Сварочный аппарат сопротивления постоянного тока Pico-DC

Pico DC

Users Guide

Direct Current Resistance Welder

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Chapter 1: Overview

The Sunstone Pico is a closed-loop feedback, direct-current, resistance welder engineered for thermocompression and other fine welds. With built-in force and displacement monitoring, the Pico provides unmatched precision, energy control, and monitoring using a color touchscreen interface.

The Pico provides you with many advantageous benefits, including built-in weld monitoring, SPC tools, PLC communication, closed-loop feedback, and more—all controlled with a 100% digital interface. The touchscreen provides easy access to all weld parameters in addition to a visual representation of the weld waveform graph, weld histograms, alarms, and warnings.

For automated production settings, the welder has PLC protocols. A cloning feature provides a simplified method to set up multiple identical welders. Cloning copies all parameters and settings from one welder and quickly exports them to other welders.

DC resistance welders, like the Pico, can provide consistent and repeatable energy discharges with accurate controls and fine adjustments. DC resistance welders are ideal for thermocompression applications and small wires due to the lower peak currents and maintainable energy discharge.

The Pico provides the following features and benefits:

- Small heat-affected zone during the weld
- Ability to monitor Force and Displacement during the weld (coupled with the Micro E weld head)
- Versatility to weld very small, thin, and delicate metal parts
- Single or Dual Pulse operation
- Low maintenance required
- Touchscreen Interface
- Weld Monitoring
- Weld Head Controls
- Remote Schedule Select
- Weld Counter
- Histogram of weld results
- Weld Comparator
- Full welder parameter cloning
- Lock-Out Mode
- PLC communication ready
- Software Updates
- Multiple Languages available
- Alarms and warnings

What is Direct Current Resistance Welding?

The Sunstone Pico welder converts the AC power coming from the wall to DC power and utilizes an internal control system to regulate and maintain the weld discharge for accurate, repeatable welds. The control system allows for fine tuning and manipulation of the weld energy to adjust for various welding applications. DC power can be ideal for very fine wires and thin components that need the precision other welding power supplies do not provide. The peak current of DC welders is lower than that of CD welders, but more sustainable throughout the weld process. The sustained peak currents are ideal for using thermocompression electrodes because the constant current provides a more even heat during the length of the weld.

DC RESISTANCE WELD FORMATION

Resistive spot welding relies on metal resistivity to heat and fuse metal. Current is generated by the DC power supply and is passed through the workpiece metal. Energy is dissipated in the form of heat due to the metal's resistance to the current. This resultant heat melts the weld materials, fusing them together. There are two phases to the melting process and the welder must overcome both the "Contact Resistance" and the "Bulk Resistance" of the material.

Contact Resistance

On the micro scale, surfaces of materials are rough and uneven, resembling peaks and valleys, as shown in Figure 2.1. When two surfaces are pressed together, contact is only made in a limited number of locations (where the peaks meet the peaks), instead of across the entire surface. These contact points act as resistive bridges for the current to flow across and create contact resistance. During the first few milliseconds of weld formation these bridges melt, allowing other bridges to come into contact to continue the melting process.

Bulk Resistance

Once all the bridges have fused, the contact resistance nears zero. At this point the second phase of the melting process begins and the bulk resistance of the materials plays the final role in weld formation. The "Bulk Resistance" is the inherent resistive nature of the material and varies depending on the type of material. As conductivity increases, resistivity decreases. Conductive metals such as copper require much larger amounts of energy to form a weld compared to more resistive materials such as steel.

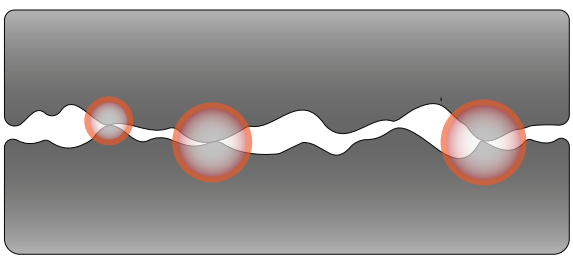


Figure 2.1. Surface roughness limits surface-to-surface contact. More contact points result in a lower contact resistance.

What is Thermocompression Welding?

Thermocompression welds utilize the resistive nature of the electrode material to generate the heat for fusion instead of relying on the resistive nature of the materials being welded. Thermocompression electrodes (generally made of tungsten) are specially designed to be fused at the very tip. As current is passed through the resistive tip of the electrode, heat is generated. Constant contact between the electrode and material being welded must be maintained with the correct amount of compressive force to create fusion with the substrate material.

Welding Tips and Recommendations

Remember that every weld application is different. Several factors must work together and be balanced to achieve successful welds. Sometimes experimentation and tweaking is required to get just the right weld. As previously discussed, the resistivity of the materials and contact resistance play a major role. Other important factors include the force being applied, the weld discharge energy, the weld discharge length, and the electrodes being used.

WELD FORCE

Since contact resistance plays such an important role in the weld process, the weld force being applied by the electrodes is critical. The larger the contact resistance, the hotter the resultant weld.

