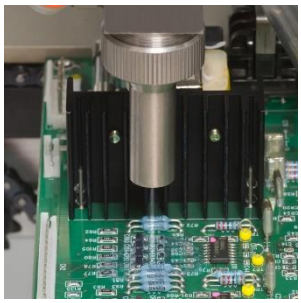
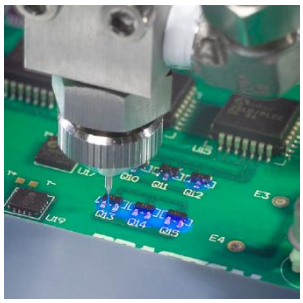
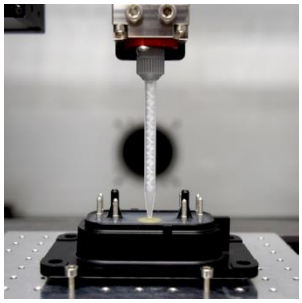
INNOVATION. PRECISION. EXCELLENCE.



PVA Workcell

Installation, General Guidelines, Troubleshooting & Maintenance

Rev G

Precision Valve & Automation
Six Corporate Drive
Halfmoon, NY 12065

Table of Contents

1. Introduction 7
1.1 PVA Contact Information 7
1.2 Document History 7
1.3 Safety 8
1.4 System Description 10
1.5 Personal Protective Equipment 11
1.6 Notices and Warnings 11
1.7 Best Practices 11
1.8 Environmental 12
1.9 Workcell Location 12
1.10 Handling, Transportation, and Storage 12
1.11 Storage, Temperature, and Humidity 12
1.12 Dispensing/Spraying Equipment 12
1.13 Light Tower Operation 13
2. Installation and Setup 14
2.1 Uncrate and Inspect 14
2.2 To Place the Dispense System 14
2.3 Light Tower Operation 15
2.4 Board Sensor Sensitivity Adjustment Procedures 16
2.4.1 To Adjust the Board Sensors 16
2.5 Servo Motor Couplings 17
2.6 Inspection 18
2.7 Install the Teach Pendant 19
2.8 Connect the Computer and Flow Monitor 19
2.9 Install Light Tower 20
2.10 Level the Workcell 21
2.11 Power Up 22
2.11.1 LCD Mounting Requirements 23
2.12 Machine Communications (SMEMA) 24
3. Operating Safety 25

3.1 Safety Circuit 25
3.2 Polycarbonate and Safety Glass Guarding 25
3.3 Doors 25
3.4 Light Curtain 25
3.5 Exhaust Fan 26
3.5.1 Standard Machine Exhaust Requirements 26
3.6 Air Velocity Test Points 27
3.6.1 Delta 6, Delta 8, Flex Cell, Queue, and Inspect Station 27
3.6.2 DeltaTherm and Spectra 27
4. Manual Location 28
5. Troubleshooting 29
5.1 Calling Technical Support 29
5.2 Records 29
5.3 Fault Diagnostic for Closed Loop Servo Systems 30
6. Maintenance 32
6.1 Overview 32
6.2 Schedule 32
7. Procedures 34
7.1 Ball Screw Slides 34
7.2 Inspection 34
7.3 Conveyor Belt Replacement 34
7.4 Devices and Valves 34
7.5 Servicing the Inline Material Filter 35
7.6 Exhaust Fan Setup 35
7.7 Pressure Differential Switch Setup 36
7.8 Motor Feedback Test 37
7.9 Encoder Feedback Test 39
7.10 Computer and Workcell Communication 40
7.10.1 RS-232 Communication 40
7.10.2 DMC-2200 Dip Switch Settings 40

7.10.3 Serial Communications 41
7.11 Common Main Program Changes 45
7.12 Install Spectra Lamp 45
8. Part Replacement 48
8.1 Ordering Parts 48
8.2 Return Material Authorization (RMA) 48
8.3 Training 48
8.4 Warranty 48
8.5 Shipping 48
9. DMC Programming Basics 49
9.1.1 Labels 49
9.1.2 Important Commands 49
10. DMC Error Codes 54
11. Technical Support 55
12. Table of Figures 59

This document is based on information available at the time of its publication. While efforts have been made to ensure the contents of this manual are accurate, the information contained herein does not purport to cover all specific details or variations in hardware, or to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. Precision Valve and Automation, Inc. assumes no obligation of notice to holders of this document with respect to changes subsequently made.

Precision Valve and Automation, Inc. makes no representation or warranty, expressed, implied, or statutory with respect to, and assumes no responsibility for the accuracy, completeness, sufficiency, or usefulness of the information contained herein. No warranties of merchantability or fitness for purpose shall apply.

This document, including the information contained herein, is the property of Precision Valve and Automation, Inc. and is considered confidential and proprietary information. It is delivered on the express condition that it not be used, disclosed, or reproduced, in whole or in part, for any reason without prior written consent of Precision Valve and Automation, Inc.

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

Main Office **PVA**

Six Corporate Drive

Halfmoon, NY 12065

Tel +1-518-371-2684

Fax +1-518-371-2688

Website: http://www.pva.net

Email: info@pva.net

Technical Support

Tel +1-844-734-0209

Email: **cs@pva.net**

1.2 Document History

Revision	Revision Date	Reason for Changes
REV G	November 2021	Updated Air Velocity Test Points
REV F	November 2020	Added Exhaust Requirements for DeltaTherm Humidity
REV E	October 2020	Combined Troubleshooting Maintenance Guide and Spectra Install Info
REV D	December 2019	Exhaust Requirements and Shipping Bracket Info
REV C	November 2019	Marketing Rebrand
REV B	March 2019	Technical Support and Exhaust Updated
REV A	January 2015	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 PVA UV cure 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.

CE

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 System Description

This manual applies to the following Precision Valve & Automation, Inc. workcells:

PVA350™	PVA6000™
PVA650™	Delta 6
PVA2000™	Delta 8
PVA3000™	

The valves are mounted to the end effector of a two, three, or four axis Cartesian robot. All dispensing is done in the work area enclosed with safety glass or polycarbonate. The axes have limits to prevent damage to the machine. The dispense path and active heads are controlled by a program stored in the motion controller. The motion controller can save up to 30 programs at one time.

The operator controls the workcell with PVA Portal software. This includes machine setup, manual operation, program selection, and automatic operation. Machine status and error messages are shown in the program window and the light tower. The operator(s) must have read this manual, or have been trained and understand the operation of the machine.

Any uses that are not approved could result in dangerous conditions that the safety features on the system cannot prevent.

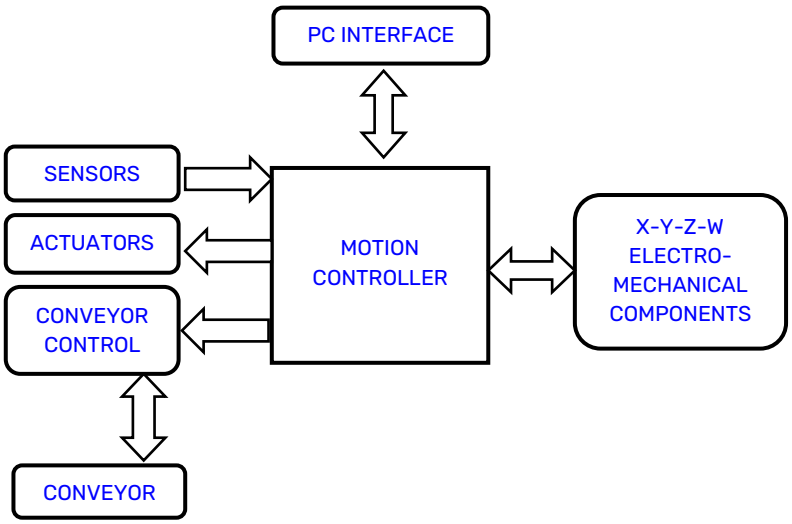


Figure 1: Workcell Functional Block Diagram

1.5 Personal Protective Equipment

Workcell operation includes air pressure, electrical power, mechanical devices, and the use of hazardous materials. Only qualified personnel can operate and service workcells. Operators must use eye protection because material contents are under pressure. Always wear gloves when handling materials and solvents. Refer to MSDS sheets on the material that is used for other precautions.

1.6 Notices and Warnings

- You must wear safety glasses, gloves, and long sleeves.
- Lock-out and tag the air and power supplies before you service or clean the workcell
- Release the pressure before any hose (air or fluid) is removed
- All hoses must have the correct pressure rating
- Use only replacement parts recommended or supplied by the manufacturer
- Stay away from all parts that move when the system is in operation

1.7 Best Practices

- Do not wear loose clothes or jewelry when you operate the workcell
- Do not touch the dispense head while it is moving
- Make sure cables and pneumatics hoses are attached and do not cross walkways
- Immediately engage the Emergency Stop button if personnel is in danger
- Locate and define all safety labels on and around the workcell before you turn the machine “On”
- There must be two people during maintenance procedures
- Dispose of all used parts and materials in accordance with local laws and regulations

Safety is a joint responsibility between the OEM and the end-user. All precautions and practices should be in accordance with local regulations.

Do Not: Use incompatible tools, remove door interlocks or bypass safety devices, make custom mechanics or fluid delivery modification or change material from the original design.

1.8 Environmental

Area of Possible Concern	System Information
Audible Noise Levels	Below 65 dBA.
Material and Chemicals	There are no known dangerous materials or chemicals on this workcell. Refer to the MSDS sheet for the dispensed material.
Hazards Due to Contact	The workcell has safety features to minimize injuries. In some modes of operation it is possible to override safety features. Only qualified personnel should enter the work area when the workcell has power. All hot surfaces have a warning label.

1.9 Workcell Location

The machine should be installed on a level surface away from standing water, possible overspray, and overhead leaks.

1.10 Handling, Transportation, and Storage

The workcell should be handled and transported with minimal vibration and shock on the system. Use an air-ride truck for roadway transport. The machine is built for an industrial environment, but excessive abuse will decrease the performance of the machine. Use a forklift to gently move the workcell. Make sure the forks are all the way in and that the blades reach from front to back.

1.11 Storage, Temperature, and Humidity

When in storage, all enclosures and connector covers should be closed tightly. Put a cover over the system if there is dust or other airborne debris in the storage area. Store the workcell in an area that is 40°F - 105°F (4°C – 41°C) and low humidity. Do not let condensation collect on the machine.

1.12 Dispensing/Spraying Equipment

When the workcell is stored for an extended period of time, it should be flushed with a solvent compatible with the application material and workcell components.

NOTE: PVA is not responsible for damages incurred by incorrect transportation and handling of the workcell. The instructions given for the transportation, handling, and storage of the workcell are the correct manufacturer's procedure.

1.13 Light Tower Operation

Three stacked indicator lights and a buzzer are used to show the machine status. The lights are green, amber, and red and can be seen from all sides of the machine. The buzzer is below the green light. The lights and buzzer operate as follows:

- The green light is on when the machine is in cycle and parts are made. It is off at all other times.
- The amber light is on when the machine is in Auto Cycle and ready to make parts, but cannot cycle because the workcell is waiting for another machine or there is an external material handling problem (no incoming parts or no room to unload parts).
- The red light is on steady when the machine is not in Auto Cycle. It will flash when the workcell is in an error state.
- The buzzer operates with the red light during machine errors.

State	Red	Amber	Green	Buzzer
Cycle Stop	ON	OFF	OFF	OFF
Auto Cycle	OFF	ON	OFF	OFF
In Cycle	OFF	OFF	ON	OFF
Machine Error	FLASH	OFF	OFF	FLASH

Figure 2: Light Tower & Buzzer Status

Note: This is the standard configuration. Actual configuration depends on the workcell.

2.Installation and Setup

Before you operate the workcell, know the components. Do the steps in this manual for safe and correct operation.

WARNING: Only qualified personnel should do these procedures. Obey this manual and all applicable safety regulations. A "qualified person" is defined as "a person or persons who, by possession of a recognized degree, certificate, or professional training, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work." (Ref. ANSI/ASME B30.2-1983.)

2.1 Uncrate and Inspect

1. Use the utility knife to cut the straps and the shrink wrap.
2. Remove the cardboard as well as all packing materials and straps.
3. Use a 9/16" wrench to remove the bolts that anchor the workcell to the floor of the crate, there are two (2) bolts in each foot (8 Total).
4. Use a forklift to gently remove the workcell off the pallet. Lift the workcell from either the back or the front. Make sure the forks are all the way in and that the blades go all the way under the workcell (from front to back).

