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PathMaster X

Software Manual

Revision C

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1. Introduction

Before you operate this system, read the operation and setup manual. This will help you to become familiar with the product and ensure successful operation.

If any questions or problems arise, contact PVA's Technical Support department.

1.1 PVA Contact Information

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1.2 Document History

Revision	Revision Date	Reason for Changes
REV C	June 2025	PMX Version 1.2.0.1 Updates
REV B	September 2024	PMX Version 1.1.0.0 Updates
REV A	January 2024	Initial Release

Note: All photographs and CAD model representations in this document are a "general representation" of the system and its components. The actual appearance of the system and its components can differ based upon customer specific configuration.

1.3 Safety

Certain warning symbols are affixed to the machine and correspond to notations in this manual. Before operating the system, identify these warning labels and read the notices described below. Not all labels may be used on any specific system.

Always wear approved safety glasses when you operate or work near the workcell.

Before you operate the system, read and understand the manuals provided with the unit.

Never put hands or tools in areas with this symbol when the machine is in operation. A dangerous condition may exist.

Read and understand the manuals provided with the unit before any repairs or maintenance is done. Only a qualified individual should do service.

Use caution when there are pressurized vessels. Find and repair any leaks immediately. Always wear appropriate safety equipment when you work with pressurized vessels or vessels that contain chemicals

Shear hazard from moving parts. Avoid contact.

Do not remove protective guarding.

In situations where inattention could cause either personal injury or damage to equipment, a warning notice is used.

Do not smoke near the machine. Always have a fire extinguisher available for emergency use.

Before performing any repairs or maintenance to the system, turn off power and lock out the power disconnect switch.

Warning notices are used to emphasize that hazardous voltages, current, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use. Only qualified personnel should enter areas designated with this symbol.

Laser light source present. Do not stare directly into the beam. Do not use in the presence of highly reflective surfaces

Pinch hazard from moving parts. Avoid contact.

Hot surface. Avoid contact.

Warning, Ultraviolet (UV) light hazard. Do not look directly at the UV light source.

This product meets EU standards for health, safety, and environmental protection.

Warning, no open flames.

Electrostatic sensitive device warning. Observe precautions for handling.

1.4 Theory of Operation

The operator controls the workcell with PathMaster X software. This includes machine setup, manual operation, program selection, and automatic operation. Machine status and error messages are displayed through the application and the light tower. The operator(s) must read this manual or be trained to understand the operation of the machine.

1.5 Hardware and Software Requirements

PathMaster X requires a Windows 10 Operating System, Windows 10 LTSC (Long-Term Servicing Channel), or Windows 11 Operating System.

1.5.1 Minimum Hardware Requirements

- XE4 with 12th Gen i7 or equivalent
- 32GB RAM
- 512GB SSD
- Upgrade Media/License if updating from Windows 10

1.5.2 Software Requirements

In order to use any camera features, the Matrox MIL X Vision Library version 23H2 must be installed.

1.5.3 Offline Requirements

To run the PathMaster X application offline, the computer must also have:

- (1) Monitor of Variable Size and 1920 x 1080 Resolution
- Mouse (USB)
- Keyboard (USB)

1.5.4 Workcell Requirements

To run the PathMaster X application with a workcell or alternate dispense platform, the computer must have:

- (2) Ethernet Adapters
- (1) RS232 Serial Communications Port
- Keyboard Extension Cable, 6 feet
- Mouse Extension Cable, 6 feet
- HDMI Monitor Cable, 15 feet

PathMaster X may not work correctly with systems that do not meet these minimum requirements.

1.5.5 Supported Controller Drivers

PathMaster X supports DMC 4000 Galil controllers with a firmware revision of D400s08q.

Controllers must be purchased from PVA.

1.5.6 Security Software

Some security software packages and firewalls can interfere with PVA system software.

By default, PVA uses ethernet ports 23, 60007, and 502. Security software and firewalls must be configured to allow traffic on these ports.

2. Setup and Communication

2.1 Startup Procedure

Note: Do not power on the workcell or add material to the pressure vessels until they are correctly grounded.

1. Turn the main power switch **OFF**.
2. Confirm the fluid and air pressures are in the correct pressure range.
3. Close all doors.
4. Turn the **Door Bypass Key** switch to the **OFF** position (if applicable).
5. Engage the **Emergency Stop** button.
6. Turn the main power switch to the **ON** position.
7. Ensure the computer associated with the workcell is powered on.
8. Launch the **PathMaster X application** and log in.

2.2 Accessing PathMaster X

1. To open PathMaster X, click the PathMaster X shortcut  . *Once all modules successfully load, PathMaster X will require a user login.*
2. Select the appropriate user profile and enter the user PIN. The default user PIN is "00000".
3. Select the green **Checkmark** button  to log in. Select the **Back Arrow** button  to select a different user.

Note: If modules do not successfully load, contact PVA Customer Support.

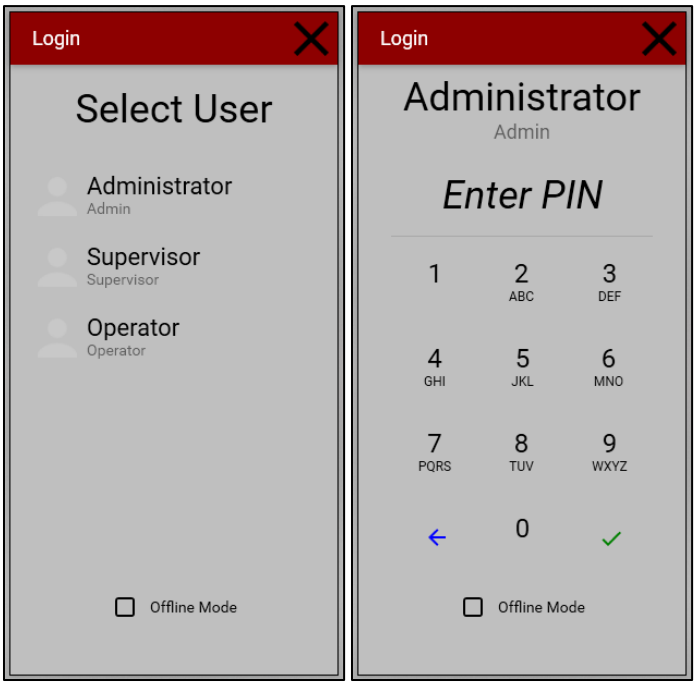

Figure 1: Select User and Enter PIN

2.3 Exhaust Verification

Once the workcell has been initialized, it will perform an exhaust flow rate test. If initialization fails, refer to your workcell manual for fault diagnostics. The exhaust flow rate is monitored with the on-board pressure differential switch.

The workcell exhaust rate must be no less than 300 cubic feet per minute (CFM), otherwise a critical fault will occur and stop the motors. The test will also help to evacuate any vapors that are in the work area. The time this takes is based on the CFM and the area that must be evacuated.

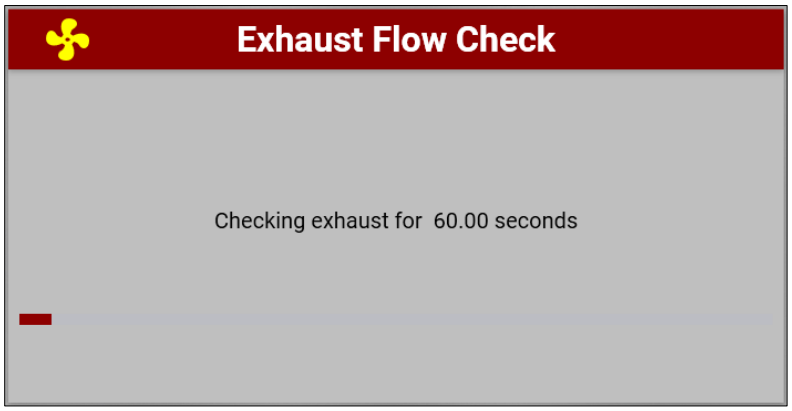

Figure 2: Exhaust Flow Check

2.4 Machine Safety Check

Once initialization and exhaust verification are complete, the machine will require a check of all attached safety devices. The machine safety check ensures the workcell safety devices (Emergency Stop, door interlocks, light curtain, etc.) operate correctly. This safety check is configured to be executed once per day, on PathMaster X startup.

1. The machine will automatically begin the safety check.

Figure 3: Machine Safety Check

2. You must activate and deactivate the safety devices when shown on the screen. All events in this procedure are timed. If an action is not completed before the displayed timer runs out, an error screen will be shown.

3. If an error occurs, select **OK** to repeat the test or the **Shutdown** button to close PathMaster X.

Figure 4: Safety Check Error

Note: If the safety check fails for any reason other than failure to respond to the prompts in time, a qualified person must examine the full system before the machine is operated again. Refer to the Troubleshooting Power Check Failures Document.

2.5 Homing the Axes

After the safety check is complete, the Home Robot screen will display.

Figure 5: Home Robot

1. Select **OK** to home the system.
2. The axes home in the following order: Z, W (if installed), then X and Y simultaneously.

Figure 6: Homing Gantry

3. PathMaster X Navigation

Navigating the PathMaster X application is performed through a series of modes, pages, and tabs. The three modes are: **Production**, **Creation**, and **Configuration**.

Each mode, as well as their subsections, can be accessed immediately by clicking the list button located in the upper left corner of the screen on the top banner.

1	**Dropdown Menu**	*Houses Production, Creation, and Configuration Modes*
2	**Production Mode**	*Houses Process Page*
3	**Creation Mode**	*Houses Program, Product, and Process Pages*
4	**Configuration Mode**	*Houses Device, Machine, and Application Pages*

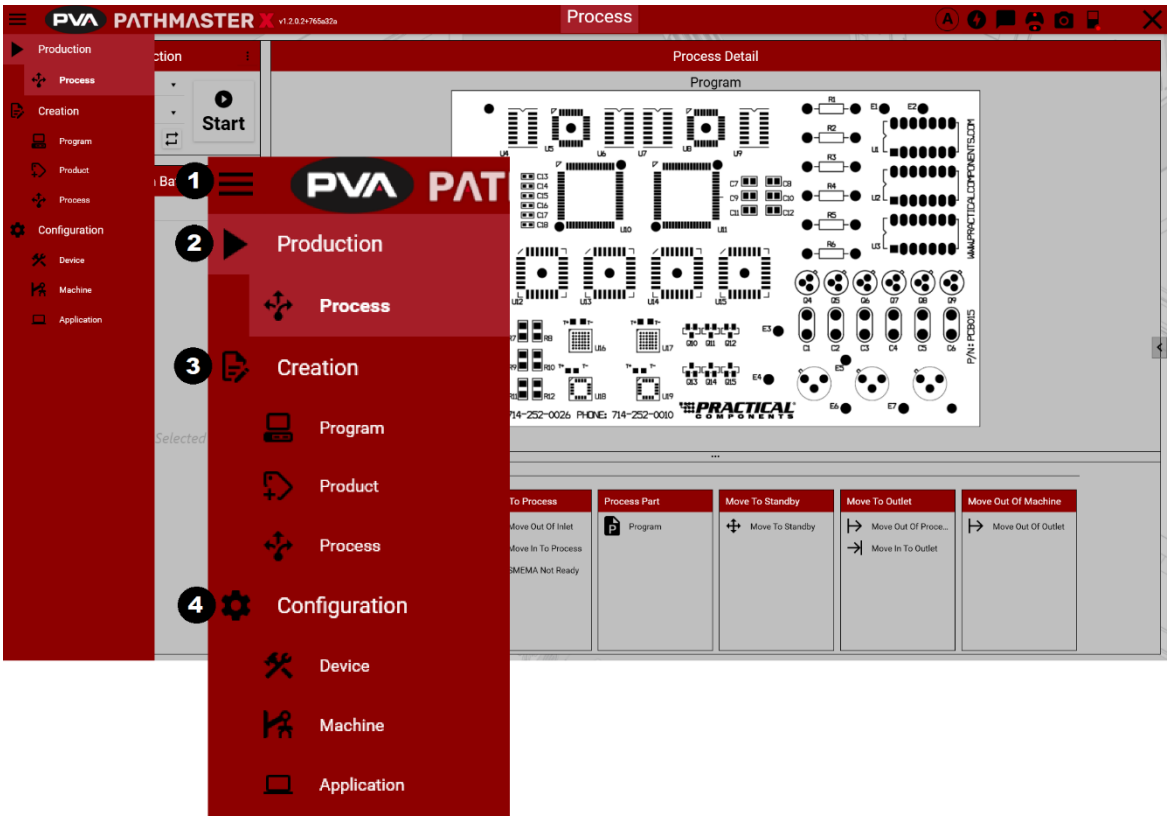

Figure 7: Access Modes Sidebar Menu

3.1 Application Header

The application header contains menu items that provide functionality that can be used throughout the application, regardless of mode, as well as the available pages to navigate to in the current mode.

Figure 8: Application Header

	1 Available Pages	Available main pages of the current mode. Selecting a different page will navigate to that page.
	2 Current Page	Highlighted tab is the currently active page. *Ex. Program, Product, and Process in Creation Mode.*
	3 User Login	Quick reference of which user is logged in. Select the icon to log out the current user and log in a new user without shutting down the application.
	4 Quick Actions	Allows execution of certain functions and motions from any page, such as set tool width, spray width, staging device width, and run shot scale checks, as well as allowing for a quick run of needle calibration or manual tip change for a selected tool.
	5 Notifications	Notifications sent by the application will appear here.
	6 Pendant	Virtual pendant control of the X-PAD. See Section 3.2.5 0 for more details.
	7 Camera	Allows you to see a live view of the camera. The camera view is able to pop out into its own window.
	8 Machine Status	Displays machine connectivity status. Also allows a user to go into offline mode, as well as view the robot home, safety check, and exhaust flow statuses.
	9 Shutdown	Shuts down the application.
	10 Header Menu	Callouts 3-8 make up the header menu.

3.2 Header Menu

3.2.1 User Login

User Login menu item allows for the changing of the active user, as well as indicates which user is currently logged in.

3.2.2 Quick Actions

Quick Actions allows the execution of certain functions, locations, and triggers.

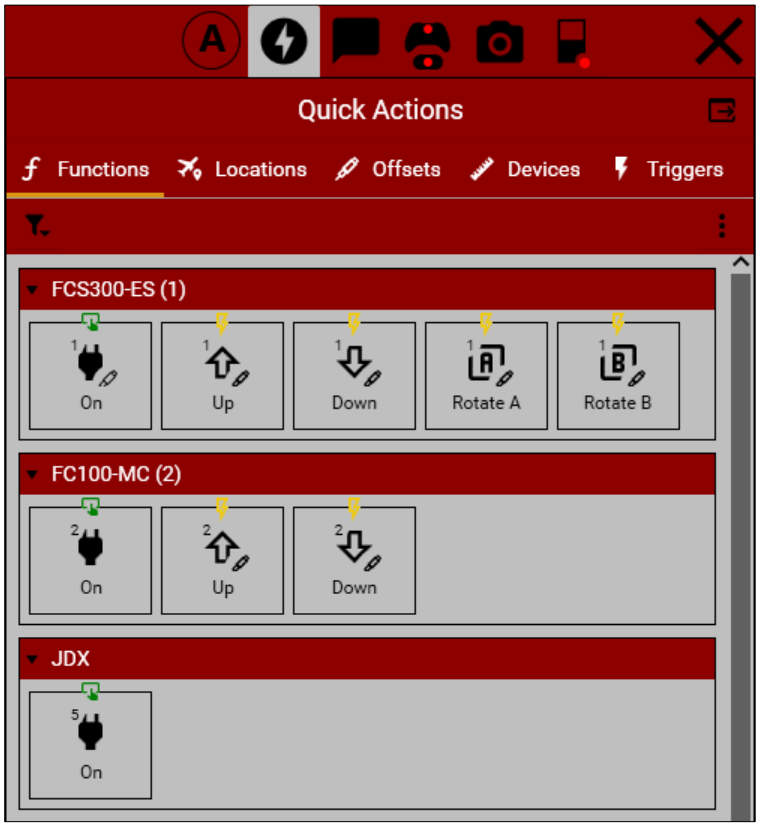

Figure 9: Quick Actions

The **Filter** button in the top left corner allows for filtering available functions, locations, and manual triggers. These can be filtered by:

- **Name** – The display name of the function, location, or trigger
- **Category** – The type of function, location, or trigger
- **Provider** – The device or tool of the associated function, location, or trigger

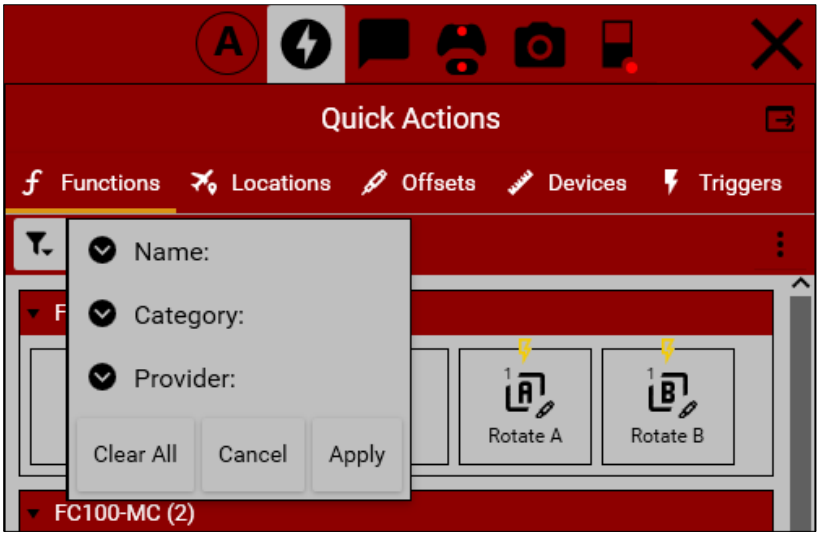

Figure 10: Filter Quick Actions

The **More** button allows the user to toggle Condensed View on or off, expand all menus, or collapse all menus.

Quick Actions can pop out to its own window. The popout button is in the upper right corner of the toolbox. This will keep the toolbox on top of the application pages.

The toolbox can be moved anywhere on the screen. Press the button again to return the toolbox to its location on the toolbar.

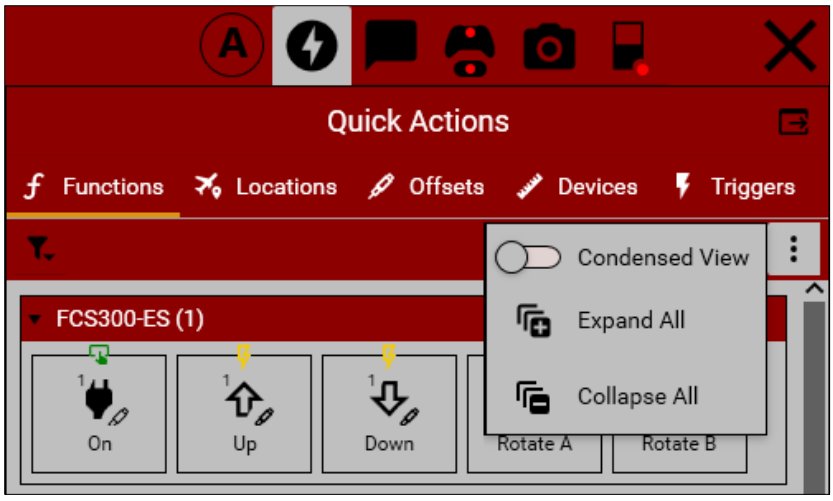

Figure 11: Quick Actions View Options

3.2.2.1 Functions

Tool and device functions that are configured as Quick Actions will appear here.

Click on a function to execute.

Functions with a  icon are “click and hold”. This means the function will only execute while the button is clicked and the mouse button is held down.

Functions with a  icon execute once when clicked.

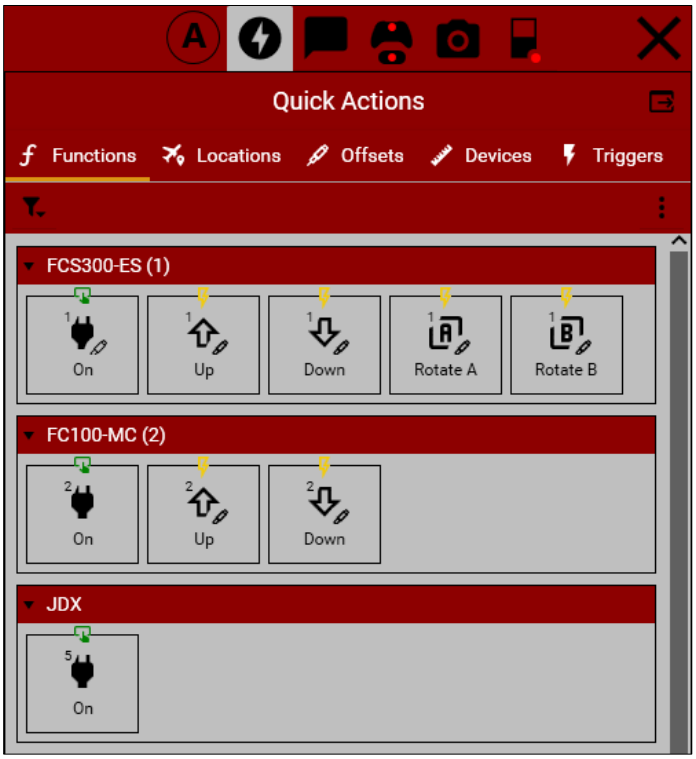

Figure 12: Function Quick Actions

3.2.2.2 Locations

Robot and Tool locations that are enabled in the Quick Actions menu will appear here. Clicking on a location coordinate item will move the gantry to the corresponding location. The dropdown menu on the **Tool Locations** menu bar allows the user to select a different Tool for the associated coordinates.

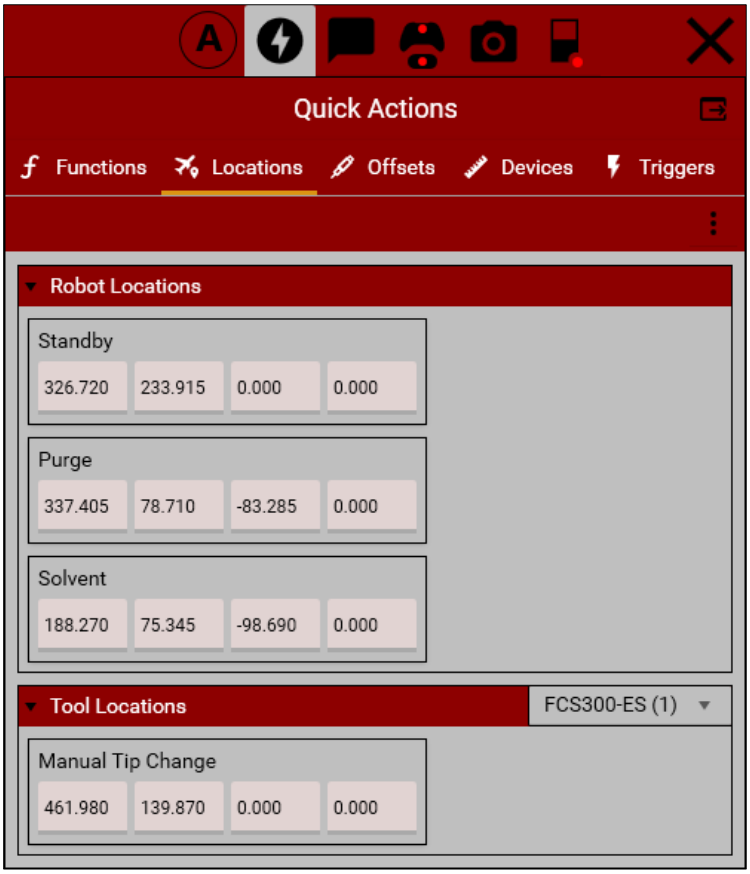

Figure 13: Quick Access Locations

3.2.2.3 Offsets

The Offsets tab allows for a quick run of needle calibration to set a tip offset or a manual tip change for a selected Tool.

3.2.2.3.1 Needle Calibration

1. Select the desired Tool from the available options. Select multiple Tools to calibrate them consecutively in the displayed order.

2. Click the **needle button** to begin.

Note: Machine functions will be suspended while the needle is calibrating.

Note: A calibration position must be set up through configuration to use the calibrate needle function.

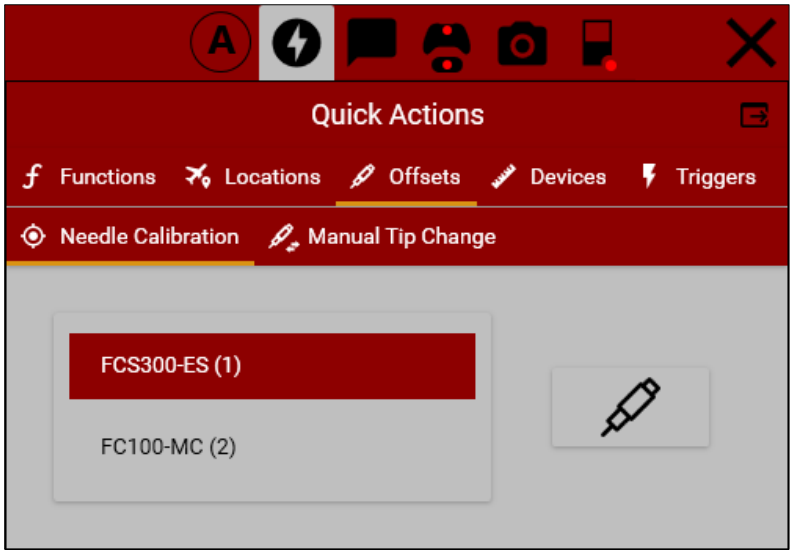

Figure 14: Needle Calibration

3.2.2.3.2 Manual Tip Change

1. Select the desired location from the available tool locations (see machine options).
2. Choose the appropriate tool from the tool dropdown.
3. Select the **Move** button .

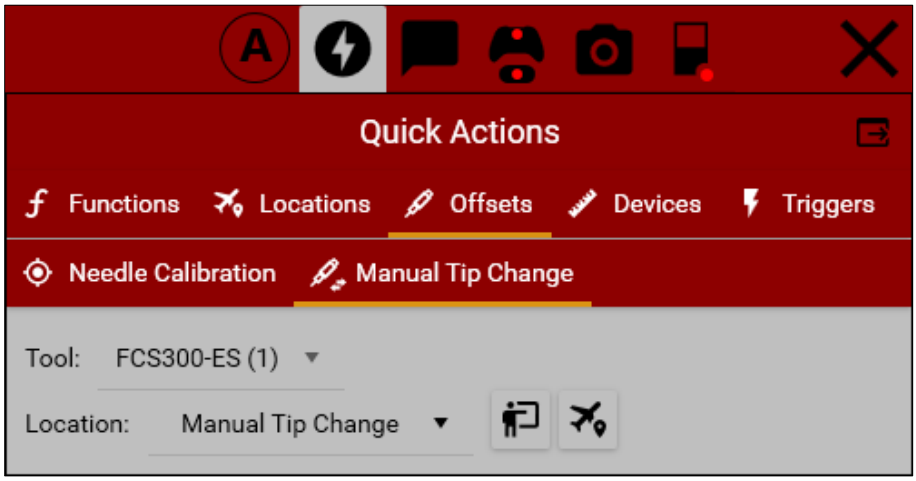

Figure 15: Manual Tip Change

3.2.2.4 Devices

The Calibrated Devices tab will allow the user to view and perform calibrations on certain devices and tools.

3.2.2.4.1 Servo Adjust

To set the current staging device position, select the appropriate staging device from the dropdown and manually select **Decrease** or **Increase** to modify the device position. Once selected, it will jog the staging device at the set default speed for the duration of the click.

The device width can also be moved incrementally by setting the **Move By** value and clicking the **+** or **–** button or set to a specific value by setting the **Move To** value and clicking the **Go** button. The staging device can be manually adjusted by clicking on the **Begin Manual Adjustment** button.

If one or more Products have a configured width for auto-width adjustment, clicking on the **Set Width from Product** button will list all Products with a configured width. Clicking on one of these Products will populate the **Move To** field with its width value.

The current width of the selected staging device is displayed between the **Decrease** and **Increase** buttons.

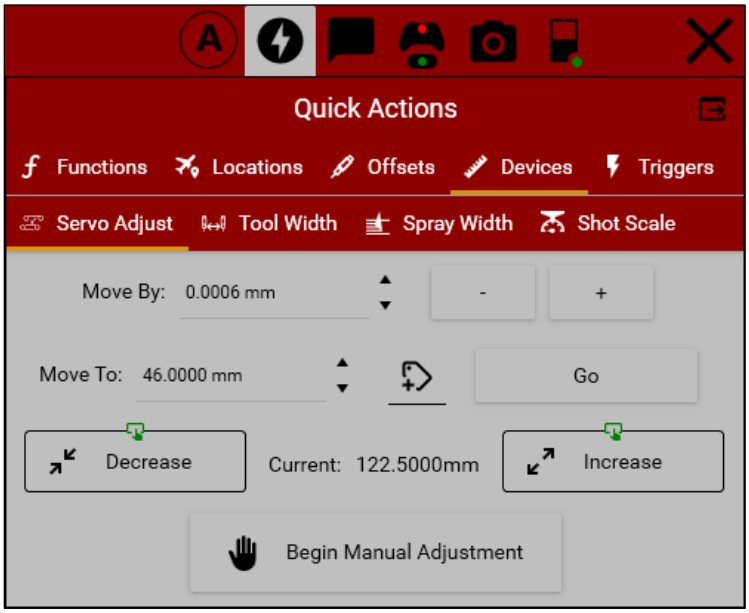

Figure 16: Servo Adjust

3.2.2.4.2 Tool Width

To set the width of an adjustable Tool, select the appropriate Tool from the dropdown and manually select **Decrease** or **Increase** to modify the device position. Once selected, it will jog the staging device at the set default speed for the duration of the click. The Tool width can also be moved incrementally by setting the **Move By** value and clicking the **+** or **–** button or set to a specific value by setting the **Move To** value and clicking the **Go** button.

If one or more Products have a configured width for auto-width adjustment, clicking on the **Set Width from Product** button will list all Products with a configured width. Clicking on one of these Products will populate the **Move To** field with its width value.

The current width of the selected Tool is displayed between the **Decrease** and **Increase** buttons.

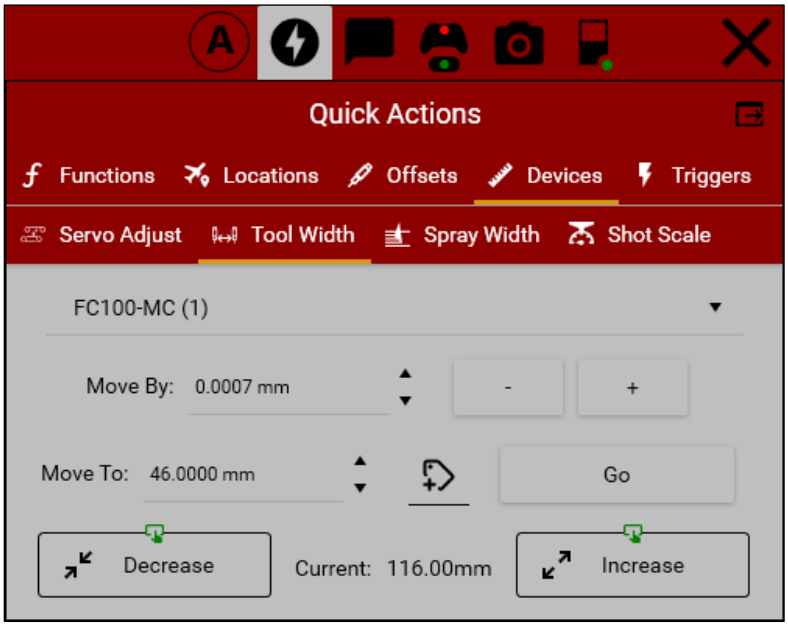

Figure 17: Tool Width

3.2.2.4.3 Spray Width

To perform a spray width check, select the spray tool and formula. Select the **Run Spray Width Test** button to begin. The machine will automatically move to the location and begin the spray test.

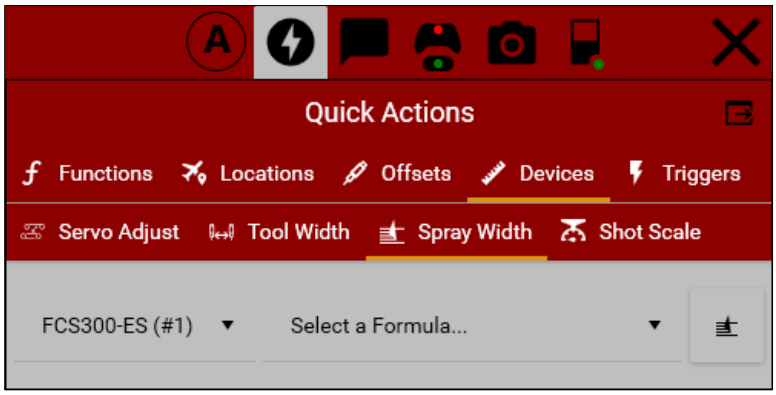

Figure 18: Spray Width

3.2.2.4.4 Shot Scale

If a Shot Scale is installed and has been set up and configured, manual shot weight checks can be performed from this menu.

1. Select a Tool from the dropdown menu.
2. Change **Target Weight**, **Dispense Time**, and **Tolerance** as necessary.

Note: These values are linked to the values in the Shot Scale Calibration page.

3. Click on the **Run Shot Weight Check** button to run the shot weight check.

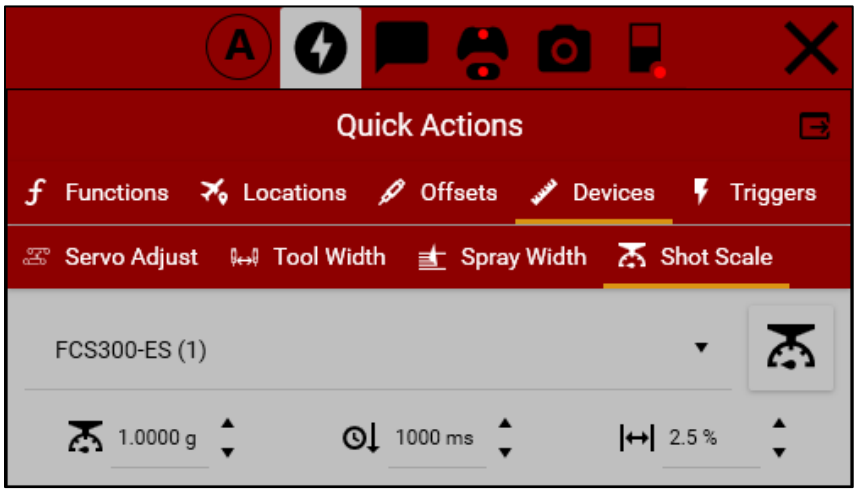

Figure 19: Shot Scale

3.2.2.5 Triggers

Triggers with a Manual source type will appear here. Clicking on a trigger will execute the associated trigger.

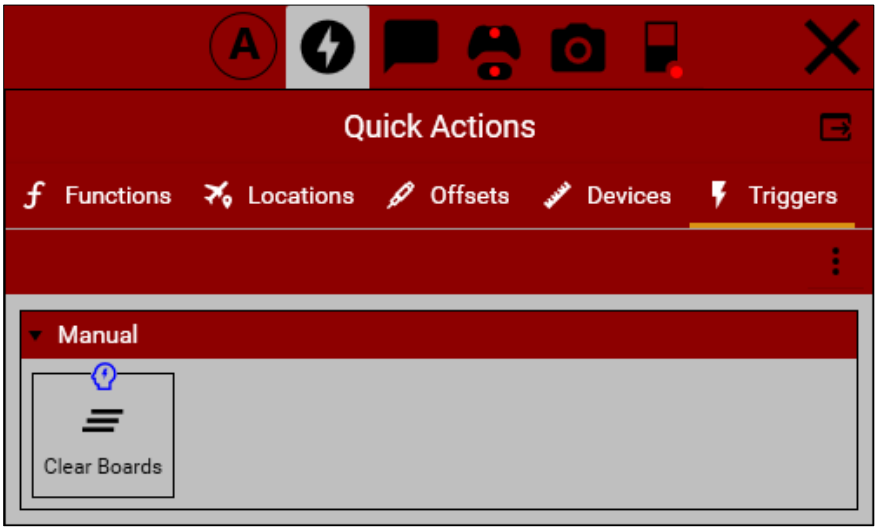

Figure 20: Quick Access Triggers

3.2.3 Notifications

Notifications sent by the application will appear here. If there is a dot by the notification bell, there are currently unread notifications. Notifications can be dismissed, navigated to the sender, or viewed in the log.

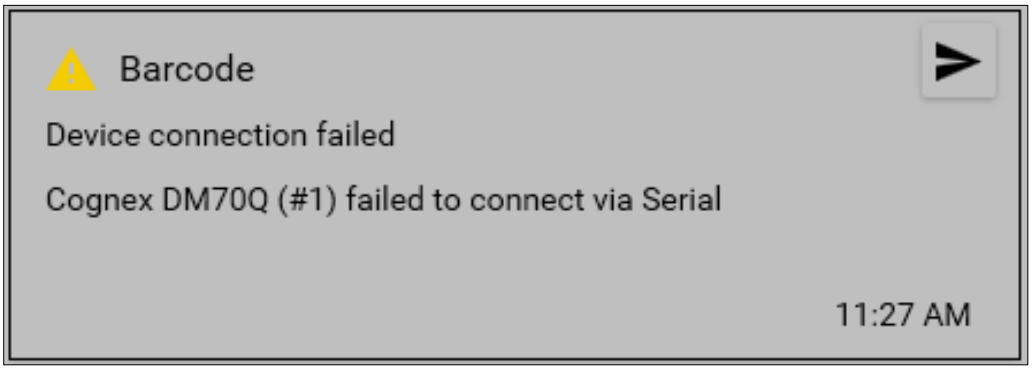

Figure 21: Notifications

3.2.4 Virtual Pendant

The pendant tab allows the user to control the virtual pendant and view the button assignment of pendant profiles from any tab. If the upper controller indicator is green, this means the virtual pendant is available for use. If the lower controller indicator is green, the machine may use device pendant functions. The **Settings** button allows further options such as changing the view to a minimized virtual pendant, viewing current button assignment, and navigating to the pendant page. The pendant feature can also pop out into its own window.

Figure 22: Virtual Pendant

3.2.5 Camera

The camera tab allows the operator to see a live view of the camera. The camera can pop out into its own window. The overlay on the camera may be changed with any available overlays that have been created for that camera device. Camera capture settings can be temporarily modified while in this window. This will not change the default capture settings. Multiple overlays can be selected from the overlay dropdown.

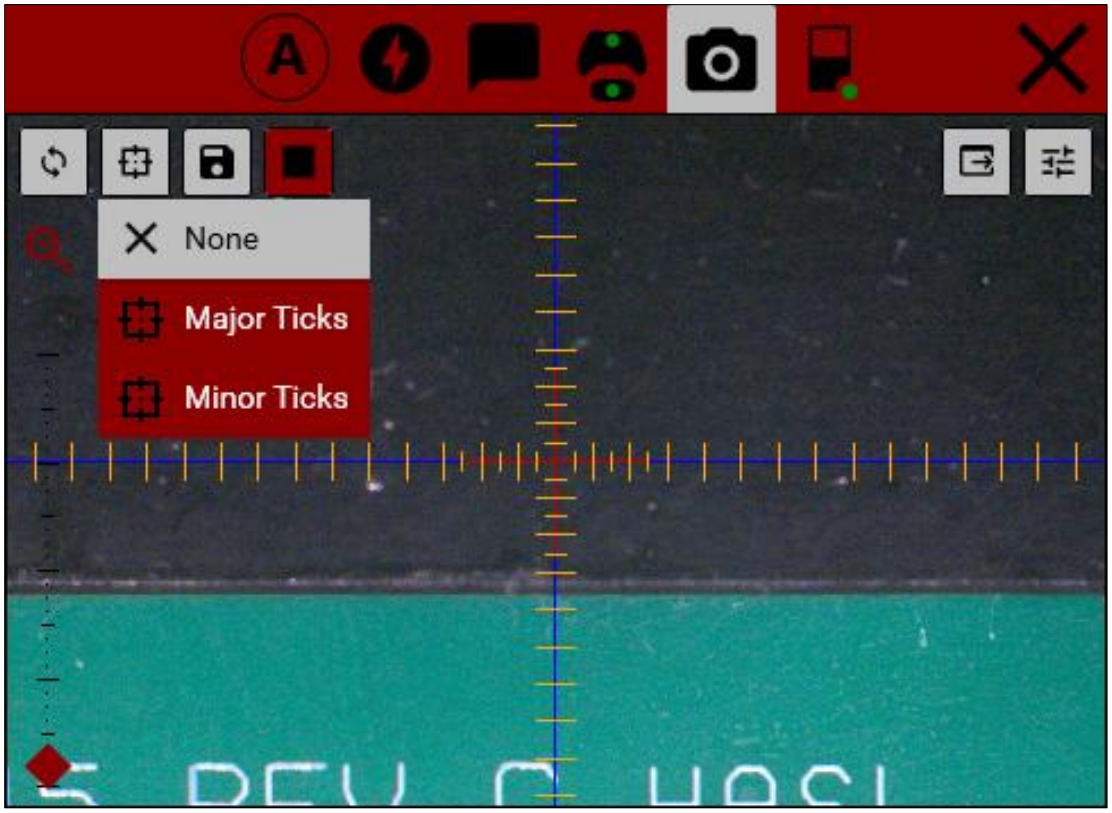

Figure 23: Camera

3.2.6 Machine Status

The machine status tab indicates machine connectivity status. If the indicator is green, the machine is connected and there are no issues.

The dropdown allows the user to toggle between online and offline mode. When in offline mode, no devices will be connected, Production and playback will be disabled, and Triggers will not activate. If the application started in offline mode and is then switched to online mode, startup triggers such as exhaust flow check, safety check, etc., will be executed.

The status of Robot Homed, Safety Check, and Exhaust Flow can also be viewed from this menu.

- If the indicator is green, the associated check has been successfully executed and passed since the last time PathMaster X was started.
- If the indicator is red, the associated check has not been successfully ran, or not ran at all, since the last time PathMaster X was started.

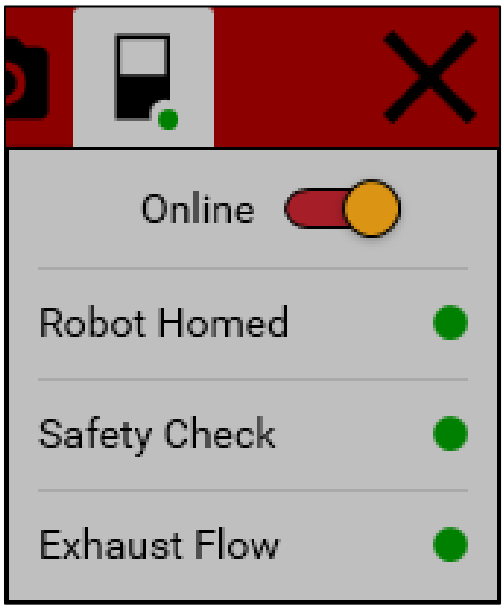

Figure 24: Machine Online

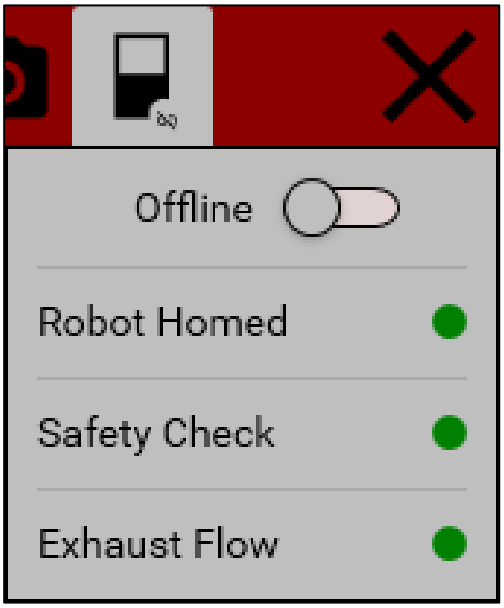

Figure 25: Machine Offline

4. Production Mode

4.1 Process

Process mode allows continuous running of an existing Process. Select the desired Process and Product to be run, set the number of cycles to be run, and press the **Start** button to begin. Cycles can be a set number or run indefinitely.

The currently selected Process and Program(s) within the Process will be displayed in the **Process Detail** section. The Process lanes will change to match the currently selected or running Process.

When a Process has started, **Production Batches** will populate with production data.

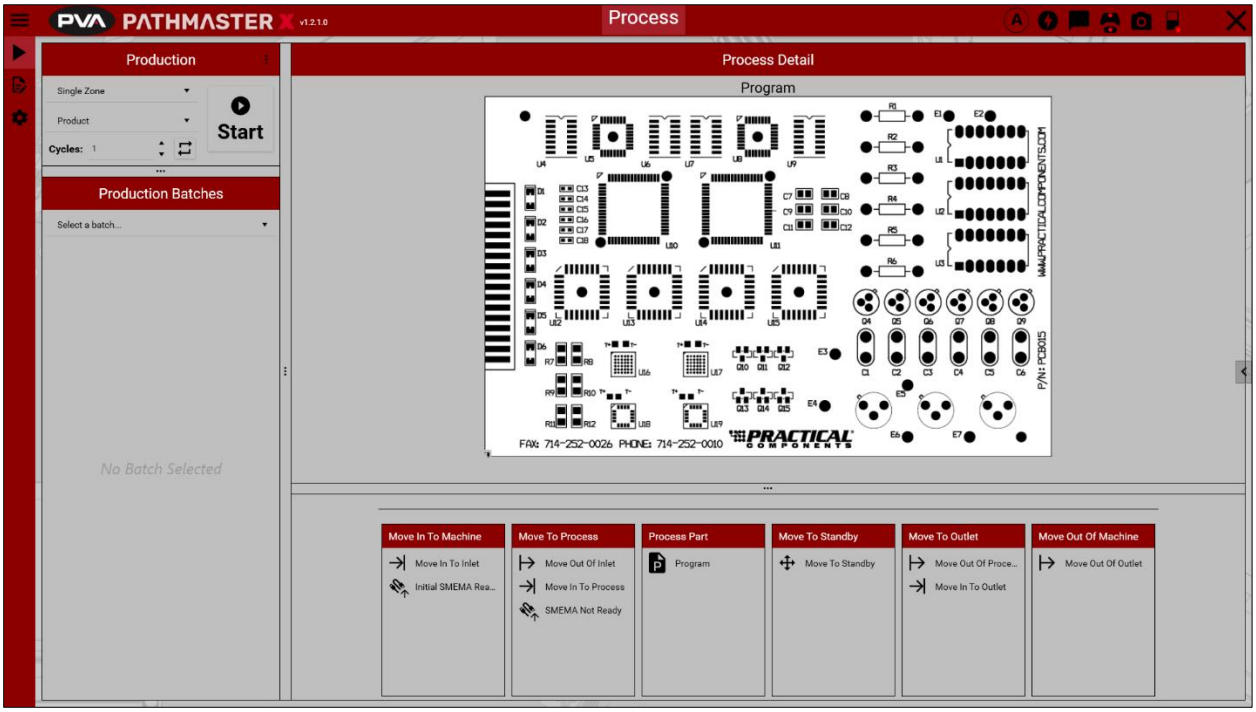

Figure 26: Process Detail

The production batches will indicate which user started running the Process, how long the Process has been running, and how long individual parts in the batch have taken.

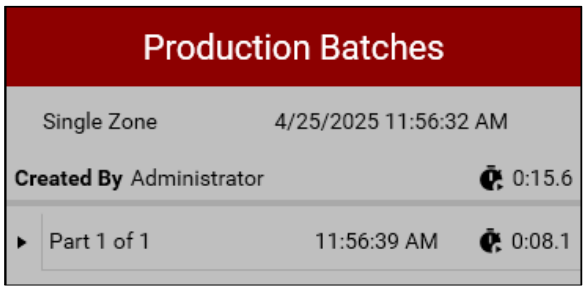

Figure 27: Production Batches

The lane icon  indicates the current lane that the Process is executing. This allows the operator to view what part of the cycle the machine is in at any time.

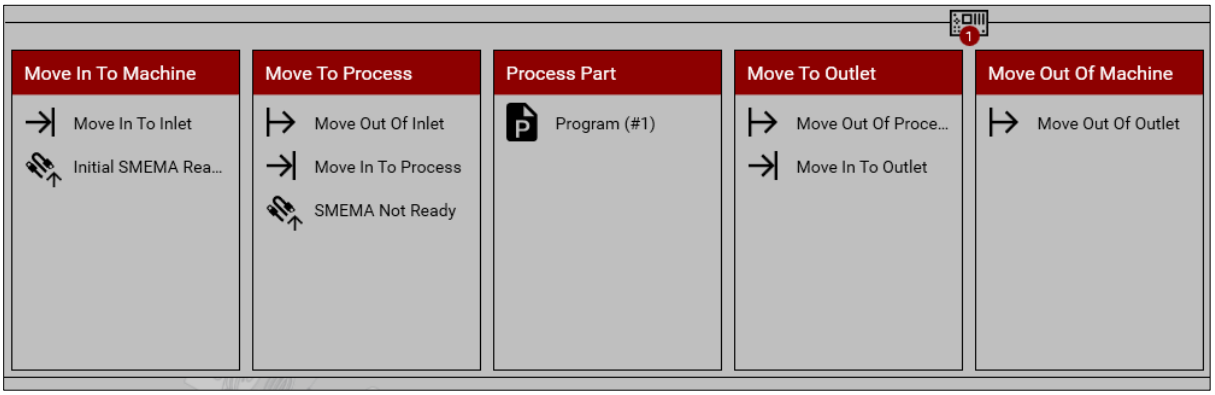

Figure 28: Lane Icon

4.1.1 Dashboard

The Dashboard consists of small tiles that display relevant data to the user. It can be opened or closed with ease from anywhere in the application through the small arrow on the right-hand side of the application.

When selected, the Dashboard will expand outward. Select the **Plus** button  at the top to add a page.

Within each page is a collection of tiles. Tiles display a specified set of data. Click the Plus button on a page to add a new tile.

Clicking the Pin button  will permanently keep the Dashboard on the right side of the screen. Unpinning will bring the Dashboard to its original location.

The **Delete** button will delete the current page, while the **Lock/Unlock** button will lock the dashboard to the current page, preventing the top arrows from being used for navigation. Being in a locked state will also prevent the addition, deletion, and editing of tiles. The **Pop-Out** button will pop out the page to a separate window.

When a tile is added, go to the settings to configure the tile. The pin icon will pin the tile in place so it cannot be moved.

To access the configuration options of a tile, click the **Settings** button at the top-right of the tile.

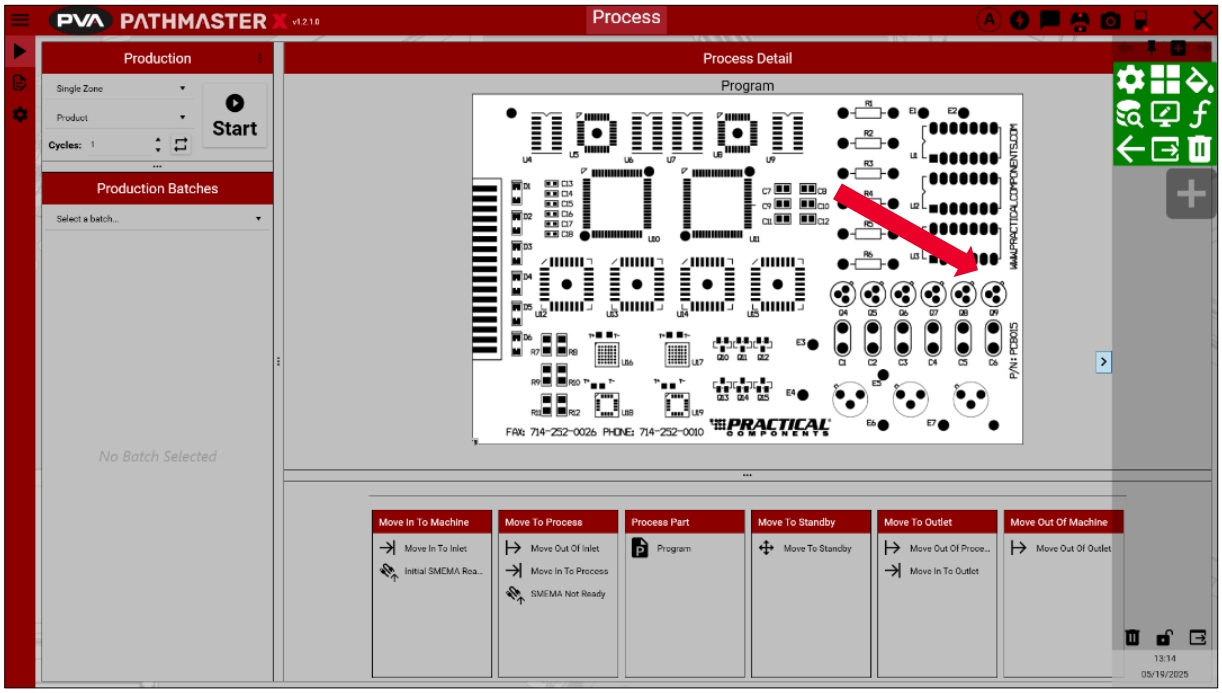

Figure 29: Dashboard Arrow

4.1.1.1 Settings

The **Settings** button allows the user to edit the title of the tile as well as the poll rate of the data, set the number of digits to display, and whether or not to invert the value.

4.1.1.2 Tile Format

The **Tile Format** button allows the user to change the size and shape of the tile to stack tiles together on a page as desired.

4.1.1.3 Color

The **Color** button allows the user to change the background color of the tile.

4.1.1.4 Data Source

The **Data Source** button allows the user to select a data source for the tile. Navigation is sorted by devices, then narrows down to parameters of the device.

4.1.1.5 Data Format

The **Data Format** button allows the user to change how data is displayed on the tile. For example, an analog signal can be displayed as a radial gauge, linear gauge, two-axis graph, or plain text.

4.1.1.6 Conditionals

The **Conditionals** button allows the user to add conditionals to modify the tile. For example, if a signal is True, False, or out of a specific range, the tile can change colors to indicate what state it is in.

4.1.1.7 Back

The **Back** button navigates back to the main tile view.

4.1.1.8 Pop Out

The **Pop Out** button pops the tile out for free movement.

4.1.1.9 Delete

The **Delete** button deletes current tile.

5. Creation Mode

5.1 Program

The Program Editor allows the user to set up individual program paths for the machine to execute as part of a Process.

Programs are created using sequential steps by taking functions from the Toolbox and adding them to the program. Once a step is placed in the Program, step details can be edited for accuracy.

Programs can be added by selecting the **Plus** icon  under the Program Edit section. The current program can be selected through the dropdown menu.

