AutoJet® 2850+ Spray Control Panel

OWNER'S MANUAL

AutoJet®
TECHNOLOGIES

Spraying Systems Co.®
Experts in Spray Technology

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PREFACE

1.1 IMPORTANT

The AutoJet® 2850+ Spray Control Panels are produced, tested, and checked at the factory. The system can be dangerous if used incorrectly. Read this manual carefully and pay attention to any safety instructions.

Operators must always follow the general safety instructions in the working area and aim to prevent accidents.

The manufacturer reserves the right to make changes in standard construction without prior notification.

Images and diagrams in this manual may not be exact representations of your system configuration.

1.2 HOW TO USE THIS MANUAL

This manual is intended to be a source of information for the operators and technicians who may be installing, interacting with or servicing/maintaining Spraying Systems Co.® systems and components.

This manual contains important safety warnings, installation instructions, operating instructions, troubleshooting and maintenance information.

ICONS

⚠️ **WARNING: The user can be seriously injured, damage their health, and/or damage the system.**

⚠️ **CAUTION: Product, process, or environment can be damaged or be in danger if the instructions are not followed correctly.**

⚠️ **ATTENTION: Supplementary information for the user that draws attention to possible problems.**

SAFETY

2.1 GENERAL SAFETY INFORMATION

READ AND FOLLOW INSTRUCTIONS

All safety-related and operating instructions should be read before the system is operated. Follow all operating instructions.

SERVICING

Do not attempt to service this system unless you have been trained or authorized to conduct repairs. Only authorized and qualified service personnel should attempt to service this system. Service by unauthorized personnel may void any and all warranties.

⚠️ **WARNING: Before performing any maintenance, make sure electrical power is off and any air/liquid pressure is bled from the system.**

UNINTENDED USE

Use of Spraying Systems Co.® equipment in ways other than those described in the documentation supplied with the equipment may result in injury to persons or damage to property. Examples of unintended use of equipment would be:

- Using incompatible materials/damaged parts
- Making unauthorized modifications/using unapproved auxiliary equipment

- Removing or bypassing safety guards or interlocks
- Operating equipment in excess of maximum ratings

REGULATIONS AND APPROVALS

Make sure all equipment is rated and approved for the environment in which it is used. Any approvals obtained for Spraying Systems Co.® equipment will be voided if instructions for installation, operation, and service are not followed. All phases of equipment installation must comply with federal, state, and local codes.

PERSONAL PROTECTIVE EQUIPMENT

Spraying Systems Co.® strongly recommends the use of appropriate safety equipment when working in potentially hazardous environments and chemicals. This safety equipment includes, but is not limited to, the following:

- Protective hat
- Safety glasses or face shield
- Chemical-resistant safety gloves and apron
- Long sleeve shirt and long pants

Users of this product should never place themselves in the path of the spray. Users should consult and follow the recommendations of the Safety Data Sheet (SDS) of any chemical or fluid sprayed using this system.

PRESSURIZED SYSTEMS

It is important to recognize proper safety precautions when using a pressurized spray system. When dealing with pressure applications, the system pressure should never exceed the lowest rated component. Always know your system, all component capabilities, maximum pressures and flow rates.

WARNING: Fluids under pressure can penetrate skin and cause severe injury.

ATTENTION: Always remember to carefully read the chemical manufacturer's labels, follow SDS and all directions.

WARNING OF SHOCK HAZARD

To reduce the risk of electric shock, do not open the cover on electrical control panel. For service contact Spraying Systems Co.® at 1-866-321-2250.

WARNING: Plug panels into a GFCI outlet.

WARNING: To prevent injury, avoid contact with potentially hot parts. Components can cause severe burns. Do not aim the spray at any person or part of the body. Do not place any part of your body into the spray pattern.

USE OF CHEMICAL COMPONENTS

Spraying Systems Co. does not manufacture or supply any of the chemical components used in this equipment and is not responsible for their effects. Because of the large number of chemicals that could be used and their different chemical reactions, the buyer and user of this equipment should determine compatibility of the materials used and any of the potential hazards involved.

2.2 UNPACKING THE SYSTEM

The system components come packaged to protect them from damage. Use caution when opening the crate. The crate will contain all parts needed to install the unit. Parts of the unit may be wrapped in bubble wrap. Remove all of the packaging material wrapping the system. Once unpacked and removed the from the crate, the system is ready for installation and connection.

CAUTION: The packaging may contain exposed cables, hoses, and other components. Always exercise caution when opening boxes to avoid accidental damage or slicing of various components.

PANEL OVERVIEW

3.1 OVERVIEW

The 2850+ Control Panel contains a PLC, power supplies, relays, fuses, and more equipment for advanced spray control and operation. The 2850+ control panel can support up to 16 PulsaJet® nozzles per channel, up to 2 channels. Optional I/P air regulation for various methods of open and closed loop control.
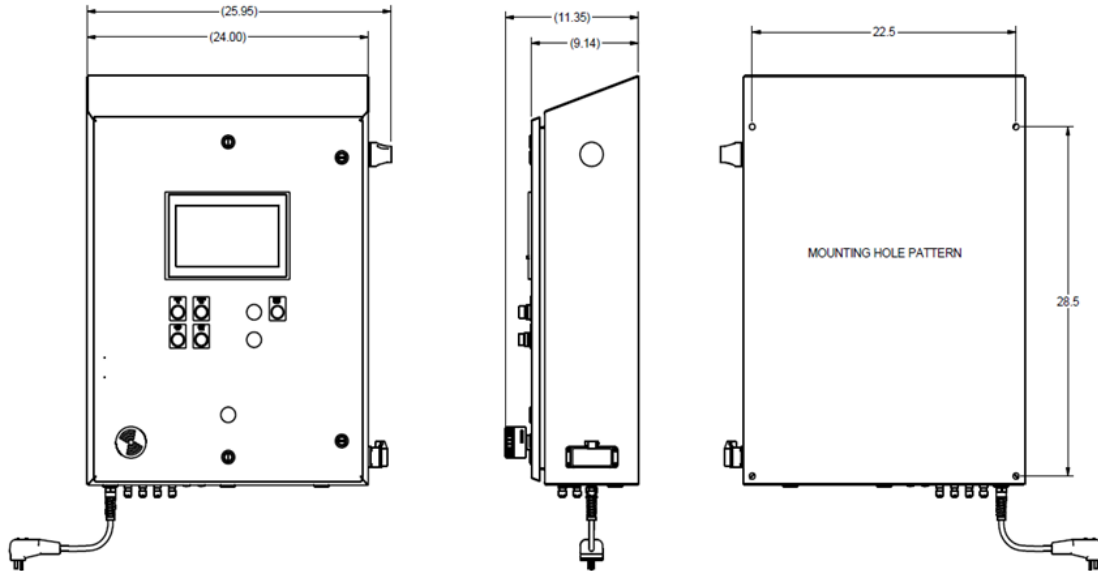
RUNNING THE SYSTEM:

1. Plug in GFCI.

2. Turn on GFCI by depressing green button on GFCI.

3. Press amber POWER ON button on front panel. Input all settings PRIOR to pressing channel 1 run for the first time.

Inspections, Cleaning, Replacement Parts:

- Check condition of power plug regularly.

- Control panel can be cleaned with non-aggressive cleaning agents, e.g. isopropyl alcohol

Maintenance/repair other than described is intended to be performed by skilled personnel.

SPECIFICATIONS:

- 16x PG7 cable gland

- Nozzles, EMC cable glands and shielded cables ordered separately

- Technical Documentation Set

- Leave the system (parts) in the original packaging for transportation and storage.

- Until assembly, store in a dry place at a room temperature between 32° F and 122° F (0 and 50°C).

- Do not drop any of the parts.

- Mount the panel so that the power buttons and HMI are easily accessible/visible.

3.2 PANEL CONTROLS

The main electrical panel contains the controller for the system and all supporting electronics. The front panel is equipped with a 10-inch touch screen, POWER ON, POWER OFF, Spray triggers, reset and alarm acknowledge buttons. The reset buttons may be used for operating the system manually, without an external product sensor but otherwise, the reset buttons, are not used under normal operating conditions.
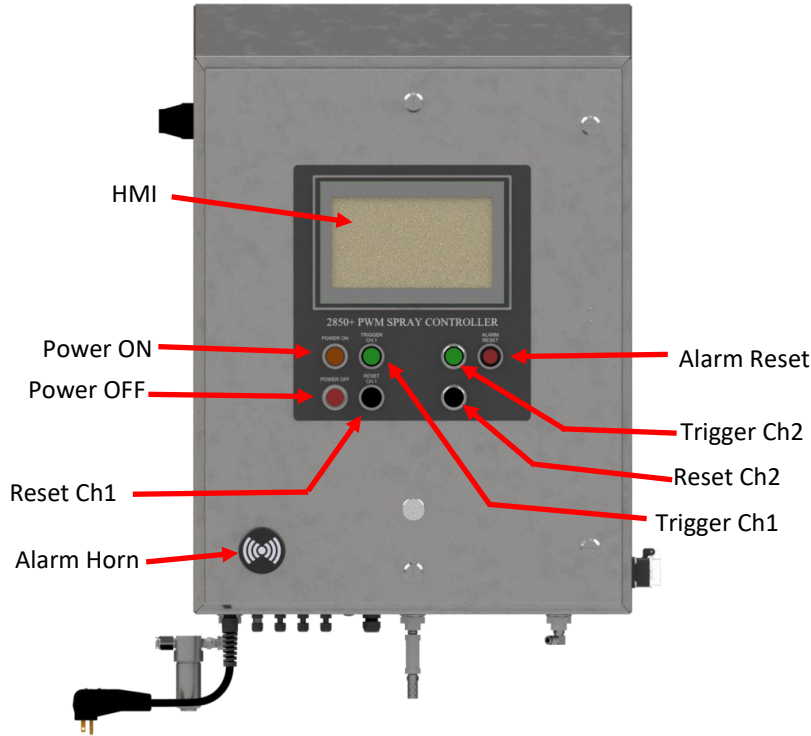
Item	Description/Function
Power On	Electrical power enable, power indicator
Power Off	Electrical power disable/Stops system
Manual Spray Trigger Ch.1/Ch.2	Used to manually trigger spray for the respective channel
Manual Spray Trigger Reset Ch.1/Ch.2	Used to manually reset spray trigger for respective channel
Alarm Reset	Resets Alarm
Alarm Horn	Audibly alerts when alarm is triggered
HMI	Human Machine Interface touch panel

