VORTEX® eMINENCE™ User Manual



VORTEX® eMINENCE™

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Safety

Intended Use of Equipment

The Vortex Eminence is intended to be installed and operated by qualified personnel and is intended to be integrated into machinery for the purpose of welding plastics. The integrator is solely responsible for ensuring the machinery adequately protects the operator from all hazards according to local and national rules and regulations.

The Vortex Eminence is designed for use in the following environments:

- Indoor, dry use
- 2000 m altitude or lower
- 5-40 °C
- 80% maximum relative humidity, non-condensing
- Mains supply fluctuations up to ±10%
- Overvoltage Category II
- Pollution Degree 2

Cautions and Warnings

Please read and be aware of all caution and warning messages that appear throughout this manual. The following symbols are used to direct your attention to areas where special consideration is required to ensure the safety of personnel operating or working around this equipment.



Caution: General caution or warning



Warning: Shock hazard



Warning: Pinch hazard



Important: Read this information



Read manual thoroughly, take all necessary precautions, and heed to all warnings prior to installation and usage of the unit.

Operator Safety





- To be aware of safe operating procedures read and understand this manual before operating this equipment.
- **Warning:** Potential pinch hazard between upper and lower tooling. Necessary safeguards are intended to be provided in end application as per applicable local and national requirements.
- **Warning:** Do not wear loose clothing while operating this piece of equipment. Clothing may get caught in the equipment and cause injury to the operator.
- **Warning:** Long hair must be tied back to prevent getting caught in any moving parts and causing injury.
- Do not attempt to bypass any safety feature either mechanically or electrically.
- Do not operate the equipment while under the influence of drugs or alcohol.



Notice: Read and understand this manual before using the equipment. Failure to follow operating instructions could lead to equipment damage or personal injury. Portions of the equipment contain hazardous voltages that can cause serious injury or death.

Electrical Safety



Warning: Hazardous voltages are present internally to the Vortex Eminence. A trained professional must properly terminate and verify all protective earth ground connections to maintain safe operation.

All connectors are equivalent to at least IP22, finger safe.



Caution: Directly controlled valves/solenoids must include surge suppression.

Regulatory Compliance

The Vortex Eminence was designed in compliance with the following standards:

- NFPA 79 2021 Ed.
- ISO 13849-1:2015

Plastics Health Notice

Be aware of any governmental regulations concerning the plastic(s) you are assembling. Certain types of plastics may emit hazardous fumes or gases while being processed. Proper ventilation or respiratory protection should be utilized where necessary.



Warning: Some plastics emit hazardous fumes or gases while being processed. Know your materials and use proper ventilation or respiratory protection when necessary.

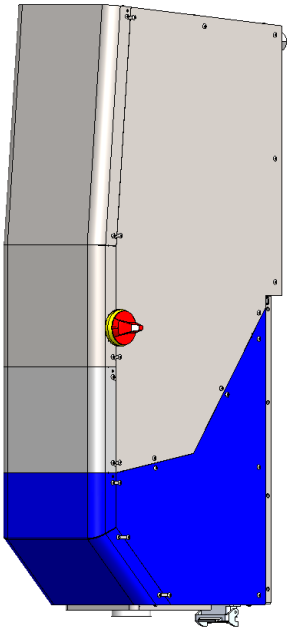
Airborne Noise Emissions

Generally, spin welding is relatively quiet. This equipment is intended to be integrated into machinery, so the distance to the operator for sound pressure level measurements is variable. Tooling may also have an impact. It is the responsibility of the integrator to test and ensure that overall machine noise emissions are below the required levels.

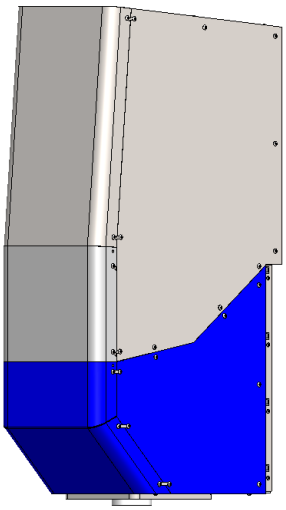
Introduction

The Vortex Eminence is a dual-servo plastic spin-welding platform, based on Allen-Bradley controls. It is used to manufacture plastic assemblies for many different applications and industries. The Eminence comes in three standard stroke lengths: 200 mm (8 in), 300 mm (12 in), and 400 mm (16 in).

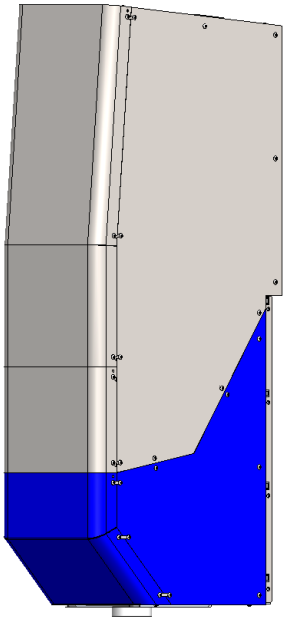
These welders come with options chosen to fit the needs of a given application. Options include the welding motor size and optional gearboxes, remote or integrated HMI, optional upper tool vacuum, and optional integrated spindle guarding. Various mounting, safety, and guarding solutions may be paired with the Eminence depending on the needs of the application. Ask your Extol sales representative about the possibilities.



200 mm (8 in) Stroke, Integrated Controls



300 mm (12 in) Stroke, Remote Controls



400 mm (16 in) Stroke, Remote Controls

Theory of Operation

Spin welders create a strong weld by bringing together two part-halves having a circular cross section, using a specified speed or force. One part half is spun against the other. This creates friction, which creates localized heat, which softens the plastic of both part-halves near the interface. Once softened, the plastic begins to flow, intermixing material from each part half. Then, once certain criteria are met—such as time, distance, or revolutions—spinning stops. Lastly, the welded part is held together while the plastic solidifies. The entire process takes only a few seconds.

Weld Cycle Phases

Z Extend

The first phase of the cycle extends the Z axis at a high speed towards the welding position. Once it reaches the *Weld Start [Max] Position* minus the *Weld Approach Distance* it transitions to the next phase.

Z Approach

Once the Z axis is within the *Approach Distance* from the *Weld Start [Max] Position* it slows down to the *Approach Speed*, and if *Force Feedback* is enabled, will lower the Z axis force to the *Approach Force*. The Z axis extends until it reaches the specified *Weld Start Position* (*Start Position* set to *Programmed*) or detects contact with the part (*Start Position* set to *Detect*).

Z Part Pickup (Optional)

If enabled, the welder will pick up the upper part half at this point. If the Start mode is set to *Static*, this phase looks very similar to the normal Approach phase. But if Start is set to *Dynamic*, the Z axis will retract slightly after picking up the part to allow the spindle to start spinning before the part halves make contact.

Delay

If *Part Pickup* is not enabled and the Start mode is set to *Static*, a delay may be set before spinning starts. (In *Part Pickup* this time is repurposed as the *Part Pickup Time*.)

Spin Weld

This is the main portion of the cycle. During this phase the spindle spins and the Z axis slowly extends until the weld conditions are satisfied.

Hold

Once the spindle stops the Z position or force is briefly maintained for a specified *Hold Time* to allow the weld to solidify.

Z Retract, Spindle Reset

The last phase of the cycle returns the Z axis to home (using the same speed as the *Extend* phase), followed by homing of the spindle.

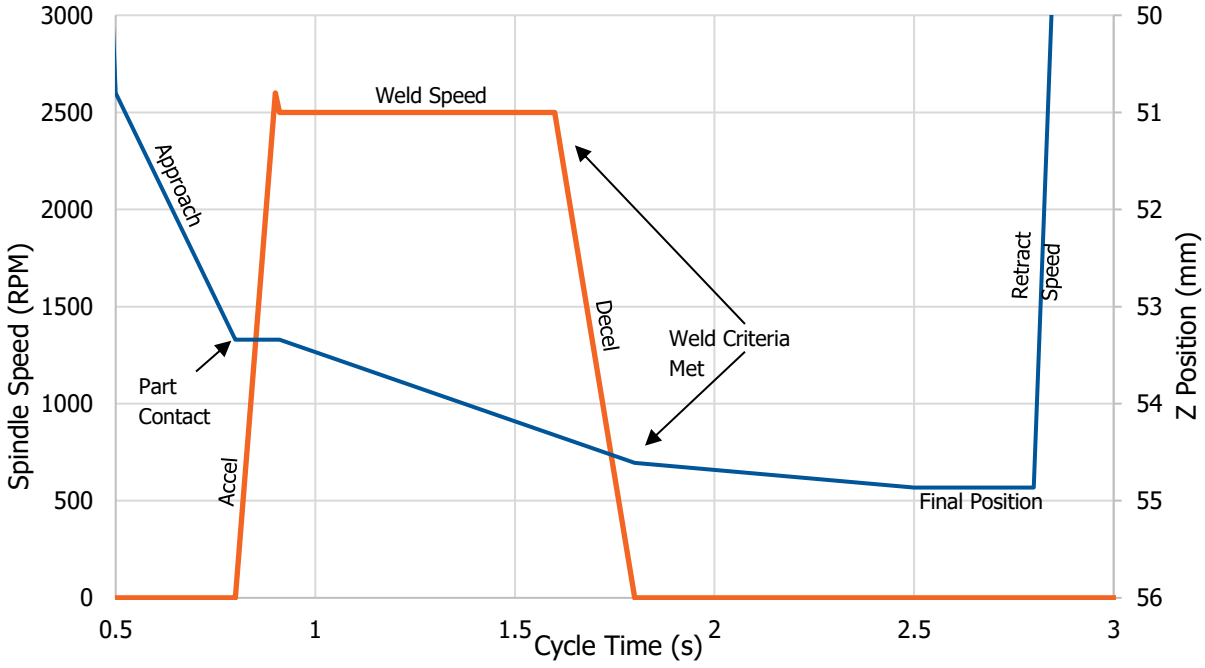


Figure 1: Typical Spin Weld Cycle

Unpack and Install

Mounting

Welding Unit Mounting

There are several threaded holes and dowelled holes for mounting and positioning on the mounting plate of the Vortex Eminence. See the hole pattern below.

Mounting must support the weight of the Vortex Eminence head (150 kg / 330 lbm) and the maximum Z force (2300 N / 520 lbf), and must be torsionally stiff to prevent the spindle location from shifting while welding.

When designing mounting and installing the spin welder head, integrators should consider the following factors:

1) Does the mounting position take into account the stroke of the spin welding unit?
2) Is the mounting location safe relative to operators?
3) Is there X/Y adjustment either in the lower tooling (recommended) or the spin welder mounting so that the weld process is centered?
4) Is there leveling adjustment either in the lower tooling (recommended) or the spin welder mounting so that the weld process is in-line?

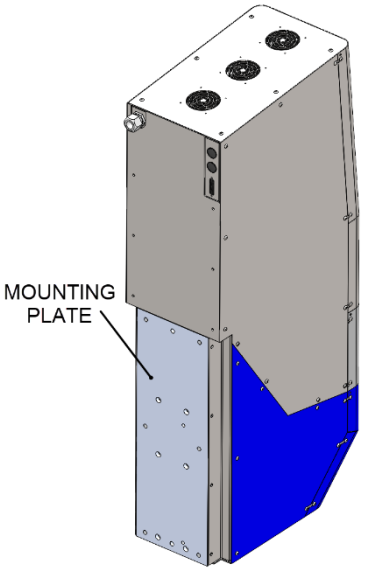
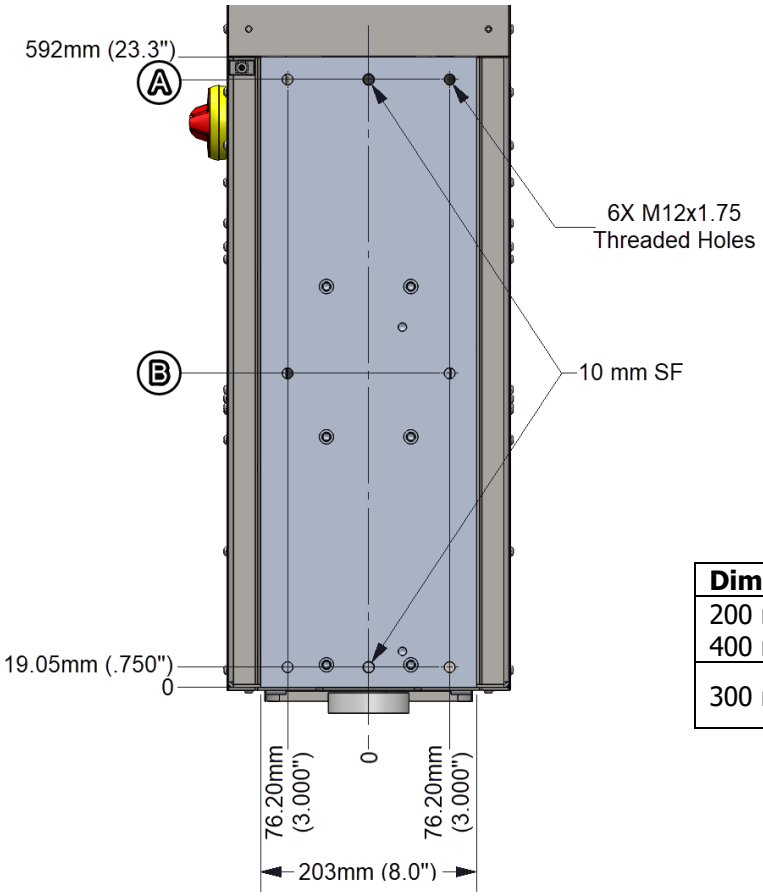


Figure 2: Mounting Plate



Dimension:	A	B
200 mm (8 in) stroke, 400 mm (16 in) stroke	571.50 mm (22.500 in)	295.28 mm (11.625 in)
300 mm (12 in) stroke	417.53 mm (16.438 in)	218.29 mm (8.594 in)

Figure 3: Mounting and Positioning Hole Pattern on Mounting Plate

Leveling Procedure

Extol offers a leveling and centering tool to assist in properly aligning the spin welder unit with the lower tooling. The following procedure describes how to level the tooling.

1) Attach the leveling and centering tool to the spindle.
2) Position the indicator so that it lightly touches a flat portion of the the lower tooling or a loaded part.
3) With the spindle brake unlocked (see the Manual Control section), rotate the spindle while watching the tool's indicator for high and low spots.
4) Adjust the leveling adjustment.
5) Redo steps #3 and #4 until the spin welder is level with the lower tooling.

Centering Procedure

After completing the leveling procedure, the centering procedure can be done. Please note that a centered hole in the lower tooling or a loaded part will be needed for reference. In order to center the spin welder unit with the lower tooling,

1) Position the leveling and centering tool that is attached to the spindle in such a way that the indicator touches the inside wall of the centered hole in the lower tooling.
2) With the spindle brake unlocked (see the Manual Control section), manually rotate the spindle while watching the indicator.
3) Adjust the X/Y adjustment.
4) Redo steps #2 and #3 until the spin welder is centered with the lower tooling.

Upper Tool Mounting

Refer to the upper tool bolt pattern figure. When attaching the upper tool to the spindle, use the dowel for location and secure the tool with M6x1.0 SHCS. If the spindle moves while tightening the bolts, engage the spindle brake to allow the motor to hold the spindle in position. NOTE: Remove your wrench before engaging the spindle in case the motor performs its homing sequence.