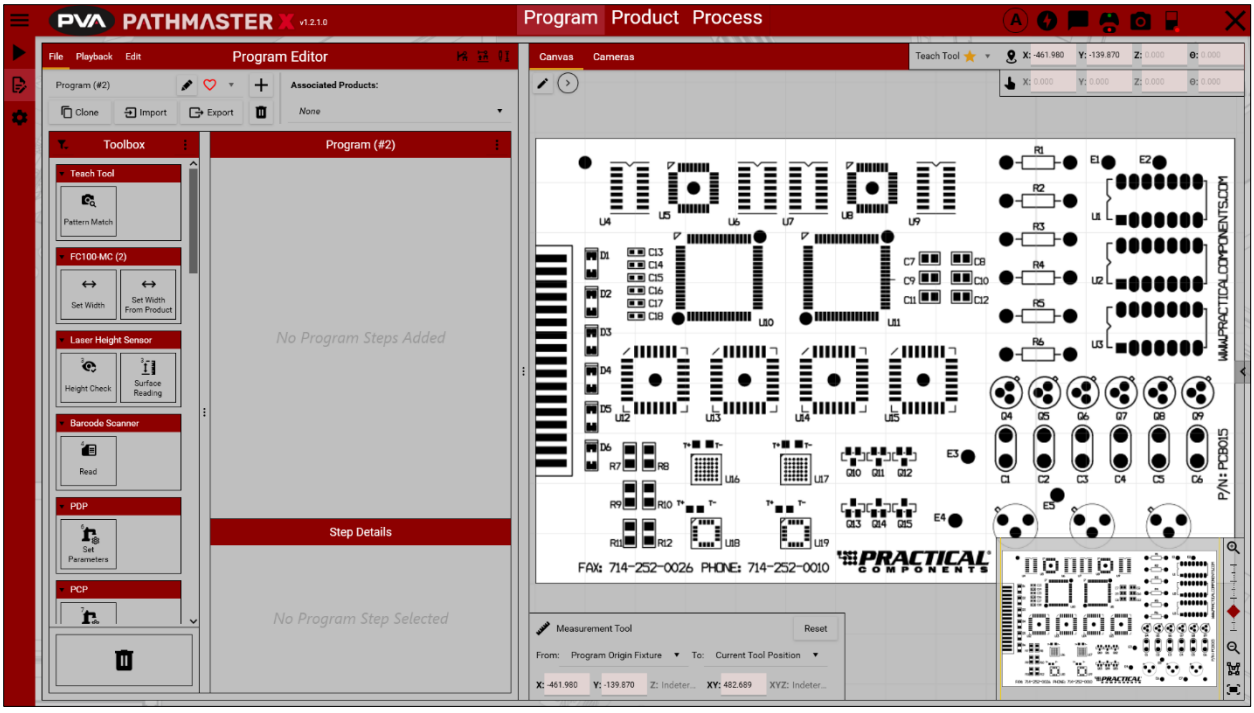

Figure 30: Program

5.1.1 Program Editor Sections

5.1.1.1 Program Editor Header

The Program Editor header features a tabbed menu that contains various options and features. The header also contains a number of buttons for additional functionality.

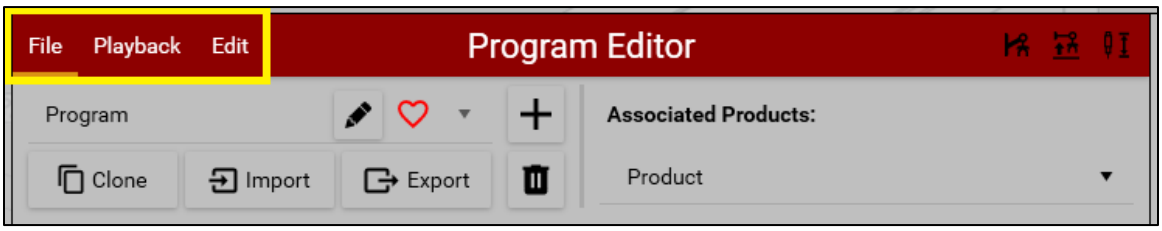

Figure 31: Program Editor Header Tabbed Menu

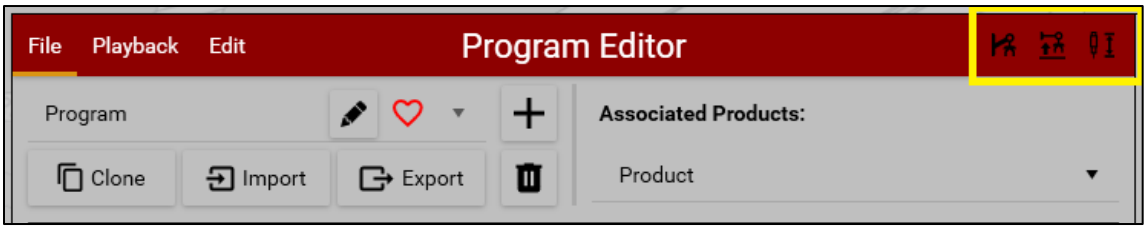

Figure 32: Program Editor Header Buttons

5.1.1.2 File Header Tab

The file tab contains content for editing a Program as a file. The following operations can be performed from the file tab:

1. Add a new Program by clicking the **Add New Program** button .
2. Rename the current Program with the **Edit Name** button .
3. Set the current Program as a favorite with the **Set as Favorite** button .
4. Clone (copy) the current Program with the **Clone** button.
5. Import a Program with the **Import** button.
6. Export the current Program with the **Export** button.
7. Delete the current Program with the **Delete** button .
8. Associate the Program with a Product with the **Associated Products** dropdown menu.

Several functions are available from the Program selection dropdown menu:

- **Program Deletion:** Delete program without loading it into the editor
- **Select Multiple Programs**: Allows user to delete more than one program at a time

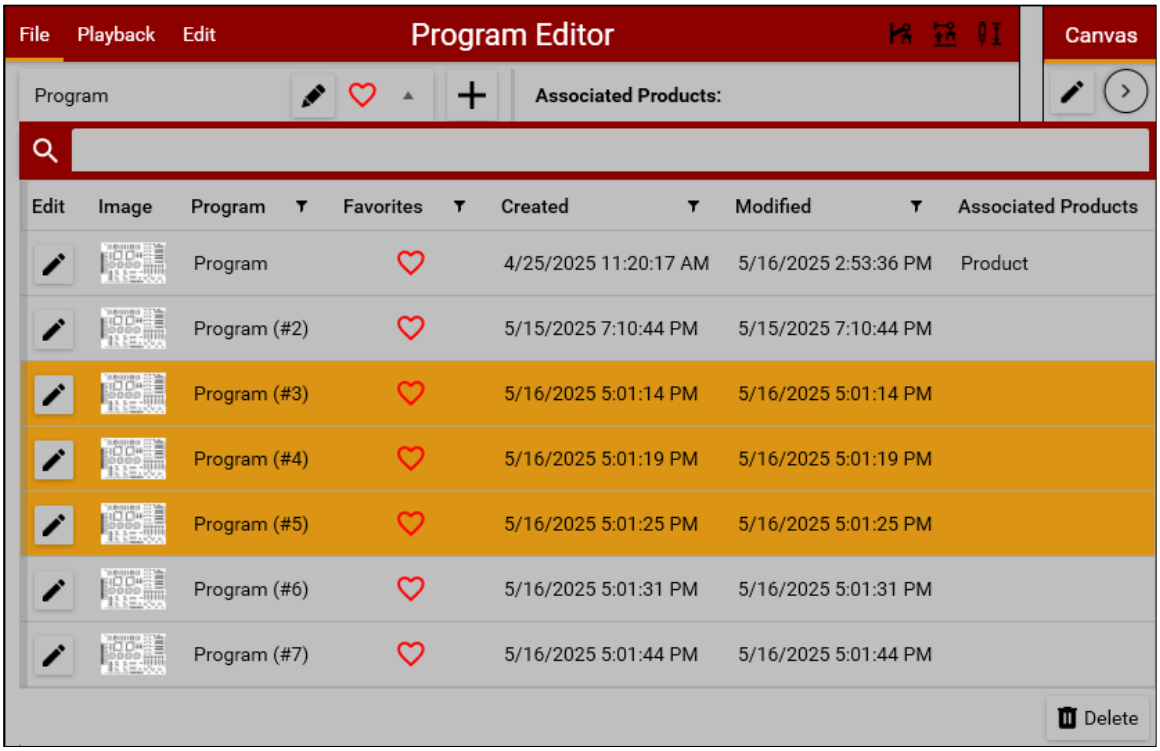

Figure 33: Program Multi-Selection

- **Search**: Search for program by name

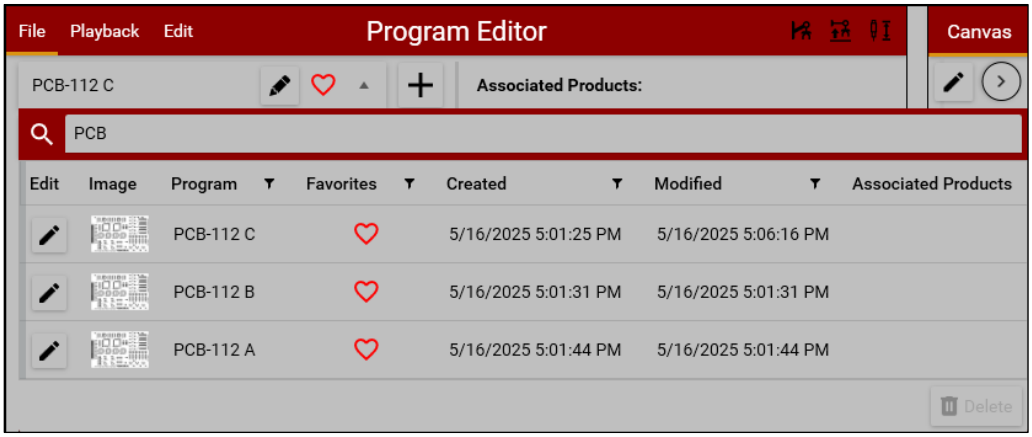

Figure 34: Program Search by Name

- **Sort Programs**: Can be sorted by Name, Favorite, Created, and Modified

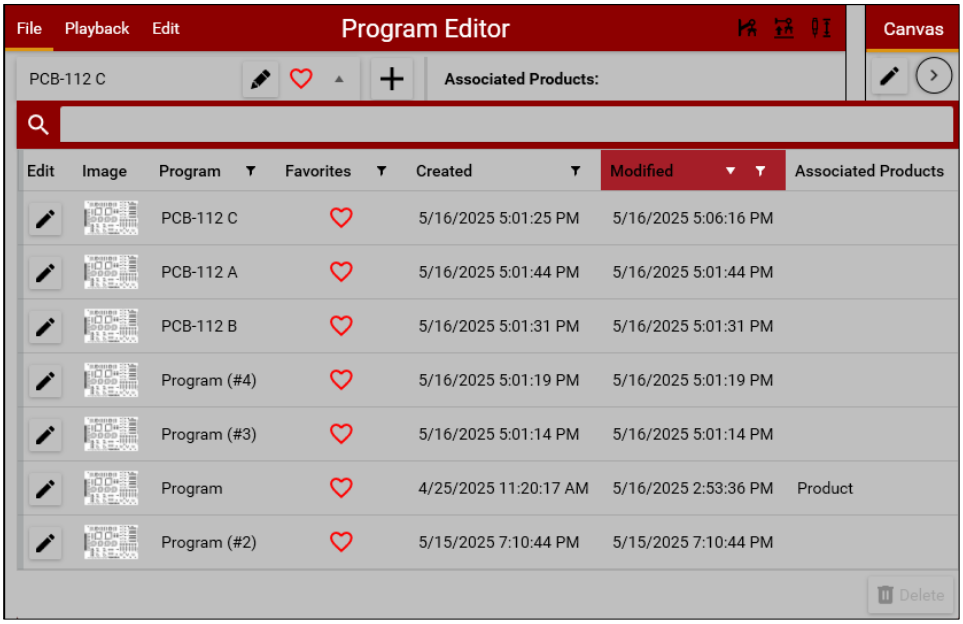

Figure 35: Program Sort by Modified

- **View**: Associated products, program image, or dispense path by hovering over program image

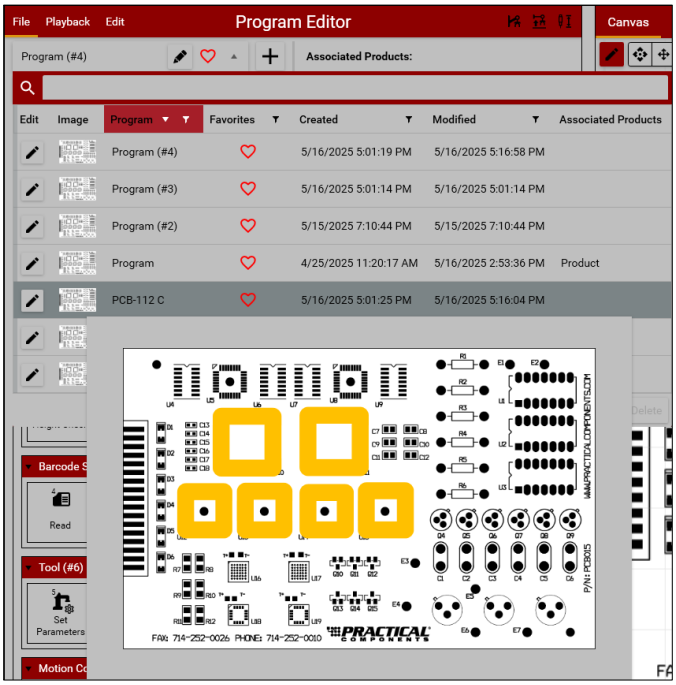

Figure 36: Program Dispense Path Preview

5.1.1.3 Playback Header Tab

The Playback tab contains all the controls for manual playback of the Program as well as information related to playback. The main playback controls are located on the left side of the tab content.

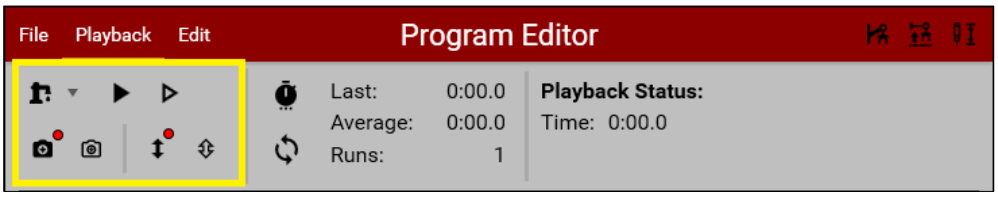

Figure 37: Playback Controls

There are five modes of playback:

1. **Wet**: Dispense Tools will be turned on during playback.
2. **Dry**: Dispense Tools will not be turned on during playback.
3. **Teach Tool**: All paths will be played with the Teach Tool.
4. **Virtual**: Paths will be played back on the canvas in real-time. There is no gantry movement.
5. **Estimation**: The time needed to run the path will be calculated. There is no playback in the canvas, and no gantry movement.

The entire Program or a selection of the Program can be played back. Click the **Play Program** button  to begin playback of the entire Program. Click **Play Selected** button  to begin playback of the selected section of the Program. Use the **Evaluate Conditionals** toggle button  to choose between evaluating conditional step conditions, or to use their currently selected value during playback.

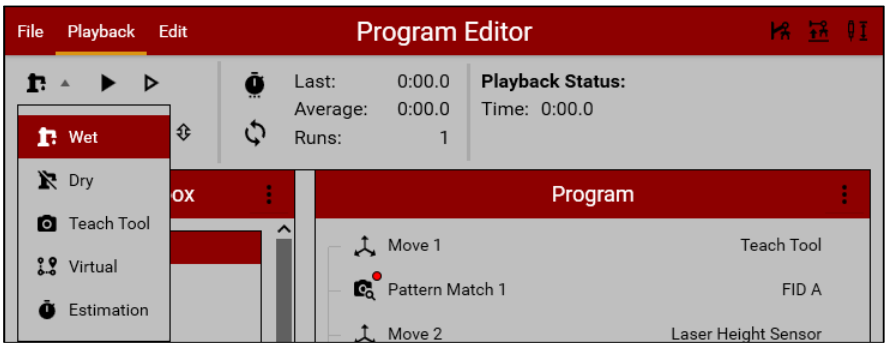

Figure 38: Program Playback Options

The playback time statistics are located in the middle section of the tab content. The content will show the playback time statistics for the current selected playback mode only.

To compare across multiple modes, click on the **Show Runtime Data** button . Click on the **Reset** button to clear all runtime statistics.

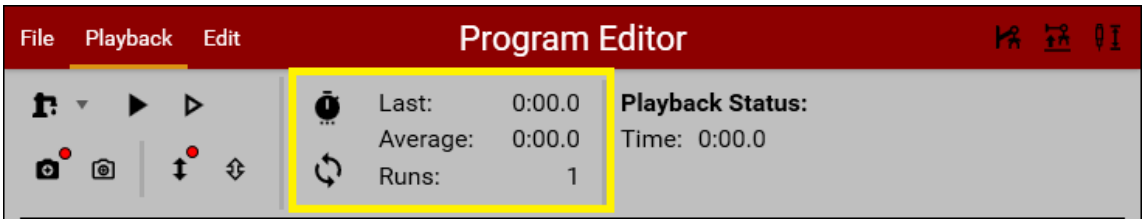

Figure 39: Playback Time Statistics

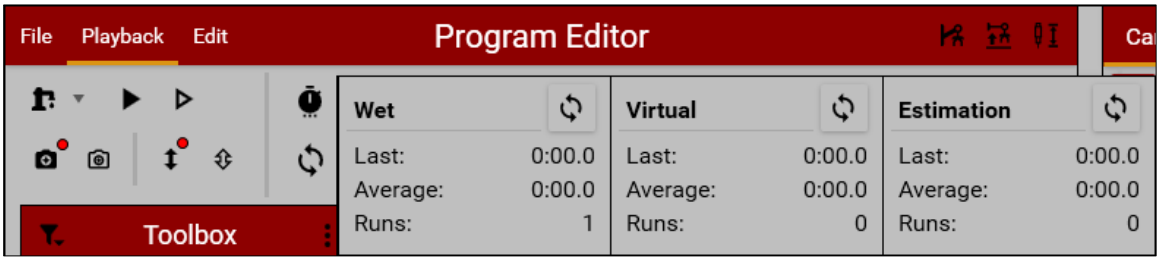

Figure 40: Statistics of Playback Modes

Fiducials and surface heights can also be executed from this tab. Click the **Run Fiducials** button to run all fiducial check steps in the current Program. Click **Run Surface Heights** button to run all surface height steps in the current Program.

Fiducial and surface height buttons will have an indicator showing the status of the respective check: **Green** (All Run), **Gold** (Some Run), **Red** (None Run)

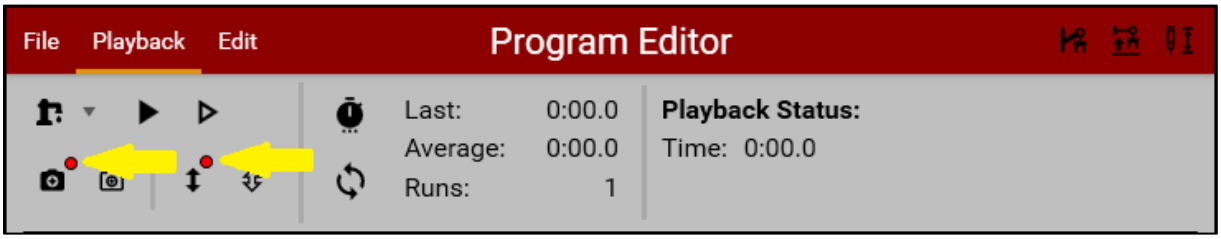

Figure 41: Fiducial and Surface Height Status

Fiducial and surface height information can be cleared by pressing the respective buttons. Click the **Clear Fiducials** button to clear all fiducials. Click the **Clear Surface Heights** button to clear all surface heights.

5.1.1.4 Edit Header Tab

The Edit tab contains all the options for editing the content of the selected program. This includes buttons for undo/redo, as well as all options that exist in the context menu of the step editor.

Figure 42: Edit Tab

The step edit options will enable/disable based on the selected steps in the program step editor.

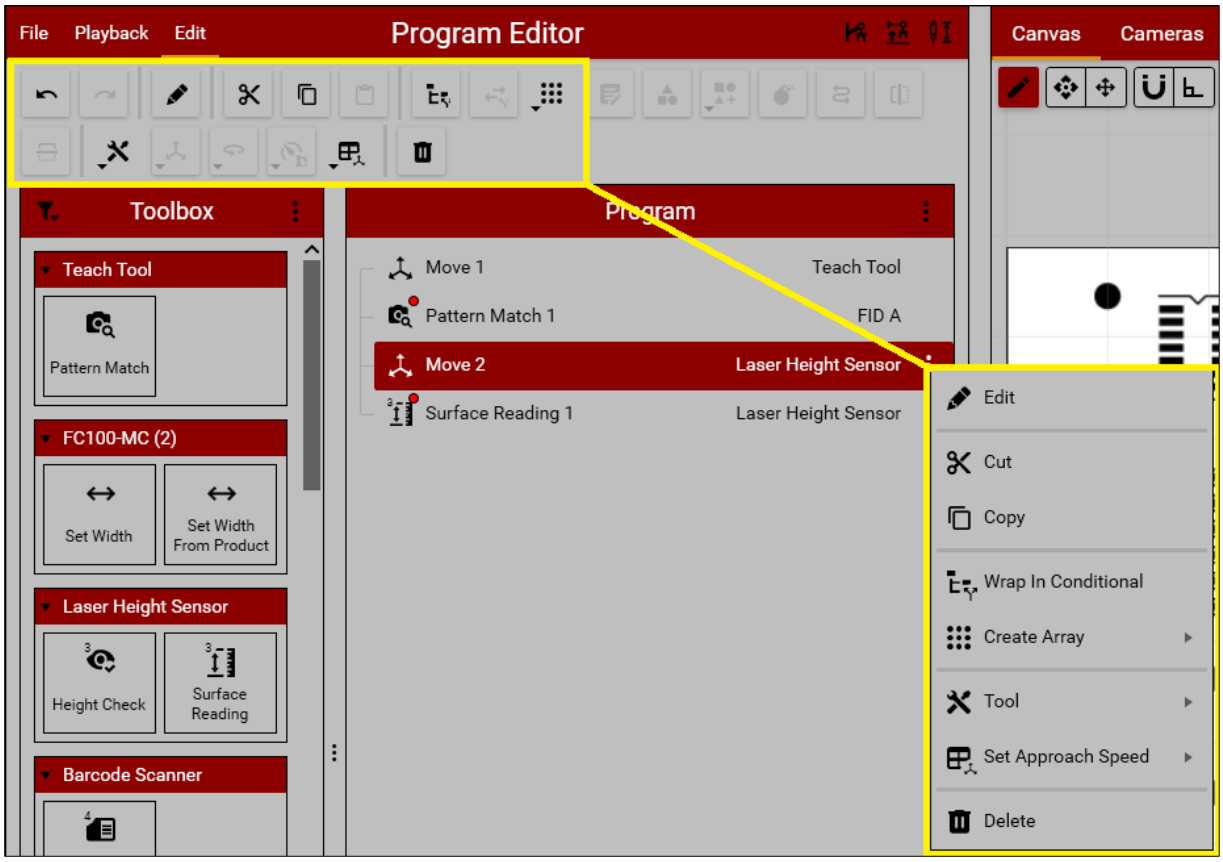

Figure 43: Program Step Edit Options

5.1.1.4.1 Step Edit Options

Undo	Undo an action
Redo	Redo an action
Edit	Change the name of the step
Cut	Copy and delete selection
Copy	Copy selection
Paste	Insert previously cut or copied selection
Wrap in Conditional	Insert selected steps into a conditional step
Swap True/False	Switch steps in the True and False conditions in a conditional step
Create Array	Create an array from the selected dispense path
Edit SubProgram	Edit the selected subprogram
Create Shape	Create a shape from the selected dispense path
Save Shape	Save the selected custom shape to the toolbox
Explode	Convert a shape to its constituent path steps
Reverse	Reverse the motion direction
Mirror Horizontal	Mirror the selected path horizontally
Mirror Vertical	Mirror the selected path vertically
Tool	Edit tool options
Offset	Move a selection by a specified coordinate amount
Rotate	Rotate a selection by a specified angle
Set Dispense Speed	Set the dispense speed of the selected steps
Set Approach Speed	Set the approach speed of the selected steps
Delete	Delete the selected steps

5.1.1.5 Program Editor Header Buttons

Click on the **Program Options** button to open the Program settings. From here, Program settings such as the Program **Origin** and **Image** can be set.

Click on the **Move to Safe Z** button to move the gantry to the configured safe Z height.

Click on the **Move to Substrate Height** button to move the currently selected Tool to the configured substrate height.

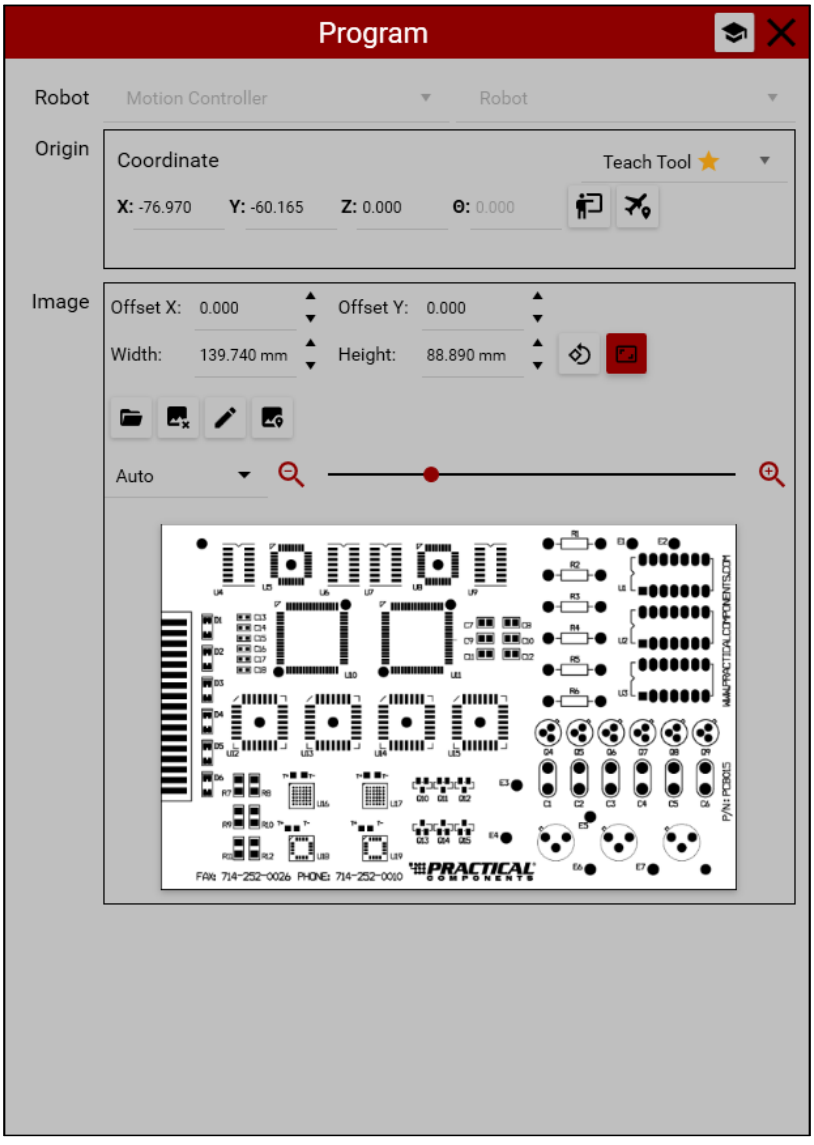

Figure 44: Program Options

5.1.1.6 Toolbox

Program steps are found here, separated by their type. The motion controller functions are necessary for gantry movement to points that require dispense, while tool functions have their own category.

Program steps can be set as a favorite by clicking the **Set as Favorite** button in the individual step. Favorited steps can be displayed by selecting the **Favorites** category when filtering steps.

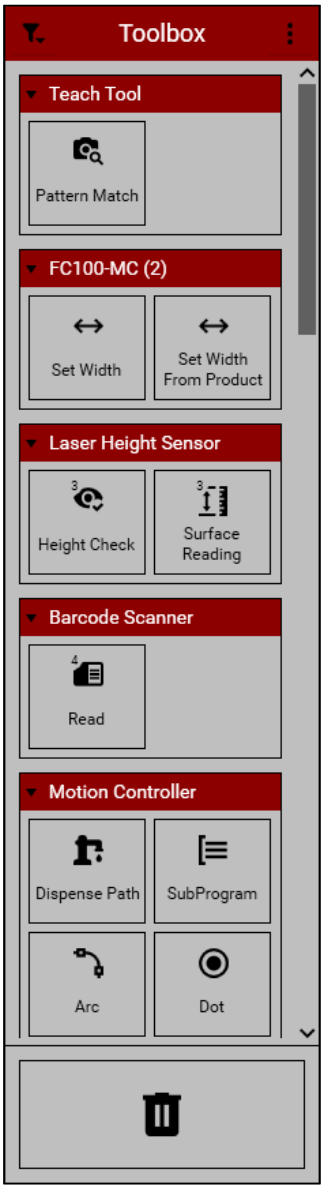

Figure 45: Program Toolbox

5.1.1.7 Program Steps

Program steps are listed out in sequential order of execution. Steps can be reordered by clicking and holding, then dragging them to the proper place in sequence before releasing.

An indicator bar will appear to display what two steps the current step will go between when released.

Program steps can be edited by double clicking on the step, right-clicking and selecting edit, or clicking on the three dots to the right of the step and selecting edit.

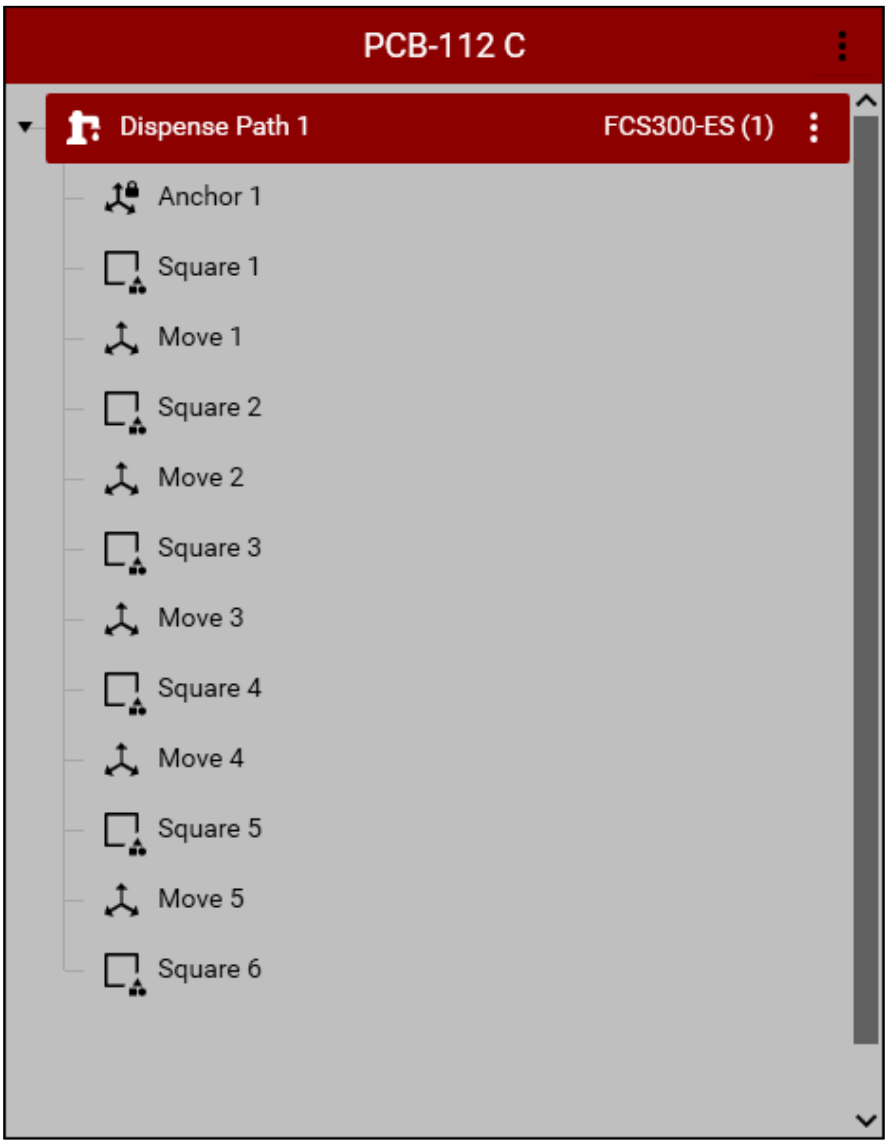

Figure 46: Program Steps

5.1.1.8 Program Settings

Selecting the kebab menu  will bring up more options, such as disabling reorder of program steps and expanding or collapsing sub steps.

Figure 47: Additional Program Options

5.1.1.9 Step Details

Details of steps such as move positions, area settings, etc. are visible through the Step Details pane. To edit any step settings, they must be accessed through the step editor. Program steps can be edited by double clicking on the step, right-clicking and selecting edit, or clicking on the three dots and selecting edit.

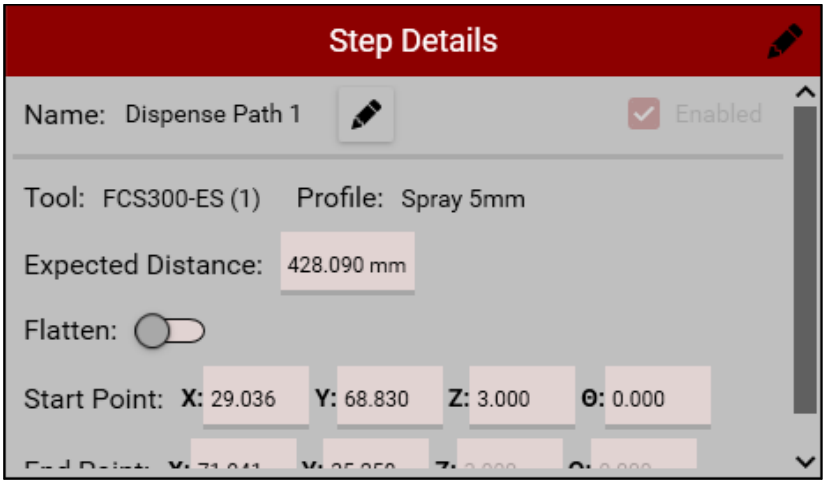

Figure 48: Step Details

5.1.1.10 Program Origin

The program origin is the starting point for the program. The program origin setting can be found in the Program Edit menu by clicking on the **Program Options** button in the Program header.

All path program points are relative to the program origin. A variable origin lets the program be executed anywhere in gantry space starting from the defined origin. To properly define a program origin, the Z location must first be taught at substrate height using a physical tool that can reference the substrate such as a valve.

The teach tool cannot be used because it cannot reference the substrate. After this, the teach tool can be used to find a more precise X and Y coordinate, as Z coordinate is disabled when teaching program origin with a teach tool.

Warning: It is critical to teach the Z coordinates at the substrate first! If the XY coordinate is taught before the Z, the XY coordinates will be overwritten. Always teach Z before XY.

5.1.2 Canvas

The canvas is part of the Program page that displays the current tool profiles executed in the program. Options for viewing and editing the program are also available through the canvas.

5.1.2.1 Edit Button

Allows access to edit features on the canvas. If selected, function steps can be dragged directly on the canvas rather than needing to be placed in the program steps section.

Figure 49: Canvas Edit Options

5.1.2.2 Drag and Snap Options

Drag and snap options allow the user to customize how steps will snap to positions when editing the program positions through the canvas, as well as along which axes program steps can be dragged across the canvas to edit.

The drag options button opens a list of available drag types: **Disabled**, **Freeform**, **Horizontal**, **Vertical**, and **Perpendicular**. The button to the immediate right indicates the currently active drag mode, as well as cycles through drag options when clicked.

The snap options button opens a list of available snap options: **Disabled**, **Horizontal**, **Vertical**, **Perpendicular**, **To Point**, and **To Increment**. The button to the immediate right indicates the currently active snap mode, as well as cycles through the snap options when clicked.

5.1.2.3 Canvas Settings

Canvas settings allows the user to modify opacity, padding, and scale of icons.

- **Show Motion**
- **Image Opacity**
- **Grid Line Opacity**
- **Tool Change Opacity**
- **Robot Location Opacity**
- **Selection Padding**
- **Border Padding**
- **Thumb Size**
- **Arrow Scale**

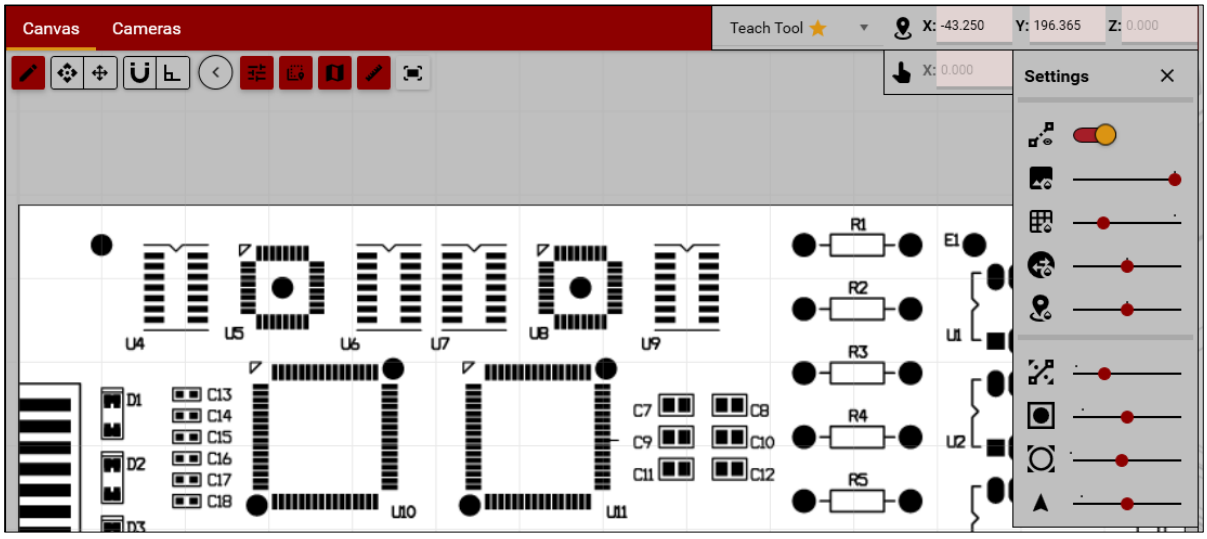

Figure 50: Canvas Settings

5.1.2.4 Image

The image of the canvas can be changed, allowing an exact image of the product to be used instead. The image file format is **.png**. For best results, images should be generated from CAD drawings or using the image stitching feature.

Note: Images captured with a handheld device such as camera and cell phones are generally not acceptable. It is very difficult to account for perspective and skew with a handheld device.

5.1.2.4.1 Upload an Image

1. Select the **Program Settings** button in the Program Editor header. Select the **Folder** button under the Image section to navigate to and select the desired image for use.

2. Images that are uploaded can be reoriented and cropped to get the correct representation.

3. The width and height of the image can be modified to match a physical part, with the units being determined by axis units set up in configuration.

4. The modified image can be saved or deleted using the buttons to the right of the folder.

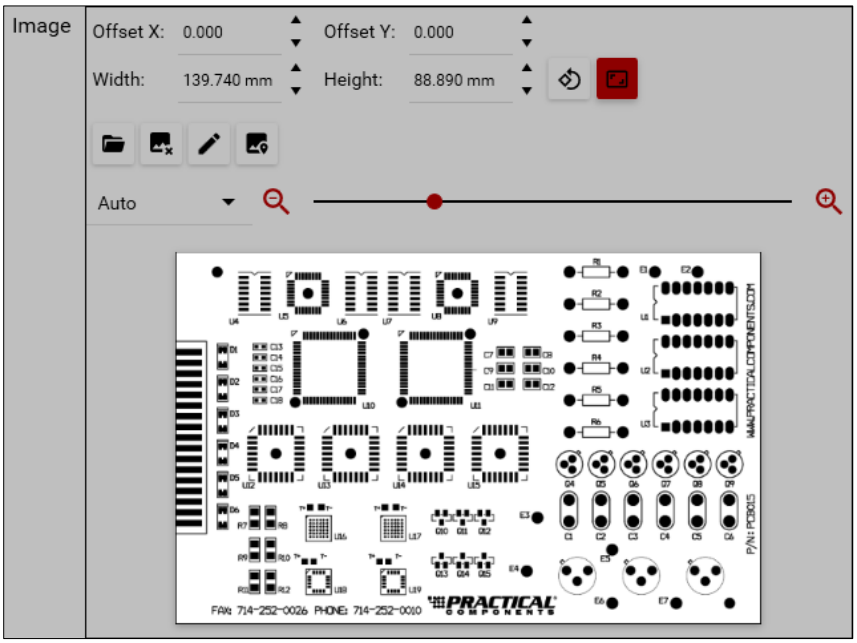

Figure 51: Edit Uploaded Image

5.1.2.5 Coordinate View

The Cursor Coordinate View shows the current position of the selected tool and the position of the cursor on-screen relative to the Program origin. The cursor position can be toggled on and off with the button.

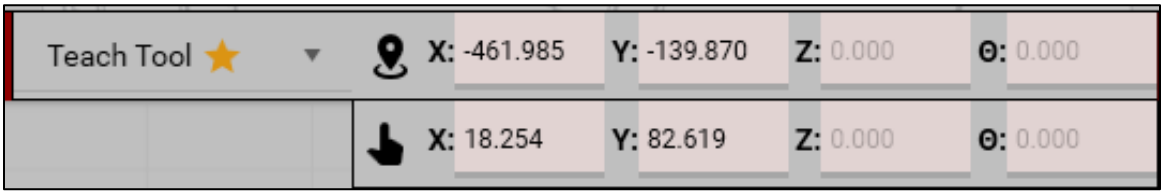

Figure 52: Coordinate View

5.1.2.6 Canvas Mini Map

The Canvas Mini Map appears in the bottom right corner of the canvas for a preview of the entire board. The Mini Map can be toggled on and off with the button.

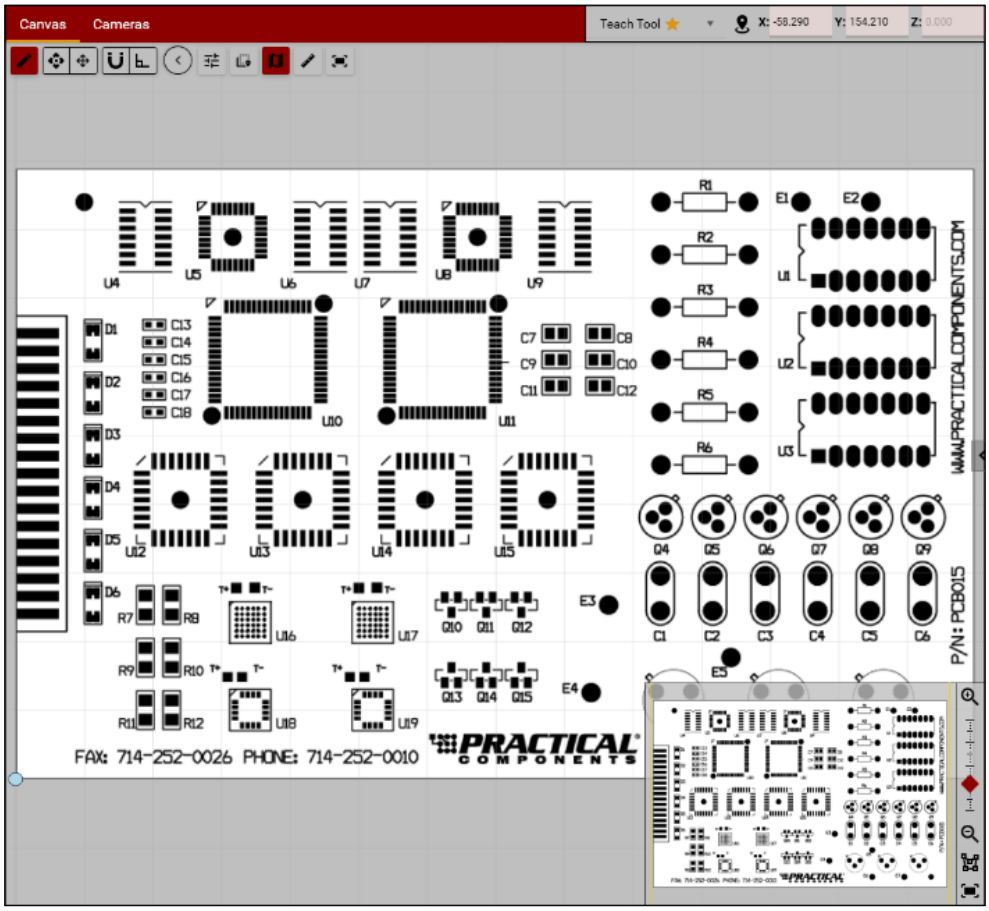

Figure 53: Canvas Mini Map

5.1.2.7 Canvas Menu

Right-clicking on the canvas gives multiple options including **Move to Cursor** and **Pin Measurement for Cursor**. The menu is context-sensitive and will change depending on the selection.

5.1.2.7.1 Pin Measurement for Cursor

This option allows the user to make a pin to measure between the pinned location and the cursor location. Pinned locations become selectable from the Measurement Tool.

5.1.2.7.2 Pin Measurement for Tool Position

This option allows the user to make a pin to measure between the pinned location and the selected Tool location. Pinned locations become selectable from the Measurement Tool.

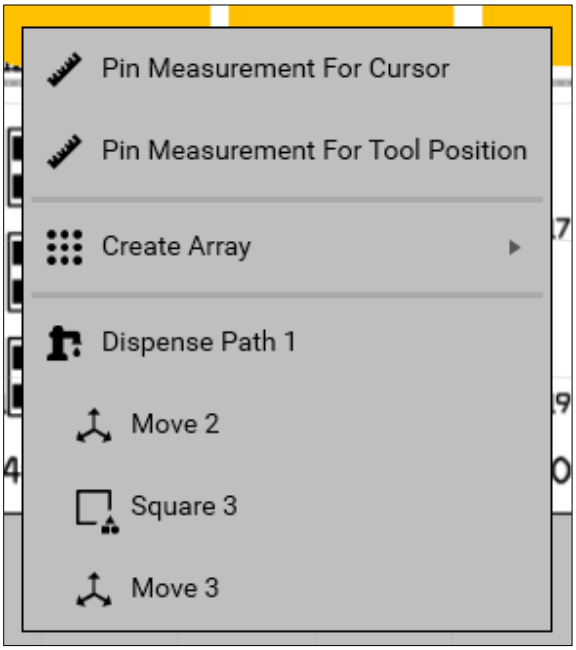

Figure 54: Canvas Right-Click Menu

5.1.2.8 Measurement Tool

The Canvas Measurement Tool allows the user to measure the distance between two selectable locations. The Measurement Tool view can be toggled on and off with the  button.

Measurements are broken down between X, Y, and Z axes so legs of triangular coordinates can be determined, while XY and XYZ determine the hypotenuse of triangles formed to the X and Y axes between the two selected locations.

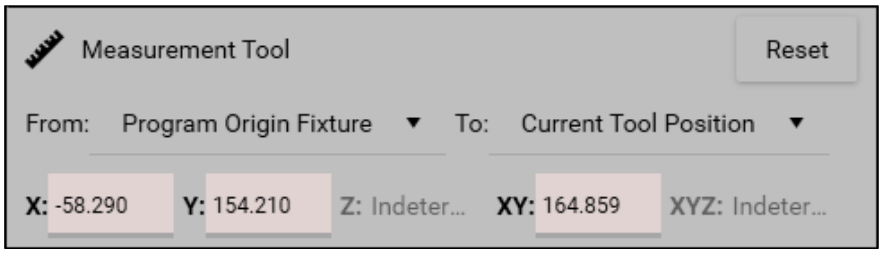

Figure 55: Measurement Tool

Measurements can also be determined between two points on the canvas.

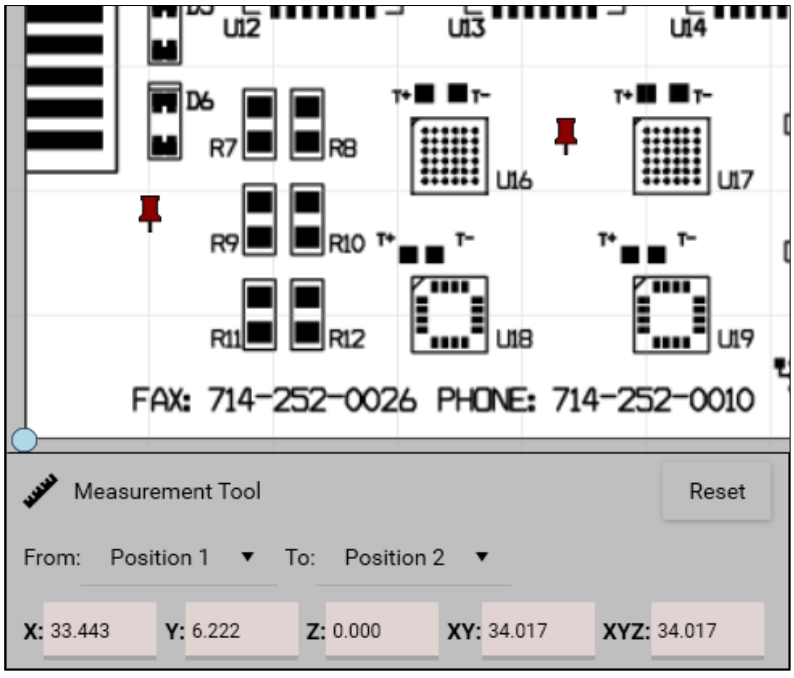

Figure 56: Measurement Between Two Points

5.1.2.9 Reset Program View

The  button will reset the Program view back to default.

5.1.2.10 Cameras (Program View)

The cameras section provides the ability to see a live location feed from the camera to confirm points in the canvas. A program overlay will not be displayed on the camera page. All overlays available to the camera are available in the upper left corner.

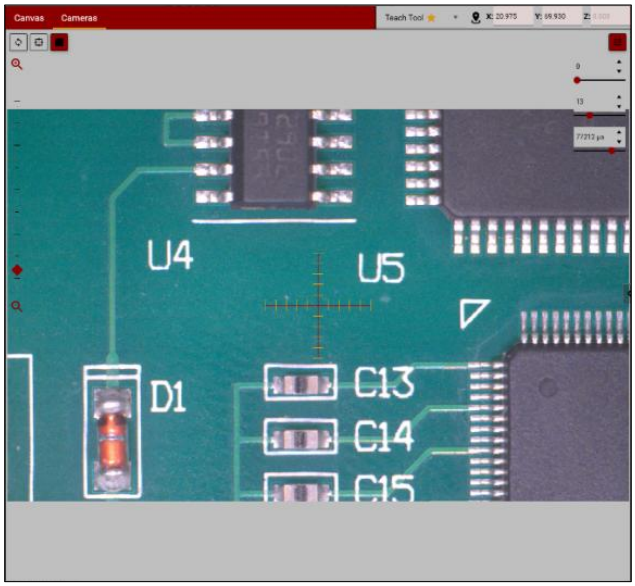

Figure 57: Cameras (Program View)

As with the program canvas, right-clicking on the live view of the camera allows the camera to move to the cursor location.

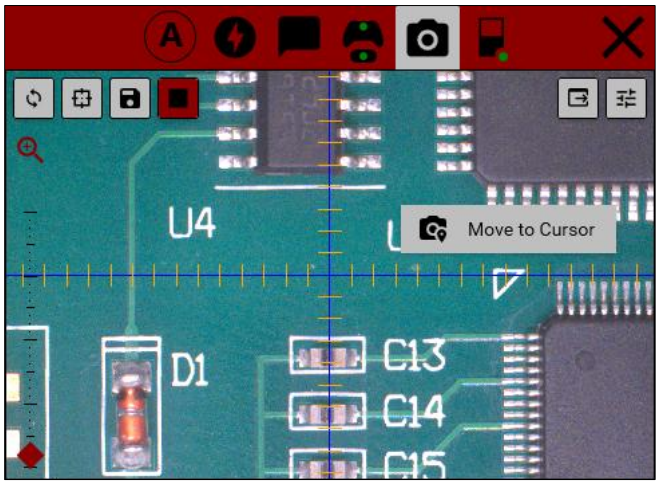

Figure 58: Cameras (Move to Cursor)

5.2 Product

The Product tab allows Programs to be assigned to specific Products. The **Settings** icon will indicate which Processes the Product belongs to.

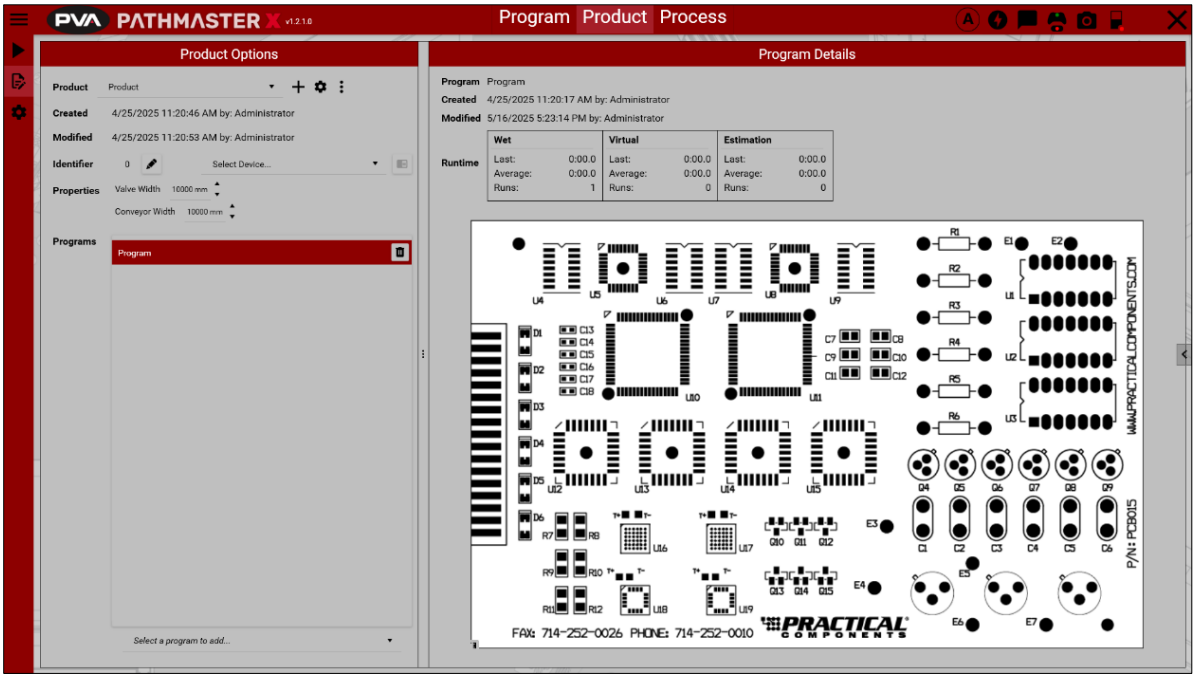

Figure 59: Product

5.2.1 Add Product

To add a Product, select the **Plus** button . Programs can be added to the Product by selecting them from the dropdown menu at the bottom of the page.

Conveyor Width is set in the Product page, if applicable. Setting a width requires a properly calibrated staging device.

A Program must be associated with a Product to make it available to the Process. Each Product can have multiple Programs associated with it.

5.2.2 Edit Product

Product names can be edited by selecting the **Settings** button and clicking the **Edit Name** button . Once the name is edited, select the checkmark to confirm the name change. The Product can be set as a favorite by clicking the **Set as Favorite** button .