2.2 To Place the Dispense System

1. Move the workcell to the necessary location.
2. Adjust the forklift height until the workcell is at the necessary height.
3. Loosen the lock nuts on each foot of the workcell, if necessary.
4. Make sure that all four (feet) touch the ground. If any feet do not touch the ground, use the adjustable wrench to lower the feet by turning the feet clockwise.
5. When you lower the feet, you raise the workcell. When you raise the feet, you lower the workcell.

See Figure 3 on next page.

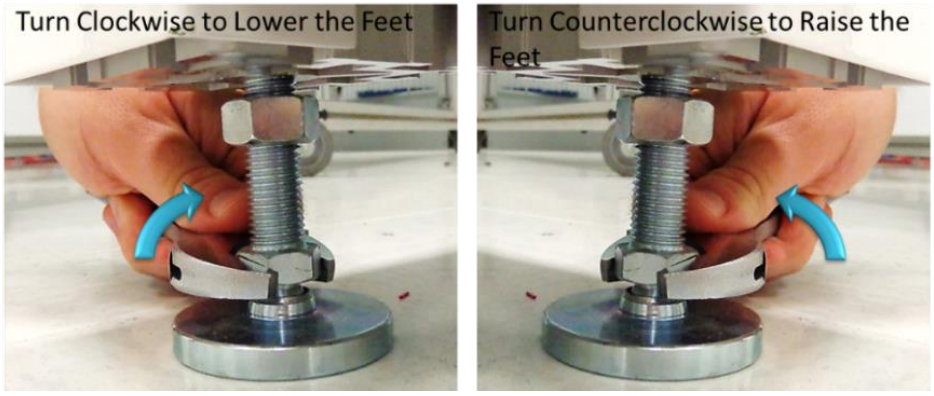


Figure 3: Adjust the Feet

6. Gently lower the workcell and remove the forklift. It is not necessary to tighten the lock nuts at this time.

2.3 Light Tower Operation

Three stacked indicator lights and a buzzer are used to show the machine status. The lights are green, amber, and red and can be seen from all sides of the machine. The buzzer is below the green light. The lights and buzzer operate as follows:

- The green light is on when the machine is in cycle and parts are made. It is off at all other times.
- The amber light is on when the machine is in Auto Cycle and ready to make parts, but cannot cycle because the workcell is waiting for another machine or there is an external material handling problem (no incoming parts or no room to unload parts).
- The red light is on steady when the machine is not in Auto Cycle. It will flash when the workcell is in an error state.
- The buzzer operates with the red light during machine errors.

State	Red	Amber	Green	Buzzer
Cycle Stop	ON	OFF	OFF	OFF
Auto Cycle	OFF	ON	OFF	OFF
In Cycle	OFF	OFF	ON	OFF
Machine Error	FLASH	OFF	OFF	FLASH

Figure 4: Light Tower & Buzzer Status

Note: This is the standard configuration. Actual configuration depends on the workcell.

2.4 Board Sensor Sensitivity Adjustment Procedures

Board sensors are optic sensors that face upward along the length of the front of the conveyors. They detect the presence of a part and send a signal to the motion controller. If a board is reflective or shiny, or does not process correctly adjust the board sensors.

The number of sensors depends on your system, but your workcell may have up to five board sensors. There can be one for each zone (entry zone, primary spray/work area, exit zone, return work area, and part detection). Adjust each sensor as necessary.

2.4.1 To Adjust the Board Sensors

You will need a small flat head screwdriver and part or sample board to be processed.

1. Put a part on the conveyor's rail and examine sensor sensitivity.
2. To increase sensitivity, use a small screwdriver to turn the sensor screw clockwise. To decrease sensitivity turn the sensor screw counterclockwise.

Figure 5: Board Sensor

3. Use the sample part to examine the board sensors on both sides (top and bottom) of the conveyors.
4. If only the green LED is on, the sensor is OFF. If the Orange LED is on the sensor is ON.

2.5 Servo Motor Couplings

Servo couplings are compensating couplings that are backlash free with conformal torque transfer. They supply high torsion stiffness and a low moment of inertia. Examine the servo motor couplings if shifting is suspected and to tighten the set screws.

Note: It may be necessary to remove the motor to get access to the second set screw. The second set screw is not always visible but must also be tightened periodically.

Figure 6: Servo Couplings

2.6 Inspection

1. Open the doors and remove all straps, tie wraps, and sponges around the dispense heads and gantry.

NOTE: In order to prevent any movement during the shipping process, many workcells are equipped with green shipping brackets inside the machine. The placement of these brackets will vary by workcell. The shipping brackets must be removed before continuing the inspection.

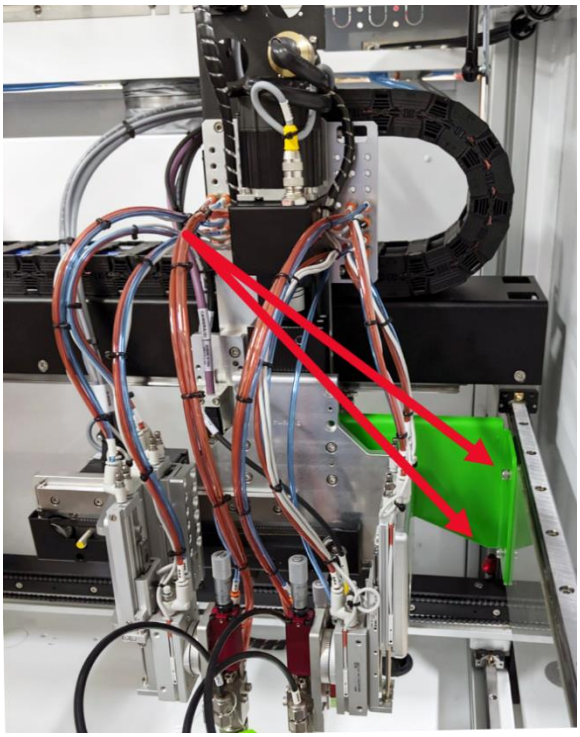


Figure 7: Shipping Bracket

2. Fully examine the workcell for damage, loose fasteners, etc.
3. Use your hands to move the X and Y-axis slide to the center of the work area.
4. Examine all tubing connections, gauges, and regulators.
5. Open the electrical enclosure and visually inspect connectors and components for signs of vibration during shipping. Close the door, the machine should not operate with the doors open.
6. Make sure all cables and connections are fully and correctly installed.

2.7 Install the Teach Pendant

1. Find the teach pendant and connect the end into the 15 pin connector on the front of the workcell.
2. Use a small flat head screwdriver to tighten the two screws on the teach pendant connector into the threads on the workcell.

Figure 8: Teach Pendant Connection

2.8 Connect the Computer and Flow Monitor

1. Find the cords to connect the computer. Do the steps recommended by the PC manufacturer to connect the computer. Make sure the computer is correctly grounded.
2. Make sure the flow monitor is correctly connected and prime the flow monitor. Refer to the flow monitor manual for instructions on how to prime the flow monitor.

2.9 Install Light Tower

1. Find the light tower on the top rear of the workcell.
2. Remove all packaging and material from the light tower, this includes: wrapping paper, bubble pack, and tape.
3. Find the light tower connection on the top of the workcell.
4. There will be a nut on the top of the workcell and a lock nut and washer inside the workcell. Remove the bottom lock nut and washer.
5. Align the mast to the extrusion. The power cord should go through the hole down inside the workcell.
6. Tighten the lock nut to the bottom of the light tower mast. Use an adjustable wrench as necessary to tighten.
7. Connect the two ends of the light tower cables.

Figure 9: Light Tower Connection

2.10 Level the Workcell

This is the procedure to level the workcell. If the workcell will be used as an in-line system, it needs to be leveled and aligned with the upstream and downstream systems. This document does not include procedures for upstream and downstream systems. Alignment procedures should be developed and followed by your facility.

1. Put the level in the center of the front conveyor.
2. Look at the position of the bubble in the level window. The bubble will be centered between the two lines when the workcell is level.

TIP: If the bubble is outside or closer to the right line, raise the left side of the workcell. If the bubble is outside or closer to the left line, raise the right side of the workcell.

3. If necessary, loosen the locking nut on each foot with an adjustable wrench.
4. Use an adjustable wrench to adjust the feet of the workcell. Put the wrench on the flat (unthreaded) part of the pedestal and turn in the necessary direction until the workcell is level from side to side.

TIP: Turn the pedestal clockwise to raise the workcell and counterclockwise to lower the workcell. See Figure 2.

5. Put the level along the length of the rail to check for level at both ends of the conveyor's rails.
6. Look at the position of the bubble in the level window. The bubble will be centered between the two lines when the workcell is level. Do steps 3 and 4 to make the workcell level.
7. Put the level across the center of the conveyor's rails, with one end on the front conveyors and one end on the back rail.
8. Look at the position of the bubble in the level window. The bubble will be centered between the two lines when the workcell is level. Complete steps 3 and 4 to make the workcell level.
9. In each corner, put your hands on top of the workcell and push down. If one of the feet does not touch the ground the workcell will rock back and forth. Adjust the feet so that they all bear equal weight.
10. After you check the corners, level the workcell from side to side and front to back again, if necessary.
11. When the workcell is level from front to back and side to side, is stable, and all four feet bear equal weight, use your hand to turn the locking nuts on the workcell feet counterclockwise until they are tight.

2.11 Power Up

After the accessories are installed, connect the workcell to air and power supplies. After the workcell is correctly connected, turn the main power switch “On” and make sure system components function correctly.

WARNING: Failure to obey electrical specifications can damage the machine and injure personnel. Electrical hookup must be done by a qualified electrician and must comply with any applicable local standards.

1. Plug the machine into an appropriate power source as shown on the legend plate on the rear of the machine.

The electrical service must be correctly grounded and the power source “clean”. If high-power equipment uses the same source, a line conditioner may be necessary. Poor power quality can cause machine errors. All workcells shipped from the PVA factory can operate with the voltage used at the installation site, per engineering design.

WARNING: Make sure that the main power switch is “Off” before you connect the workcell to the facility power source.

2. Find the main air regulator.
3. Attach the workcell to the facility air supply. There is a ¼” NPT female fitting at the rear of the machine. Connect to a source of clean, dry air. Compressed air with a dew point of 50° F (10° C) is sufficient. A hose with ¼” inside diameter is sufficient for most machines and typical air consumption is 2-6 CFM (3.4 to 10.2 mˆ3/hr).
4. Slowly open the facility air valve.
5. Close any access doors and engage in the Emergency Stop button.
6. At the rear of the machine, turn on the red air lockout valve.

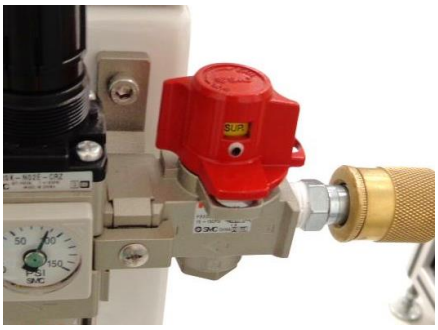


Figure 10: Example of a Red Air Lockout Valve

7. Ground any pressure vessel to earth or the machine.
8. Attach a correctly designed ventilation system to the exhaust port. It is necessary that the exhaust flow is correct for the specified CFM of your workcell.

NOTE: Refer the Material Safety Data Sheets (MSDS) for safety precautions on any chemicals used in PVA equipment.

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

9. Turn the main power switch "On".

Figure 11: Example of a Main Power Switch

10. Do the safety check and homing routine through Portal.
11. Select Manual mode and manually (using teach pendant) move the head around the entire work area. Make sure there are no components that can be hit by the head in the work area.
12. Make sure that the pneumatic and electrical cables do not decrease the heads travel and will not be cut or snagged when moved. Please contact Technical support if there are any problems.
13. Make sure the valve and brackets are tight and that the valve does not rock or wiggle in the bracket.
14. Close the doors.

2.11.1 LCD Mounting Requirements

If a monitor will be mounted on a PVA arm it must:

- Weigh no more than 9 lbs.
- Have either 75mm or 100mm hole spacing for the VESA mount.
- Be flat on rear of the monitor for PVA keyboard tray bracket.