As more force is applied, the contact resistance is reduced due to an increased number of contact points between the two surfaces at the weld spot (more contact points result in lower contact resistance). More contact points results in a cooler weld.

Conversely, too little force can lead to arcing between the two surfaces, which causes undesirable weld results. Too much force can lead to weaker welds and part deformation.

Note: Weld force, as specifically described above, applies to resistance welding only. Thermocompression welds are not affected by contact resistance and therefore lighter forces do not lead to increased weld heat. In fact, higher forces are sometimes necessary to create good contact fusion (hence the term "compression" used in the name).

WELD ENERGY

The weld energy is adjusted using the welding power supply. Sunstone recommends that you first try a weld at a low energy setting and then increase energy until the desired hold strength is achieved. This tactic helps prevent destroying the workpiece by having too much energy to start out. With thermocompression welds, when set too high, energy settings can even lead to electrode tip degradation/failure.

WELD LENGTH

Some applications require longer weld times than others to achieve good welds. Keep in mind that the longer the weld lasts, the larger the heat affected zone will become. Weld length plays an important role in Thermocompression welding because the electrode tip must remain heated long enough for the coating and wire to melt.

Common Electrode Types

Thermocompression

Thermocompression electrodes are typically used to weld magnet wires or other coated wires. Thermocompression electrodes typically have an 1/8" diameter shaft body; different tip sizes/shapes can be available to cater to various applications. Larger tips require more energy to heat sufficiently while smaller tips can be more fragile and require less force.

Parallel Adjustable Gap

Parallel adjustable gap electrodes can be used to weld thin foils and strips and offer flexibility in gap distance, also allowing for a step configuration if required. They are available with a variety of tip sizes and come in Glidcop® or molybdenum.

Fixed Gap

Fixed gap electrodes can be used for similar welding applications to the adjustable gap but have the advantage of easily maintaining the exact same gap for every weld with no need to adjust the gap. They have a smaller gap that can often be achieved by the adjustable gap electrodes (but cannot be used for step weld configurations). They are available in molybdenum.

Opposed

The opposed configuration is ideal for cross-wire welds and welds that offer access to both top and bottom of the material. Electrodes come in Glidcop, Molybdenum, and Tungsten, with a variety of tip shapes.

Electrode Tip Ratings

Different electrode tip sizes can handle different amounts of force. Use the following as a guide:

- .01" x .01" – 40-1000 grams
- .015" x .025" – 125-1500 grams
- Anything larger – 400-2000 grams

Common Electrode Configurations

Direct weld (Opposed)

Current passes from one electrode through both workpieces and out the opposing electrode. Typically the easiest configuration to achieve good weld nuggets and strength. See Figure 5.1.

Step (Adjustable Gap)

The electrode is placed on both materials, but from the same side. A step or adjustable gap electrode configuration can be challenging when maintain proper pressure at each electrode due to possibly uneven surface. See Figure 5.2.

Series (Adjustable Gap/Fixed Gap)

The electrodes are placed on the surface material only. Because the current is split between both materials, sometimes this configuration requires more weld energy than a direct weld would. See Figure 5.3.

Thermocompression

In a thermocompression configuration, the current does not pass through the materials being welded, but rather the current passes through the electrode tip. A thermocompression configuration is most useful for coated surfaces like magnet wire. See Figure 5.4.

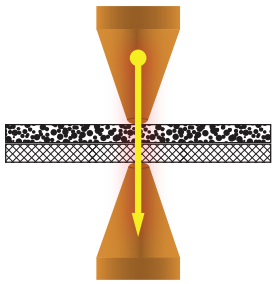


Figure 5.1. Direct (opposed) electrode configuration.

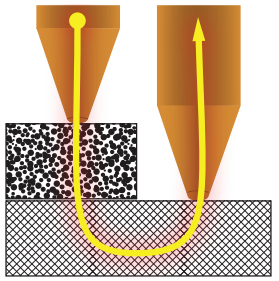


Figure 5.2. Step (adjustable gap) electrode configuration.

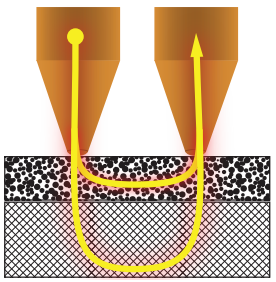


Figure 5.3. Series (adjustable gap/fixed gap) electrode configuration.

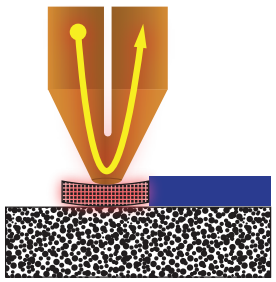


Figure 5.4. Thermocompression electrode configuration.