Use the dropdown menu to display all Processes associated with the Product.

5.2.3 Import, Export, or Delete Products

Products can be exported, imported, or deleted using the kebab menu button  .

5.2.4 Product Details

Program details will display Program information, such as when the Program was created and last modified, as well as the last runtime of the program.

5.2.5 Adding Programs

Programs can be assigned to a Product using the dropdown menu at the bottom of the Product Options pane.

Program steps in a Process will execute Programs in the order they are listed in the **Programs** list on the Product Options pane.

Program order can be changed by simply dragging and dropping Programs to a different position.

Programs can be removed from the Product by using the **Delete** button  .

5.2.6 Automatic Process Selection

If the machine is equipped with a barcode reader, different Products can be automatically selected.

1. Set the **Identifier** value using the **Edit Name** button  to the code to associate the selected Product with.
2. Select the barcode reader device to use.
3. If a production barcode is available, use the **Read** button  to scan it. The read value will populate the **Identifier** field. Edit the value as necessary.

A Select Product step will need to be added to a Process to enable automatic Process selection.

5.2.7 Valve and Conveyor Width

If a conveyor staging device or Tool has Servo Adjust enabled, a corresponding field will be added to **Properties**. Set the value to the desired width. A Set Width from Product step will need to be added to the Product to trigger the setting of the width of the conveyor or Tool.

5.3 Process

The Process tab allows building custom Processes using the process toolbox. A Process consists of one or more lanes. Process lanes execute sequentially. Steps in a lane are carried out concurrently (parallel to each other).

Just like Program steps, Process steps can be set as a favorite by clicking **Set as Favorite** button on the step. Favorited steps will appear when filtering steps by the **Favorites** category.

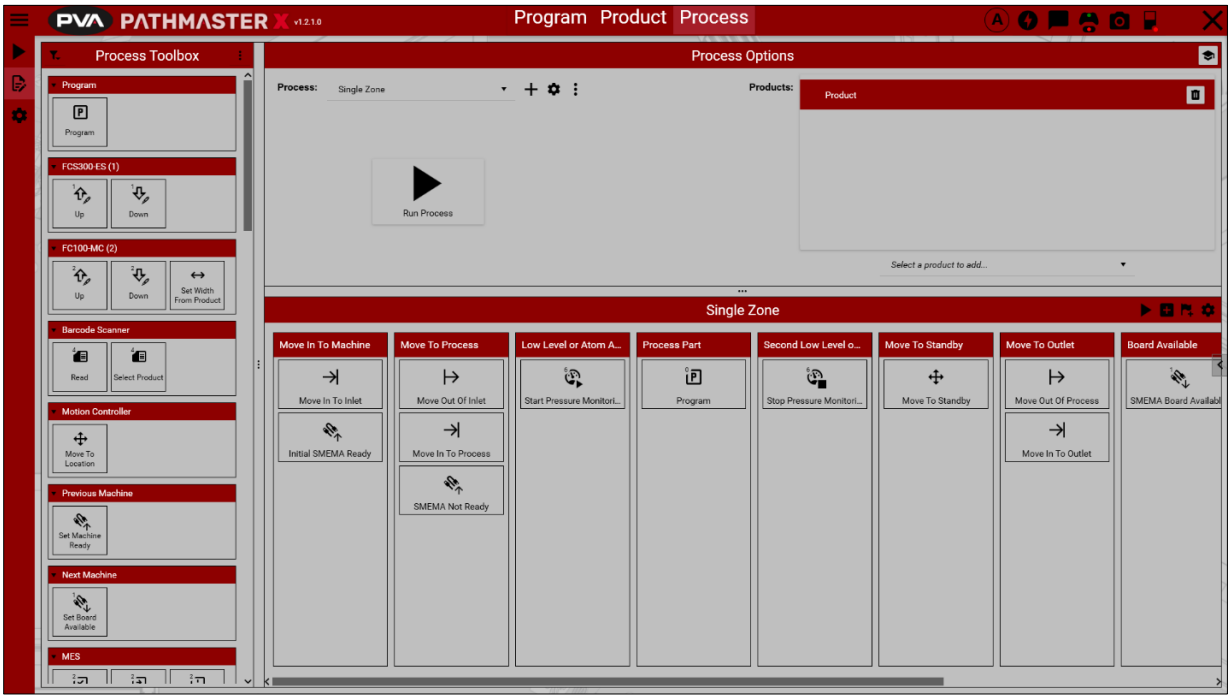

Figure 60: Process

5.3.1.1 Process Creation

All systems come preconfigured with a functional Process for the system. Additional Processes can be added, or modifications can be made to existing Processes using the Process editor.

Click the **Plus** button to create a new Process. The **Settings** button will allow renaming the Process after creation. Click the button to reveal a tool menu with options to undo an action, redo an action, import a Process, export a Process, or delete a Process.

5.3.1.2 Product Association

Products must be associated with a Process to make them available to run in Production. The Products section of Process Options will indicate which Products are assigned to the currently selected Process. Products can be assigned to a Process by selecting them from the dropdown menu below the Product list.

5.3.1.3 Process Lanes

Lanes can be added to a Process by selecting the **Plus** button in the Process header bar. Once a lane is added to a Process, it can be dragged and dropped to a different position in the Process (if necessary). Lanes can be re-ordered by dragging and dropping them to a different position.

Individual lanes can be run with the **Play** button that appears when hovering over the lane and can be edited with the **Settings** button. The full Process can be played with the **Play** button in Process header bar.

5.3.1.4 Process Steps

To add a step to a Process, drag and drop it from the Process Toolbar into the desired lane. Steps can be re-ordered in a lane by dragging and dropping them to a different position and can be dragged and dropped into a different lane entirely.

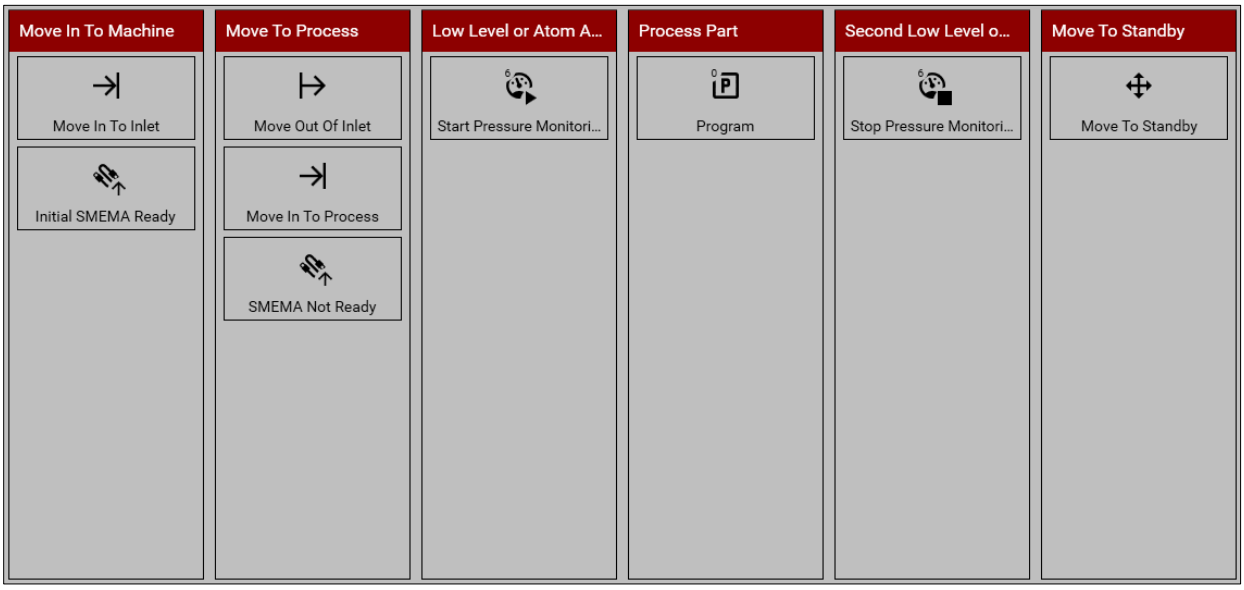

Figure 61: Lanes

5.3.1.5 Conditional Process Lanes

Conditional Lanes can be added by pressing the **Flag** button on the Process header bar. Conditional lanes can contain other Process lanes which will or will not execute depending on if the given condition is true or false. Within the lane settings, an Expression Evaluator is provided to set up the Boolean condition. Select **True** or **False** to display lanes for that result.

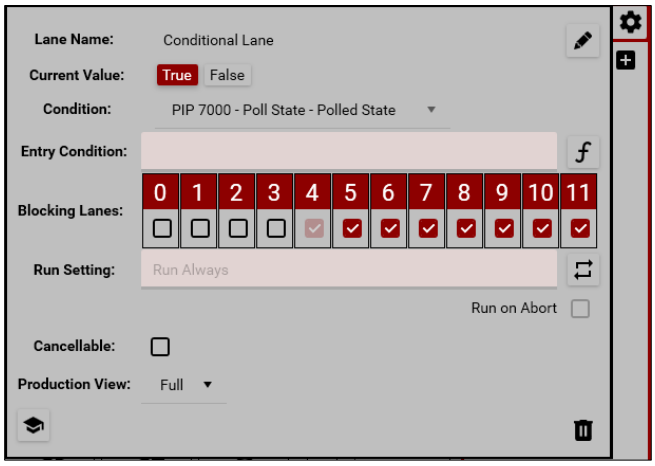

Figure 62: Conditional Lane Settings

Click the **Plus** button to add new lanes into the conditional lane of the Process.

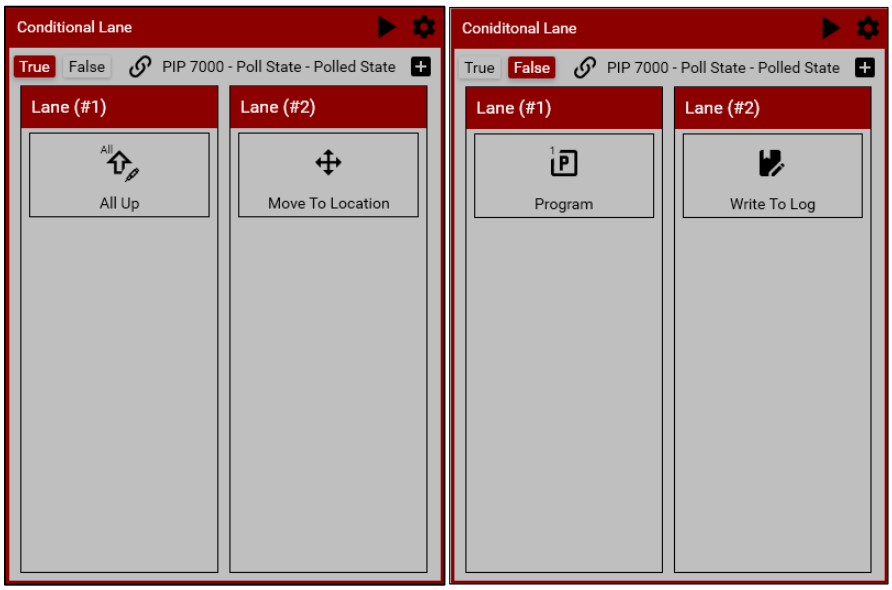

Figure 63: Add Conditional Lanes

5.3.1.6 Process Run Setting

There are five different run settings for a lane in the Process to allow greater versatility in uncommon situations.

1. **Run Always** – The lane will run for every cycle of the Process.

2. **Run All but First** – The lane will run for every cycle of the Process, except for the very first when the Process is started.

3. **Run All but Last** – The lane will run for every cycle of the Process, except for the last one defined by the batch count (running a single cycle will not run this lane).

4. **Run Once, First** – This lane will only run once on the very first cycle of Production.

5. **Run Once, Last** – This lane will only run once on the last expected cycle of Production. An early termination of the cycle will not run this lane unless the checkbox is marked to allow the lane to run if Production is halted early. Aborting the Process must be done manually, and the lane will not necessarily run in the case of an error.

5.3.1.7 Blocking Lanes

Blocking lanes show the required order of completion for a lane to execute. Blocking lanes for each specific lane indicate which lanes can or cannot be running when entering that lane.

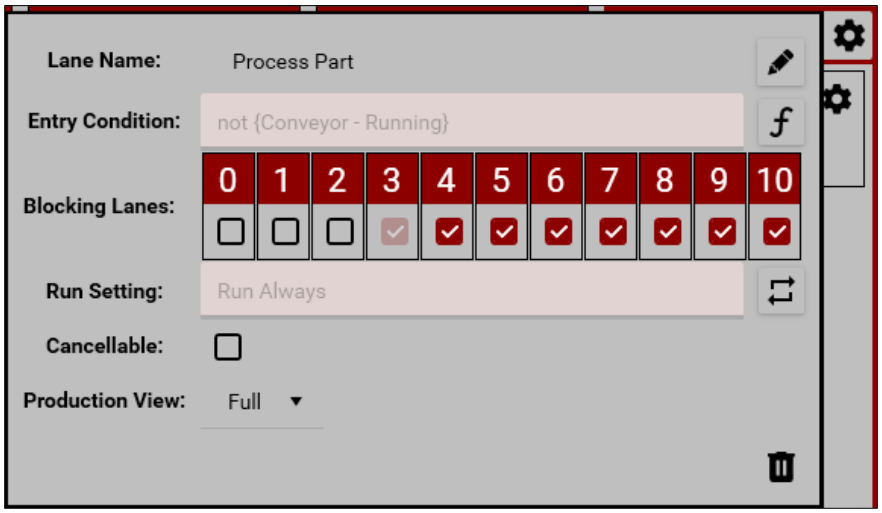

Figure 64: Blocking Lanes

5.3.1.8 Production View

Production view shows how Process lanes appear when running the machine in Production mode. There are three options:

- **Full** view shows the lane name, as well as all script icons and names within a given lane.
- **Condensed** view only shows lane icons. The lane is condensed to the icon width.
- **Hidden** view hides the lane completely from Production view

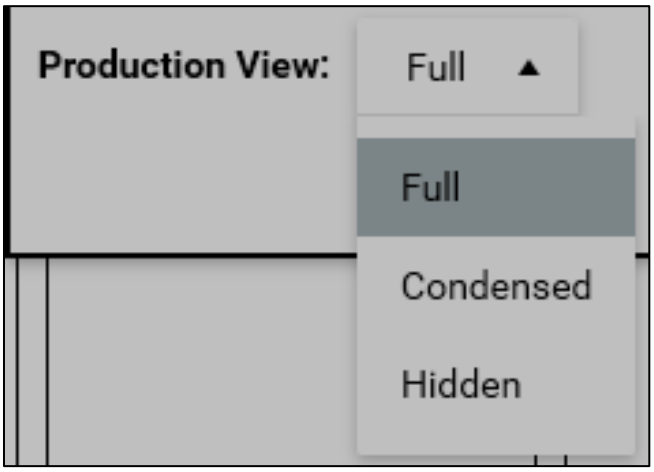

Figure 65: Production View

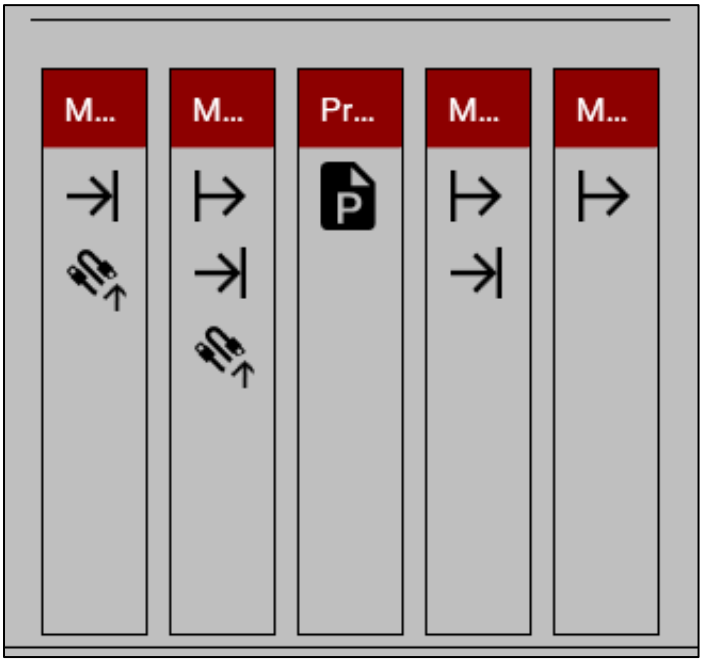

Figure 66: Condensed Production View

6. Configuration Mode

All machines come fully configured from the factory. Changes to the system configuration because of hardware or process changes can be made in **Configuration** mode.

6.1 Device

The Device tab holds information on all the collective devices on the machine. Specific device types are listed on the left-hand menu.

6.1.1 Add a Device

1. Select the menu item of the device type you wish to add from the left menu.
2. Select the dropdown under the Devices pane to select the specific device on your machine.
3. Functions and configuration options will populate automatically and may be adjusted for specific machine needs.

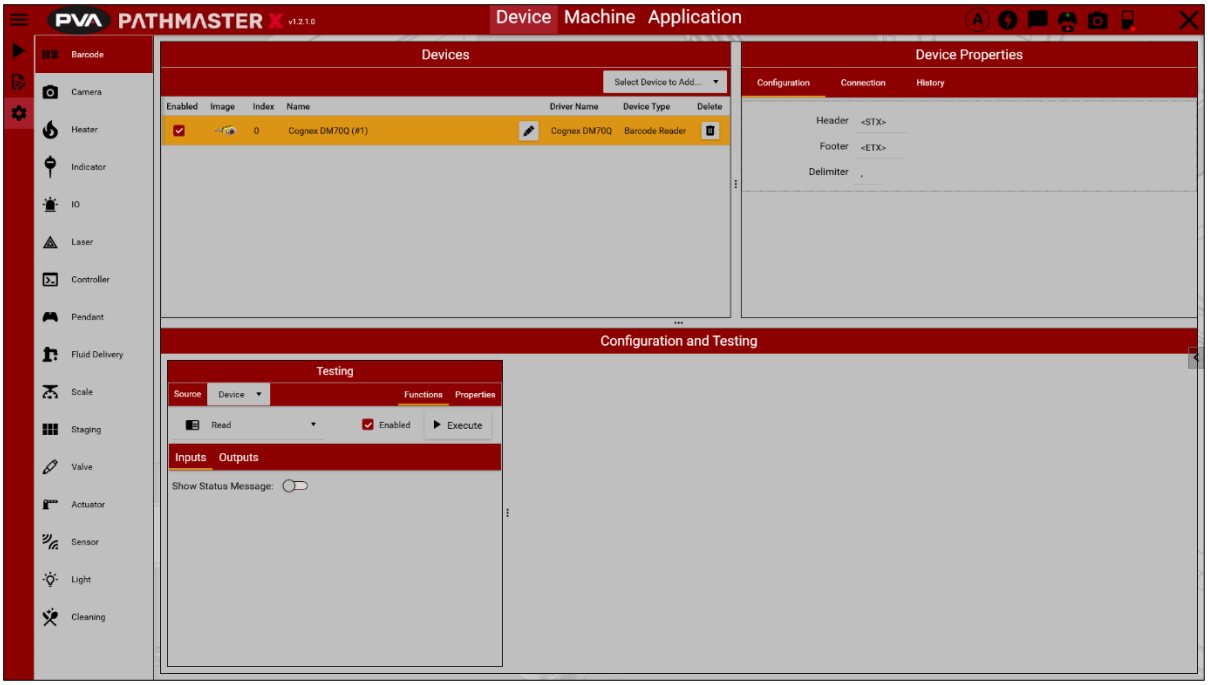

Figure 67: Add a Device

6.1.2 Device Properties

The Device Properties pane will contain two or more tabs, depending on how a device is connected: Configuration, Connection, and History.

6.1.2.1 Configuration

The Configuration tab will contain any general settings required for device functionality. If there are no settings, this tab will be blank.

Certain devices require IO input and/or output assignments for proper use. The Configuration tab is where these settings are listed. The user can select which IO bus the device is connected to and select individual IO points from that bus. As a part of configuration, users can also set a default ON state to invert the expected polarity of the signal.

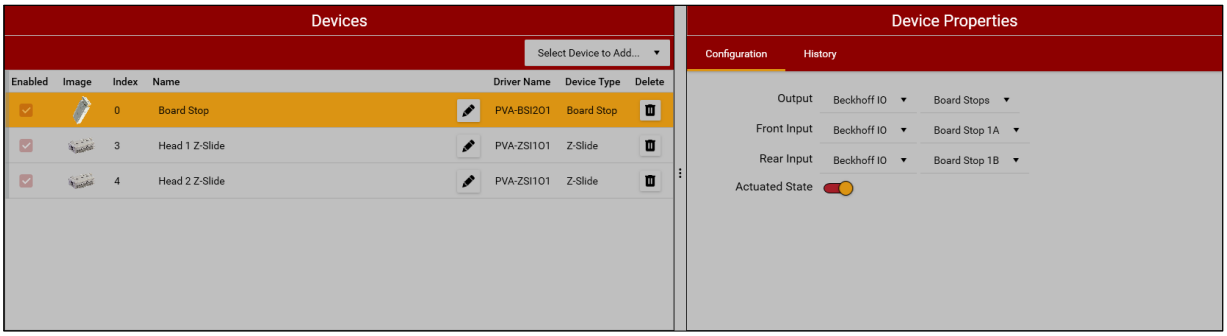

Figure 68: Device IO Configuration

6.1.2.2 Connection

The Connection tab will contain all available connection types (Ethernet, Serial, etc.) for the device, and the associated settings required for the connection type. If the device does not require a connection, this tab will not be present.

6.1.2.3 History

The History tab will contain edit history information about the device such as the user who initially created the device, the timestamp of the device's creation, the last user to edit a device's settings, and the timestamp of the most recent edit.

6.1.3 Configuration and Testing

All devices will have a Testing pane. All of the functions associated with the device will be listed and can be executed individually for testing purposes. All necessary inputs and available outputs will be listed under the respective tabs.

Some tabs have special options under the Configuration and Testing pane.

For example, the machine IO has tables for setting or viewing individual input and output names and states.

Some devices will also contain a pane for launching an external configuration application.

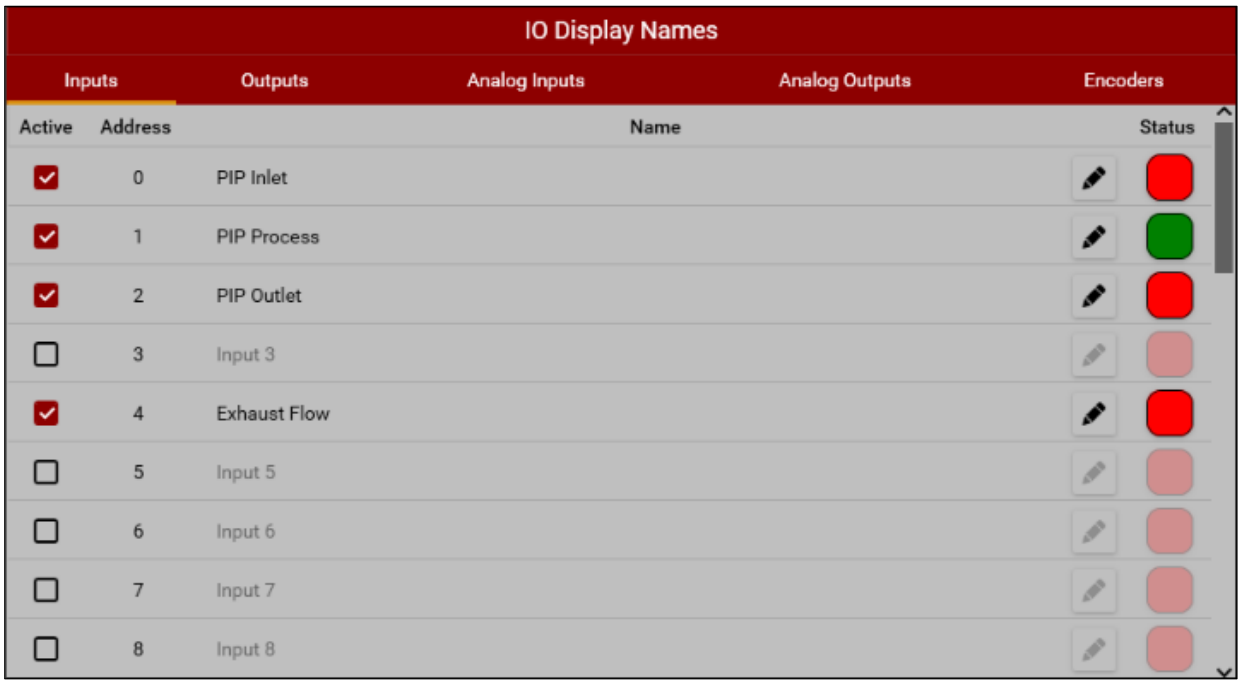

Figure 69: Machine IO Settings

6.1.4 Controller Axes Options

One of the devices most critical to the proper functioning of a machine is the Controller. The Axes pane under Configuration and Testing will allow the operator to set individual axis parameters. Select the **More** button to set parameters for a desired axis.

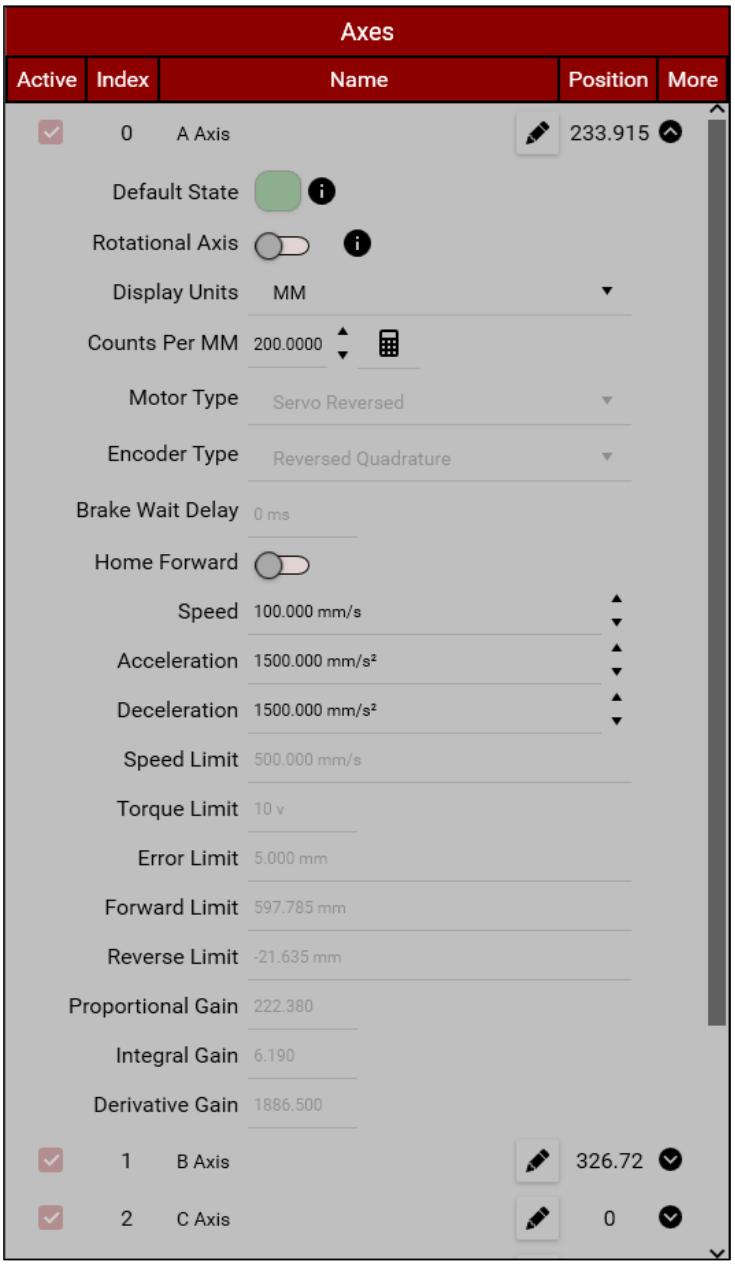

Figure 70: Axes Options

6.1.4.1 Axes Options

Rotational Axis	When toggled on, this axis will be rotational. When toggled off, this axis will be linear.
Display Units	The user can select between counts, mm, or custom units.
Counts Per MM	Sets the encoder resolution per mm (degree for rotational axis).
Motor Type	*Internal Use Only*
Encoder Type	*Internal Use Only*
Brake Wait Delay	Used for machines with a Z-axis. *Internal Use Only*
Home Forward	Determines the direction that the axis homes. This typically homes to reverse limit switch.
Speed Controls	Set speed, acceleration, deceleration, speed limit, and torque limit. **Note: Parameters set will not be flagged as unsafe. It is the operator's responsibility to ensure the speed controls are set to safe and effective parameters.**
Limit Controls	Set how many counts from the expected position the axis may move before a limit error is triggered. Set forward and backward software limits.
Axis Tune	Set PID axis tune parameters.

6.1.5 IO Device Table Configuration Options

IO devices also play a critical role in the correct operation of the machine. The IO table can be configured in the IO Display Names pane under the IO device Configuration and Testing pane. Discrete input and output, analog input and output, and encoder tables all have four properties in common for each parameter:

1. **Active**: Indicates whether the parameter is used by any devices on the machine. If it is not active, it will not be listed in any assignment option menus.
2. **Address**: The relative address of the corresponding parameter.
3. **Name**: The parameter display name. Names can be edited with the **Edit** button.
4. **Status**: The current value of the parameter.

Discrete and analog output parameters will also have a **Default** property. This property can have a set value that will be used whenever PathMaster X is started or Reset IO Device is used or set to none. If set to none, the value will not be changed.

6.1.6 Pendant Configuration Options

Another key component of machine functionality is the teach pendant. Multiple button assignment profiles may be created for the same pendant, allowing for switching between controls. Optionally, pendant profiles can be changed by the press of a button, giving greater control flexibility and reducing the limitations of the number of controller buttons available.

6.1.6.1 Button Assignment

All buttons, including joysticks, allow for a pressed/unpressed option. Joysticks are highly recommended for jog axis control. Button assignment allows for setting a pressed action with no unpressed action but does not allow unpressed actions without first assigning a pressed action. Unpressed actions are allowed to be unrelated to the pressed action.

To enable profile switching via a button press, assign the Next Profile option to a button.

The Back and Start buttons are reserved and cannot have their assignments changed.

Figure 71: Pendant Control and Button Assignment

6.1.7 Staging Device Servo Adjust

In order for staging devices to use auto width adjustment, it must first be enabled through the device configuration properties. The Servo Adjust tab is located in the Properties pane. There are four settings:

1. **Enable**: Enables or disables servo adjustment. If Servo Adjust is enabled, then later disabled, servo width properties elsewhere in the application will still appear but be disabled. Disabling with the **Delete** button will remove the property entirely.
2. **Adjustment Axis**: The controller device and enabled axis that controls the servo width.
3. **Pre-Adjust Trigger**: Trigger function to execute before adjustment begins. Function can be unassigned by selecting the **Delete** button.
4. **Post-Adjust Trigger**: Trigger function to execute after adjustment is complete. Function can be unassigned by selecting the **Delete** button.

Note: A Set Width from Product step in a Process is required to trigger the actual width adjustment. Only triggers with a Manual Source type will be available for assignment.

6.2 Machine

6.2.1 Tool

In order for most devices to be used as part of a Program, Product, Process, or Trigger, they must first be assigned to a Tool.

6.2.1.1 Tools

Add new tools by selecting the **New Tool** button. Created Tools will use the next available index for its identifier. Edit the name of the Tool by clicking the **Edit Name** button. Delete a Tool by selecting the **Delete** button.

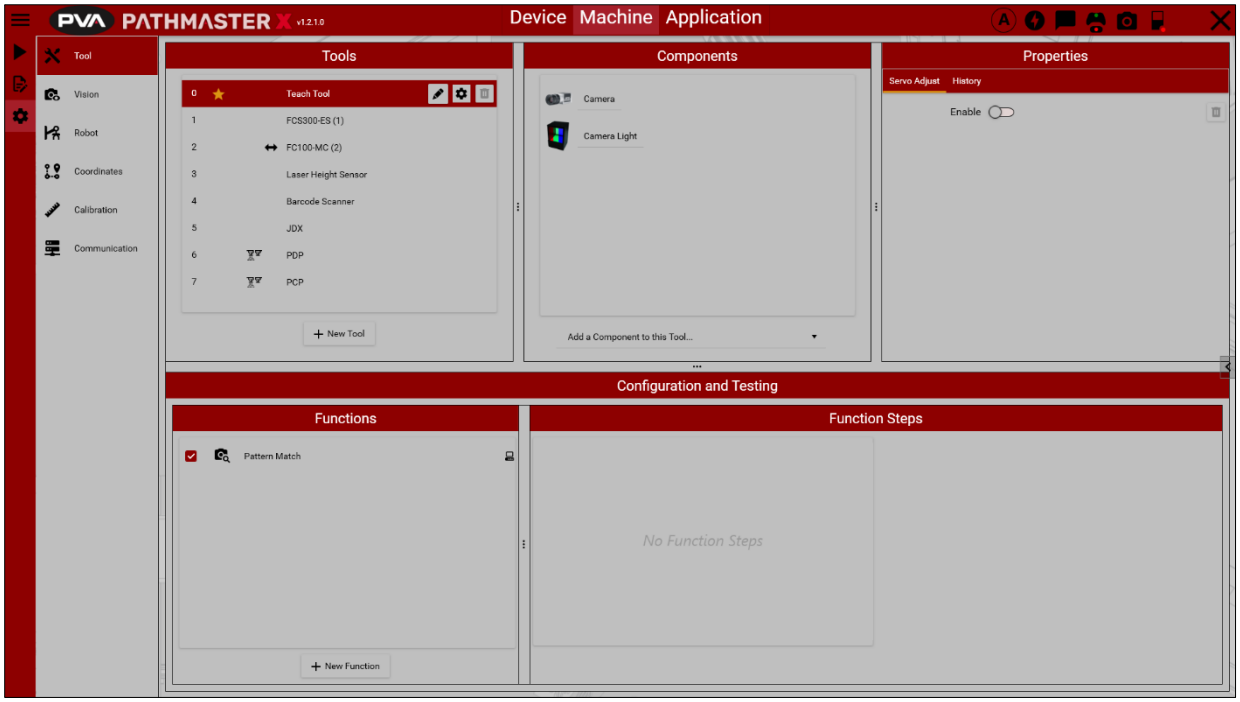

Figure 72: Tools

6.2.1.1.1 Tool Function Groups and Assignments

There are two tool groups: **Tool All Up/All Down** and **Tool All On/Off** . To add a Tool to a group, select the Tool, then press the **Settings** button . Use the toggles to make the desired group selections for that tool.

Note: Most tools will need to belong to both groups for Auto Purge and Solvent to work correctly.

A Tool's On and Off function can also be changed from this screen. Functions available for these options are from the Functions pane under Configuration and Testing. By default, the Tool's existing On and Off functions will be assigned.

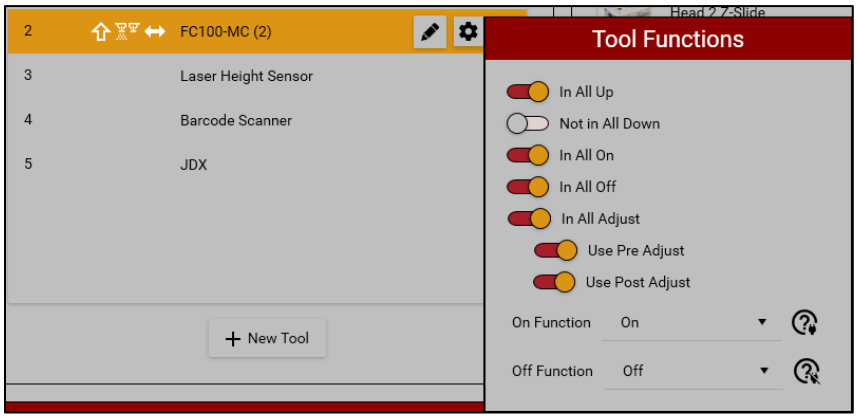

Figure 73: Tool Function Groups and Assignments

6.2.1.2 Components

Components may be added to a currently selected Tool. To add a component to a Tool, select the Tool in the Tools section. Add a component to a Tool using the dropdown in the Components section. Each component that is selected will be grouped together for that Tool. For example, if a valve has an associated z-slide and rotate assembly, all three components would need to be added to that Tool.

6.2.1.3 Properties

The Properties pane has two tabs: Servo Adjust, and History

6.2.1.3.1 Servo Adjust

Servo Adjust allows the Tool to be automatically set to a specified width during Production. There are four settings:

5. **Enable**: Enables or disables servo adjustment. If Servo Adjust is enabled, then later disabled, servo width properties elsewhere in the application will still appear but be disabled. Disabling with the **Delete** button will remove the property entirely.
6. **Adjustment Axis**: The controller device and enabled axis that controls the servo width.
7. **Pre-Adjust Trigger**: Trigger function to execute before adjustment begins. Function can be unassigned by selectin the **Delete** button.
8. **Post-Adjust Trigger**: Trigger function to execute after adjustment is complete. Function can be unassigned by selectin the **Delete** button.

A Set Width from Product step in a Process is required to trigger the actual width adjustment. Only triggers with a Manual Source type will be available for assignment.

6.2.1.3.2 History

The History tab will contain edit history information about the Tool, such as the user who initially created the Tool, the timestamp of the Tool's creation, the last user to edit a Tool's settings, and the timestamp of the most recent edit.

6.2.1.4 Functions

Certain components will automatically add common tool functions. New functions can be added by selecting the **New Function** button. The function may be renamed and edited with different available steps. Function flags allow the function to be used in Programs, mapped to pendant buttons, and used through Quick Actions.

6.2.1.5 Function Steps

Select the function in the Functions section. Search for available scripts using the dropdown list in the Function Steps section. The functions available depend on the components selected for the tool.

Select steps in the order you wish to use them. Steps cannot be reordered without deleting steps.

Note: Certain steps have inputs and outputs attributed to them. Inputs can be configured through this section, while outputs can be viewed as the function or function step executes.

6.2.2 Vision

6.2.2.1 Calibration Tab

1. To create a calibration, select **Add** when viewing available calibration options. A physical calibration grid is required when setting up a calibration.
2. Move the camera over the calibration grid so full dots are visible and cover as much of the screen as possible.
3. Count the number of rows and columns visible and enter the amounts in their appropriate sections. Modify the grid spacing of rows and columns if needed.
4. **Single Calibrate** will take a single frame when the button is pressed and attempt to find the calibration grid from the single image. **Live Calibrate** will allow the camera to stay live and the grid to be moved so the user can see when a successful grid is found.
5. Press **Save** to save the calibration to the available list.

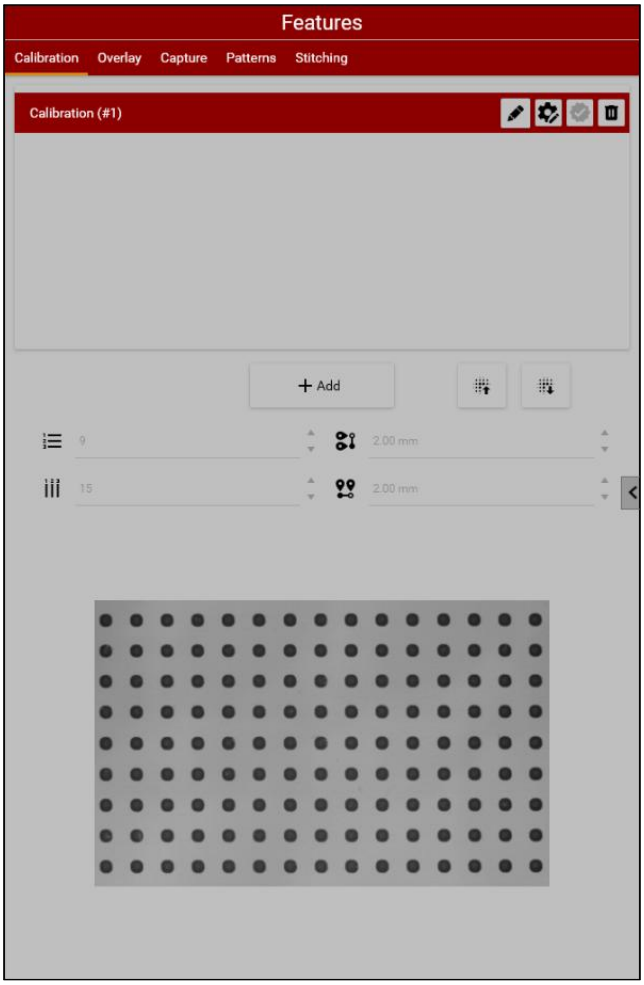

Figure 74: Calibration

If there is more than one calibration, the default calibration is selected by pressing and holding the **Default Calibration** button for one to two seconds. Overlays are based on the default calibration. If there is only one calibration, it is set as the default automatically.

Figure 75: Default Calibration

6.2.2.2 Overlay Tab

The Overlay displays on top of live images of the camera to help the user identify critical points in the field of vision, such as the center point of the camera field of view.

1. To add an overlay, select **Add** in the section displaying available overlays.
2. Select the type of overlay using the dropdown. Available overlays are **Crosshair, Grid, Circle, Rectangle,** and **Region**.
3. Modify the aspects of the selected overlay. Press **Save** to save the overlay to available options.

Figure 76: Overlay

6.2.2.3 Capture Tab

Capture settings determine the camera settings, calibration used, and machine light states when capturing an image.

Camera black level, gain, and exposure time are used to filter the amount of light that the camera receives. Before modifying these values with a live image, turn available lighting options on or off to match how they are desired for an image capture.

1. Select the toggle options to match the lights desired for the current capture.
2. Modify the camera settings as needed to ensure the live image is clear and defined.
3. Select the calibration used for the capture.

4. Click **Save** to save the capture settings.

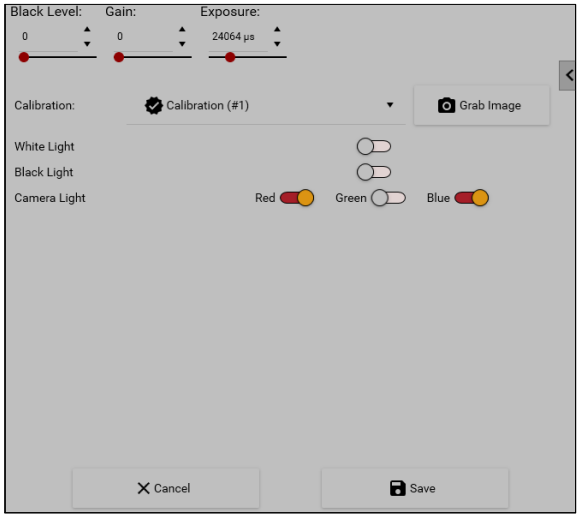

Figure 77: Capture

6.2.2.4 Patterns Tab

1. To add a pattern, select **Add** under the available pattern options.
2. Drag the four corners of the pattern box to crop the pattern that must match.
3. The minimum match score can be modified to allow lesser or greater levels of allowable variation.

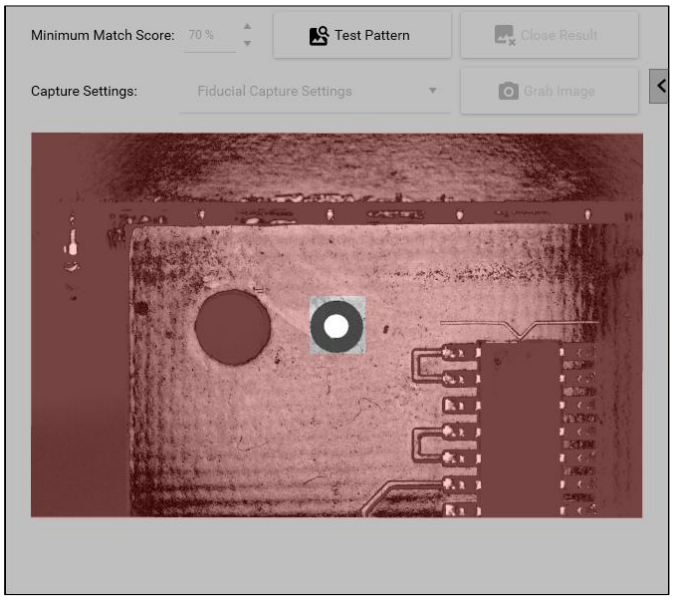

Figure 78: Patterns

6.2.2.5 Stitching

Stitching allows the creation of an accurate representation of a part or pallet using the camera mounted on the machine. The process involves taking a number of still images and forming them together to create a geometrically accurate image of the part to the given constraints.

To begin stitching, the machine needs two defined corners for the rectangular space that will define the image result. It is recommended that the first coordinate be on the left side, top or bottom, and the second coordinate on the opposite corner of the right side. Click the **Advanced** button to see advanced features.

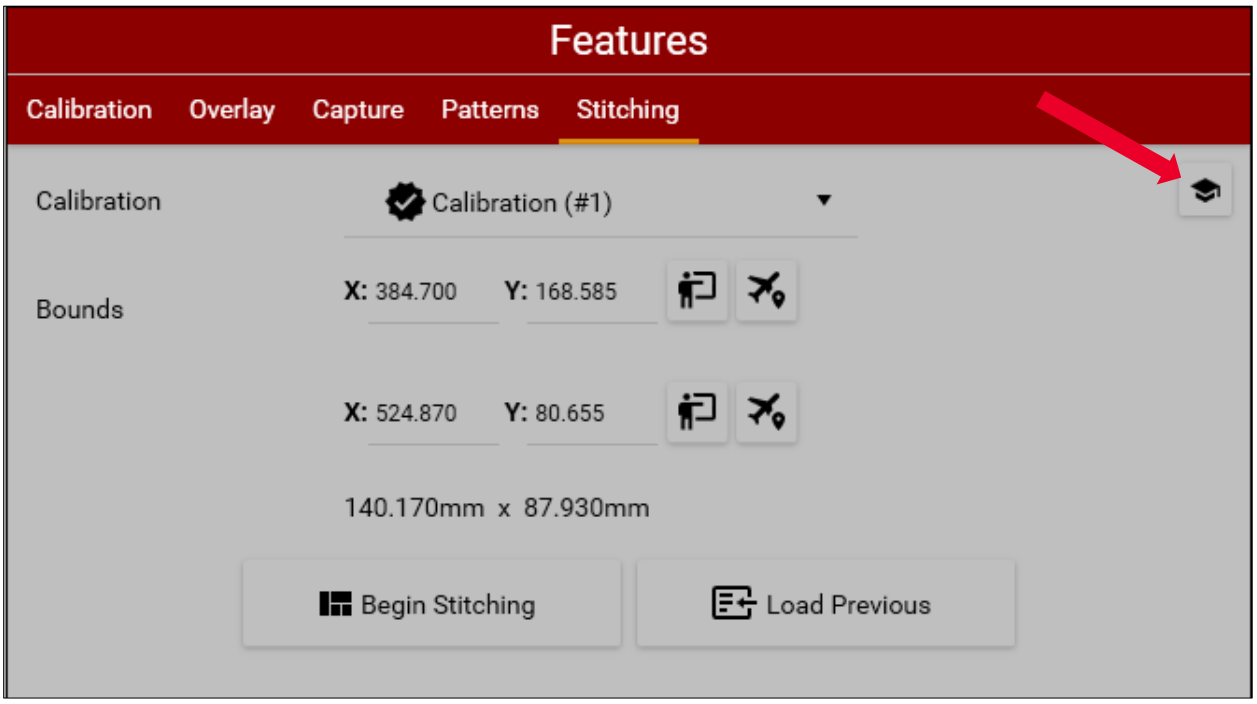

Figure 79: Begin Stitching

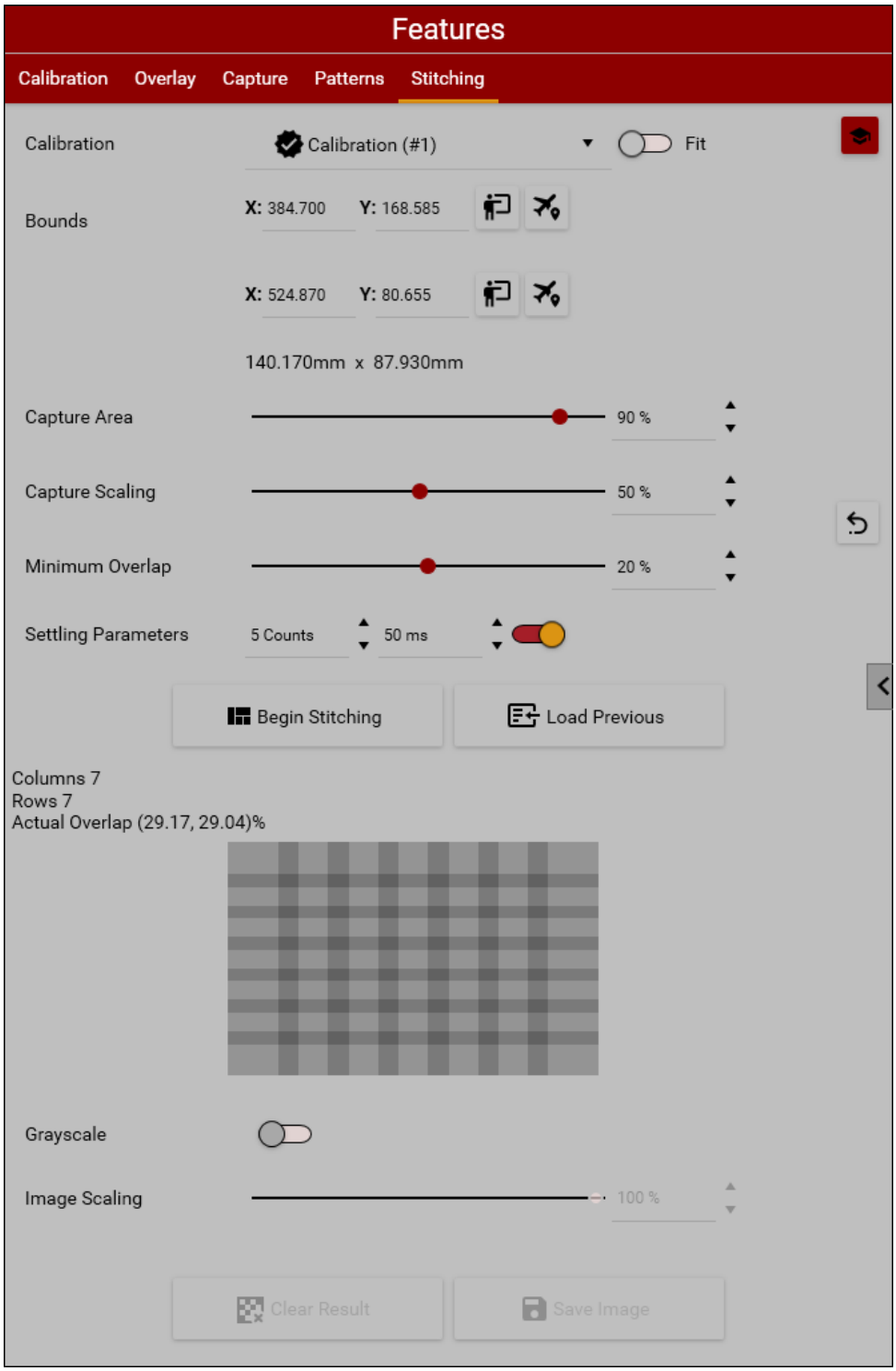

Figure 80: Advanced Stitching Features

A selected calibration is necessary to begin image stitching. The default settings allow for a 20% minimum overlap on images so that images taken can be combined without rough edges appearing between them.

Once options are configured as desired, click **Begin Stitching** to start the process.

As stitching begins, a resulting image will appear in the **Result** portion of the camera view. Even if stitching is interrupted, a partial result can be saved and loaded for the future.

Previous stitching results can be loaded by selecting the **Load Previous** button.

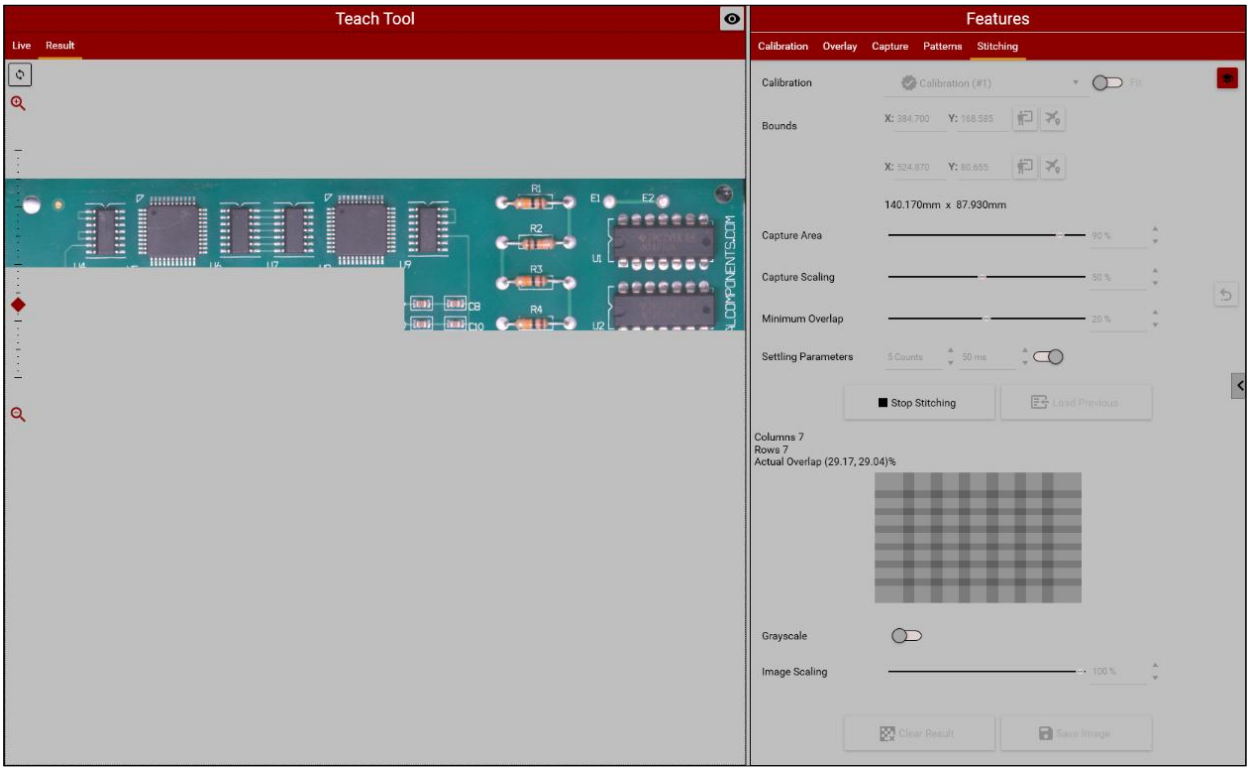

Figure 81: Stitching Result

To load a previous result into the current result, select the desired result from the list.