3.3 INTERIOR PANEL COMPONENTS

The electrical panel houses the spray controller, electronically controlled current to pressure converters (I/P), PLC, ethernet switch, power supplies and zoning modules.
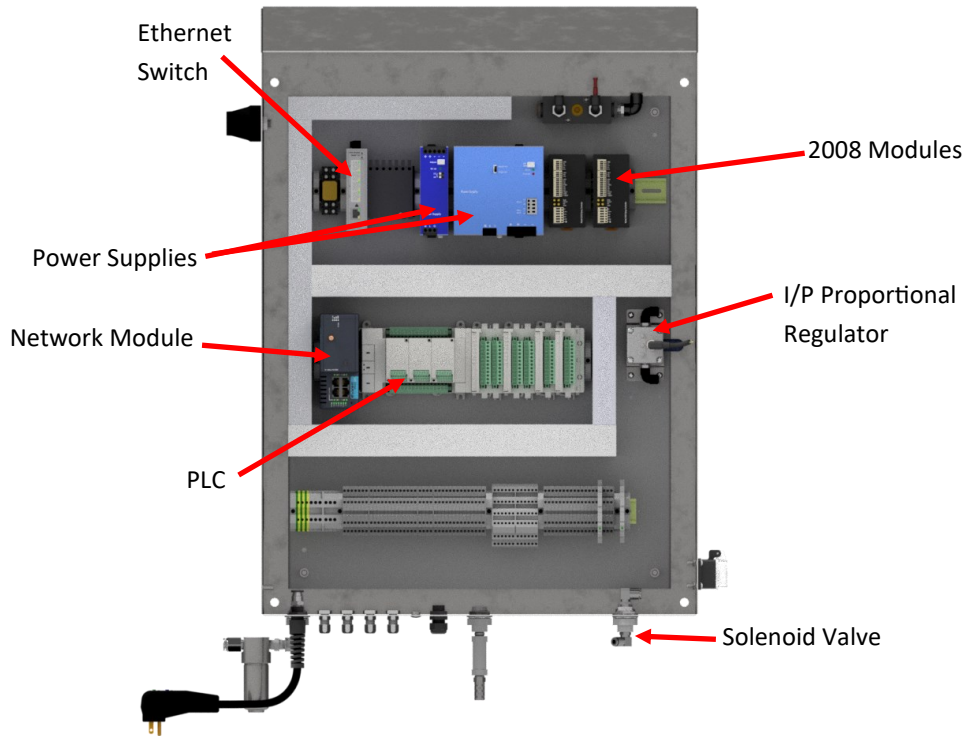
Item	Description / Function
Power Supply (S*tandard*)	24V 10A power supply standard.
Power Supply (*Choice*)	24V 10A, 24V 20A, or 48V 20A option for secondary power supply
2008 Module (*Standard*)	Model 2008 PWM driver module, 2nd channel optional
2008 Module (*Optional*)	Model 2008 PWM driver module for optional 2nd channel.
PLC	Logic Control
Air Manifold (*Optional*)	Air distribution manifold. Included with other air control options.
I/P (*Optional*)	Proportional current to pressure regulator. (1) or (2) in panel regulator options available.
Solenoid Valve (*Optional*)	Optional 3-way solenoid valve for air control.
Ethernet Switch	Network Communication
Network Module	Allows for network conductivity and remote access.
Terminals	Terminal blocks for external connections

See electrical drawings and part specific documentation in TDS for detailed information on and labeling of other internal parts of the Control Panel.

3.4 USER PASSWORDS AND MODBUS

USER PASSWORDS

Description	Username	Password
Operator	OPER	O
Engineer	ENG	E

MODBUS TAGS

PLC Tag Name	Variable Type	Address
HMI_SPRAY_EN_CH1	BOOL	000001
ALARM_HORN	BOOL	000002
CH1_LEVEL_SENSOR_ALM	BOOL	000003
REM_CH1_RUN_INPUT	BOOL	000100
REM_CH2_RUN_INPUT	BOOL	000101
HMI_LIQ_PRESS_CH1	REAL	300001-300002
HMI_CH1_FM	REAL	300003-300004
CH1_LINE_SPEED	REAL	300005-300006
HMI_APP_RATE_CH1	REAL	300007-300008
DUTY_CYCLE_2008	REAL	300009-300010
FREQUENCY_2008	REAL	300017-300018
HMI_LIQ_PRESS_CH1	REAL	400001-400002
TOTAL_SPRAY_TM_2008	REAL	400011-400012
SYS_ON_TM_2008	REAL	400013-400014
GUN_CYCLES_2008	REAL	400015-400016
CH1_ACTIVE_RECIPE	INT	400100
CH2_ACTIVE_RECIPE	INT	400101

3.5 RECOMMENDED MAINTENANCE

MONTHLY:

Check that all indicator lights work. Replace lamps as required.

Check all ribbon cable connections. Reinsert any partially inserted connectors.

Check all other cable type connections. Reinsert any partially inserted connectors.

EVERY 6 MONTHS:

Retighten all screw terminal connections to insure proper bonding.

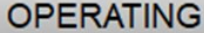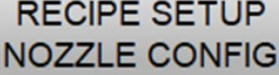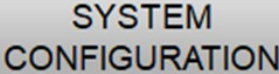Check all control relays to see that they are properly connected.

EVERY 12 MONTHS:
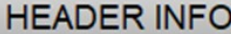
Check calibration of any controls that required calibration. Calibrate as required. See individual control component manuals for calibration procedures.

OPERATION SCREEN

4.1 HMI TOUCH PANEL OPERATIONS

Operating Screen

|	
2850+ MENU	The 2850+ Menu Button in the top right corner is used to open the navigation menu.
OPERATING	Navigates to Main Screen as seen on start-up. Use during regular operation to toggle between Standby and Run modes, change recipe and observe setpoints and current values.
RECIPE SETUP NOZZLE CONFIG	Navigates to Recipe Setup and Nozzle Config screen. Use to setup recipes and change nozzle parameters.
SYSTEM CONFIGURATION	Navigates to System Configuration screen. Use to configure analog inputs and outputs, or manual setpoints related to sensors and actuators.
HEADER INFO	Navigates to Header Info screen. Use to enter Spray Width, Reference Flow, Reference Pressure, Enable/Disable Zone Control and Configure Zones.
ALARMS	Navigates to the alarm page. Access to alarm history, view active alarms, and change alarm settings per channel. **Note:** Turns red while alarms are active (as shown here).
MONITOR IO	Navigates to IO Monitor page. Monitor Analog IO and access digital IO monitor as well.
HELP	Navigates to Help page. Displays vendor revision and serial number of 2008 and access to screen map.
LOG IN / LOGGED OUT	Use to log in to available password levels. Certain access may be required to change some parameters/settings.

4.2 OPERATING SCREEN
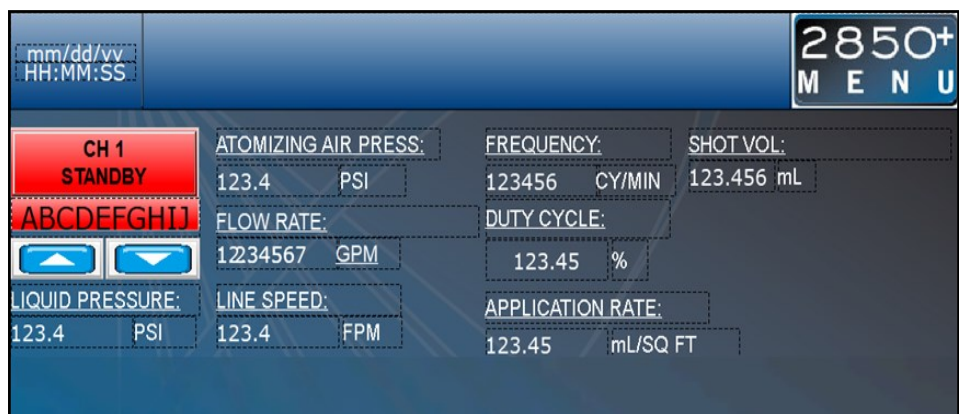
Item	Description
Active Zone Recipe (read only)	The current zone being operated, if zoning is active, is displayed here.
Frequency (read only)	The spray gun operating frequency is displayed here.
Application Rate (read only)	The current application rate output by the 2850+ based on flow and user input density.
Active Recipe (read only)	The current recipe being used by the 2850+ is displayed here.
Atomizing Air Press (read only)	Pressure of the atomizing air is displayed here.
Duty cycle (read only)	The current duty cycle (ratio of the ON time to the OFF time) output of the spray guns is displayed here. The Duty Cycle can be changed here while in Duty Cycle regulation mode.
Theoretical Flow Rate (read only)	The maximum flow rate possible based on the current liquid pressure, reference flow, and reference pressure of the tip.
Liquid Pressure (read only)	The liquid pressure is displayed from a pressure transmitter. The controller uses feedback from this transmitter to hold the pressure at a constant value based on the programmed set-point.
Flow Rate (read only)	The flow rate is displayed, using either actual flow meter data or a simulated value. In this case the value displayed is a summation of each of the system integrity flowmeters. It is normal for some fluctuation in the displayed value.
Line Speed (read only)	The line speed, whether real or simulated is displayed here.

RECIPE SETUP

5.1 RECIPE SCREEN OPERTIONS

Item	Description
Recipe # (selection)	These arrows allow for the selection of the recipe displayed and available to be edited. Please be aware this can change during operation.
Recipe Name (editable)	Allows the user to associate a character string with each recipe number. This recipe name will appear on the operating screen as the active recipe to assist the operator.
Timing Function (selection)	**Fixed Spray Time:** After seeing a trigger, will send spray signal for designated amount of time. **Variable Spray Time:** Will send spray signal for the time the trigger is active. **Fixed Spray Distance:** After seeing a trigger, will send spray signal for designated amount of distance. **Variable Spray Distance:** Will send spray signal for the distance the trigger is active.
Regulation (selection)	**Constant Flow, Air Act:** Uses I/P to regulate flow. Used with air actuated nozzles. **Constant Flow, PWM:** Based on the liquid pressure, reference flow and pressure, the controller will calculate the correct duty cycle to maintain the flow rate setpoint. Used with PWM nozzles only. **Application Rate, PWM:** This sets the system to apply a constant application rate of liquid per unit of surface area of substrate on a moving conveyor. The flow rate of liquid will vary as the line speed ramps up or down, but the add-on rate to the substrate will remain fixed. Used with PWM nozzles only. **Freq & Duty Cycle, PWM:** This allows manual entry of frequency and duty cycle. Gun output will not be determined by normal application logic. Used with PWM nozzles only. **Application Rate, Air Act:** This sets the system to apply a constant application rate of liquid per unit of surface area of substrate on a moving conveyor. The flow rate of liquid will vary as the line speed ramps up or down, but the add-on rate to the substrate will remain fixed. Used with air actuated nozzles only.

# of Triggers (selection)	**Trigger:** The system will spray while the start trigger is held high. **Trigger/Reset:** The system will spray continuously after the start trigger is held high momentarily. The spray is stopped by holding the reset trigger momentarily.
Recipe # (selection)	This menu allows for the selection of the recipe being used by the controller. This is the location the operator will change the recipe during operation. This can only be changed while the system isn't spraying.
Liquid Pressure SP (editable)	Enter the desired liquid pressure. The system will vary the current going to the I/P to achieve this setpoint. Only used based on certain regulation mode chosen.
Atom Air SP (editable)	Enter the desired atomizing air pressure. The system will vary the current going to the I/P to achieve this setpoint. Only used based on hardware purchased and settings chosen.
Flow Rate SP (editable)	Enter the desired flow rate. The system will vary the duty cycle or liquid pressure to achieve this setpoint. Only used based on regulation mode chosen.
App Rate SP (editable)	Enter the desired application rate. The system will vary the duty cycle, or pressure based on nozzle selection, to maintain the amount of fluid distributed per surface area on a moving conveyor. The rate of liquid will vary as the line speed varies but the add-on rate to the substrate will remain fixed. Only used based on regulation mode chose.
Shot Weight SP (editable)	Enter the desired weight of each shot, or weight sprayed on each product.
Manual DC Entry (editable)	Manually Enter Duty Cycle. Used based on regulation mode.
Start Delay (editable)	Enter the time-based delay which occurs between when the system is triggered, and the nozzles start spraying.
Stop Delay (editable)	Enter the time-based delay which occurs between when the system stops triggered, and the nozzles stop spraying.
Rep Off Period (editable)	Repeat Off Period. Only used with Fixed Spray Time or Fixed Spray Distance. This determines the time spent NOT spraying during the Spray Period. See page 18, FIXED SPRAY TIME - WITH REPEAT.
Rep On Period (editable)	Repeat On Period. Only used with Fixed Spray Time or Fixed Spray Distance. This determines the time spent spraying during the Spray Period. See page 18, FIXED SPRAY TIME - WITH REPEAT.
Header Config (editable)	Enter the desired zone for this recipe. This number will pull the reference flow, spray width, and nozzle on/off selection from the zone control settings screen and use these while this recipe is selected.

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5.2 NOZZLE CONFIGURATION

The Nozzle Configuration screens allows the operator to control spray patterns and behavior. In the configuration page, the operator can input parameters that will control the nozzle. Use the channel specific page to adjust the nozzle settings for the correct channel.