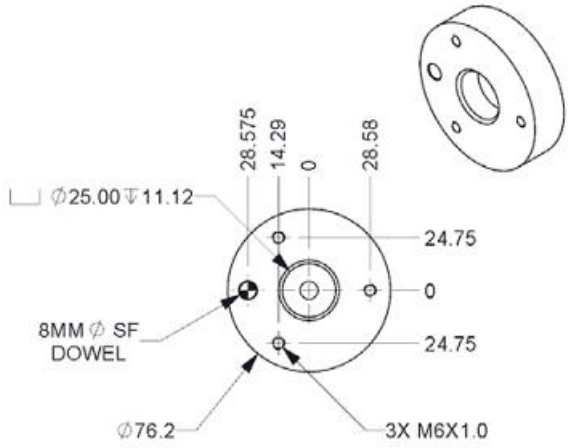


Figure 4: Upper Tool Bolt Pattern (mm)

Lower Tool Mounting

The integrator is responsible for lower tool mounting. When designing lower tool mounting, ensure that the position of the tool is repeatable. Leveling and centering adjustment can be designed into the lower tooling.

Electrical Requirements

The Vortex Eminence operates on 480 VAC three phase power. A 30 A service is required. A 4 m cord with a NEMA L16-30P plug is included.

Pneumatic Requirements

The Vortex Eminence only requires a compressed air supply in applications where spindle pressure or vacuum is used, or when tooling includes pneumatic actuators. For these instances, a 10 mm (3/8 in) airline is recommended with a minimum of 0.55 MPa (80 psi) non-lubricated dry air.

Wiring

The Vortex Eminence includes two electrical connectors. One is used for control and safety. This connector is located on the rear of the unit. It also may be used as a tool connector for legacy tooling. Control may also be done over Ethernet/IP.

The other connector is for tooling and is located on the bottom of the head near the spindle.

Rear Connector

Female 25-pin D-sub receptacle. Machine control may also be done over an Ethernet/IP connection. Safety must be physically wired unless the machine has been configured for CIP network safety. Safety I/O may be wired in several configurations. See sections below for more information.

Some pins have alternate purposes if *Legacy Tool I/O* is selected for the *Remote Connector Function*. These are indicated by the word 'legacy'. Legacy I/O is compatible with tooling designed for the Vortex Precedence.

Pin	I/O	Description	Notes
1	input	Cycle start	Starts a spin weld cycle. The program looks for a rising edge.
2	input	Machine reset	Resets any faults and returns the welder and outputs to their home positions/states. The program looks for a rising edge.
3	input	Fail acknowledge / Legacy UDI0	Clears part faults, allowing the machine to retract to home.
4	input	Legacy UDI1	Only used for legacy tooling.
5	input	Legacy UDI2	
9	output	Ready / Legacy UDO0	Indicates the welder is in a valid condition to start a cycle.
10	output	Good part / Legacy UDO1	Indicates a passed cycle.
11	output	Failed part / Legacy UDO2	Indicates a failed cycle.
12	output	Machine fault	Indicates any machine or part fault is present.
13	output	Running	Indicates the welder is in cycle.
14	output	Safety NC contact 1	These contacts may be used to provide feedback that the safety circuit is engaged.
15	output	Safety NC contact 2	
16	output	Safety reset OUT	Resets the safety circuit. Reset can be manual or automatic. See the Safety Wiring Options section for more information.
17	input	Safety reset IN	
18	output	Safety ch1 OUT	These are the safety inputs for the safety relay. See the Safety Wiring Options section for more information.
19	output	Safety ch2 OUT	
20	input	Safety ch1 IN	
21	input	Safety ch2 IN	
22	power in	Output power	24 VDC power input. Provides power to the safety relay and all outputs. **Must be able to provide at least 200 mA plus tooling current requirements.**
23	power out	24 VDC	24 VDC power source. One positive and two common outputs are provided. **Fused at 1 A.**
24	power out	DC COM	
25	power out	DC COM	

Safety Wiring Options

The safety circuit supports dual- and single-channel, automatic or manual reset, and solid-state or dry contact switching. It is capable of up to SIL2/PLd. A risk analysis must be performed to determine the required safety level and guarding.

To use safety devices with dual-channel solid-state outputs, the safety relay inside the Vortex Eminence enclosure needs to have a pair of DIP switches turned OFF. See adjacent images.

See the Banner UM-FA-11A manual for more information.

See the wiring diagrams on the next pages for each of the four wiring options.

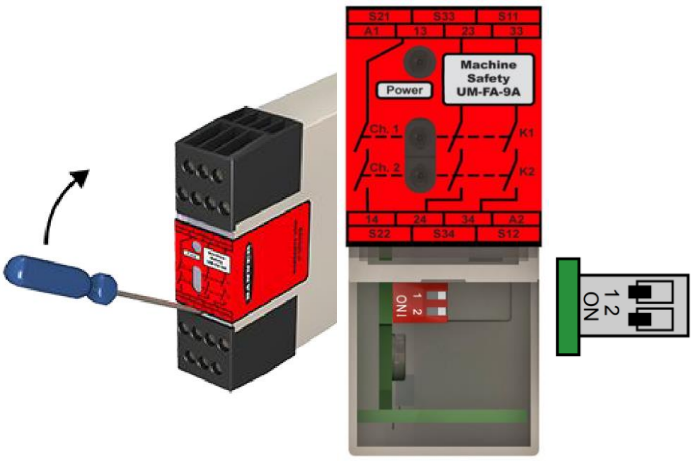


Figure 5: Safety Relay DIP Switch

Network Safety

The Vortex Eminence is not equipped for network safety by default. However, the machine may be customized to use CIP safety, by using different servo drives. This must be requested during quoting.

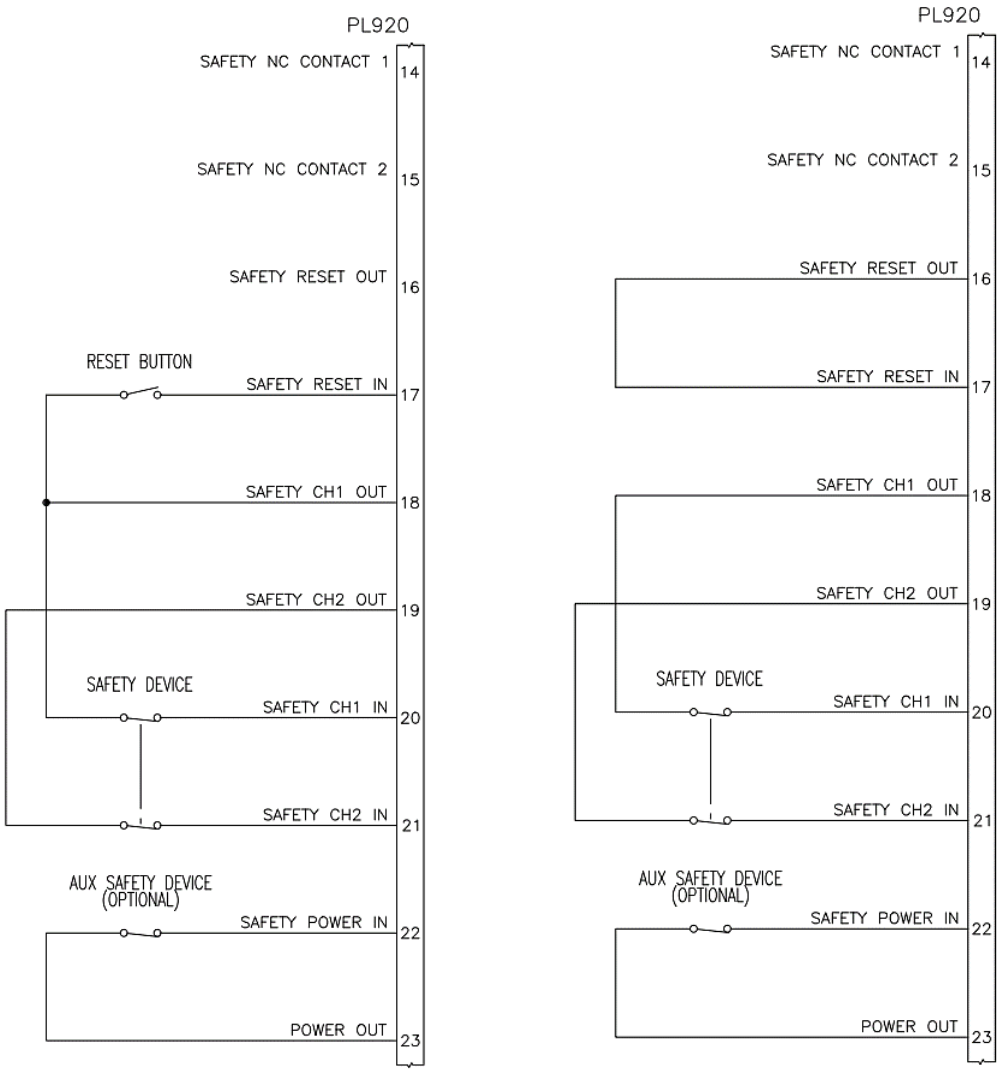


Figure 6: Dual-channel safety with manual reset (left) and automatic reset (right)

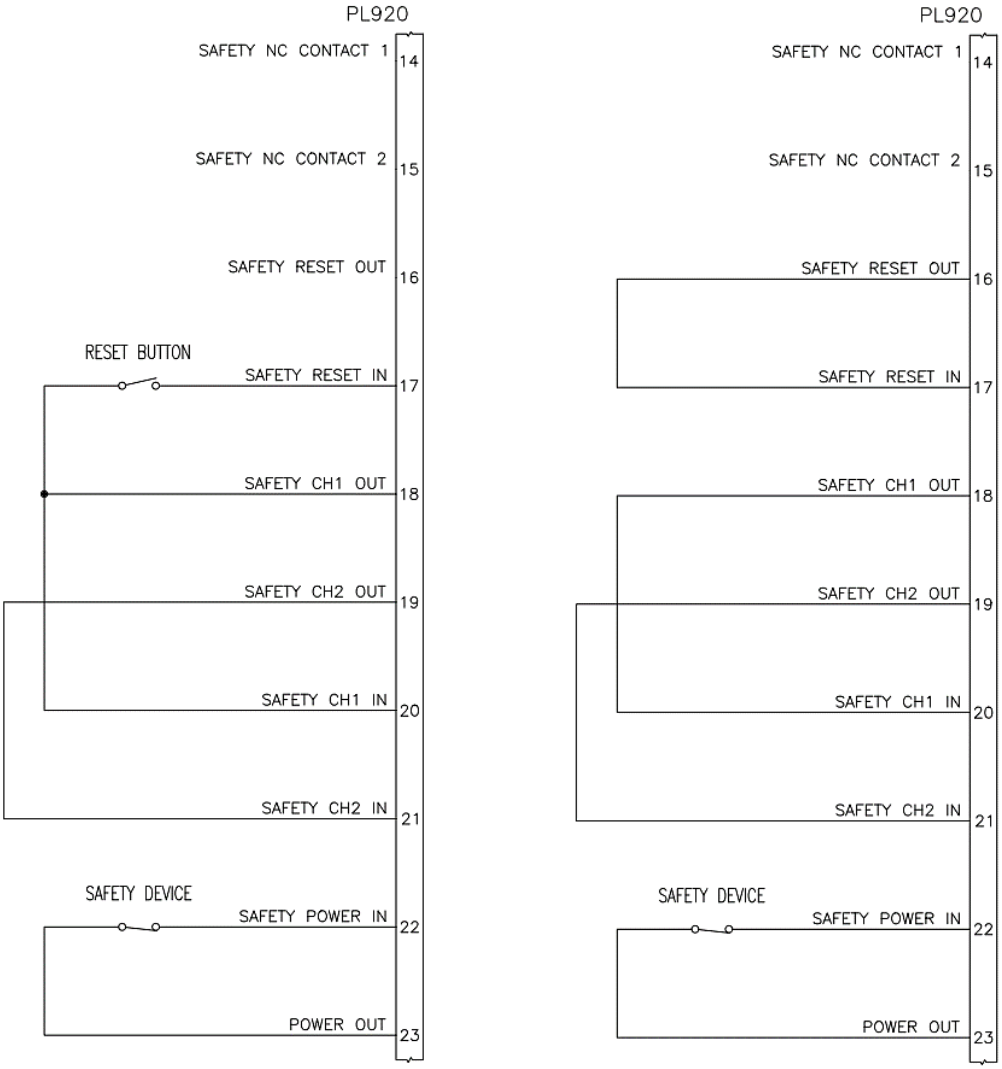


Figure 7: Single-channel safety with manual reset (left) and automatic reset (right)

Tool Connector

Tooling connects to a female Harting HAN D 25-pin receptacle, located behind the spindle.

The mating tool-side connector can be configured in multiple ways. Some default options are listed below, but please refer to Harting's catalog, or use the Configurator on their website to explore the full range of options. A hood, top insert, pins, and cord grip will likely be needed. A crimping tool is required as well. Ask Extol about tooling connector kits.

Output power is provided by the *Output Power* pin on the Rear Connector.

Description	Manufacturer	Part Number	Qty.
Hood	Harting	19 20 016 0446	1
Insert	Harting	09 21 025 3001	1
Pins	Harting	09 15 000 6103	25
Cord grip	M25 thread		1
Multiconductor cable	25c, min 26 AWG (0.14 mm²)		1

Pin	I/O	Description
A1	input	UDI0
A2	input	UDI1
A3	input	UDI2
A4	input	UDI3
A5	input	UDI4
A6	input	UDI5
A7	input	UDI6
A8	input	UDI7
A9	output	UDO0 *
B2	output	UDO1
B3	output	UDO2
B4	output	UDO3
B5	output	UDO4
B7	input	Tool ID 1
B8	input	Tool ID 2
C1	input	Tool ID 4
C2	input	Tool ID 8
C4	power out	24 VDC
C5	power out	24 VDC
C6	power out	24 VDC
C7	power out	DC COM
C8	power out	DC COM
C9	power out	DC COM

** UDO0 also controls the spindle pressure/vacuum if enabled in the Recipe.*

Ethernet/IP Control

In addition to physical control signals, it is also possible to control and monitor the machine over Ethernet/IP. The *Remote Connector Function* must be set to *Normal/Remote Control* (see the Setup section for more information).

There are two controller-scoped tags that contain the control inputs and outputs respectively. These consist of User-Defined Data Types (UDTs), as outlined below. If multiple welders share the same controller, their I/O UDTs will have a different prefix, e.g. "Welder2_...", "Welder3_...", etc.

Tag Name	Data Type
Welder1_Inputs.ConnectionStatus	CONNECTION_STATUS
Welder1_Inputs.NetworkControl_Welder	BOOL
Welder1_Inputs.NetworkControl_Tool	BOOL
Welder1_Inputs.Manual	BOOL
Welder1_Inputs.CycleStart	BOOL
Welder1_Inputs.Reset	BOOL
Welder1_Inputs.FaultAck	BOOL
Welder1_Inputs.UDI.[0..7]	SINT
Welder1_Inputs.ToolID	SINT

Tag Name	Data Type
Welder1_Outputs.ConnectionStatus	CONNECTION_STATUS
Welder1_Outputs.Manual	BOOL
Welder1_Outputs.Ready	BOOL
Welder1_Outputs.Running	BOOL
Welder1_Outputs.Fault	BOOL
Welder1_Outputs.Pass	BOOL
Welder1_Outputs.Fail	BOOL
Welder1_Outputs.UDO.[0..7]	SINT

To control the inputs over the network, turn on one or both tags *NetworkControl_Welder* (overriding the rear connector inputs) and *NetworkControl_Tool* (overriding the tool connector inputs). Otherwise, the physical inputs will be used.