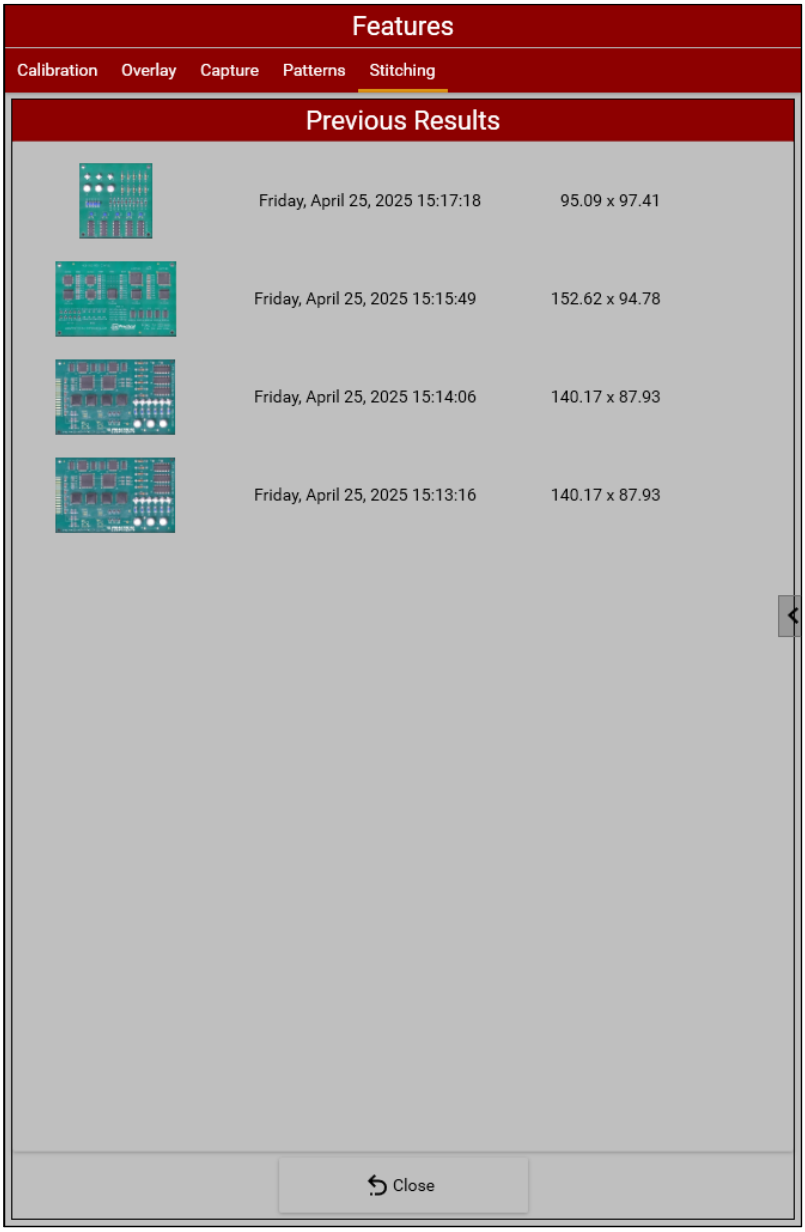

Figure 82: Previous Stitching Results

6.2.3 Robot

Robots may be added and removed from this list. A robot requires an associated controller that is set up in the Devices tab.

Note: The current release allows only one robot and one controller.

6.2.3.1 Robot Properties

Select which axes of the controller are associated with the X, Y, Z, and Theta (if applicable) of the robot, create default robot speeds, and set the defined home origin. The Safe Z Height and Virtual Settling Time are also set in this section.

The home origin coordinates override the 0 position for that axis. While the axis will still home to its sensor, it will then move to this position and treat it as coordinate 0. The robot may be manually homed from this section. Typical theta home origin is set such that tools in positions 1 and 2 are facing the operator and parallel with the conveyor.

6.2.3.2 Add Tools to Robot

Once Tools are configured in the Tools section, they must be added to the robot to be used. Add available Tools using the dropdown menu. Once all available Tools are added to the robot, the menu will display that no more Tools are available to add.

By default, the first Tool added to a robot will be defined as the Teach Tool. To change which Tool is the Teach Tool, select the Tool, and then click the **Set Teach Tool** button  . Only one Tool can be set as the Teach Tool.

To remove a Tool from the robot, select the Tool, and then click on the **Delete** button  .

6.2.3.3 Tool Properties

Tool Properties allow settings such as whether the tool travels on the Z (vertical) axis, as well as whether it travels on a rotational theta axis, if one is present.

The Tool's Default On and Off Waits are also configured here. Options for On and Off Wait include **None**, **Distance**, **Time Before**, and **Time After**.

The Tool's Default Tool Height is also set here. This is the Tool's height above the substrate.

If a Tool uses Sub Tools, they are also set up here.

6.2.3.3.1 Sub Tools

Sub Tools can be utilized to extend the functionality of Tools that can have multiple end effector positions without the need for duplicate tools within the Tool and Robot Tool lists. Sub Tools differ from Tools in that when the parent Tool is selected, a Sub Tool belonging to it is automatically selected when the Sub Tool's corresponding Input Reference is true.

To add a Sub Tool to a Tool, click the **Add** button  at the bottom of the Tool Properties pane.

The list of Sub Tools will have a new entry with two fields:

1. **Offset Name**
   - Shown after the Tool's Name to denote the current offset being used.
2. **Input Reference**
   - This can be a reference to any API output or defined through the **Expression Evaluator**.
   - This is evaluated to determine what Offset to use when Teaching Points, Running Program Steps, or displaying the Current Tool Position.

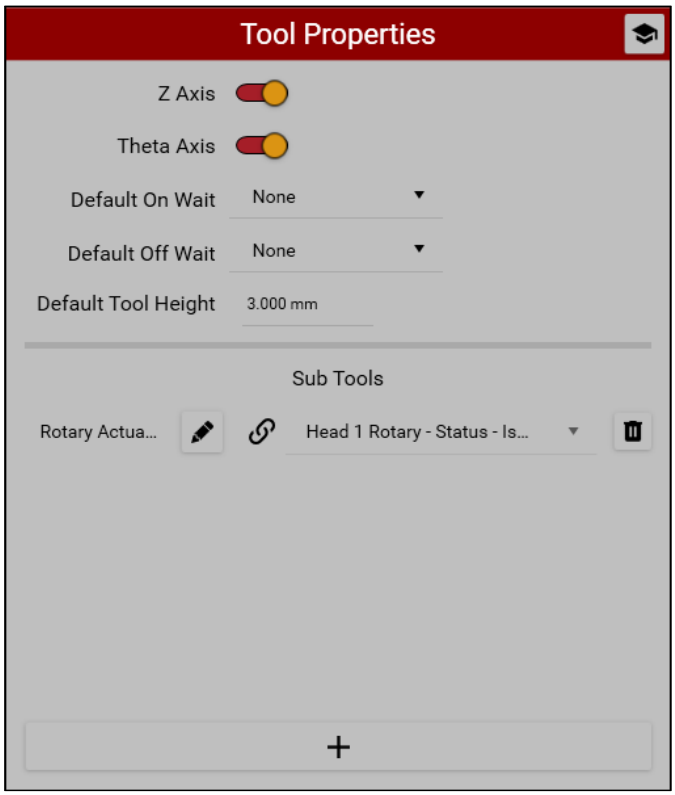

Figure 83: Tool Properties and Sub Tools

6.2.3.4 Tool Profiles and Profile Settings

Tool profiles are set up to allow the user to view the Tool's movements on a Program canvas. It is recommended that profiles have a distinct color or shape to differentiate between them on a canvas. The color of the Tool during a motion step and dispense step are selectable, as well as the color of the path when the path step is selected. The width of the path and the shape of the beginning and end of the path are also editable, along with the opacity of the path. A preview of what the path types will look like on the canvas are provided.

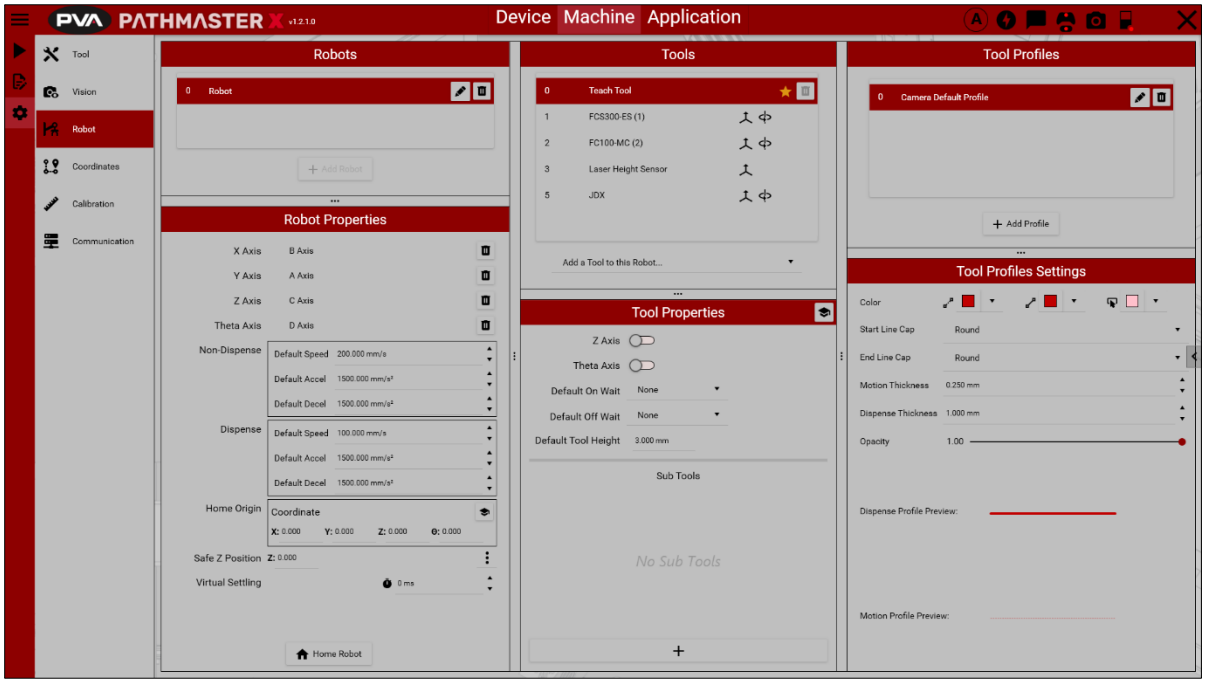

Figure 84: Tool Profiles

6.2.4 Coordinates

This section is where various robot locations (such as Solvent Park, Purge, and Standby) are taught, as well as the offsets between created Tools, the workspace origin, and the theta axis calibration.

6.2.4.1 Calibration Plate

The calibration plate is used to establish a fixed reference within the robot workspace. A calibration plate is provided with all systems from the factory. The calibration plate will have a reference point engraved on it. Systems that are equipped with a theta axis will have a proximity sensor mounted on the calibration plate for theta calibration.

- To use the standard calibration plate, put the plate on the conveyor or flex fixture so it is against the fixed rail and the hard stop or board stop.
- The purpose of the calibration plate is to define a consistent workspace reference position. This is very important to the efficacy of machine transportability.

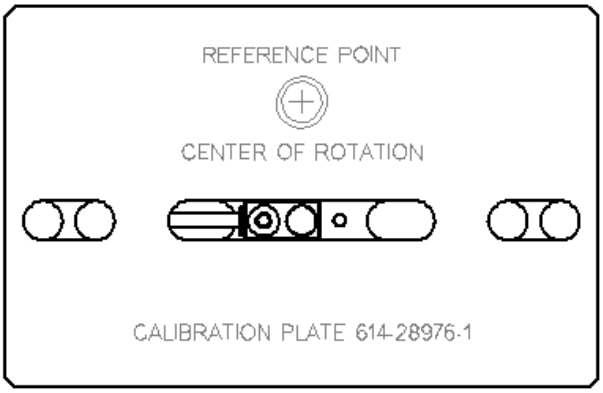

Figure 85: Calibration Plate

6.2.4.2 Robot Locations

Robot locations are coordinates relative to the gantry homed position. Robot locations can be added by clicking the **Add Location** button.

The name of the position can be edited with the **Edit Name** button and the position may be deleted with the **Delete** button.

A position can be taught by manually entering the coordinates, or by using the pendant to move the gantry to the desired location. Once set, select the **Teach** button to save the location. Clicking the **Move** icon will move the gantry to the taught position.

Robot locations are absolute and not tool specific. Tool selection or changes to offsets, workspace reference, or program origin will not transform robot location coordinates.

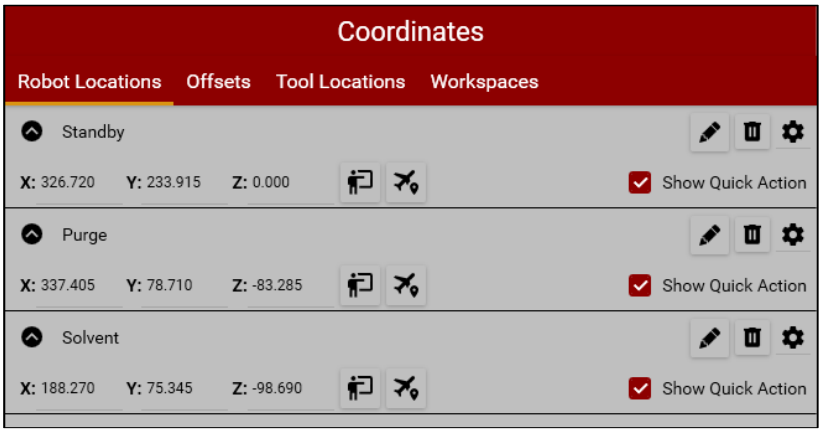

Figure 86: Robot Locations

6.2.4.3 Offsets

Tool offsets define the X, Y, theta relationship (offset) between the Teach Tool (usually a camera) and every other physical Tool installed on the workcell. Tool offsets are used to transform coordinates from one Tool to another.

Note: Proper calibration of offsets is essential to workcell functionality.

6.2.4.3.1 Offset Fixture Location

This is the location of the reference position used to teach all tool offsets. This position is taught with the Teach Tool at the reference position on the calibration plate. There will not be a Z or Theta coordinate when taught with the Teach Tool. For systems with a theta axis, all tools are taught at a theta position of 0 degrees. When teaching the reference position, theta will move to 0 degrees when entering teach mode if it is not already there.

Tool offsets are relative to the Offset Fixture Location. If the reference position for the Offset Fixture Location is changed, tool offsets are not affected. However, offsets should still be verified after making a change to the Offset Fixture Location.

6.2.4.3.2 Tool

This is the Tool selection dropdown. Select the intended Tool prior to teaching the offset.

6.2.4.3.3 Tool Offset Location

This displays the tool offset reference coordinate for the selected Tool at the Offset Fixture reference position (calibration plate reference position). This coordinate can be taught or modified with the steps below.

To teach tool offsets:

1. Confirm the selected Tool.
2. Put the tool pneumatics in their asserted location (z-slide down, rotary vertical, etc.). Quick Actions can be used to put the Tool in the correct state.
3. Align the Tool with the calibration reference point with the tool tip at the substrate height.
4. Press the **Teach** button  to access the teach menu.
5. Press the **Teach Coordinate** icon  to set teach the new reference position.
6. Press the **Move** icon  to verify the position after taught.
7. Repeat this process for the remaining Tools.

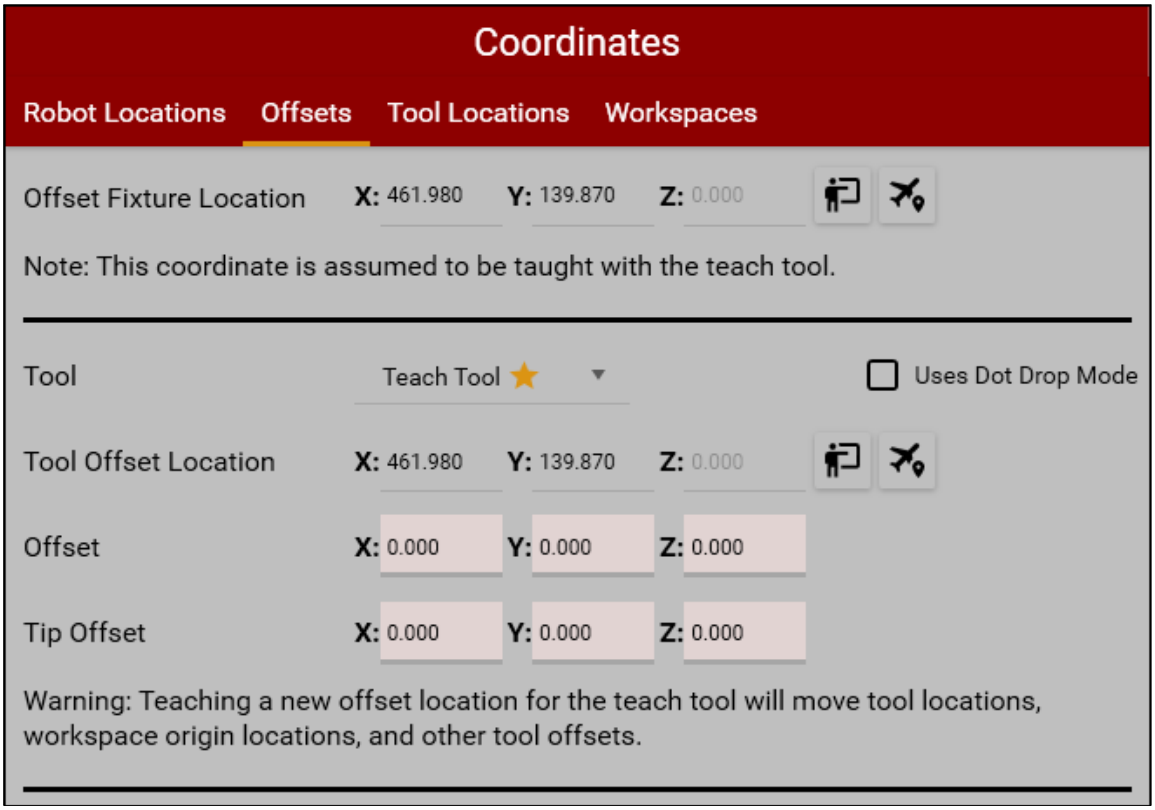

Figure 87: Offsets

Tip offsets are cleared when tool offsets are taught. Tool process offsets are a combination of tool offsets and tip offsets.

When the Teach Tool is used to teach the Offset Fixture Location (calibration plate reference position), the Teach Tool offset is automatically applied and does not typically need to be taught. All other Tools need offsets taught including the Theta Teach Tool (if applicable).

If the Teach Tool position physically changes, the Teach Tool offset would need to be retaught. An example of this would be if the Teach Tool was removed for maintenance or replaced. Reinstalling would result in some change in position that needs to be corrected.

All tool offsets are relative to the Teach Tool, therefore, when the Teach Tool offset is taught, every other Tool is adjusted to account for the change in position to the Teach Tool.

Additionally, Offset Fixture Location, Workspace Reference, and Tool Locations are adjusted.

6.2.4.3.4 Sub Tools

To teach the offset for a Tool's Sub Tool, the Input Reference must be evaluated as **True**. For example, if the Tool uses a rotary device, the Tool's Sub Tool requires that the rotary is rotated to the B Position. Once True, selecting the parent Tool will select the actively True Sub Tool offset instead of the parent Tool offset.

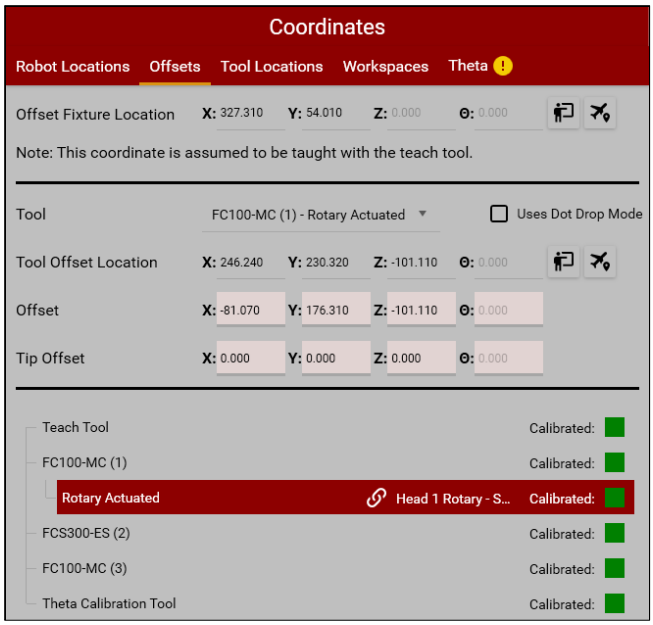

Figure 88: Sub Tool Reference True

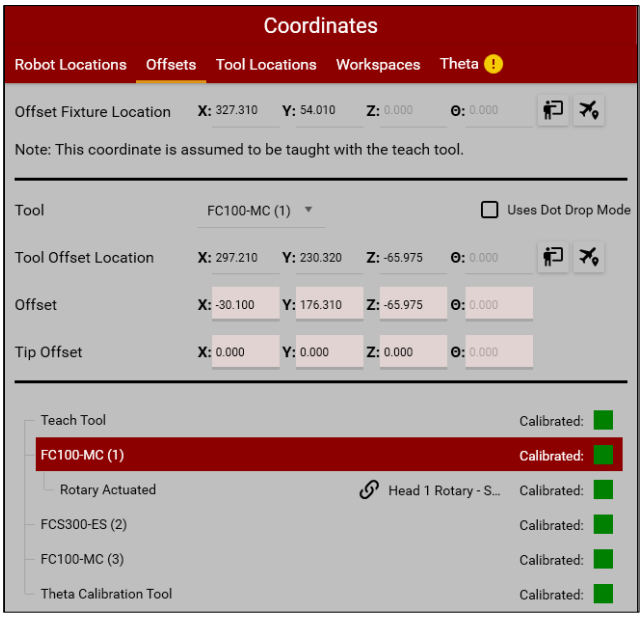

Figure 89: Sub Tool Reference False

Once the Sub Tool Input Reference is True, the offset is taught like any other Tool offset.

Note: Changing the offset of a Sub Tool's parent Tool will NOT affect the offset of any Sub Tools.

To use a Sub Tool during Program creation, select **Run Tool**, which will display an expansion arrow next to any Tools with one or more Sub Tools. Click on this arrow to assign a Sub Tool to a Program step.

Note: When a Sub Tool is assigned as a Run Tool, it is up to the operator to ensure that the Sub Tool's Input Reference state is True during Program execution or playback, otherwise the path will not run correctly.

If a Program step is taught with the Teach Tool, the active Sub Tool (if any) of the corresponding Run Tool will automatically be used.

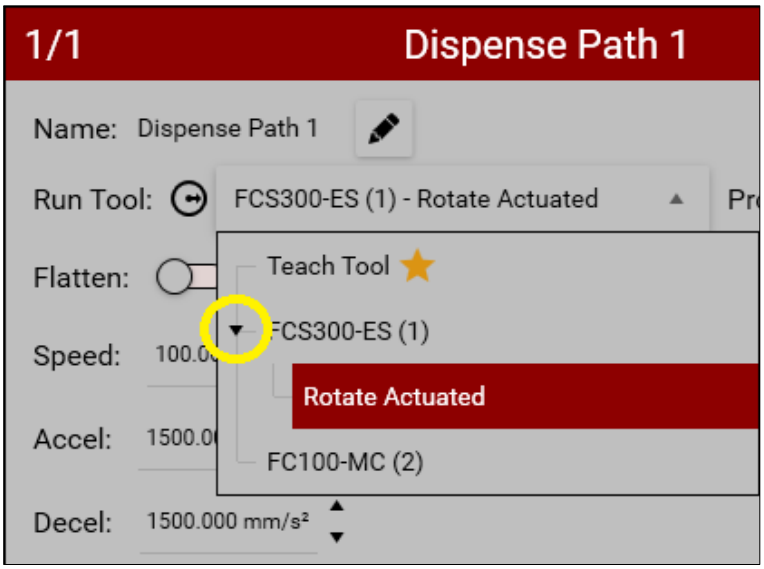

Figure 90: Run Tool Sub Tool

6.2.4.3.5 Dot Drop Mode

Selecting **Uses Dot Drop Mode** allows precise offsets to be configured by utilizing a Dot dispense and defining the point with the Teach Tool.

Using the Pendant, move and Teach the **Dot Location** with the Tool in the correct actuated state. Configure the **Dot On Time** and press **Dot Drop** button to turn the Tool On for the configured time.

Using the Pendant, Teach the **Teach Tool** Location by aligning the dot with the Teach Tool.

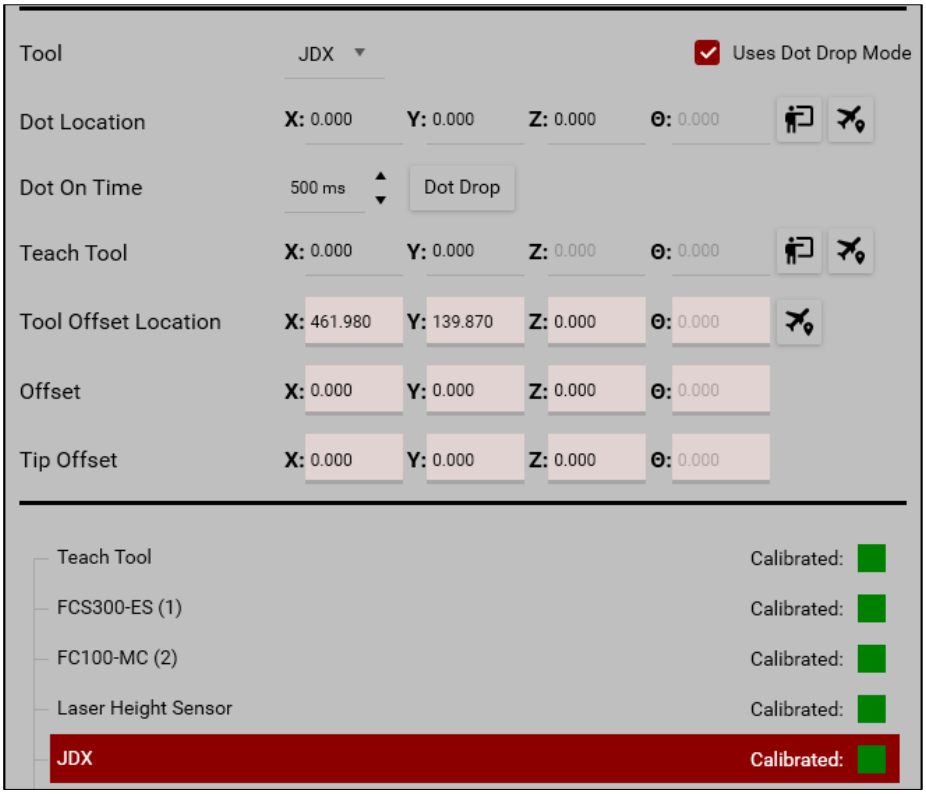

Figure 91: Dot Drop Mode

6.2.4.3.6 Camera on Z-Axis

Note: The setup process for a camera on the robot Z-axis is similar to previous versions of PathMaster X, but there are some important things to consider. All mentions of the laser in this section refer to a camera Teach Tool that is on the robot's Z-axis.

6.2.4.3.6.1 Tool Offset Teaching

The process for the initial setup for the Tool's offset is nearly identical to previous versions of PathMaster X, with the exception that Z locations for the Offset Fixture Location and the Tool Offset Location will be enabled. When the camera is on the Z-axis, its focus is dependent on the robot's Z-position. Because of this, the Offset Fixture Location should be taught at a height where the camera has the best focus.

6.2.4.3.6.2 Coordinate Teaching

Teaching Z positions with a camera on the Z is generally unreliable. This is because you are using the focus as the determining factor for the correct Z-position, and the camera can be focused anywhere within its focal depth. Because of this behavior, there are several things the user needs to be aware of:

- When reteaching the camera's Tool Offset Location, any changes in the Z will **invalidate** all Tool offsets. This is a precautionary measure to ensure that the user must reverify or reteach all Tool offsets. This does have a trickle-down effect in that it will delete theta calibrations. In this situation, it is fully recommended that the user reconfigures all the tabs on the Coordinates page (except for Robot Locations).
- When teaching workspace or program origins with the camera, it is recommended to teach with the Z-position **disabled**. The user should be using another Tool to teach the Z-component of an origin.
- When teaching program positions with the camera, it is recommended to teach with the Z-position **disabled**, even when the position is for the camera. For camera positions specifically, it is better to manually enter the desired height.
- For example:
    - Most pattern matches will require the camera to be at substrate height. If the program origin is taught correctly, the substrate height is at 0, so 0 can be manually entered into the Z-position.
    - If an inspection is required at a component that is off the substrate height, the user can manually enter the height of the component into the Z-position (i.e. 10 mm tall component → 10 mm Z-position).

6.2.4.3.7 Laser on Z-Axis

Note: The setup process for a laser Tool on the robot Z-axis is similar to previous versions of PathMaster X, but there are some important things to consider. All mentions of the laser in this section refer to a Laser Tool that is on the robot's Z-axis.

6.2.4.3.7.1 Tool Offset Teaching

The process for the initial setup for the Tool's offset is nearly identical to previous versions of PathMaster X, with the exception that Z locations for the Tool Offset Location will be enabled. When teaching the offset, the Z-position should be such that the laser is outputting a valid reading. It is recommended that the offset is taught near the top of the valid range (i.e. 140 mm reading for a laser that is valid from 50 mm-150 mm).

6.2.4.4 Workspaces

Workspaces are a fixed reference point within the robot work area. The workspace reference position is typically the calibration plate reference point. Program origins are relative to workspace reference.

Only one workspace may be created for a robot. The workspace can be renamed but may not be deleted. Teach the position by using the pendant to move the gantry to the desired position, then pressing the **Teach** button  . The position can be returned to by pressing the **Move** button  .

When teaching a workspace, the Z coordinate must be taught at appropriate height first, followed by the X and Y coordinates. The Z coordinate must be taught with a physical tool such as a valve that can be set at the substrate height. The X and Y coordinates can be taught with any Tool. Usually, the Teach Tool is used to teach the workspace XY component.

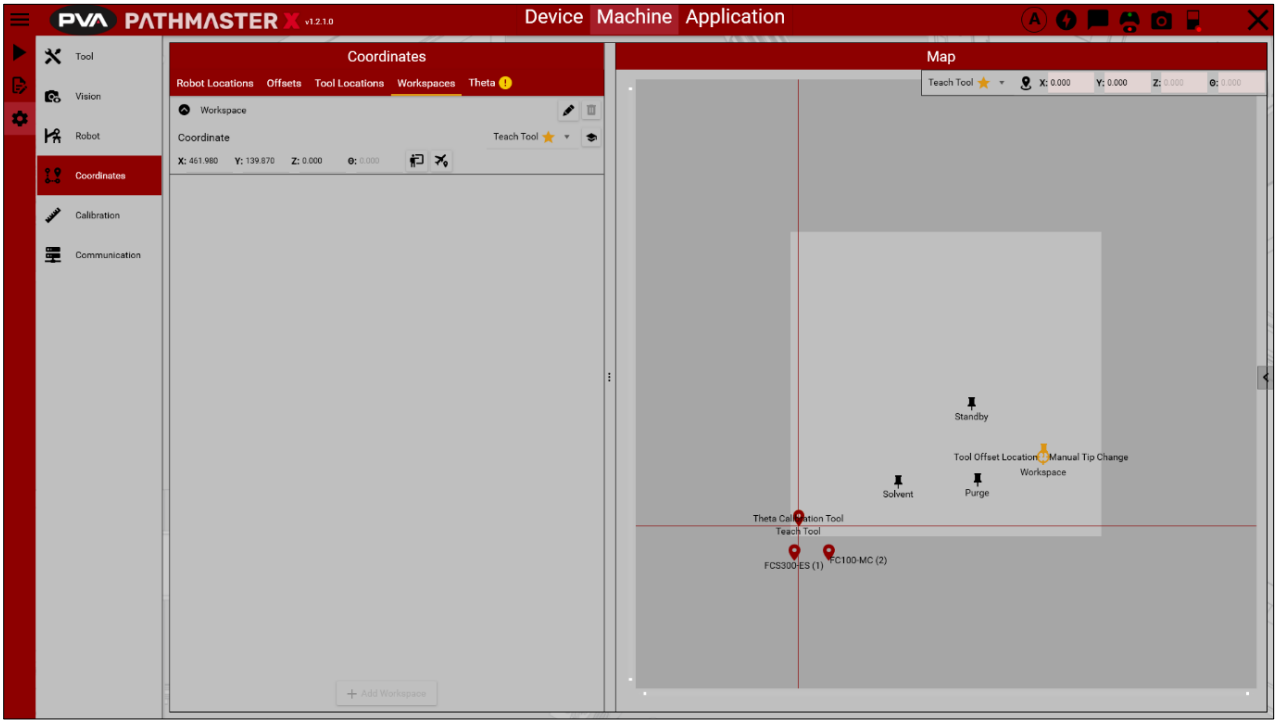

Figure 92: Workspaces

6.2.4.5 Theta

Theta calibration is used to calculate the theta center of rotation for each Tool in order to transform each Tool's X and Y position at any angle of the theta axis. Rather than forcing the Tool to a specific taught theta for use, the Tool can now be used accurately at any theta angle. Theta calibration uses a wizard to walk the user through a series of steps to complete the calibration successfully.

Two types of theta calibration are available: **Sensor Theta Calibration** and **Manual Theta Calibration**.

- The **Sensor Theta Calibration** uses a proximity sensor mounted on the calibration plate. The Theta Teach Tool finds the proximity sensor at three defined angles on the theta axis to calculate the center of rotation.
- The **Manual Theta Calibration** does not use a proximity sensor. In place of the sensor, the user aligns the Theta Teach Tool with the reference point on the calibration plate at three defined angles.

6.2.4.5.1 Tool Angle Selection

1. Select the theta calibration Tool.
2. Select three angles to use for the calibration. One of these angles must be 0°.
3. Typically, these angles will be set to **First**: *0°*, **Second**: *90°*, **Third**: *180°*.

6.2.4.5.2 Sensor Selection

1. Use the **Sensor** checkbox to select the **Sensor Theta Calibration** option. To run **Manual Theta Calibration**, leave this box unchecked.
2. Select the theta calibration sensor device from the dropdown menu.

6.2.4.5.3 Speed and Timeout

1. Sensor Theta Calibration requires speed and timeout to be defined. **Find Speed** is the speed used to find the edge of the theta calibration sensor with the theta calibration tool.
2. **Travel Speed** is used to position the Tool before the sensor find operation.
3. **Timeout** is the amount of time the system waits for the sensor to be asserted before throwing an error.
4. Typical settings are: **Find Speed**: 0.5 mm/sec, **Travel Speed**: 5.0 mm/sec, **Timeout**: 10000 ms.

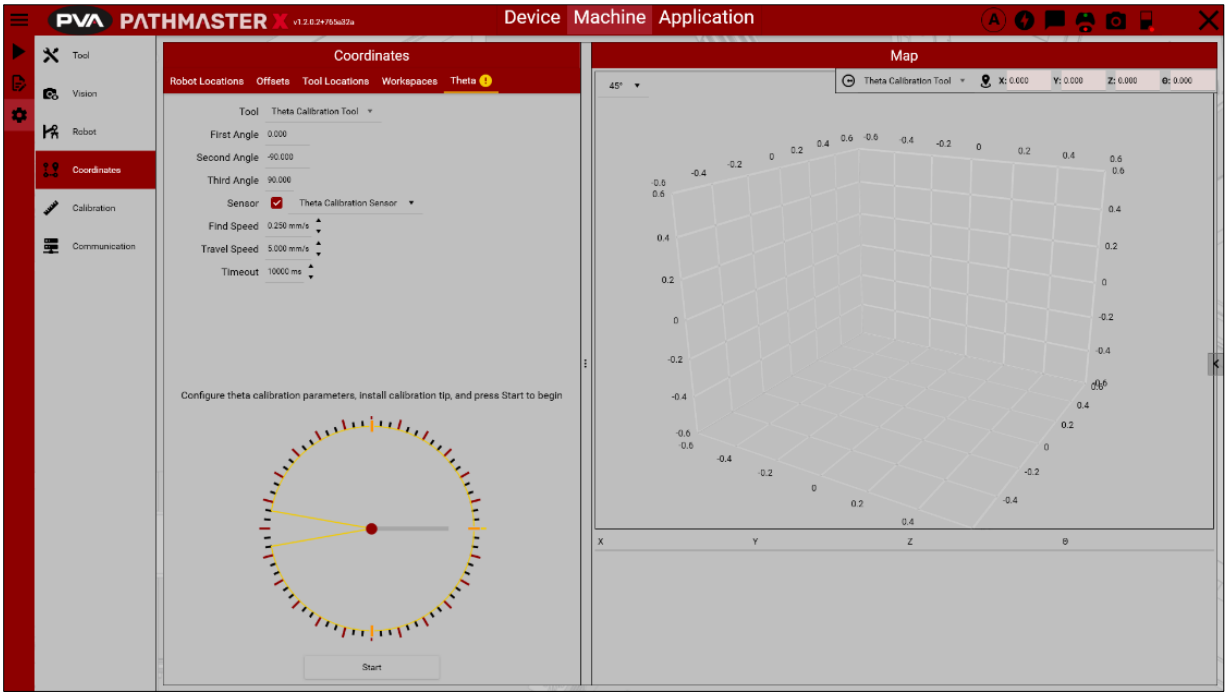

Figure 93: Theta Calibration

6.2.4.5.4 Calibrating a Theta Axis

1. Install the Theta Calibration Tool.
2. If applicable, use Quick Actions or devices to actuate the board stops to a down position. Place the theta calibration sensor/plate in place against the board stops or fixed workspace.
3. Press **Start** to begin calibration steps.
4. When prompted, use the pendant to move the calibration tool over the sensor (Sensor Theta Calibration) or calibration reference point (Manual Theta Calibration).
5. If the theta axis is moved to a different angle than the one required, select **Fix Theta** and the machine will move the theta axis back to the correct angle.
6. Once the calibration tool is aligned with the sensor or calibration point, click **Next**.
7. If using a sensor, the machine will determine an exact offset to the sensor before moving to the next angle.
8. Complete all three angles repeating steps 4-6 and review the points displayed.

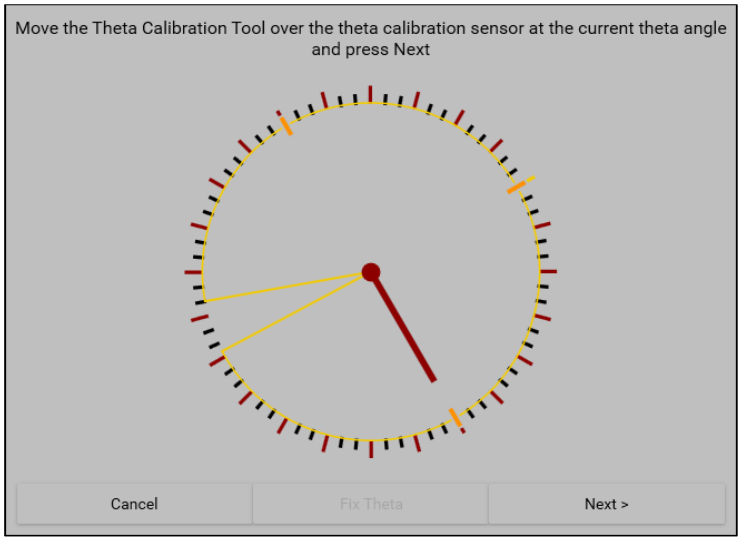

Figure 94: Sensor Theta Calibration

6.2.4.5.5 Calibration Override

Calibration override performs a center of rotation calculation based on a specific Tool's location. Global calibration extrapolates the Center of Rotation calculations for all Tools based on the Theta Teach Tool.

1. If applicable, use Quick Actions or devices to actuate the board stops to a down position. Place the theta calibration sensor/plate in place against the board stops or fixed workspace.
2. Select the Tool that will have its global offset overridden, as well as the angle between steps of the override. The selected step angle determines how many reference points need to be taught.
3. Press **Start** to begin calibration steps.
4. The machine will automatically move to the theta angle needed. When prompted, move the Tool over the fixed calibration point or theta sensor (if selected).
5. Once overrides are taught, a **Clear Overrides** button will be visible in the Theta tab of the Coordinates pane. Click this button to clear all taught overrides.

Note: Changing a tool offset will also clear any theta overrides.

The graphic in the Map pane of the Theta tab provides a visual representation of the swing arcs for each Tool. The user can select the number of points displayed in the graphic with a dropdown near the top of the display. The total number of points shown is equal to 360 degrees of the circle divided by the number selected. Large sets such as those displayed by 1 or 2 degrees require more resources to calculate and will slow down the page.

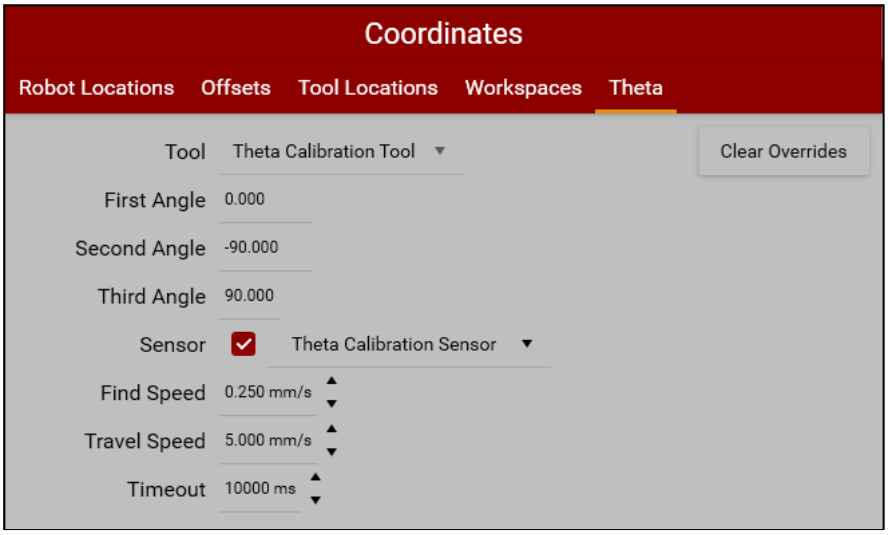

Figure 95: Calibration Override

6.2.5 Calibration

6.2.5.1 Needle Calibration

To set up needle calibration, a reference position showing where the needle calibration unit is within robot space needs to be taught. Next, the location of the sensors within the unit needs to be determined. The steps below outline the setup process.

Note: Setting up needle calibration requires valves compatible with the needle calibration sensor and a PVA needle calibration sensor purchased with the machine.

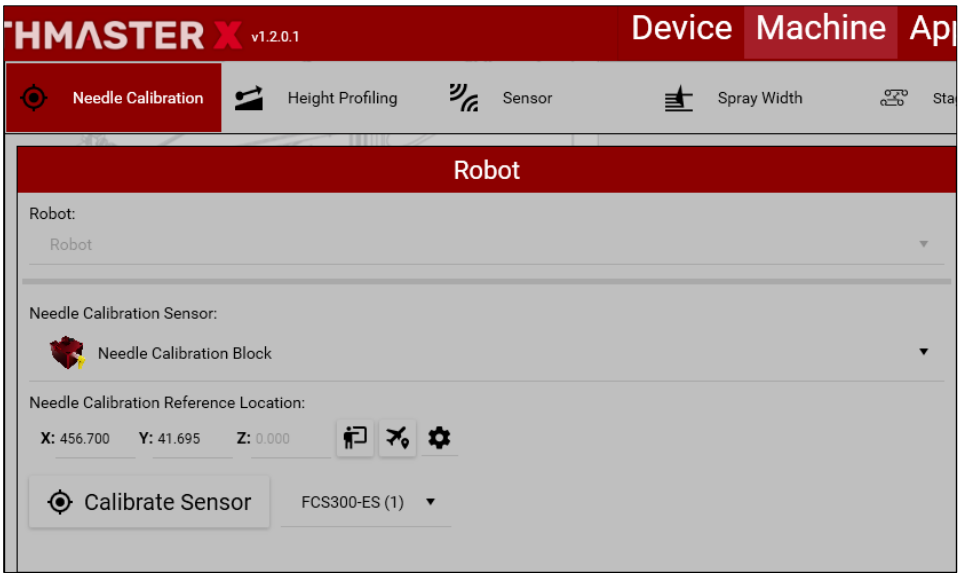

Figure 96: Needle Calibration Sensor

1. Select the **Needle Calibration Sensor** from the dropdown. *If one does not appear, the sensor must be created and configured in the Devices section.*

2. Move the Teach Tool to the crosshair on the calibration sensor. *A Teach Tool offset must be defined before the needle calibration reference location can be taught.*

3. Teach the calibration sensor reference position by pressing the **Teach** button  . This position may be returned to with the **Move** button  .

4. Select the Tool to use for the Calibrate Sensor sequence. The Calibrate Sensor process uses this Tool to find the location of all sensors in the calibration unit. Any needle calibration compatible Tool can be used. For best results, use a Tool and needle that are common to most applications.

5. Start sensor calibration by pressing the **Calibrate Sensor** button. Wait until the calibration routine is complete before continuing.

6. When complete, review the Sensor Visualization graph and tip offsets under the Tools section to verify. The graph represents the location of the calibration reference position and sensors.

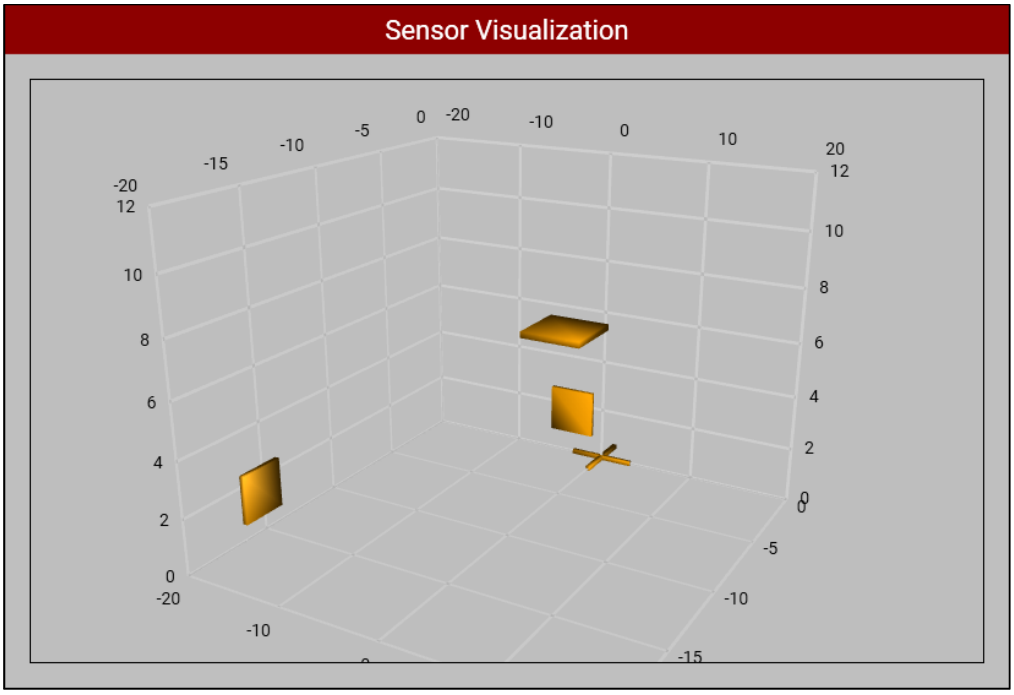

Figure 97: Sensor Visualization

The **Tools** pane on the Needle Calibration page is used to define which Tools are made available to the needle calibration process. Use the selector switch to the left of each Tool that will be used for needle calibration.

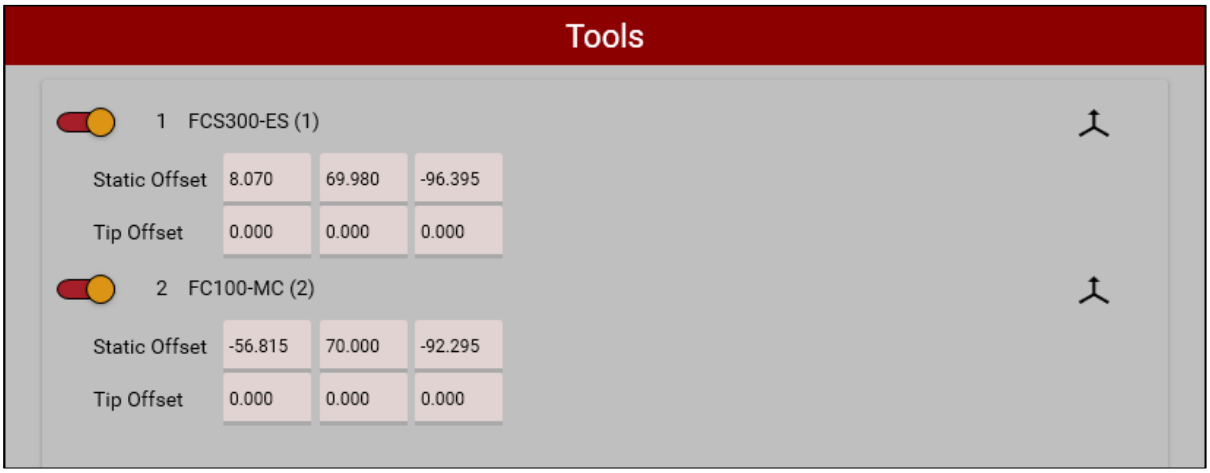

Figure 98: Needle Calibration Tools

Once the needle calibration is configured, each needle calibration Tool needs to be calibrated. In the Tools view, click and select all Tools that require calibration and press the **Calibrate Select Tools** button.

Note: The tip offset for a Tool is updated after needle calibration is run. Offset positions are displayed for information purposes on this page and can only be updated from the Coordinates page.

Needle calibration can be run from the needle calibration configuration page or the header menu. Once configuration is complete, needle calibration is typically run from the header menu. Only Tools that have been enabled on the Needle Calibration tab will be available for use through the header menu. Needle Calibration can be added as a Trigger step as well.

6.2.5.2 Height Profiling

Height profiling devices are used to establish a relationship between the height profiling device and physical Tools in order to support multi-surface dispensing.

1. Teach the **Calibration Location**. This must be done with the Teach Tool.
2. Select the physical Tool to perform the calibration with from the **Robot Selected Tool** menu.
3. Click the **Start** button to begin calibration.
4. Follow the on-screen instructions. When complete, click the **Finish** button.

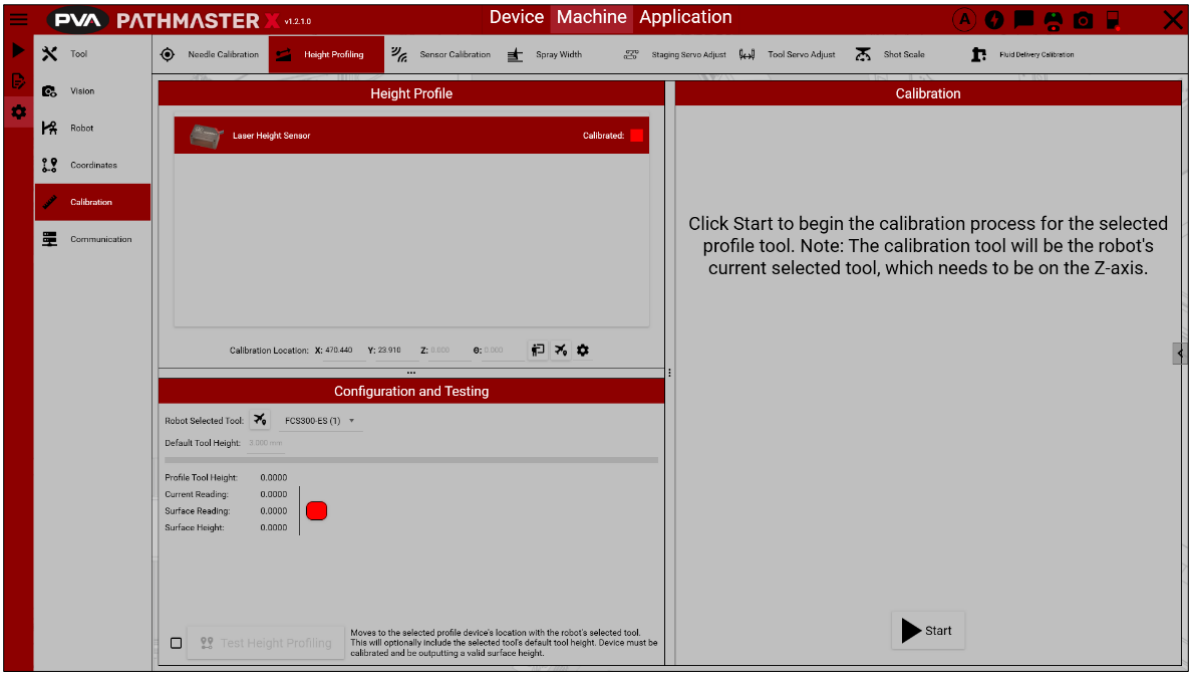

Figure 99: Height Profiling

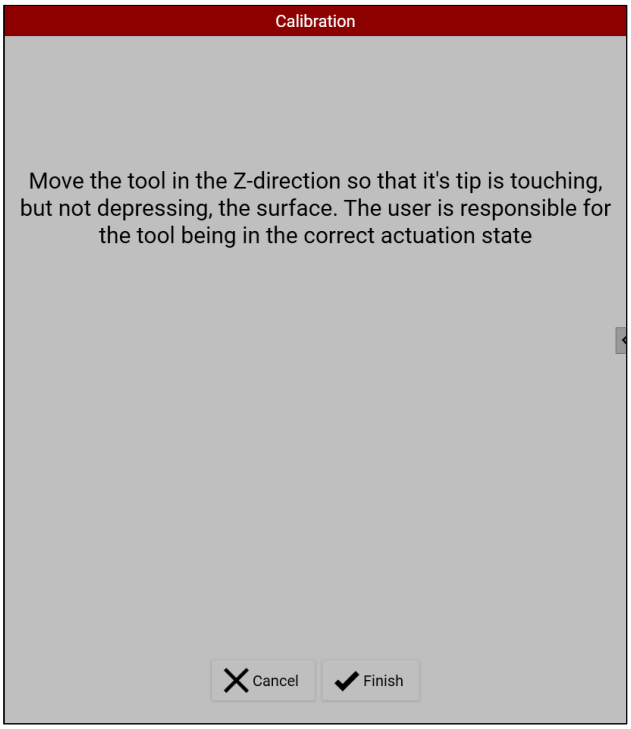

Figure 100: Height Profiling Calibration

Once calibration is complete, the height profile can be tested from the Configuration and Testing pane.

1. Move the height profiling device over the surface to test.
2. Select a Tool to test with from the **Robot Selected Tool** menu.
3. Click on the **Test Height Profiling** button. Select the checkbox next to the button to move to the **Default Tool Height** instead of the surface itself.
4. The selected Tool will move to the z-height of the surface that was profiled by the height profiling device.

