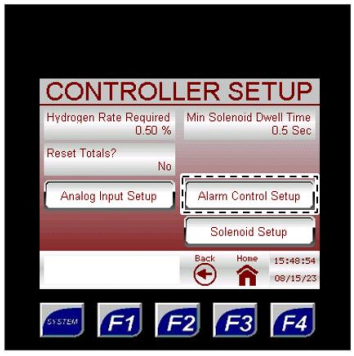


Hydrogen Rate Required
Set the percentage of hydrogen relative to gas volume flow.



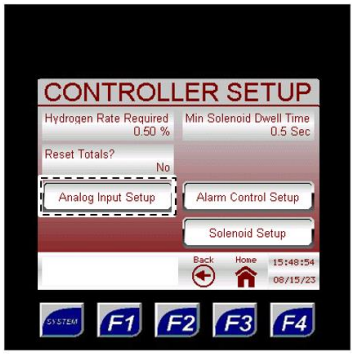
Reset Totals
Toggling this field to "Yes" causes the gas flow and hydrogen usage totals to be reset.

Once reset, this field will automatically revert to "No."



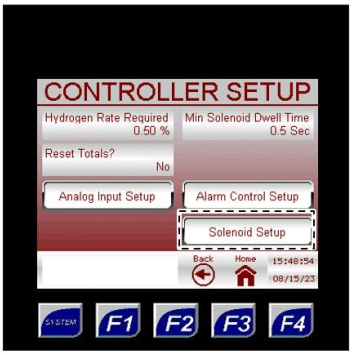
Alarm Control Setup
Takes you to the Alarm Control Setup screen.

See *Figure 21*



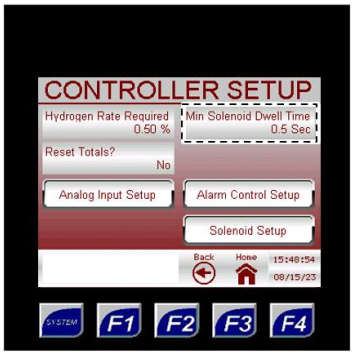
Analog Input Setup
Enter this submenu to configure analog inputs.

See *Figure 20*



Solenoid Setup
Enter this submenu to configure the solenoid setup if the system is equipped with two (2) or three (3) solenoids.

See *Figure 26*



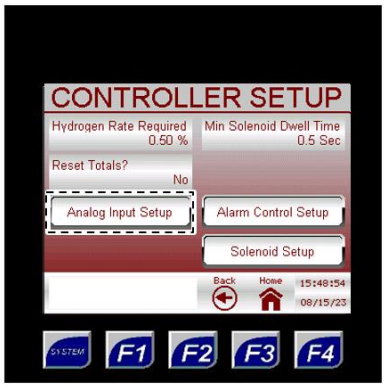
Min Solenoid Dwell Time
This indicates the minimum length of time that the metering solenoid will be held open during hydrogen injection.

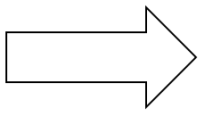
See *Figure 26*

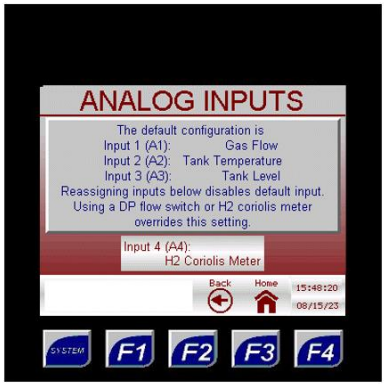
If the system status totals are used to track system performance, they should be periodically reset through the Controller Setup submenu (*Figure 19*). As the total values increase, they will begin to lose accuracy and will eventually stop accumulating.

Analog Inputs Setup

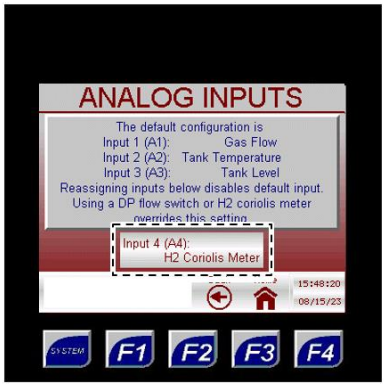
Figure 20: Controller Setup – Analog Inputs Setup







Analog Inputs Setup
Enter this submenu to configure the analog inputs if the customer desires to manually disable the H2 Coriolis Meter.

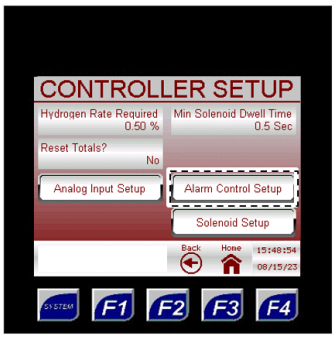


Input 4 (A4)
H2 Coriolis Meter and Disable.

Analog Output Conversion	
Signal (mA)	**Raw Count**
4	6400
20	32000

Alarm Control Setup

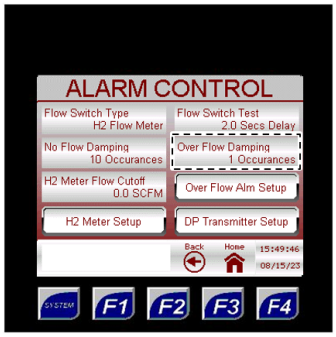
Figure 21: Controller Setup – Alarm Control Setup



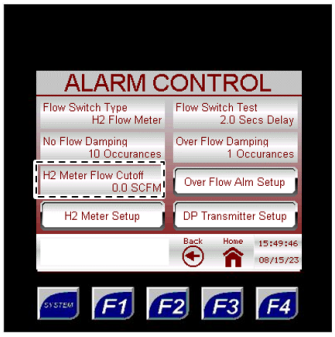
Flow Switch Type
Toggle between the following options:
- Flow Switch
- DP Transmitter
- H2 Flow Meter (Default)

Flow Switch Test
A delay that allows for the measurement from the H2 meter to come in prior to triggering an alarm.

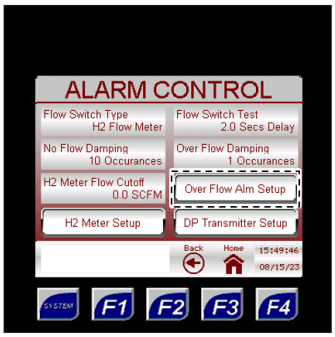
No Flow Damping
The number of times a No Flow indication is allowed to occur before an alarm is triggered.



Over Flow Damping
The number of times an Over Flow indication is allowed to occur before an alarm is triggered.



H2 Meter Flow Cutoff
The value too low to measure and therefore indistinguishable from noise at zero flow.

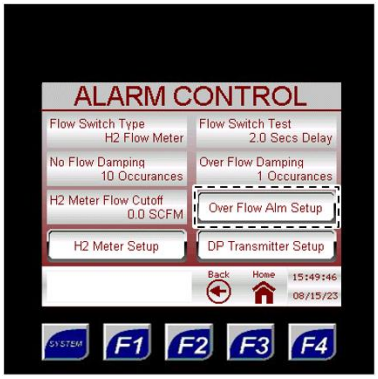


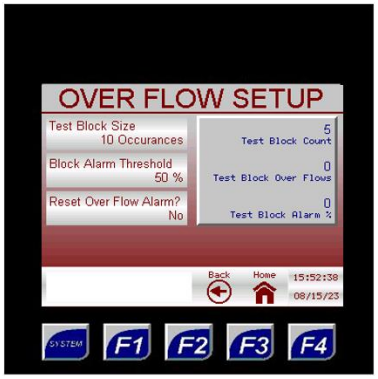
Overflow Alarm Setup
Takes you to the Over Flow Alm Setup screen.

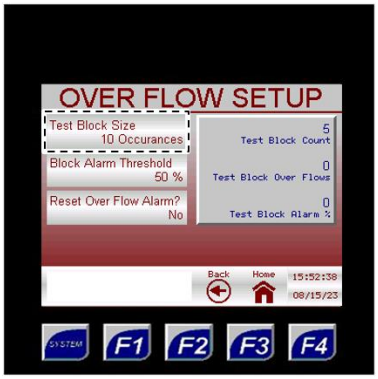
H2 Meter Setup
Takes you to the H2 Meter Setup screen.

DP Transmitter Setup
Takes you to the DP Transmitter Setup screen.

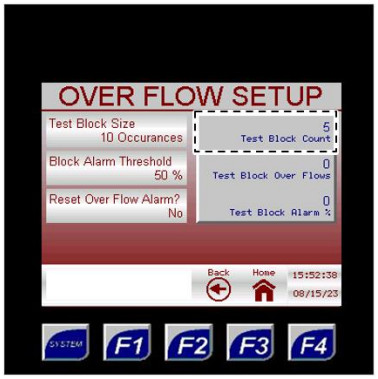
Figure 22: Alarm Control – Over Flow Setup



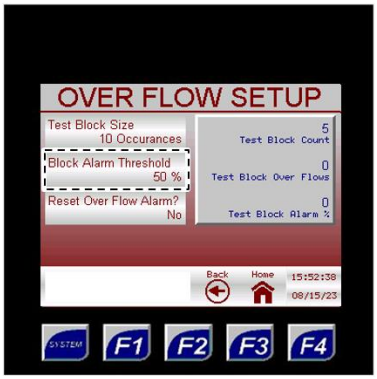




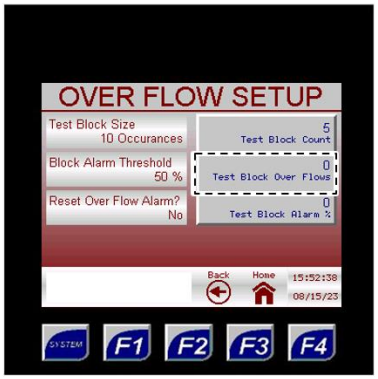
Test Block Size
Select the number of readings to average for the overflow alarm.