One connection option is to use Produced and Consumed Tags. This allows another Rockwell controller to communicate with the Eminence's controller. The *ConnectionStatus* tag may be used to monitor the connection of each UDT. The controller program will need to be slightly modified to enable this method.

Another connection option is to use a device that can access these tags over an Ethernet/IP tag client connection. No controller program modification is necessary in this case.

A third connection option is to use an Ethernet/IP CIP message connection. This also requires a slight modification of the controller program to implement.

Operation

See the sections Theory of Operation and Weld Cycle Phases in the Introduction for general information on spin welding.

Screen Navigation

Header

The header shows the current screen title, basic information for system status, and a message banner. From left to right there is: machine mode, current user, screen title, current time, and a button linking to the About screen. The 'mode' and 'user' indicators are also buttons.

Footer

The footer contains buttons to navigate between screens.

Servo Axes Icons and Color Coding

Various objects associated with a servo axis include an icon and color-coding to add clarity. A legend is included on most screens to remind the user of this association.



Navigation Tree

- Home Screen
  - Modes
- Recipe
  - Recipe Management
    - User-Defined Inputs (UDI) Setup
    - User-Defined Outputs (UDO) Setup
  - Recipe – Down
  - Recipe – Weld
    - Segmented Z Move
    - Variable Z Force
  - Recipe – Hold
  - Pass/Fail
- Cycle Data
  - Page 1
  - Page 2
- Machine
  - Fault History
  - Servo Diagnostics
    - Z-Axis
    - Spin-Axis
  - Security
  - Setup
  - I/O Monitor
  - Manual Control
    - Z Axis
    - Spin Axis
    - User-Defined Outputs
- Modes (Header, top left)
- Security (Header, top left)
- About Screen (Header, top right)

Home Screen

The home screen presents the operator with key process monitoring criteria and machine control functionality.

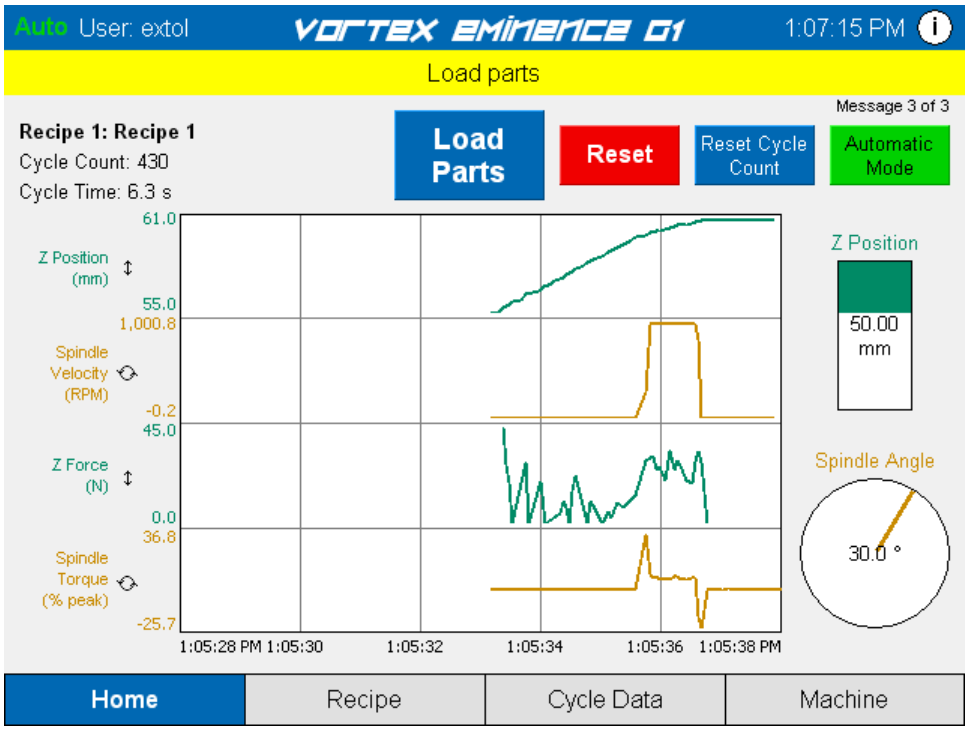


Figure 8: Home Screen

Load Parts / Release Part Button

This button may be used to actuate part retention tooling features before and/or after a cycle. It is configured through the User-Defined Outputs setup.

Reset

Resets the machine and tooling to home state. The button is only accessible to users with a sufficient security level.

Part Fault Reset

Resets part-specific faults. Most faults are configured from the Pass/Fail screen. There are also a few machine fault criteria. The head does not retract until pressed.

The button can be configured to immediately cause a reset, or to require a passcode first.

Reset Cycle Count

Resets the resettable cycle counter. There is also a non-resettable counter. A second press is needed to confirm the action.

Mode Selection

Selection between different operating modes. The available modes depend on the user security level.

Z Position, Spindle Angle

These are visual indicators of the servo positions.

Recipe Selection, Cycle Count, Cycle Time

These show the status of the current Recipe, cycle count, and most recent cycle time.

Cycle Graph

This graph shows how the welder performs during a cycle. This may be used to monitor welder performance and to adjust welding parameters. Only the portion of the cycle between extend and retract is shown.

Modes

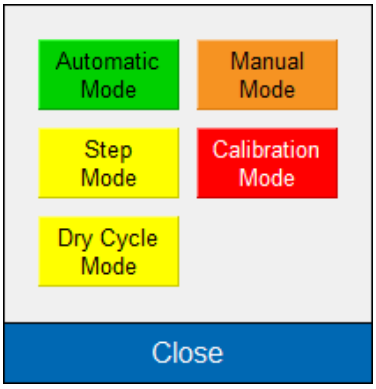


Figure 9: Modes

Automatic

The default mode of operation, used to run normal weld cycles for production.

Step

This mode causes the spin weld cycle to pause between each step in the sequence. This can be useful in setting up a process or for troubleshooting.

Dry Cycle

In this mode certain features are bypassed to allow the welder to repeatedly cycle without parts present. Use caution.

Manual

In Manual Mode, the operator has full control of the machine manual functions. See the Manual Control section for more information. Use caution in Manual Mode, as many programming safeguards are removed.

Calibration

This mode is used to calibrate the machine. Only qualified personnel may perform calibrations. The *Setup* screen content changes while in this mode.

About Screen

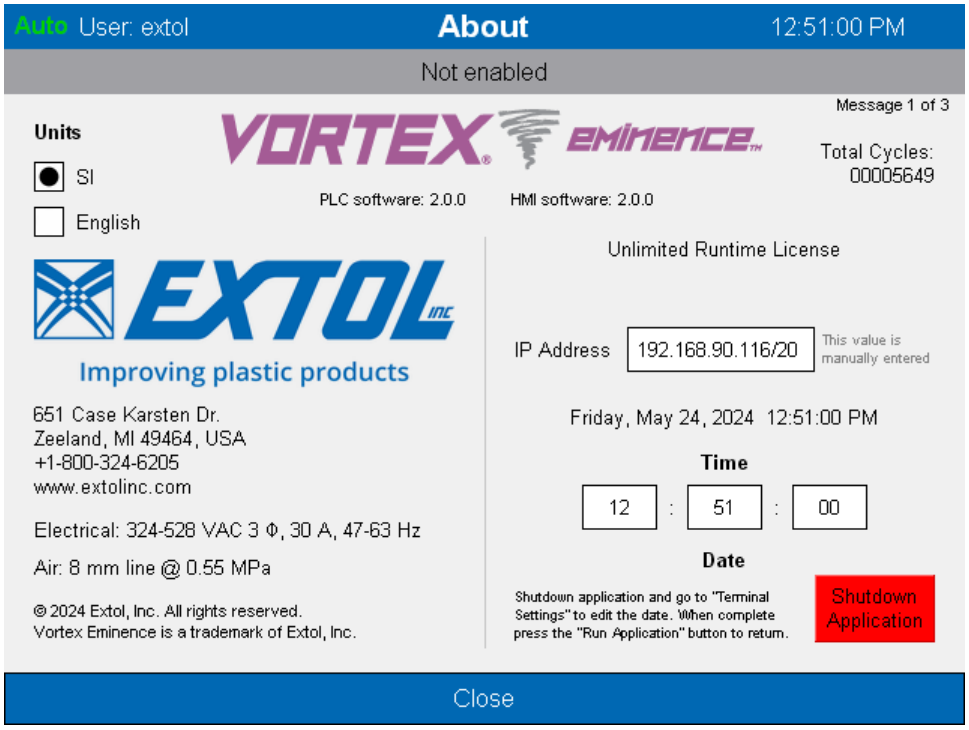


Figure 10: About Screen

Program Versions

The PLC and HMI program versions are displayed here. The first digit should match.

Units Selection

Select between English and SI user units for Z position and force.

Contact Information

Please contact Extol with any questions or concerns.

Electrical and Pneumatic Ratings

The welder requires an electrical power source to operate. It may also require pressurized air, depending on the tooling.

Runtime License

In most cases, an unlimited runtime license is included with the equipment. In a few cases, a payment plan or some other situation warrants limiting the runtime license to a certain period. If that is the case, there may be one or more licensed time periods where the machine is operable, after which a passcode must be entered to continue operating. The machine will give warnings to the operator as these dates approach.

IP Address

This indicates the HMI's IP address. Remote data logging is done on the HMI, and this IP address may be used to access this data. (Network access may be limited in some cases.) Please note, this value is manually entered and so may not be accurate.

Date and Time

The date and time are shown here and may be edited by following the on-screen instructions. Note that if Runtime Licensing is enabled, it is not possible to set the clock back in time, or to change the hour or minute more than once per day.

Shutdown

Exits the application. This may be used if a configuration change to the HMI is needed.

Security

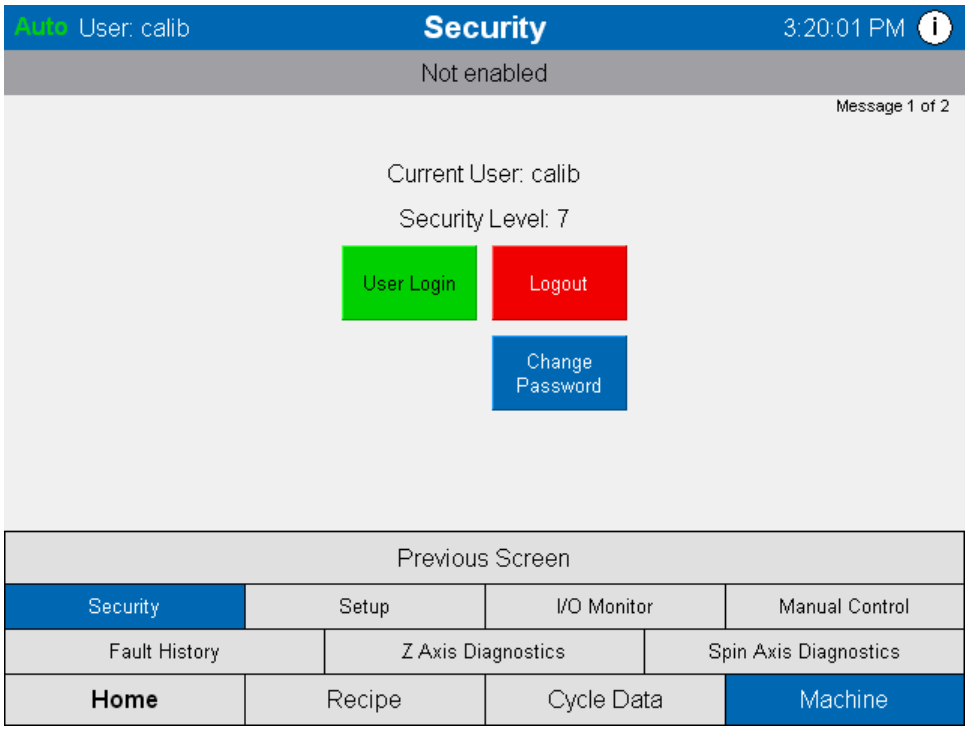


Figure 11: Security Screen

Configurable Security Levels

The Vortex Eminence includes configurable security levels for various aspects of the user interface. These are found in a table on the PLC. The default values should be appropriate in most cases.

Please note that subsequent discussions of the user interface generally do not mention the security level needed to view or modify certain objects. Extol can provide further information upon request.

Login

Use the login interface to enter security credentials, to gain access to locked features.

Change Password

The passwords for each user level can be changed from their defaults.

User Name	Default Password
maint1	1111
maint2	2222
calib	3333

Setup

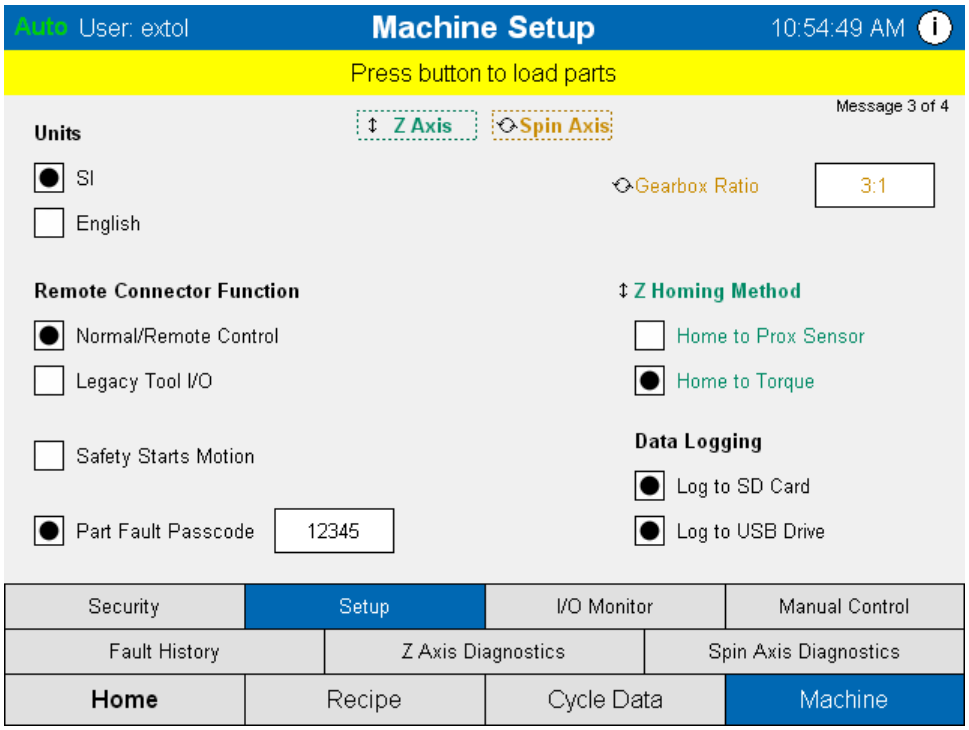


Figure 12: Machine Setup Screen

Units Selection

Select between English and SI user units for Z position and force.