Nozzle Configuration Screen

| Item	Description
Spray Nozzle Select (selection)	Select the nozzle that you want controlled. There are Default settings which will be loaded depending on nozzle selected. There is "OTHER" selection for custom settings
Max Cycle (editable)	This is auto-populated based on nozzle selection. Edit the default number of max cycles per minute allowed by the spray gun only if necessary. This is used to calculate the nozzle signal frequency.
Min Cycle (editable)	This is auto-populated based on nozzle selection. Edit the default minimum number of cycles per minute the system should try to maintain only if necessary. This is used to calculate the nozzle signal frequency.
Anticipator Time (editable)	Enter the time the atomizing air is on before the spraying is started. Note: Only used with air atomizing.
Follower Time (editable)	Enter the time the atomizing air is on after the spraying has stopped. Note: Only used with air atomizing.
Startup Mode (editable)	Determines whether the system boots up in standby or in run mode. Please examine how your system operates while in run mode versus standby before changing this option.

TIMING AND SPRAY SETTINGS

6.1 PRECISION SPRAY CONTROL (PSC)

The PulsaJet® automatic spray nozzle is an electrically-activated hydraulic, atomizing nozzle. This nozzle sprays the product in a controlled way using a PWM algorithm to control the sprayed amount without affecting the spray angle. PWM is the fundamental control principle that allows a significant reduction in flow by regulating the relationship between the on/off times that the nozzle operates.

Short pulses of on-time and longer pulses of off-time produce a spray pattern that appears continuous, but actually reduces the overall flow delivered to the target surface. This provides better flow control with larger spray tips that are less prone to clogging. The droplet size is affected by the pressure of the liquid. With PSC, the droplet size and spray angle are independent of the liquid flow because the nozzle can work at the same liquid pressure for variable liquid flows.

PSC involves switching the spray nozzle on and off repeatedly at a controlled rate, called the modulating frequency. The modulating frequency is the number of times the nozzle is switched on and off in one second and is measured in Hertz (Hz). If a spray nozzle is switched on and off 10 times per second, the modulating frequency is 10 Hz. The time from when the nozzle turns on to the next time the nozzle turns on is called the period, in this case 1/10th of a second.

Within a single period, the nozzle is switched on, then off. The time that the nozzle is on, divided by the total time of the period, gives a percentage which is called the duty cycle. For example, if the period is 0.10 seconds, and the nozzle is on for half of that time, then the duty cycle is 50%. For the same period, if the nozzle is on for 0.08 seconds then the duty cycle is 80%. Therefore, at an 80% duty cycle, the flow will theoretically be 80% of the maximum flow rate (= 100% flow rate) at a given pressure for the nozzle. Using PSC, the flow rate for a spray application can be easily controlled without the need to adjust the spray pressure or spray tip.
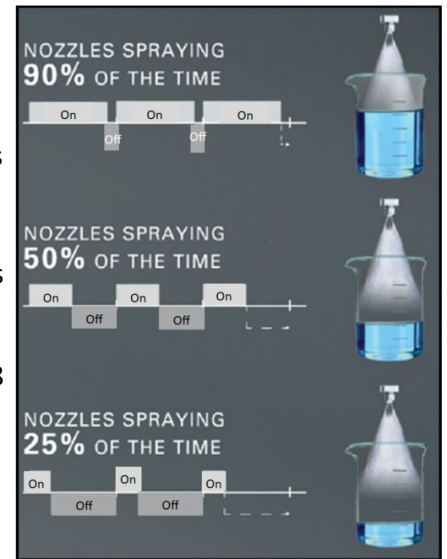

6.2 TIMING AND SPRAY OVERVIEW

ANTICIPATOR/FOLLOWER TIME

The system will start spraying when it receives a trigger signal and stop when the trigger signal is removed.

If the system is equipped with an air atomizing nozzle, the 2850+ will switch the air output on before it starts spraying to allow the spray pattern to develop fully. When the system stops spraying, the air will continue for a short period after to guarantee no large droplets can drip off of the nozzle. Max time for both is 10 seconds.

Anticipator-Follower

Note: The anticipator time must not be shorter than the start delay time set in the timing settings.

When a spray pattern is generated where the off time < (anticipator time + follower time), the air output remains on for the duration of this pattern.
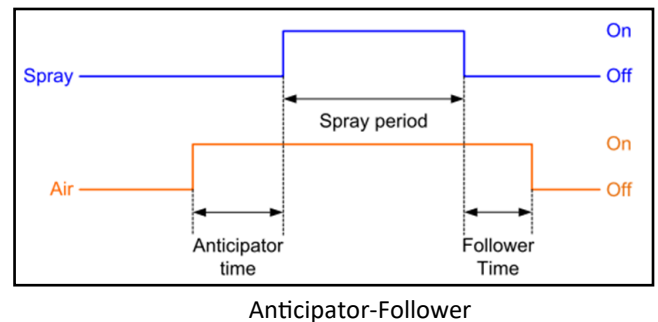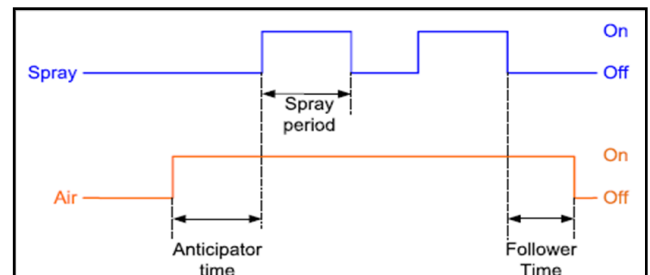
Overlapping anticipator / follower sequence

CYCLE SPEED

The maximum frequency parameter (f_{max}) determines the maximum speed of the nozzle at 50% duty cycle and is entered as a number of cycles/minute. This parameter can be found in the datasheet of the electric spray nozzle being used. However, it is sometimes possible to use a higher value when a supply voltage of 48VDC is used.

The spray control panel will calculate the cycle speed to conform to the following requirements (in this order):

- As slow as possible to prevent wear of the spray nozzle.

- Correct duty cycle means ON-time / (ON-time + OFF-time) = duty cycle.

- OFF time lower than or equal to the maximum on/off time parameter. This prevents striping and very low frequencies at low duty cycles.

- ON time lower than or equal to the maximum on/off time parameter. This prevents striping and very low frequencies at high duty cycles.

- Frequency of the signal higher than the PWM minimum cycles/min setting. This can be used to keep the frequency constant for a large range of duty cycles.

- ON and OFF time higher than or equal to the minimum pulse width of the nozzle. This ensures that the nozzle is able to open and close at the same speed as the signal.

Cycle speed settings allows for the editing of the minimum and maximum cycles per minute, as well as the spray thickness which is the depth of the spray pattern. Maximum cycles speed is 15,000 cycles/min, minimum range is 0-60 cycles/min.

- **Maximum cycle speed:** Maximum speed that the nozzle should switch at for this application. This entry will be limited by the type of nozzle selected.

- **Minimum cycle speed:** Minimum cycle speed for the 2850+ is recommended for this application.

Note: If you want a constant cycle speed, enter a large spray thickness, and use the minimum cycle speed as your required cycle speed entry. The 2850+ will then cycle at this speed whenever possible.

Cycle Speed Example:

For a nozzle that can achieve 10,000 cycles/min, the minimum pulse width is 3ms. This ensures that the combination of duty cycle and cycle speed falls within the triangle curve of the PulsaJet® electric spray nozzles (See figure below). The triangle is the approximate operating range of the nozzle. As long as operating parameters (duty cycle and frequency) are inside this triangle, the nozzle will operate normally. If the operating parameters are outside the triangle, the nozzle will not operate.
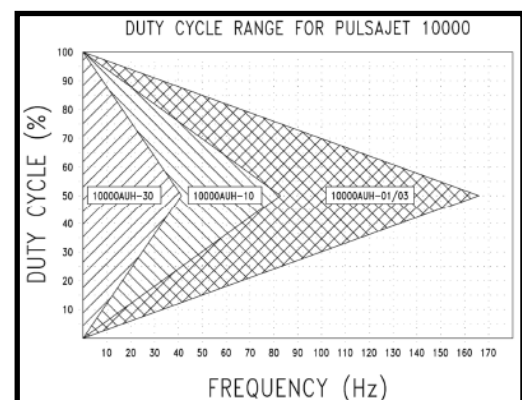

Example:

Spray Nozzle: AA10000AUH-03

- Maximum cycle speed: **10000 cycles/min**

- Minimum cycle speed: **0 cycles/min** (= disabled)

- Minimum pulse width: **3ms**

Objective:

- Maximum on/off time: **0.010 s or 10ms**

- Duty cycle: **30%**

DISTANCE BASED SPRAY TIMING

The fixed and variable spray length timing modes have an alternative in which distances are used instead of time. These modes are called *fixed spray distance* and *variable spray distance*. In these modes, delays are expressed in distance units. These are the units that were chosen when calibrating the frequency input.

The anticipator time in this mode has a special behavior, it is converted to a distance using the maximum speed, meaning that it is a minimum anticipator time. At speeds below the maximum speed, it will be longer.
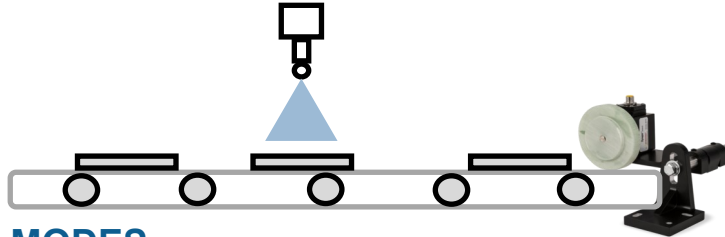
6.3 SPRAY TIMING MODES

Determine the spray mode required for the process.

There are four (4) timing modes you may utilize in the 2850+ Spray Control System.

- Fixed spray time no repeat
- Fixed spray time with repeat
- Variable spray time no repeat
- Variable spray time with repeat

Timing modes are selected by going to the HMI settings page and selecting the "Timing" button.

The system will spray for a predetermined time depending on the timing mode selected. The spray controller allows for accurate time-based control over the spray nozzle, based on an external trigger signal.

SPRAY PERIOD

- The spray period is the time the object remains under the spray nozzle or the time that it takes to dispense a dose. This will be in time units.
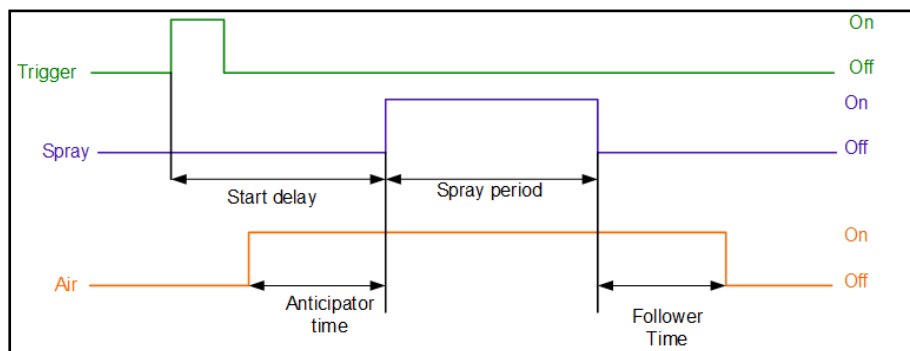
START DELAY

- The time that the system should wait between a trigger event and the start of the spray.
- Typically, this is the distance between the sensor and the spray nozzle.
- The start delay must always be longer than the configured minimum signal length of the trigger.

6.4 FIXED SPRAY TIMING

This timing mode is used to create a delayed spray pulse for a fixed predetermined amount of time.

Set parameter value to 0.