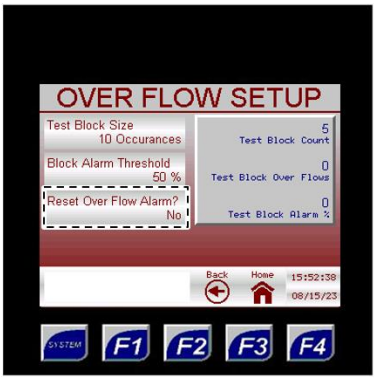
Test Block Count
Displays a continually running counter up to the test block size, which then resets and continues.



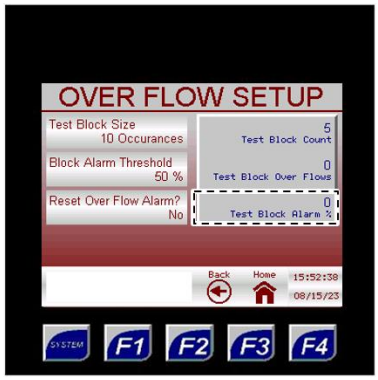
Block Alarm Threshold
Alarms if the percent of readings above threshold exceeds this setpoint.



Test Block Over Flows
Displays the current number of readings in this test block that have been above the threshold.

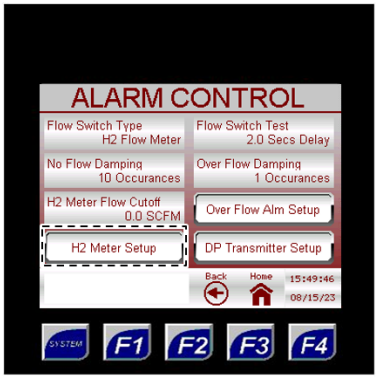


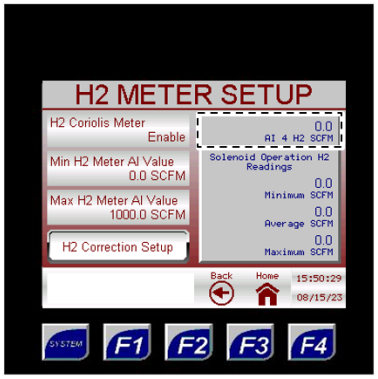
Reset Over Flow Alarm
Manually clears the overflow alarm.



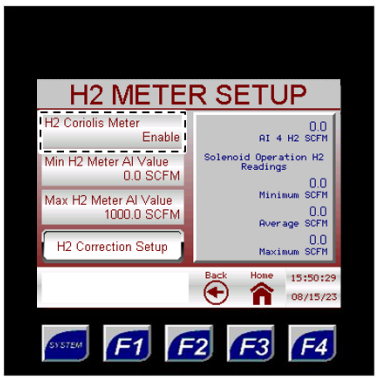
Test Block Alarm %
Displays the current percent of readings that have been over threshold in this test block.

Figure 23: Alarm Control Setup – H2 Meter Setup

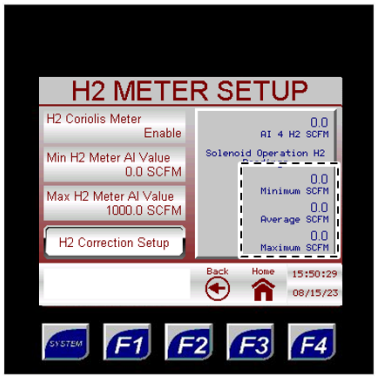




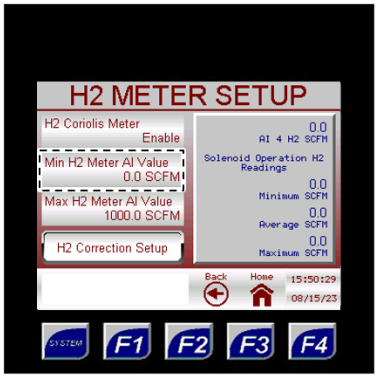
AI 4 H2 SCFM
The current instantaneous measured H2 flow rate.



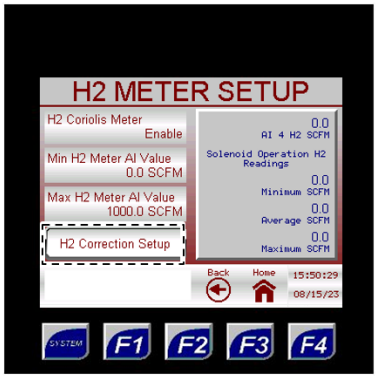
H2 Coriolis Meter
Choose between Enable or Disable.



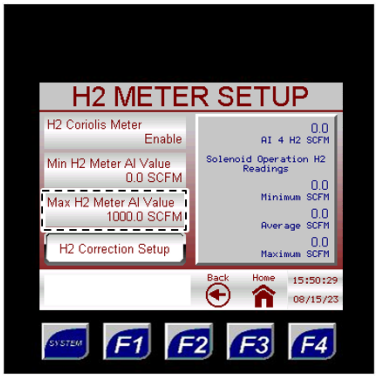
Solenoid Operation H2 Readings: Min / Avg / Max
Minimum, average, and maximum measured H2 flow values (SCFM).



Min H2 Meter AI Value
The value that 4 mA from the H2 meter represents (normally 0).

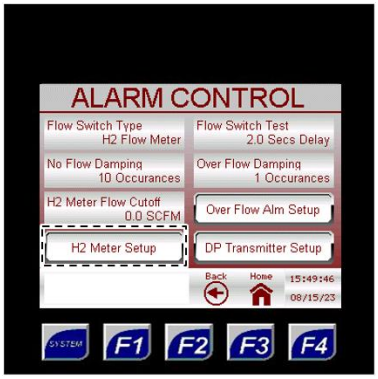


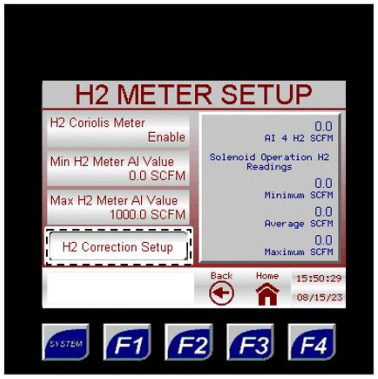
H2 Correction Setup
Enter this option should the customer desire to set up the H2 correction factor (difference between expected flow and measured flow).



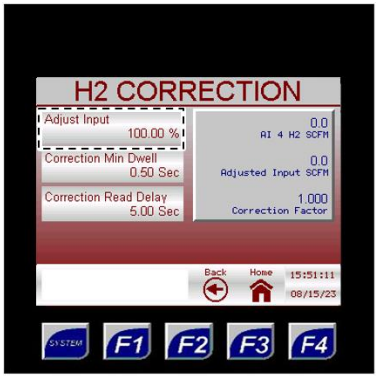
Max H2 Meter AI Value
The value that 20 mA from the H2 meter represents.

Figure 24: H2 Meter Setup – H2 Correction Setup

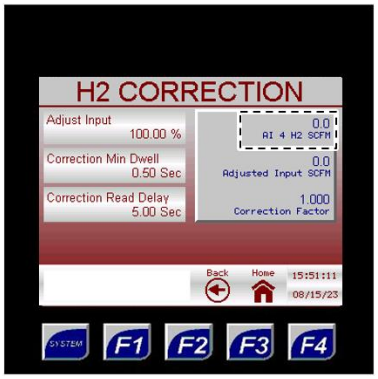




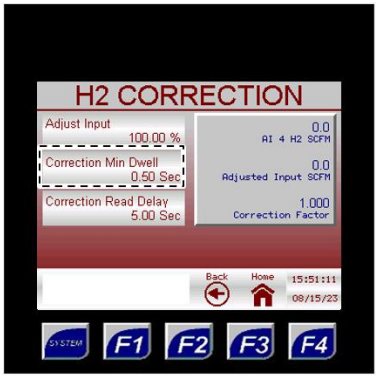
H2 Correction Setup
Enter this H2 Meter Setup submenu to adjust and view H2 correction measures.



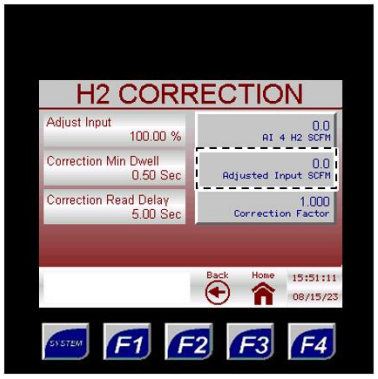
Adjust Input
Choosing this allows a correction to the readings from the H2 meter.



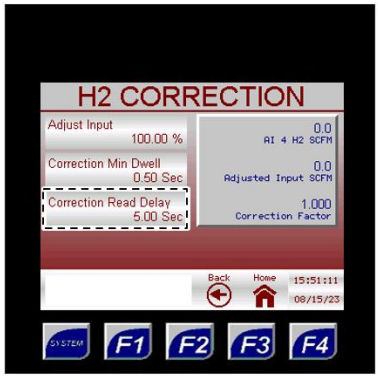
AI 4 H2 SCFM
Displays the current instantaneous measured H2 flow rate.



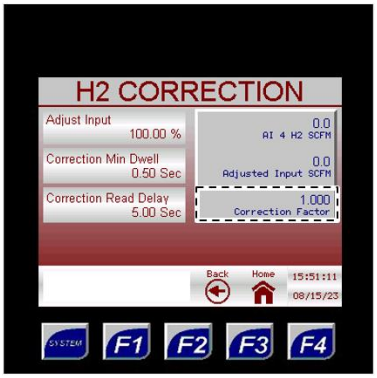
Correction Min Dwell
This is the minimum time a solenoid must be open to have a valid reading for calculation corrections.