2.12 Machine Communications (SMEMA)

For manufacturing lines (multiple machines with conveyor systems) SMEMA cables must be connected in the correct manner for the individual modules to communicate reliably. Not all workcells have SMEMA plugs. Please note on the diagrams the J# refers to the label on the machine, not the label on the cable.

The Surface Mount Equipment Manufacturers Association (SMEMA) Electrical Equipment Interface Standard is used to make sure the sequence of boards is correct. If you do not have these connections, boards cannot move from one machine to another. SMEMA cables have male 14-pin, amp-type CPC connectors. The cables are straight through, so orientation does not matter. SMEMA machine plugs may be on the inside or the outside of the machine, depending on the workcell.

Each machine must have the same transport conveyor height from the floor to the bottom of the PC board. For equipment with an adjustable conveyor width, the front rail is not adjustable. The range of adjustment will change with the workcell.

Two signal lines will be used: Ready and Board Available. On each module, the cable to the J1 (Previous) plug must connect to the J2 (Next) plug on the machine upstream. The J2 plug on each machine must connect to the J1 plug on the machine downstream, as shown in the following diagram:

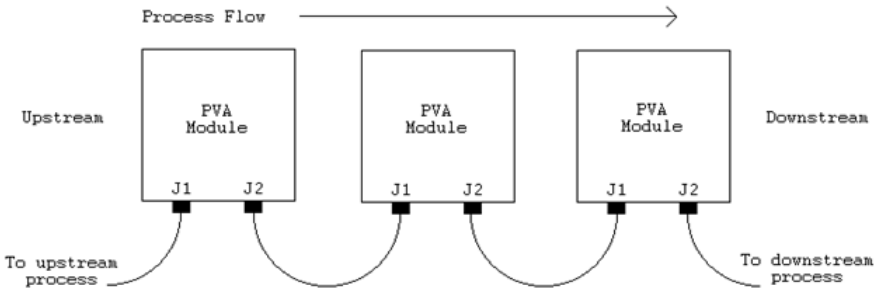


Figure 12: SMEMA Diagram

NOTE: For bidirectional machines there may be J3 and J4 that follow J1 and J2 respectively.

Figure 13: SMEMA Machine Plugs

3. Operating Safety

The workcell has several safety features that protect the operator from hazards in normal machine operation.

Warning! The safety features should NEVER be bypassed, disabled, or tampered with. PVA is not responsible for any damage, mechanical or human, caused by changes or destruction of any safety features.

3.1 Safety Circuit

The main power to the workcell is monitored and controlled by the safety circuit. The safety circuit contains two relays under-voltage protection and one or more safety devices. The relays are wired in a redundant manner. The tripping contacts of the relays are connected in series so the safety circuit will disconnect power even if one of the relays fails. The relays are self-checking with positive guided contacts electrically forced to operate together. If one redundant relays fails or a safety switch is activated, the power contacts are opened.

3.2 Polycarbonate and Safety Glass Guarding

The work area is enclosed with either polycarbonate or safety glass guarding. The front of the workcell is either open, for the manual processing of parts, or has doors.

3.3 Doors

Workcells with an automatic load/unload cycle will have one or two doors in the front. Each door is monitored by a non-defeatable limit switch. When a door is opened, power to the motors and pneumatics is disconnected. The DOOR BYPASS key switch is for maintenance personnel to access the work area without disconnecting power. The bypass switch can only be used in manual or calibration mode.

3.4 Light Curtain

Some workcells have a light curtain. The light curtain is redundant and self-checking. The control signals from the light curtain are safety devices in the safety circuit.

3.5 Exhaust Fan

Some machines have an optional exhaust fan to remove fumes from the work area. You must use the exhaust fan if your workcell was designed with one. Please refer to the workcell specifications for the specific necessary exhaust flow for your workcell. The exhaust flange should be connected to a duct system that can receive the required* CFM (cubic feet per minute) while maintaining less than 1.0" H_2O static pressure in the duct. If airflow through the exhaust system is not sufficient, it will generate an error.

3.5.1 Standard Machine Exhaust Requirements

Machine	Exhaust Requirement	Machine Duct Size	Air Velocity at Test Point (ft/min)	Air Velocity at Test Point (m/sec)
PVA350	300 CFM	4" (102mm)	3438	17.5
Delta 6	300 CFM	4" (102mm)	3438	17.5
Delta 8	300 CFM	4" (102mm)	3438	17.5
Flex Cell	Contact PVA	Varies	Varies	Varies
DeltaTherm 4'	200 CFM	4" (102mm)	2292	11.6
DeltaTherm 8'	300 CFM	6" (152mm)	1528	7.8
DeltaTherm 8' H	140 CFM	6" (152mm)	713	3.6
DeltaTherm 12'	600 CFM	6" (152mm)	3056	15.5
DeltaTherm 12' H	210 CFM	6" (152mm)	1070	5.4
DeltaTherm 16'	1000 CFM	6" (152mm)	5093	25.9
DeltaTherm 16' H	280 CFM	6" (152mm)	1426	7.2
Spectra*	600 - 1200 CFM*	6" (152mm)	3056	15.5
Queue/Inspect Station	300 CFM	4" (102mm)	3438	17.5

***H** *denotes Humidity Option*

**Spectra units that are double-sided have two exhaust ports and an exhaust requirement of 1200 CFM (600 CFM for each exhaust port).*

Note: Check machine specifications. Custom order machines and processes may require higher exhaust flow rates.

Note: Refer the Material Safety Data Sheets (MSDS) for safety precautions on any chemicals used in PVA equipment.

Note: The safety devices on your workcell will be different with each model

3.6 Air Velocity Test Points

3.6.1 Delta 6, Delta 8, Flex Cell, Queue, and Inspect Station

If there is no optional exhaust blower, measure the velocity at the port located inside the workcell. The port is typically on the back wall or the horizontal deck pan inside the machine. If an optional blower is present, measure the velocity at the inlet to the factory supplied duct.

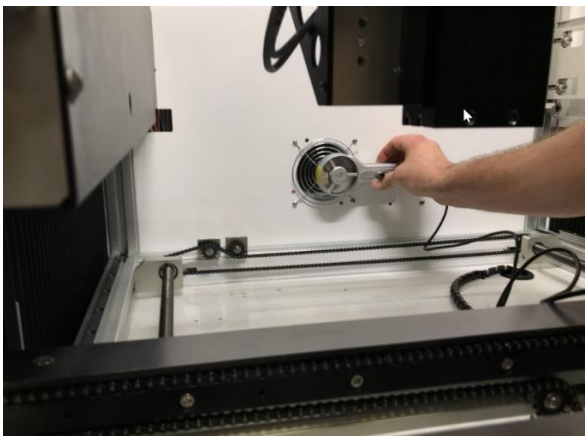


Figure 14: Measure Velocity at Port

3.6.2 DeltaTherm and Spectra

Measure the velocity at the inlet to the factory supplied duct.

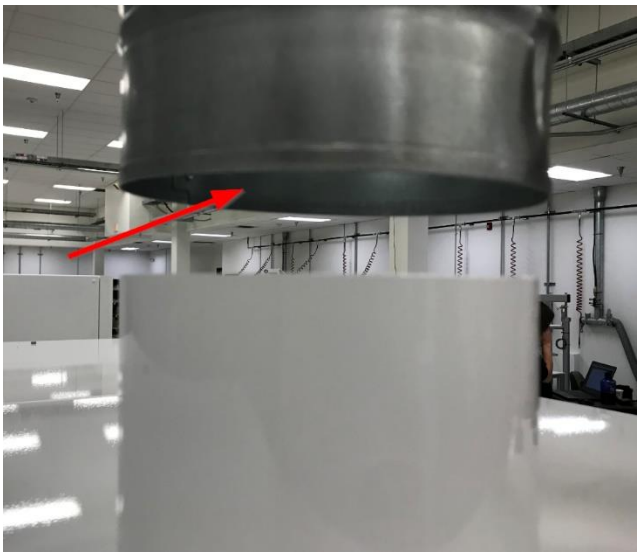


Figure 15: Measure Velocity at Duct Inlet

4.Manual Location

Your manual is saved to your workcell's PC (if you have one).

1. To find your manual, start the workcell computer and open Portal Shell.

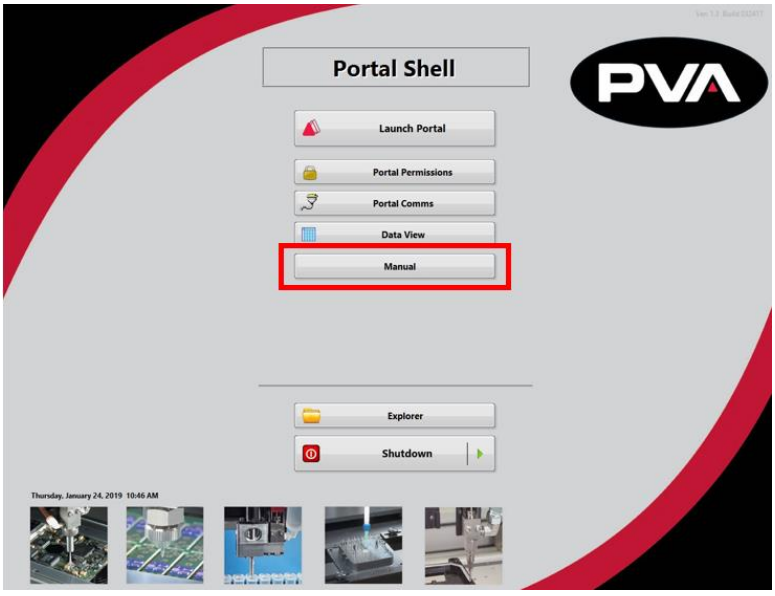


Figure 16: Portal Shell

2. Select the "Manual" button.
3. The file location will display all of the documentation for your workcell.

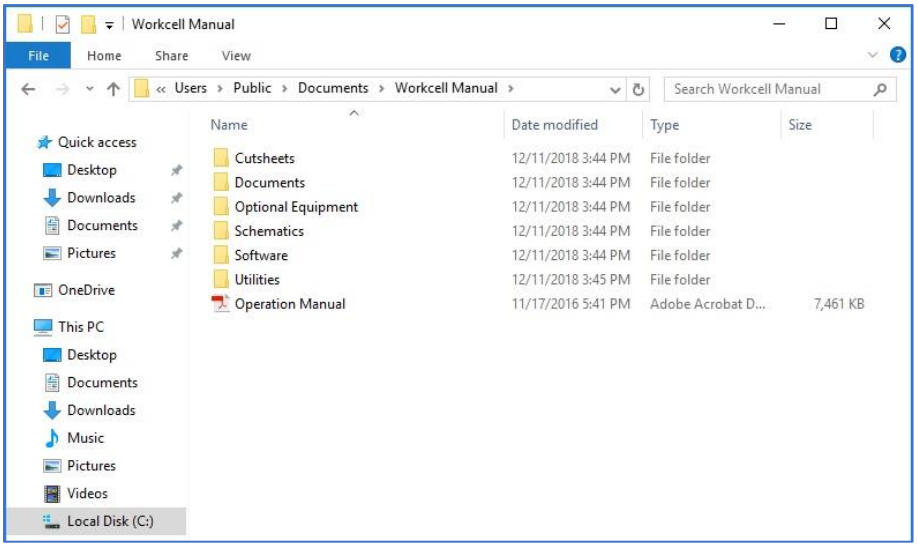


Figure 17: Workcell Manual Location

5. Troubleshooting

The troubleshooting section is designed to solve problems before you call PVA for help. Use this section if a mechanical or electrical problem occurs. If you have problems that are not listed in this section, or continue to have problems after you have done different procedures, please contact PVA Technical Support.

Note: If a problem occurs while running a particular path program, consult the separate PathMaster® Manual for information on debugging code problems.

5.1 Calling Technical Support

The technical support staff is available to help solve any problems. The phone number is +1-518-371-2684. Before you call for help, make sure you have information or documentation for the following items:

1. Please have the serial number of the machine(s) available.
2. Record all the information from the Portal screen when the error occurred.
3. Record the operation that was in progress when the machine had the problem (when did it have problems, what was it doing, etc.).
4. If the error was not dangerous or damaging, try to cause the error again. If the error does not occur again, the problem may have been operator generated.
5. Use a terminal screen to communicate with the motion controller. It is necessary to give commands directly to the motion controller for most troubleshooting.
6. If the problem is programming related, a hard copy or email of the program in question may be requested by PVA, please be prepared to send one. The PVA fax number is (518) 371-2688, or the technical support representative will provide an email address.