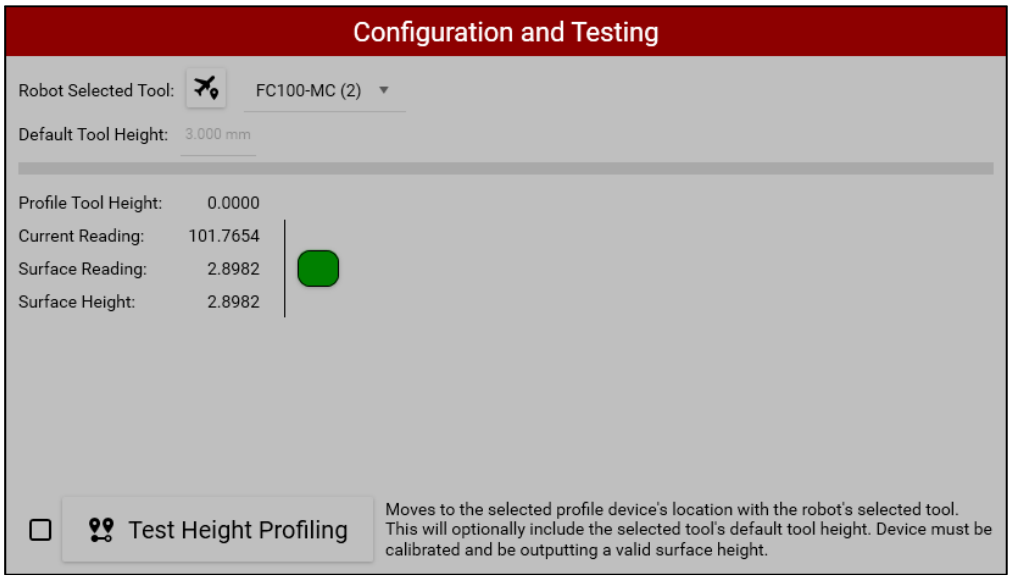

Figure 101: Height Profiling Testing

To use height profiling in a Program, simply add a Surface Reading step to the Program at the location to be profiled. After the Surface Reading step, all paths will run relative to the height measured at that step.

If the height profiling laser is on the z-axis, the process for calibrating the laser Tool as a profiling Tool is also nearly identical, with one minor difference. The laser Tool will travel to the calibration location using its current tool offset.

For example, if the reading for the tool offset was ~140 mm, the laser will travel to ~140 mm off the calibration location. This is important to remember when teaching the tool offset, as it's possible that certain machines may not be able to reach the calibration location at this height.

6.2.5.3 Sensor

Analog sensors are calibrated to ensure that readings are accurate to measured values within their range.

Sensors that are not calibrated appear with a red square. The square turns green when that device is calibrated.

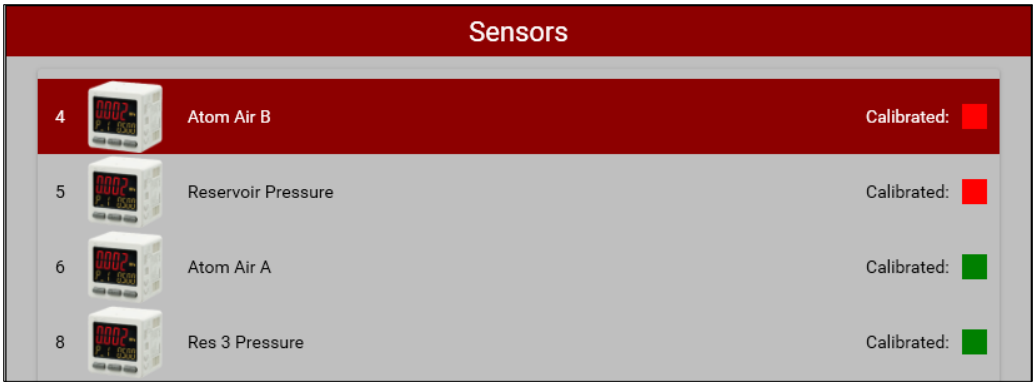

Figure 102: Sensor Calibration

The Properties pane displays the current analog signal, as well as the calibrated low and high levels of signal and measurement.

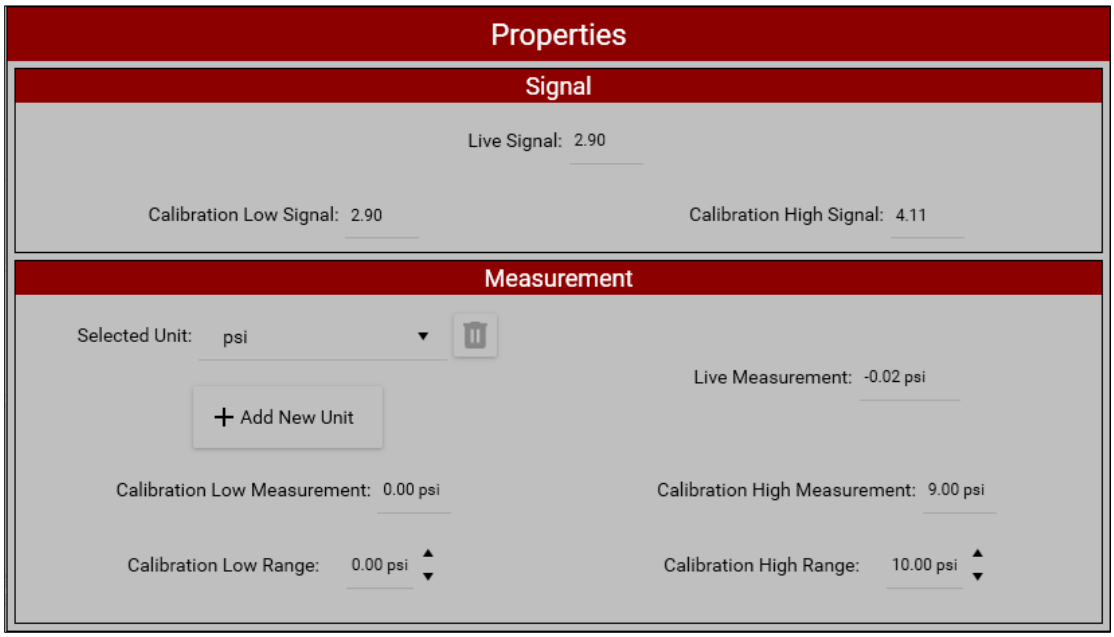

Figure 103: Sensor Calibration Properties

A calibration is configured and performed under the calibration section on the right-hand side of the page. If a calibration is already completed, a new calibration can be performed by clicking the **Recalibrate** button. The **Total Reading Time** and **Time Between Readings** determine how many samples are used for calibration. The default settings take ten samples per second for 10 seconds.

6.2.5.3.1 Calibrating an Analog Sensor

1. Select the sensor to be calibrated under the Sensors section.
2. Under the Calibration section, select the **Start** button to begin calibration.
3. As prompted, modify the signal to be as low as reasonably possible, and enter the measurement reading into the numeric text editor. Note that Galil analog signals will be in voltage, while PLC analog signals will be in the units used by that particular device.
4. If manual calibration is desired due to high noise levels, etc. mark the **Manually Enter Signal** checkbox at the bottom which will allow entry of a low and high **signal** value. Continue with the given instructions to complete a calibration.

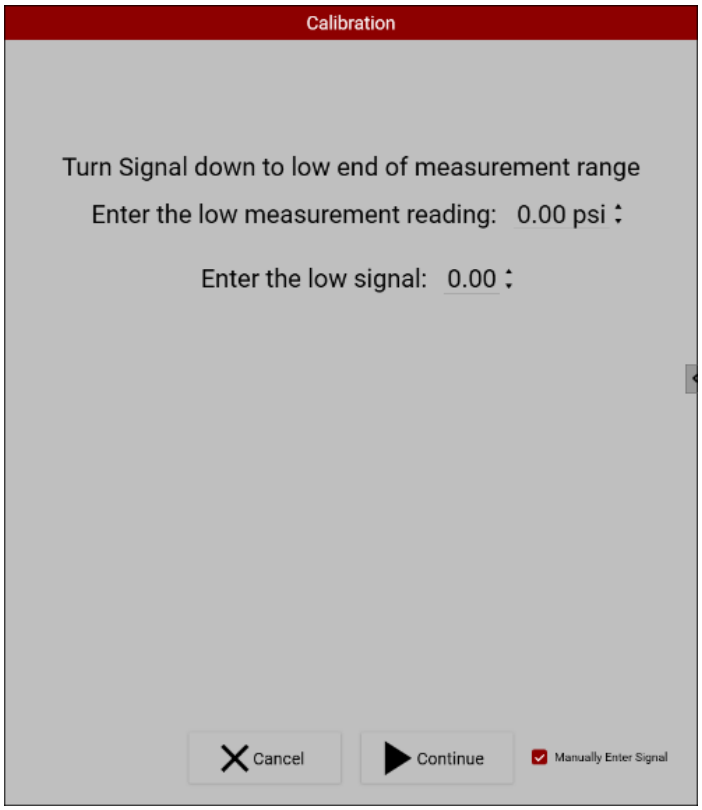

Figure 104: Manually Enter Signal

5. If the output needs to be turned on/off for readings, press the **Toggle Output** button. Click **Continue** when the low actual reading matches the low measurement reading in the application.

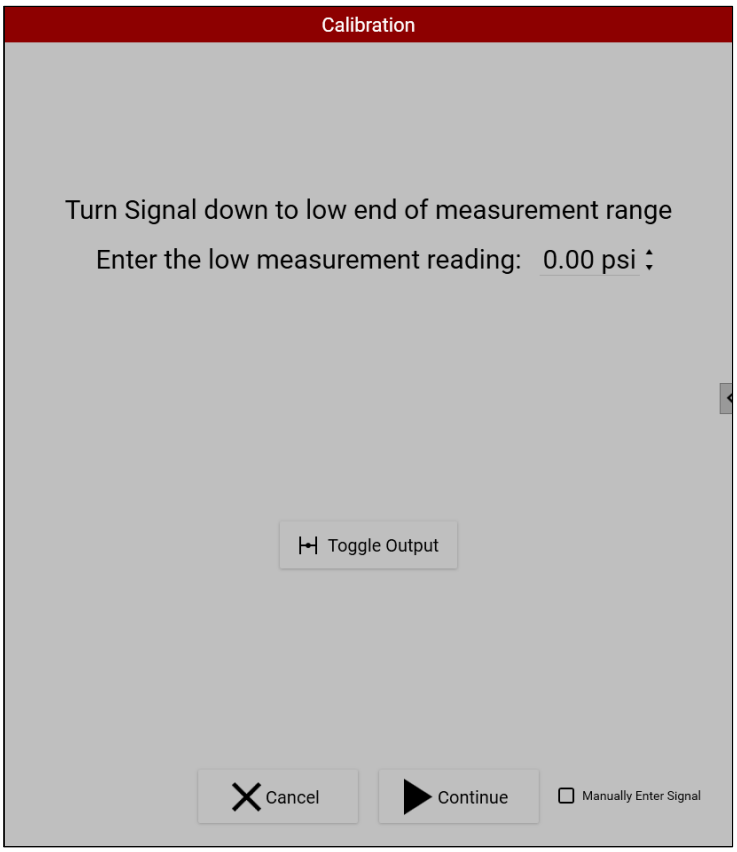

Figure 105: Low Measurement

6. The program will gather signal readings for 10 seconds to filter noise and get an average signal.

7. In the Properties section, review the calibration low signal and low measurement.

8. As prompted, modify the signal to be as high as reasonably possible, and enter the measurement reading into the numeric text editor. If the output needs to be turned on/off for readings, press the **Toggle Output** button.

9. Press **Complete** when the high actual reading matches the high measurement reading in the application.

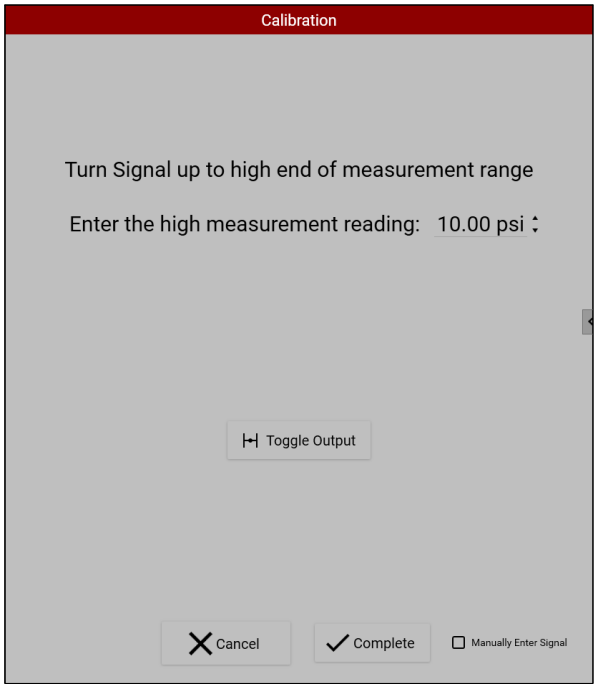

Figure 106: High Measurement

10. The program will gather signal readings for 10 seconds to filter noise and get an average signal.

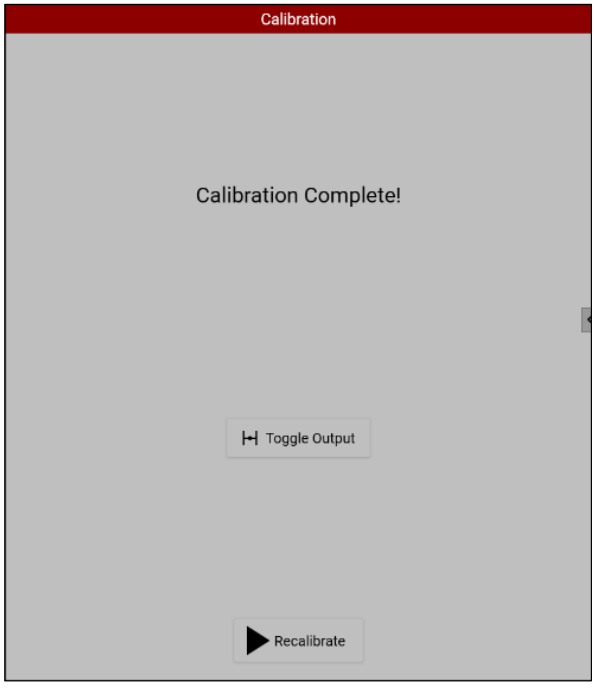

Figure 107: Sensor Calibration Complete

6.2.5.4 Spray Width

Valves that have automatic adjustable spray need to be calibrated. The Spray Width section allows setup and refinement of spray width procedures. A compatible spray width sensor device and at least one Tool with an E/P Regulator device component added are required to perform calibration.

1. Teach the **Spray Width Reference Location** on the Robot pane.

This point does not need to break the laser plane. There is no verification of the taught point as it is not guaranteed the valve will reach.

2. Add a Spray Tool with the dropdown menu at the bottom of the Tools pane. Only Tools that have an E-P Regulator as a component will be visible.

3. Set the Tool's parameters in the Tools pane under the selected Tool:

    - Minimum and maximum values for Pressure.
    - Minimum and maximum values for Width.
    - Whether to rotate to the B position of any existing Rotary devices.
    - The Theta position to use when checking or setting a spray width.

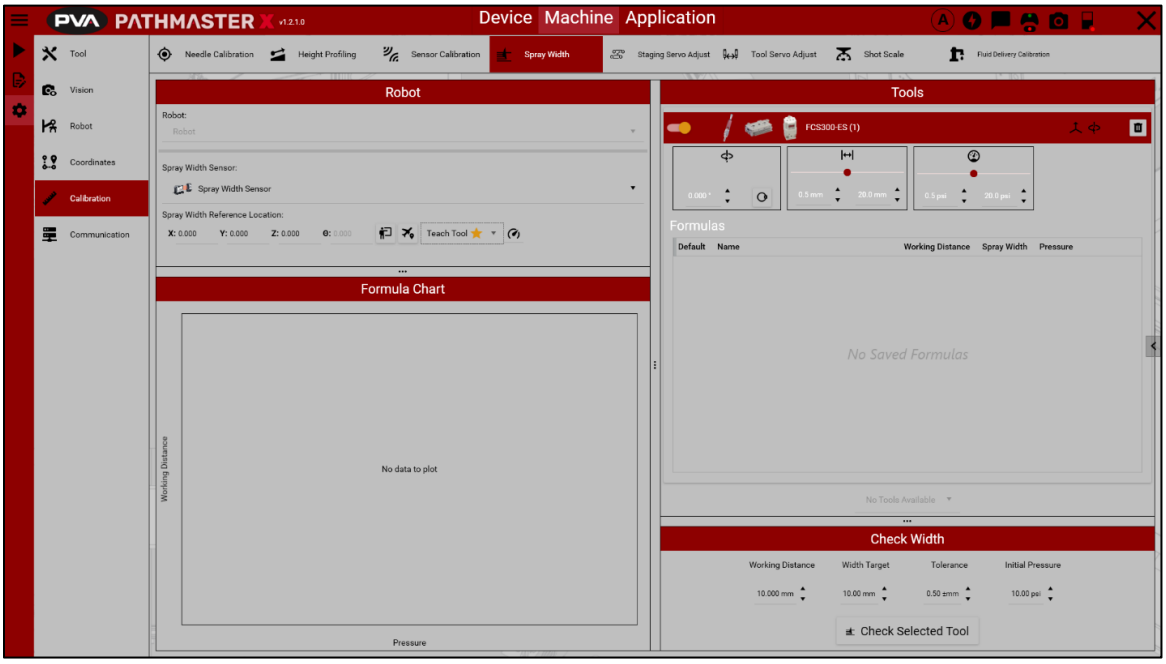

Figure 108: Spray Width

To perform a check, set the parameters in the Check Width pane on the right side:

1. Set the **Working Distance** (Z Distance from taught reference location).
2. Set the **Width Target**.
3. Set the allowable **Tolerance** from the Width Target.
4. Set the **Initial Pressure** to use to attempt to get the Target Width.
5. Click the **Check Selected Tool** button.
6. On successful attainment of the Target Width, a formula will be created.
7. The last accepted formula will be displayed on the Formulas list under the selected Tool and can be used on a per-device basis for use in the “Set Spray Width” script.

Formulas from the selected Tool will appear in the Formula Chart pane with the following information:

- Pressure used to achieve the spray width is the X Axis
- Working Distance represented on the Y axis
- Each data point has a small rectangle to roughly depict the attained width

Spray width checks can be performed automatically by adding the “Set Spray Width” step to a Process or Trigger.

6.2.5.5 Staging Servo Adjust

For devices capable of auto width adjust, proper calibration is required for accurate functionality.

In the Staging Devices pane, all devices capable of width adjustment will be displayed along with their calibration status. If the status is red, it has not been calibrated. If it is green, it has been successfully calibrated.

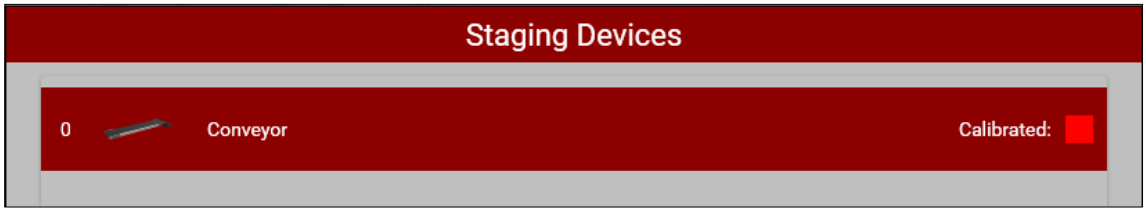

Figure 109: Conveyor Width Adjust

6.2.5.5.1 Calibrating a Staging Device

1. Select the device to be calibrated.
2. Under the Calibration pane, select the **Start** button to begin calibrating.

Note: The device must be homed to properly calibrate.

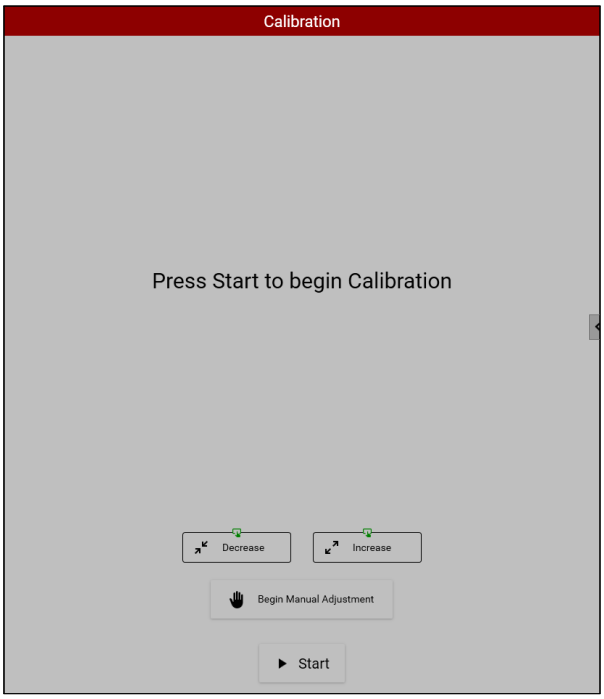

Figure 110: Staging Adjust Start

3. Use the **Decrease** button to move the conveyor to its minimum width.
4. To manually adjust the conveyor width, click the **Begin Manual Adjustment** button and adjust the conveyor to its minimum width.
5. Use a ruler to measure the actual low measurement of the conveyor at its minimum width.
6. Enter this value into the space provided.
7. Click the **Continue** button.
8. Adjust the conveyor to its maximum width using the **Increase** button, or via manual adjustment.
9. When the conveyor is at its maximum width, use a ruler to take the actual measurement. Enter the value into the space provided, then click the **Complete** button.

10. If manually calibrating, the **End Manual Adjustment** button will servo the drive, preventing manual changes to the device position.

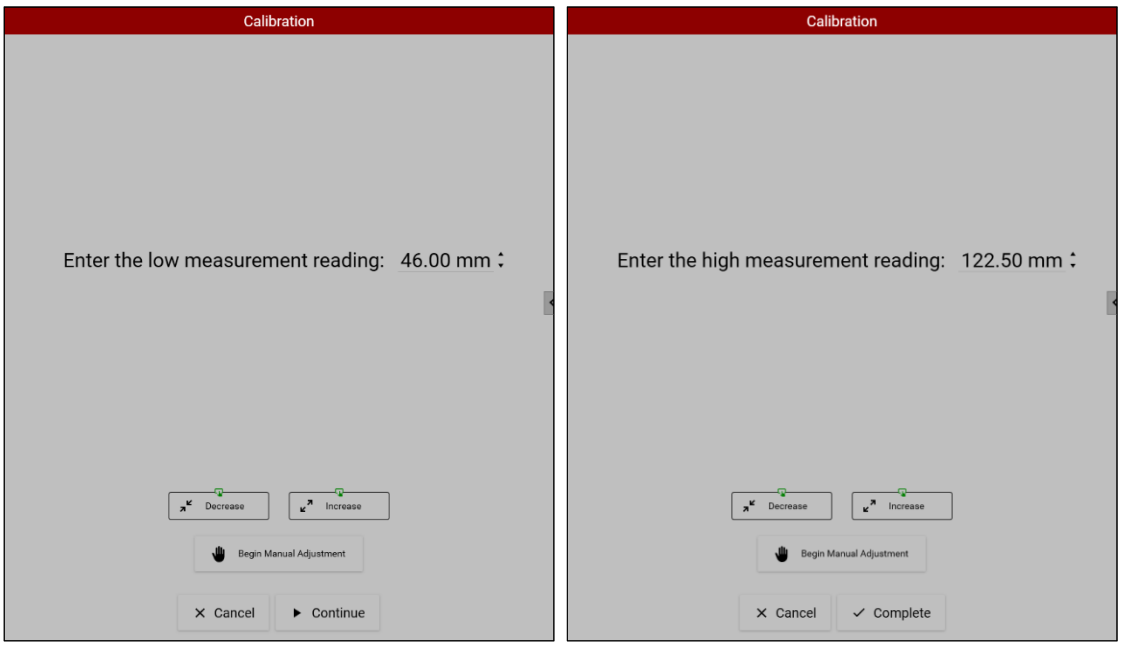

Figure 111: Staging Adjust Calibration (Low and High Measurement)

Once calibration is complete, the staging device's width can be adjusted incrementally or set to a specific value.

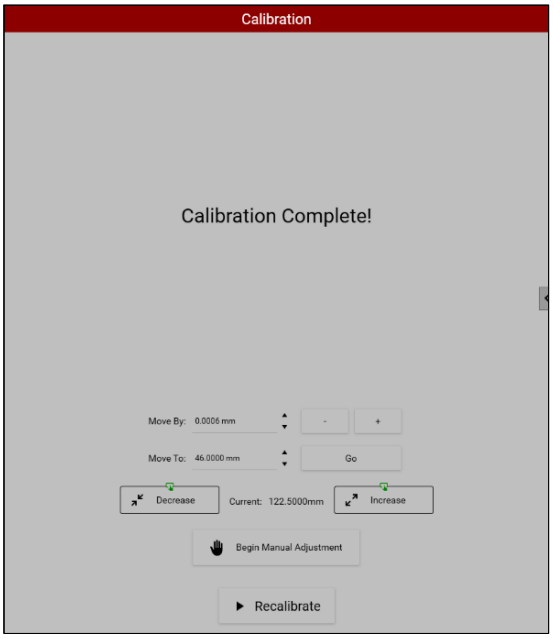

Figure 112: Staging Adjust Calibration Complete

6.2.5.6 Tool Servo Adjust

For Tools capable of auto width adjust, proper calibration is required for accurate functionality. The process for calibrating Tool width is nearly identical to the Staging Device calibration process.

In the Tools pane, all Tools capable of width adjustment will be displayed, along with their calibration status. If the status is red, it has not been calibrated. If it is green, it has been successfully calibrated.

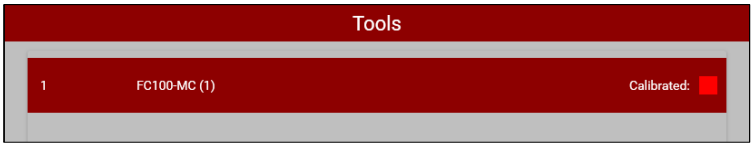

Figure 113: Tool Width Adjust

6.2.5.6.1 Calibrating a Tool

1. Select the Tool to be calibrated.
2. Under the Calibration pane, select the **Start** button to begin calibrating. The Tool must be homed to properly calibrate.
3. Use the **Decrease** button to move the Tool to its minimum width.
4. Use a ruler to measure the actual low measurement of the Tool at its minimum width. Enter this value into the space provided, then click the **Continue** button.

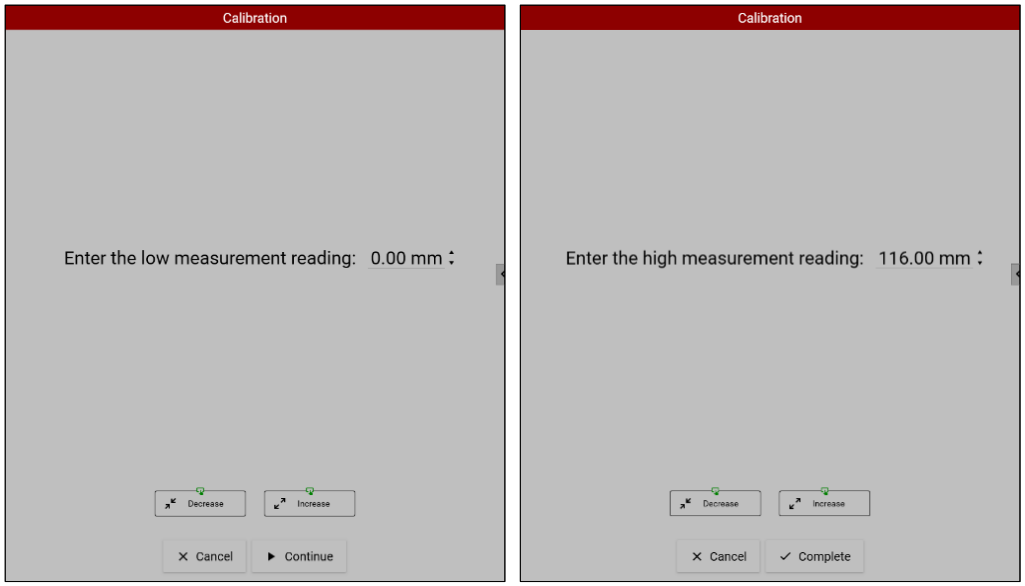

Figure 114: Tool Adjust Calibration (Low and High Measurement)

5. Adjust the Tool to its maximum width using the **Increase** button.

6. When the Tool is at its maximum width, use a ruler to take the actual measurement. Enter the value into the space provided, then click the **Complete** button.

Once calibration is complete, the staging device's width can be adjusted incrementally, or set to a specific value.

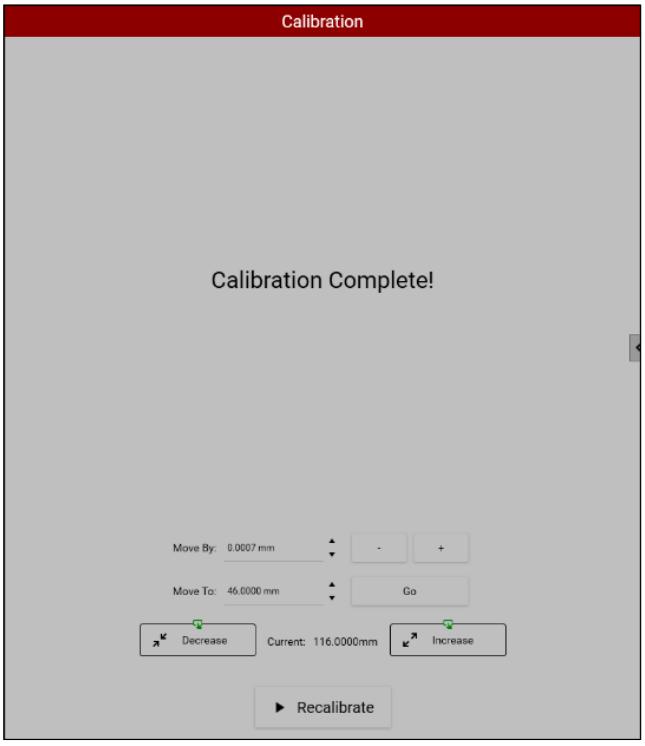

Figure 115: Tool Adjust Calibration Complete

6.2.5.7 Shot Scale

The Shot Scale tab is used to set up and configure scales to be used for shot weight checks. A compatible scale device needs to be created and configured prior to calibration.

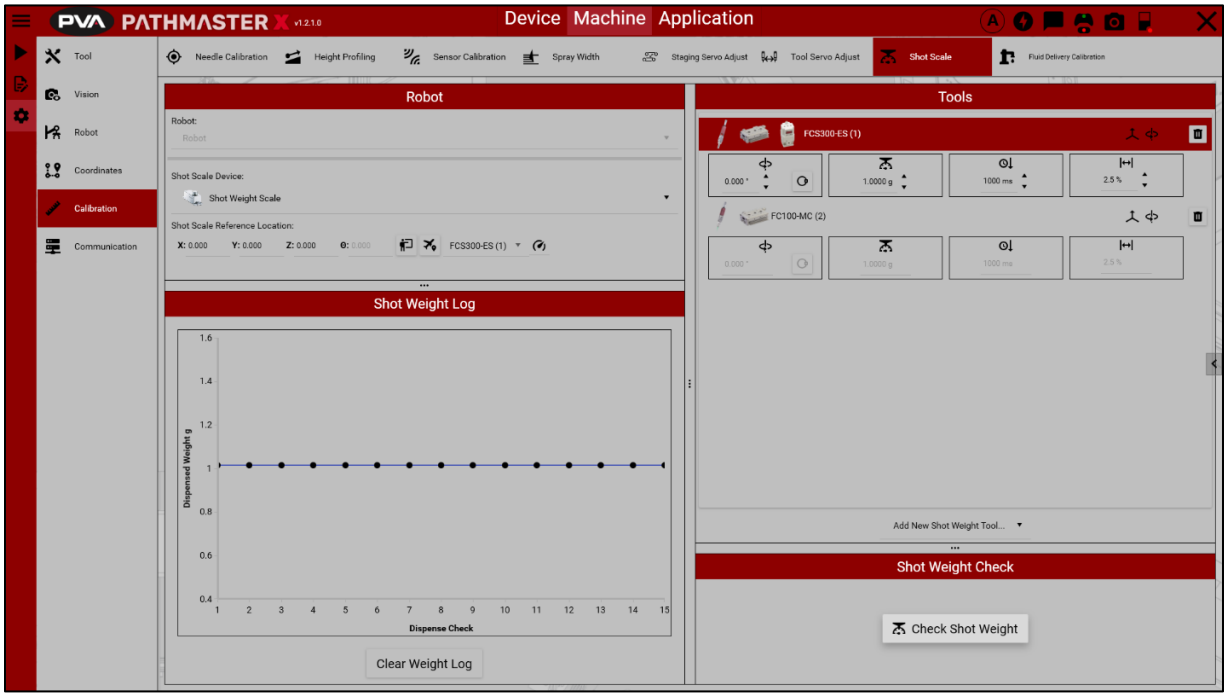

Figure 116: Shot Scale

6.2.5.7.1 Shot Weight Check Setup

1. Select the shot scale device from the **Shot Scale Device** dropdown menu.

2. Teach the **Shot Scale Reference Location**. This is where the material will be dispensed for the shot weight check. The location can be taught with any configured Tool.

3. Add Tools that can be used with the Shot Weight Check. These Tools will be available as parameters for the Shot Weight Check Program, Process, and Trigger steps.

4. Set the Theta Position, Target Weight, Dispense Time, and Tolerance values for each Tool. Theta Position can be manually entered or set to the current Theta position value using the Set Current Theta Position button.

Units for the Target Weight will be automatically populated by the shot scale once the scale has a valid reading. The default unit is grams.

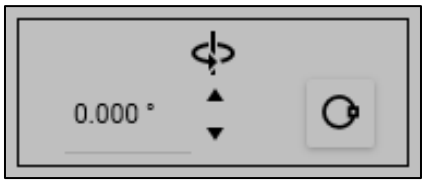

Figure 117: Shot Location Theta

5. In the **Shot Weight Log** pane, a graph will display the 30 most recent shot weight checks for the selected Tool.

6. Hovering over a data point will display the target weight, actual weight, dispense time, and tolerance values of the shot weight check performed.

7. Clicking the **Clear Weight Log** button will delete the shot weight check history. Any user-defined Program or Process logging will be unaffected.

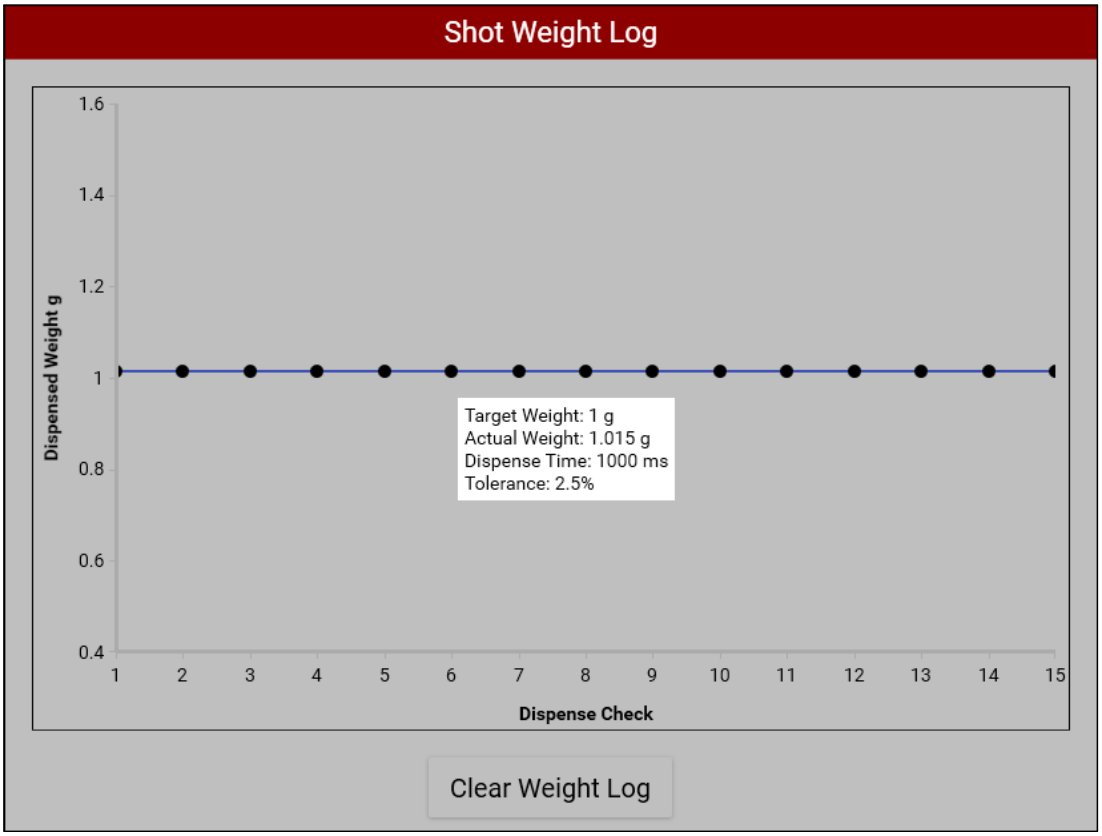

Figure 118: Shot Weight Log

6.2.5.7.2 Manually Performing Shot Weight Check

1. Select a configured Tool.
2. Under the Shot Weight Check pane, click the **Check Shot Weight** button.
    - The Shot Weight Check will be performed with the selected Tool and given values.
    - The results will be displayed once the check is complete.
    - An error will be displayed if the dispensed weight is out of tolerance.

6.2.5.8 Fluid Delivery

PCP and PDP devices are calibrated through this page. PCP and PDP devices can be calibrated through Volumetric and Continuous.

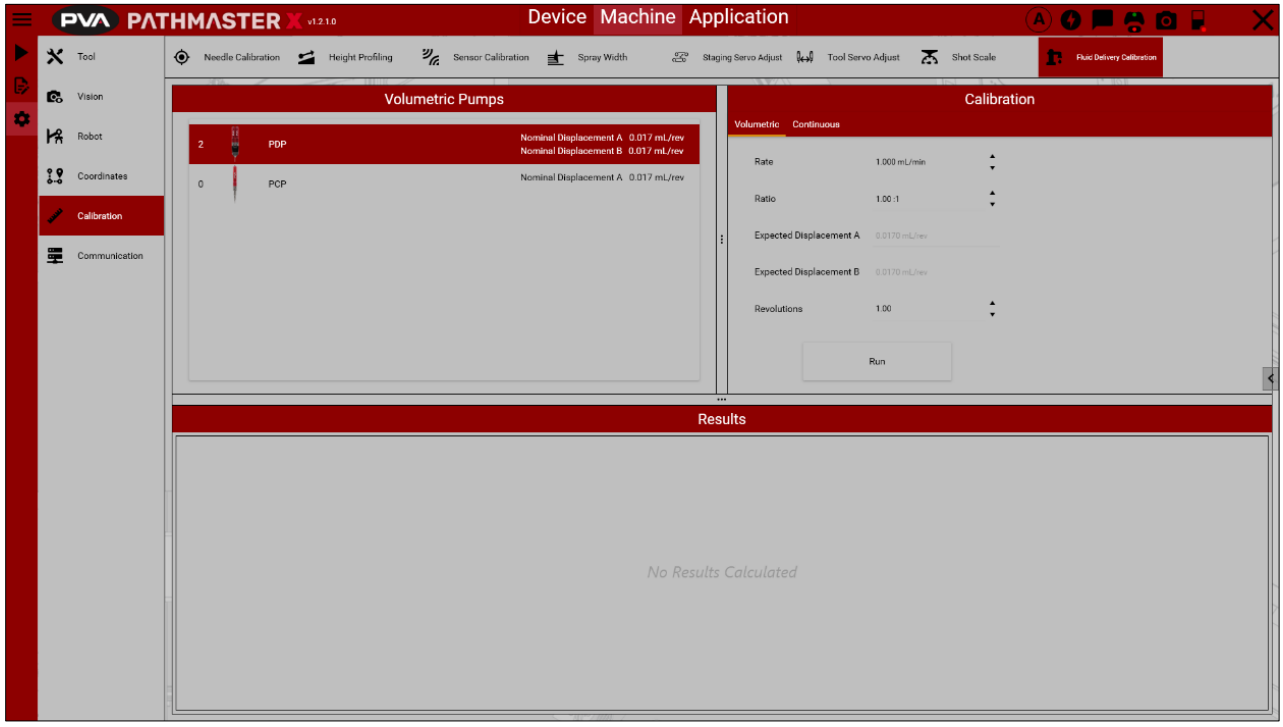

Figure 119: Fluid Delivery

Volumetric Calibration is used to get the measured volume dispensed from the pump(s) after the given number of revolutions.

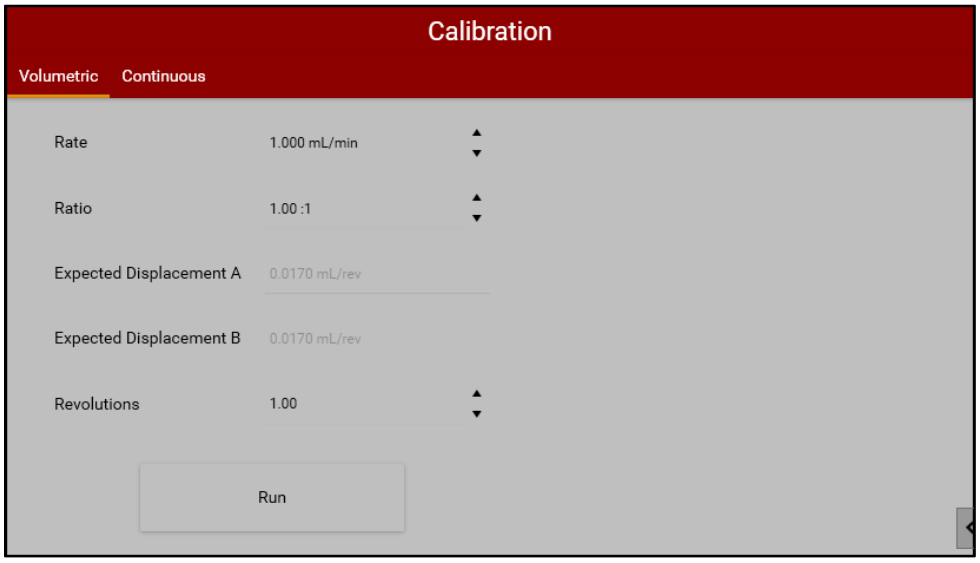

Figure 120: Volumetric Calibration

Continuous Calibration uses the Expected Displacement and calculates the rate based on the ratio between the Expected Displacement and the Nominal Displacement. The Continuous Calibration method can be performed multiple times for a more accurate result.

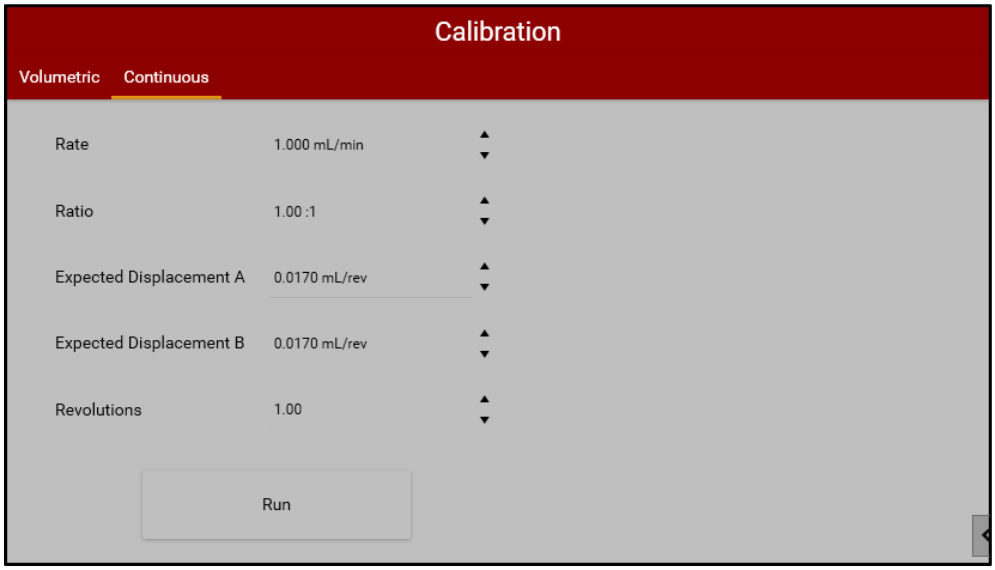

Figure 121: Continuous Calibration

Both calibrations give the actual displacement, per pump, at the set rate. The results are calculated after the Measured Volume is entered and the user presses the **Run** button.

6.2.6 Communication

The Communication tab allows for the creation and configuration of connection interfaces with factory servers and other machines. The creation and configuration of these interfaces are very similar to those of Devices.

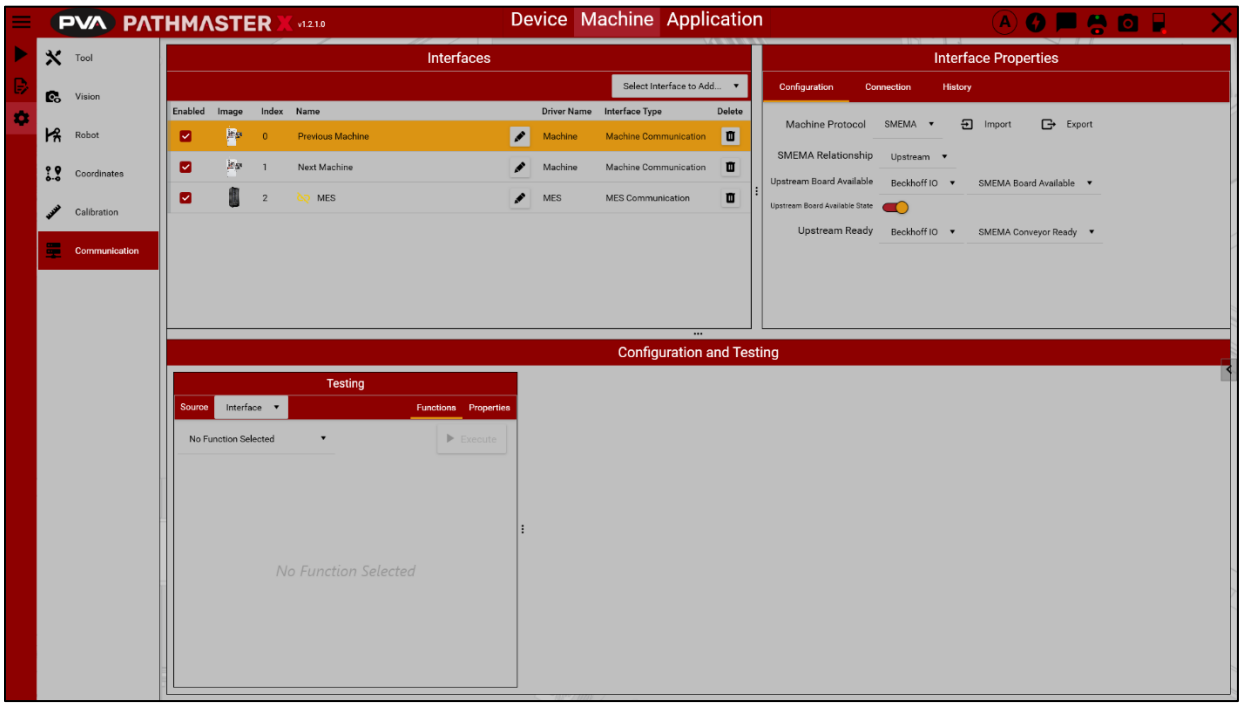

Figure 122: Communication

6.2.6.1 Machine

Machine interfaces allow for communication between PVA machine and other assembly line machines. To facilitate communication with other machines, an interface must be created and configured:

1. Under the Interfaces pane, select **Machine** from the **Select Interface to Add** dropdown menu. Add an instance of the machine interface for each machine that is connected to the one you are configuring. Name each interface something easily identifiable and that describes the relationship to the machine being configured, i.e. “Previous,” “Next,” “Upstream,” “Downstream.”

2. From the Configuration tab in the Interface Properties pane, select the **Machine Protocol** from the dropdown menu, or import a protocol with the **Import** button. Any protocol-specific settings will be displayed when a protocol is selected.

6.2.6.1.1 SMEMA Setup

1. Select SMEMA from the **Machine Protocol** dropdown menu. At present, this is the only option, but in future releases other options such as Hermes will appear here.
2. Choose the interface's relationship to the machine being configured:
    - **Upstream**: This interface describes a machine that will supply parts to this machine.
    - **Downstream**: This interface will allow communication with a machine that will receive parts from this machine.
    - **Bidirectional**: This interface describes a machine that can both supply and receive parts to and from this machine.
3. After selecting a relationship, configure the rest of the IO properties as defined by that relationship.
4. Once configured, SMEMA functions can be used as part of a Trigger or Process.

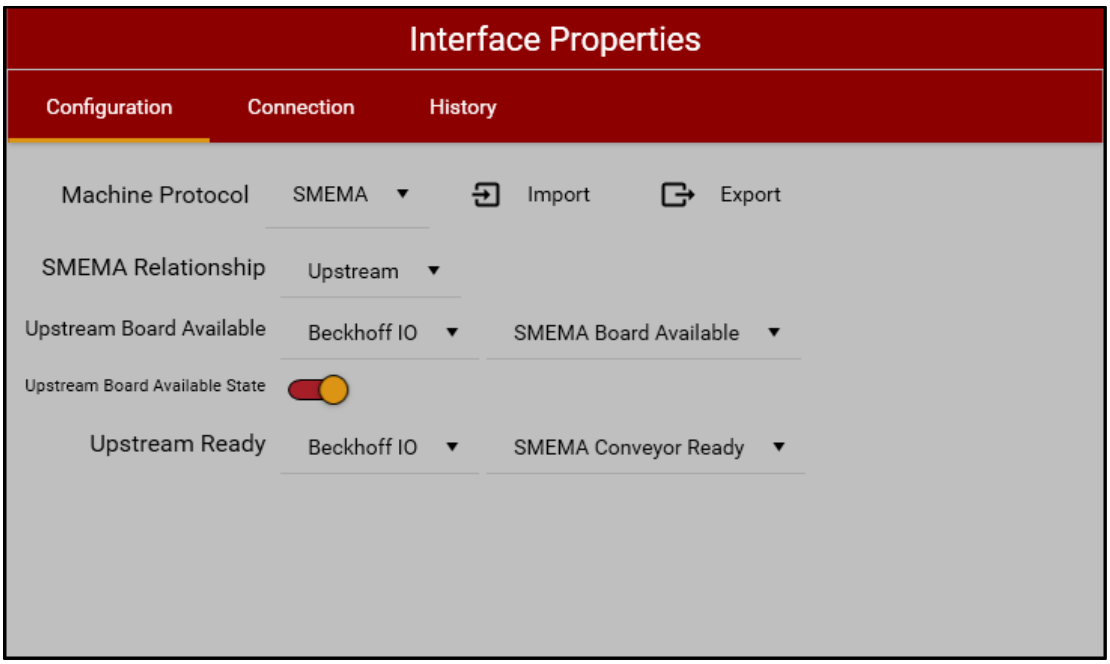

Figure 123: SMEMA Configuration Properties

6.2.6.2 MES

MES interfaces allow for communication between a PVA machine and a factory system. In order to integrate MES communication and functionality into a Process, an interface must first be created and configured:

1. Under the Interfaces pane, select “MES” from the **Select Interface to Add** dropdown menu.

2. From the Configuration tab in the Interface Properties pane, select the **MES Protocol** from the dropdown menu or import a protocol with the **Import** button. Any protocol-specific settings will be displayed when a protocol is selected.

Note: No MES protocols are included by default.

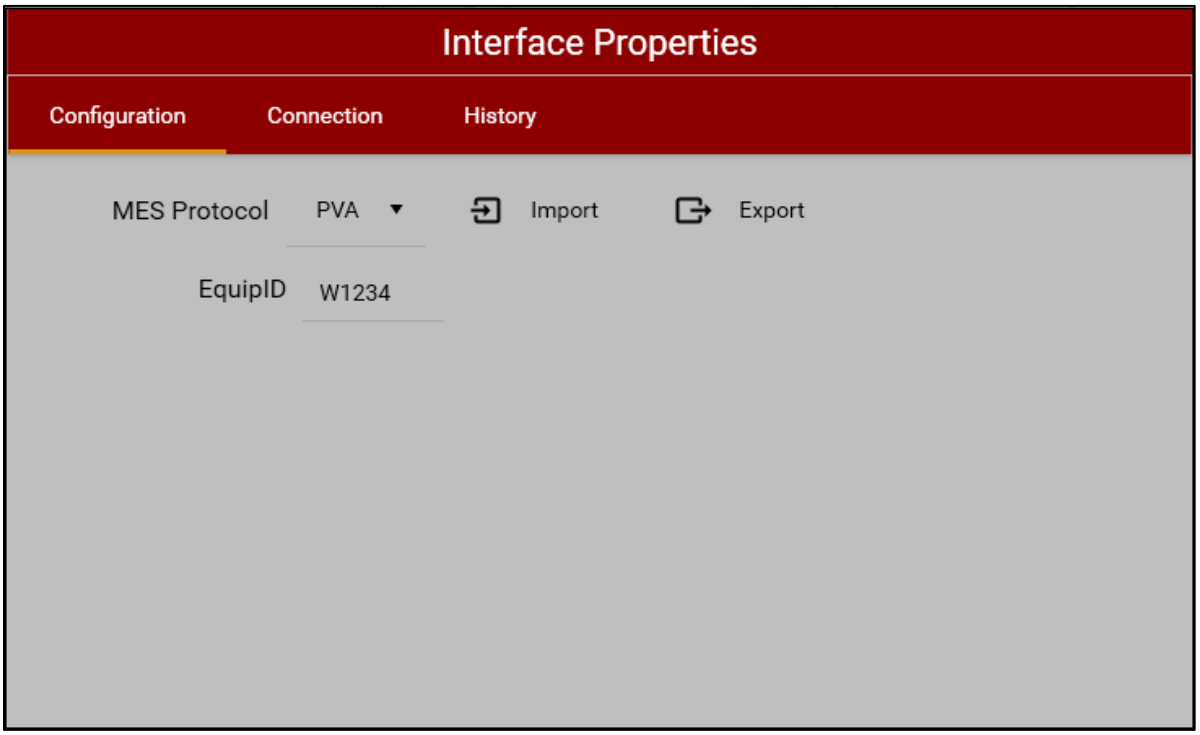

Figure 124: MES Interface Properties

3. Under the Connection tab, select the communication protocol from the dropdown list at the top of the pane. Once a protocol is selected, enter the appropriate values for all of the settings.

4. Once configured, available MES functions can be used as part of a Trigger or Process. Which functions are available depend on the MES protocol used.

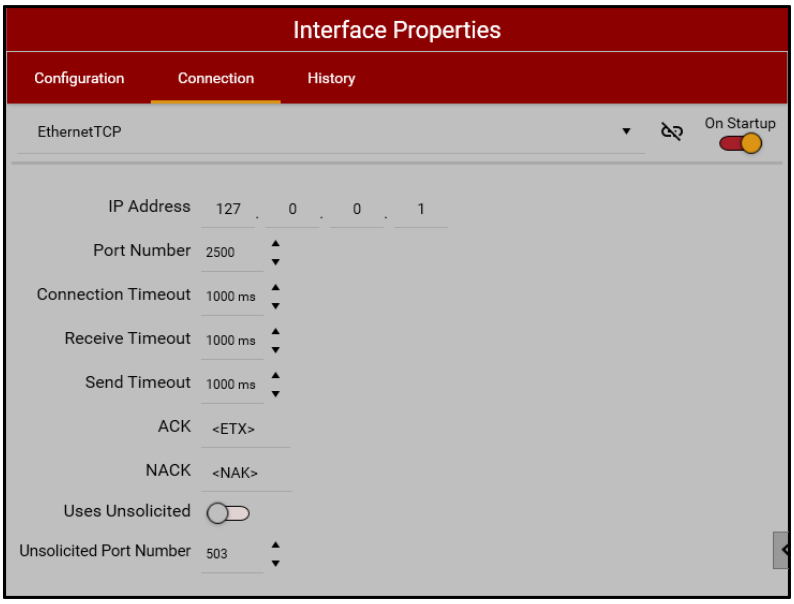

Figure 125: MES Connection

6.2.6.2.1 MES Function Viewer

The MES Function Viewer allows viewing and hot reloading of scripts used in the MES protocol. Functions are written and executed in the Python programming language. Existing PVA functions can be used as a formatting guide for more custom functions. The **Refresh** button at the bottom allows the application to reload the script without needing to restart the application.