Fixed Spray Time

ANTICIPATOR PRIORITY

By default, the system gives priority to the start delay, potentially resulting in a too short or a zero-anticipator time, which may negatively impact the spray pattern if the start delay is too short. In this case, the start delay will be extended as required to provide a correct anticipator time. This is particularly useful when the start delay may not be known beforehand, for example when setting the timing using analog signals.
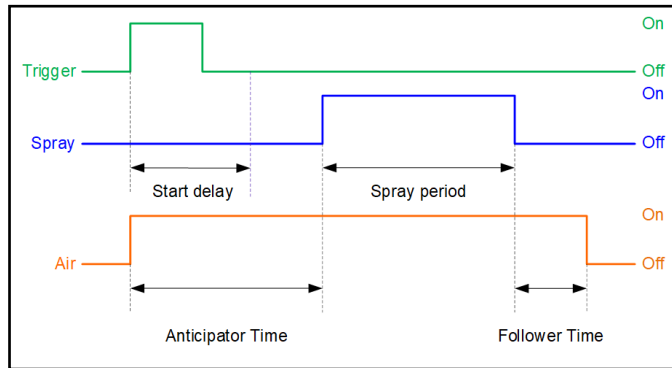
Anticipator Priority

## SPECIAL CASE: MULTIPLE TRIGGERS **WITHOUT** SPRAY OVERLAP

Occurs if the system receives multiple start events (rising edge of trigger signal) before a spray cycle is finished. If the time delay between two successive start events (or trigger pulses) is higher than the spray time, then there is no overlap.
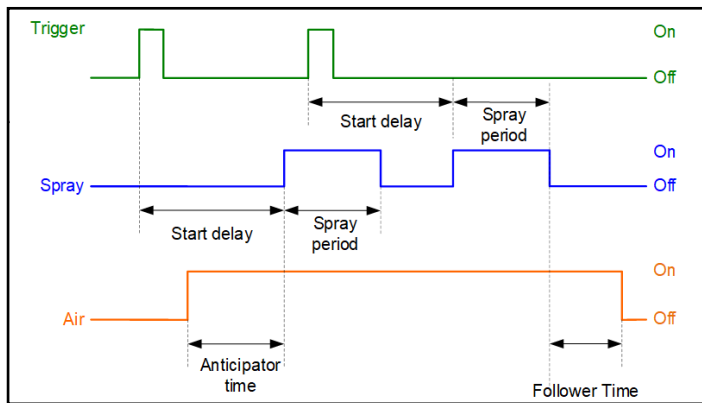
Multiple Triggers without Spray Overlap

SPECIAL CASE: MULTIPLE TRIGGERS **WITH** SPRAY OVERLAP

Occurs if the system receives multiple start events (rising edge of trigger signal) before a spray cycle is finished. If the time delay between two successive start events (or trigger pulses) is lower than the spray time, then there is an overlap of two successive spray pulses.
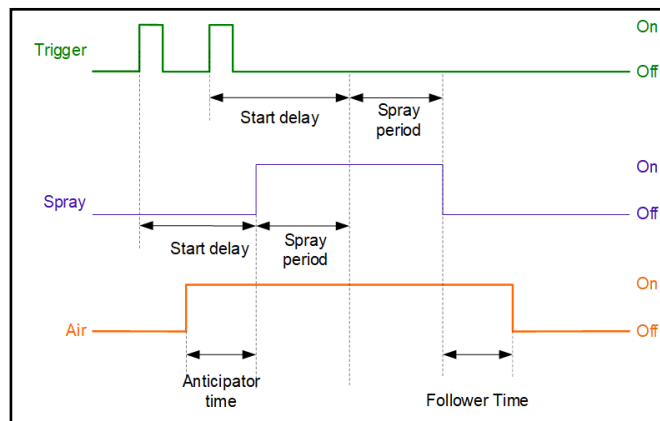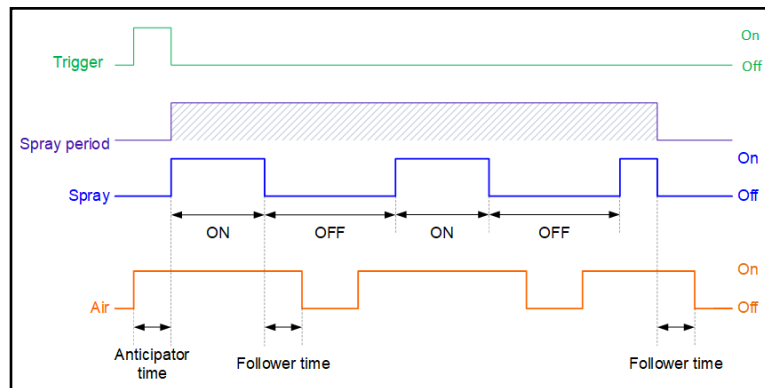

Multiple Triggers with Spray Overlap

FIXED SPRAY TIME - WITH REPEAT

This timing mode is used to create a continuous repetition of spray period for a fixed time.

Note: See Configuration settings or Recipe Settings for more information on Timing Mode setup.

Repeat Spray: The system can generate a repeating pattern inside of a spray period.
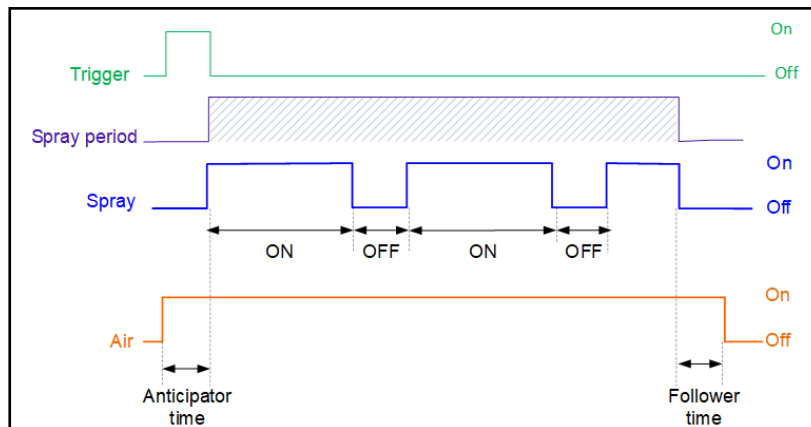

Repeat Spray

Special Case: Repeat Spray, Air Overlap: If repeat off-time <= (anticipator + follower time), the air will remain on.

Note: This can happen in both fixed and Variable spray times.

- Sum of Anticipator and Follower Time is Higher Than Start Delay Time

  —If (anticipator time + follower time) > off period, then the air will be kept on during the complete repeat cycle.
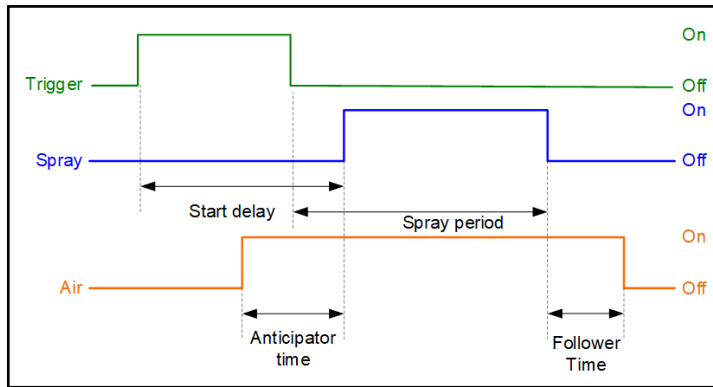

Repeat spray, air overlap

PARAMETER	VALUE
Start Delay	In seconds (s) or meters (m) - requires speed sensor
Off Period	In seconds (s) or meters (m), set value greater than 0
On Period	In seconds (s) or meters (m), set value greater than 0
Spray Period	In seconds (s) or meters (m), set value greater than 0
Anticipator Time	In seconds (s)
Follower Time	In seconds (s)

6.5 VARIABLE SPRAY TIMING

This timing mode is used to create spray pulses with variable length. The lengths of the spray pulses depend on the specific time delays between the rising and falling edge of the trigger input.

Variable Spray Time

| PARAMETER	VALUE
Start Delay	In seconds (s) or meters (m) - requires speed sensor
Stop Delay	In seconds (s) or meters (m) - requires speed sensor
Off Period	Set value equal to 0
On Period	Set value equal to 0
Spray Period	Set value equal to 0
Anticipator Time	In seconds (s)
Follower Time	In seconds (s)

INCREASING AND DECREASING SPRAY LENGTH

The 2850+ will spray exactly as long as the object has been detected by the sensor when the Start/Stop Spray Delay are the same. This delay should then be equal to the time/distance delay between the position of the sensor and the position of the spray nozzle.

The spray distance (or time) will now always be exactly the same as the object length (or time).

INCREASED SPRAY LENGTH

- Decrease Start-delay: The spray is started before the object has reached the spray nozzle.
- Increase Stop-delay: The spray continues after the object has passed the spray nozzle.
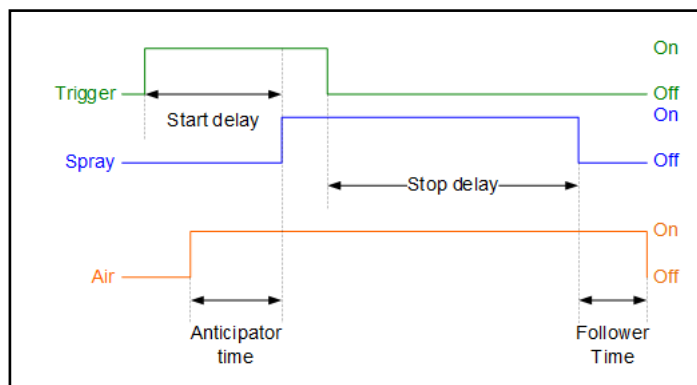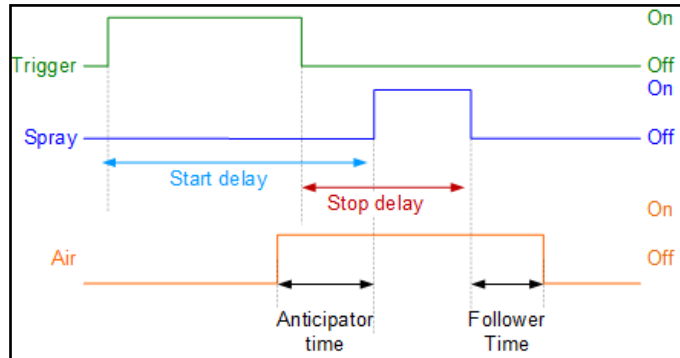

Variable spray time—increased spray period

## DECREASING SPRAY LENGTH

The spray length can be decreased by:

- Increasing the Start Spray Delay: the spray is started after the object is already under the spray nozzle. In this case the beginning of the object is not sprayed

- Decreasing the Stop Spray Delay: the spray stops before the object has completely past the spray nozzle. In this case the end of the object is not sprayed.

Variable spray length - decreased spray period

MULTIPLE TRIGGER EVENTS DURING SPRAY

If the system receives multiple start events before the spray cycle is finished, they will be added to a queue and executed according to the given delay times.
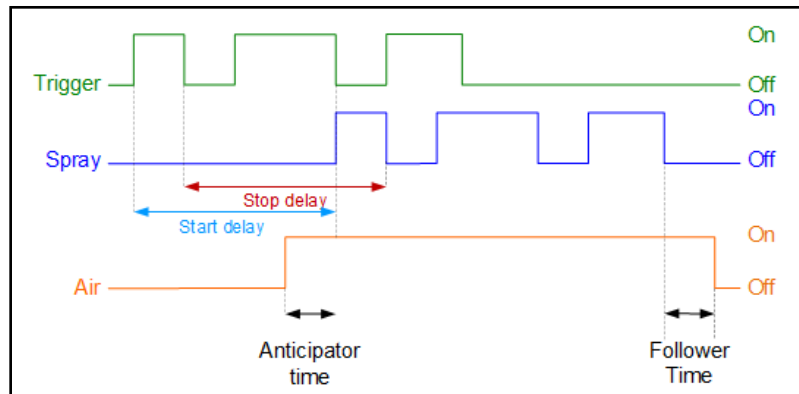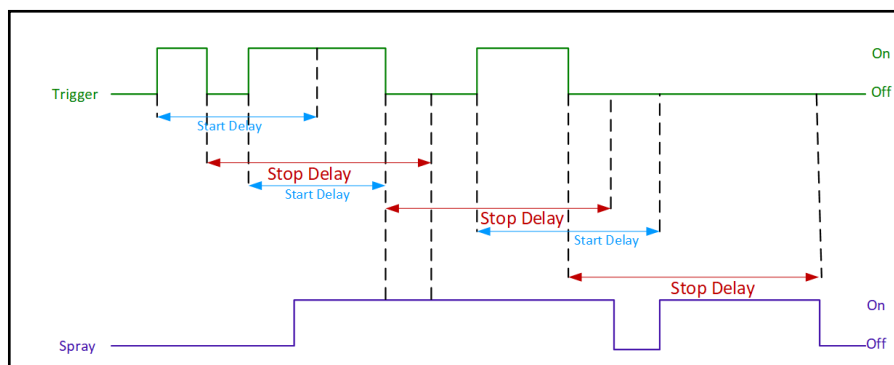

Variable spray period - multiple triggers

OVERLAPPING SPRAY EVENTS

If spray events overlap, the overlapping event will be ignored, and the system will continue to spray to ensure the objects are sprayed correctly. This situation may occur when the following is true:

- stop delay > start delay

- delay between two objects < (stop spray delay – start spray delay)

Variable spray events - overlapping triggers

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OBJECTS TOO SMALL

If spray events overlap, the overlapping event will be ignored, and the system will skip the small object.