5.2 Records

Any service or replaced components should be recorded in maintenance records with any other pertinent data for future reference.

5.3 Fault Diagnostic for Closed Loop Servo Systems

The workcell uses a closed loop servo drive system. Shown below is a general fault diagnostic table for this type of system.

Problem	Other Symptoms	Possible Cause	Corrective Action
When the axes are homed, the end effector moves past the home sensor and hits the hard stop		Home sensor is out of position or too far away from the homing tab	• Engage the "**Emergency Stop"** button. Use your hand to move the axis so the homing tab moves into the home sensor, and the sensor is on. Loosen the lock nut on the sensor and adjust to .020" gap
		Sensor cable is loose or not connected	• Check the cable connections and correct any loose connections
When the axes are homed, the Z-axis does not move	SSR-1 is not ON when the Z-axis drive is enabled	The Z-axis brake does not disengage when the drive is enabled	• Examine the SSR-1 wiring, it should be on when the Z- axis drive is enabled
	SSR-1 is ON when the Z-axis drive is enabled	The fuse for SSR-1 is blown or damaged	• Examine the fuse with an OHM meter and replace if necessary
Note: *If the SSR is on that does not mean it is functioning correctly. Use the test procedure for SSR5 in the power check relay document to test SSR1 for correct operation.			
The axis does not have any motion	Encoder works according to the test in Section 13.6	Axis speed/ acceleration is set to zero	• Set the speed and acceleration to a positive, non-zero value with the SP and AC commands
	The axis drive light is RED	The axis drive is not enabled	• Enable the drive with the SH command
		The axis cables are loose or not connected	• Examine the cable connections and repair any loose connections
		The "**Emergency Stop**" button is engaged	• Disengage the "**Emergency Stop**" button
		Hall Effect sensors are not correctly connected	• Examine the cable connections for the axis, and correct any loose connections • Use the electrical drawings to make sure the Hall Effect sensor phasing is correct
		The axis amplifier is bad	• Replace the amplifier
		Doors are open	• Close the doors tightly
The axis runs away	Axis encoder does not work	Motor power connections are wired incorrectly	• Use the electrical drawings to make sure the phasing is correct
		Axis encoder/brake cable is loose or not connected	• Examine the cable connections, and repair any loose connections
		The axis amplifier is bad	• Replace the amplifier

Problem	Other Symptoms	Possible Cause	Corrective Action
Pneumatic actuator failure	Pneumatics work slowly	Air lockout valve on the workcell is in the OFF position	• Turn the air lockout valve to the ON position
		Not sufficient air pressure	• Examine and adjust the system pressures to the correct values, refer to the Machine Specific Information for pressure settings
		The air line is bent or blocked	• Repair any tight bends or restrictions in the air lines
		A fitting or tube connection is loose	• Tighten loose connections • Examine flow control fitting
		The air line is frayed or damaged	• Replace the damaged air line(s)
		Sensor is not positioned correctly	• Adjust the sensor location
Part in place sensor failure		Cable is loose or not connected Gain Adjustment	• Examine the cable connections, and repair any loose connections • Refer to sensor manual
Conveyor does not run		Conveyor belt stuck to rails	• Clean or replace belt
	No power to conveyor motor	Control relay not energized or Power On light not illuminated (Certain Models)	• Examine voltages and connections
			• Examine conveyor power fuse
Exhaust fan does not run	No air flow	The motor overload relay, OL-1, is in the tripped state	• Reset the exhaust fan overload relay
			• Examine FU-5 in the electrical enclosure
		Insufficient air flow capacity in the factory air ducts	• Install larger air ducts to increase air flow • Reset the exhaust fan overload relay
	The filter and ducting are fine and the motor temperature is normal.	The overload relay current setting has been changed	• Make sure the current setting on the overload relay is correct. Refer to exhaust fan setup for more information • Examine the overload relay for a tripped flag. Push the reset button to reset the relay

Figure 18: Systems Fault Diagnosis

6.Maintenance

6.1 Overview

Do the preventative maintenance as shown in the table below to increase the life of the workcell and make sure every run is high quality.

Note: Only qualified personnel should do workcell maintenance.

6.2 Schedule

Type Of Service				
Service Area	**Every Shift**	**Weekly**	**Monthly**	**Quarterly**
Dispense Equipment	Examine all fluid pressures and dispense weights	Clean material buildup on fixtures and locating surfaces Examine for leaks around compression fittings, tighten or replace if necessary	Examine the fluid delivery lines for excessive wear	Examine the inline material filter for clogs
Electro-mechanical components		Examine the motors for overheating and smooth operation Examine wires, pneumatic lines, and material lines for wear	Apply lithium grease (JIS Type 2) to the ball screw slides	Examine all moving cables for excessive wear
Conveyor System	Clean conveyor belts	Clean material and dust buildup from the sensors	Examine the conveyor belts for wear **Conveyor System Chain:** Lubricate chain with Darmex 773ND or equivalent **Conveyor System Rails:** Clean and lubricate with Mobil DTE-24 or equivalent. You can also use a thin film of the conveyor grease, Darmex 773ND or equivalent.	

Type Of Service				
Service Area	**Every Shift**	**Weekly**	**Monthly**	**Quarterly**
Part-in-Place Sensors	Clean with warm water, a mild solvent (like dish soap), and a soft cloth, do not use moderate or harsh solvents, such as Isopropyl Alcohol, Acetone, OS120, etc.			
Pneumatics		Examine for correct operation Drain any water from the main filter/regulator		Examine the slides for wear and smooth operation
Dispensing / Spraying Equipment		Do the manufacturers procedure to lubricate the packing. Refer to individual component manuals for the procedure.		
Clean Purge Cups	Daily			
Clean Valve Tips	Daily			

Figure 19: Preventive Maintenance Schedule

7. Procedures

7.1 Ball Screw Slides

The slides should be greased with the fitting on the carriage every 100KM or approximately once a month. Clean buildup on the ball screw and seals. Use lithium-type, soap base, grease (JIS Type 2). Not all models have slides with grease fittings. If a slide does not have a grease fitting, apply a small amount of grease to the slide, and move the slide back and forth.

7.2 Inspection

The cables in the flexible cable carrier should be examined for wear. Replace all worn cables. Examine the top frame and end effecter for loose screws.

7.3 Conveyor Belt Replacement

1. Disconnect and lockout the power and air supplies.
2. Remove the dust cover plate. The dust cover plate is near the conveyor motor on the inside of the conveyor.
3. Remove the conveyor belt from the pulley wheels.
4. Clean the conveyor rails where the belt rides.
5. Install a new conveyor belt. Put the belt on the pulley wheels farthest from the motor first.

Note: Make sure that there are no twists in the belt.

6. Put the belt around the large pulley wheel, then around the other wheels.
7. Rotate the pulley wheels several turns by hand to make sure the belt is correctly installed.
8. Put the cover plate on again.

7.4 Devices and Valves

Refer to the individual component and valve manuals for information about the dispensing/spraying equipment and any other installed devices.

7.5 Servicing the Inline Material Filter

Machines that dispense low viscosity materials may have an inline stainless-steel filter on the pressure vessel. If material flow is reduced, the filter element could be clogged. All parts of the filter are stainless steel and can be cleaned several times before replacing. To clean or replace the filter:

1. Turn air supply pressure to the pressure vessel "**Off**".
2. Turn the material valve on the vessel "**Off**".
3. Use two large adjustable wrenches to separate the two sections of the filter.
4. Remove the stainless steel filter element, record the correct orientation.
5. Clean or replace the filter as necessary.
6. Assemble the filter and pressurize the system. It may be necessary to purge air from the system.
7. Turn air supply pressure to the pressure vessel "**On**".
8. Turn the material valve on the vessel "**On**".

7.6 Exhaust Fan Setup

1. Turn the power "**OFF**".
2. Open the electrical enclosure.
3. Use the dial in the overload relay in the electrical cabinet to set the overload relay current to **1.0 * FLA** for the motor. The FLA is shown on the motor nameplate.
4. Set the reset button to Manual.
5. Restart the machine.

7.7 Pressure Differential Switch Setup

Note: The flow velocities referred to are only valid for a 5" duct diameter.

1. Turn on the exhaust at 100% speed.
2. Examine the operation of the pressure switch input. The input should be "ON" with the exhaust at 100% speed.
3. Turn off the exhaust. Make sure the pressure switch input turns "OFF".
4. Decrease the outlet of the exhaust until the airflow velocity is between 2200-2350 ft/min (300-320 CFM) at the exhaust flange screen.
5. Make sure that the exhaust pressure switch input is still "ON". If it is not, turn the adjustment screw counterclockwise until the input turns "ON".
6. Turn off the exhaust. Make sure the pressure switch turns "OFF".
7. Turn on the exhaust. Make sure the pressure switch input turns "ON". If not, turn the adjustment screw counterclockwise again until the input turns "ON". Make sure that the input turns "OFF" when the exhaust is turned off.
8. Decrease the outlet of the exhaust until the airflow velocity is between 1840-2000 ft/min (250-275 CFM) at the exhaust flange screen.
9. Make sure that the pressure switch input stays "OFF" at this airflow velocity. If the input stays "ON", turn the adjustment screw clockwise SLOWLY until the input turns "OFF".
10. If an adjustment is made, make sure the input at the airflow velocity used in step 4 still operates. The input should still turn "ON" at an airflow velocity within the range used in step 4.
11. Set the exhaust to off and back on again. Make sure that the pressure switch input stays "OFF" for an airflow velocity within the range used in step 8.

7.8 Motor Feedback Test

Use this procedure to make sure that the motor power and Hall Effect sensors are wired correctly. If a problem is found with any of the axes, repair it and tell a production supervisor.

WARNING! Make sure that the workspace has no parts or objects in it. If the axis runs away, the machine can be irreversibly damaged.

1. Turn the machine "**ON**".
2. Engage the "**Emergency Stop**" button. This stops the power to the amplifiers.
3. Open a terminal program and establish communication with the motion controller, this can be done with the '**terminal'** option in PathMaster® or PVA Portal.
4. Enter HX and MO in the terminal screen
5. Disengage the "**Emergency Stop**" push button.

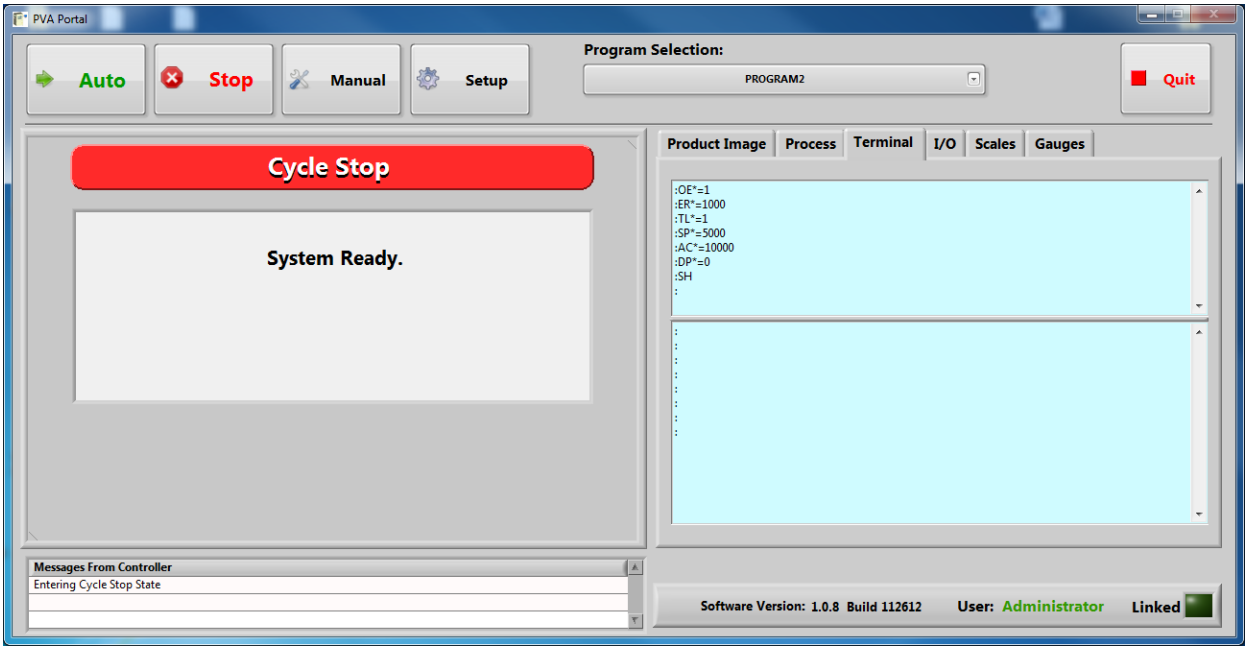


Figure 20: Terminal Window

The motors may be wired incorrectly. The program below limits the acceptable error and power available to the amplifiers. This protects personnel and equipment.