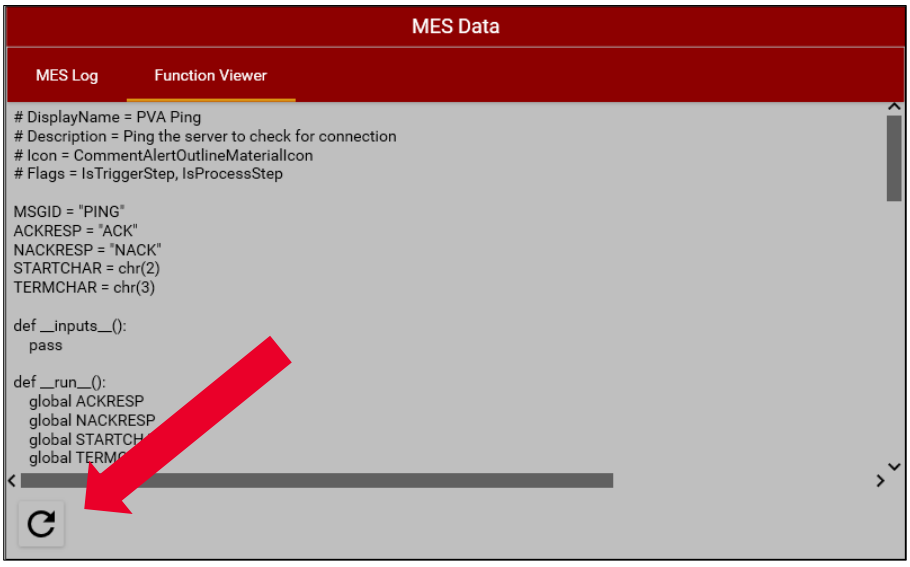

Figure 126: MES Function Viewer

Once a function is written and placed properly, it will appear in the Functions dropdown in the Testing pane which allows it to be executed from within the application.

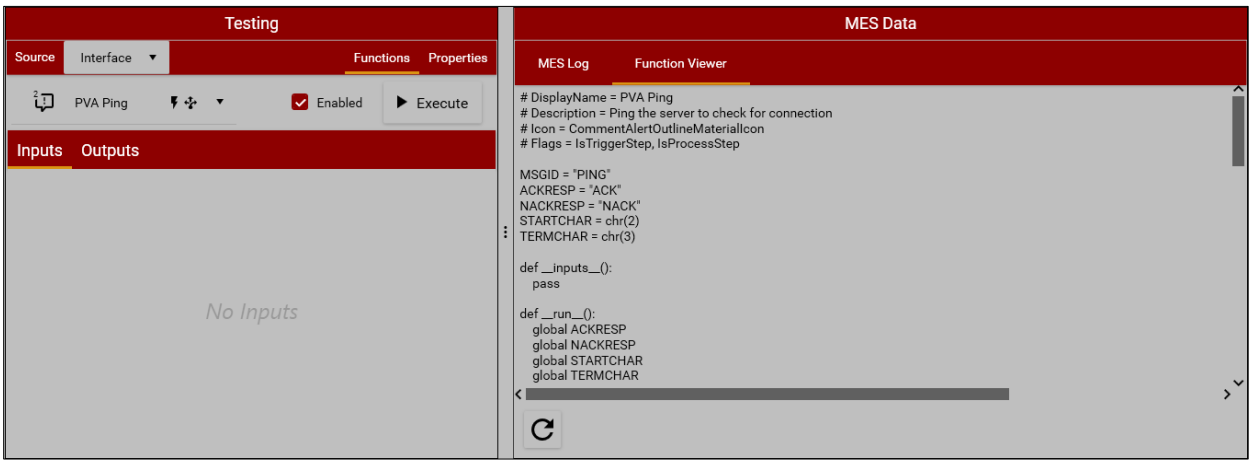

Figure 127: MES Testing

6.2.6.2.2 MES Log

An MES log is provided to track messages between client and server. Each instance of MES retains its own log and can be viewed by selecting it from the **MES Interfaces** dropdown menu. This log is also viewable from the Notifications header menu item.

Log details show the direction of the message relative to the machine's PC (**SENT** by MES, **RECEIVED** from remote server, or **LOCAL** status message), the timestamp of the message, and the actual data sent or received in the exact format it was sent or received in.

How non-printable control characters are displayed can be changed through a menu under the **Information** button  on the top-right of the MES Data pane and header menu. Non-printable characters can be displayed as **Text**, **Hexadecimal**, and **None**. A button to clear the log is also on this menu.

The log only displays the most recent 200 messages and clears them in a First In, First Out order, with the most recent messages being at the bottom of the log.

The Log displayed in the application clears every time the software shuts down and restarted. Old logs are saved in the application's file structure as text documents with a .meslog extension and are not viewable in the application.

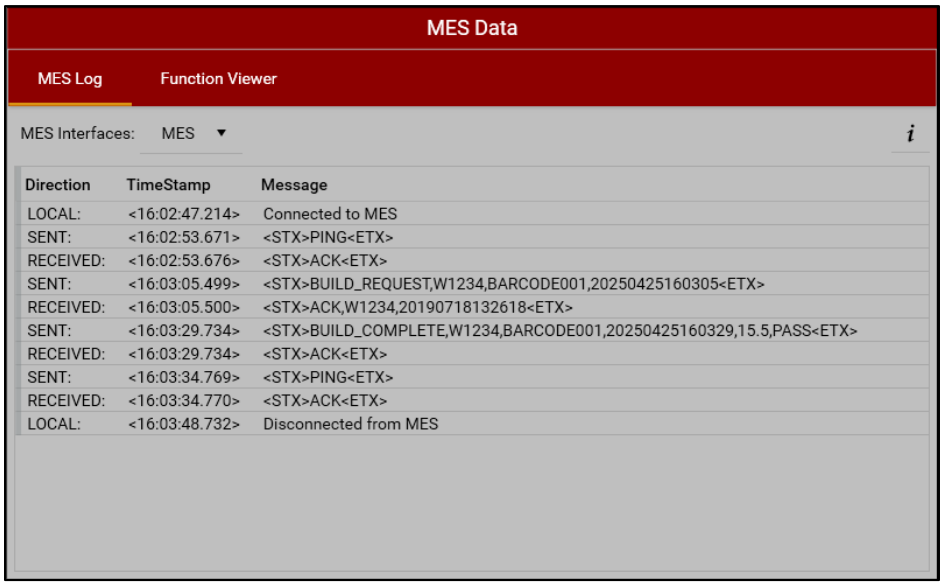

Figure 128: MES Log

6.3 Application

6.3.1 Triggers

Triggers are used to run specific features and scripts at certain events.

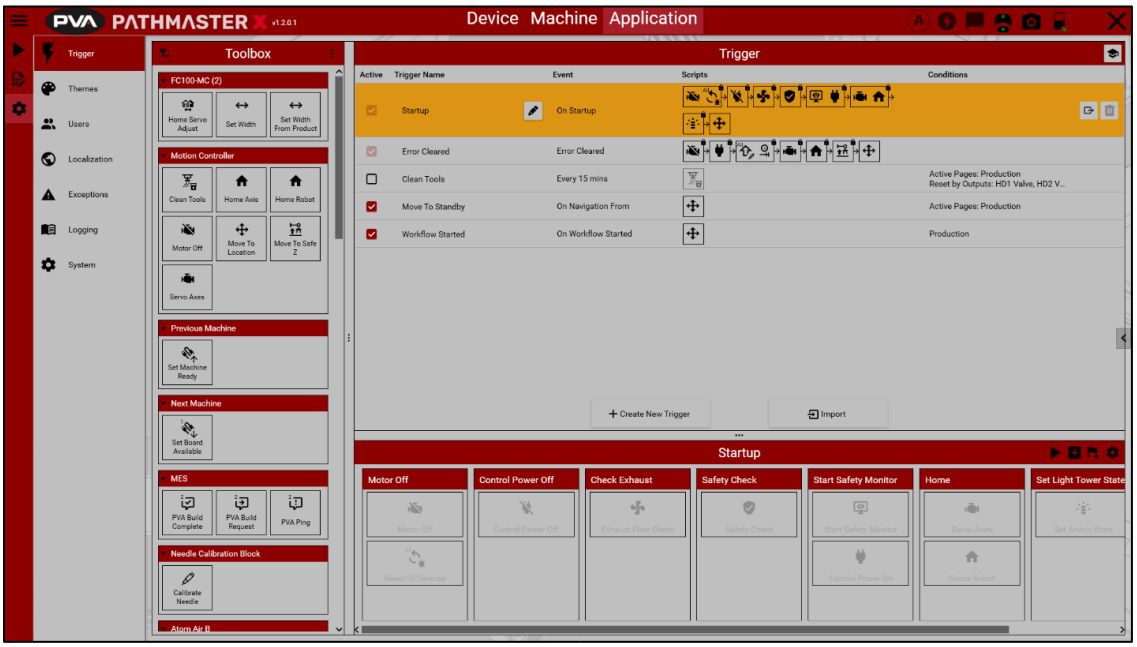

Figure 129: Triggers

6.3.1.1 Creating and Configuring a Trigger

1. Select **Create New Trigger**. Pressing the **Edit Name** button allows the trigger to be renamed.
2. To configure a trigger, open the configuration menu with the **Configure Trigger** button on the trigger header bar.
3. Select a **Source** from the dropdown list. Source types include: Navigation, Error, User, Time, Application, Manual, Program, Process, Workflow, and Cyclical. More information on these and their associated Events are provided later in this section.
4. Select an **Event** from the dropdown list. What Events are available depend on the Source selected.
5. When **Wait for Completion** is checked, the trigger will hold up the application until execution is finished instead of running parallel to other application processes. This way the trigger gains priority.
6. **Locked** triggers cannot be edited.

Note: Locked triggers are for PVA use only.

Figure 130: Configure Trigger

7. When the event scheduler is selected, a trigger will only run once within the given time period. Below is an example of a trigger that will run at most once per day.

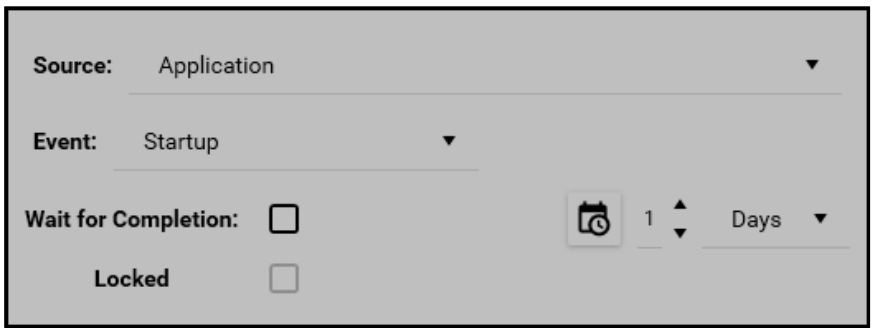

Figure 131: Event Scheduler

8. Setting up trigger functionality is exactly the same as setting up a Process. Select a trigger step from the toolbox and drag it into the first available lane. Additional lanes can be added with the **Add Lane** button  , and conditional lanes can be added with the **Add Conditional Lane** button  .

Some steps have inputs that will need to be configured correctly to work as intended. Both lanes and trigger steps can be reordered in any desired order. Multiple triggers within the same lane run parallel to each other, and lanes run sequentially. Event schedulers are available for lanes and individual scripts as well.

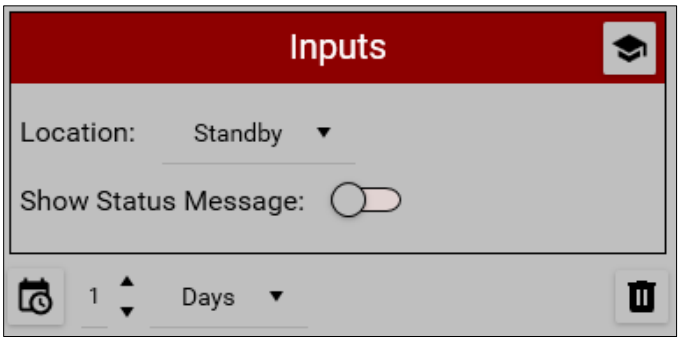

Figure 132: Trigger Inputs

Triggers can be enabled and disabled with the checkboxes on the left side.

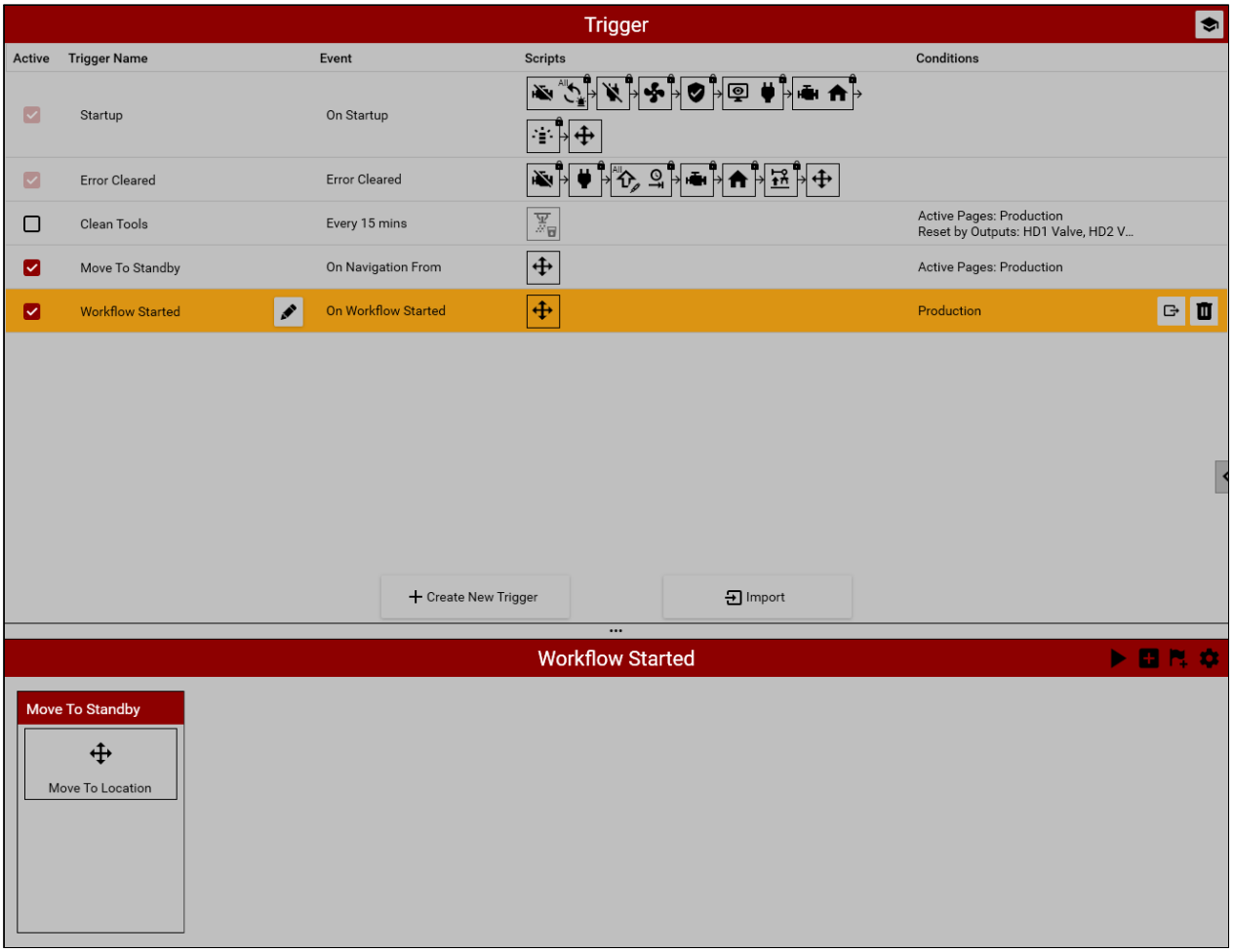

Figure 133: Configured Triggers

6.3.1.1.1 Types of Triggers

The following are the types of trigger sources, their associated events, and descriptions of their use:

Source	Events	Description
Navigation	Enter, Exit	Navigation triggers activate when a user enters or exits a page. Pages can be assigned to the trigger through the **Pages** tree menu, and added using the **Add Page** button ⊞.
Error	Active, Cleared	Error triggers activate whenever an error occurs, or when a user acknowledges it.
User	User Log On	User triggers activate whenever a user logs on.

Time	After, Every	Time triggers activate after a specified duration while on a certain page or pages. **After** events activate only once after the specified duration, and **Every** events activate and will restart and activate again after the specified duration. Pages can be assigned to the trigger through the **Pages** tree menu, and added using the **Add Page** button ⊞.
Application	Startup, Shutdown	Application triggers activate whenever PathMaster X is started, or shutdown.
Manual	<None>	Manual triggers are activated by the user from the Triggers tab of the Quick Actions menu. A manual trigger can be excluded from the Quick Actions menu by deselecting the **Is Quick Action** option.
Program	Started, Completed	Program triggers active whenever a Program is started or completed. Program triggers also have a **Context** option. These options are **Always**, **Production**, and **Creation**. Always will activate whenever a Program is run, while Production and Creation will be restricted to Programs executed while only on that mode.
Process	Started, Halted, Completed	Process triggers active whenever a Process is started, completes, or is unexpectedly stopped, either by error or user intervention. Process triggers also have a **Context** option. These options are **Always**, **Production**, and **Creation**. Always will activate whenever a Process is run, while Production and Creation will be restricted to Processes executed while only on that mode.
Workflow	Started, Completed	Workflow triggers active whenever a Workflow is started or completes. Workflow triggers also have a **Context** option. These options are **Always**, **Production**, and **Creation**. Always will activate whenever a Workflow is run, while Production and Creation will be restricted to Workflows executed while only on that mode.
Cyclical	<None>	Cyclical triggers will activate after a certain number of Process cycles are ran. The number of cycles is set by the **Cycles** option.

Note: Process Triggers activate when a Production cycle is started, completed, or halted. Workflow Triggers activate when an individual cycle inside of Production is started or completed.

6.3.2 Themes

In the Themes section, themes may be added using the **Add Themes** button. Theme names can be edited using the **Edit Name** button  . Themes may be deleted using the **Delete** button  .

6.3.2.1 Settings

In settings, the user can modify color settings of the currently selected theme. Using the dropdown provides standard colors as well as a custom color selector. To apply a custom color, match the desired shade then deselect the dropdown menu or click elsewhere on the page.

6.3.2.2 Content Preview

The Content Preview pane displays all major controls present in the application and provides a preview of what the theme changes will look like. Some controls are interactable, such as the timed button.

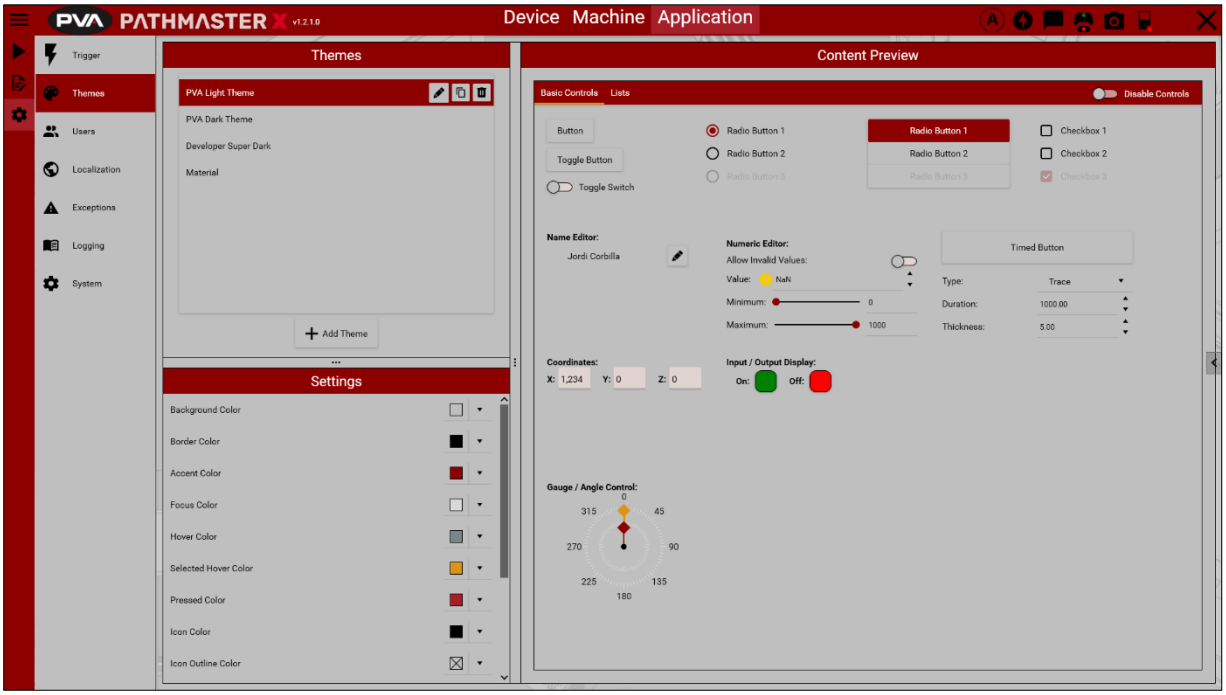

Figure 134: Themes

6.3.3 Users

Users and roles can be added to allow different access to application features. Each user that is created has a role. Roles act as a template for permissions. Role permissions for specific users can be overridden by an admin. Created users and roles are listed under their respective panes. The Info pane contains information on the selected user/role, and includes the user or role's profile image, name, timestamp of creation, name of the user that created it, timestamp of most recent modification, the user that most recently modified it, the user's role, active status, and Change PIN option if a user is selected, or a list of users assigned to the role if a role is selected. The Permissions pane includes all configurable permissions, grouped by category.

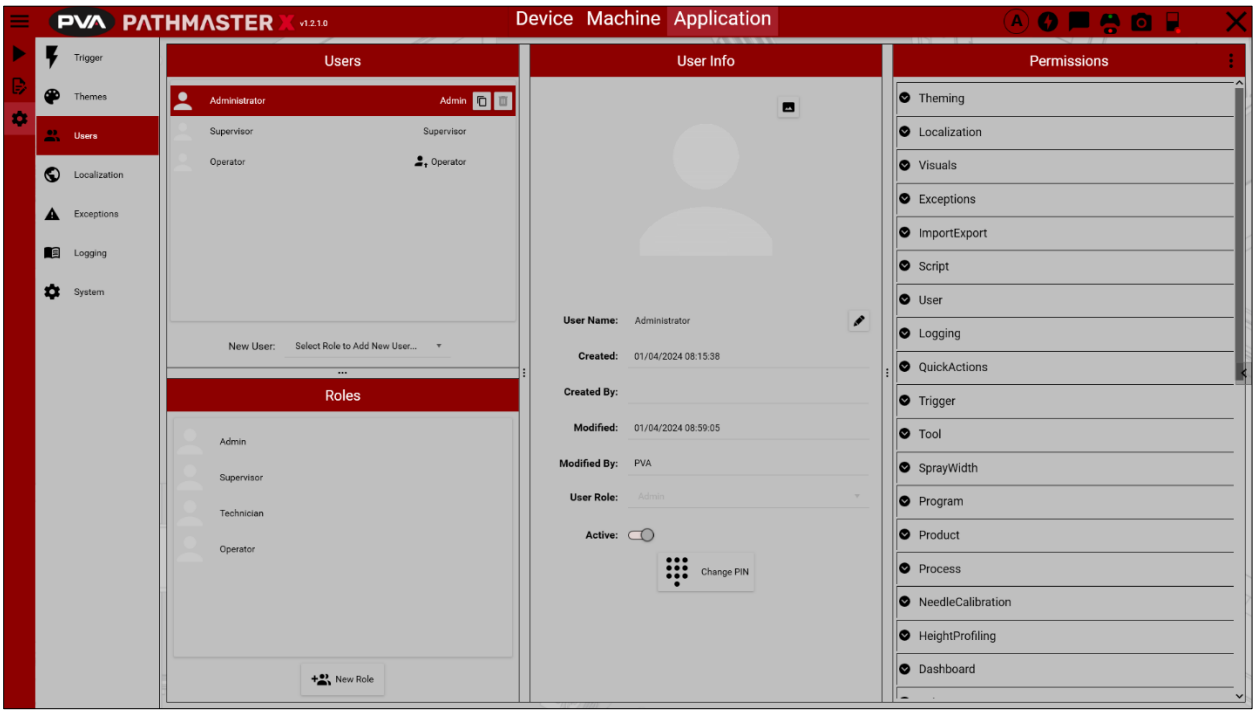

Figure 135: Users

6.3.3.1 Access Types

- **Full**: User has complete access and can view, create, edit, delete, etc. all areas associated with the permission.
- **Read Only**: User can only view the areas associated with the permission.
- **None**: User has no access to the areas associated with the permission, and any associated menu and navigation items will not be displayed.

6.3.3.2 Add a User

To add a new user, select a role from the dropdown list at the bottom of the Users pane. PathMaster X comes with four pre-configured roles.

Existing users can be copied by selecting the user and clicking the **Copy** button, or deleted using the **Delete** button.

To change the name of the user, click the **Edit Name** button next to the **User Name** in the User Info pane.

To change the user's profile image, select the **Change Image** button in the User Info pane.

A user's role can be changed at any time by selecting a new one from the **User Role** dropdown menu in the User Info pane.

6.3.3.2.1 Setting or Changing User's PIN

A user can change their PIN with the **Change PIN** button. When selected, the keypad will prompt the PIN of the user currently logged on. This is not the existing PIN of the user selected, but the PIN of the current user to prevent fraudulent changes.

Once entered, the keypad will prompt a new PIN. Once entered, click the **Next** button. The new PIN must be reentered to confirm, then click the **Finish** button. Once confirmed, the user's PIN will be successfully changed.

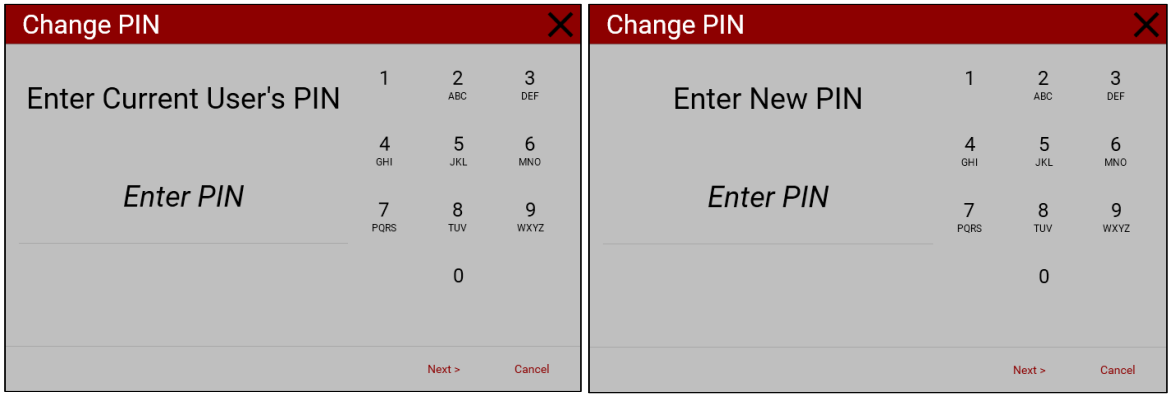

Figure 136: Change PIN

6.3.3.2.2 Overriding Role Permissions

User permissions can be overridden for a specific user if an admin is logged in. Select the desired user and go to the permissions section dropdowns. Selecting the **Edit Permission** button on the left allows the permission to be overridden. Selecting the button again will reset the permission to the base role's permission level.

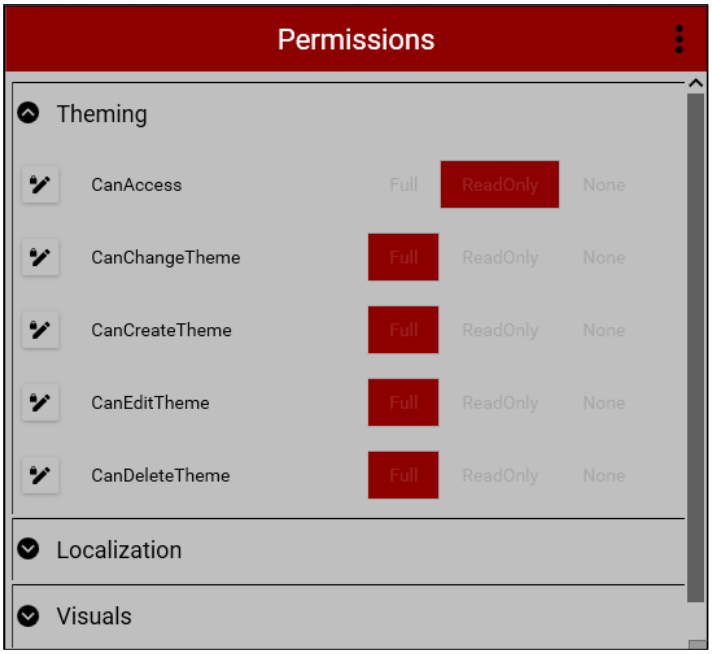

Figure 137: Override User Permissions

An icon next to the user role for a user indicates that a role permission has been overridden for that user.

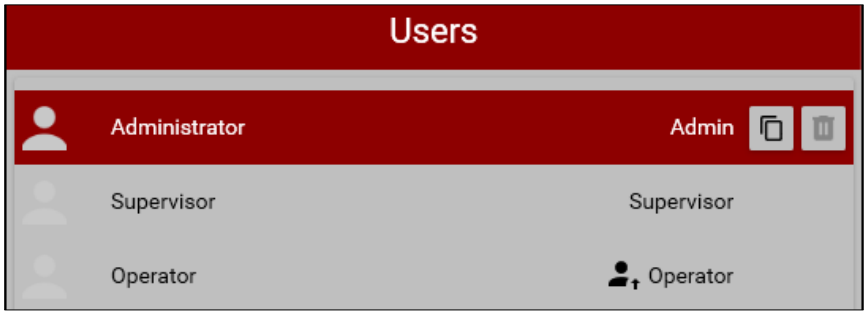

Figure 138: User Override Indicator

6.3.3.3 Add a Role

To add a role, select the **New Role** button. Existing roles can be copied by selecting the role and clicking the **Copy** button , or deleted using the **Delete** button .

To change the name of the role, click the **Edit Name** button next to the **Role Name** in the Role Info pane.

To change the role's profile image, select the **Change Image** button in the Role Info pane.

Role permissions can be edited when a role is selected through the Permissions section. When a role's permissions are edited, the edits will apply to all users with that role.

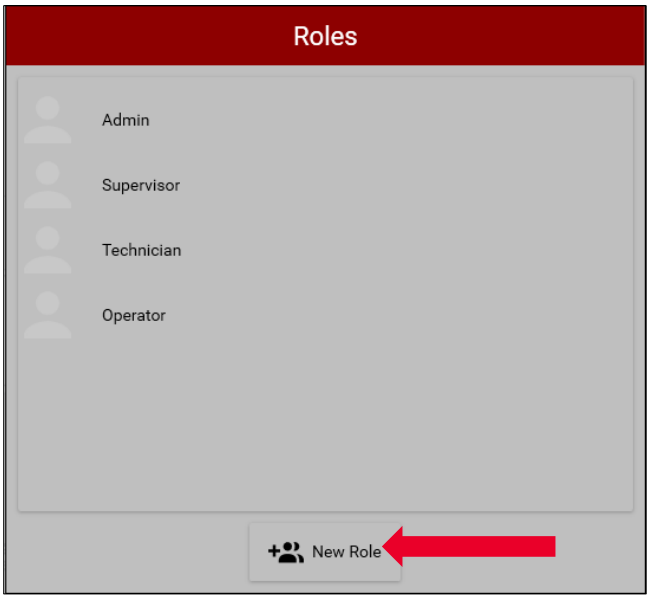

Figure 139: Add a Role

6.3.4 Localization

Localization allows changing the language of the application. New languages, or localizations, can be added through the **Import/Export** feature at the bottom of the page.

Localization files are typically expected to be CSV files, but any file format can be used if the delimiter between texts is consistent.

The Module Localizations section allows the user to see what texts are available in the translation.

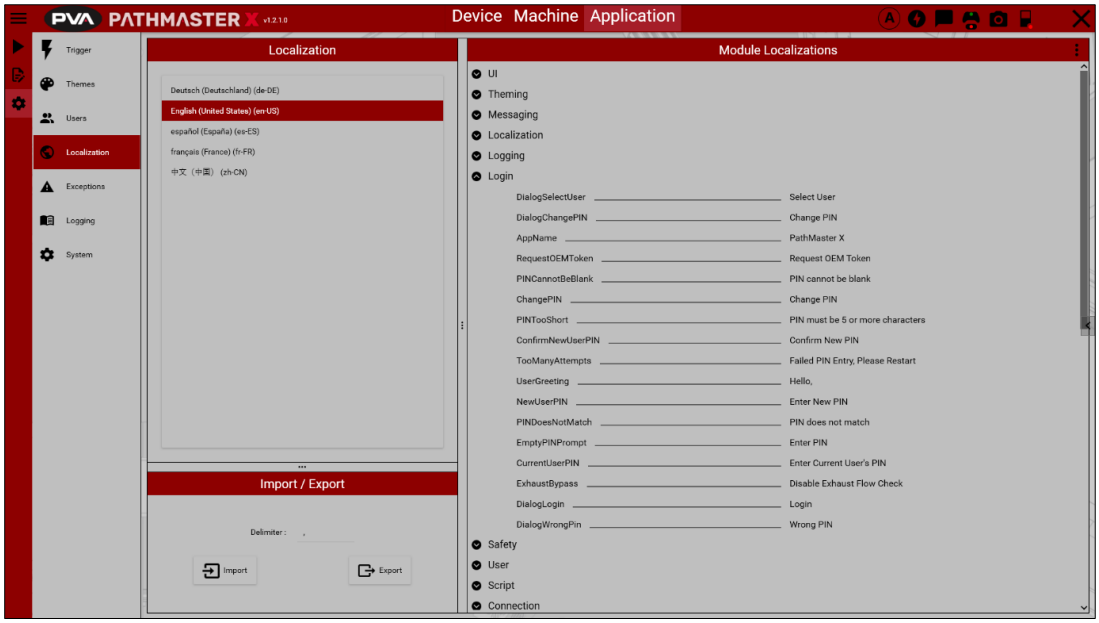

Figure 140: Localization

6.3.5 Exceptions

Exceptions allow a user to view all error exceptions associated with functions. This section is currently read-only.

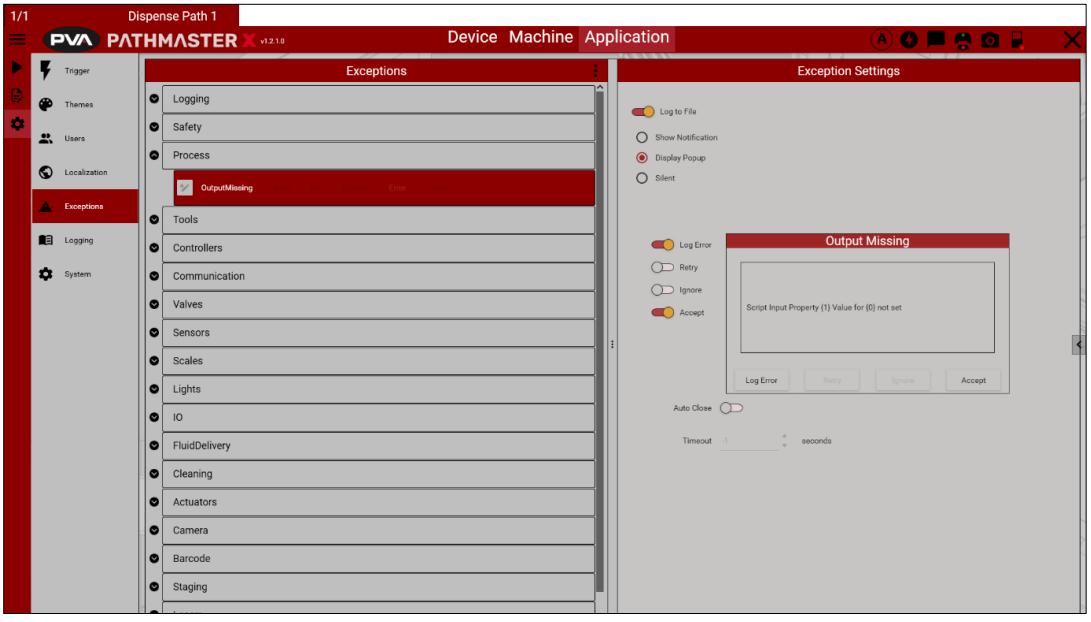

Figure 141: Exceptions

6.3.6 Logging

Logging allows the user to see important events that occur for the machine and allows tracing of machine errors to give a better understanding of their cause.

The latest log entries are available in the live view list, while the full log can be accessed through the **View Log** button in the upper right. The log name can be edited using the **Edit Name** button  in the upper left.

Set Directory allows the user to set a new destination directory for log files other than the default. A new log file is created for each day for improved resolution of logged events.

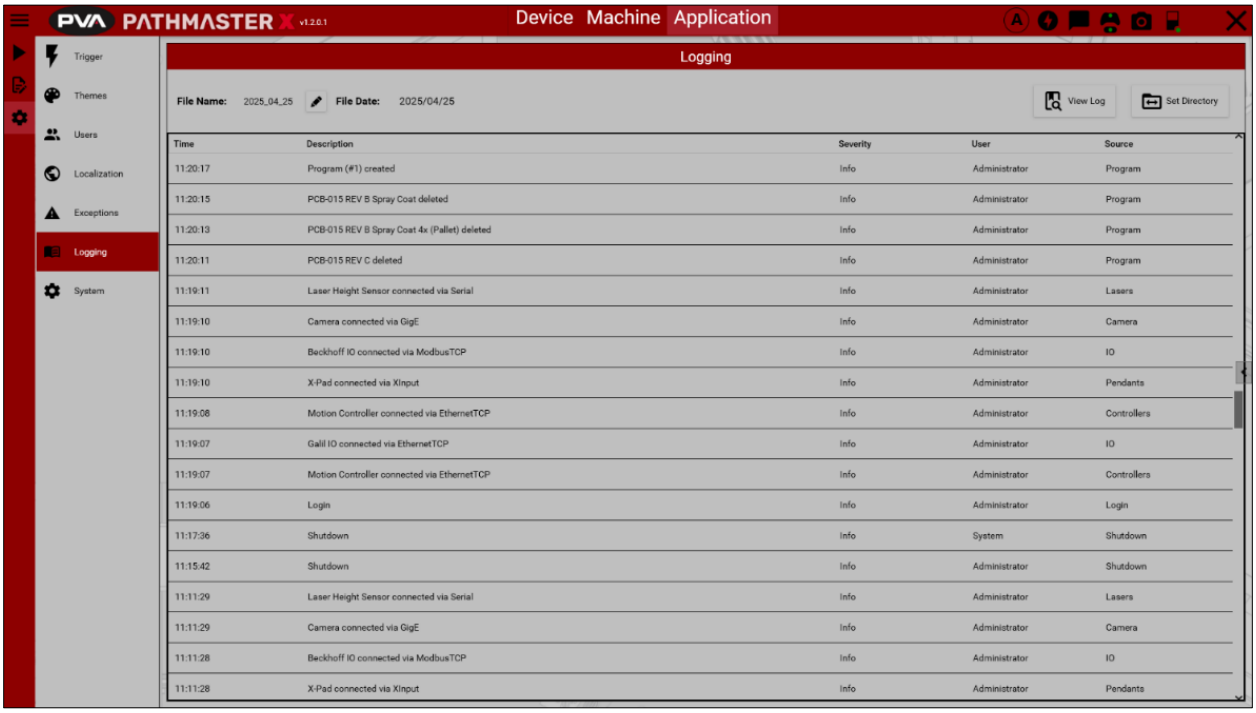

Figure 142: Logging

6.3.7 System

The System tab contains options for machine name, import/export, backup settings, licensing, and general visual effect settings.

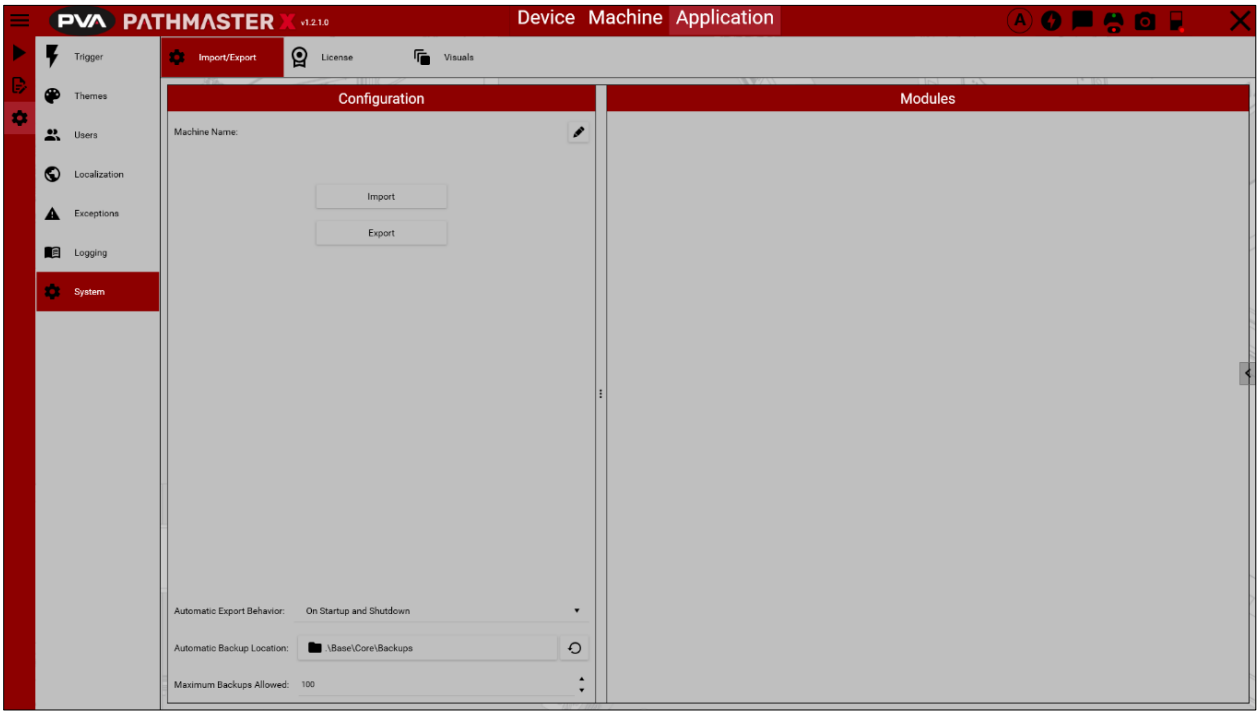

Figure 143: System

6.3.7.1 Import/Export

6.3.7.1.1 Assigning a Machine Name

To assign a machine name, click the **Edit Name** button  next to **Machine Name**.

6.3.7.1.2 Importing and Exporting

To import, select the **Import** button, navigate through the file explorer to the intended file, and select the file containing a valid machine export. The list of modules will populate and allow selection of those to import. Once satisfied with the selections, select the Import button again. The application will need to be restarted for imported changes to take effect.

To export, select the **Export** button and select the modules needed to be exported. Select the export button again to allow saving of the file. Navigate to the desired file location, enter the desired file name, and click the **Save** button.

6.3.7.1.3 Automatic Backup Settings

PathMaster X has an automatic backup feature. By default, backups are created on application startup and shutdown and keep the 100 most recent backup files.

Automatic Export Behavior determines when a backup is created. Options include On Startup and Shutdown, On Startup, On Shutdown, and Never (not recommended).

Automatic Backup Location determines the folder where the backup will be written to.

Maximum Backups Allowed is the number of backup files that will be created before the oldest backups are replaced.

6.3.7.2 License

The License tab allows users to view the current license status of PathMaster X, as well as request and load a license if one is not present.

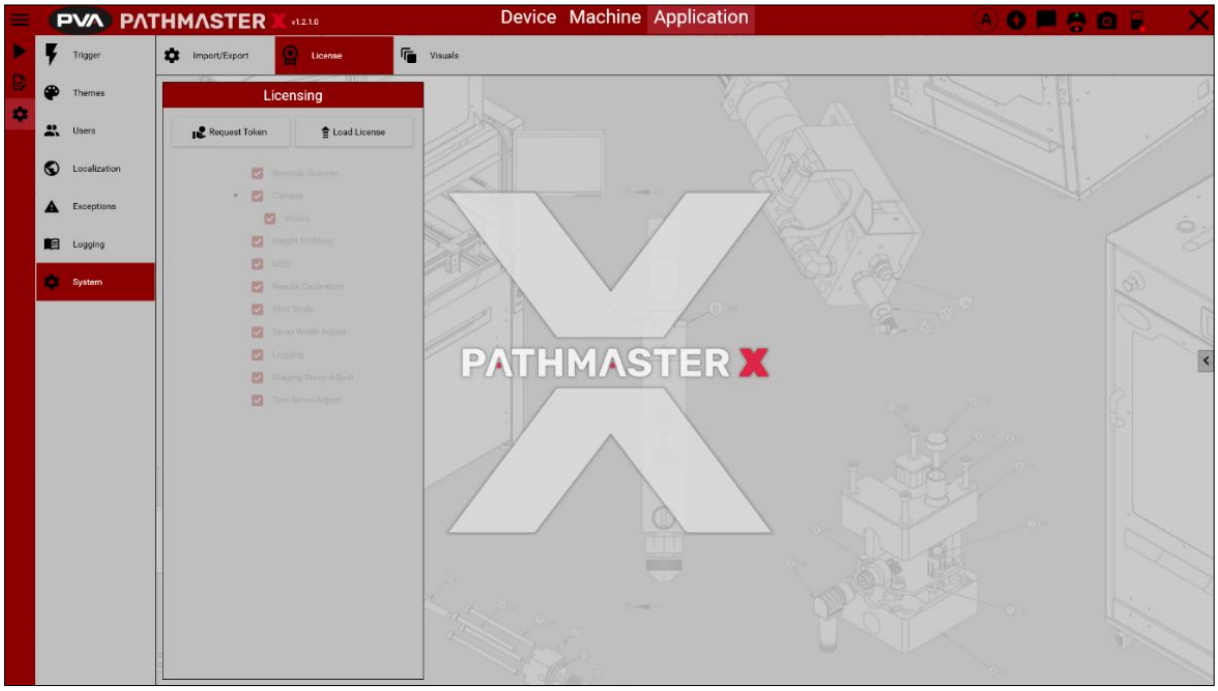

Figure 144: License

If no license is present, PathMaster X will permanently be in Offline Mode. A 72-hour temporary license can be generated by checking the box next to “Generate 72 hr Temporary License” and clicking the **Request Token** button.

During this time, PathMaster X will have full functionality. A timer will be displayed that counts down the time remaining for the temporary license. Once this temporary license expires, PathMaster X will return to Offline Mode and another temporary license cannot be generated.

6.3.7.2.1 Requesting a License

Follow these steps to obtain a license for PathMaster X:

1. Click on the **Request Token** button.
2. Choose a location and save the generated token.
3. Send the generated token to PVA Customer Service.
4. A license file will be sent back from PVA.
5. Click on the **Load License** button.
6. Select the license file that was sent by PVA in Step 4.

Once a valid license has been established, a list of all enabled PathMaster X features will be listed.

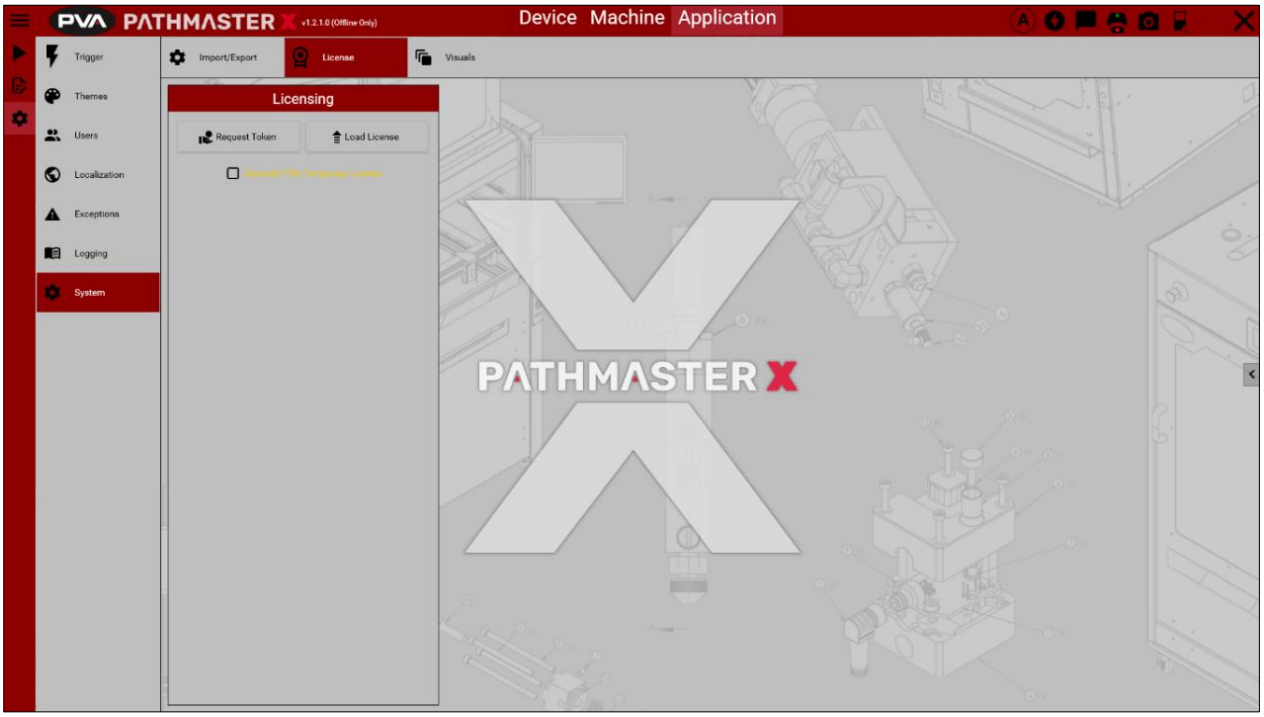

Figure 145: No License Present

6.3.7.3 Visuals

The Visuals tab under System allows the user to change certain options related to the visual aspects of the application.

- Select an **Animation** speed for changing between tabs and modes. Available options are **Slow**, **Fast**, and **None**.
- **Button Duration** options allow the user to change the duration a button must be pressed to complete an action for delete and shutdown.
- **Horizontal/Vertical Drag Start** sets the number of pixels the mouse cursor must move before a drag operation begins.
- **Bitmap Scaling Mode** sets the render mode for images.
- **Edge Mode** sets the render mode for application icons.
- The **Color Selector Preset** allows the user to choose which preset options are available when selecting color options such as in themes or editing tool profiles.

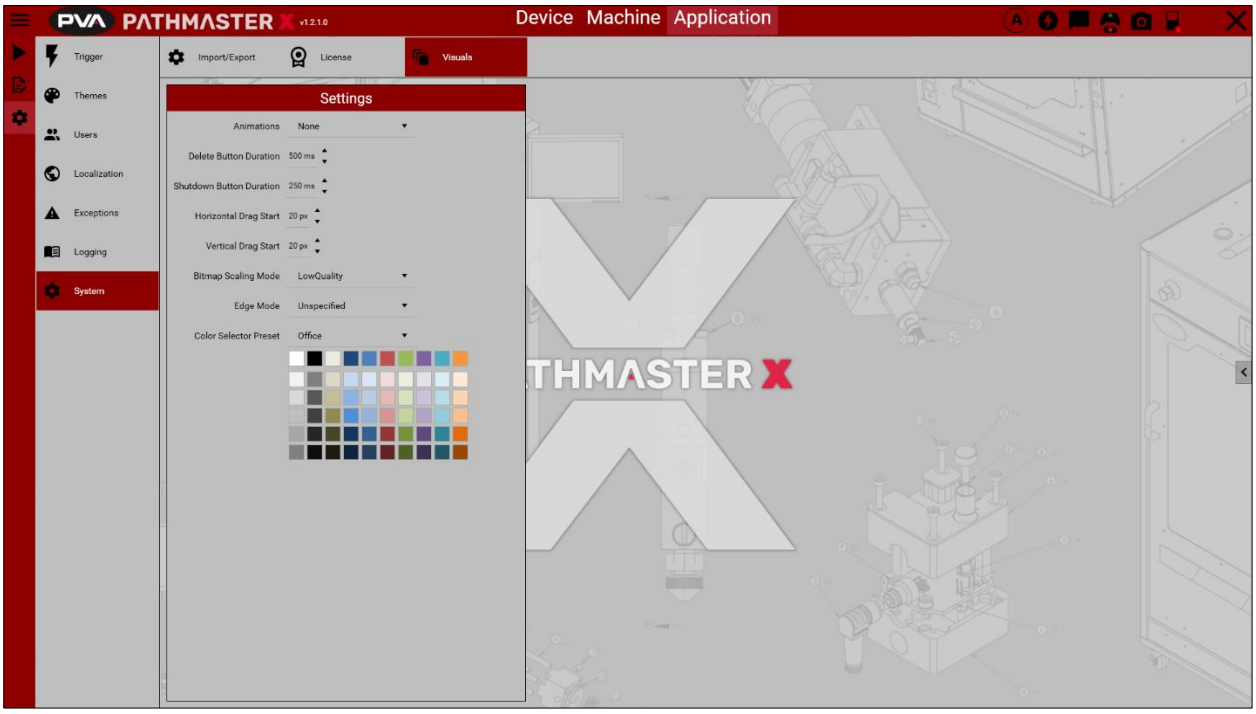

Figure 146: Visuals

7. Operation

7.1 Expression Evaluator

Throughout the application, there are configuration options that can require inputs to be calculated. These inputs can be Boolean values to determine which action(s) to take, numerical values calculated from multiple sources, etc. These options are set using the Expression Evaluator.

Figure 147: Expression Evaluator

7.1.1 Creating an Expression

Expressions are functions that evaluate to particular datatype determined by the input the expression is being created for. Expressions can be manually typed in or built using the items in the list to the lower left. The following categories are always available:

- **Constants**: Constant values, such as True, False, numbers, etc.
- **Operators**: Operations available, such as arithmetic (add, subtract, etc.), logic (and, or, etc.), and comparisons (greater than, less than, equal, etc.).