Adjusted Input SCFM
Displays the current instantaneous corrected measured H2 flow rate.

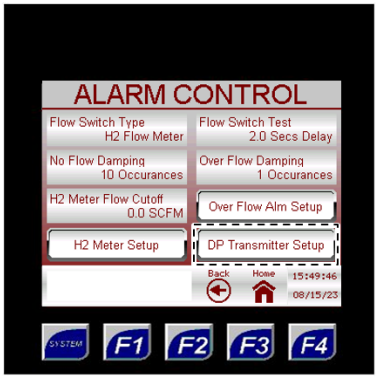


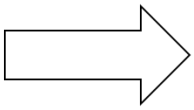
Correction Read Delay
This indicates how long to wait after the cycle finishes before implementing correction.

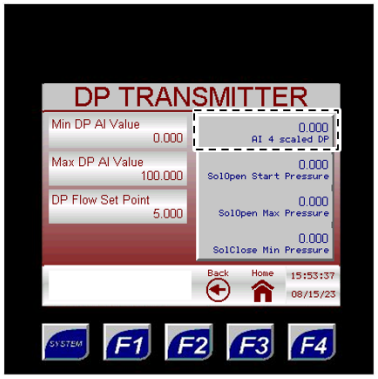


Correction Factor
Displays the currently calculated correction factor.

Figure 25: Alarm Control Setup – DP Transmitter Setup

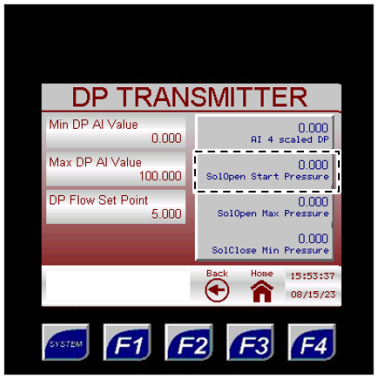




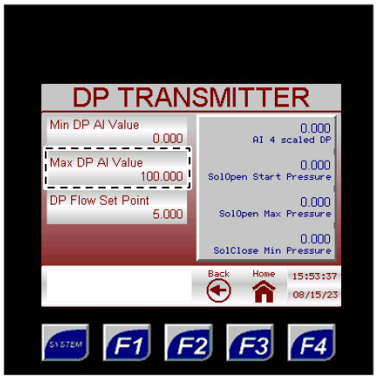


AI 4 Scaled DP
Instantaneous DP reading.

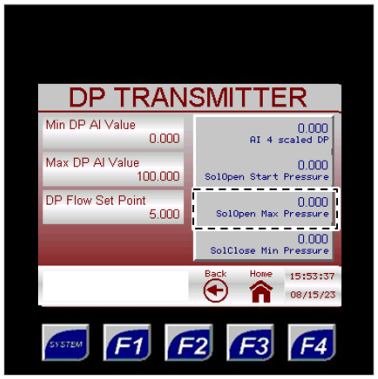
Min DP AI Value
DP transmitter zero value.



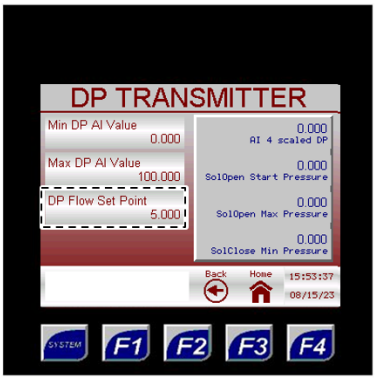
SolOpen Start Pressure
DP when solenoid opened at the beginning of a cycle.



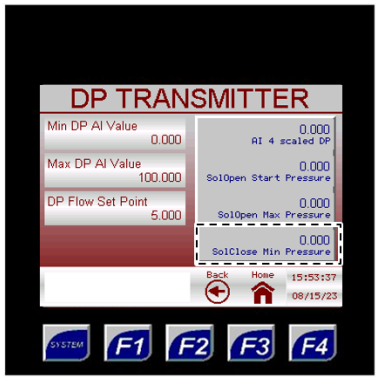
Max DP AI Value
DP transmitter span value.



SolOpen Max Pressure
Maximum pressure measured while solenoid is open (gas flowing).



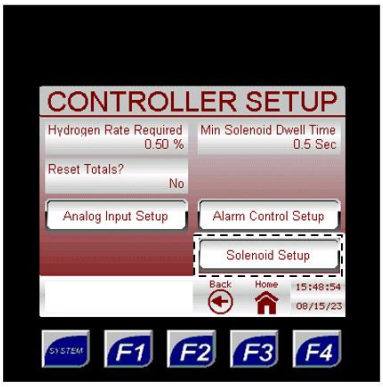
DP Flow Set Point
Pressure drop setpoint to indicate flow is occurring.

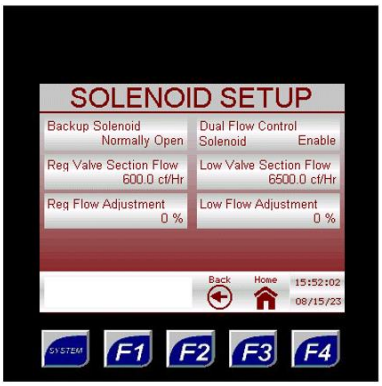


SolClose Min Pressure
Maximum pressure measured when solenoid is closed.

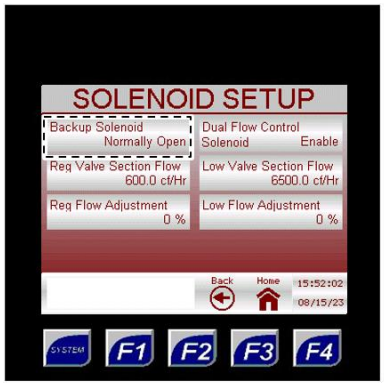
Solenoid Setup

Figure 26: Controller Setup – Solenoid Setup





Solenoid Setup
Enter this submenu to configure the solenoid setup if the system is equipped with two (2) or three (3) solenoids.



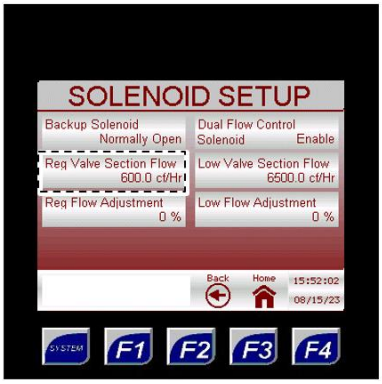
Backup Solenoid
For systems that use a backup solenoid in series with the primary solenoid, the backup solenoid can be normally open or normally closed.

This must be set correctly so that the system will operate properly in the event of primary solenoid failure.

Dual Flow Control Solenoid
For dual solenoid systems, this should be **disabled**.

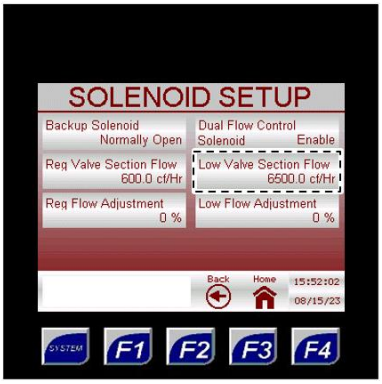
For triple solenoid systems, this should be **enabled**.

This is set at the factory.



Reg Valve Section Flow
This constant, which is based on the inlet pressure and the pressure drop across the solenoid, is the volume of gas (cf/hr) used by the control logic for calculations.

This value is factory-set according to customer specifications and should not be changed unless instructed by Welker® personnel.