6. Enter the commands that follow on the terminal screen.

OE*=1	Off-on-error enabled for all axes
ER*=1000	Error limit for all axes
TL*=1	Torque limit of 1 for all axes
SP*=5000	Set the speed
AC*=10000	Set the acceleration
DP*=0	Define the current position as (0, 0, 0, 0)
SBN	Enable power (only on machines without a POWER ON button) where **N** = the control output power bit, refer to electrical schematic or call PVA Technical Support
SH	Apply power to the servo motors

Figure 21: Terminal Screen Commands

7. Push the "**POWER ON**" button (if present) so it lights up. This restores power to the amplifiers. Use caution, any of the axes can move at this time.

8. Enter an X-axis positive move command. If the axis runs away, debug and do the procedure again.

PRX=2000
BGX

If the results are not correct, make sure the command was entered correctly and repeat the previous tests.

9. Enter the command to see the current position and position error, **TP; TE**.

10. Enter an X-axis negative move command. If the axis runs away debug and do the procedure again.

PRX=-2000
BGX

11. Enter the command to see the current position and position error, **TP; TE**.

12. Repeat step 6 through 10 for the Y, Z and W axes. Replace the X in both commands with the necessary axis. Example for the Y axis it would be:

PRY=2000
BGY

7.9 Encoder Feedback Test

Use this procedure to test the encoder feedback for all of the axes. If a problem is found with any of the encoders, repair it and then report the error to a production supervisor. Most encoders used with Portal generate 5080 counts/inch. Make sure that the position feedback is in the correct range.

(500*4 counts/rev)*(1 rev/cm)*(2.54 cm/in) = 5080 counts/inch.

1. Turn the machine "**OFF**" and disconnect the motor power.
2. Move all of the axes to the center of travel position.
3. Turn the machine "**ON**".
4. Login to PVA Portal.
5. Select the terminal tab. Push "**Enter**". You should see a colon response.
6. Enter **HX**.
7. Define the current position as (0, 0, 0, 0). Enter **DP*=0**.
8. Use your hand to move the X-axis in the positive direction and look at the current position. The current position should reflect the numbers listed above (5080 counts/inch, 2000 counts/rev, or 200 counts/mm).
9. Enter **TP**.
10. Refer to step 10 for steps 13-19.
11. Move the X-axis in the negative direction and look at the current position.
12. Move the Y-axis in the positive direction and look at the current position. Move the Y-axis in the negative direction and look at the current position.
13. Move the Z-axis in the positive direction and look at the current position. Move the Z-axis in the negative direction and look at the current position.
14. Move the W-axis in the positive direction and look at the current position. Move the W-axis in the negative direction and look at the current position.
15. Select "**Quit**" to shutdown Portal.
16. Shutdown the PC.

17. Turn the workcell "**OFF**".
18. Connect the motor power cables.
19. Turn the workcell "**ON**".

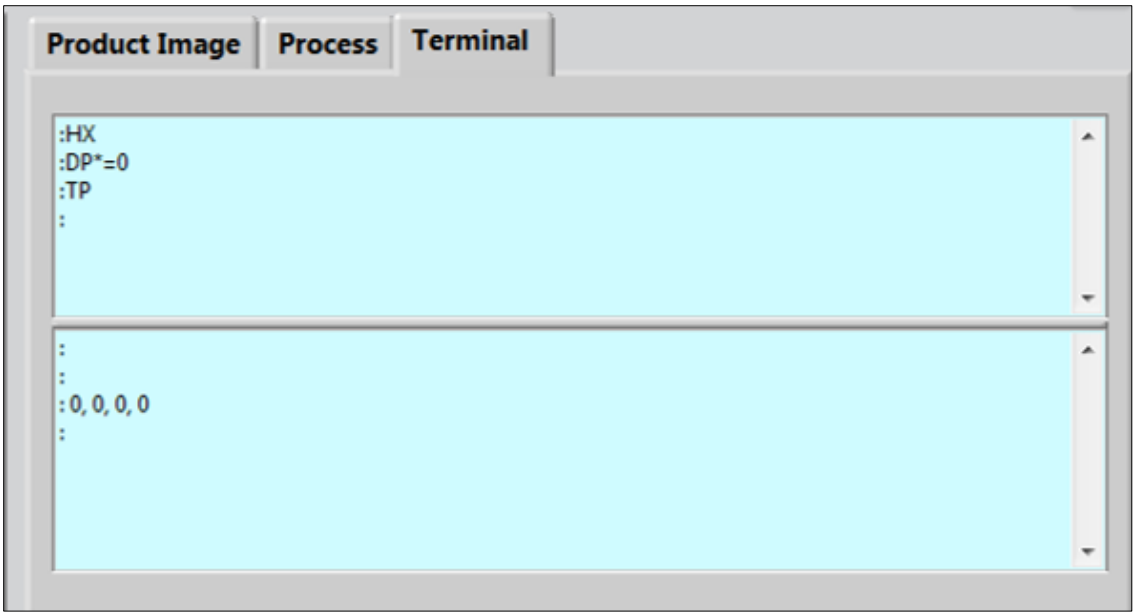


Figure 22: Encoder Feedback Test

7.10 Computer and Workcell Communication

7.10.1 RS-232 Communication

A RS-232 connection will use a straight through connection. The Rx and Tx lines are crossed internally on the controller so a null modem is not necessary. The controller baud rate and handshaking are set with dip switches on the Galil controller inside the workcell enclosure. Hardware handshaking must be enabled to communicate with PathMaster® over RS-232.

7.10.2 DMC-2200 Dip Switch Settings

The main RS-232 port on the DMC-2200 controller must be configured as shown to communicate with the PathMaster® software. Baud rate can be adjusted, but handshaking must be "On".

See Figure 23 on next page.

Switch	Position	Description
MRST	OFF	Master Reset Switch
XON/XOFF	OFF	Software Handshaking Switch
HSHK	ON	Hardware Handshaking Switch
9600	OFF	Baud rate
19.2K	ON	Baud rate
38.4K	OFF	Baud rate

Figure 23

Note: If hardware handshaking is enabled and a computer is not attached to the Main RS-232 port, when the program uses the message command the controller eventually halts. A computer must be attached to the controller when handshaking is enabled and message commands are used.

7.10.3 Serial Communications

To configure serial connections do the steps below.

1. Select *Setup → Machine Parameters* from the Main menu in PathMaster to open the Machine Parameters window.
2. Select the "**Edit Controllers**" button in the Machine Parameters window.
3. Select "**OK**" if a message shows that PathMaster® could not find any controllers in the Windows® registry. This means that no control handles have been configured yet.
4. Select "**New Controller**" in the Edit Registry window.

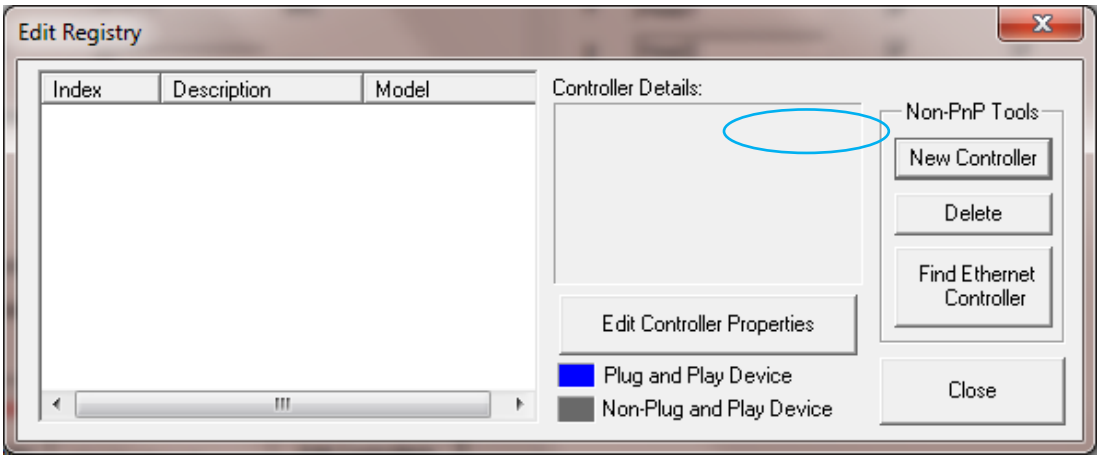


Figure 24: Setup New Controller

5. Select the controller model installed in the workcell from the **Model** dropdown box. Select DMC4000 for Delta class systems and DMC2000 for all other systems.

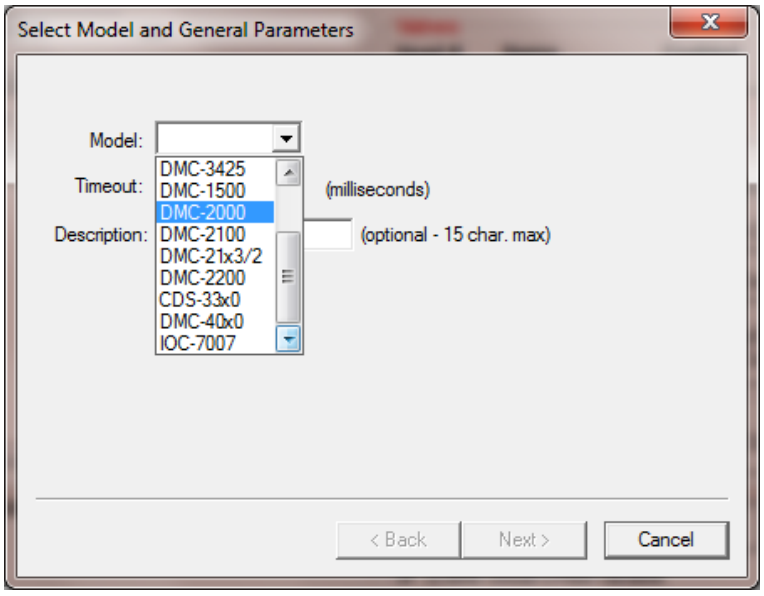


Figure 25: Controller Models

6. Use the default **Timeout** for all controllers.

7. Select "Serial" for **Connection Type**.

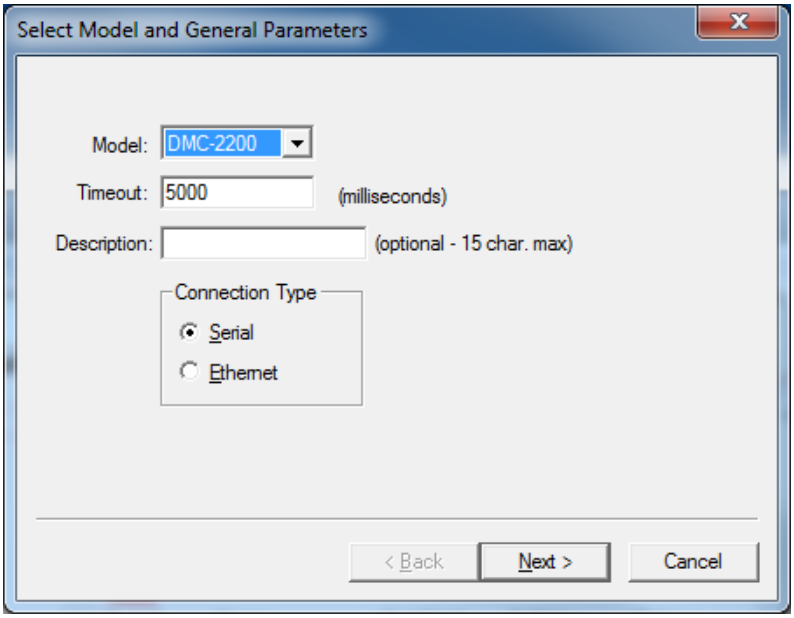


Figure 26: Connection Type

Note: It is not necessary to configure the Connection Type for all controller models.