Other context-sensitive categories will appear as well. For example, when an expression is being created for use by a Process, data outputs from the Workflow and associated Product will be listed. Data outputs from configured devices are also common. These will appear under the Shared category.

To add an item to an expression, first select a category from the list, then navigate through the tree menu to the desired item, then double-click it to add it at the end of the expression. Click the **Insert** button instead to add the item to the current cursor position. Repeat this process as necessary with any required operators and data values.

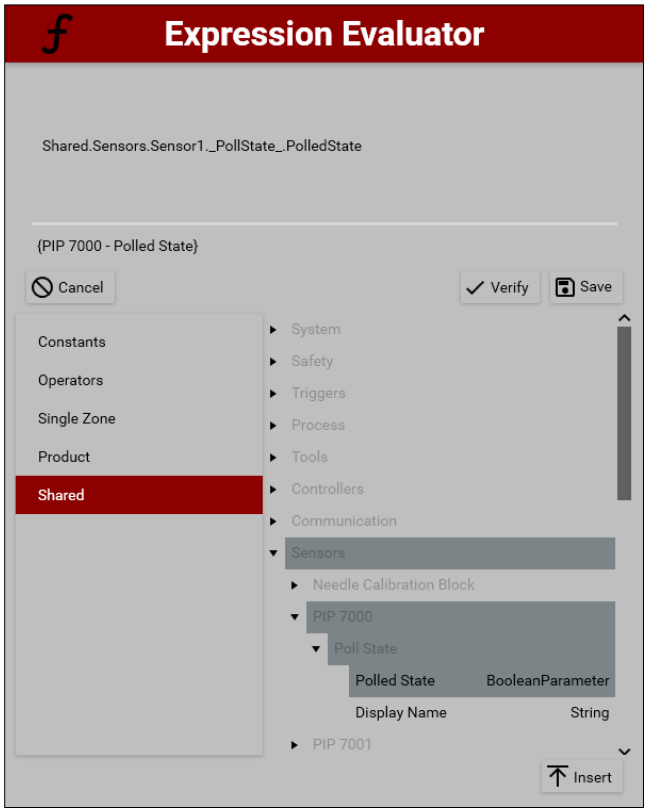

Figure 148: Selecting a Data Point

Once the expression is built, click on the **Verify** button to check for valid syntax. Note that this does NOT check the value of the expression, only that it will evaluate correctly. If the expression is valid, a green border will appear around the expression. If the expression is not valid, an error message will be displayed.

When the expression is complete, click the **Save** button to save it. Invalid expressions cannot be saved, and the expression will be validated prior to closing the Expression Evaluator screen. Click the **Cancel** button to close the Expression Evaluator without saving any changes.

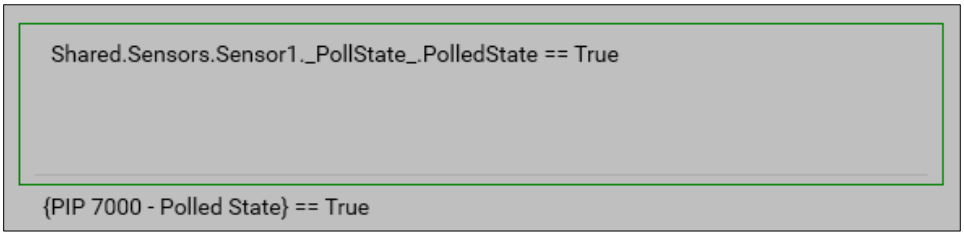

Figure 149: Valid Expression

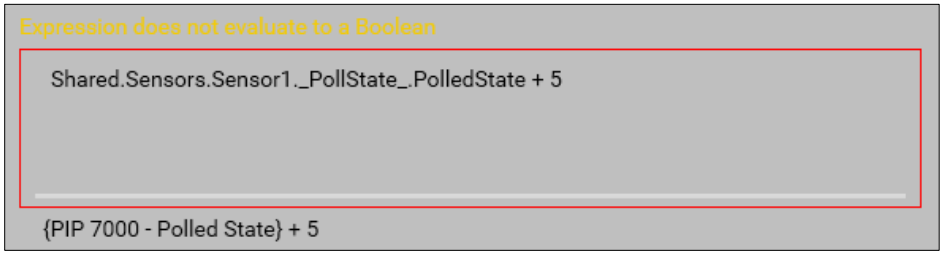

Figure 150: Invalid Expression

7.2 Programming Functions

7.2.1 General Editor Parameters and Buttons

7.2.1.1 Tool / Cursor Position

The current Tool position is shown in the coordinates view box in the upper right corner.

Press the **Coordinate View** button on the canvas to see the coordinate view box. Tool Coordinates update as the robot moves or if another Tool is selected.

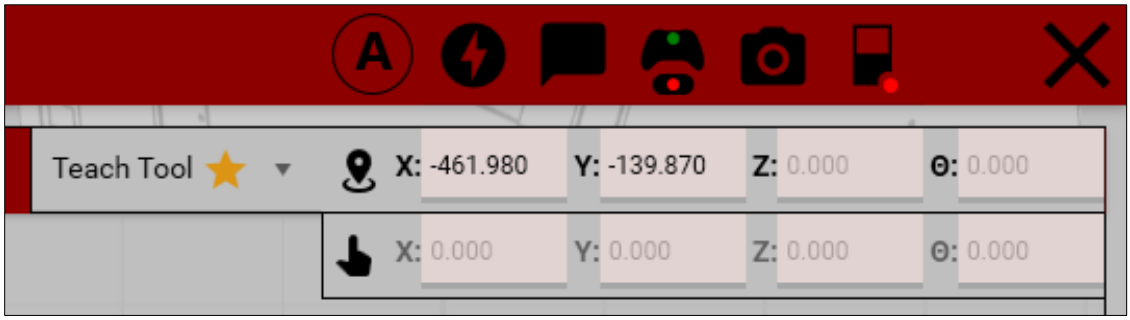

Figure 151: Coordinates View

Tool Position shows the position of the current tool (in user units) within the program coordinate system.

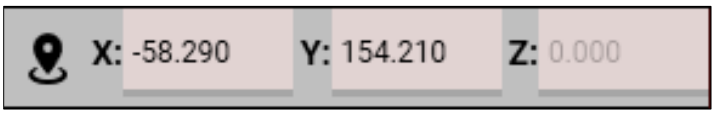

Figure 152: Tool Position

Cursor Position shows the position of the cursor (in user units) within the program coordinate system.

Figure 153: Cursor Position

7.2.1.2 Edit Mode

Edit mode allows the user to drag function steps on the canvas. Select the **Edit** button to toggle Edit mode on and off.

7.2.1.3 Step Edit Menu

The Step Edit menu allows the user to edit any step function parameters. Editable parameters in the Step Edit menu look different for each distinct function. To menu can be accessed in three ways:

1. Double click on the desired step function.
2. Right click on the desired step function and click **Edit**.
3. Select the kebab menu on the right-hand side of the desired step function, then select **Edit**.

When using the Step Edit menu, use the left and right arrow keys to move between step functions without having to back out of the edit menu. Use the up and down arrow keys to move between parent and child steps, with program editing at the top and individual functions at the bottom.

7.2.2 General Path Steps

7.2.2.1 Dispense Path

The Dispense Path is used to associate all dispense moves with a desired profile and easily groups multiple dispense moves from the same Tool. All dispense moves must be a part of a dispense path.

1. Select the **Dispense Path** from the toolbox and drag it to the program editor list.
2. Open the **Step Edit** menu.
3. Select a desired Tool and profile. Modify other parameters as necessary.
4. All dispense paths have an initial move by default. Set the location of this move to the position where a dispense will begin.

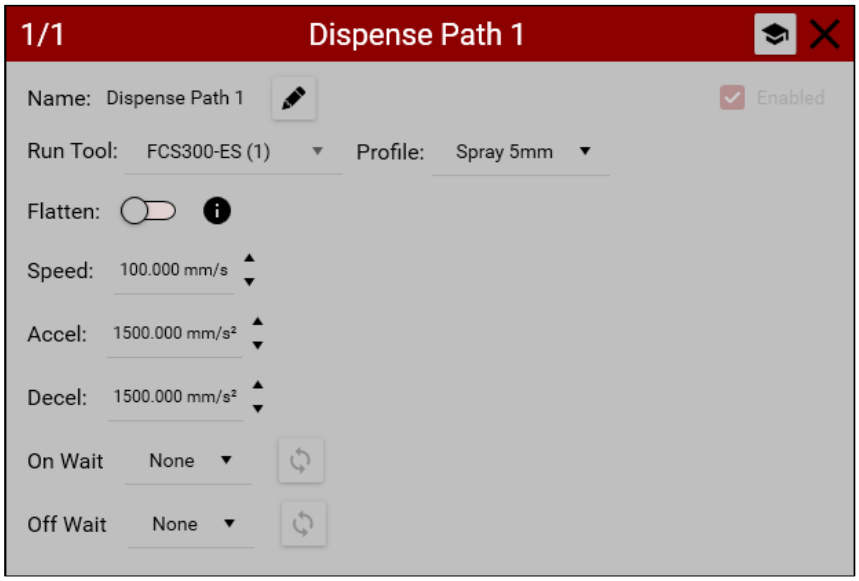

Figure 154: Dispense Path

7.2.2.2 Move

The Move command is a non-dispense move. The speed and approach of individual moves are definable by editing the move.

1. Select the **Move** function and drag it to the desired place in the program step list or drag it onto the canvas.
2. Open the **Step Edit** menu for the move.
3. Select the tool that is moving to position. If a move is part of a dispense path, the tool cannot be changed.
4. Select the Tool that will be used to teach the position.
5. Use the teach pendant to move to the desired location or input the coordinates for the move.
6. If live location is being used, select **Teach**.

7. Select the desired approach. Axes can be toggled from the approach by selecting the green or red rectangle under the coordinates. Green enables the axis, red disables it.

8. Select the **X** to close the Step Edit menu.

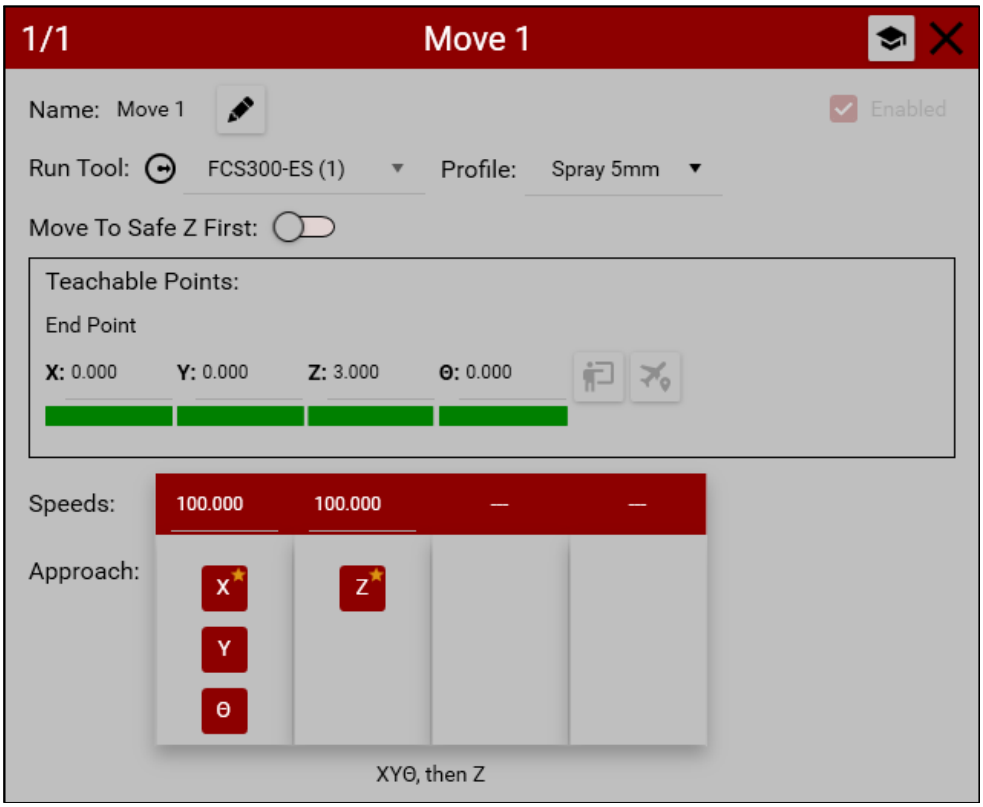

Figure 155: Move

7.2.2.3 Arc

This function teaches an arc. An arc must have three points. The Z-axis may change position in the path.

1. Select the **Arc** function. An existing dispense path is required to use an arc function.

2. Open the **Step Edit** menu for the Arc.

3. Select the Tool and profile performing the arc.

4. The start point will be established from the last move end position or dispense step move. Mid and end points can be taught by dragging their locations on the canvas, moving to the desired location, and clicking **Teach** or entering the desired coordinates.

5. The **Is Circle** toggle, when turned on, will turn the arc into a full circle.
6. Select the **X** to close the Step Edit menu.

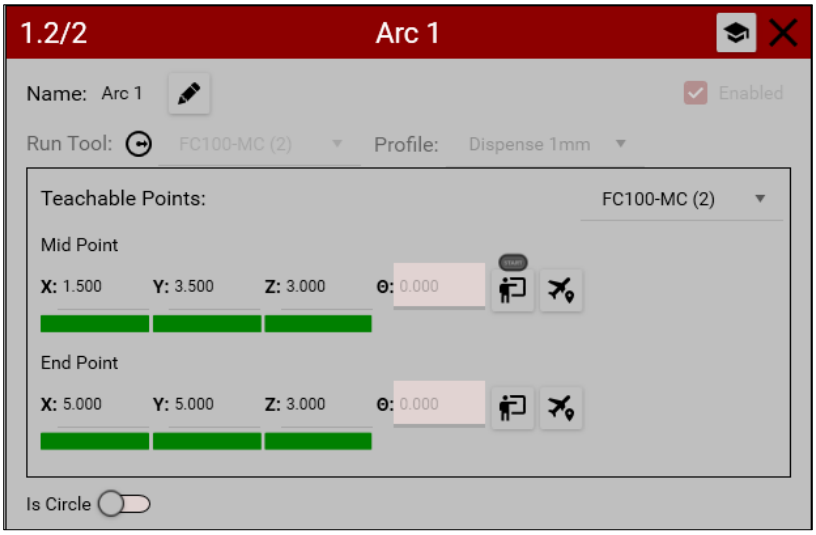

Figure 156: Arc

7.2.2.4 Circle

This function teaches a circle. No points are taught; the circle is only draggable on the canvas. The Z-axis does not change position in this path.

The circle start point and direction can be edited through the reverse, offset, or rotation options by right-clicking on the step or clicking the kebab menu  .

Figure 157: Circle

7.2.2.5 Line

This function teaches a straight line between two points. The start point is determined from the last moved position of the previous step.

1. Select the **Line** function and drag it to the program steps or canvas. An existing dispense path is required to use lines.

2. Open the **Step Edit** menu for the Line.

3. Teach the endpoint by dragging its location on canvas, moving to the desired location and pressing **Teach,** or entering the desired coordinates.

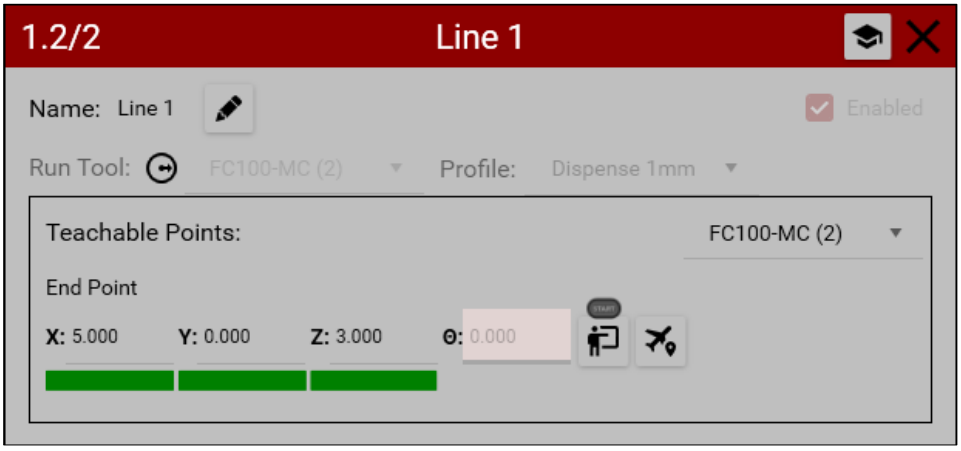

Figure 158: Line

7.2.2.6 Dot

This function teaches a timed dispense over a coordinate point.

1. Select the **Dot** function and drag it to the program steps or canvas. An existing dispense path is required to use a dot function.

2. Open the Step Edit menu for the Dot.

3. Select the desired tool, profile, dwell time, and retract distance.

4. Teach the point by dragging its location on canvas. A dot may need an associated **Move** step to move to the desired coordinates before dispensing.

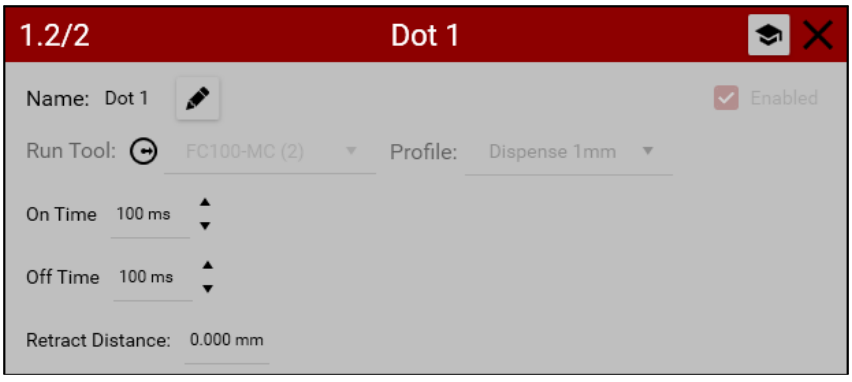

Figure 159: Dot

7.2.2.7 Array

Arrays can be created from several different types of Program steps. The process for creating an array from a single Program step is the same for all Program step types, for example, a dot array. The array can be defined by several dots with specified spacing or filling a certain area with the defined number of dots.

1. Create a dot move. It is best to set up a common retract and dwell time before creating the array.
2. Access the create array option by either right clicking on the dot move or selecting the kebab menu. Select **Create Array**.
3. Determine the X and Y count of the array.
4. Select either a spacing interval or an end point of the array (the first dot acts as the opposite corner to the endpoint)
5. Use the toggles to define pathing through the array. A preview of the completed path will be displayed in the window above the setting options.
6. Press **Create** to create the array. An array is defined by individual Dot and Move steps and cannot be moved or edited as a whole step.

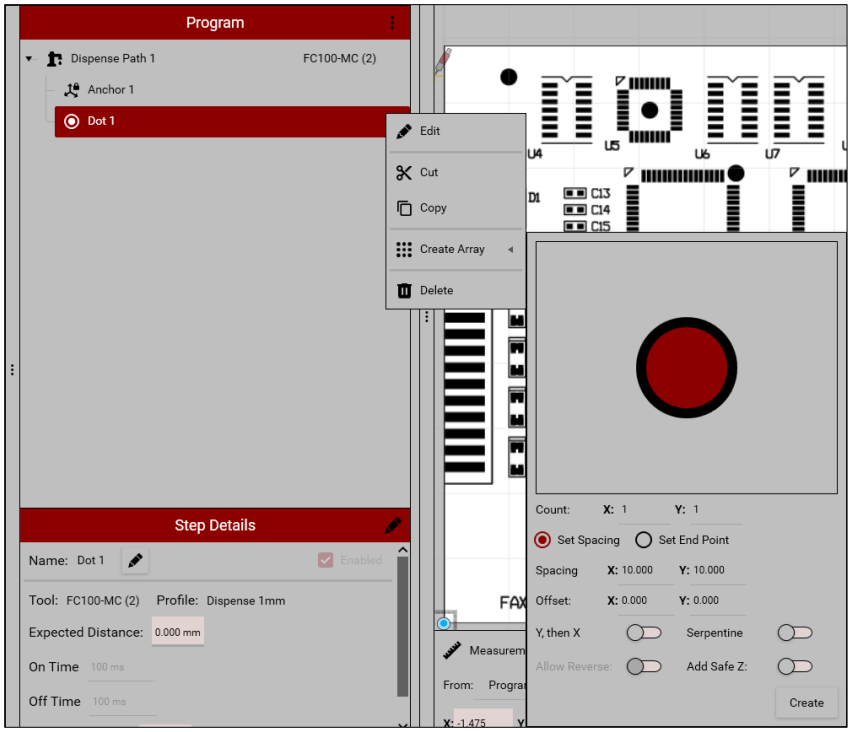

Figure 160: Create Dot Array

7.2.2.8 Area

This function teaches a rectangular or circular area dispense. The Z-axis does not alter its position during the path. The area has multiple fill options to allow increased flexibility.

1. Select the **Area** function and drag it to the program steps or canvas.
2. Open the **Step Edit** menu for the Area dispense.
3. Select the area shape and fill. If using a Serpentine pattern, select the button to change between rounded edges or square edges.
4. Either drag beginning and end points on the canvas to their desired locations or teach their positions under **Teachable Points**.
5. Set the spacing interval of the area. Modify the space or fill angle if desired by using the radial diagram or entering the values into the text boxes.

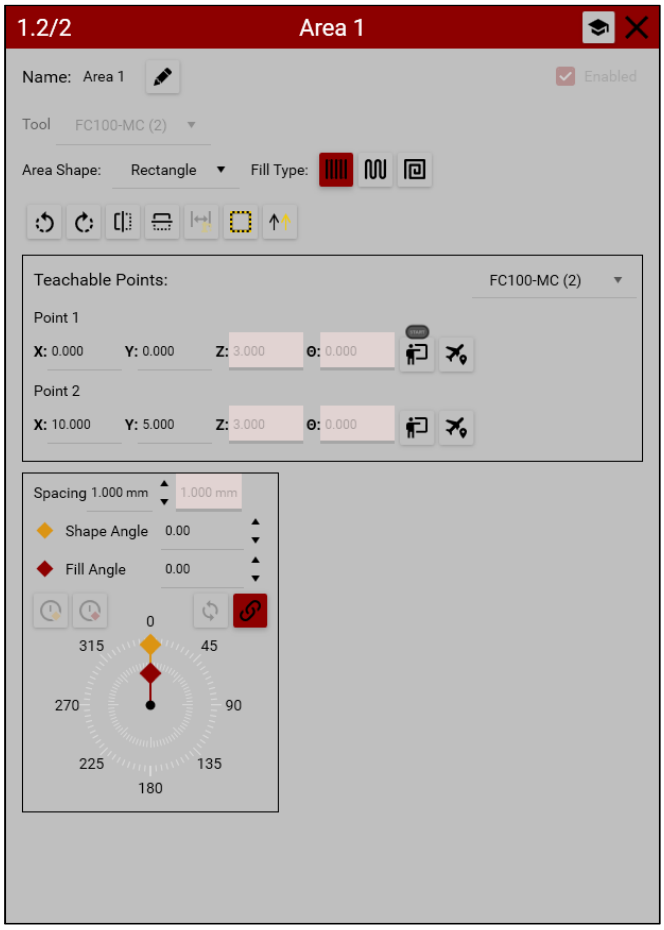

Figure 161: Area

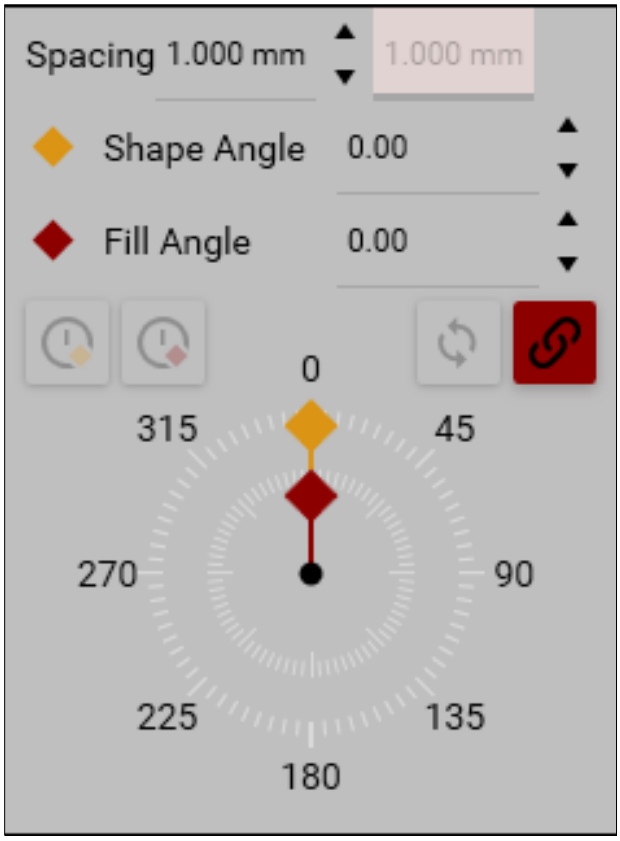

Figure 162: Set Spacing Interval

7.2.2.9 Square

This function teaches a square outline. No points are taught. The square is only draggable on the canvas. The Z-axis does not change position in this path.

The square start point and direction can be edited through the reverse, offset, or rotation options by right-clicking on the step or clicking the kebab menu  .

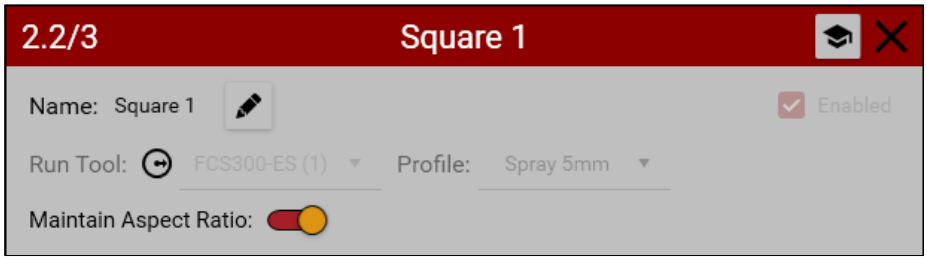

Figure 163: Square

7.2.2.10 Rectangle

This function teaches a rectangle outline. No points are taught; the rectangle is only draggable on the canvas. The Z-axis does not change position in this path.

The rectangle start point and direction can be edited through the reverse, offset, or rotation options by right-clicking on the step or clicking the kebab menu ⋮.

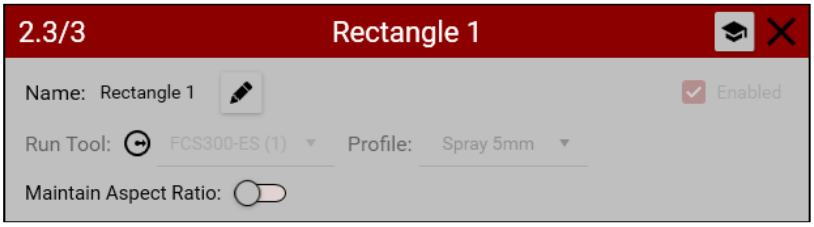

Figure 164: Rectangle

7.2.2.11 Tool Function

All tool functions can be done through a **Tool Function** program step. Several Tool functions are included as their own steps for convenience. These include Down, Up, Rotate A, and Rotate B. To use a Tool function in a program:

1. Select the **Tool Function** from the toolbox and drag it to the program steps in the desired position.
2. Open the **Step Edit** menu for the Tool Function.
3. Select the **Tool** and the **Function** (if using a general Tool Function step).

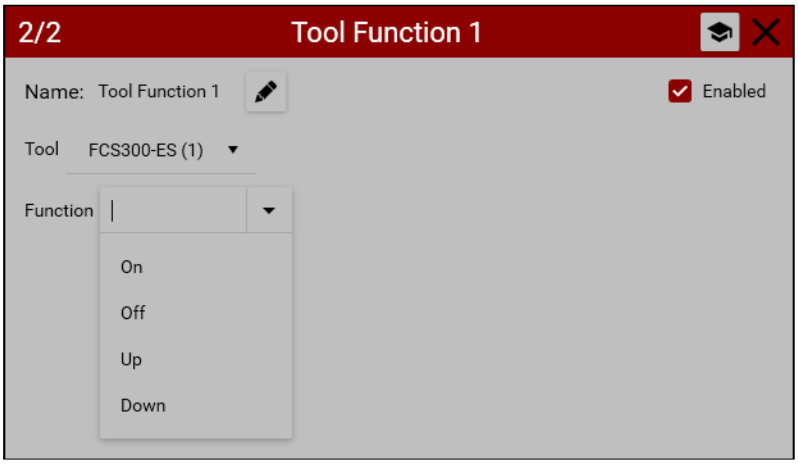

Figure 165: Tool Function

7.2.3 Additional Functions

7.2.3.1 SubProgram

With this function, another existing program can be run from within the current program.

1. Select **SubProgram** from the toolbox and drag it to the program steps in the desired position.
2. Open the Step Edit menu for the **SubProgram**.
3. Select the program to be used as a **SubProgram**. In order for a Program to be usable as a SubProgram, it cannot be assigned to any Products.
4. The beginning point of the SubProgram can be taught using a Tool or manual entry of coordinate points. This aligns the origin of the Program selected as a subroutine to the defined point. This does not guarantee a dispense will begin at the point selected. Refer to the selected program to anticipate behavior. SubProgram paths will also be displayed on canvas to view.

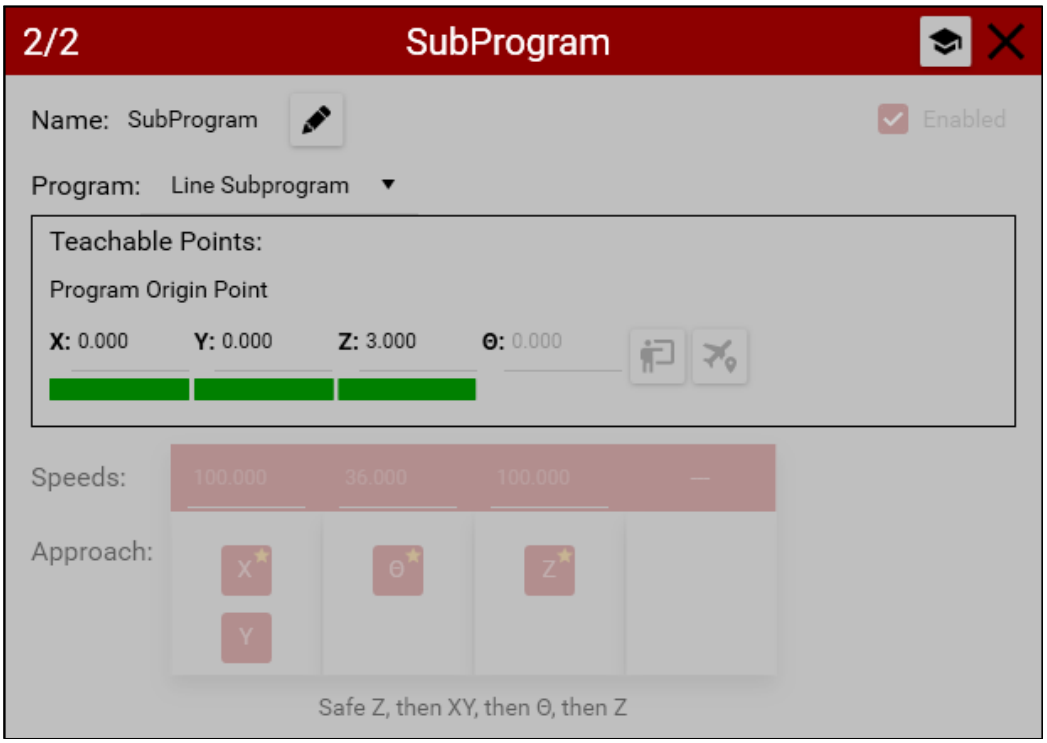

Figure 166: SubProgram

7.2.3.2 Set Speed

Set Speed will change the gantry **Speed** to the entered value for the **Type** of movement. Movement type options are Dispense, NonDispense, and All.

Note: If the speed is changed, existing default speeds will be overridden. Commands running in the program after set speed will run using the new speed unless a new set speed command is used. Speeds reset to default values at the beginning of a program playback.

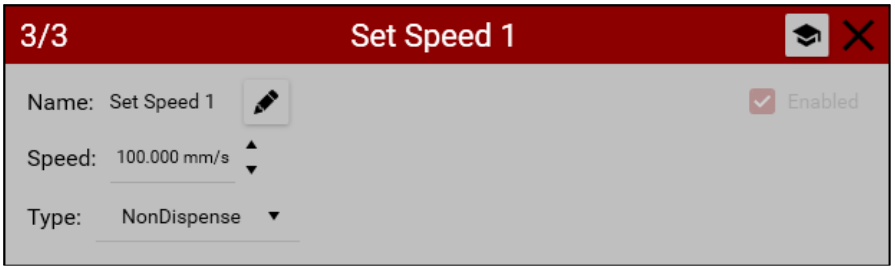

Figure 167: Set Speed

7.2.3.3 Set Move Accel Decel

Set Move Accel Decel will change the gantry **Acceleration** and **Deceleration** to the entered values.

Note: If the accel/decel is changed, existing default accel/decels will be overridden. Commands running in the program after set accel/decel will run using the new accel/decel unless a new set accel/decel command is used. Accel/decels reset to default values at the beginning of a program playback.

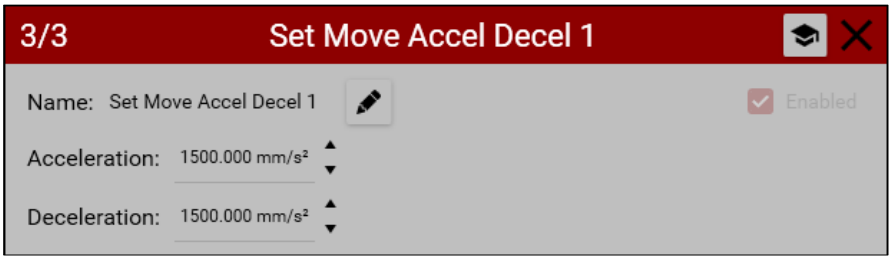

Figure 168: Set Move Accel Decel

7.2.3.4 Motion Smoothing

The **Motion Smoothing** command is a jerk limiting function applied to independent and vector motion profiles. The **Smoothing Percentage** value will be applied to all enabled axes.

All axes configured in the robot can be individually enabled or disabled for motion smoothing.

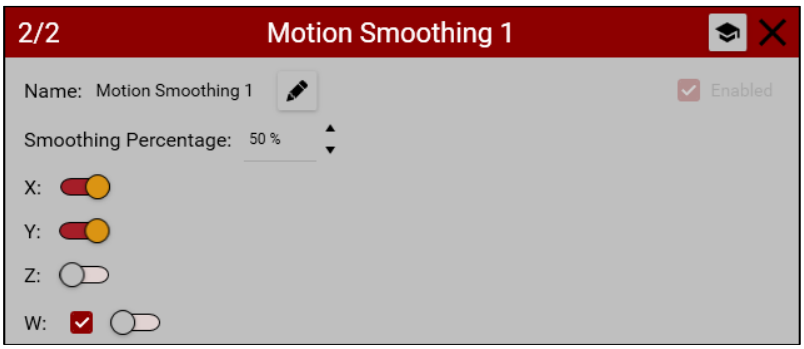

Figure 169: Motion Smoothing

Note: If motion smoothing is set, the default smoothing curve is overridden. Commands running in the program after motion smoothing will run with the set motion smoothing unless a new motion smoothing is defined. Motion smoothing resets at the beginning of a program playback.

7.2.3.5 Pattern Match

The Pattern Match is used to find and confirm identifiable locations such as fiducials on physical parts. The use of two pattern matches configured as fiducials creates a corrected space based on the pattern location.

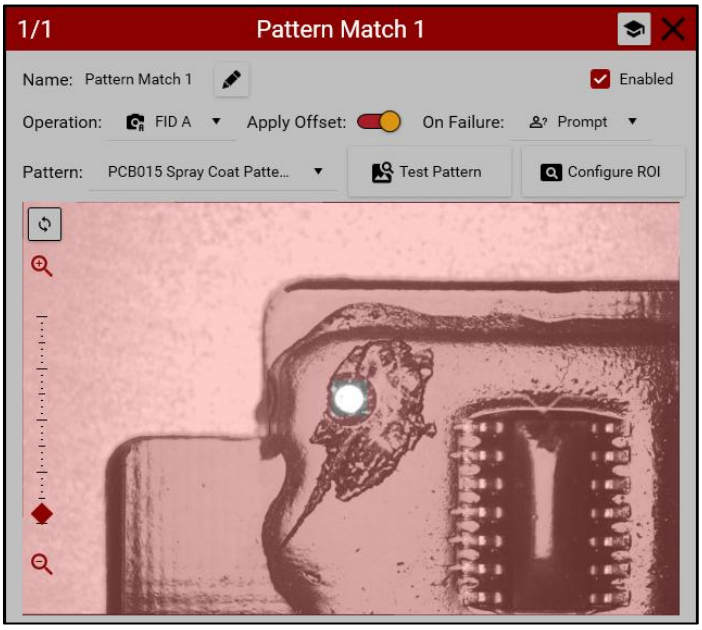

Figure 170: Pattern Match

1. Select **Pattern Match** from the toolbox and drag it to the desired position in the Program.

2. Open the Step Edit menu for the **Pattern Match**.

3. Select the operation:
   - **Inspection**: At the current location, run an inspection comparing the live image to the selected pattern using the image match score of the calibrated pattern. Pass/fail behavior is used to configure following program steps.
   - **Fid A**: At the current location, run an inspection comparing the live image to the selected pattern with match score. Fid A calculates the distance of the found pattern to the expected location and applies an XY translation for all subsequent steps.
   - **Fid B:** At the current location, run an inspection comparing the live image to the selected pattern with match score. If Fid A offset is currently applied, it will calculate the skew using expected positions and found pattern positions. At this point the Fid A translation is removed, and skew is applied to all subsequent steps as new corrected space or will error if no transformation is found.

4. Select the **On Failure** option:
   - **Prompt**: Ask the operator what to do with an on-screen prompt.
   - **Use Expected**: Proceed as though the pattern match passed.
   - **Skip Program**: Do not execute the Program but continue with the Process.
   - **End Production**: Halt Process.

5. Set **Region of Interest (ROI)**
   - This step is optional, but using a Region of Interest can speed up matches or omit potential interference from other similar product features within the Camera's field of view.
   - Click **Configure ROI** button to open the Region of Interest creation menu.
   - When opened, the Configure ROI menu shows a preview of the Pattern Source Image and the Pattern in a highlighted box.
6. The **Add Rectangle** button will prompt the user to begin drawing the Region of Interest by clicking on the image and dragging to define the rectangle's size and location. The resulting rectangle can be dragged and resized after adding it.

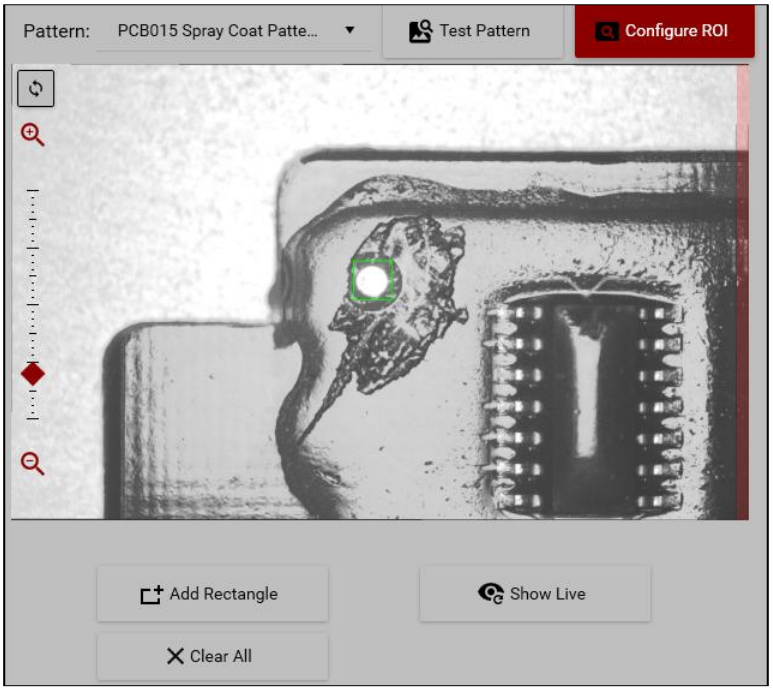

Figure 171: Configure ROI Creation

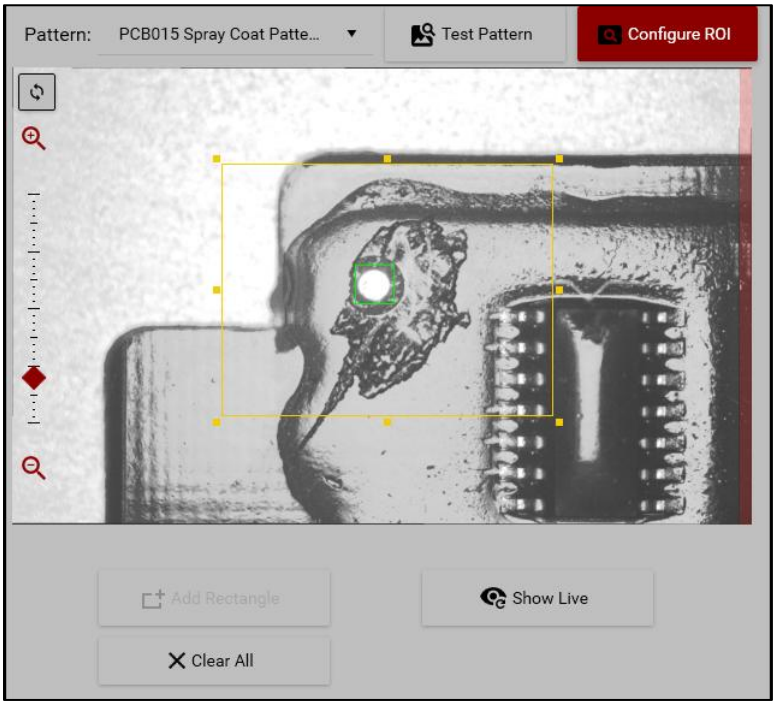

Figure 172: ROI Rectangle

7. The **Clear All** button can be pressed and held to clear the Region of Interest.

8. The **Show Live** button will switch the view from a preview of the Pattern to the Camera's Live view. The label will change to **Show Source** and can be pressed again to view the preview of the Pattern.

9. Clicking **Configure ROI** button again will save your settings and close the ROI menu.

10. The operation must use an existing pattern. To configure a pattern, refer to Section 6.2.2.4.

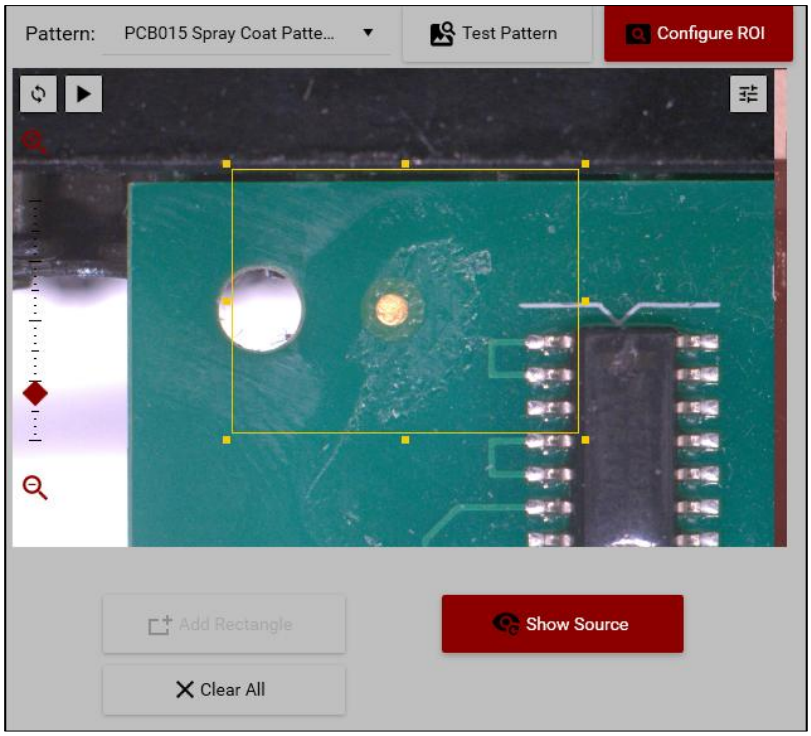

Figure 173: ROI Show Source

7.2.3.6 Conditional

The Conditional Program step is used to branch the program on two paths depending on a given condition. For example, if a pallet with multiple parts using a fiducial identifier for each part, a conditional step would allow the program to skip over empty places on the pallet if a fiducial point is not identified or run the subprogram for the part if a fiducial point is identified.

1. Select **Conditional** from the toolbox and drag it to the program steps in the desired position.

Like a dispense path, conditionals contain child steps which can include dispense paths. To add a child to the conditional, drag the desired step or steps to the bottom edge of the function name, rather than to the bottom edge of the step where the conditional expression is given. Make sure the current value of true or false is selected as intended before adding children for each branch.

2. Open the Step Edit menu for the **Conditional**.

3. Select an option for the condition and set the condition. If there are any existing conditions in the program that can be used, they are suggested, such as the result of a pattern match or evaluation of a preceding conditional step. The Expression Evaluator can also be used to create custom conditions.

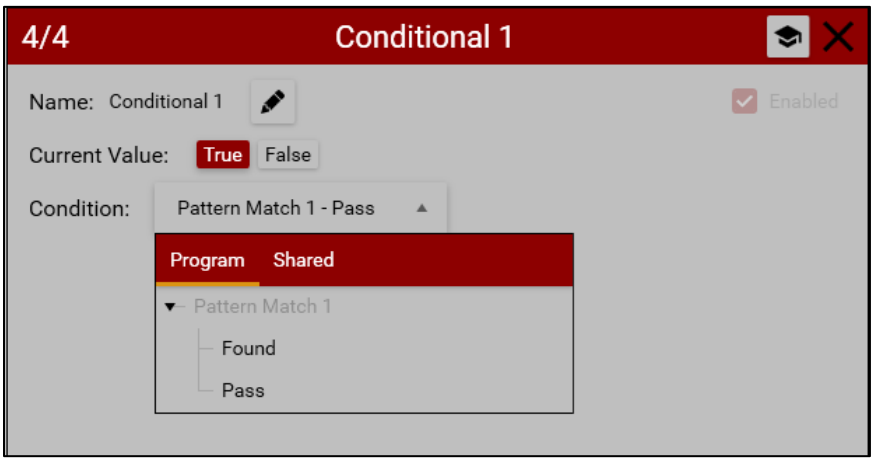

Figure 174: Conditionals

Below is an example of a conditional that uses the result of a pattern match inspection to either run a dispense path (on pass) or write the failure to log (on fail).

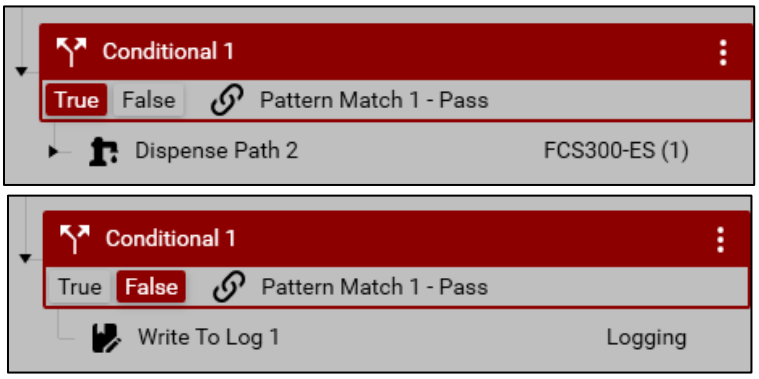

Figure 175: Conditional Example

7.2.3.7 Custom Shape Options

Custom shapes can be created in addition to the default shapes using custom shape options. To create a custom shape, a dispense path must be made in the desired shape. The dispense path can consist of lines, arcs, and other shapes. The dispense path created for a custom shape does not need to be fully enclosed or begin and end at the same point.

1. Right click on the dispense path or all steps included in the desired shape, then select **Create Shape**. This will group the steps into a single shape step.

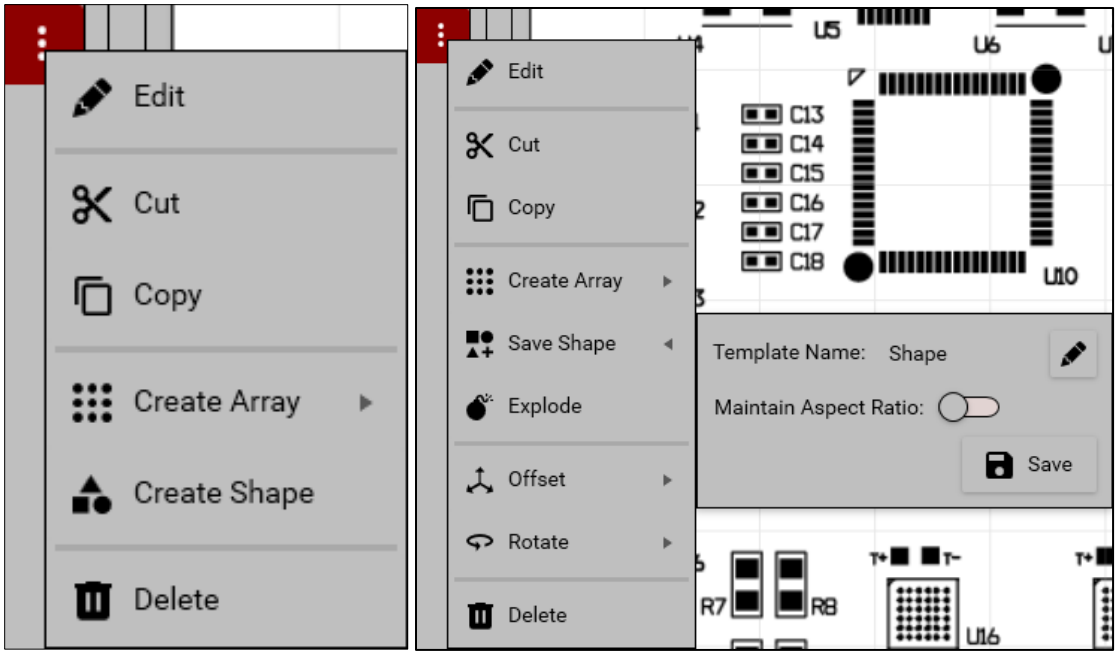

Figure 176: Create / Save/ Delete Shape

2. To save the shape so that it can be copied or used again, right-click on the shape and select the **Save Shape** option.

3. Select the **Edit Name** button  to edit the template name and click **Save**. A new toolbox step will now appear with the shape name.

4. In the event a custom shape is no longer needed, the step can be deleted from the toolbox by dragging it to the trash can  at the bottom of the toolbox pane.

7.3 Process Functions

7.3.1 Move In

This function uses the conveyor staging device to move a board to a specific PIP sensor. If board stops are selected, the board stops will go down at the beginning of the script.

1. Select the **Move In** function from the Process Toolbox and drag it into the desired Process lane.

2. Open the **Step Settings** menu by pressing the **Settings** button  in the top right corner of the step.

3. Select the sensor, timeout, and off delay. If applicable, check the box for board stops and select the set of board stops. Select the conveyor direction with the **Reverse** toggle.

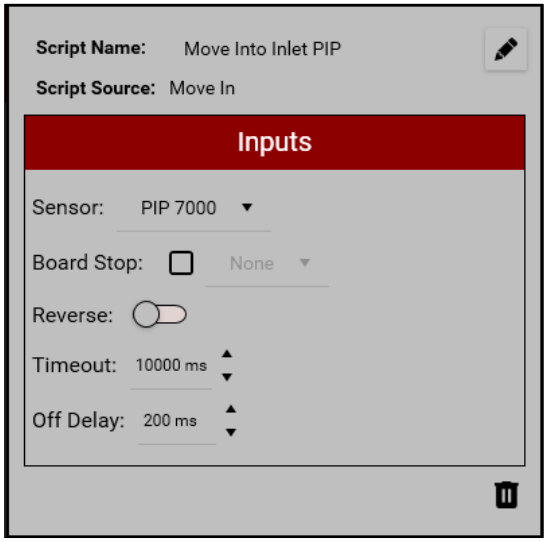

Figure 177: Move In

7.3.2 Move Out

This function uses the conveyor staging device to move a board away from a specific PIP sensor. If board stops are selected, the board stops will go up at the beginning of the script.

1. Select the **Move Out** function from the Process Toolbox and drag it into the desired Process lane.

2. Open the **Step Settings** menu by pressing the **Settings** button  in the top right corner of the step.

3. Select the sensor, timeout, and off delay. If applicable, check the box for board stops and select the set of board stops. Select the conveyor direction with the **Reverse** toggle.

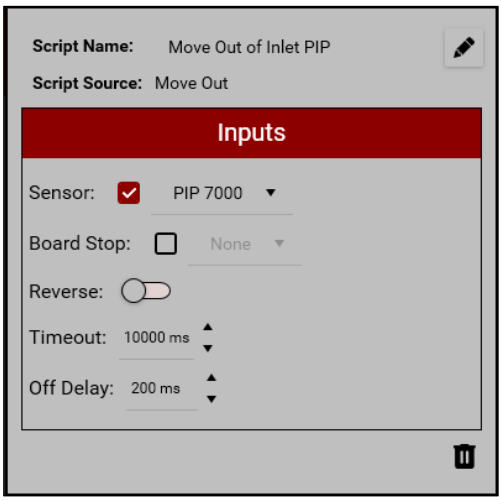

Figure 178: Move Out

7.3.3 Place Part

Specific to Flex Fixture staging devices, this function allows the user to temporarily bypass safeties to place a part. Placing the part uses a part in place check for an existing sensor, but this feature can be bypassed.

1. Select the **Place Part** function from the Process Toolbox and drag it into the desired Process lane.

2. Open the **Step Settings** menu by pressing the **Settings** button in the top right corner of the step.

3. Enabled or disable **Bypass Part Check**.

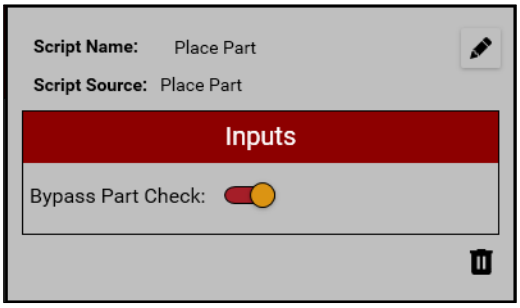

Figure 179: Place Part

7.3.4 Remove Part

Specific to Flex Fixture staging devices, this function allows the user to temporarily bypass safeties to remove a part. Removing the part uses a part in place check for an existing sensor, but this feature can be bypassed.

1. Select the **Remove Part** function from the Process Toolbox and drag it into the desired Process lane.

2. Open the **Step Settings** menu by pressing the **Settings** icon in the top right corner of the step.

3. Enable or disable **Bypass Part Check**.

4. **Place While Removing**, when enabled, will allow a part to be placed as part of this Process step instead of requiring another Place Part step. Disable to only remove a part.