Remote Connector Function

Select between *Normal/Remote Control* and *Legacy Tool I/O*. If replacing a Vortex Precedence and using old tooling, the legacy option may be needed. The validity of this selection may depend on how the machine is controlled, as this limits and/or remaps the rear connector I/O.

Safety Starts Motion

Select to start a cycle as soon as the safety circuit is engaged. This is typically used with two-hand control. Use with caution.

Part Fault Passcode

Enable and set the part fault passcode here. A four- or five-digit numeric code may be used. This must be entered when there is a part fault. The head does not retract until the code is entered.

⥁ Gearbox Ratio

Set the gearbox ratio. Any positive integer is allowed. Setting this resets spin position calibration.

↕ Z Homing Method

Select between homing to a proximity sensor or homing to a hard stop. Toggling this selection resets Z position calibration, and write default offset values into the *Z Home Offset*.

Data Logging

Select which remote data logging destinations will be used. Both are selected by default. Cycle data, Recipe changes, and settings changes are logged.

Calibration

Calibration may only be performed by qualified personnel.

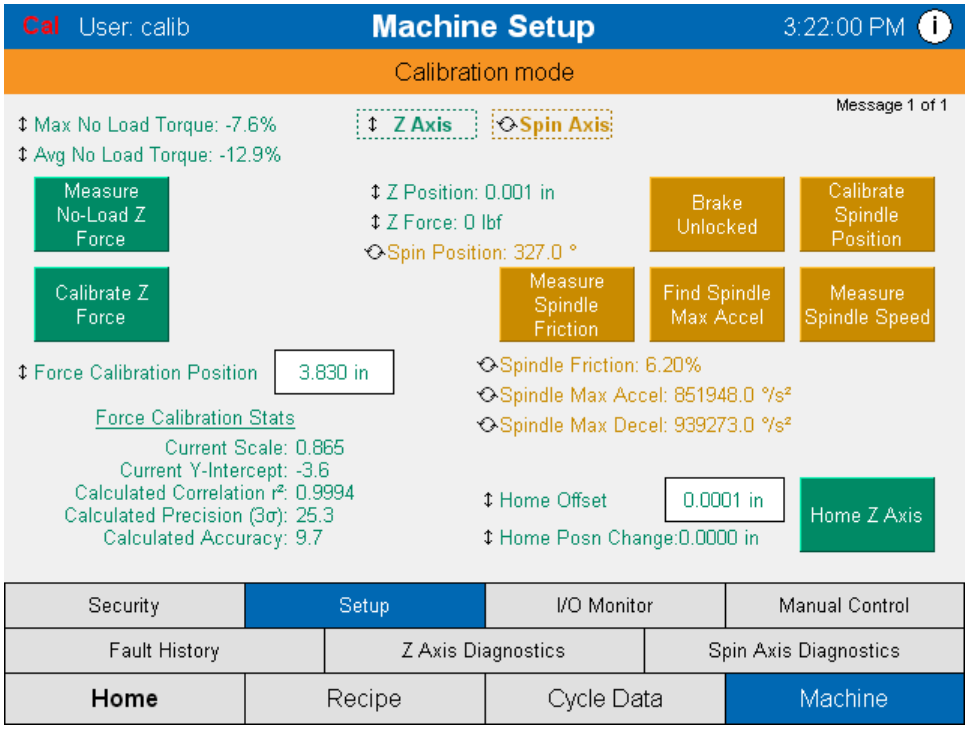


Figure 13: Calibration Screen

↕ Measure No-Load Z Force

Pressing this causes the Z axis to travel slowly through its full range of motion. Along the way, it records the torque feedback and stores this in an array. It will repeat this motion a few times. No tooling should be installed during this process. Ensure the axis can travel its full range without interference.

This process should be performed prior to force calibration. However, if force calibration makes a substantial adjustment to the scaling or offset, it may be advisable to rerun this test.

↕ Calibrate Z Force

This extends the Z axis with an assumed force towards a load cell. The load cell position may be set on screen. The operator then observes the load cell reading and enters this into the HMI. After repeating this over a range of forces, the welder uses a least-squares regression technique to apply a scaling and offset.

It may be advisable to repeat the process a few times. If the scaling or offset are changed substantially it may also be advisable to rerun the No-Load Force process before repeating.

Force Calibration Statistics

These values are calculated from the data entered during the force calibration procedure. They indicate how well the axis performed during calibration.

⥁ Calibrate Spindle Position

After installing and aligning the spin calibration fixture, press this button to set the current position to 0°. The spin axis must be off, and the brake unlocked.

⥁ Measure Spindle Friction

This button causes the spindle to rotate at a slow speed. The torque is measured during the move and the average used to compensate for spindle friction for the *Energy* cycle data statistic.

⥁ Find Spindle Max Accel

This button will repeatedly move the spindle at varying acceleration and deceleration rates, while hunting for the values that just barely max out torque. These values are then used to scale the *Accel* and *Decel* percentages. No tooling should be installed during this process.

⥁ Measure Spindle Speed

Pressing this will cause the spindle to rotate at 500 RPM for five seconds. With the spindle rotation measurement tool installed, use an external tachometer to verify the speed is as expected.

↕ Home Offset

Enter a Z axis home offset value based on position calibration measurements or differences. This value depends on the *Z Homing Method* set during Setup. The value does not take effect until the homing procedure is completed.

↕ Home Z Axis

Depending on the homing method selected in Setup, pressing this button will cause the Z axis to either retract until it senses a home proximity switch, or extend until it detects a torque increase. In the latter case, ensure a 1x2x3 block is placed against the homing datum on the welder. When a torque increase is detected, the welder will prompt the user to confirm the Z axis is pressed against the block. If it is not, it will increase the torque threshold and try again.

I/O Monitor

The I/O monitor provides the status of all machine I/O. The descriptions may change based on the Setup configuration. This does not include servo I/O, which may be viewed within the Servo Diagnostics screens.

Note: I/O may differ with customizations or multiple units.

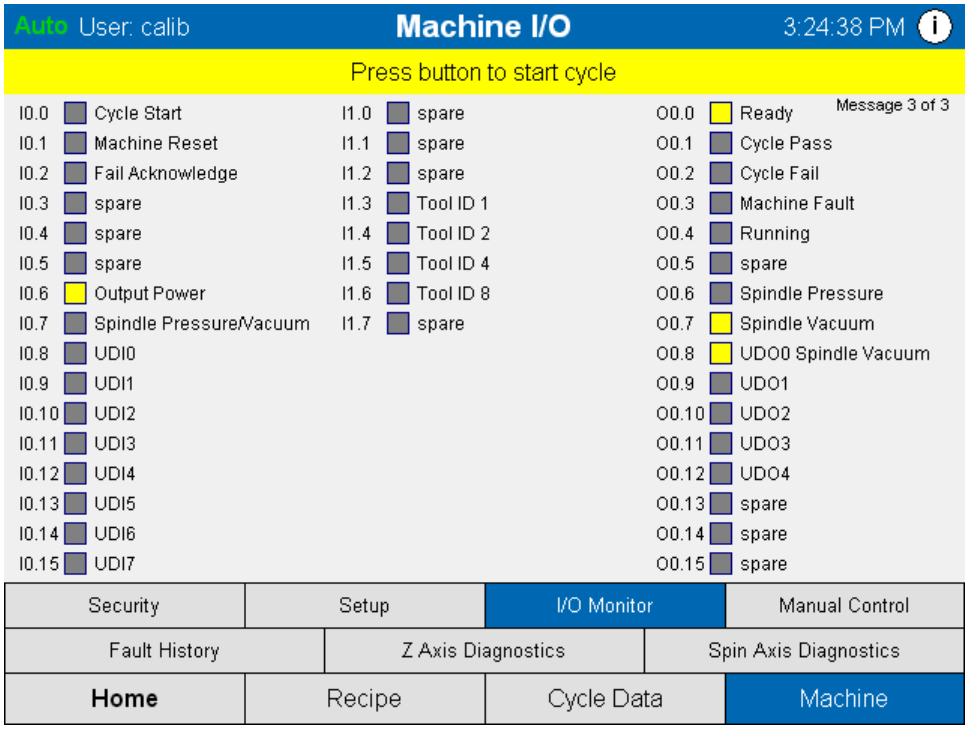


Figure 14: Machine I/O Screen

Manual Control

In Manual Mode the user is provided controls to manually move the servo axes and actuate outputs. Use caution in Manual Mode, as many programming safeguards are removed.

Servo Controls

The Z and spin axes have similar controls that allow manual jogging, as well as moves to defined positions. Servo torque is reduced in Manual Mode, except during *Spin at High Speed*.

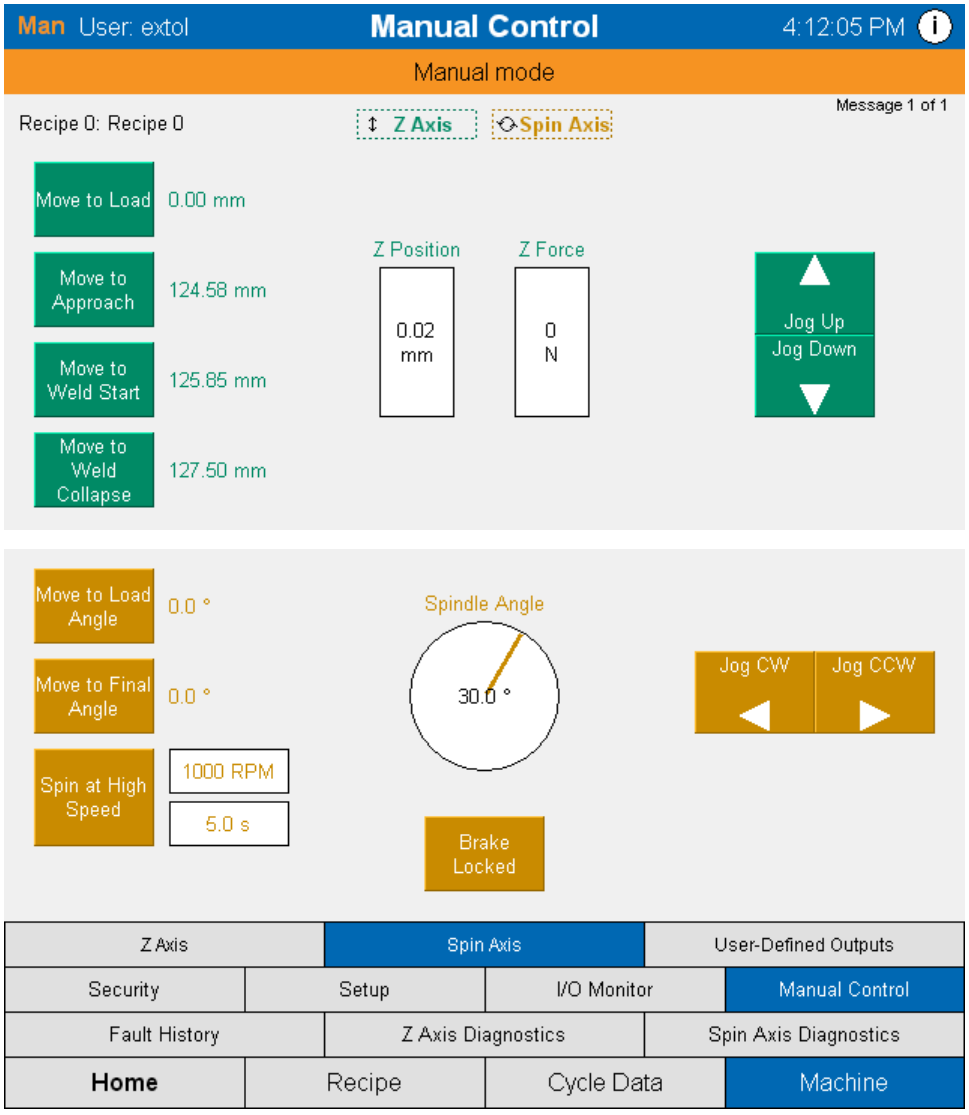


Figure 15: Manual Control Screen – Z and Spin Axes

User-Defined Outputs

Buttons to actuate any configured UDO, as well as the spindle pressure and vacuum, may be found here. Note that dual solenoids are controlled individually.

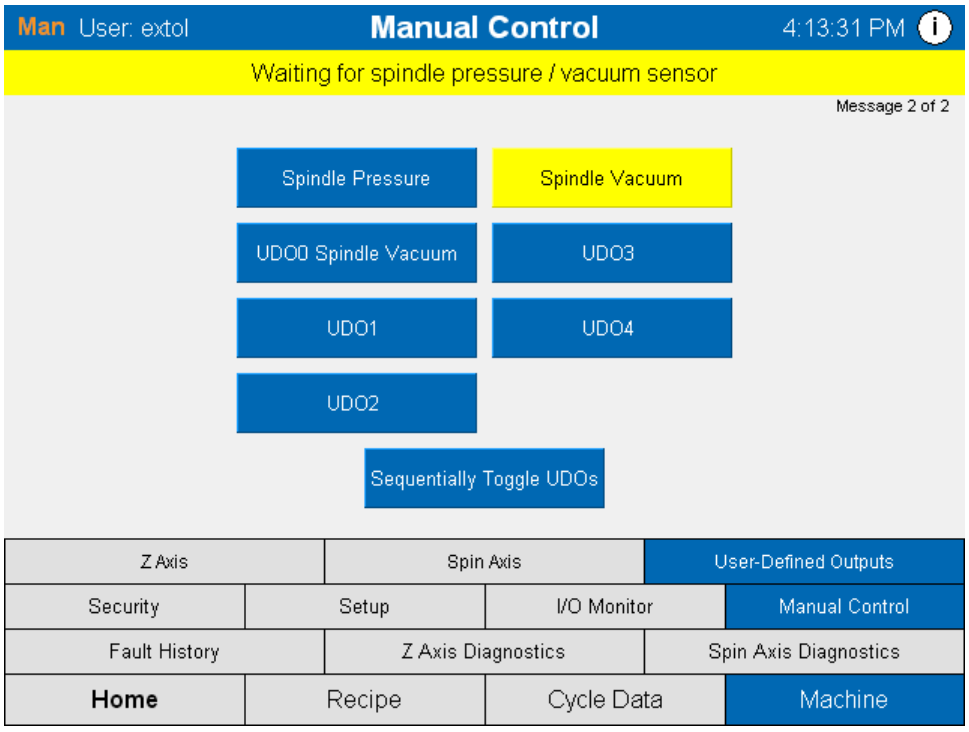


Figure 16: Manual Control Screen – UDO

Fault History

The Vortex Eminence includes a fault history screen that records any faults when they occur. See the Messages section for more information on each fault message. There are also additional fault messages that are generated by the servo faceplate - information on these can be found within the faceplate.