8. Select the "**Next"** button.
9. Select the "**Comm Port**" (communication port) that the PC uses.

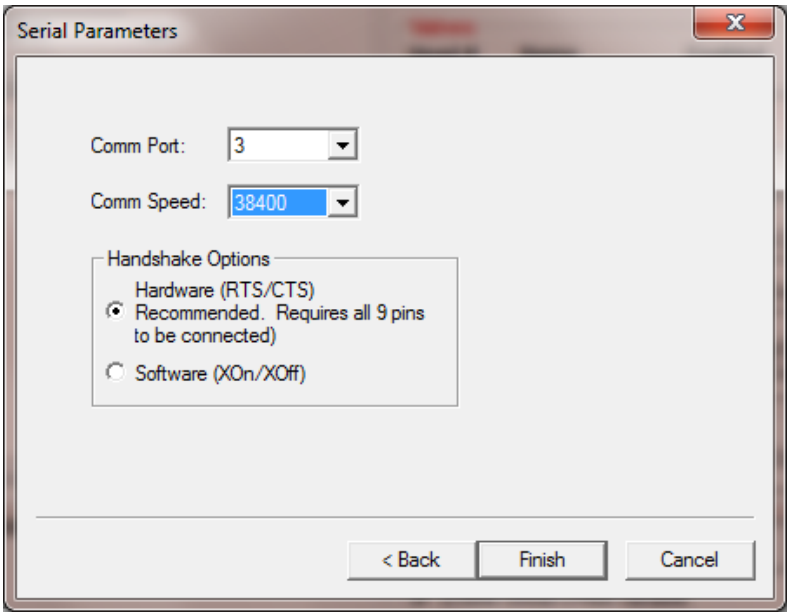


Figure 27: Serial Parameters

10. The **Comm Speed** in this box should match the comm speed set on the controller. This is set to 19200 or 38400 by PVA.
11. Select "**Hardware**" under Handshaking Options.
12. Select "**Finish**".

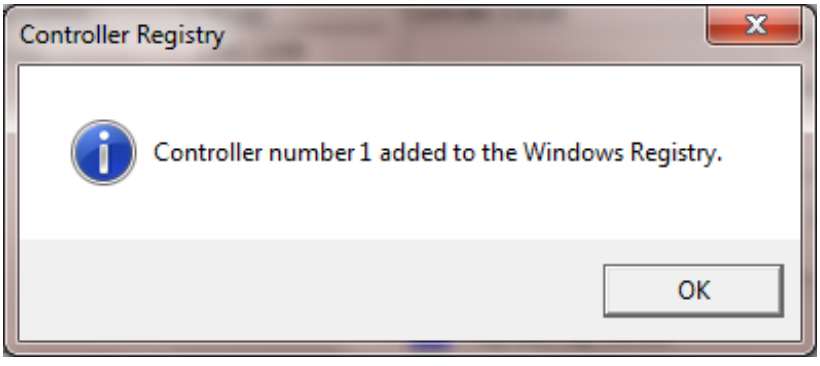


Figure 28: Controller Added

13. Select "**OK**" in the Controller Registry dialog box after the controller is added.

14. To make changes, highlight the controller and select "**Edit Controller Properties**".
15. Multiple control handles can be added.
16. To delete control handles, select the control handle and select "**Delete**".
17. Select "**Close**" when you are finished.

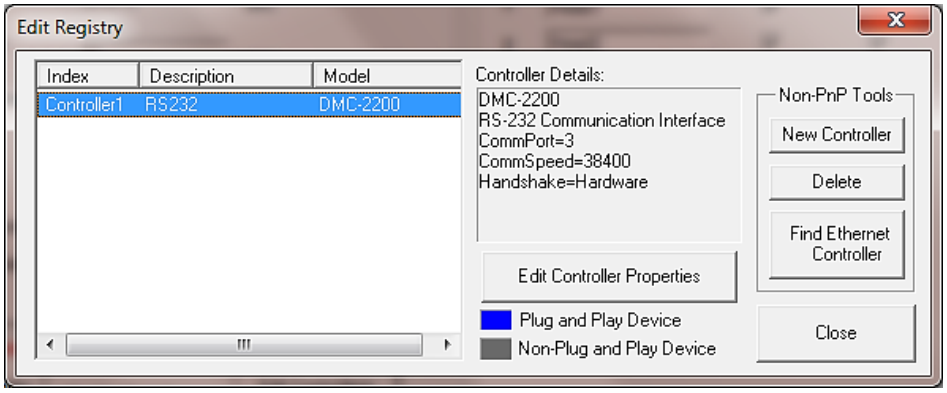


Figure 29: Edit Registry

18. Select the "**Change Controller**" button in the Machine Parameters window to change the controller that PathMaster® uses with the workcell.
19. Select the controller to be used.

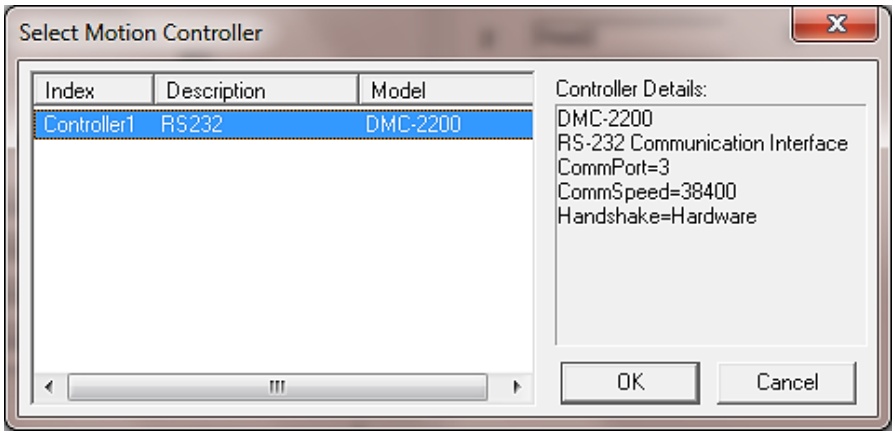


Figure 30: Change Controller

20. Select the "**OK"** button.

7.11 Common Main Program Changes

Variable	*Explanation*
AP_EN	Default value for auto purge. 1=on, 0=off.
AP_LEN	Length of auto purge, in milliseconds.
AP_TIME	Time between auto purges, in milliseconds.
SLP_TM	Sleep timer value for solvent rest, in milliseconds.
SO_EN	Solvent rest enable/disable. 1=enable, 0=disable.

Figure 31: Variable Explanations

7.12 Install Spectra Lamp

1. Unpack the Spectra from crating.
2. Locate the irradiator (lamp) package(s) and carefully remove the lamps from the packaging.
3. Place the irradiator on a flat surface so that the bulb/screen side is accessible.

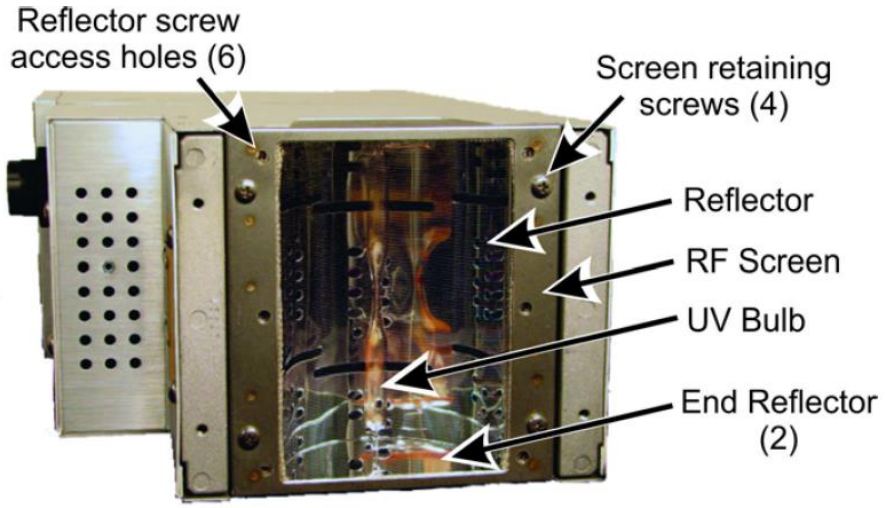


Figure 32: Irradiator Bulb Side

4. Make sure that the reflectors, bulb, and RF screen are installed properly. Refer to Heraeus F300S manual for more details.

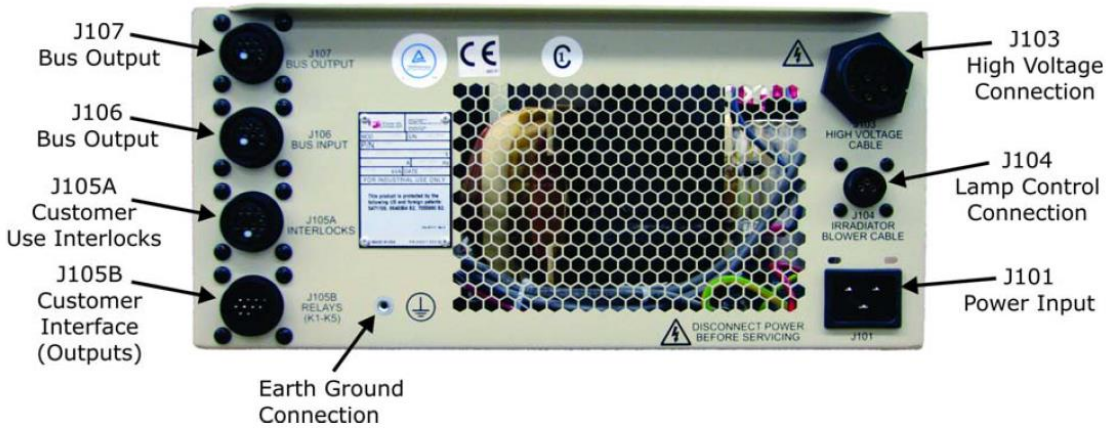
5. Install irradiators into the Spectra carefully by placing the light/screen side facing down.

Figure 33: Install Irradiators

6. If there is more than one lamp, place all lamps in place before the next step.
7. Connect the lamp cables, taking note of the labels on the cables and lamps.

Figure 34: Connect Lamp Cables

8. Install the lamp power supplies, taking note of the labels on the cables and power supplies. The master power supply is typically installed first (left side).



9. Turn all lamp power supply CB1 switches to the "I" (On) position before powering up the Spectra.

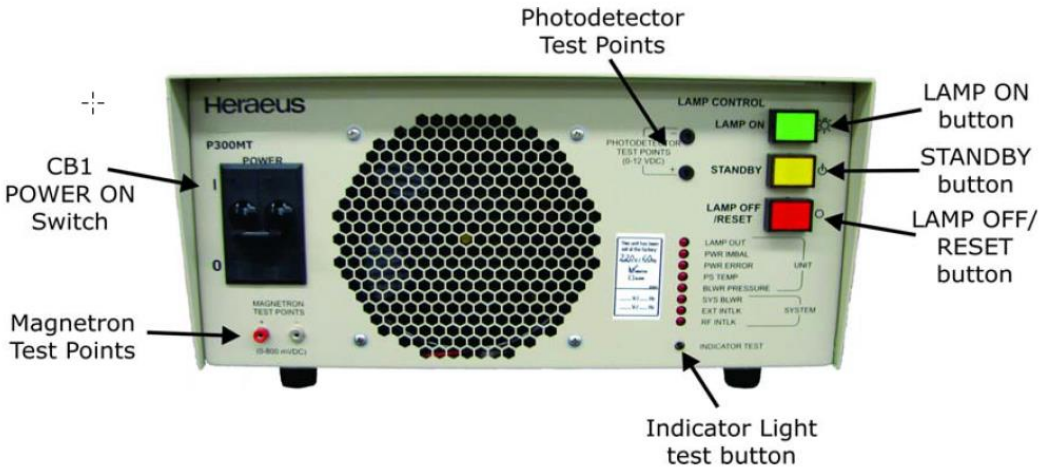


Figure 35: Turn Lamp Power Supply On

8.Part Replacement

8.1 Ordering Parts

To order parts, contact Inside Sales (kdurante@pva.net). When you order parts, be prepared to supply the following information:

- Your company name
- Billing address
- Shipping address
- Serial number of the workcell (found on the back of the workcell)
- Part number or description
- Quantity
- Purchase order or credit card information
- Shipping instructions

Note: An extra set of frequently used spare parts can reduce down time.