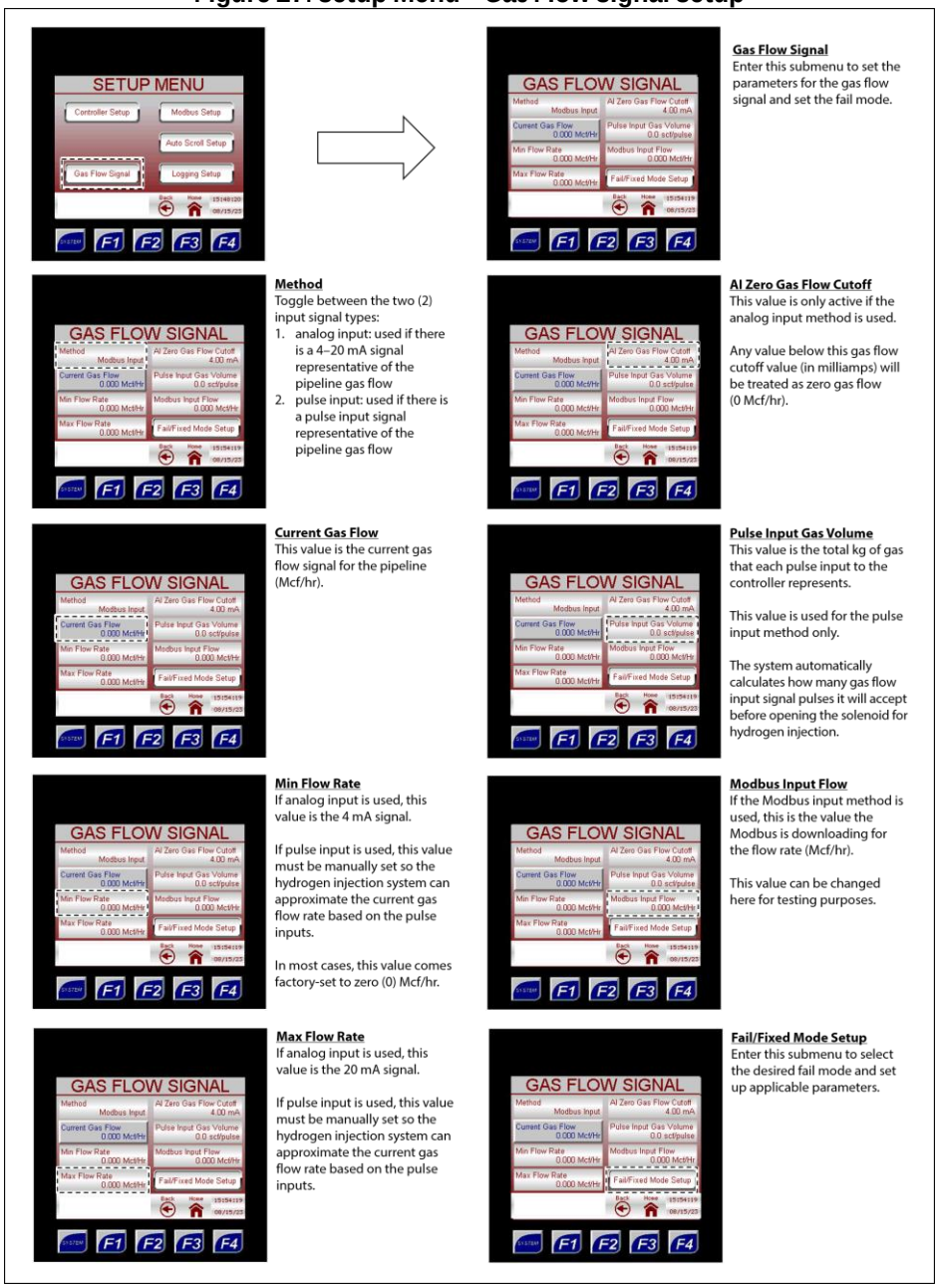


Low Valve Section Flow
This value is factory-set according to customer specifications and should not be changed unless instructed by Welker® personnel.

Gas Flow Signal

Through the Gas Flow Signal submenus, the user can set up the parameters of the hydrogen gas flow input signal.

Figure 27: Setup Menu – Gas Flow Signal Setup



Gas Flow Signal
Enter this submenu to set the parameters for the gas flow signal and set the fail mode.

Method
Toggle between the two (2) input signal types:
1. analog input: used if there is a 4–20 mA signal representative of the pipeline gas flow
2. pulse input: used if there is a pulse input signal representative of the pipeline gas flow

AI Zero Gas Flow Cutoff
This value is only active if the analog input method is used.

Any value below this gas flow cutoff value (in milliamps) will be treated as zero gas flow (0 Mcf/hr).

Current Gas Flow
This value is the current gas flow signal for the pipeline (Mcf/hr).

Pulse Input Gas Volume
This value is the total kg of gas that each pulse input to the controller represents.

This value is used for the pulse input method only.

The system automatically calculates how many gas flow input signal pulses it will accept before opening the solenoid for hydrogen injection.

Min Flow Rate
If analog input is used, this value is the 4 mA signal.

If pulse input is used, this value must be manually set so the hydrogen injection system can approximate the current gas flow rate based on the pulse inputs.

In most cases, this value comes factory-set to zero (0) Mcf/hr.

Modbus Input Flow
If the Modbus input method is used, this is the value the Modbus is downloading for the flow rate (Mcf/hr).

This value can be changed here for testing purposes.

Max Flow Rate
If analog input is used, this value is the 20 mA signal.

If pulse input is used, this value must be manually set so the hydrogen injection system can approximate the current gas flow rate based on the pulse inputs.

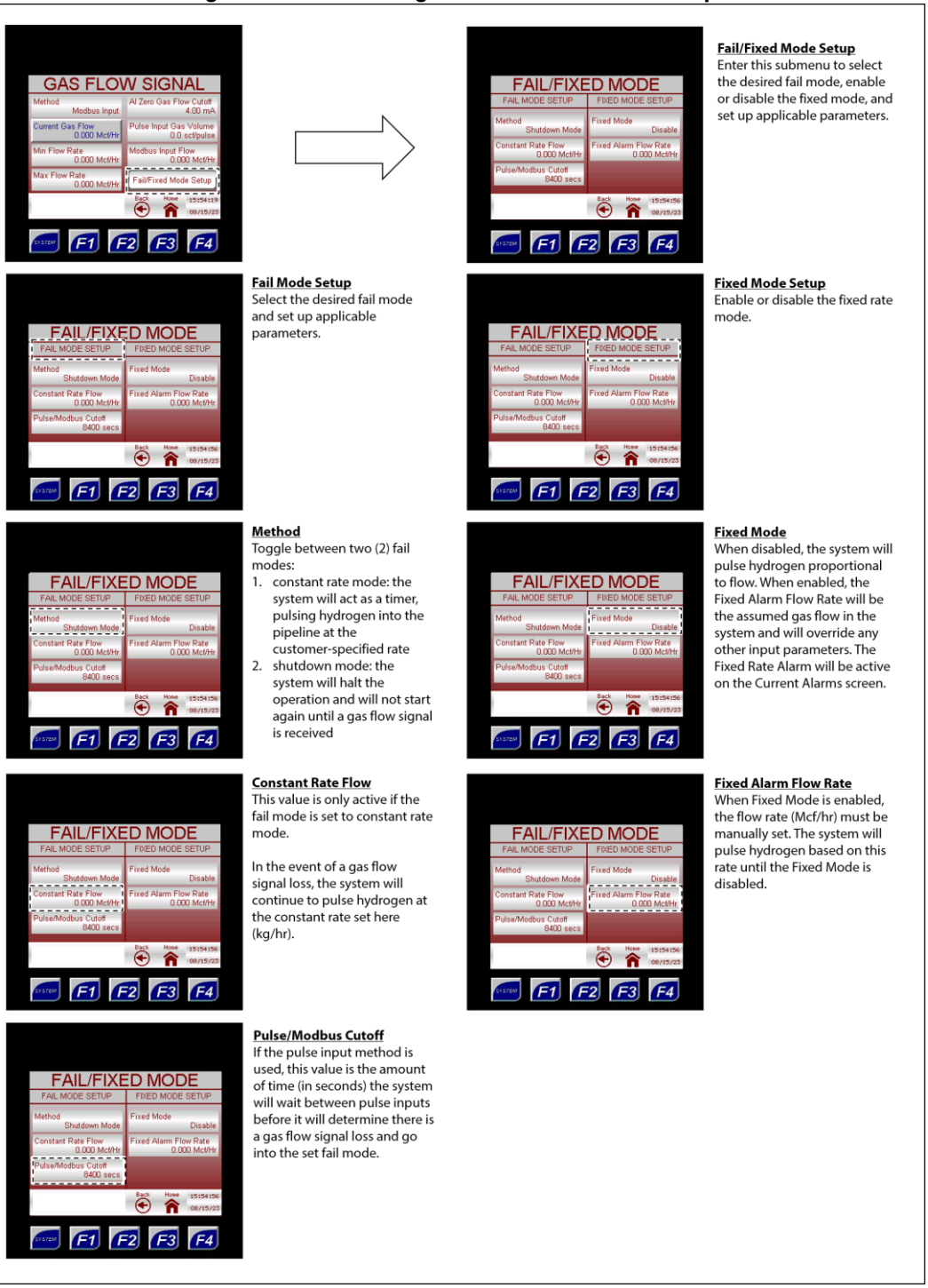
Fail/Fixed Mode Setup
Enter this submenu to select the desired fail mode and set up applicable parameters.

If the gas flow signal will be analog, the analog signal must be 4–20 mA powered by the user.
If the gas flow signal will be a pulse, the pulse will be a digital pulse powered by the controller.

If the pulse input method is selected, the Pulse/Modbus Cutoff must also be set (*Figure 26*).

Fail/Fixed Mode Setup

Figure 28: Gas Flow Signal – Fail/Fixed Mode Setup



Fail/Fixed Mode Setup
Enter this submenu to select the desired fail mode, enable or disable the fixed mode, and set up applicable parameters.

Fail Mode Setup
Select the desired fail mode and set up applicable parameters.

Fixed Mode Setup
Enable or disable the fixed rate mode.

Method
Toggle between two (2) fail modes:

1. constant rate mode: the system will act as a timer, pulsing hydrogen into the pipeline at the customer-specified rate
2. shutdown mode: the system will halt the operation and will not start again until a gas flow signal is received

Fixed Mode
When disabled, the system will pulse hydrogen proportional to flow. When enabled, the Fixed Alarm Flow Rate will be the assumed gas flow in the system and will override any other input parameters. The Fixed Rate Alarm will be active on the Current Alarms screen.

Constant Rate Flow
This value is only active if the fail mode is set to constant rate mode.

In the event of a gas flow signal loss, the system will continue to pulse hydrogen at the constant rate set here (kg/hr).

Fixed Alarm Flow Rate
When Fixed Mode is enabled, the flow rate (Mcf/hr) must be manually set. The system will pulse hydrogen based on this rate until the Fixed Mode is disabled.