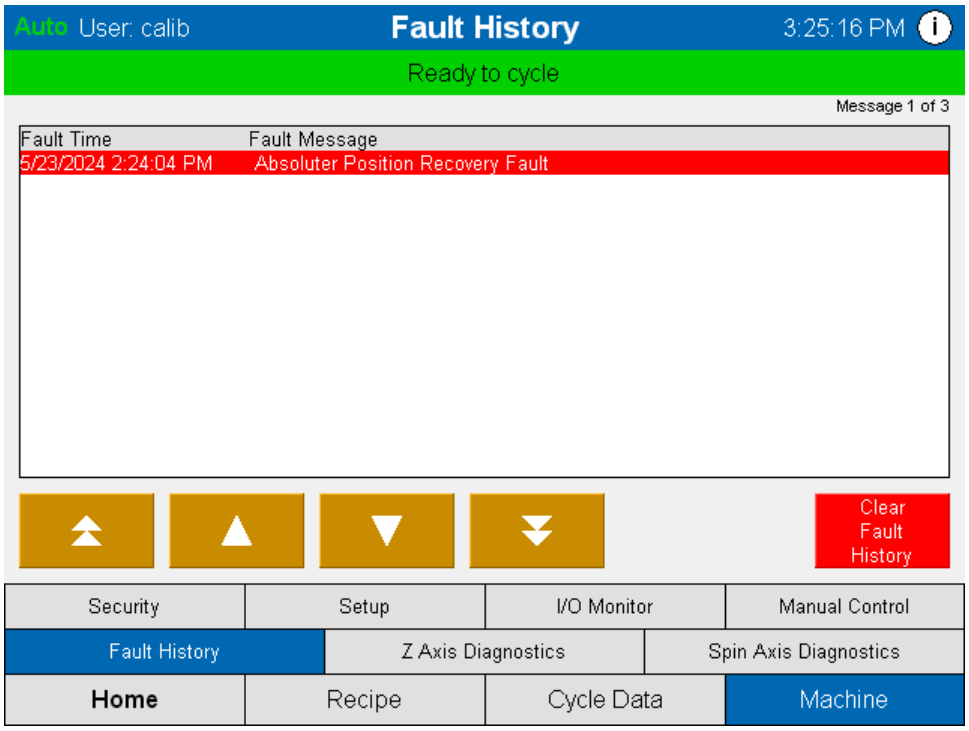


Figure 17: Fault History Screen

Servo Diagnostics

The servo diagnostics screens are Allen-Bradley-created faceplates which include several features to help inspect and diagnose the servo drives and motors. It includes a built-in help feature for further reference.

Of particular use is the 'alarm' icon to the left. This shows the most recent servo fault. When on this screen, pressing the question mark icon on the right reveals further diagnostic information for the fault.

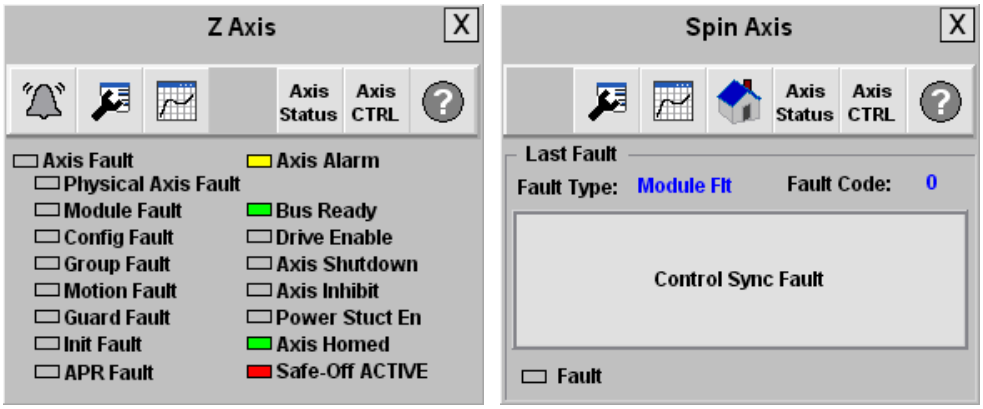


Figure 18: Servo Diagnostics

Recipes

The Vortex Eminence includes 32 weld Recipes by default. This may be expandable depending on available PLC memory.

Recipe Management

This screen lets the operator select between Recipes, as well as manage overall settings such as name and tooling I/O.

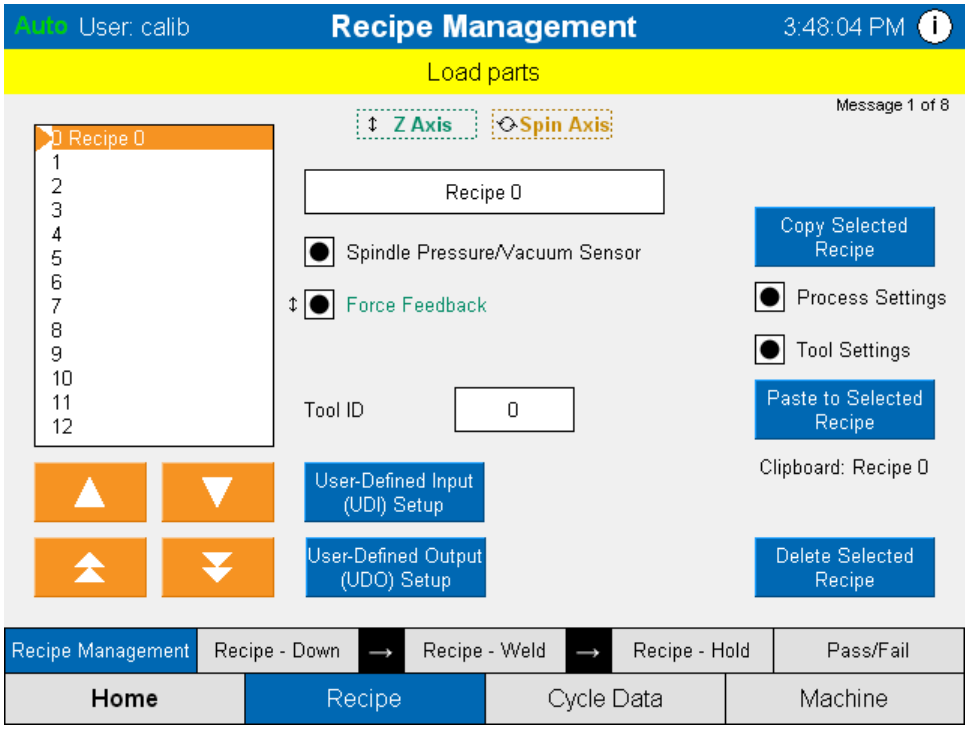


Figure 19: Recipe Management Screen

Recipe Selection

Use the up/down or page up/page down buttons to navigate between Recipes, or tap directly on the Recipe list to enter a Recipe number.

Name

Enter the Recipe name here. Use descriptive names to help easily identify each Recipe.

Spindle Pressure/Vacuum Sensor

Check this box to utilize the spindle's vacuum/pressure sensor. If spindle pressure or vacuum is used, having this enabled helps ensure that the spindle pneumatics have responded correctly. There may be some unique situations where the sensor does not respond appropriately.

A single sensor turns on both with negative and positive pressures. There is a threshold and hysteresis for each of these, and these may need adjustment based on the application. The sensor is located inside the Vortex Eminence head.

↕ Force Feedback

Check this box to enable force feedback. Typically force feedback will be enabled. But for small parts, or when the Z axis should be controlled by position only, this feature may need to be disabled. Force cycle data is collected in either case.

Tool ID

Enter a non-zero tool ID to enable this feature. The associated tool must turn on the appropriate Tool ID bits found on the tooling connector, or else an error will be thrown.

Copy, Paste, Delete

Use these buttons to duplicate or erase Recipes. Process settings and/or tool settings may be pasted. A prompt will make the user confirm their action.

User-Defined I/O

The Vortex Eminence includes tool I/O that may be programmed by the user.

User-Defined Inputs (UDI) Setup

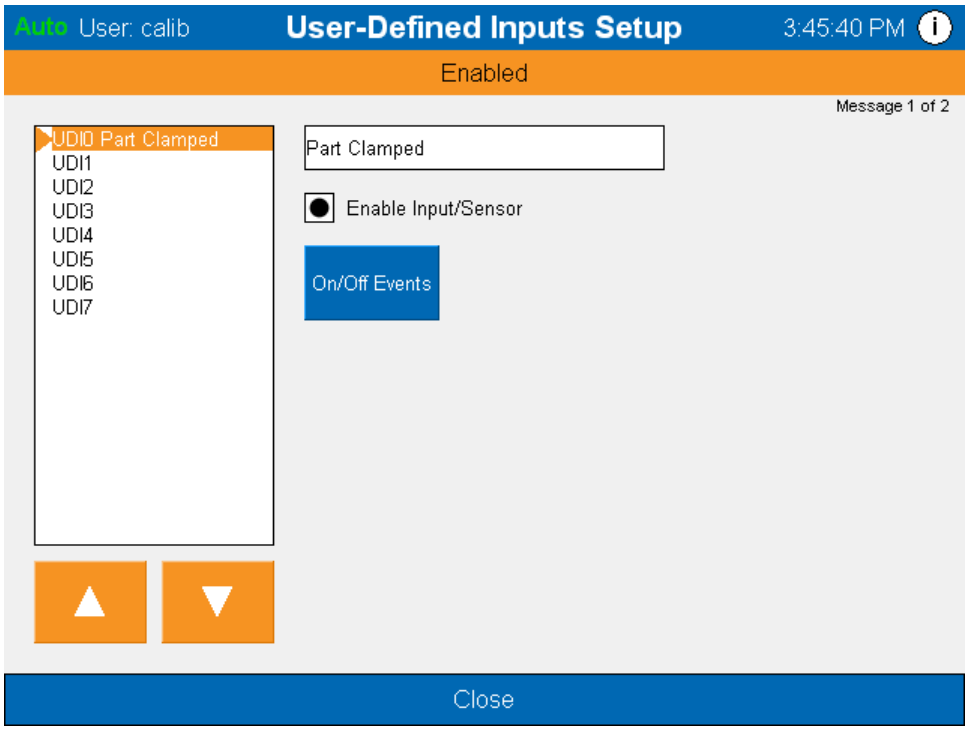


Figure 20: User-Defined Inputs

UDI Selection

Use the up/down arrows to navigate between each UDI, or tap directly on the UDI list to enter a UDI number.

Description

Give the UDI a meaningful description. This will be used in messaging alerts.

Enable

Enable or disable the UDI.

On/Off Events

Select when the UDI should be on or off. The input is checked only at an 'on' or 'off' event (green and red respectively), not in between. See the UDIO On/Off Events section for information on each event.

User-Defined Outputs (UDO) Setup

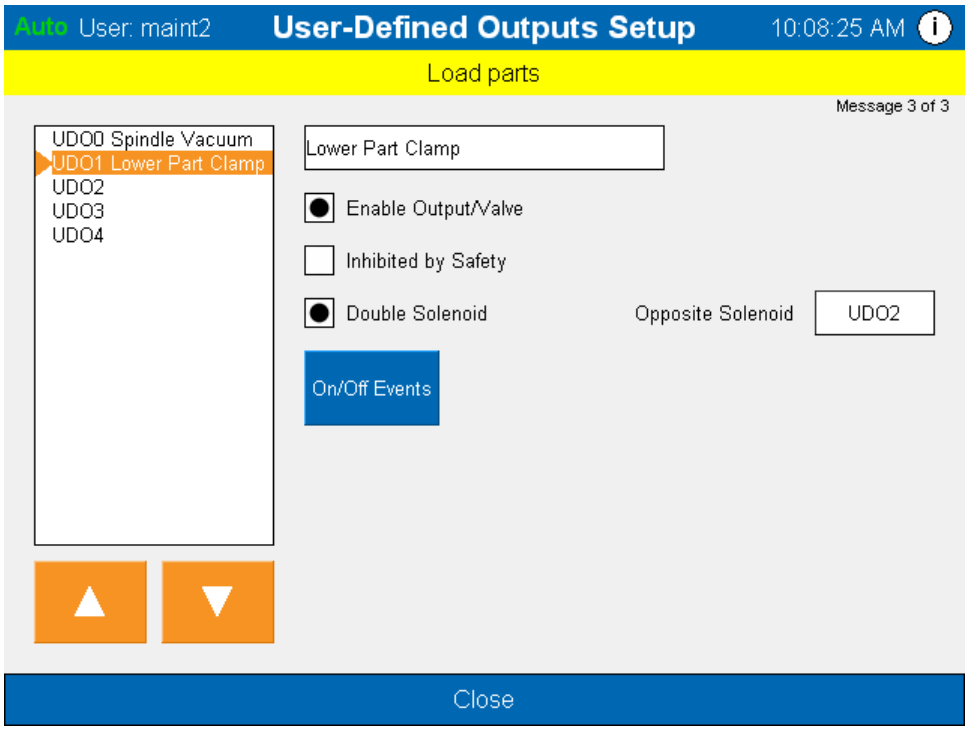


Figure 21: User-Defined Outputs

Note: UDO0 also controls the spindle vacuum/air. The spindle vacuum or air is selected on the Recipe – Down screen, under *Part Hold*. If it is set to either *Vacuum* or *Pressure*, UDO0's description will be overwritten to indicate this.

UDO Selection

Use the up/down arrows to navigate between each UDO, or tap directly on the UDO list to enter a UDO number.

Description

Give the UDO a meaningful description. This will be used in messaging alerts and manual control buttons.

Enable

Enable or disable the UDO.

Inhibited by Safety

Check this box to only allow the UDO to turn on when the safety circuit is engaged. Note this is a software solution only and is not safety-rated. To inhibit all outputs on a hardware level, use the *Output Power* input on the Rear Connector.

Double Solenoid

Select this if the output is part of a double solenoid. Select the *Opposite Solenoid* from the list. The opposite solenoid turns on and off complementarily to the main solenoid and cannot be controlled directly.

On/Off Events

Select when the UDO should turn on or off (green and red respectively). The UDO maintains its current state between events. See the UDIO On/Off Events section for information on each event.

UDIO On/Off Events

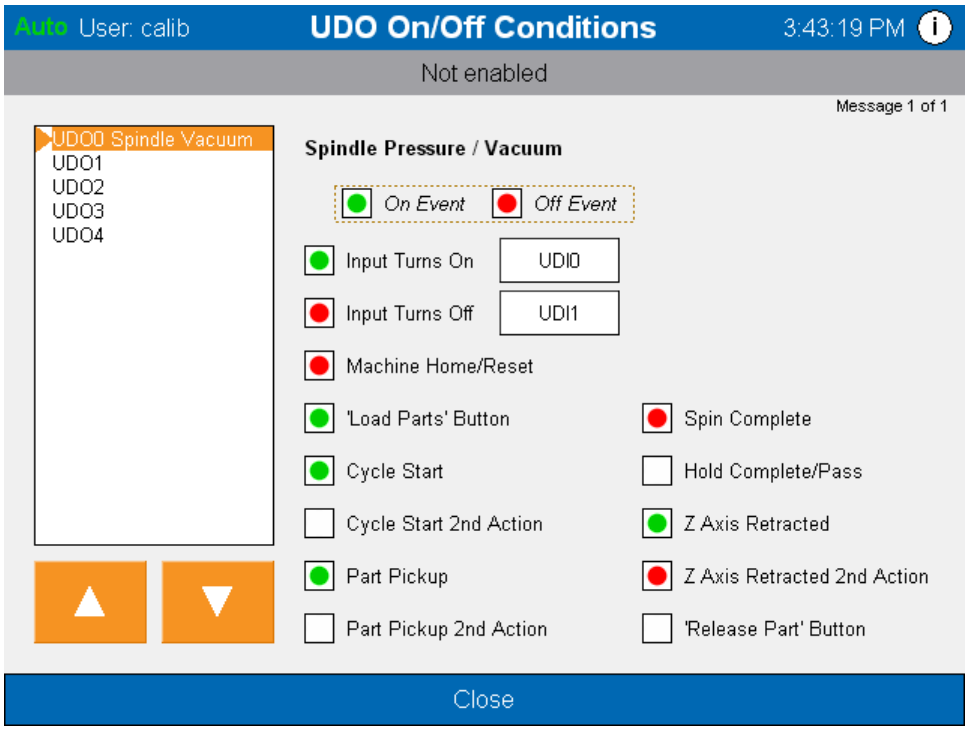


Figure 22: UDIO On/Off Conditions

UDIs can be examined, and UDOs toggled, at various events or conditions. These are listed below. Where applicable, they are ordered from the beginning to the end of a spin cycle. Some of these events may be hidden depending on the Recipe and/or UDIO configuration. Note some conditions apply to UDOs only.