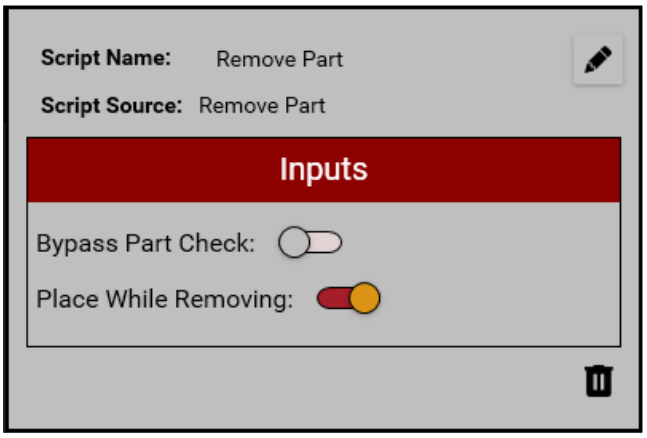

Figure 180: Remove Part

7.3.5 Set SMEMA

This function is used to set the states of SMEMA outputs for upstream and downstream communication. This does not read states from other machines, only sets states on the current machine.

1. Select the **Set SMEMA** function from the Process Toolbox and drag it into the desired Process lane.

2. Open the **Step Settings** menu by pressing the **Settings** button in the top right corner of the step.

3. Select the correct IO address output pertaining to the SMEMA output and select the desired state using the toggle.

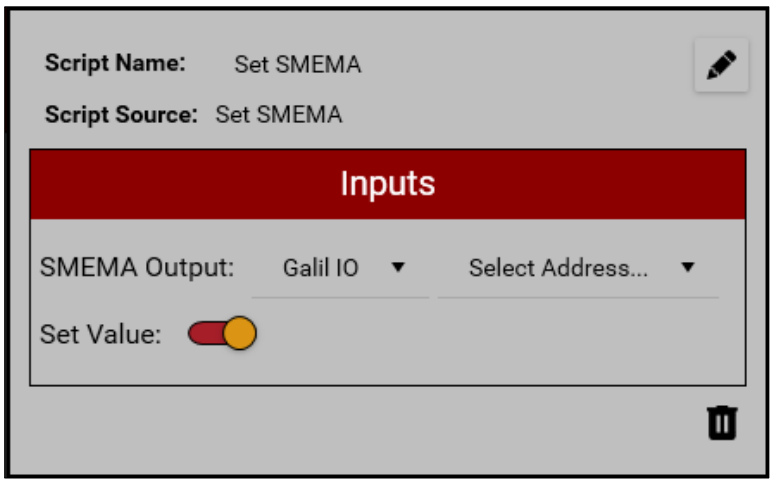

Figure 181: Set SMEMA

7.3.6 Timed Wait

Timed Wait is used to suspend the Process for a specified amount of time.

1. Select the **Timed Wait** function from the Process Toolbox and drag it into the desired Process lane.

2. Open the **Step Settings** menu by pressing the **Settings** button  in the top right corner of the step.

3. Define the amount of time to wait (in milliseconds).

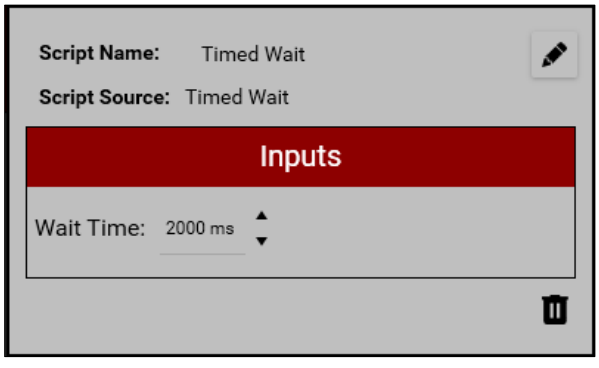

Figure 182: Timed Wait

7.3.7 Data Logging

To enable data logging, a **Write to Log** step must be added to Program or Process.

1. **File**: Click on the folder icon to change where the log file will appear when written to. This will open the File Explorer which will prompt selecting a folder. The name of the log itself is editable using the **Edit Name** button .

2. **Data**: This is the data that will be written in the file. The first checkbox enables or disables the writing of that data point to the log file. The second text input field is the name of the header that will be used in the file. The third field is the actual data values that will be logged. The data values can be set in one of three ways:

   - Select the **Constant** button to manually enter a constant value.
   - Select the **Link** button to select a shared value from the dropdown list.
   - Select the **Function** button to set a function through the Expression Evaluator. The result of the function is the value that will be logged.

   Select the **Add** button to add another data field to the list.

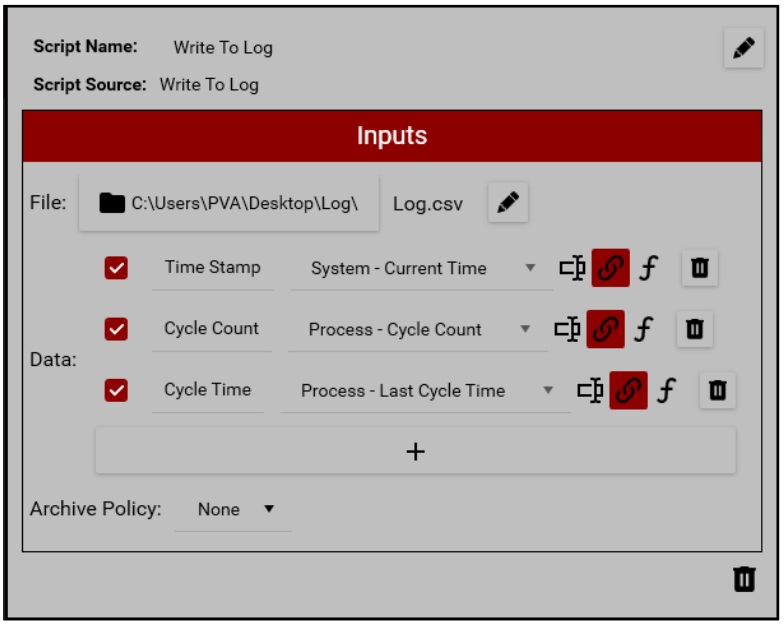

Figure 183: Write to Log

3. **Archive Policy**: This option sets how often a new log file is created:
    - **None**: A new file is never created. The same file is always written to.
    - **Yearly**: A new file is created when the year changes.
    - **Monthly**: A new file is created with the month changes.
    - **Weekly**: A new file is created every week.
    - **Daily**: A new file is created every day.

A timestamp will be added to the archived file's filename when a new log file is created.

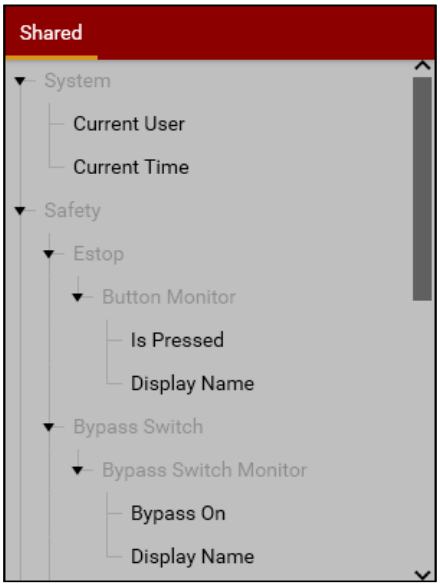

Figure 184: Shared Data

The log file generated is in .csv format, allowing it to be opened in several applications such as Notepad or Excel. The time header and timestamp of the log entry are automatically generated for every log file.

	A	B	C	D
1	Time Stamp	Cycle Count	Cycle Time	
2	5/8/2025 10:51	1	0:00:10:00	
3	5/8/2025 10:51	2	0:00:10:00	
4	5/8/2025 10:51	3	0:00:10:00	
5	5/8/2025 10:51	4	0:00:10:00	
6	5/8/2025 10:52	5	0:00:10:00	
7	5/8/2025 10:52	6	0:00:10:00	
8	5/8/2025 10:52	7	0:00:10:00	
9	5/8/2025 10:52	8	0:00:10:00	
10	5/8/2025 10:52	9	0:00:10:00	
11	5/8/2025 10:52	10	0:00:10:00	
12				

Figure 185: Data Log File .csv

7.3.8 Shot Weight Check

Shot Weight Checks can be performed automatically as part of a Process.

1. Drag the step into the desired lane and step position for Processes and Triggers or sequence step in Programs.
2. Set the Inputs:
    - **Shot Weight Tool**: The Tool to run the Shot Weight Check with.
    - **Target Weight**: The expected weight of the dispense shot.
    - **Dispense Time**: The amount of time to dispense the material.
    - **Tolerance**: The allowed percentage the dispensed weight can be from the target weight.
    - **Error on Out-of-Range**: Whether or not to throw an error that will stop the Program, Process, or Trigger if the dispensed weight is out of tolerance.
    - **Display Results**: Whether or not to display a message with the results of the Shot Weight Check once complete.

Note: Displaying the results will pause the Program, Process, or Trigger until the message box is acknowledged by a user or are automatically closed.

    - **Auto Close Results After**: Whether or not to automatically close the displayed results, and how long, in milliseconds, to automatically close the results after they are displayed.

Note: These inputs are independent of the settings in the Shot Scale Calibration page and Shot Scale Tool header menu.

3. Shot Weight Check has the following outputs, all of which can be used as inputs for Program and Process data logging steps:
    - **Shot Weight**: The weight of the shot dispensed.
    - **Target Weight**: The expected weight of the dispense shot.
    - **Dispense Time**: The amount of time to dispense the material.
    - **Tolerance**: The allowed percentage the dispensed weight can be from the Target Weight.
    - **Result**: Whether or not the Shot Weight Check passed.

Shot Weight Checks may also be included as part of a Program or Trigger. The setup process is the same for both.

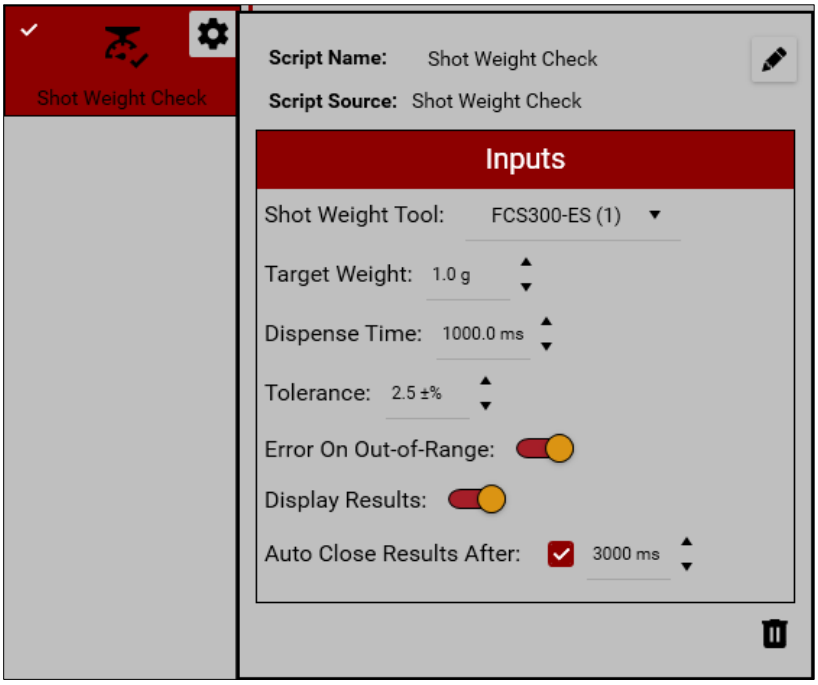

Figure 186: Shot Weight Check Inputs

7.4 Trigger Functions

To use a Trigger Function as part of an active application Trigger, first select the function from the Trigger Toolbox and drag it into the desired lane of the selected Trigger. Next, open the **Step Settings** menu by pressing the **Settings** button  in the top right corner of the step and set all values as necessary. Not all Trigger Functions will have configurable settings.

7.4.1 Clean Tools

Clean Tools allows movement of all dispense tools to an existing solvent location and/or complete a purge.

- **Solvent Location**: This is where the gantry will go after the purge is complete. Select the location from the list of created robot locations.
- **Purge Location**: This is where the valves will be dispensed during the purge routine. Select the location from the list of created robot locations.
- **Purge Time**: This is how long the valves will be set to dispense during the purge.
- **Show Status Message**: When enabled, an on-screen status message will be displayed during the step execution.

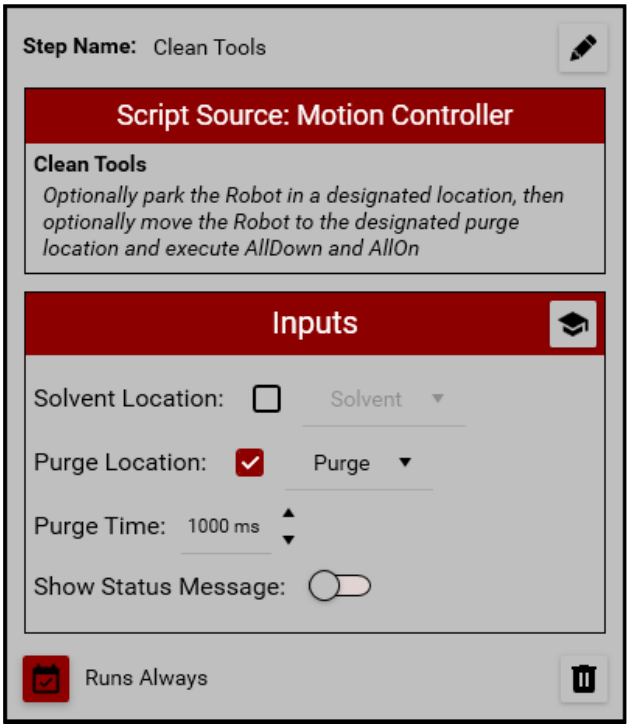

Figure 187: Clean Tools Inputs

7.4.2 Home Robot

Home Robot causes robots to home all defined axes on the controller. The application will prompt the operator before movement begins. Once in motion, the home must complete before any other gantry motion can occur.

- **Robot**: Which robot will be homed.

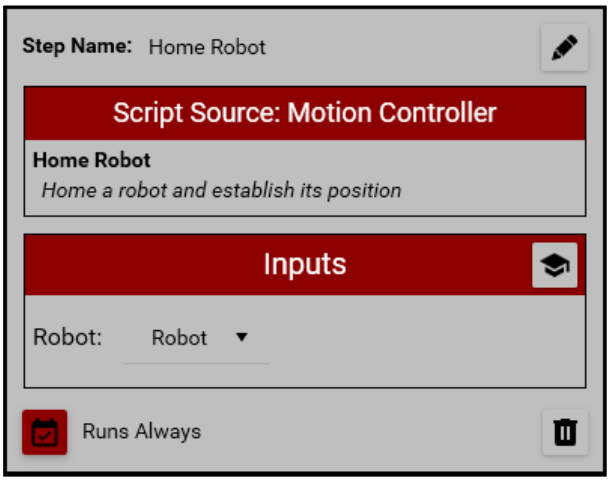

Figure 188: Home Robot Inputs

7.4.3 Move to Location

Move to Location moves to a location defined in the Robot Locations section of Coordinates. On trigger, if axes are servoed and the machine has control power, the gantry will move to the defined position. **Location** displays a list of available robot locations that can be moved to. **Show Status Message**, when enabled, displays an on-screen status message will be displayed during the step execution.

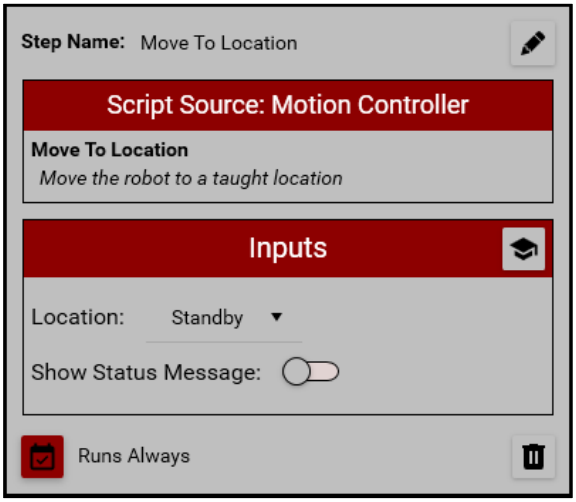

Figure 189: Move to Location Inputs

7.4.4 Move to Safe Z

Moving to Safe Z moves the gantry to a safe Z location that should not crash anywhere within X and Y machine limits. The safe Z position is typically the Z home sensor but can be altered in the Robot Tab of Machine configuration. **Robot** indicates which robot will be moved to safe Z height.

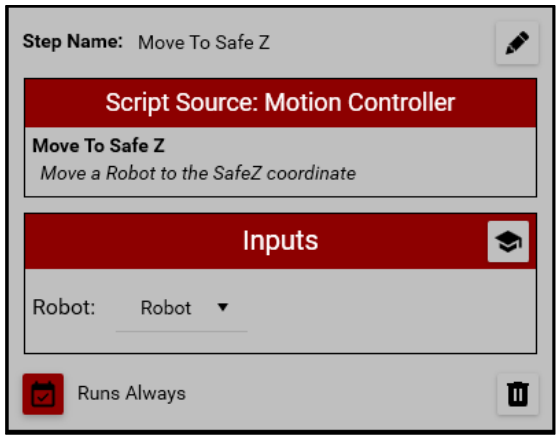

Figure 190: Move to Safe Z Inputs

7.4.5 Servo Axes

Servo Axes define the servo position for all axes encoders, allowing automated movement. This requires control power. Servo Axes does not have any configurable settings.

7.4.6 Clear Boards

This function is used to remove all boards currently in the workcell. For those experienced with the legacy PVA Portal application, this operates in the same manner. This function requires a conveyor staging device.

- **Reverse**: Enable to have the conveyor run in the direction opposite of the configuration.
- **Overall Timeout**: The total time the routine will run before error if the conveyor is still not cleared.
- **PIP Travel Timeout**: How long the routine will run without any PIP sensors being active before completing successfully.
- **Stop PIP**: The last PIP on the conveyor.
- **Additional PIPs**: Any other PIPs that are installed on the conveyor.
- **Board Stops**: Any board stop devices installed on the machine that need to be raised.
- **Locators**: Any locator devices installed on the machine that need to be raised.

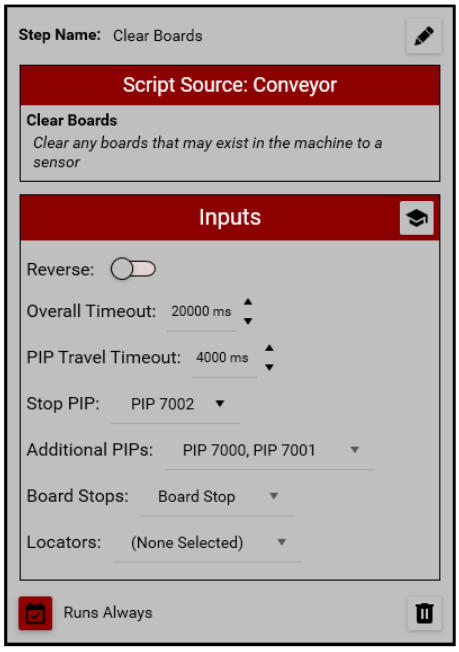

Figure 191: Clear Boards Inputs

7.4.1 Motor Off

Motor Off turns off the motor for all axes, preventing automated movement. With the motors off, the gantry can be pushed or pulled, but doing so gives the machine a position error. Motor Off does not have any configurable settings.

7.4.2 Set Andon State

Set Andon State turns the light tower outputs on or off to defined behavior. Useful for changing the light tower when in different Process modes, when automated movement is allowed, or indicating a machine error.

- **Red**: Value to set the red light to.
- **Amber**: Value to set the amber light to.
- **Green**: Value to set the green light to.
- **Alarm**: Value to set the audible alarm to.
- Options for all settings are on, off, and flash.

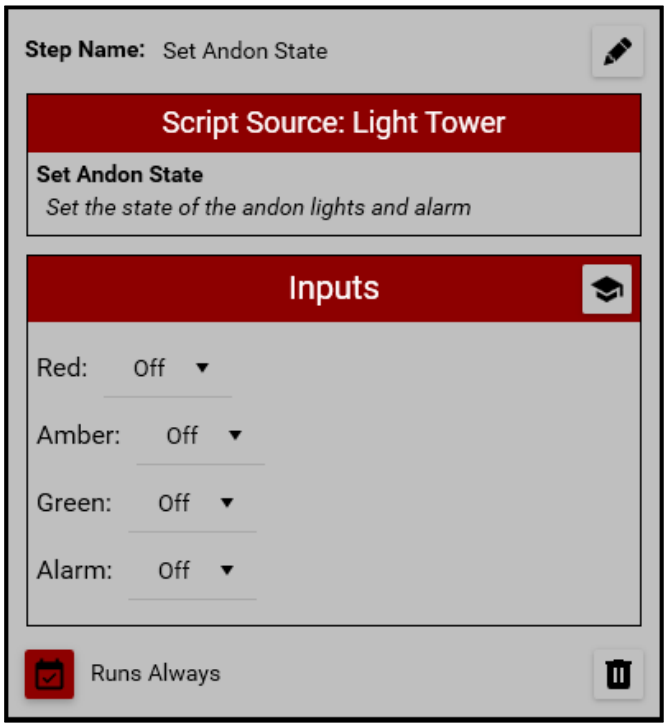

Figure 192: Set Andon State Inputs

7.4.3 Reset IO Devices

Reset IO Devices resets all IO to their assigned default states under the Devices section. Reset IO Devices does not have any configurable settings.

7.4.4 Control Power On

Control Power On prompts the operator to enable control power. Control power will only successfully turn on if the safety circuit is satisfied.

- **Wait Time**: The amount of time after the function begins execution before control power is restored.
- **Show Prompt**: Whether or not to display a prompt before restoring control power.

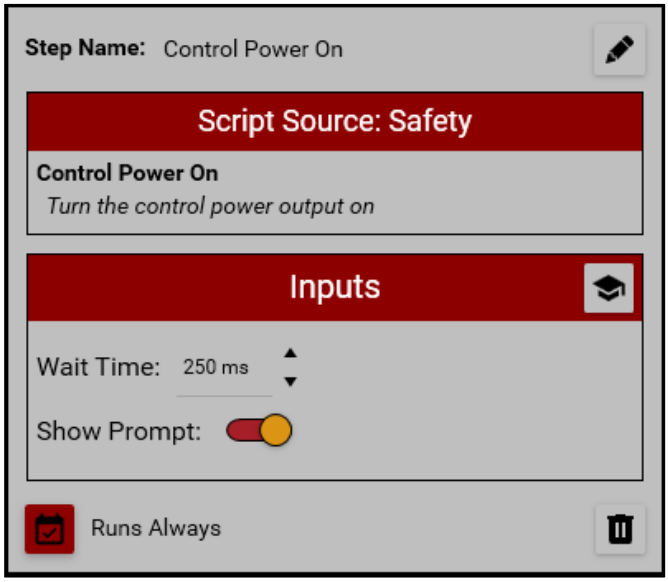

Figure 193: Control Power On Inputs

7.4.5 Control Power Off

Control Power Off immediately cuts control power to the machine. Control Power Off does not have any configurable settings.

7.4.6 Exhaust Flow Check

Exhaust Flow Check runs a subroutine ensuring the machine is properly ventilated.

- **Exhaust Switch**: Configured exhaust flow device.
- **Startup Time**: Amount of time to wait after the function begins before status checks begin.
- **Check Time**: The amount of time to run the exhaust flow check.
- **Check Interval**: How often to check the status of the Exhaust Switch.

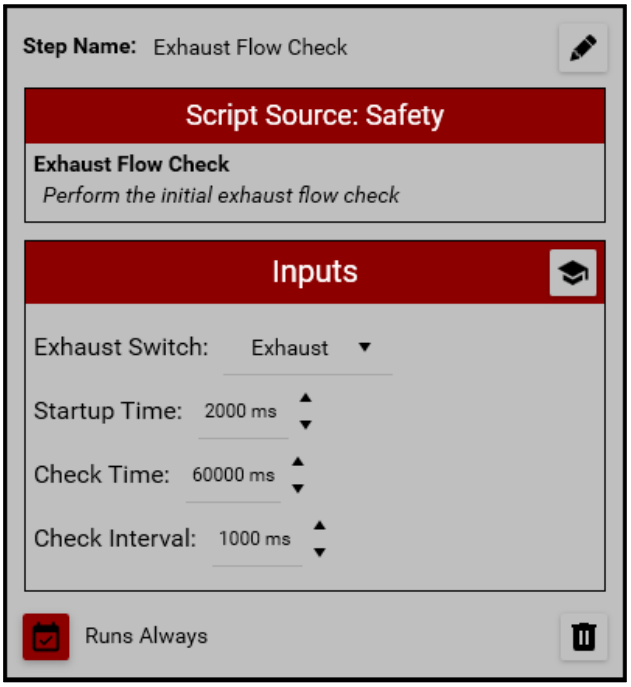

Figure 194: Exhaust Flow Check Inputs

7.4.7 Safety Check

Safety Check runs a safety check routine. Safety checks are predefined by safety devices on the machine. Once a safety check begins, all safety devices must be satisfied before automated motion can resume. Safety Check does not have any configurable settings.

7.4.8 All Off

All Tools that are selected as part of the All Off script will turn to an Off state. All Off does not have any configurable settings.

7.4.9 All On

All Tools that are selected as part of the All On script will turn to an On state. All On does not have any configurable settings.

7.4.10 All Down

All tools that are selected as part of the All Down script will actuate their motion to a Down state. All Down does not have any configurable settings.

7.4.11 All Up

All tools that are selected as part of the All Up script will actuate their motion to an Up state. All Up does not have any configurable settings.

7.4.12 Timed Wait

Timed Wait waits a specified time before continuing. This is useful with other trigger scripts to stagger their effects or useful on its own to create a delay.

- **Wait Time**: The length of the time delay.

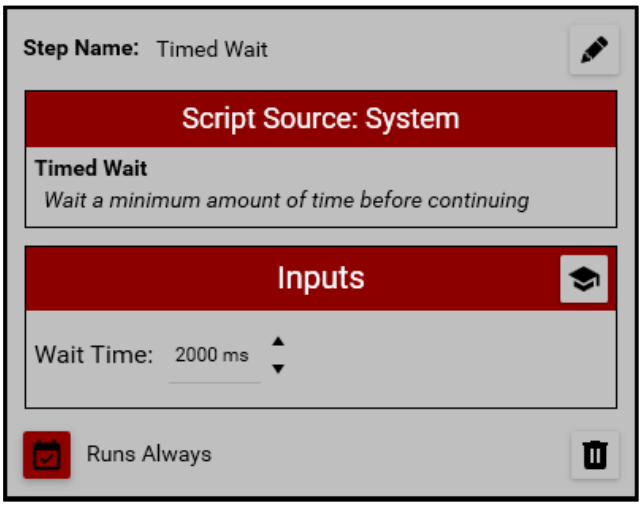

Figure 195: Timed Wait Inputs

7.4.13 Enable Pendants

Enable Pendants is used to allow Pendant profiles in certain scenarios, as well as undo a Disable Pendants step.

- **Set Default as Enabled**: Sets the default state of pendants to enabled.

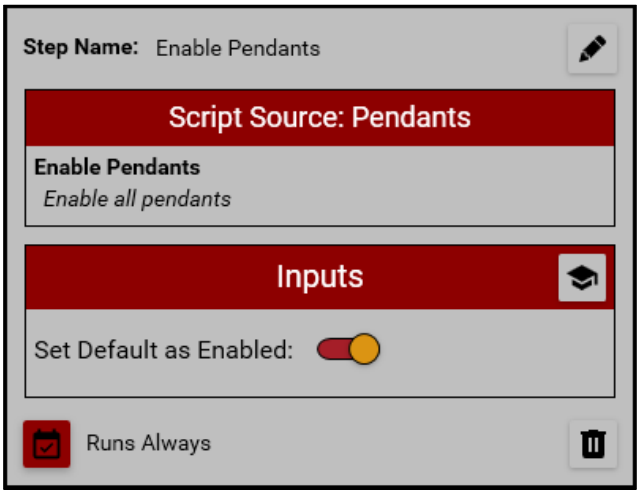

Figure 196: Enable Pendants Inputs

7.4.14 Disable Pendants

Disable Pendants prevents the usage of any actions within a pendant profile until Pendants are re-enabled from an application or trigger level event.

- **Set Default as Disabled**: Sets the default state of pendants to disabled.

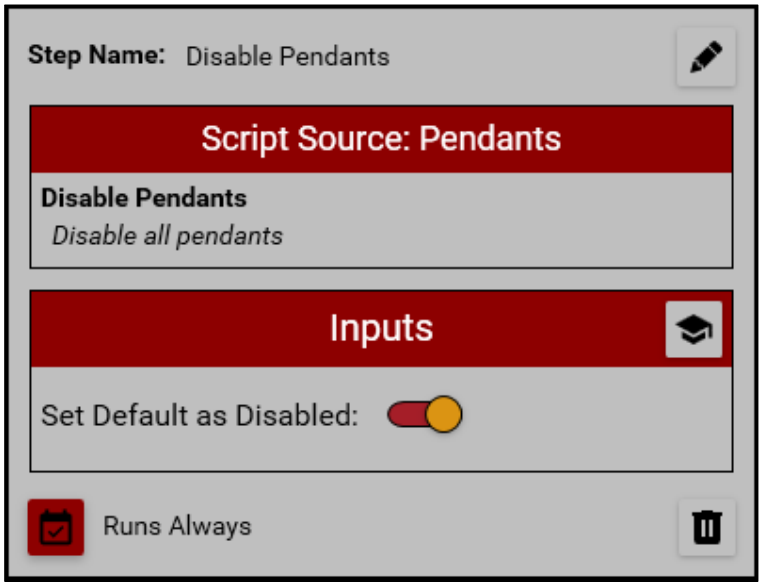

Figure 197: Disable Pendants Inputs

7.4.15 Enable/Disable Quick Actions

Disable Quick Actions prevents the usage of any actions within the Quick Actions menu until Quick Actions are reenabled from an application or trigger level event. Enable Quick Actions is used to allow Quick Actions in certain scenarios, as well as undo a Disable Quick Actions step. Enable/Disable Quick Actions do not have configurable settings.

7.5 Feature Setup and Usage

7.5.1 General

7.5.1.1 Combined Acceleration/Deceleration Settings

Most machine motion settings have separate values for acceleration and deceleration. However, there are a few features in PathMaster X where both values come from a single property.

Staging Servo Adjust	When adjusting the width of a staging device from either the header menu or the configuration page, the **Increase** and **Decrease** buttons will both use the same value for acceleration and deceleration. This value is the default acceleration set for the axis used.
Tool Servo Adjust	When adjusting the width of a Tool from either the header menu, or the configuration page, the **Increase** and **Decrease** buttons will both use the same value for acceleration and deceleration. This value is the default acceleration set for the axis used.
Pendant Jogging	When jogging the gantry with a pendant using the default profile, the same value will be used for both acceleration and deceleration. The value used is the default acceleration for the axes used in the movement.
Single Axis Jog	This assignable function will use the default acceleration value for the selected axis for both acceleration and deceleration.
Dual Axis Jog	This assignable function will use the default acceleration value for the selected axis for both acceleration and deceleration.

7.5.2 Solvent Flush

7.5.2.1 Setup

7.5.2.1.1 Set Up Drain Bottle Sensors

1. Create the sensor(s). The standard sensor driver for the solvent drain bottle is the IFM KI6000.

2. Configure the sensor(s). Note that the IFM KI6000 can configure its normal state. The sensor itself should be configured so that it is normally closed.

3. The debounce time should be configured to a value of 1000 ms.

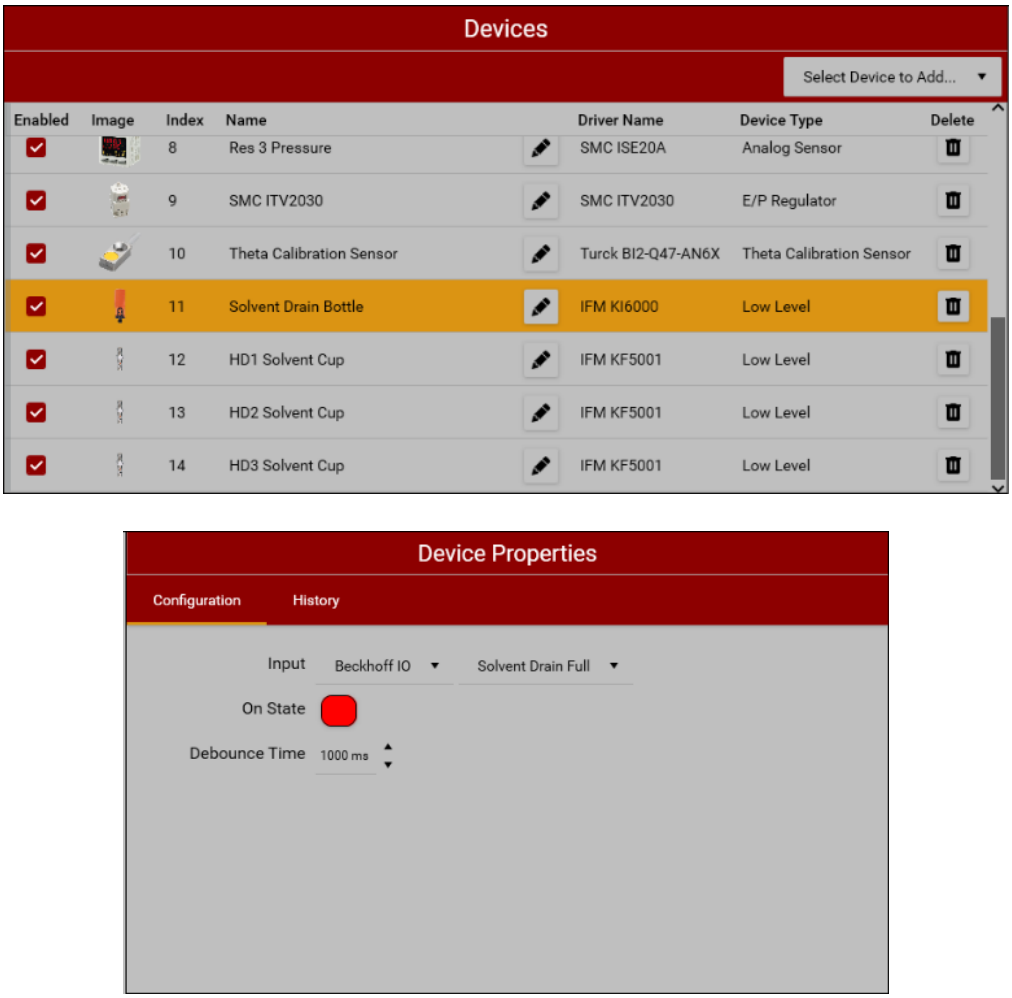

Figure 198: Drain Bottle Sensor Setup

7.5.2.1.2 Set Up Cup Sensors

1. Create the sensor(s). The standard sensor driver for the solvent drain bottle is the IFM KF5001.

2. Configure the sensor(s). The debounce time should be configured to a value of 1000 ms.

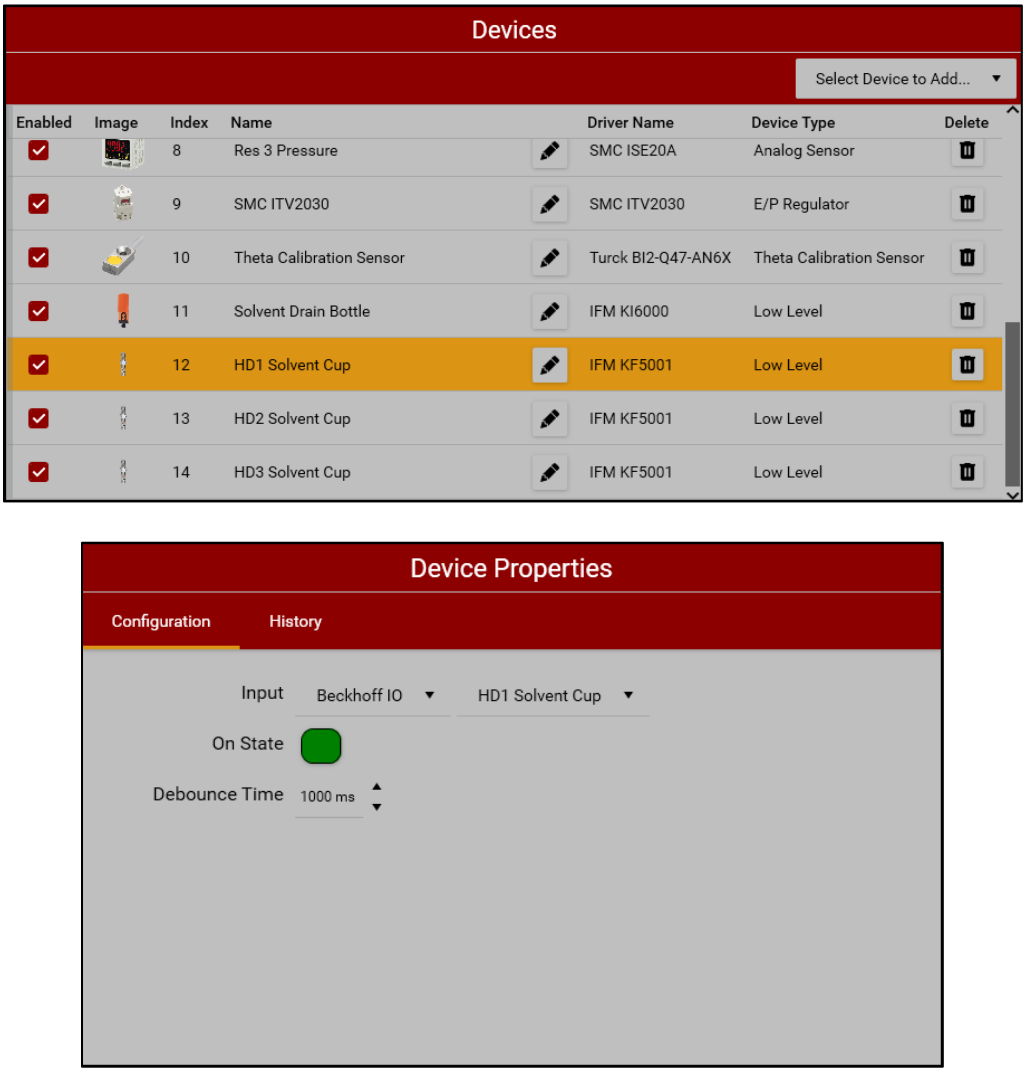

Figure 199: Cup Sensor Setup

7.5.2.1.3 Set Up Solvent Flush Cleaning Device

1. Create the Solvent Flush device.
2. Configure the device.

Note: Because of the design of the system, the Flush Output may be named as the solvent refill output. This is because the system is flushed by filling the solvent cup.

- The Cup Sensors are the same as configured in Step 2. Multiple can be selected.
- The Bottle Sensors are the same as configured in Step 1. There is typically only one, but multiple can be selected.
- The Manual Flush time is used when flushing the system manually (see Usage section below).

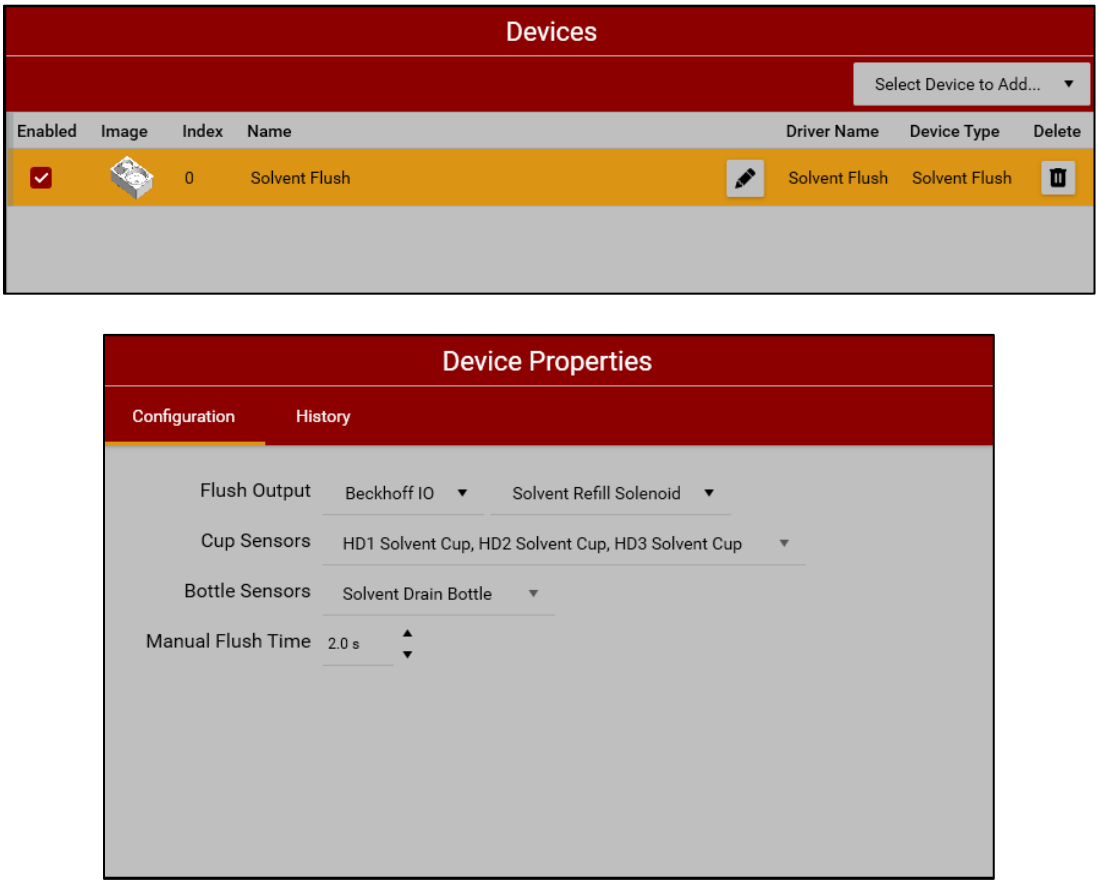

Figure 200: Cleaning Device Setup

7.5.2.1.4 Set Up Trigger

1. Locate the existing **Clean Tools** trigger.

Note: Older systems may have separate solvent and purge triggers instead of the Clean Tools trigger. In this case, the following steps will need to be added to both triggers.

2. Add a lane directly following the lane that purges the valves.
3. Rename the new lane to **Solvent Flush**.
4. Add the Solvent Flush's **Flush** script to the new lane.

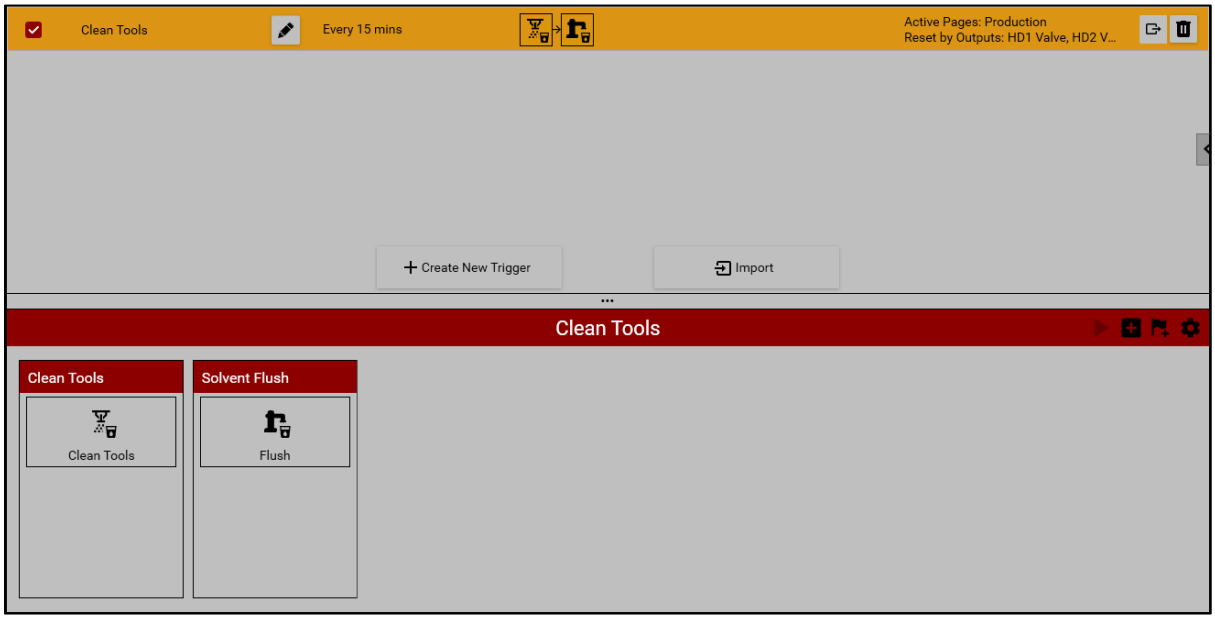

Figure 201: Clean Tools Trigger

7.5.2.1.5 Supply Tanks with Analog Sensor

If the solvent supply tank is equipped with an analog sensor, follow the steps below.

1. Add a lane before the **Solvent Flush** lane.
2. Rename the lane to **Start Pressure Check**.
3. Add the **Start Pressure Monitoring** script from the appropriate analog sensor.
4. Configure the script with the following settings:

Note: Low and High may differ depending on machine requirements.

- **Low** – 5.0 psi
- **High** – 74.5 psi**

Note: This is the sensor's maximum value.

- **Error Immediately** – True
- **Build Pressure Delay** – Disabled

5. Add a lane after the **Solvent Flush** lane.
6. Rename the lane to **End Pressure Check**.
7. Add the **Stop Pressure Monitoring** script from the appropriate analog sensor.

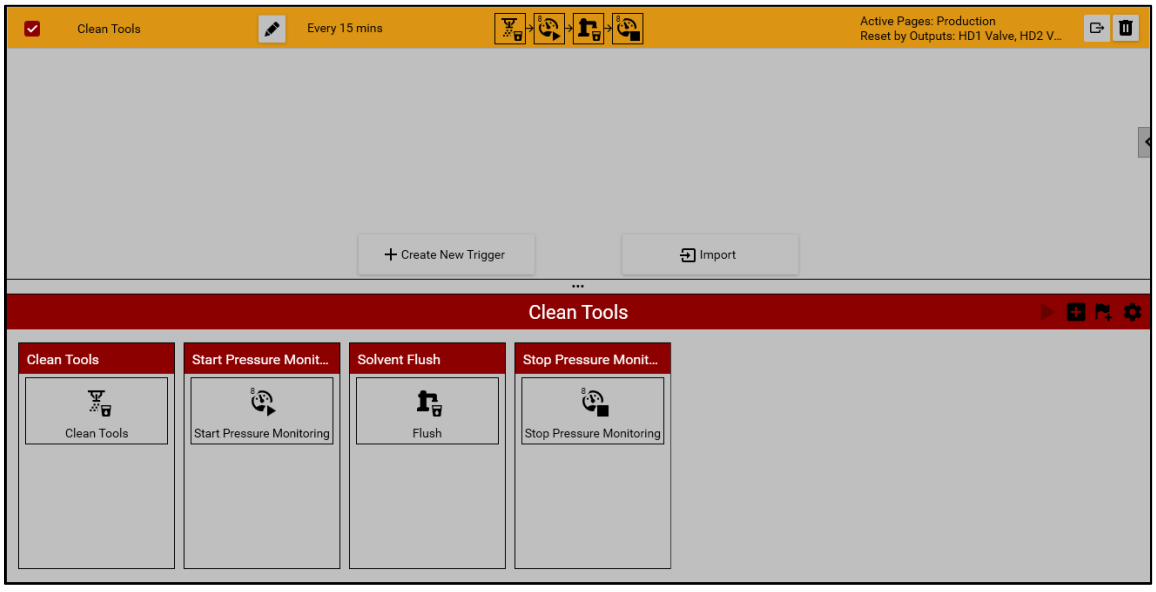

Figure 202: Add Pressure Check

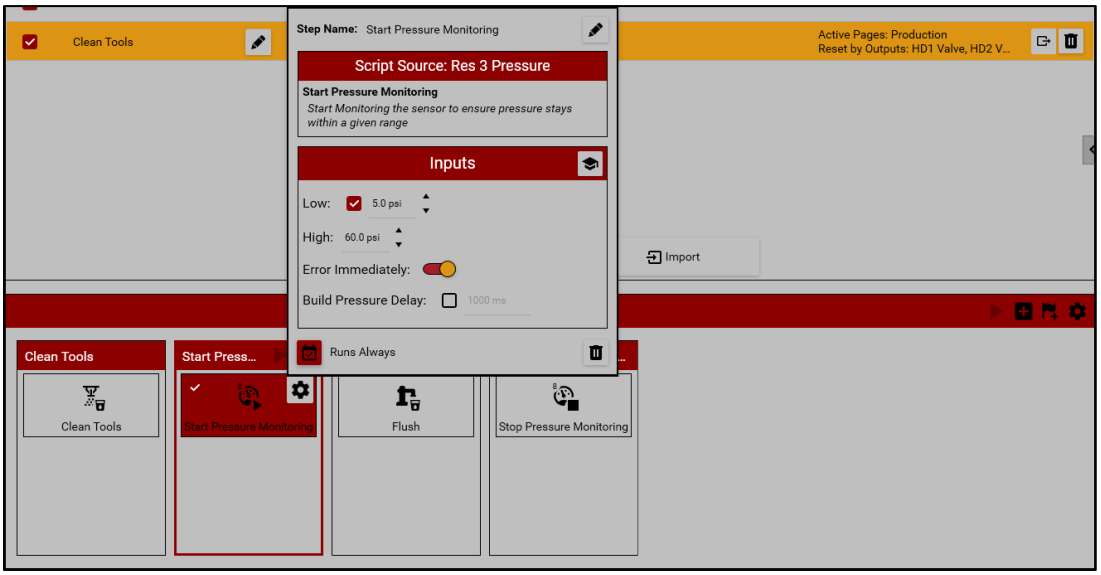

Figure 203: Start Pressure Monitoring Inputs

7.5.2.2 Usage

7.5.2.2.1 Flush

This function will flush the system for a configurable amount of time. It will run any time the machine purges as configured in 7.5.2.1.4 Set Up Trigger.

7.5.2.2.2 Manual Flush

This function will flush the system for the time configured on the Solvent Flush device, which was set up in Section 7.5.2.1.3 Set Up Solvent Flush Cleaning Device. This function is accessible in the Quick Actions menu by default.

Figure 204: Manual Flush Quick Action

7.5.3 Endurance Cart

7.5.3.1 Setup

1. Navigate to the Configuration > Device > Fluid Delivery page.
2. From the **Select Device to Add** menu, select **Endurance**.
3. In the Configuration tab of Device Properties, set the IO points.

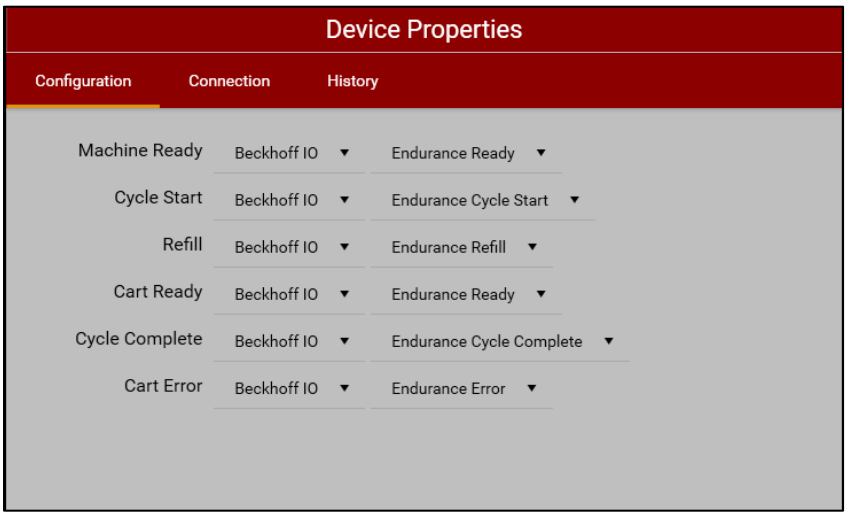

Figure 205: Endurance IO Configuration

4. In the Connection tab of Device Properties, set the communication settings.

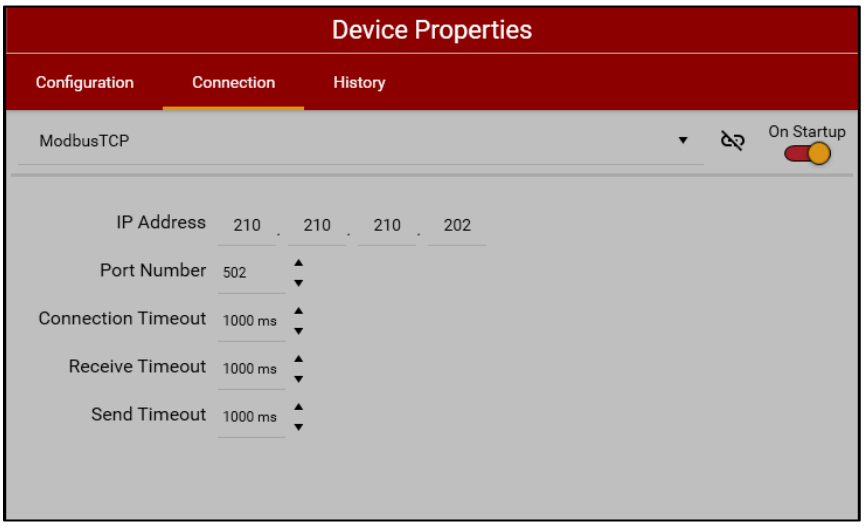

Figure 206: Endurance Communication Settings

7.5.3.2 Usage

To control the Endurance cart directly, click the **Launch vncviewer** button  under the Configuration and Testing pane.

The Endurance device provides two functions for use as Program steps: Refill and Set Recipe. Two functions are provided as process steps including **Start Error Monitoring** and **Stop Error Monitoring**.

Refill, Set Recipe, Start Error Monitoring, and Stop Error Monitoring are all available for use as Trigger steps.

7.6 Keyboard Shortcuts

Shortcut	Description
Ctrl + Alt + B	Disable PMX topmost (Top Menu bar should have focus before shortcut is keyed)
Ctrl + Alt + K	Kill Popup Dialog Box
Ctrl + Alt + X	Request Application Shutdown
Ctrl + Alt + C	Remove Application background blurring
Ctrl + Alt + S	Silence Alarm

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9. Notes

10. Warranty

PVA Warranty Policy

PVA warrants the enclosed product against defects in material or workmanship on all components for one year from the date of shipment.

The warranty does not extend to components damaged due to misuse, negligence, or installation and operation that are not in accordance with the recommended factory instructions. Unauthorized repair or modification of the enclosed product, and/or the use of spare parts not directly obtained from PVA (or from factory authorized dealers) will void all warranties.

All PVA warranties extend only to the original purchaser. Third party warranty claims will not be honored at any time.

Prior to returning a product for a warranty claim, a return authorization must be obtained from PVA's Technical Support department. Authorization will be issued either via the telephone, facsimile, or in writing upon your request.

To qualify as a valid warranty claim, the defective product must be returned to the factory during the warranty period. Upon return, PVA will repair (or replace) all components found to be defective in material or workmanship.

(Retain this for your records)

Product Information:

PRODUCT: _____

SERIAL NUMBER: _____

DATE OF PURCHASE: _____