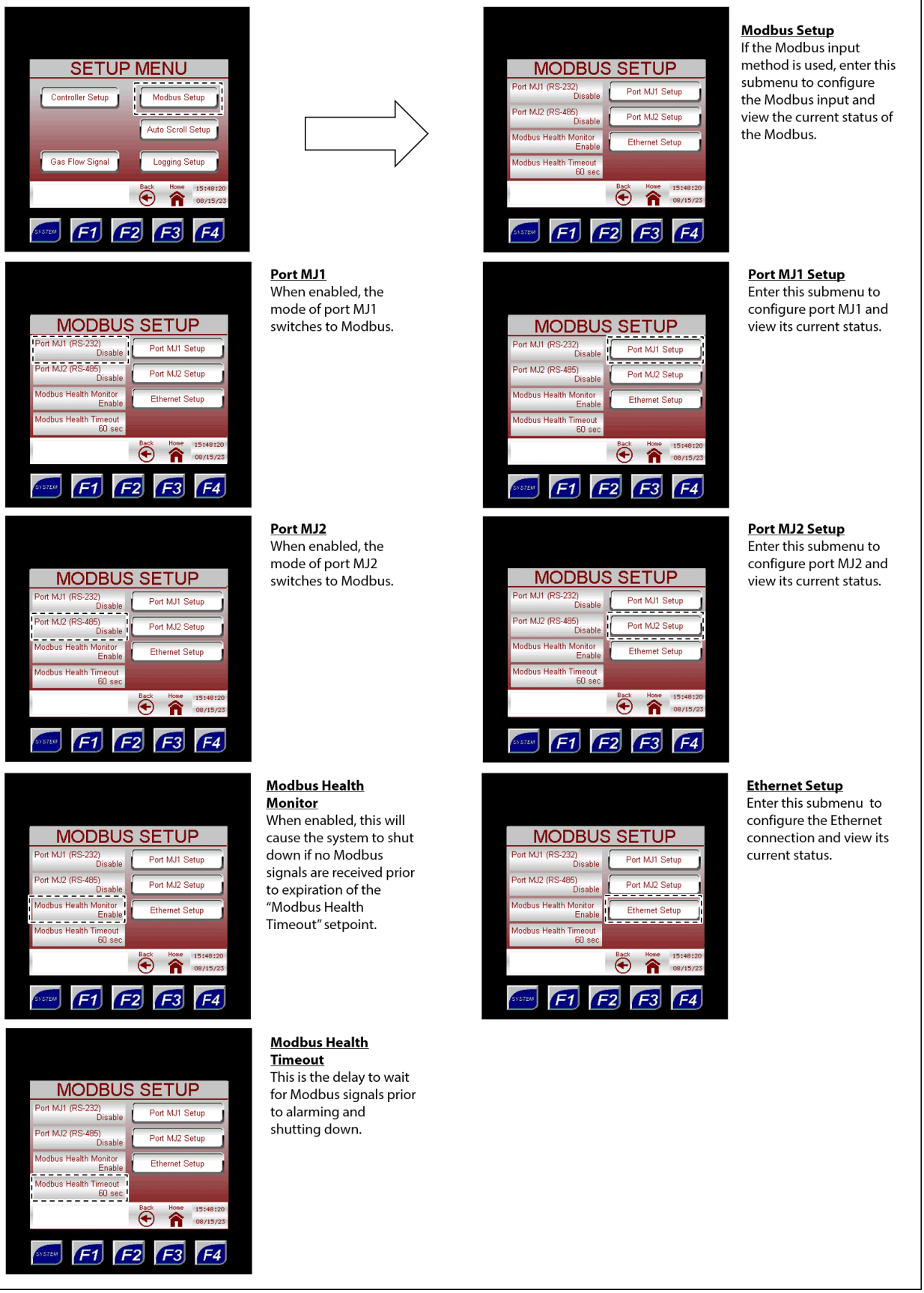
Pulse/Modbus Cutoff
If the pulse input method is used, this value is the amount of time (in seconds) the system will wait between pulse inputs before it will determine there is a gas flow signal loss and go into the set fail mode.

Setting the Fail Mode to Constant Rate will allow injection to continue at the specified rate.
Setting the Fail Mode to Shutdown will halt injection until the alarm is cleared.

If the gas flow value does not change during the Pulse/Modbus Cutoff time, the system will alarm for loss of flow and will enter the specified Fail Mode. The alarm will clear on the next pulse input or change in Modbus gas flow, and the system will resume normal operation.

Modbus Setup

Figure 29: Setup Menu – Modbus Setup



Modbus Setup
If the Modbus input method is used, enter this submenu to configure the Modbus input and view the current status of the Modbus.

Port MJ1
When enabled, the mode of port MJ1 switches to Modbus.

Port MJ1 Setup
Enter this submenu to configure port MJ1 and view its current status.

Port MJ2
When enabled, the mode of port MJ2 switches to Modbus.

Port MJ2 Setup
Enter this submenu to configure port MJ2 and view its current status.

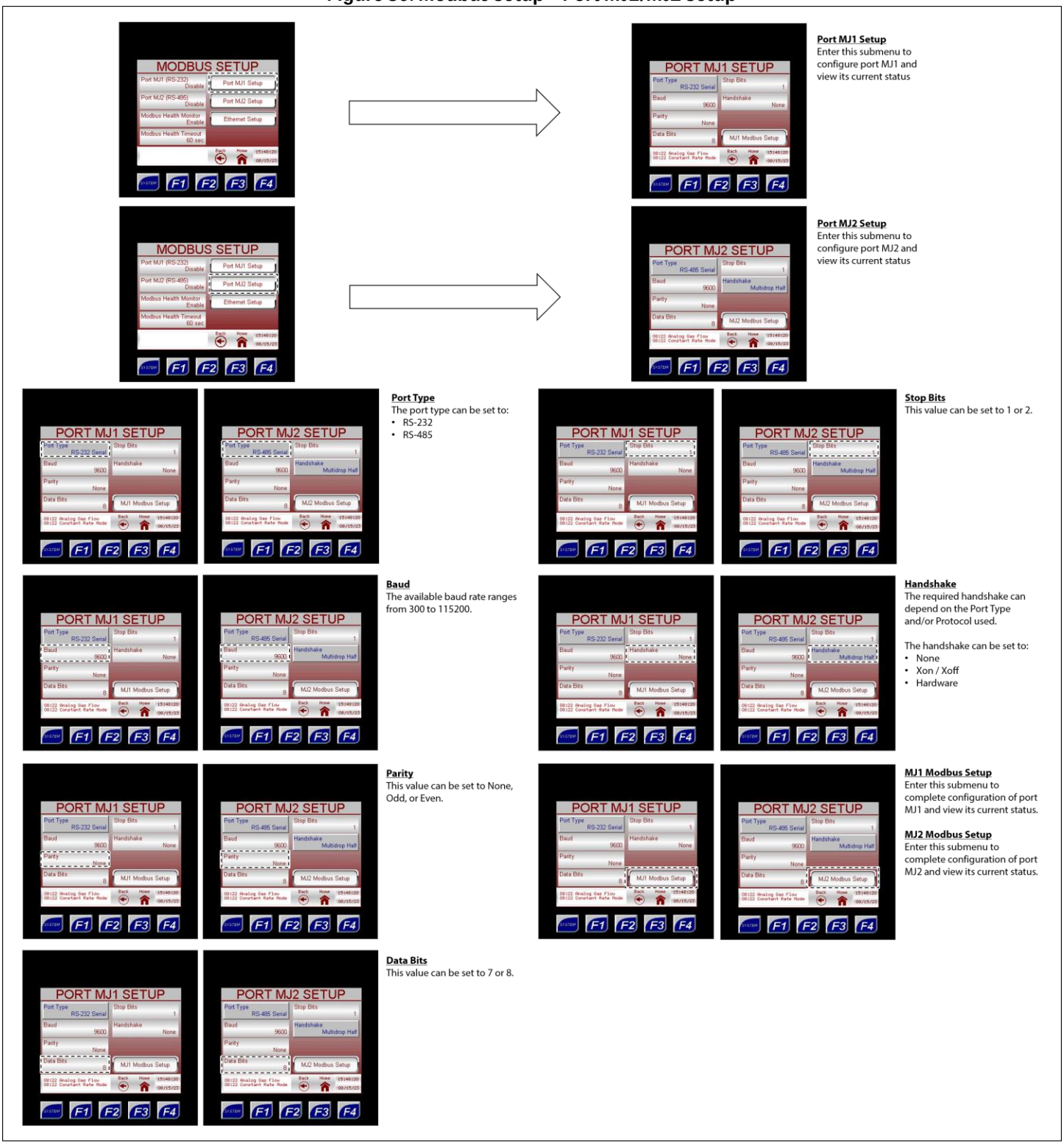
Modbus Health Monitor
When enabled, this will cause the system to shut down if no Modbus signals are received prior to expiration of the "Modbus Health Timeout" setpoint.

Ethernet Setup
Enter this submenu to configure the Ethernet connection and view its current status.

Modbus Health Timeout
This is the delay to wait for Modbus signals prior to alarming and shutting down.

Port MJ1/MJ2 Setup

Figure 30: Modbus Setup – Port MJ1/MJ2 Setup



Port MJ1 Setup
Enter this submenu to configure port MJ1 and view its current status

Port MJ2 Setup
Enter this submenu to configure port MJ2 and view its current status

Port Type
The port type can be set to:
- RS-232
- RS-485

Stop Bits
This value can be set to 1 or 2.

Baud
The available baud rate ranges from 300 to 115200.

Handshake
The required handshake can depend on the Port Type and/or Protocol used.

The handshake can be set to:
- None
- Xon / Xoff
- Hardware

Parity
This value can be set to None, Odd, or Even.