- Input Turns On / Off (UDO Only)
- Machine Home/Reset
- 'Load Parts' Button (UDO Only)
- Cycle Start, Cycle Start 2nd Action
- Part Pickup, Part Pickup 2nd Action
- Spin Complete
- Hold Complete / Pass
- Z Axis Retracted, Z Axis Retracted 2nd Action
- 'Release Part' Button (UDO Only)

2nd Actions appear only if the first action is used somewhere. These occur back-to-back in the cycle. 2nd actions are useful in cases where there is a compound UDO actuation, if a UDI should be verified before a UDO is activated, and other unique situations.

Recipe – Down

In the first phase of the cycle, the Z axis extends towards the weld position. It may also pick up the upper part half.

Some parameters may be hidden depending on selections.

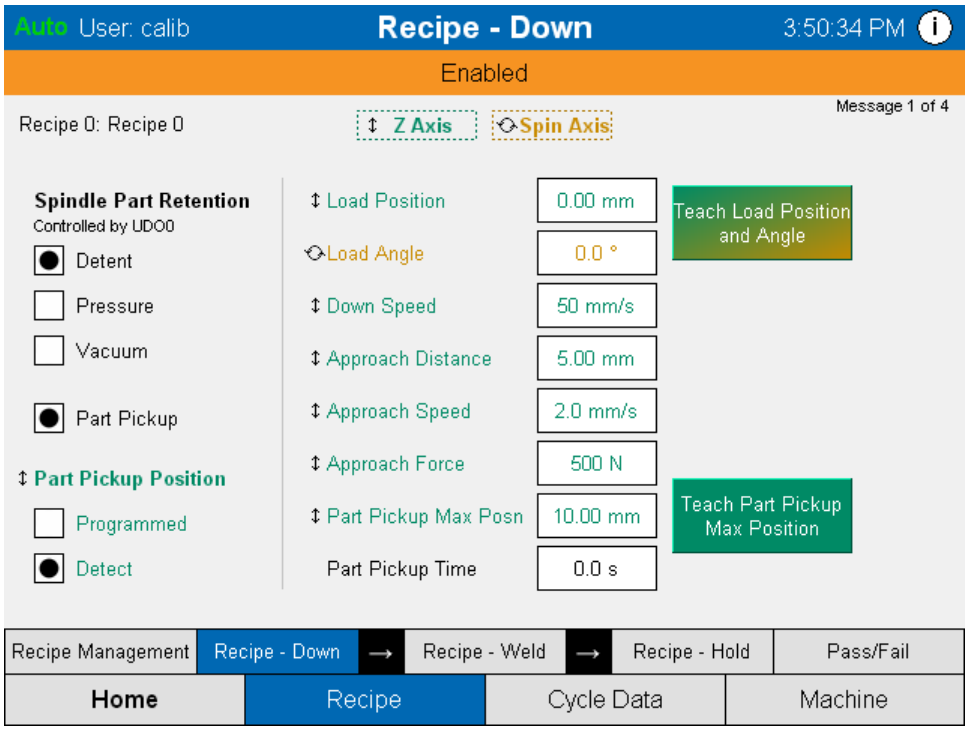


Figure 23: Recipe - Down Screen

Spindle Part Retention

The upper part can be held in place through friction, vacuum, or pressure. If vacuum or pressure are selected, UDO0 is renamed to "Spindle Vacuum/Pressure". Modify UDO0's on/off conditions to toggle spindle vacuum/pressure as appropriate for the application.

Part Pickup

Select whether part pickup is used. In this mode, both part halves are loaded together on the lower tooling, and the welder extends down to pick up the upper half before welding.

↕ Part Pickup Position

Only available when *Part Pickup* is selected. Select whether the *Part Pickup Position* is pre-programmed or detected. When *Programmed* is selected, the Z axis extends to the specified *Part Pickup Position* and picks up the upper part half.

When *Detect* is selected, the Z axis extends until it detects a force increase, and picks up the upper part half wherever it is detected. In this mode, a *Part Pickup Max Position* is set—if the part is not detected before reaching this position the cycle will not continue.

If *Force Feedback* is enabled, the *Approach Force* will be used to detect the part and/or stop the axis. If disabled, a preprogrammed torque increase is instead used to detect and stop.

↕ Load Position

This is the position of the Z axis for loading parts. While the welder has a long range of travel, not all of this may be needed in some applications. Reducing the distance between load and weld also can improve cycle time.

A *Teach* button is available to set this position based on the current Z axis position. Note, this also teaches the spindle *Load Angle.*

↻ Load Angle

This is the angle of the spin axis for loading parts. If there are any clocking features on the upper tooling there may be certain angles that are required to avoid a crash, or to make loading easier for the operator.

A *Teach* button is available to set this position based on the current spindle angle. Note, this also teaches the Z *Load Position.*

↕ Down Speed

Sets how fast the Z axis extends to the *Approach [Max] Position*. This also sets the retract speed at the end of the cycle.

↕ Approach Distance

The *Approach Distance* is the distance from the *Weld Start [Max] Position*, or if *Part Pickup* is enabled, from the *Part Pickup [Max] Position*. After quickly extending the Z axis to this position, the axis continues moving forward more slowly until welding commences.

↕ Approach Speed

This is the speed at which the Z axis extends from the *Approach Distance* to the start of the weld.

↕ Approach Force

If *Force Feedback* is enabled, the Z axis uses this force to detect part contact and stop movement.

↕ Part Pickup [Max] Position

Available only if *Part Pickup* is selected. This is the position that the welder Z axis extends to pick up a part. If set to *Detect*, this position is a maximum that will not be exceeded. Note, a window may be set around the weld start position under the Pass/Fail screen.

A *Teach* button is available to set this position based on the current Z axis position.

This is the same parameter as *Weld Start [Max] Position* when part pickup is not selected.

Delay Time / Part Pickup Time

If *Part Pickup* is disabled, the *Delay Time* pauses movement before the weld starts. If *Part Pickup* is enabled, this is the time needed to pick up the upper part half.

Recipe – Weld

In the main phase of the cycle, the spindle rotates with part halves in contact, creating friction and heat to melt the plastic. The Z axis advances at a defined force or speed until certain criteria are met, depending on the weld mode.

Some parameters may be hidden depending on selections.

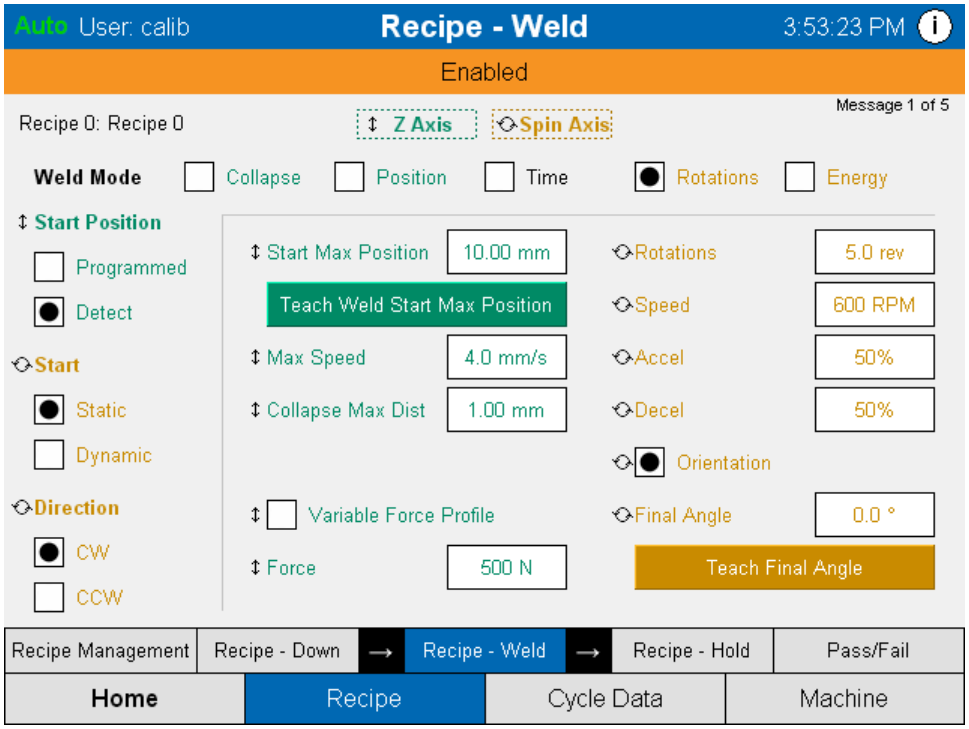


Figure 24: Recipe - Weld Screen

Weld Mode

Select the weld mode that will be used.

↕ *Collapse* – The weld is considered complete once the Z axis has travelled a specified distance from the weld start position.

↕ *Position* – The weld is complete once the Z axis reaches a certain position.

Time – The simplest weld method, this mode simply using a timer to determine when the weld is complete.

⟲ *Rotations* – Another simple method, this mode spins a certain distance for the weld to complete. The amount of heat generated is proportional to the number of revolutions, so this is an intuitive parameter to adjust.

⟲ *Energy* – A similar but more sophisticated method to *Rotations*, which accounts for the energy expended by the spindle. While much of the energy goes into the part, some is used by the motor and spindle. Note that in some instances cycle data may be slightly below the set point. This is because decelerating subtracts from the total energy.

↕ Start Position

Only available when *Part Pickup* is not selected. Select whether the *Weld Start [Max] Position* is programmed or detected.

When *Programmed* is selected, the Z axis extends to the specified *Weld Start Position* and begins the weld.

When *Detect* is selected, the Z axis extends until it detects a force increase, and then starts the weld. In this mode, a *Weld Start Max Position* is set—if the part is not detected before reaching this position the cycle will not continue.

⏲ Start

There are two weld start modes. *Static* begins welding after the parts have made contact.

Dynamic begins spinning before contact is made. This can be useful to overcome static friction. In *Dynamic* mode, with *Part Pickup* enabled the Z axis will retract slightly after picking up the part and then start spinning.



Use caution when using *Dynamic* mode. Upper tooling needs to be designed to prevent the part from ejecting.

It is possible part detection may be less reliable in *Dynamic* mode, leading to inaccurate processing and/or cycle data.

⏲ Direction

Select between *Clockwise* and *Counterclockwise*. This is usually irrelevant for most applications.

Cycle data indicates counterclockwise movement with a negative speed value.

↕ Start [Max] Position

Available only if *Part Pickup* is not selected. This is the position the welder Z axis starts a weld. If set to *Detect*, this position is a maximum that will not be exceeded. Note, a window may be set around the weld start position under the Pass/Fail screen.

A *Teach* button is available to set this position based on the current Z axis position.

This is the same parameter as *Part Pickup [Max] Position* when part pickup is selected.

↕ [Max] Speed

This is the speed at which the Z axis moves during the weld. If *Force Feedback* is enabled, this is a maximum—if set too low, the force setting may not be reached; if set too high, the actual force may overshoot the set point.

If *Force Feedback* is turned off, this setting is calculated automatically in some weld modes.

↕ Collapse [Max] Distance

This is the distance the Z axis will move during the weld. In some weld modes, if *Force Feedback* is enabled this may be a maximum distance not to exceed. This setting is not available with the *Position* weld mode.

↕ Collapse Position

Only available with *Position* weld mode. This is the Z axis position at which the weld will stop.

A *Teach* button is available to set this position based on the current Z axis position.

↕ Segmented Move

Only available with *Force Feedback* turned off. Enabling this mode allows one to define the shape of the Z axis move during the weld. Up to five position midpoints may be added to control how quickly the Z axis advances.

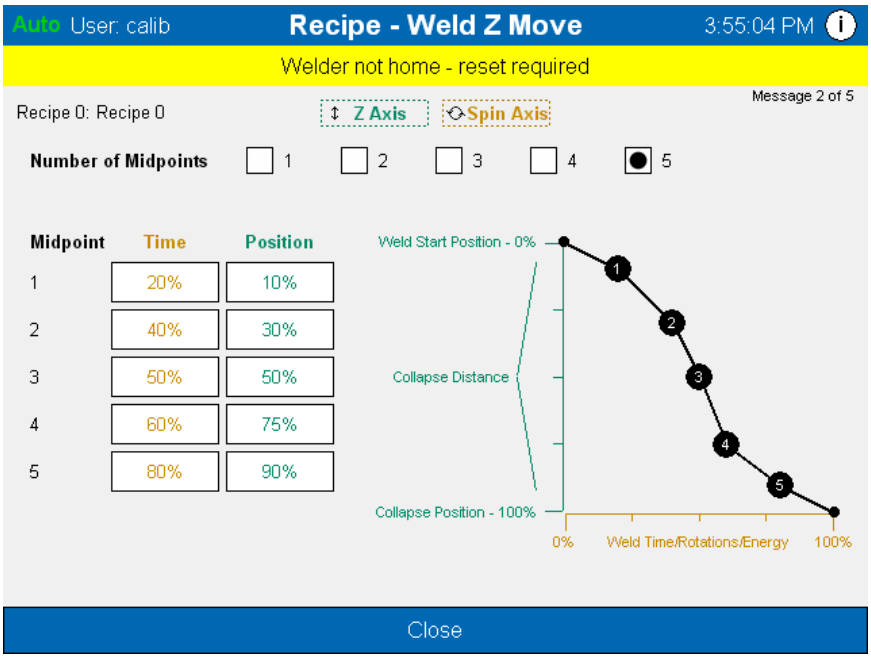


Figure 25: Segmented Move

↕ Variable Force

Only available with *Force Feedback* turned on. Enabling this feature allows one to define the force profile of the Z axis during the weld. Up to six force set points may be used, with the force transitioning smoothly between each.