8.2 Return Material Authorization (RMA)

Contact PVA Inside Sales to get a Return Material Authorization (RMA) from Precision Valve & Automation.

8.3 Training

Precision Valve & Automation offers Training Certificate programs to customer technicians to increase safety and familiarity with the equipment. Contact PVA for more information.

8.4 Warranty

Contact PVA Technical Support for any warranty issue related to spare parts.

8.5 Shipping

When you order parts, specify which carrier you prefer to use. Precision Valve & Automation will determine the best shipping if no instructions are received.

9. DMC Programming Basics

- All commands must be in uppercase letters.
- Positions are given in counts. In most cases there are 5080 counts per inch, 200 counts per millimeter.
- No line of code may contain more than 80 characters.
- A semicolon (;) is used as a carriage return. This allows for multiple commands on the same line and can be used to save space in the program.

9.1.1 Labels

Sections of a program (subroutines) are defined by **labels**. PathMaster® generates its own labels for programs. These labels do not appear in the edit window, so the operator cannot alter them.

- Labels start with the pound (#) sign followed by a maximum of seven characters.
- The first character must be a letter, after there can be numbers.
- There can be no spaces.
- There can be no duplicate labels anywhere in memory. The *Main* program and PathMaster® are written without any duplicate labels.
- If the operator must put special labels into programs it can cause duplicate labels. If any duplicate labels occur, the operator must find the duplication and fix it.

This usually happens when a section of code has been copied and pasted. There can be no duplicates anywhere within a project, which includes all 30 programs in that project.

- Labels must be at the start of a line. When code is entered manually, make sure there are no labels in the middle of a line. This causes an error when the program is run.

9.1.2 Important Commands

The DMC programming language contains over 135 commands. The program for the workcell does not use most of these commands, and even fewer are used to create a dispense path.

The commands in the table below are the most important for an advanced operator to know. A complete list of commands can be found in the separate DMC-1500 or 2200 manual that came with the machine. Any reference to manually changing or querying in the examples below requires the use of the terminal option in PathMaster® to communicate directly with the controller.

Cmd	Description	Example	Tips
AC	Acceleration for independent moves are in counts per second²	AC*=100000 (sets all axes) ACX=100000 (only sets the X axis acceleration)	Make sure the acceleration is large enough to get the motion to speed in a reasonable amount of time
AM	After move. This command holds the program until the movement on the specified axes is completed	AM (wait for all axes to finish its motion) AMS (wait for coordinate sequence to finish motion)	The AM command tests for profile completion. Use the AM command to separate multiple movements
AV	After vector distance. This command holds the program until a specified distance has been traveled with a coordinated move, the units are in counts	AV1000 (wait until the axes have moved 1000 counts)	The AV command resets to zero after every use. It can be calculated by summing the distances between each point on the coordinated move
BG	Begin. BG starts a motion on an axis or a sequence	BGX (begin motion on the X axis), BGS (begin motion sequence), BG (begin motion on all axes)	A second BG command cannot be given until the first BG motion is finished. The AM command can hold the program until the first motion is done. The exact axes to put in motion must be given. The BG command starts all the axes according to the last specified motions
BL	Reverse Software Limit		
CB	Clear bit. Clears a bit on the output port	CB40 (clears the bit for the buzzer)	Clearing a bit in DMC terminology turns the bit on. The opposite of CB is SB (set bit). A complete list of the outputs can be found in the Operating Guide
CR	Circle. Select a radius, a start angle and the angle to be traversed. Movement is counterclockwise in the Cartesian coordinate system. This is either clockwise or counterclockwise, as viewed from the front of the machine, and depends on the setup of the machine. A negative traverse angle yields clockwise motion in the Cartesian coordinate system	CR 5000,90,180 arc with length of 5000 counts, starting at 90° and doing a half circle (180°)	The circle command is a coordinated two dimensional move. The structure is the same as all other coordinated moves, using the VM, VP and VE commands. A start angle of 0° gives a circle, relative to the start point, entirely negative in the X direction and half positive, half negative in the Y. Starting at 180° yields an entirely positive X circle and a half positive, half negative Y. 90° is an entirely negative Y circle 180° entirely positive Y, with both having X half positive, half negative
CS	Clear Sequence	Clears Memory of prior coordinated sequences	

DC	Deceleration for independent moves. The units are in counts per second²	DC*=100000 (sets all axes), DCX=100000 (only sets the X axis deceleration), DC 10000,30000,40000 (sets X, Y and Z Decelerations separately)	The higher the deceleration, the faster an axis stops its move
DE	Dual (Auxiliary) Encoder Position		
DL	Download. This transfers a text file from the computer to the controller	DL (then select a text file to download)	Use the HX (halt execution) command before using DL. Damage may result otherwise
EN	End. This terminates a subroutine, program thread or program	EN	The Dispensing System also has a subroutine used for a conditional end. The command JP#NOOP operates the same as the EN command
FL	Forward Software Limit		
HX	Halt execution. Halts the execution of the program or any of its threads	HX1 (halt thread 1) HX (halt the entire program)	Always use the HX command before executing a DL command
JG	Jog		
JP	Jump to a program location. Locations are marked by labels. This command can be used in a conditional statement and the jump occurs if the conditional is true	JP#NOOP (jump to location #NOOP), JP#NOOP,COUNT>10 (jump to location #NOOP if the value of COUNT exceeds 10)	It is important not to confuse JP with JS. Using a JP when a JS is required results in the thread being halted once the EN command is reached
JS	Jump to subroutine. Subroutines are marked by labels	JS#H1UP (jump to subroutine #H1UP)	It is important not to confuse JS with JP. Using a JS when a JP is required can result in “nesting” the program continuously until a nesting error occurs. Subroutines can only be nested 16 deep
LI	Linear Interpolation Distance		
LM	Linear Interpolation Mode		
LS	List. The operator can list a single line or multiple lines of the program in a terminal screen	LS 300,0 (show line 300), LS 250,270 (show lines 250 to 270), LS (show all lines in memory)	If a runtime error occurs, use the LS command in the terminal screen to check the line containing the error
MG	Message. This command sends data out the bus. It can also be used by the operator to query the controller for information	MG “Path Complete” (displays the message “Path Complete” on the terminal screen), MG@IN[60] (displays the value of input 60, where 0 is on and 1 is off)	Do not put message commands in programs! If there are message commands, and there is no computer attached to the workcell, the controller halts once the output buffer is full

MO	Motor off. Shuts off motor control	MO (turn all motors off), MOX (turn off only the X axis motor)	MO shuts off the motor(s).The motors are reactivated with the SH (servo here) command
MR	Reverse Motion to Position		
MT	Motor Type		
NO	No operation. This command performs no action and is used to comment a program	NO!!! PROGRAM 1!!!! (description for program)	A semicolon (;) terminates the NO command. Any statements following a semicolon are executed
PA	Position absolute. This sets the destination of a move, referenced to the origin. The units are in counts	PA 10000,10000,1000 (commanded position for X, Y and Z axes), PAX=10000 (commanded position of X axis)	It is best to limit the use of the PA command to designating the start of a dispense path. Overuse of the PA command complicates program editing
PF	Position Format		
PR	Position relative. This sets the incremental position of the next move, referenced to the current position. The units are in counts	PR 10000,10000,1000 (commanded change in position for X, Y and Z axes), PRX=10000 (commanded change in position of X axis)	Be careful not to confuse PA with PR. The PR command begins its move from the current position, without reference to the origin
RS	Reset. Resets the controller to its power on state. All the information in the controller's RAM is erased	RS	If PathMaster® fails to download a file correctly; the program may be halted in the controller. Executing an RS command from the terminal screen restarts the program
SB	Set bit. Sets a bit on the output port	SB40 (sets the bit for the buzzer)	Setting a bit in DMC terminology turns the bit off. The opposite of SB is CB (clear bit). A complete list of the outputs can be found in the Operating Guide
SH	Servo here. The controller uses the current position as the command position and enables motor control	SH (activate all motors) SHZ (activate only the Z motor)	The opposite of SH is MO (motor off) SH resets all position errors to zero
SP	Speed. Sets the speed for independent moves. Units are in counts per second	SP*=100000 (sets all axes), SPX=100000 (only sets the X axis speed), SP 10000,30000,40000 (sets X, Y and Z speeds separately)	Make sure the value of the acceleration is high enough to get the motion to speed within a reasonable amount of time
ST	Stop. Halts motion on the specified axes. If no axes are specified, it halts program execution	STX (stop motion on the X axis), ST (stop all motion and halt the program)	Use the AM command after the ST command to wait for motion to be stopped
TB			

TC	Tell error code. Displays the number and a text description for a command error	TC1	
TD	Tell Dual Encoder		
TE	Tell error. This returns the current position error of the motors. Units are in counts	TE	Use this command in the terminal screen if a motor appears to be working incorrectly. The Dispensing System is programmed to disregard errors of less than 1000 counts
TP	Tell Position. Returns the current position of the motors	TP (All axes). TPX (X axis only)	Use in the terminal screen to verify the current location of the motors. In addition, the Manual mode of the workcell has a push button that accomplishes the same task
VA	Acceleration for coordinated moves. The units are in counts per second²	VA 100000	Make sure the value of the acceleration is high enough to get the motion to speed within a reasonable amount of time
VD	Deceleration for coordinated moves. The units are in counts per second²	VA 100000	Make sure the value of the acceleration is high enough to get the motion to speed within a reasonable amount of time
VE	Vector Sequence End		
VP	Vector Position		
VS	Vector Speed. Sets the speed for coordinated moves. Units are in counts per second	VS 100000. Query the controller with the command MG_VS	Make sure the value of the acceleration is high enough to get the motion to speed within a reasonable amount of time
WT	Wait. Holds program execution for specified time	WT500	Use the WT command whenever the program needs to pause, particularly if another action needs time for completion

Figure 36: Important Commands

10. DMC Error Codes

ID	Description	ID	Description
1	Unrecognized command	60	Download error - line too long or too many lines
2	Command only valid from program	61	Duplicate or bad label
3	Command not valid in program	62	Too many labels
4	Operand error	63	If statement without ENDIF
5	Input buffer full	65	IN command must have a comma
6	Number out of range	66	Array space full
7	Command not valid while running	67	Too many arrays or variables
8	Command not valid while not running	68	Not valid from USB port
9	Variable error	71	IN only valid in task #0
10	Empty program line or undefined label	80	Record mode already running
11	Invalid label or line number	81	No array or source specified
12	Subroutine more than 16 deep	82	Undefined array
13	JG only valid when running in jog mode	83	Not a valid number
14	EEPROM check sum error	84	Too many elements
15	EEPROM write error	90	Only X Y Z W valid operand
16	IP incorrect sign during position move or IP given during forced deceleration	95	TM too large for stepper pulse
17	ED, BN and DL not valid while program running	96	SM jumper needs to be installed for stepper motor operation
18	Command not valid when contouring	97	Bad binary code format
19	Application strand already executing	98	Binary commands not valid in application program
20	Begin not valid with motor off	99	Bad binary command number
21	Begin not valid while running	100	Not valid when running ECAM
22	Begin not possible due to Limit Switch	101	Improper index into ET (must be 0-256)
24	Begin not valid because no sequence defined	102	No master axis defined for ECAM
25	Variable not given in “IN” command	103	Master axis modulus greater than 256*EP value
28	S operand not valid	104	Not valid when axis performing ECAM
29	Not valid during coordinated move	105	EB1 command must be given first
30	Sequence segment too short	110	No hall effect sensors detected
31	Total move distance in a sequence > 2 billion	111	Must be made brushless by BA command
32	More than 511 segments in a sequence	112	BZ command timeout
33	VP or CR commands cannot be mixed with LI commands	113	No movement in BZ command
41	Contouring record range error	114	BZ command runaway
42	Contour data being sent too slowly	118	Controller has GL1600 not GL1800
46	Gear axis both master and follower	120	Bad Ethernet transmit
47	Gearing and coordinated moves cannot run simultaneously	121	Bad Ethernet packet received
50	Not enough fields	122	Ethernet input buffer overrun
51	Question mark not valid	123	TCP lost sync
52	Missing " or string too long	124	Ethernet handle already in use
53	Error in {}	125	No ARP response from IP address
54	Question mark part of string	126	Colsed Ethernet handle
55	Missing [or []	127	Illegal Modbus function code
56	Array index invalid or out of range	128	IP address not valid
57	Bad function or array	130	Illegal IOC command
58	Bad or unrecognized command in a command response (i.e. _GNX)	131	Timeout on serial port
59	Mismatched parentheses	132	Analog inputs not present
		133	Handle must be UDP

Figure 37: DMC Error Codes

11. Technical Support

PVA uses an automated ticketing system called Team Support. The fastest way to contact PVA for any technical support is to create a ticket. The ticketing system alerts the service department of your region and assigns a service engineer. All service engineers can see the information for each ticket for collaborate responses to more difficult problems from our global team. Each problem and response can be tracked from creation to resolution. The Support Portal also has information on common issues and possible solutions. If immediate support is necessary, call your regional office (https://pva.net/contact).