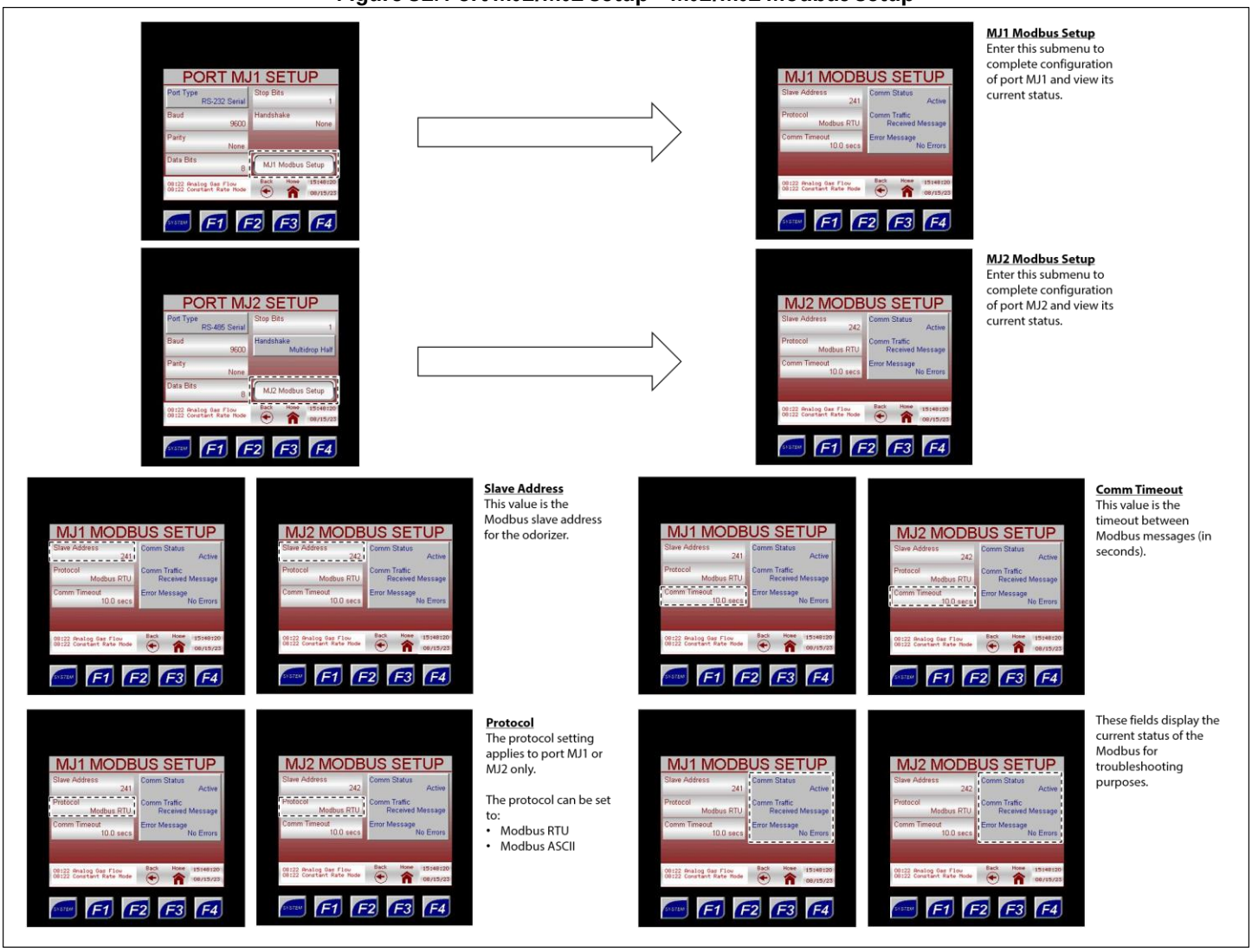
MJ1 Modbus Setup
Enter this submenu to complete configuration of port MJ1 and view its current status.

MJ2 Modbus Setup
Enter this submenu to complete configuration of port MJ2 and view its current status.

Data Bits
This value can be set to 7 or 8.

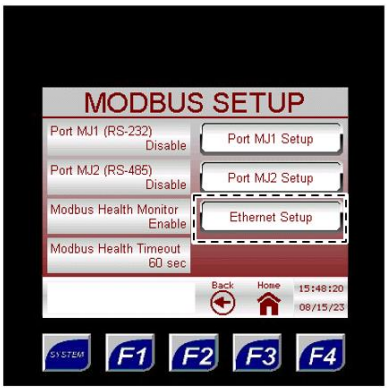
MJ1/MJ2 Modbus Setup

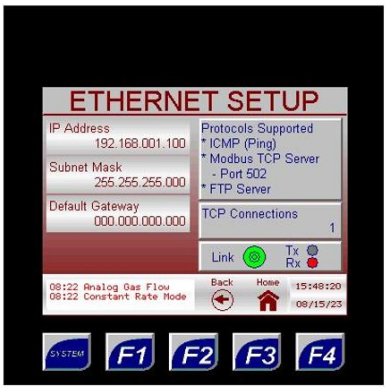
Figure 31: Port MJ1/MJ2 Setup – MJ1/MJ2 Modbus Setup



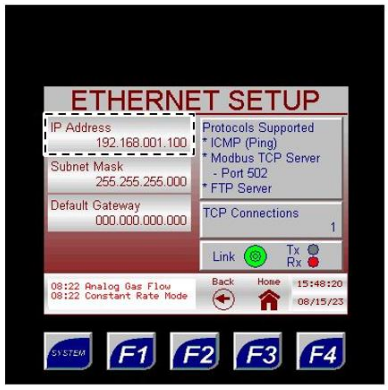
Ethernet Setup

Figure 32: Modbus Setup – Ethernet Setup



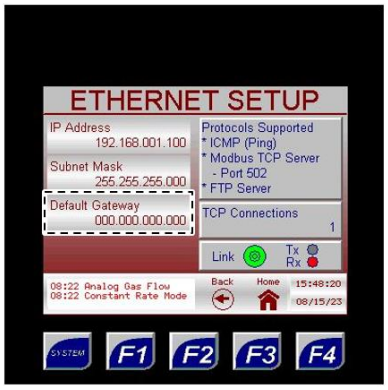


Ethernet Setup
Enter this submenu to configure the Ethernet connection and view its current status.



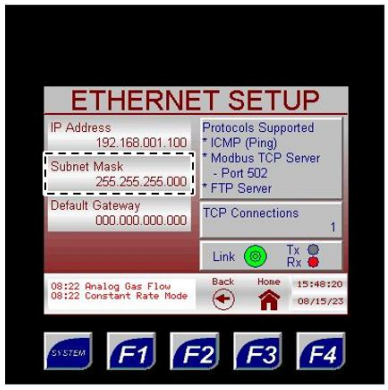
IP Address
Manually assign an IP address.

Pressing this field will bring up an on-screen keyboard for address entry.



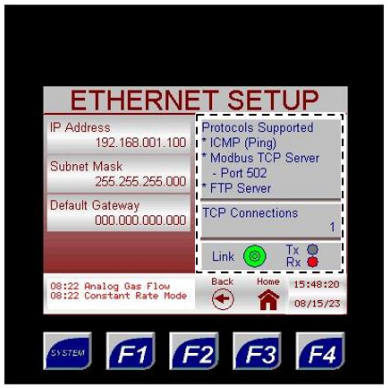
Default Gateway
Manually assign the default gateway.

Pressing this field will bring up an on-screen keyboard for gateway entry.



Subnet Mask
Manually assign the subnet mask.

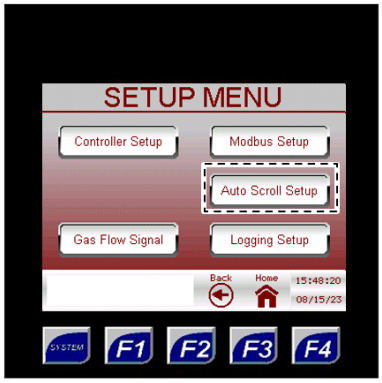
Pressing this field will bring up an on-screen keyboard for subnet mask entry.

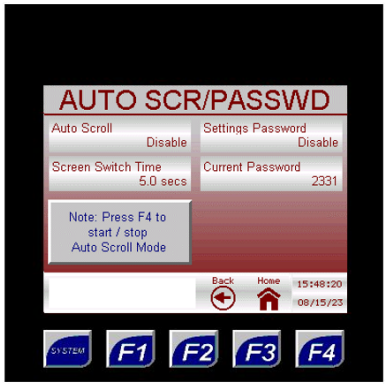


This column displays general and diagnostic information about the Ethernet connection.

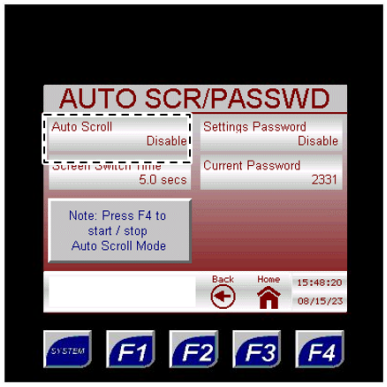
Auto Scroll Setup

Figure 33: Setup Menu – Auto Scroll / Password Setup



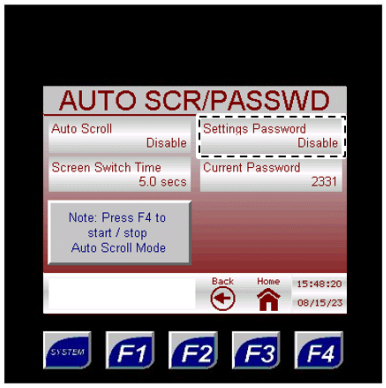


Auto Scroll Setup
Enter this submenu to customize screen operation.

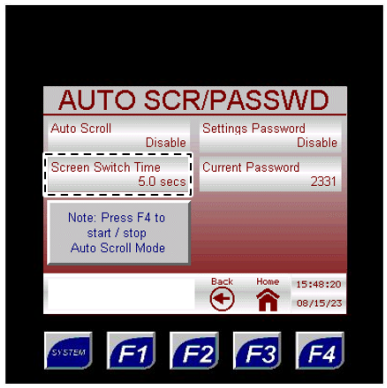


Auto Scroll
When Auto Scroll is enabled, the touch screen controller will automatically scroll through six (6) pre-set screens.

See *Figure 34.*

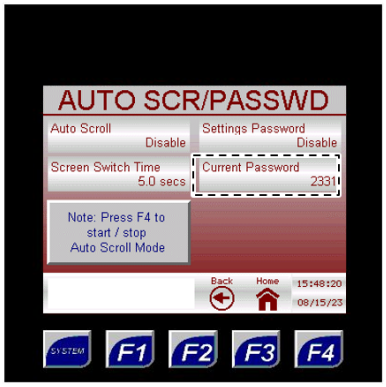


Settings Password
When enabled (default), a password is required to update any settings.