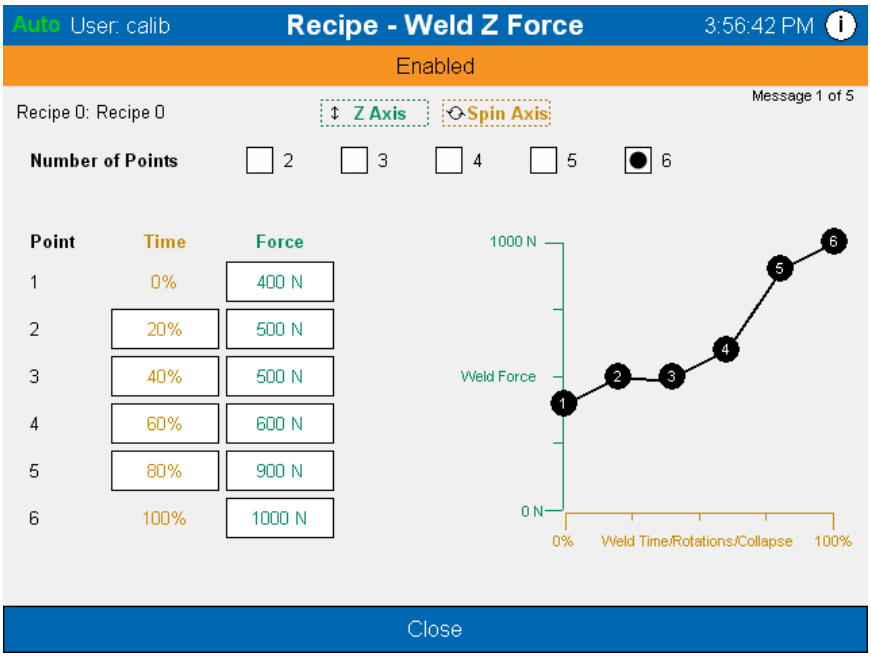


Figure 26: Variable Force

↕ Force

This is the force at which the Z axis pushes during the weld. Note if the *Max Speed* is set too low, the force may not be reached. Conversely, if *Max Speed* is set too high the force may overshoot. Only available with *Force Feedback* enabled.

↻ Rotations

If the weld mode is set to *Rotations*, this value specifies how many revolutions the spindle will rotate during the weld. Note that if a *Final Angle* is specified, this value may be modified by up to a half revolution in order to stop at the correct angle.

Time

If the weld mode is set to *Time*, this value specifies how long the spindle will spin during the weld. If a *Final Angle* is specified, the time may be modified slightly in order to stop at the correct angle.

↻ Energy

If the weld mode is set to *Energy*, this value specifies how much energy will be targeted. This energy includes both that going into the part as well as the motor and spindle, although friction is at least partially accounted for. Cycle data may be slightly less than this set point in some applications, as deceleration contributes negatively to the total energy.

↻ Speed

The speed at which the spindle rotates during the weld. Generally, the speed scales inversely to the part diameter, such that there is a consistent linear speed along the weld joint.

↻ Accel

This is how quickly the spindle will accelerate up to speed during the weld. The value is proportional to the max capability of the unloaded spindle. This value may need to be reduced if the spin axis torque is too high during the start of the spin, or if there is significant overshoot.

↻ Decel

This determines how quickly the spindle attempts to stop at the end of the weld. The value is proportional to the max capability of the unloaded spindle. Some combination of the weldment and motor will act to stop the spindle. Use the *Final Angle Overshoot* cycle data to adjust this parameter.

↻ Orientation, Final Angle

Turn on *Orientation* and set a *Final Angle* if the part needs to finish at a certain angle. This may have a slight effect on spin *Time* or *Rotations* if either mode is selected. If cycle data is offset from this setting the *Decel* or *Final Angle* may need to be adjusted to compensate.

A *Teach* button is available to set this angle based on the current spindle position.

Recipe – Hold

In the last phase of the cycle, the Z axis dwells for some time before retracting, allowing the plastic to cool and solidify.

Some parameters may be hidden depending on selections.



Figure 27: Recipe - Hold Screen

↕ Mode

If *Force Feedback* is disabled, the Z axis will hold its position during this phase and this setting is unavailable.

If *Force Feedback* is enabled, select between *Maintain Position* and *Maintain Force*. *Maintain Position* holds the Z axis in its position, while *Maintain Force* will continue to push with the specified force.

Time

This sets the length of the Hold phase.

↕ Force

If the mode is set to *Maintain Force*, this value specifies this force.

Pass/Fail

Limits may be set around various cycle parameters to ensure a good part is made.

The most recent cycle's data is shown to the right for reference. (Caution: this may correspond to a different Recipe if the Recipe was just changed.)

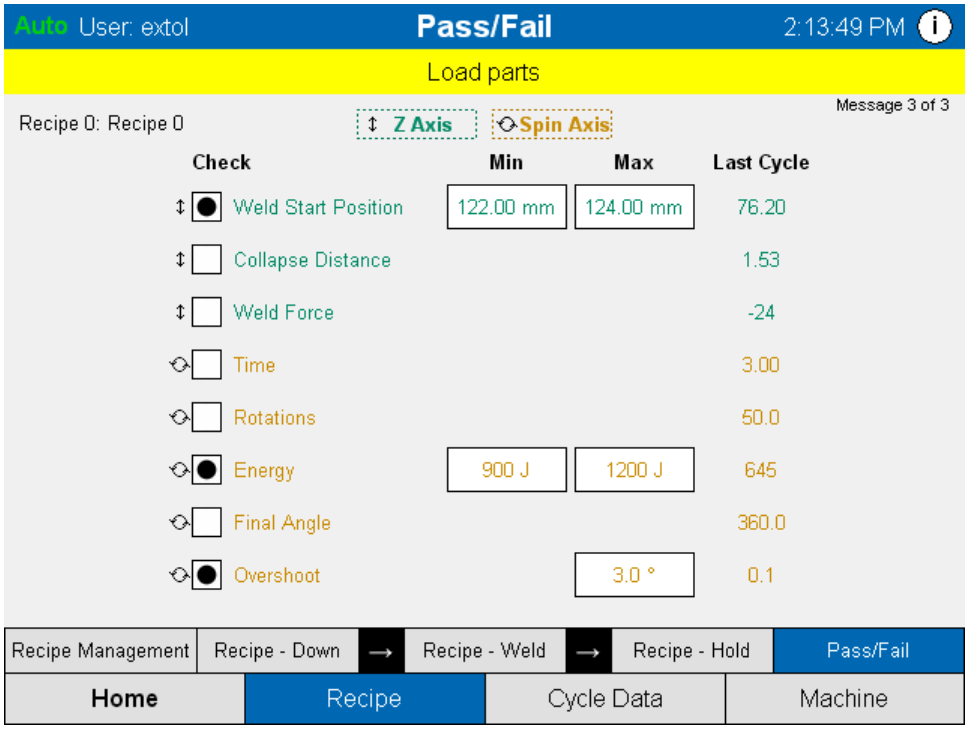


Figure 28: Pass/Fail Screen

↕ Weld Start Position

Limits around the weld start position can prevent a misloaded part from cycling.

↕ Collapse Distance

Limits around *Collapse Distance* confirm enough material was displaced to make a good weld. This check is useful with weld modes other than *Collapse*.

↕ Weld Force

Achieving a certain force range can be important to make a good weld. Note, force is still measured even with *Force Feedback* turned off.

⥁ Time

Limits may be set around weld time to catch abnormal behavior.

⥁ Rotations

Limiting the number of rotations to a valid range can catch abnormal behavior.

⥁ Energy

An energy value that falls outside an expected range can indicate a misload, short shot, or other part issues.

⥁ Final Angle

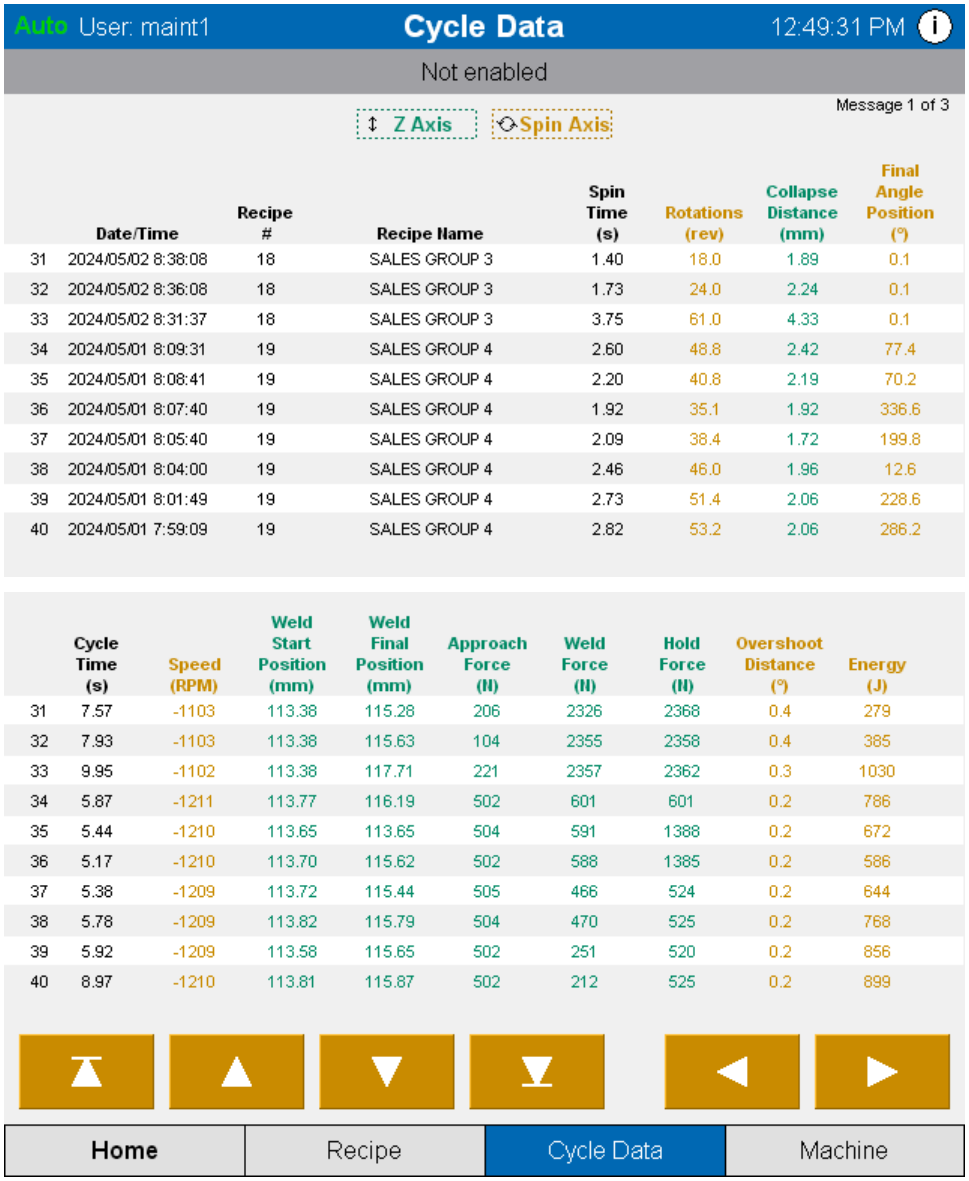
If the part has a tight angle tolerance, limits may be set around this value to ensure the requirement is met.

⥁ Overshoot

An excessive overshoot can weaken the weld joint and may indicate a non-optimized process.

Cycle Data

The last 100 cycles are viewable on the HMI in tabular form. Practically unlimited remote logging to a USB drive and an SD card are also enabled by default.



	Date/Time	Recipe #	Recipe Name	Spin Time (s)	Rotations (rev)	Collapse Distance (mm)	Final Angle Position (°)
31	2024/05/02 8:38:08	18	SALES GROUP 3	1.40	18.0	1.89	0.1
32	2024/05/02 8:36:08	18	SALES GROUP 3	1.73	24.0	2.24	0.1
33	2024/05/02 8:31:37	18	SALES GROUP 3	3.75	61.0	4.33	0.1
34	2024/05/01 8:09:31	19	SALES GROUP 4	2.60	48.8	2.42	77.4
35	2024/05/01 8:08:41	19	SALES GROUP 4	2.20	40.8	2.19	70.2
36	2024/05/01 8:07:40	19	SALES GROUP 4	1.92	35.1	1.92	336.6
37	2024/05/01 8:05:40	19	SALES GROUP 4	2.09	38.4	1.72	199.8
38	2024/05/01 8:04:00	19	SALES GROUP 4	2.46	46.0	1.96	12.6
39	2024/05/01 8:01:49	19	SALES GROUP 4	2.73	51.4	2.06	228.6
40	2024/05/01 7:59:09	19	SALES GROUP 4	2.82	53.2	2.06	286.2

	Cycle Time (s)	Speed (RPM)	Weld Start Position (mm)	Weld Final Position (mm)	Approach Force (lf)	Weld Force (lf)	Hold Force (lf)	Overshoot Distance (°)	Energy (J)
31	7.57	-1103	113.38	115.28	206	2326	2368	0.4	279
32	7.93	-1103	113.38	115.63	104	2355	2358	0.4	385
33	9.95	-1102	113.38	117.71	221	2357	2362	0.3	1030
34	5.87	-1211	113.77	116.19	502	601	601	0.2	786
35	5.44	-1210	113.65	113.65	504	591	1388	0.2	672
36	5.17	-1210	113.70	115.62	502	588	1385	0.2	586
37	5.38	-1209	113.72	115.44	505	466	524	0.2	644
38	5.78	-1209	113.82	115.79	504	470	525	0.2	768
39	5.92	-1209	113.58	115.65	502	251	520	0.2	856
40	8.97	-1210	113.81	115.87	502	212	525	0.2	899

Figure 29: Cycle Data Screens

Date/Time

The date and time of the cycle. The date is formatted as YYYY/MM/DD.

Recipe #, Recipe Name

The Recipe name and number are recorded. The Recipe configuration is also stored in the PLC for the last one hundred cycles.

↻ Spin Time

The elapsed spindle weld time.

↻ Rotations

The number of revolutions completed by the spin weld.

↕ Collapse Distance

The amount of Z-axis travel from weld start to end of hold. *Final Position* minus *Start Position* equals *Collapse*.

↻ Final Angle Position

The spindle angle at the end of hold.

Cycle Time

The total cycle time, from Z-axis extension to retraction.

↻ Speed

The maximum speed seen during the weld. This can often occur during acceleration if acceleration is set too high.

Negative values indicate a counterclockwise rotational direction.

↕ Weld Start Position

The Z-axis position at which the weld starts. This position may vary if the weld start position is set to *Detect*. But if set to *Programmed*, it will be the same every cycle.

↕ Weld Final Position

The Z-axis final position at the end of hold. *Final Position* minus *Start Position* equals *Collapse*. If the weld mode is set to *Position* this value should be approximately the same for each cycle.

↕ Approach Force

The amount of force seen when the part halves make contact.

↕ Weld Force

The most recent force seen during the welding phase.

↕ Hold Force

The most recent force seen during the hold phase.

↻ Overshoot Distance

The amount the spindle traveled past the *Final Angle* measurement.

↻ Energy

The calculated energy that went into the weld. This includes energy that goes into the part weld and into the spinning motion. Friction is partially accounted for.

↻ Min Torque, Max Torque

The minimum and maximum spindle torques seen during spinning. These two values are only available via remote logging.

Messages

A message banner is included at the top of most screens. This provides information on the welder's status.