This situation may occur when the following is true:

- Stop spray delay < Start spray delay
- Object size < (start delay – stop delay)
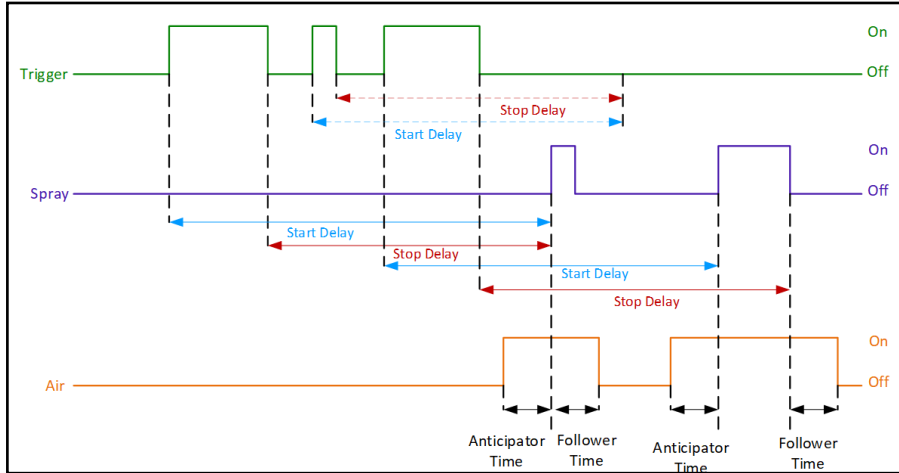
Variable spray period - objects too small

DISTANCE DELAY, <u>MAXIMUM </u>SPRAY PERIOD

This timing mode is used to create a delayed spray pulse of an unknown period when receiving a trigger signal.

- The start and stop delays are typically the distance between the object sensor and the spray nozzle.
- The spray period is limited in time to the configured spray period.

In this timing mode, the repeat functionality works in time units.
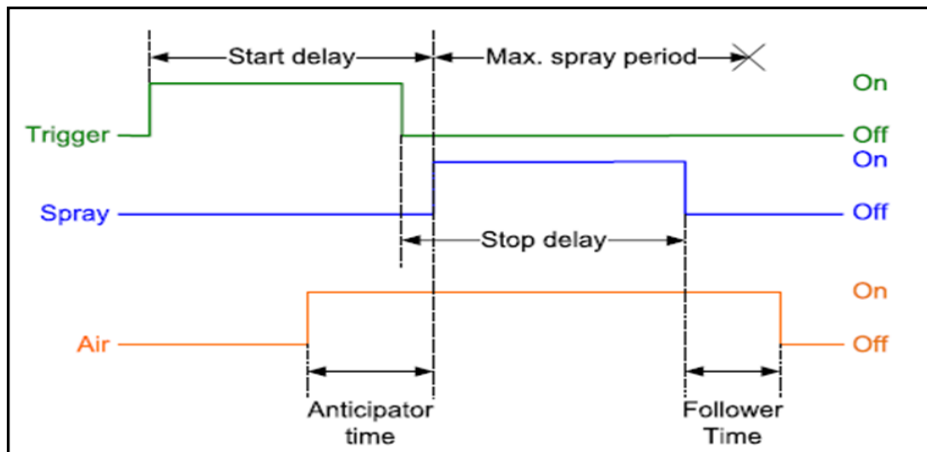
Distance delay - max. spray period

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VARIABLE SPRAY LENGTH—WITH REPEAT

This timing mode is used to create a continuous repetition of spray pulses for a variable time. The duration of the repetition depends on the specific time delays between the rising and falling edge of the trigger input.
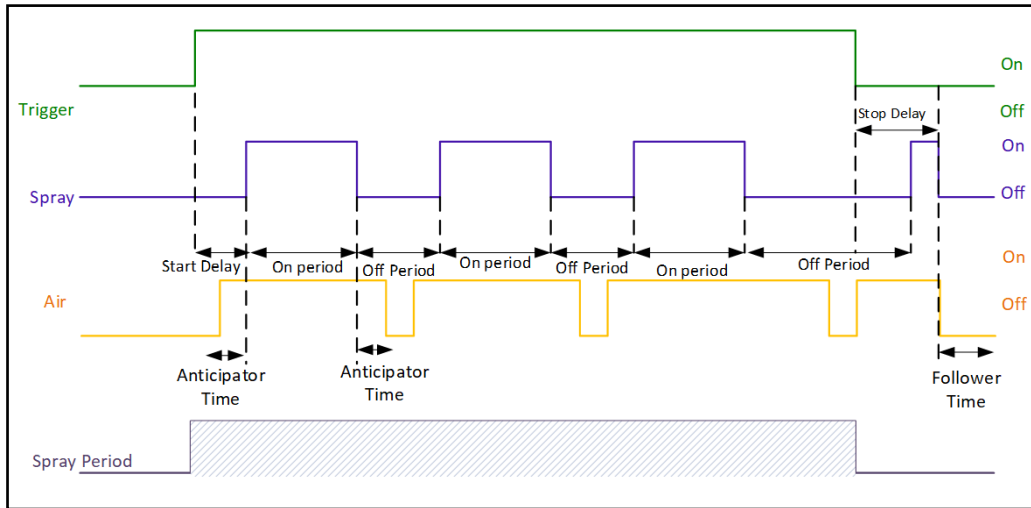
Variable spray length with repeat diagram

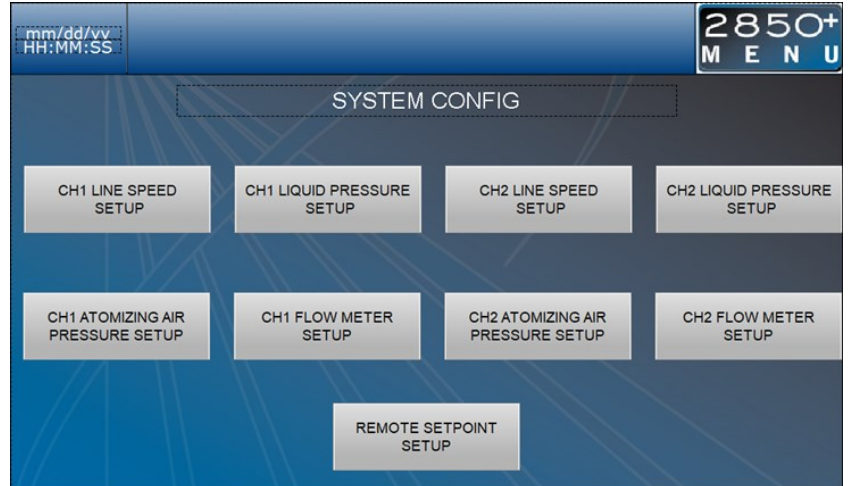| PARAMETER	VALUE
Start Delay	In seconds (s) or meters (m) - requires speed sensor
Stop Delay	In seconds (s) or meters (m) - requires speed sensor
Repeat Off Period	In seconds (s) or meters (m) - requires speed sensor, set value greater than 0
Repeat On Period	In seconds (s) or meters (m) - requires speed sensor, set value greater than 0
Spray Period	Set value equal to 0
Anticipator Time	In seconds (s)
Follower Time	In seconds (s)

CONFIGURATION SCREENS

⚠ **ATTENTION**: Channel 1 and Channel 2 screens contain identical fields and options except where noted.

7.1 SYSTEM CONFIGURATION

Press the boxes to open a secondary screen with editable fields for each feature.

System Configuration Screen

7.2 CH1 LINE SPEED SETUP

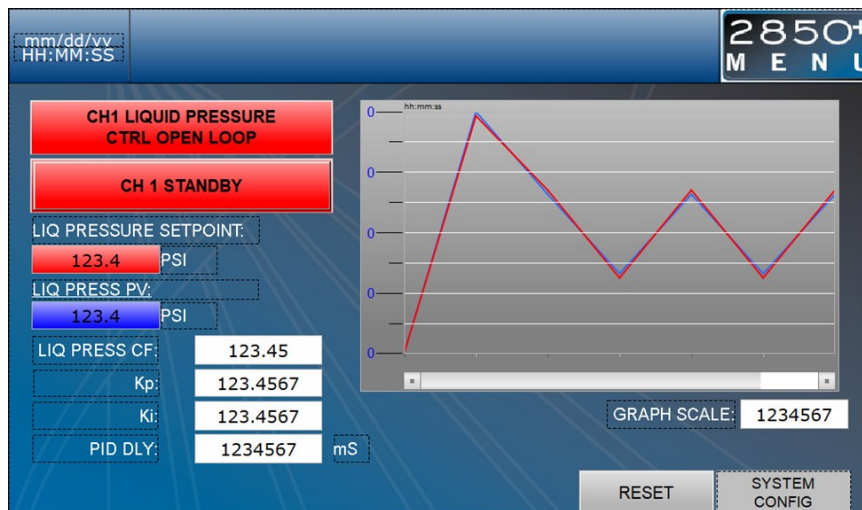| Item	Description
Line Speed 1 (editable)	Displays the channel 1 line speed
Line Speed (selection)	Selects the method of line speed feedback for control loops. **Not Installed:** There is no encoder installed. Certain features will not be enabled as they require liquid pressure feedback. **Installed:** There is an encoder installed and will be used when utilizing relevant feedback loops. **Manual:** Allows for a user to enter a line speed that can be used for feedback loops instead of the actual line speed. **Copy From Ln Spd 1** (channel 2 only): Uses the line speed input from channel 1 for channel 2
Speed Signal Input (selection)	Selects what kind of signal the encoder is sending. **HI SPD CTR 0:** For encoders sending a pulsed output. **Analog Input 1:** For encoders sending an analog output.
K-Factor (editable)	If an encoder is installed the encoder's K-Factor can be entered here.
Span (editable)	In the case of an analog encoder the 20 mA signal is entered here.
Max Off Time (editable)	Maximum time between encoder pulses before the system assumes a zero speed

7.3 CH1 LIQUID PRESSURE SETUP

Liquid Pressure Setup Screen

Item	Description
Liq Press 1	Displays the channel 1 liquid pressure
Liquid Pressure (selection)	Selects the method of liquid pressure feedback for control loops. **Not Installed:** There is no liquid pressure sensor installed. Certain features will not be enabled as they require liquid pressure feedback. **Installed:** There is a liquid pressure sensor installed and will be used when utilizing relevant feedback loops. **Manual:** Allows for a user to enter a liquid pressure that can be used for feedback loops instead of the actual pressure. **Copy From LPT 1** (channel 2 only): Uses the liquid pressure input from channel 1 for channel 2
Span (editable)	Set the span of the liquid pressure sensor based on a 4-20mA scale, with 4mA being 0 by default and 20mA will be the span you enter in this field.
Filter Constant	Smooths out input reading before being used or displayed
Ch1 Liq Press I/P Out (toggle)	Turns on or off the liquid pressure signal output
Span (editable)	Sets the 20 mA output of the liquid pressure signal, with 4 mA being 0 PSI
Ch1 Liquid Pressure PID (button)	Takes the used to the channel 1 liquid pressure PID screen.