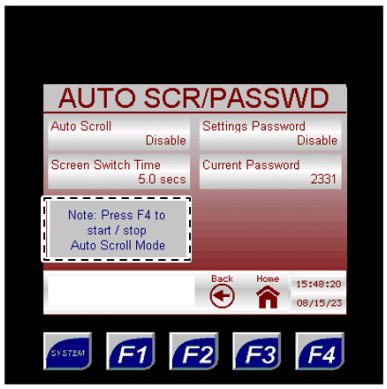


Screen Switch Time
When Auto Scroll is enabled, the Screen Switch Time is the length of time each of the pre-set screens will display before going to the next screen.

The Screen Switch Time can be set by the customer to the desired length of time.

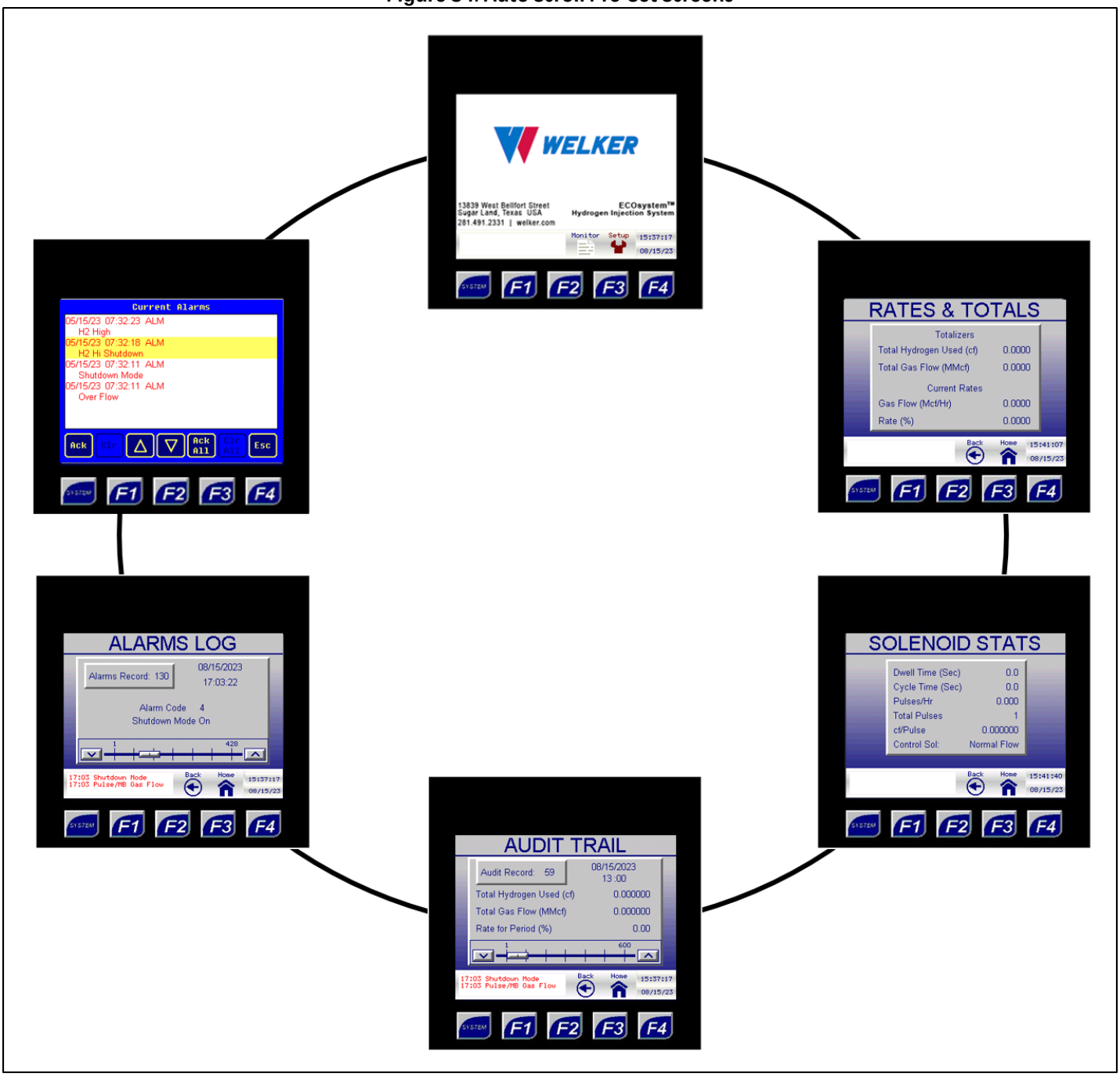


Current Password
Displays current password, which may be changed by touching the field and entering a new password.



Note
Press F4 to start / stop Auto Scroll Mode.

Figure 34: Auto Scroll Pre-Set Screens

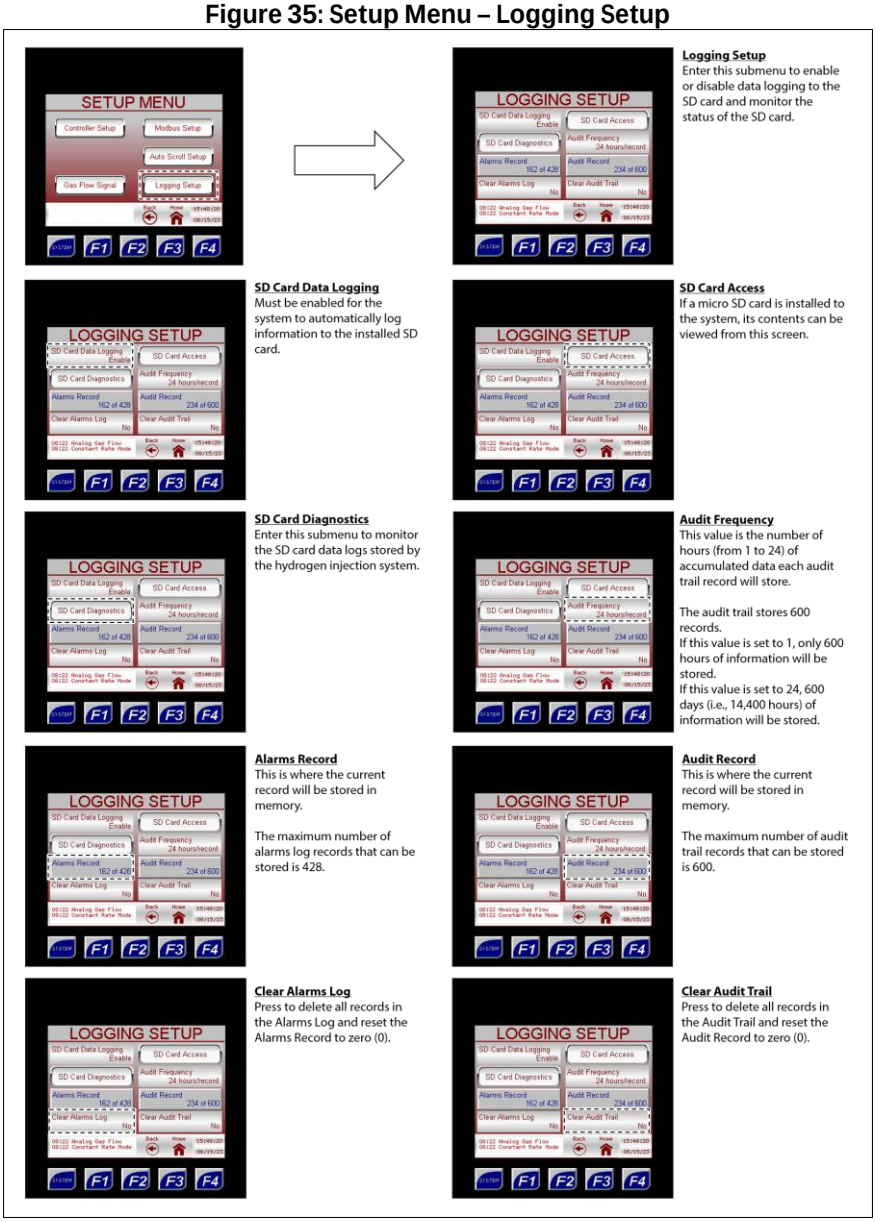


Logging Setup

Through the Logging Setup submenus, the user can set up and reset the data logs stored locally.

If a micro-SD card is installed, data will automatically be logged to the installed card when SD Card Data Logging is enabled.

Figure 35: Setup Menu – Logging Setup

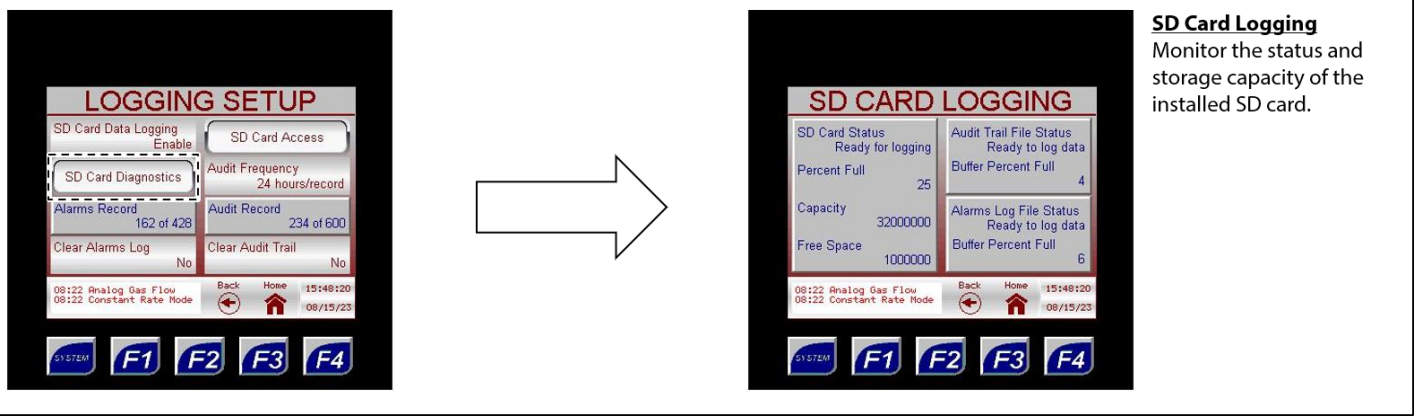


If the micro-SD card needs to be removed, first disable SD Card Data Logging. Failure to disable SD Card Data Logging prior to removing the micro-SD card will trigger the SD Card Error alarm.