Message Num	Message	Explanation
2	Not enabled	The safety circuit is off. This message is suppressed if the *Safety Starts Motion* settings is turned on.
3	Enabled	The safety circuit is on, and the welder is in Auto, Step, or Dry Cycle mode, but is not ready to cycle.
4	Calibration mode	The welder is in Calibration mode.
5	Welder not home - reset required	The welder is enabled and in Auto, Step, or Dry Cycle mode, but something is not in its home position/state.
6	Resetting	The welder is in the process of resetting.
7	Ready to cycle	The welder is ready to start a cycle.
8	Manual mode	The welder is in Manual mode.
9	Dry cycle mode	The welder in in Dry Cycle mode.
10	Load parts	The welder is waiting for parts to be loaded in order to run a cycle. Typically, this message will be accompanied by a "Waiting for UDI…" message that provides more specific information.
11	Press button to turn on spindle pressure	The welder is waiting for the operator to press the *Load Parts* button. Pressing the button turns on the spindle pressure, and may also actuate UDO(s) depending on configuration.
12	Press button to turn on spindle vacuum	The welder is waiting for the operator to press the *Load Parts* button. Pressing the button turns on the spindle vacuum, and may also actuate UDO(s) depending on configuration.
13	Press button to load parts	The welder is waiting for the operator to press the *Load Parts* button. Pressing the button actuates UDO(s).
14	Press button to start cycle	The welder is waiting for the operator or host machine to initiate a cycle.
15	Press button to release part	The welder is waiting for the operator to press the *Release Part* button. Pressing the button turns off the spindle pressure/vacuum, and may also actuate a UDO depending on configuration.
16	Z motion in progress	The Z axis is in motion while in Manual or Calibration modes.
17	Spin motion in progress	The spin axis is in motion while in Manual or Calibration modes.
20	In cycle: Z extend	These messages indicate which phase of the cycle is currently in progress. See the Weld Cycle Phases section for more information.
21	In cycle: Z part pickup	
22	In cycle: Z approach	
23	In cycle: Delay	
25	In cycle: Spin weld	
27	In cycle: Hold	
28	In cycle: Z retract	
29	In cycle: Spin reset	
30	Remove part	The welder is waiting on the operator to remove the welded part.
31	Cycle complete	The cycle has completed successfully.
32	Cycle aborted	The cycle was aborted early.
33	Spindle max accel not measured	The spindle max accel/decel has not been measured. This message usually only appears during initial commissioning or after a motor or gearbox change. While in Calibration mode, from the Setup screen, press the corresponding button to take the measurement.

34	Spindle friction not measured	The spindle friction has not been measured. This message usually only appears during initial commissioning or after a motor or gearbox change. While in Calibration mode, from the Setup screen, press the corresponding button to take the measurement.
35	Remote log error	One or more of the remote logs did not log successfully. Check that the SD card and/or USB stick is inserted, or turn off remote logging from the Setup screen.
36	Output power off	Output power is turned off. No digital outputs can turn on without power. This power is provided on the Rear Connector.
37	Z axis not homed	The Z axis has not been homed. This message usually only appears during initial commissioning or after a motor change. While in Calibration mode, perform the homing procedure. See the Calibration section for more information.
38	Spin axis not homed	The spin axis has not been homed. This message usually only appears during initial commissioning or after a motor or gearbox change. While in Calibration mode, perform the homing procedure. See the Calibration section for more information.
39	Waiting for Z axis...	The specified axis is not ready. This usually appears during boot up. It could also appear if a drive lost power or communications.
40	Waiting for spin axis...	
41	Z axis motion fault	These messages indicate a servo fault is present. To learn more about the fault go to the appropriate Servo Diagnostics screen.
42	Z axis non-motion fault	
43	Spin axis motion fault	
44	Spin axis non-motion fault	
45	Z axis force overrange fault	The Z axis experienced a force greater than the maximum. This is typically caused by unexpected interference.
46	Z axis force not calibrated	The Z axis force has not been calibrated. This message usually only appears during initial commissioning. While in Calibration mode, perform a force calibration procedure. See the Calibration section for more information.
47	Z axis position not calibrated	The Z axis position has not been calibrated. This message usually only appears during initial commissioning or after a motor change. While in Calibration mode, perform the homing procedure. See the Calibration section for more information.
48	Spin axis angle not calibrated	The spin axis position has not been calibrated. This message usually only appears during initial commissioning or after a motor or gearbox change. While in Calibration mode, perform the homing procedure. See the Calibration section for more information.
49	Tool ID mismatch	The current tool ID does not match the one specified in the Recipe. Check the Recipe Management screen to view or set the tool ID.

50	Fail - weld start position low	These messages indicate a part or process failure. See the Pass/Fail and Cycle Data sections for more information.
51	Fail - weld start position high	
52	Fail - spin overtime	
53	Fail - cycle overtime	
54	Fail - Z collapse low	
55	Fail - Z collapse high	
56	Fail - weld force low	
57	Fail - weld force high	
58	Fail - spin energy low	
59	Fail - spin energy high	
60	Fail - spin rotations low	
61	Fail - spin rotations high	
62	Fail - spin final angle	
63	Fail - spin overshoot	
64	Fail - spin time low	
65	Fail - spin time high	
66	Fail - cannot reach programmed weld start position	The welder was not able to reach the *Weld Start Position* (Start Position set to *Programmed*) or the *Weld Start Max Position* (Start Position set to *Detect*).
79	Waiting for spindle pressure / vacuum sensor	The spindle vacuum or pressure is turned on, but the vacuum/pressure sensor is off. First verify there are no air leaks. Then either adjust the sensor settings or turn off the sensor check.
80-87	Waiting for UDI[n] {UDI name} to turn off	The welder is waiting for the indicated User-Defined Input to turn on or off.
88-95	Waiting for UDI[n] {UDI name} to turn on	

Specifications

Actual specifications and features may vary depending on customization.

Mechanical	Head Dimensions (W x H x D)	200 mm / 8 in stroke	270 x 1180 x 500 mm (11 x 47 x 20 in)
		300 mm / 12 in stroke	270 x 960 x 500 mm (11 x 38 x 20 in)
		400 mm / 16 in stroke	270 x 1180 x 500 mm (11 x 47 x 20 in)
	Panel Dimensions (W x H x D)	200 mm / 8 in stroke	None—controls integrated into head
		300 mm / 12 in stroke	610 x 610 x 305 mm (24 x 24 x 12 in)
		400 mm / 16 in stroke	
	Head Weight	200 mm / 8 in stroke	150 kg (330 lbm)
		300 mm / 12 in stroke	130 kg (290 lbm)
		400 mm / 16 in stroke	160 kg (340 lbm)
	Spin axis	Actuator	Rotary servo motor
		Transmission	Direct drive or 3:1 gearbox
	Z axis	Actuator	Rotary servo motor
		Transmission	Precision ball screw, C5 accuracy grade
Electrical	Input power	Service	480 VAC, 3 Φ, 30 A
		Voltage range	324-528 VAC RMS, 47-63 Hz
		Full load current	20 A RMS
		SCCR	200 kA RMS
		Hookup	4 m (13 ft) cable with NEMA L16-30P attachment plug
Pneumatic (optional)	Input air		0.5 MPa (80 psi), clean, dry, non-lubricated
			H3C quick connect
			Required only for spindle vacuum/pressure or tool pneumatics
Environmental	Location		Indoor, dry use
	Pollution level		Pollution Degree 2
	Operating temperature		5-40 °C (40-105 °F)
	Relative humidity		80% maximum, non-condensing
	Maximum altitude		2000 m (6500 ft)
	Sound level		Tooling and speed dependent. Max 84 dBA with no tooling
Regulatory standards			NFPA 79 2021 Ed.
			ISO 13849-1:2015
Safety			**IMPORTANT:** No safety is included in welder head. Light curtains, hard guarding, two-hand control, or other safety must be added based on a risk assessment of the application.
			A safety relay is included, accessible via the rear connector. May be wired for dual- or single-channel, automatic or manual reset, dry contacts or solid state.
			Capable up to SIL2/PLd
Controls	Servos		Allen-Bradley Kinetix 5500 drives, VPL motors
	Controller		Allen-Bradley CompactLogix 5380
	Screen		Allen-Bradley PanelView Plus 7 Performance 7 in (180 mm), touch screen

Performance	Spin axis	Max power	Standard motor	12.3 kW (16.4 HP)
			Large motor	13.2 kW (17.6 HP)
		Max torque	Standard motor, direct drive	31.7 N-m (23.4 ft-lbf)
				Torque reduces from 3300 RPM - see chart
			Standard motor, 3:1 gearbox	95.1 N-m (70.1 ft-lbf)
				Torque reduces from 1100 RPM - see chart
			Large motor	48.6 N-m (35.9 ft-lbf)
				Torque reduces from 2600 RPM - see chart
		Max speed	Standard motor, direct drive	4250 RPM
			Standard motor, 3:1 gearbox	1417 RPM
			Large motor	4000 RPM
		Angle control tolerance		0.1°
	Z axis	Stroke		200 mm (8 in); 300 mm (12 in); 400 mm (16 in)
		Max speed		400 mm/s (16 in/s)
		Position control tolerance		0.02 mm (0.0008 in)
		Positional accuracy		Dependent on support column
		Force range		150-2300 N (35-520 lbf)
		Force precision		±30 N (±7 lbf)
		Force accuracy		30 N (7 lbf)

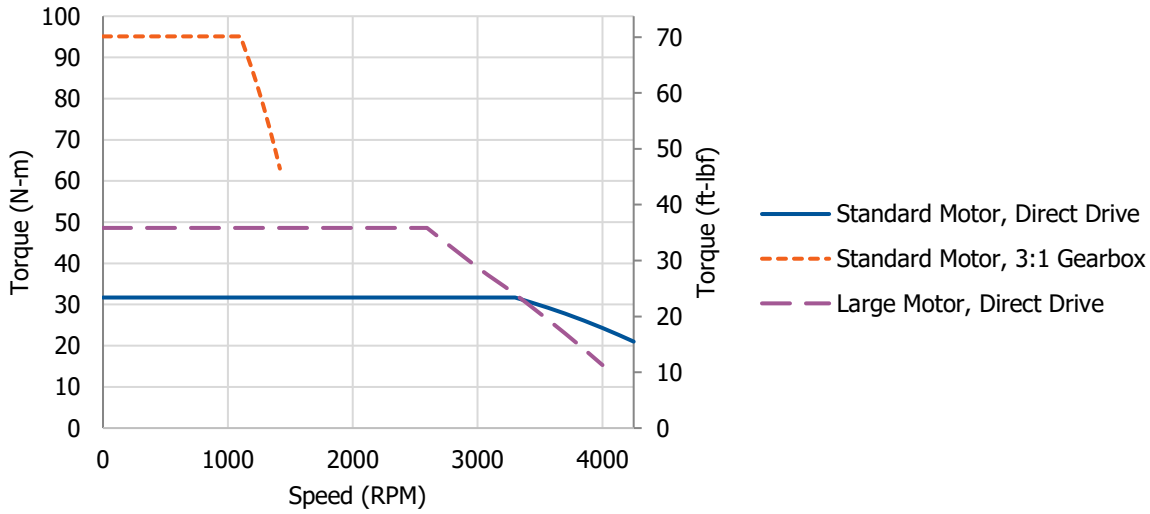


Figure 30: Spin Torque vs. Speed

Connectors	Rear connector	Safety and remote control, or legacy tool I/O
		25-pin female D-sub connector
		24 V PNP digital I/O
	Tool connector	8 general-purpose inputs, 4 tool ID inputs, 5 outputs, 3/3 power/COM supply
		25-pin female Han D connector
		24 V PNP digital I/O

Welder features	32 Recipes, expandable	
	Weld modes	Time, rotations, energy, collapse, position
	Settable load position and angle	
	Part pickup	
	Static or dynamic spin start	
	Position and angle teach	Load position and angle, part pickup position, weld start position, weld final position, weld final angle
	Force- and/or position-based Z axis control	
	Segmented weld move (position control)	
	Variable weld force (force control)	
	Real-time charting of cycle Z position, spin velocity, Z force, and spin torque	
	Cycle monitoring criteria	Weld start position, collapse distance, weld force, weld time, rotations, final angle, angle overshoot, weld energy
	Cycle data	Last 100 cycles viewable on HMI. Tabular view
		Date/time, Recipe name/number, weld time, weld rotations, collapse distance, final angle, cycle time, weld speed, weld start position, weld final position, approach force, weld force, hold force, angle overshoot, weld energy, min and max torque
	Remote logging	Unlimited logging to SD card and/or USB drive
		Accessible locally ~~or through network connection~~ (Network access coming soon)
		Data logged: cycle data, Recipe changes, settings changes
	Resettable and lifetime cycle counters	
	Recipe copy/paste/delete. Can paste process settings and tool settings separately	
	Units selection	
	Servo manual controls	
	Customizable screen security, users, and security levels	
	Part fault passcode	
	Fault history, last 1000 events	
	Servo diagnostics	
Tooling features	Spindle pressure or vacuum	Selectable from HMI
		On/off events are user-defined
		Pressure/vacuum sensor
		Manual controls
	Tool ID	15 unique IDs, expandable to 31
	User-defined I/O (UDIO)	Outputs can be turned on/off and inputs can be checked upon cycle and other events
		8 user-defined inputs (UDIs)
		5 user-defined outputs (UDOs)
		UDO manual controls
		UDO0 also controls spindle vacuum/pressure

Periodic Maintenance

The procedures for periodic maintenance to the Vortex Eminence are outlined below. Determine your usage conditions and environment and adjust as necessary.

Frequency	Item	Action	Notes
Weekly	Servo motors (2 total)	Check for abnormal vibration or noise	Inspect for abnormal noise, vibration, or any excessive pulsation. This can be done by touching the side of the machine or listening for greater than normal noise levels (do not touch the spindle while it is rotating).
Weekly	Operator interface	Wipe with a clean microfiber cloth	A clean screen reduces eye fatigue and improves touch screen responsiveness.
Weekly	Tooling	Clean with compressed air or a clean rag	Keep the tooling clean to maintain proper fit and assembly dimensions of parts.
Weekly	Tooling	Inspect for damage	Damaged tooling may affect part quality and may present a safety issue.
Weekly	Slideway on adjustable column (if present)	Wipe with a clean rag	If rust spots start to form, wipe clean and apply a very light coating of slideway oil. Do not use excess oil.
Monthly	Proximity switch (if present)	Ensure mounting screws are tight and switches function properly	Proximity switch status can be verified in the servo diagnostics I/O screen.
Every 6 months or 20,000 cycles	Ball screw	**For standard applications:** Lubricate with Shell Alvania Grease S 2 (EP 2 lithium bearing grease). **For clean room applications:** Lubricate with LG2 grease, made by NSK Ltd.	Relubrication cycle count is based off a general 100 km of travel.
Every 6 months or 20,000 cycles	Linear bearings	**For standard applications:** Lubricate with lithium based (JIS #2) grease. **For clean room applications:** Lubricate with THK AFE-CA or AFF Grease.	Relubrication cycle count is based off a general 100 km of travel.
Every 5 years or 20,000 hours	Servo motors (2 total)	Comprehensive inspection and rebuild	Contact Extol to perform this service. Do not attempt to disassemble the servo motor.
Every 5 years or 20,000 hours	Servo drives (2 total)	Comprehensive inspection and rebuild	Contact Extol to perform this service. Do not attempt to disassemble the servo drive.
Every 5 years or 20,000 hours	Motor gear box (if present)	Comprehensive inspection and rebuild	Contact Extol to perform this service. Do not attempt to disassemble the servo drive.
Every 1,000,000 cycles	All linear bearings	Replace	

Further Information

For further information please contact Extol.

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