CH1 LIQUID PRESSURE PID

The graph is a trend of the liquid pressure setpoint and process value versus time.

Item	Description
Liquid Pressure CTRL OPEN LOOP (on/off)	Toggles liquid pressure PID on/off for specified channel
CH 1 Standby	Toggles Channel 1 between 'Run' and 'Standby' modes.
Liq Pressure Setpoint (display)	Displays desired liquid pressure (PSI).
Liq Press PV (read only)	(Process Value) Display of the current liquid pressure.
Liq Press CF (editable)	The liquid pressure correction factor is determined by running the PID in closed loop. It can be manually adjusted while in open loop.
Kp (editable)	Enter the desired Kp value for PID control
Ki (editable)	Enter the desired Ki value for PID control
PID DLY (editable)	Allows the user to enter a time delay between the start of spray and when the PID loop begins to adjust values.
Graph Scale (editable)	Adjusts the scale of the Y-axis of the graph.
Reset (executable)	Resets the graph.

7.4 CH1 ATOMIZING AIR PRESSURE SETUP

Item	Description
Atom Air Press 1 (editable)	Displays the channel 1 atomizing air pressure
Atom Air Press (selection)	Selects the method of atomizing air pressure feedback for control loops. **Not Installed:** There is no pressure sensor installed in the atomizing air line. Certain features will not be enabled as they require liquid pressure feedback. **Installed:** There is a pressure sensor installed in the atomizing air line and will be used when utilizing relevant feedback loops. **Manual:** Allows for a user to enter an atomizing air pressure that can be used for feedback loops instead of the actual pressure.
Span (editable)	Set the span of the atomizing air pressure sensor based on a 4-20mA scale, with 4mA being 0 by default and 20mA will be the span you enter in this field.
Ch 1 Atom Air I/P Output (toggle)	Turns on or off the atomizing air pressure signal output
Span (editable)	Sets the 20 mA output of the atomizing air pressure signal, with 4 mA being 0 PSI
Ch1 Atomizing Air Pressure PID	Takes the user to the channel 1 atomizing air pressure PID screen.

CH1 ATOMIZING AIR PID

The graph is a trend of the atomizing air setpoint and process value versus time.

Item	Description	
Atomizing Air CTRL OPEN LOOP(on/off)	Toggles liquid pressure PID on/off for specified channel	
Atom Air Pressure SP (read only)	Display desired atomizing air pressure (PSI).	
Atom Air Press PV (read only)	Display of the current atomizing air pressure (PSI).	
Atomizing Air CF (Editable)	The atomizing air pressure correction factor is determined by running the PID in closed loop. It can be manually adjusted while in open loop.	
Kp (editable)	Enter the desired Kp value for PID control	
Ki (editable)	Enter the desired Ki value for PID control	
Graph Scale (editable)	Adjusts the scale of the Y-axis of the graph.	
Reset (executable)	Resets the graph.	
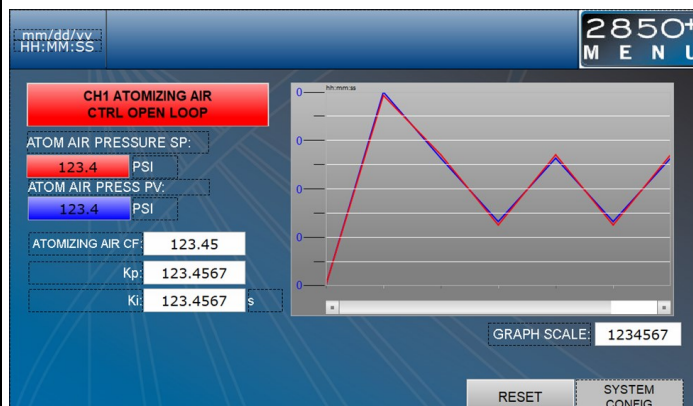
7.5 CH1 FLOW METER SETUP

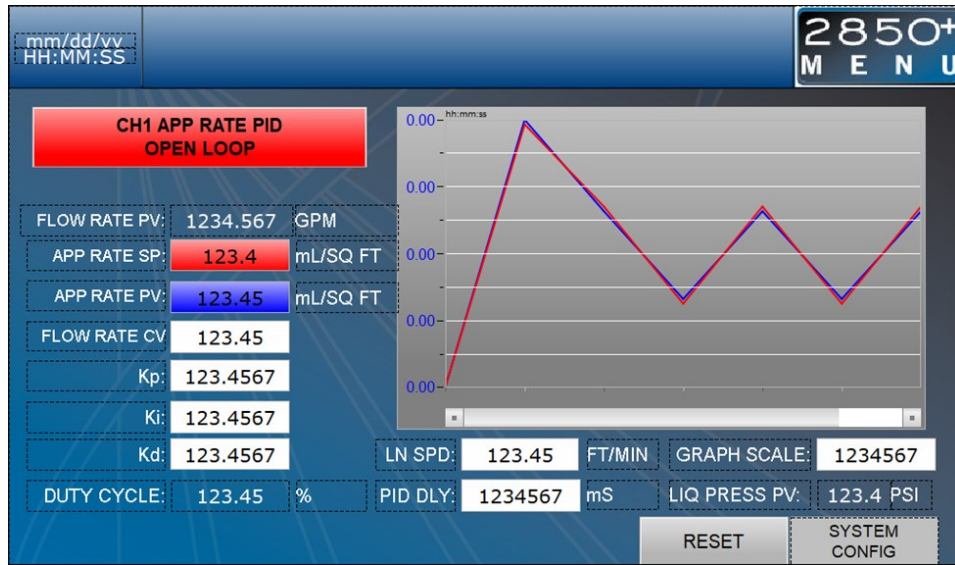| Item	Description
Flow Meter 1 (editable)	Displays the channel 1 flow rate.
Flow Meter (selection)	Selects the method of flow rate feedback for control loops. **Not Installed:** There is no flow meter installed. Certain features will not be enabled as they require liquid pressure feedback. **Installed:** There is a flow meter installed and will be used when utilizing relevant feedback loops. **Manual:** Allows for a user to enter a flow rate that can be used for feedback loops instead of the actual pressure.
Span (editable)	Set the span of the atomizing air pressure sensor based on a 4-20mA scale, with 4mA being 0 by default and 20mA will be the span you enter in this field.
Shot Volume (selection)	**Off:** Shot volume is off and hidden on the operating screen. **On:** Shot volume is on and displayed on the operating screen. *Shot Volume Alarm* on the alarms screen is used to setup parameters.
Flow Inc (editable)	Set the flow increment when using a flow meter with pulsed output for shot volume. Flow increment is the volume per pulse of the flow meter output.
Ch1 Flow Rate PID	Takes the used to the channel 1 Flow Rate PID screen.
Ch1 App Rate PID	Takes the used to the channel 1 App Rate PID screen.

CH1 FLOW RATE PID
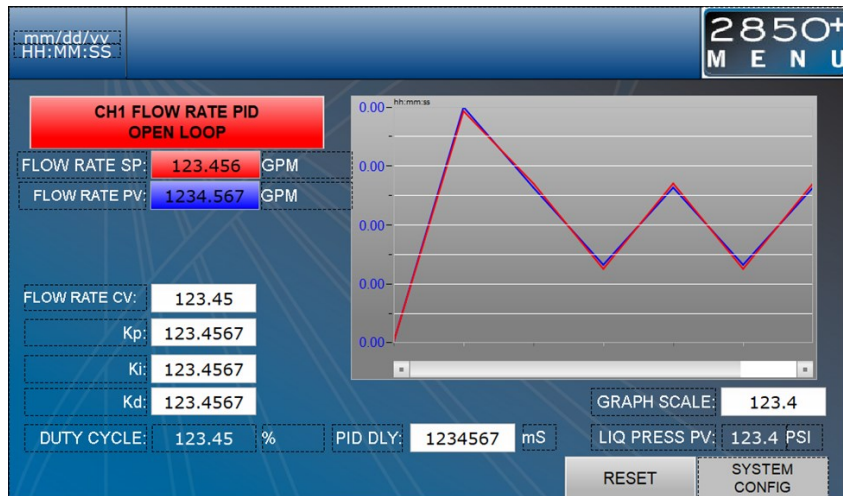
Item	Description
Flow Rate PID OPEN LOOP (on/off)	Toggles Duty Cycle PID on/off for specified channel
Flow Rate SP (GPM) (read only)	Display desired flow rate setpoint.
Flow Rate PV (read only)	Display of the current flow rate.
Flow Rate CF (editable)	The flow rate correction factor is determined by running the PID in closed loop. It can be manually adjusted while in open loop.
Kp (editable)	Proportional value in the PID loop.
Ki (editable)	Integral value in the PID loop.
Kd (editable)	Derivative value in the PID loop.
Duty Cycle (%)(read only)	Displays current duty cycle
PID DLY (mS) (editable)	Sets the PID delay, or time until the PID begins working to allow for values to ramp up.
Graph Scale (editable)	Change the scale of the graph for readability.
Liq Press PV (PSI) (read only)	Displays current liquid pressure.

CH1 APP RATE PID

Item	Description
App Rate PID OPEN LOOP (on/off)	Toggles App Rate PID on/off for specified channel
Flow Rate PV (GPM) (read only)	Display of the current flow rate.
App Rate SP (mL/SQ FT) (read only)	Display desired app rate setpoint (mL/sq. ft.).
App Rate PV (mL/SQ FT) (read only)	Display of the current flow rate.
App Rate CF (editable)	The app rate correction factor is determined by running the PID in closed loop. It can be manually adjusted while in open loop.
Kp (editable)	Proportional value in the PID loop.
Ki (editable)	Integral value in the PID loop.
Kd (editable)	Derivative value in the PID loop.
Duty Cycle (%) (read only)	Displays current duty cycle
LN SPD (FT/MIN) (read only)	Displays current Line Speed.
PID DLY (mS) (editable)	Sets the PID delay, or time until the PID begins working to allow for values to ramp up. (mS)
Graph Scale (editable)	Change the scale of the graph for readability.
Liq Press PV (PSI) (read only)	Displays current liquid pressure. (PSI)

7.6 REMOTE SETPOINT SETUP

Item	Description
Analog INP 1 (read-only)	Displays the current analog input 1 reading
Span (editable)	Set the 20 mA reading on the 4-20 mA scale for analog input 1
Analog INP 2 (read-only)	Displays the current analog input 2 reading
Span (editable)	Set the 20 mA reading on the 4-20 mA scale for analog input 2
Ch1 Ethernet Rem SP (read-only)	Displays the current channel 1 ethernet remote setpoint reading.
Ch2 Ethernet Rem SP (read-only)	Displays the current channel 2 ethernet remote setpoint reading.
Remote Flow Rate (GPM) (selection)	Select where the remote setpoint for Flow Rate is coming from **No Remote Input:** No remote input selected, system will use local setpoints **Analog Input:** Uses the analog input to determine the flow rate setpoint. **Ethernet:** Uses ethernet input to determine the flow rate setpoint
Remote AppRate (mL/SQ FT) (selection)	Select where the remote setpoint for application rate is coming from **No Remote Input:** No remote input selected, system will use local setpoints **Analog Input:** Uses the analog input to determine the application rate setpoint. **Ethernet:** Uses ethernet input to determine the application rate setpoint