To continue data logging, insert a new micro-SD card, and then enable SD Card Data Logging through the Logging Setup submenu (*Figure 36*).

SD Card Diagnostics

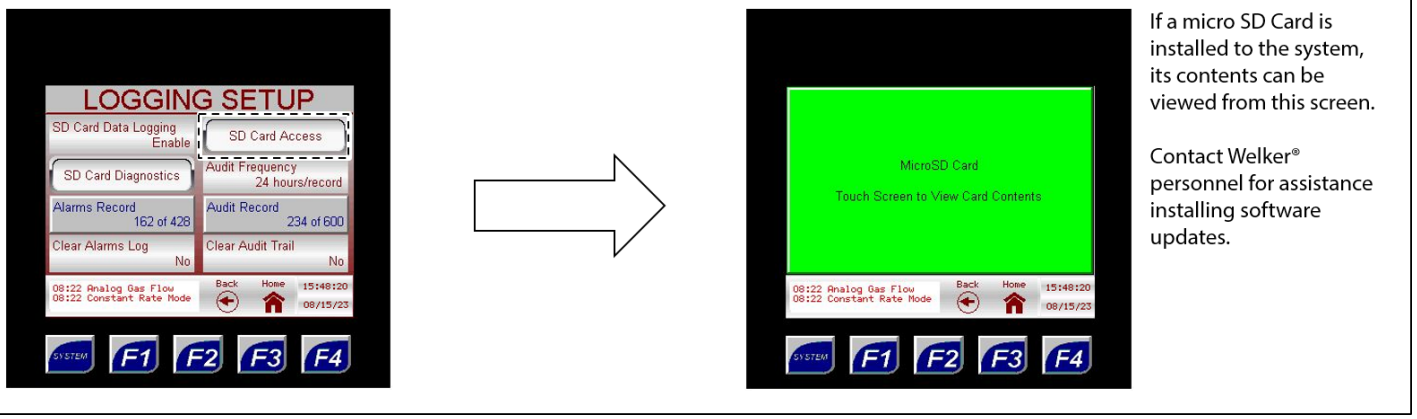
Figure 36: Logging Setup – SD Card Diagnostics



SD Card Logging
Monitor the status and storage capacity of the installed SD card.

SD Card Access

Figure 37: Logging Setup – SD Card Access



If a micro SD Card is installed to the system, its contents can be viewed from this screen.

Contact Welker® personnel for assistance installing software updates.

SECTION 4: MAINTENANCE

4.1 Before You Begin

1. **Refer to *Appendix B, Maintenance Schedule*, for the itemized Welker® recommended maintenance schedule for the ECOsystem™ Hydrogen Injection System.**
2. Prior to maintenance or disassembly of the unit, it is advisable to have a repair kit available for repairs of the system in case of unexpected wear or faulty seals.

New seals supplied in spare parts kits should be lightly lubricated before being installed to ease the installation of the seals and reduce the risk of damage when positioning them on parts. Wipe excess lubricant from the seals, as it may adversely affect analytical instrument results.

For sample-exposed seals, Welker® recommends non-hydrocarbon-based lubricants, such as Krytox®.
For non-sample-exposed seals, Welker® recommends either non-hydrocarbon-based lubricants or silicone-based lubricants, such as Molykote® 111.

After the seals are installed, the outer diameter of shafts and inner diameter of cylinders may be lubricated to allow smooth transition of parts.

3. All maintenance and cleaning of the unit should be performed on a smooth, clean surface.
4. Welker® recommends having the following tools available for maintenance. Please note that the exact tools required may vary by model.
    a. Adjustable Wrenches
    b. Flat Head Screwdriver
    c. Hex Key Set
    d. Pipe Wrench
    e. Strap Wrench
    f. Teflon® Tape

4.2 Maintenance

1. During operation, monitor the system for leaks. If leaks are present, halt operation and repair as necessary.
2. Occasionally, a system component may need to be repaired or replaced for manufacturer recommended maintenance. To perform maintenance on components:
    a. Turn OFF all electrical power to the system.
    b. Depressurize the system and close all valves.
    c. Disconnect the tubing and remove individual system components for maintenance.
    d. For complete and proper maintenance on individual system components, refer to their respective *Installation, Operation, and Maintenance* (IOM) *Manual.* A list of component *Installation, Operation, and Maintenance* (IOM) *Manuals* is available in *Appendix A, Referenced or Attached Documents,* in this manual.
    e. After performing necessary maintenance on system components, reconnect all instrument tubing.
    f. Reinstall the system according to the instructions in *Section 2.2, Installation,* and *Section 2.3, Start-Up Procedures*.

APPENDIX A: REFERENCED OR ATTACHED DOCUMENTS

Welker® *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for use with this unit:

- IOM-105: Welker® NV-1 and NV-2 Instrument Valves
- IOM-213: Welker® F-9 and F-10 Filter
- IOM-229: Welker® OdorEyes ECOsystem™ Pulse Bypass System With XL4 Controller

Other *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for use with this unit:

- Emerson Electric Co. Micro Motion™ Model 2400S Transmitter (Welker® IOM-V286)
- GE Oil & Gas Mooney Series 20/20S/20H/20HS Pilot Regulators (Welker® IOM-V101)
- Horner APG, LLC XL4 OCS Modules (Welker® IOM-V369)
- Swagelok Company Check Valves C, CA, CH, CP, and CPA Series (Welker® IOM-V076)
- Swagelok Company One-Piece Instrumentation Ball Valves 40G Series and 40 Series (Welker® IOM-V085)
- Swagelok Company Plug Valves P4T and P6T Series (Welker® IOM-V102)
- Swagelok Company Proportional Relief Valves R Series (Welker® IOM-V086)
- Versa® Valves E-Series Direct Acting Pneumatic and Hydraulic Valves (Welker® IOM-V211)
- WIKA Instrument Corporation Bourdon Tube Pressure Gauges Type 232.53 and Type 233.53 (Welker® IOM-V171)

Welker® drawings and schematics suggested for use with this unit:

- System Drawing: BSYS0160 (ECOsystem™ Hydrogen Injection System)
- System Drawing: OE181VS.9E.3 (Solenoid Cabinet)

Table 4: ECOsystem™ Hydrogen Injection System Troubleshooting Guidelines		
Issues	**Possible Causes**	**Solutions**
The system is in shutdown.	Numerous alarms can cause shutdown.	Check active alarms and follow Troubleshooting Guidelines.
There is a Loss of Gas Flow alarm.	There is a failure of a customer component in providing a signal. There is a failure of the isolator, splitter, or analog input on the Welker® system.	Trace the analog signal from the source to the Welker® system to identify the point of failure.
There is a Hydrogen Overflow alarm	The solenoid valves have failed to fully seal. Leak detection settings in the Welker® controller need adjustment.	Check the signal from the hydrogen flow meter to determine whether a leak exists. If a leak exists, replace the solenoid valves. If no leak exists, adjust the leak detection settings.
There is a Hydrogen No Flow alarm.	The solenoid valves have failed to open. There is an incorrectly closed isolation valve between the hydrogen source and the injection point. There is loss of pressure of hydrogen. There is failure of the regulator in the Welker® system.	Check all valves and pressures.
There is a hydrogen meter failure.	The hydrogen meter is not operable or is not sending an analog signal. There is a failure of the isolator or analog input in the Welker® system.	Check whether the hydrogen flow meter is alive. Trace the analog signal from the hydrogen flow meter to the Welker® controller to determine the point of failure.

APPENDIX B: MAINTENANCE SCHEDULE

Welker® recommends keeping high-wear parts on hand and replacing these parts immediately when worn or damaged.

Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for each component for maintenance instructions.

Table B1: ECOsystem™ Hydrogen Injection System Maintenance Schedule

Action	Weekly	Every 12 Months	As Necessary
Open filter drain valve C to allow moisture to drain from the filter.	X		
Verify the hydrogen supply pressure.		X	
Rebuild the F-9 using a Welker® repair kit. • Replace the O-rings and filter cartridge.		X	
View the controller's current alarms.			X
Inspect the tubing, valves, and fittings on the system for leaks.			X
Replace the controller battery.			X
Maintain the regulator.			X
Maintain the relief valve.			X
Maintain the solenoids.			X

Gas Service: Welker® recommends the unit have semi-annual (twice yearly) maintenance under normal operating conditions. For one-year maintenance and spare parts, two (2) O-ring Kits and one (1) Repair Kit are recommended.

In cases of severe service, dirty conditions, excessive usage, or other unique applications that may lead to excess wear on the unit, a more frequent maintenance schedule may be appropriate.

Table B2: ECOsystem™ Hydrogen Injection System Recommended 2-Year Spare Parts

Description	Quantity	Part Number
O-Ring Kit, NV-2 Valve	4	OKNV2
Repair Kit, F-9 (Element/Seals)	2	RKF9SS
Repair Kit, REG75	2	RKREG75
Spring, ½" NPT Ext Relief 50–350#	2	SPR114OX

NOTES

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