1. To access the ticketing system, click Support Portal located at the bottom of https://pva.net/ homepage. You can also access the Support Portal from the link https://pva.na1.teamsupport.com/dashboard.

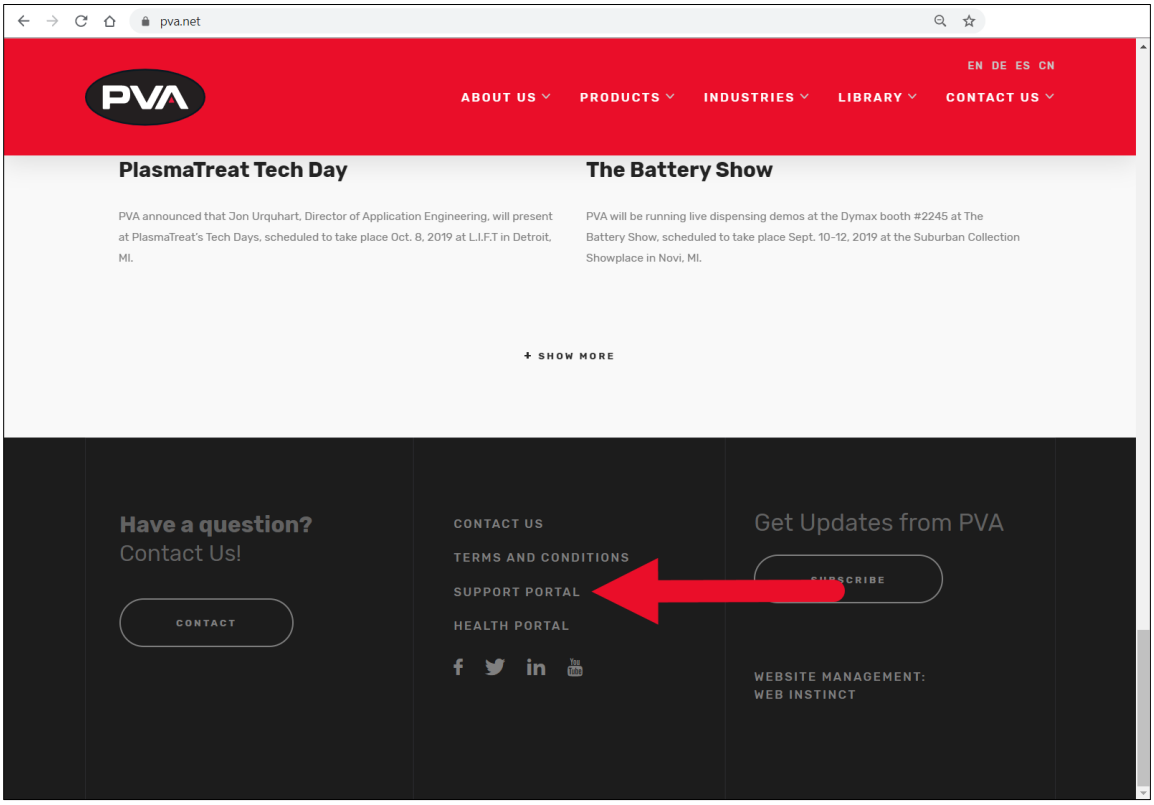


Figure 38: Support Portal

2. Select "Log In" to log in to your account or create a new one.

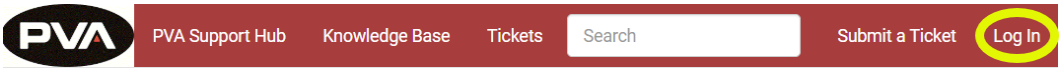


Figure 39: Log In

3. The Sign In screen will be shown. Fill in the information and select “Sign In” or, select “Create an account” fill in the information and select “Register Me!”.

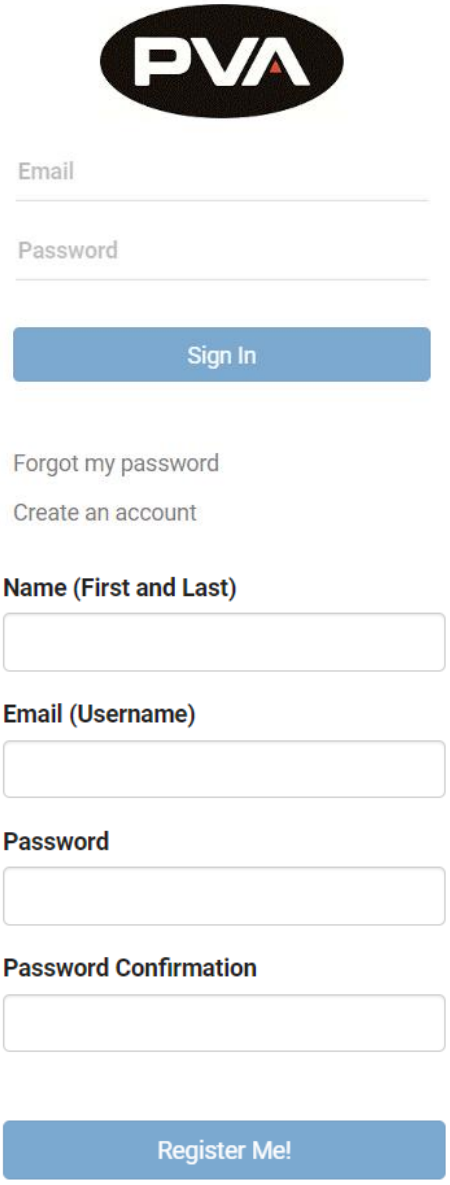


Figure 40: Sign In or Register

4. When you are signed in, select “Submit a Ticket” from the header.

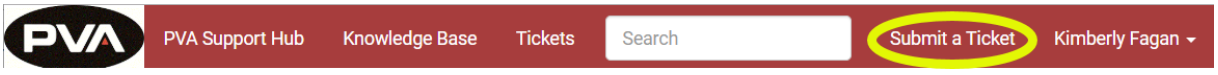


Figure 41: Submit a Ticket

5. Fill in the information requested and use as much detail as possible. Include the equipment serial number and any screenshots, photos, or videos.
6. Once complete, select “Submit Ticket.”

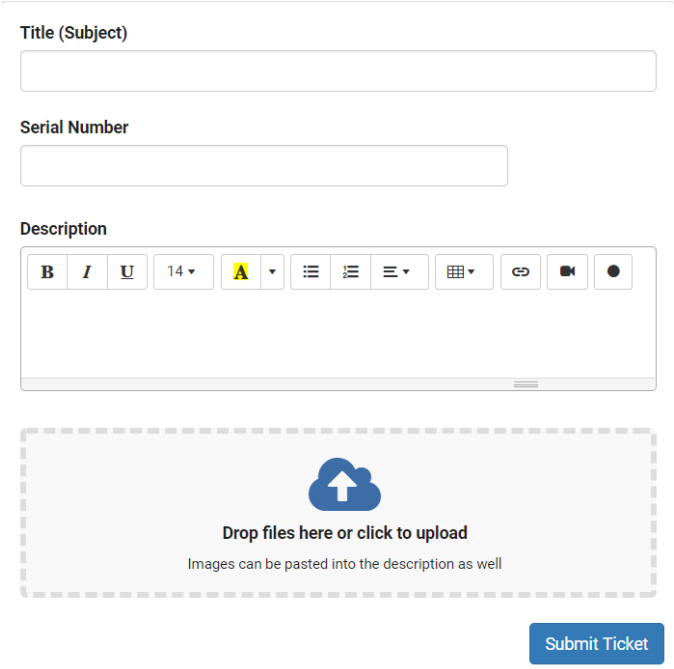


Figure 42: Complete the Ticket

7. If you cannot access the PVA Support Portal, email customer service at cs@PVA.net to create a ticket. To reply to a ticket email, select Reply (not Reply All).

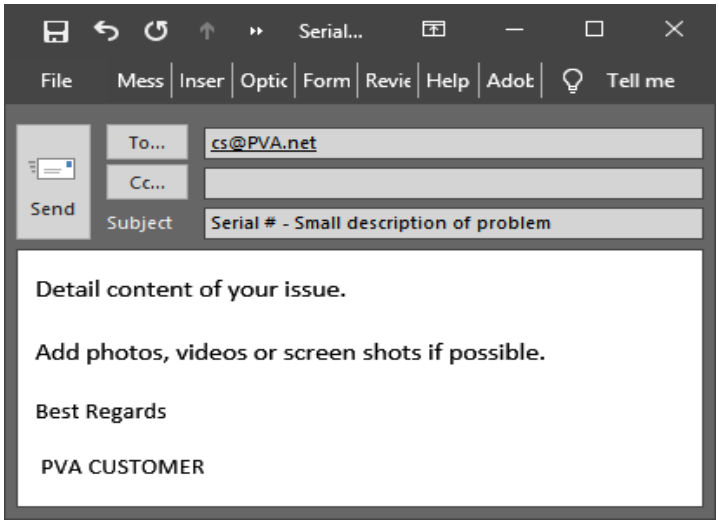


Figure 43: Example Ticket Email

8. You can also acess the PVA Support Hub from “PVA Support Hub” option in the header or through the link https://support.pva.net/. The support hub has processes and procedures on common topics and issues.

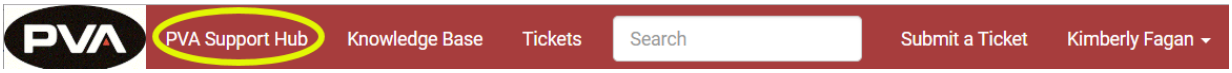


Figure 44: PVA Support Hub

Figure 45: Support Hub Website

12. Table of Figures

Figure 1: Workcell Functional Block Diagram 10
Figure 2: Light Tower & Buzzer Status 13
Figure 3: Adjust the Feet 15
Figure 4: Light Tower & Buzzer Status 15
Figure 5: Board Sensor 16
Figure 6: Servo Couplings 17
Figure 7: Shipping Bracket 18
Figure 8: Teach Pendant Connection 19
Figure 9: Light Tower Connection 20
Figure 10: Example of a Red Air Lockout Valve 22
Figure 11: Example of a Main Power Switch 23
Figure 12: SMEMA Diagram 24
Figure 13: SMEMA Machine Plugs 24
Figure 14: Measure Velocity at Port 27
Figure 15: Measure Velocity at Duct Inlet 27
Figure 16: Portal Shell 28
Figure 17: Workcell Manual Location 28
Figure 18: Systems Fault Diagnosis 31
Figure 19: Preventive Maintenance Schedule 33
Figure 20: Terminal Window 37
Figure 21: Terminal Screen Commands 38
Figure 22: Encoder Feedback Test 40
Figure 23 41
Figure 24: Setup New Controller 41
Figure 25: Controller Models 42
Figure 26: Connection Type 42
Figure 27: Serial Parameters 43
Figure 28: Controller Added 43
Figure 29: Edit Registry 44
Figure 30: Change Controller 44
Figure 31: Variable Explanations 45
Figure 32: Irradiator Bulb Side 45
Figure 33: Install Irradiators 46
Figure 34: Connect Lamp Cables 46
Figure 35: Turn Lamp Power Supply On 47
Figure 36: Important Commands 53
Figure 37: DMC Error Codes 54
Figure 38: Support Portal 55
Figure 39: Log In 55
Figure 40: Sign In or Register 56

Figure 41: Submit a Ticket..... 56
Figure 42: Complete the Ticket 57
Figure 43: Example Ticket Email.....57
Figure 44: PVA Support Hub 58
Figure 45: Support Hub Website..... 58