7.7 HEADER INFO

The header info screen is used to enter reference information about the header, enable or disable zone control, and to determine which nozzles will be activated or deactivated in a particular zone configuration. The zone configuration will be selected during the creation of recipes at the recipe setup screen. In the operation screen, the user can select the recipe to run and the proper zone configuration will be used.
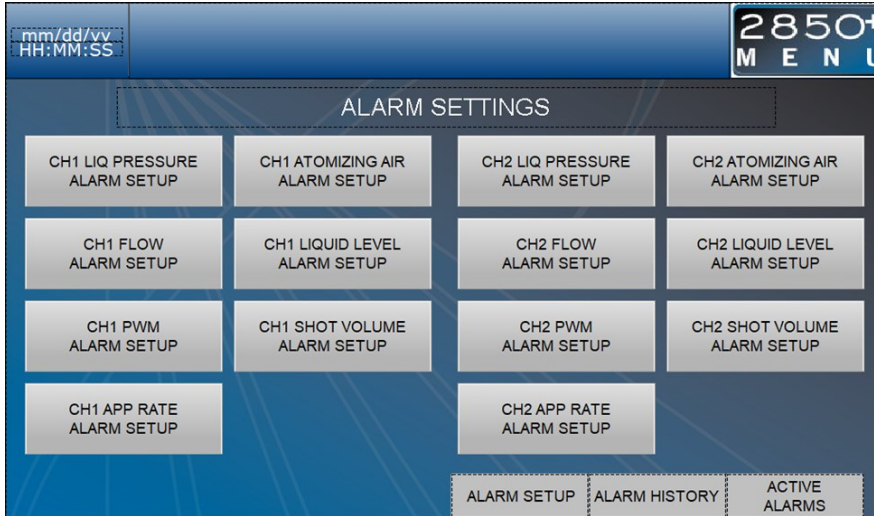

Item	Description
Spray Width (editable)	Enter the total width of the spray pattern of the manifold.
Ref Flow (editable)	Enter the reference flow of the manifold determined by the sum of the maximum capacity of each nozzle/tip in the manifold.
Ref Pressure (editable)	Enter the reference pressure at which the previous reference flow was determined.
Number of Zones (editable)	Total number of zones in the selected zone configuration. (Maximum of 12 zones)
Zone Control (toggle)	Enable or Disable zone control.
Zone Configuration (selection)	Select the zone configuration to setup/modify.
Zone Setup (toggle)	Allows user to enable or disable specific zones. The number of zones available corresponds to the number entered under "Number of Zones"

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ALARM SETTINGS

8.1 OVERVIEW

Alarm settings page sets the condition that will cause an alarm by the PLC. Each button will open a secondary screen with options for each alarm. Each alarm can either be enabled or disabled. By default, every alarm is disabled, and editable fields are set to zero.

Note: Channel 1 and Channel 2 screens contain identical fields and options except where noted.

8.2 LIQUID PRESSURE ALARM SETUP
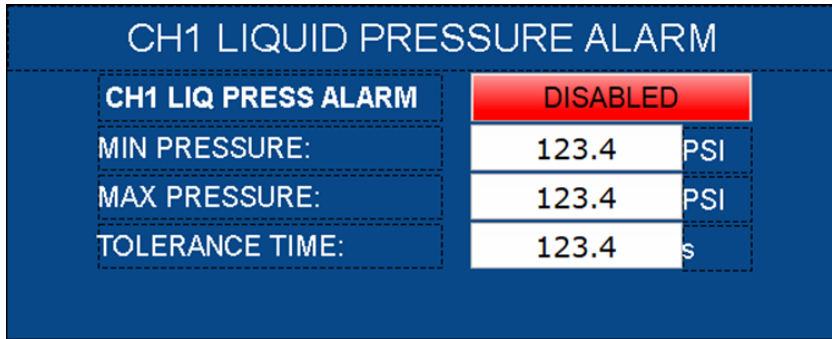
Item	Description
Ch1 Liq Press Alarm (toggle)	Enables or disables the liquid pressure alarm.
Min Pressure (editable)	Sets the minimum pressure allowable before alarming.
Max Pressure (editable)	Sets the maximum pressure allowable before alarming.
Tolerance Time (editable)	Sets the maximum allowable time outside the max or min pressure.

8.3 ATOMIZING AIR PRESSURE ALARM SCREEN

CH1 ATOMIZING AIR PRESSURE ALARM

CH1 AAIR PRESS ALM	DISABLED	
MIN PRESSURE:	123.4	PSI
MAX PRESSURE:	123.4	PSI
TOLERANCE TIME:	123.4	s

Item	Description
Ch1 AAIR Press Alarm (toggle)	Enables or disables the atomizing air pressure alarm.
Min Pressure (editable)	Sets the minimum pressure allowable before alarming.
Max Pressure (editable)	Sets the maximum pressure allowable before alarming.
Tolerance Time (editable)	Sets the maximum allowable time outside the max or min pressure.

8.4 FLOW ALARM SETUP

CH1 FLOW ALARM

CH1 FLOW ALARM	DISABLED	
LOW PERCENTAGE:	123.4	%
HIGH PERCENTAGE:	123.4	%
TOLERANCE TIME:	123.4	s

Item	Description
Ch1 Flow Alarm (toggle)	Enables or disables the Flow alarm.
Low Percentage (editable	Sets the minimum percentage of flow rate allowable before alarming. This percentage is based off the setpoint in the active recipe.
High Percentage (editable)	Sets the maximum percentage of flow rate allowable before alarming. This percentage is based off the setpoint in the active recipe.
Tolerance Time (editable)	Sets the maximum allowable time outside the max or min flow rate before alarming.

8.5 LIQUID LEVEL ALARM SETUP

CH1 LIQUID LEVEL ALARM

| LIQ LEVEL ALM | DISABLED | |
| TOLERANCE TIME: | 123.4 | s |

Item	Description
Ch1 Liq Level Alm (toggle)	Enables or disables the liquid level alarm.
Tolerance Time (editable)	Sets the maximum allowable time below the low level set on a level sensor before alarming.

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8.6 PWM ALARM SETUP

Item	Description
Ch1 PWM Alarm (toggle)	Enables or disables the PWM alarm.
Tolerance Time (editable)	Sets the maximum allowable time outside the recommended duty cycle percentages before alarming.

8.7 SHOT VOLUME ALARM SETUP

The Shot Volume Alarm operates by observing the ratio of shots outside of the desired volume to the total number of shots.

Example: Alarm If **10** Bad In **100** Evaluations. This would allow 10 shots outside of the set percentages of the shot weight setpoint for every 100 shots.
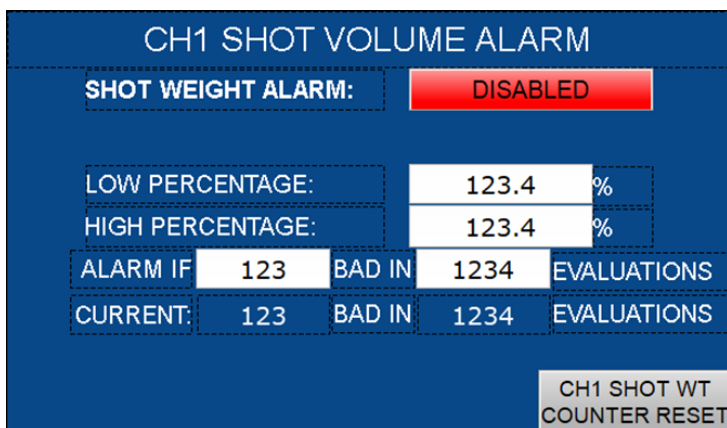
Item	Description
Ch1 Shot Weight Alarm (toggle)	Enables or disables the Shot Weight alarm.
Low Percentage (editable)	Sets the minimum percentage under the shot volume allowable. This percentage is based off the setpoint in the active recipe.
High Percentage (editable)	Sets the maximum percentage over the shot volume allowable. This percentage is based off the setpoint in the active recipe.
Alarm If _ Bad (editable)	Enter the number of allowable shots outside the setpoint and error percentages set above.
In Evaluations (editable)	Enter the number of total shot evaluations before resetting.
Current _ Bad (read-only)	Displays the number of allowable shots outside the setpoint and error percentages set above.
In Evaluations (read-only)	Displays the number of total shot evaluations before resetting.
Shot Wt Counter Reset (Button)	Resets the counters of bad and total shots to zero.

8.8 APP RATE ALARM SETUP

Item	Description
Ch1 App Rate Alarm (toggle)	Enables or disables the application rate alarm.
Low Percentage (editable)	Sets the minimum percentage of application rate allowable before alarming. This percentage is based off the setpoint in the active recipe.
High Percentage (editable)	Sets the maximum percentage of application rate allowable before alarming. This percentage is based off the setpoint in the active recipe.
Tolerance Time (editable)	Sets the maximum allowable time outside the max or min application rate before alarming.

8.9 ACTIVE ALARMS

The active alarms screen shows the current alarms that are active. Removing the alarm condition will remove the alarm from this screen but the alarm will still be recorded in the alarm history.
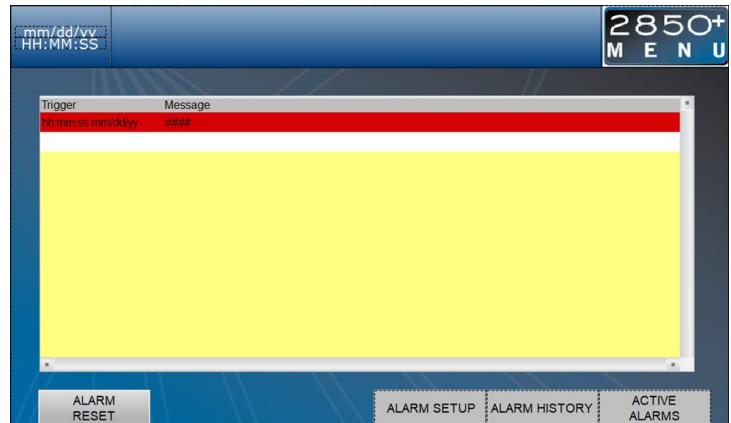
Item	Description
ALARM RESET	Alarms will be recorded in the alarm history until alarm reset is pressed.

8.10 ALARM HISTORY
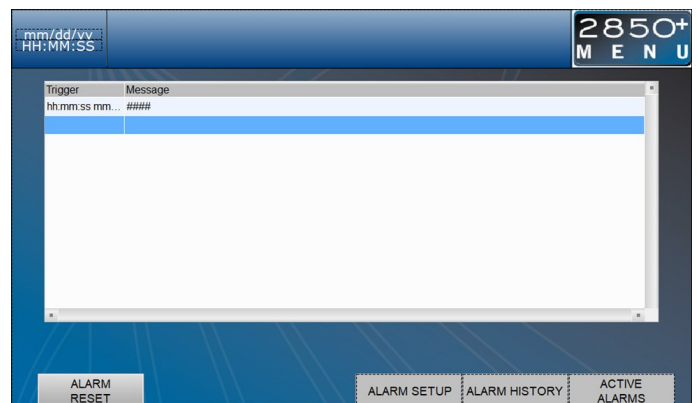
Item	Description
ALARM RESET	Alarms will be recorded in the alarm history until alarm reset is pressed.

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MONITOR I/O SETTINGS

9.1 MONITOR I/O

The Monitor IO menu option from the 2850+ menu allows the user to see several screens which provide live readings of both the analog and digital aspects of the PLC. These screens are extremely useful for troubleshooting whether or not sensors are working as the values displayed are irrespective of settings selected on the 2850+ controller.

The Monitor IO page displays Embedded IO, or monitors the IO of the PLC and to some extent the 2008 modules.

9.2 ANALOG IO MONITOR

The analog IO screen displays the current analog values for the controller and can be used for troubleshooting purposes. The displayed value is the number of counts received. Divide by 1000 and that will correspond to the mA received.
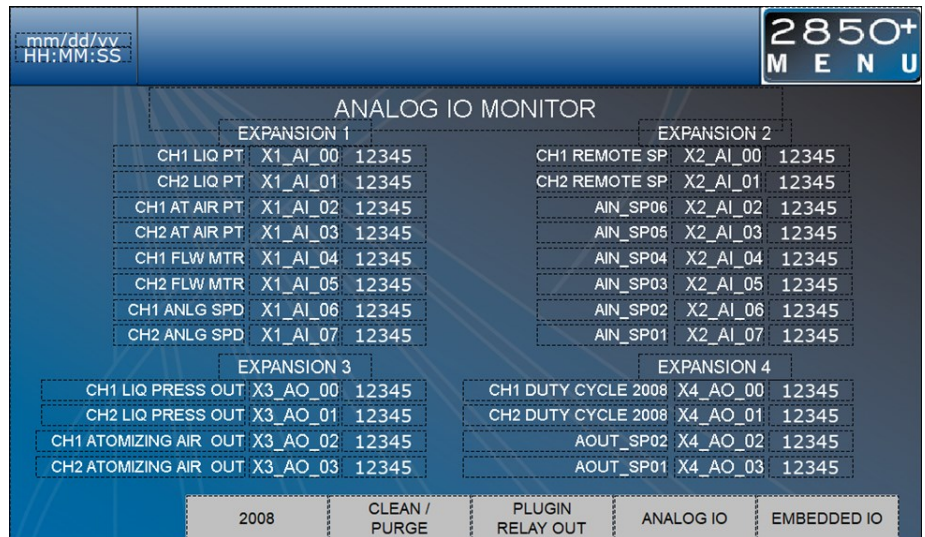
9.3 PLUGIN RELAY OUTPUT

Plugin relay output page displays the status of the relays of the plugin modules (located on the top of the PLC). These are primarily used for zone control. They can be toggled on/off even if the channel is running.
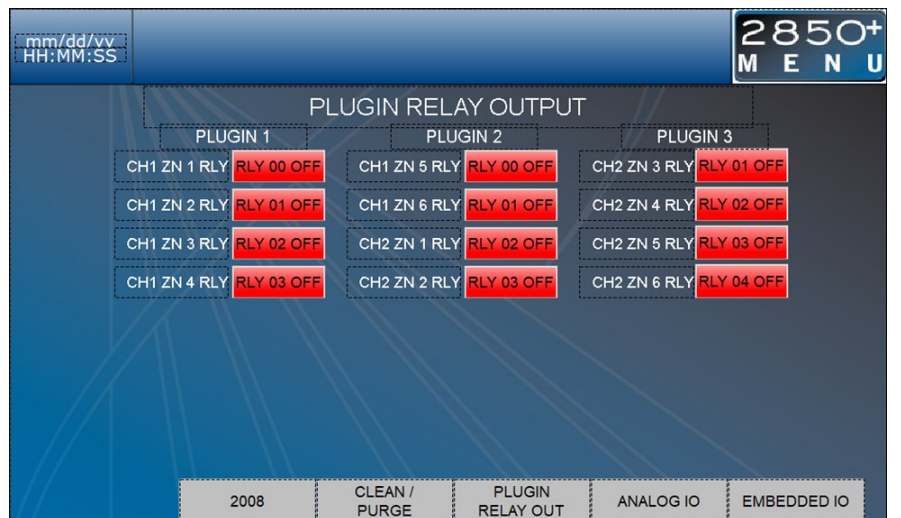
9.4 CLEAN/PURGE SETTINGS

The Clean/Purge screen allows the user to configure and control clean/purge cycles.

Item	Description
Ch1 Purge (editable)	Purges the fluid lines before an initial run of air ensuring nozzles are full of fluid.
Ch1 Clean (editable)	Pressing this button engages the clean process using the parameters set for the given channel.
Clean Duty Cycle (editable)	Enter the duty cycle the nozzles will use during the clean cycle.
Max Cycle Speed (editable)	Enter the maximum cycle speed for the nozzles during the clean cycle.
Clean Time (read only)	Enter the amount of time the nozzles will fire to clean the header.

9.5 2008 SETTINGS

2008 Settings screen is used to observe the settings in the 2008 module as decided by the active recipe. This screen can also be used to change striping behavior priority at the extremes of the nozzle's capabilities (Allow striping to spray the correct quantity, disallow striping and spray to little, avoid striping by spraying at 100%).

HELP SETTINGS

10.1 HELP SCREEN

Information such as vendor revision and serial number of the 2008 can be found in the help screen. The HMI-OS tab allows the user to visit the setup screen for the HMI. If the HMI starts to lag, it can be useful to visit this screen and re-set the power to the HMI by using the power button in the top right of that screen. Resetting the screen will not affect the PLC or HMI programs in any way. The screen map can also be navigated to from here and can be useful to access a desired page.
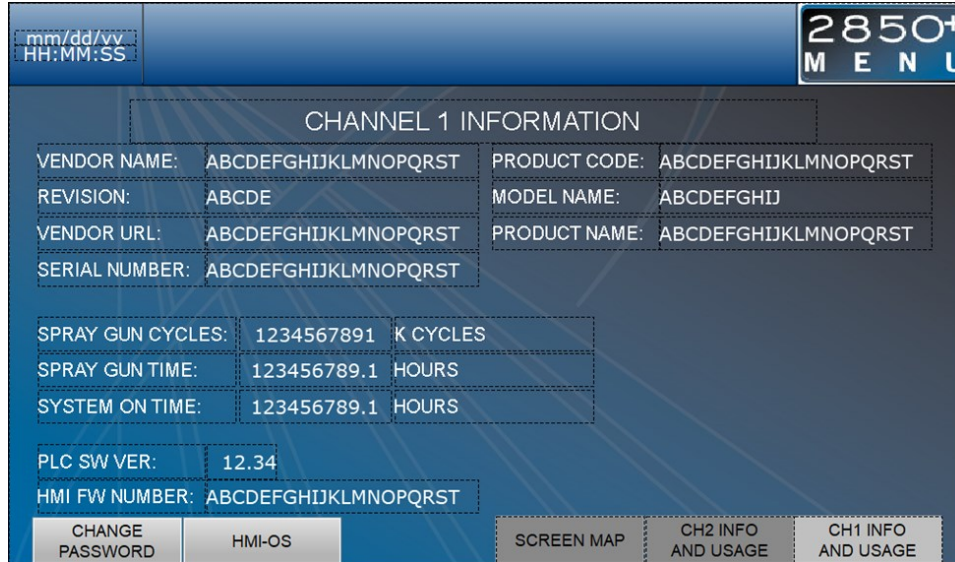
10.2 SCREEN MAP

The screen map allows the user to jump to any screen. The change password button allows the user to change its password. The user must be logged in and can only change passwords of the security level they are currently logged into, or any level with lesser credentials.
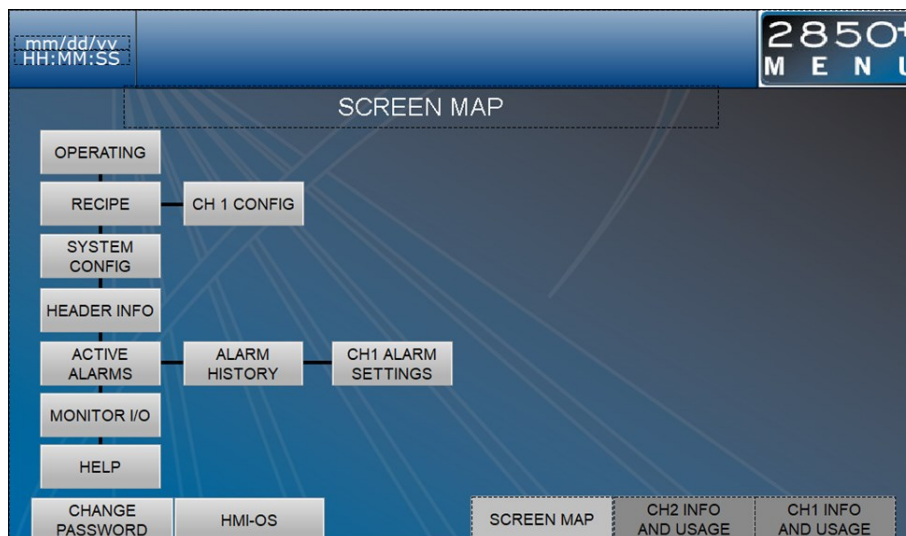
TROUBLESHOOTING AND FAULTS

11.1 TROUBLESHOOTING

Equipment required:

Multimeter (voltage/current/ohms)

Beaker (size as needed)

Scale or balance (milligram resolution)

* The main 115VAC power source should be checked and verified as the first step before any further troubleshooting is begun.

* Check and verify unregulated power supply voltage 24vdc (21vdc-29vdc).

* Check system and power supply fuses.

* Check the HMI for fault messages.

* Check and verify system air pressure.

* Check and verify liquid in the tanks.

* Check the PLC for the red fault light.

Before you start looking to see if a device is not working please ensure that all the electrical, pneumatic and hydraulic connections are secure and in their proper places.

If you have any manual valves in place, make sure they are in the proper orientation to provide the necessary media.

Make sure the controller is in run mode. If the system is in standby mode it will ignore all attempts to trigger the system. It must be in run mode to accept any trigger.

11.2 FAULTS

Alarm Message	Cause	Potential Fixes
CH1/CH2 LIQUID PRESSURE ALARM	The liquid pressure on channel 1/ channel2 has deviated outside the user set tolerance range for the user specified tolerance time.	•Check pump is on and liquid present •Check manual valve orientation if present •If desired, ensure that the Liquid Pressure PID is in closed loop •Navigate to Sensor configuration screen and check the sensor is configured correctly •Check pressure control signal (normally AO1/AO2) on the monitor I/O screen for a non-zero (4000 or greater) value •Check that alarm tolerance time and window are set correctly in the Alarm Settings
CH1/CH2 FLOW RATE ALARM	The flow rate on channel 1 has deviated outside the user set tolerance range for the user specified tolerance time.	•Check pump is on and liquid present •Check manual valve orientation if present •If desired, ensure that the DC PID is in closed loop •Navigate to Sensor configuration screen and check the sensor is configured correctly •Check that REF PRESSURE and REF FLOW are entered correctly on the config screen •If zoning is enabled, ensure that the ZONE REF FLOW is entered correctly, along with all other parameters on the zone control screen •Check that alarm tolerance time and window are set correctly on the Alarm Settings.

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Alarm Message	Cause	Potential Fixes
CH1/CH2 App Rate Alarm	The application rate on channel 1 has deviated outside the user set tolerance range for the user specified tolerance time.	•Check that the line speed reading is correct on the operating screen •Navigate to Ch1/2 Sensor configuration screen and check that linespeed is configured correctly •If desired, ensure that the DC PID is in closed loop •Check that SPRAY WIDTH is entered correctly on the Ch1/2 config screen •Check that alarm tolerance time and window are set correctly on the Ch1/2 Alarm Settings page
CH1/ CH2 PWM Alarm	The duty cycle on channel 1 has started to drift towards the edges of the nozzles' operable bounds.	Contact your Spray Specialist
CH1/CH2 Level Sensor Alarm	The channel 1/2 level sensor has indicated a low level for a longer amount of time than the user specified tolerance time.	•Ensure that the pump/liquid path to supply the tank with the level sensor is open/plumbed correctly •Check that alarm tolerance time and window are set correctly on the Ch1/2 Alarm Settings page
System Integrity (1-8) Fault	System integrity flowmeter (1-8), when compared to theoretical flow, is not reading an expected value.	•Navigate to the System Integrity screen and look for discrepancies between the flowmeter readings •Ensure that these readings are reflected correctly on the physical flowmeters themselves if accessible •Clean the tip(s) of nozzle(s) attached to the alarming meter(s) •Check that alarm tolerance time and window are set correctly on the System Integrity page
CH1/CH2 Analog LN SPD not wired	There is no signal detected coming from the channel 1/2 liquid pressure sensor.	•Check Monitor IO page for a non-error value (> 3200 and < 65000) •Ensure that the sensor is configured correctly on the Ch1 sensor configuration screen •Check sensor wiring
CH1/CH2 Atomizing Air Alarm	The liquid pressure on channel 1/2 has deviated outside the user set tolerance range for the user specified tolerance time.	•Check system air supply pressure if gauge is present •Check manual valve orientation if present •Navigate to Ch1/2 Sensor configuration screen and check that the sensor is configured correctly •Check pressure control signal (normally AO3/AO4) on the monitor I/O screen for a non-zero (4000 or greater) value •Check that alarm tolerance time and window are set correctly on the Ch1/2 Alarm Settings page.

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