How to Maintain Repeatable Welds

Consistent weld results require a consistent and repeatable process. A few suggestions for ensuring repeatable welds include:

- Keep a weld logbook documenting the process once a successful weld has been achieved. Try to keep track of the following:
    - Force applied
    - Electrodes (tip size/shape, electrode material, etc.)
    - Measured gap distances (between electrodes, between the tips and workpiece, etc)
    - Electrode placement in electrode holders (flush with top, extending "X" amount, etc.)
    - Welding Power Supply settings (energy, length, etc.)
- Make sure there are no impediments to shaft movement.
- Make sure all the screws and connectors are tight.
- Make sure the weld head is placed on a stable, level surface that does not wobble.
- Try to make sure the materials being welded are clean and free of contaminants like dirt and oil.
- Whenever possible, fixture the parts being welded to ensure repeatable positioning and stability during the weld.
- Keep electrodes clean (create a process of maintaining the electrodes after a predetermined number of welds.

Chapter 2: Setup and Installation

Safety Precautions

- Carefully read the Sunstone Safety and Basics booklet that accompanied this welder prior to operation. As the operator of this welder, you assume full responsibility for your safety and those around you.
- Carefully read the users guide that accompanied your weld head or hand piece.
- Before depressing the foot pedtal and triggering a weld, make sure nothing is obstructing the electrodes other than the workpiece being welded.
- If maintenance or setup is required, put the welder in the "Weld Off" state or turn the unit off before making adjustments to the weld head or other connected devices.

Workspace Considerations

- Ensure the workspace around the power supply is adequate for welding operations.
- Ensure there is sufficient clearance around the sides and rear of the power supply for cables to run freely.
- Good ventilation is important to keep the power supply from overheating. Be sure to have proper air flow in and around the power supply.
- Be sure to keep the work surface stable, level, free of vibration, and strong enough to support the power supply.
- Ensure the power supply is sufficiently distant from the weld head and incoming power.
- Avoid placing the power supply near sources of high frequency electromagnetic radiation.
- Keep the work area clear of excessive dust, flammable materials, acids, corrosive gases, salt, and any moisture. Keep a clean work space!

Voltage and Power Requirements

The Sunstone Pico DC welder can be used with either 110VAC or 220VAC input voltage. The voltage is automatically detected by the welder so no voltage selection is required prior to connecting and powering up.

What's in the Box

- Pico DC Welder
- 90-250VAC Power Cord
- Foot Pedal
- Users Guide
- Safety Guide

Exploring the Welder's Front Panel

The front of the welder (see Figure 7.1) consists of three components: the digital Touchscreen (A), the Power Button (B), and the Weld On/Off Button (C).

Touchscreen

The digital touchscreen (A) displays the graphical user interface and allows the operator to make changes to the welding parameters. Every interaction with the weld settings will happen via the touchscreen.

Power Button

The Power Button (B) will turn the welder on and off. When turned on, the button will latch and stay depressed. To turn the welder off, press the button again to unlatch it and start the power down sequence.

Warning: Do NOT turn the welder off during boot up. Allow the welder to complete the boot process before turning the welder off.

Weld On/Off Button

The Weld On/Off Button (C) can be used any time the welder is powered on. When pressed, the button will illuminate and stay depressed, allowing the welder to make welds. When off, the touchscreen remains fully functional, but no welds can be triggered (no energy can be released). The weld on/off button allows operators to safely make changes to welding electrodes, weld heads, and hand attachments. Operators can also perform 'dry runs' to test timing, delays, and automations without releasing any weld energy.

Figure 7.1. The front panel of the Pico includes the Touchscreen (A), the Power Button (B), and the Weld On/Off Button (C).

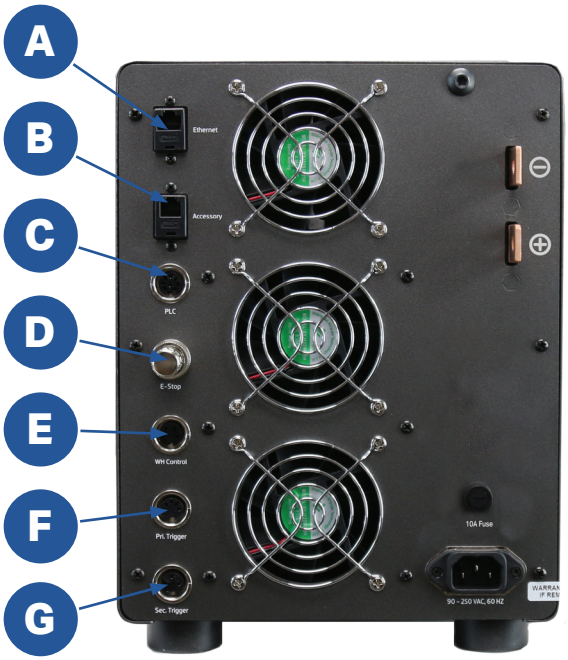


Figure 8.1. On the Pico's back panel you'll find all the ports, plugs, and connections necessary to connect the Pico to a weld head, foot pedal, power cables, and more.

Exploring the Welder's Back Panel

On the back panel of the Pico you'll find identifying details such as model and serial numbers as well as certification marks. The following components can also be found on the back panel, as shown in Figure 8.1 (see also Appendix A, 51 about connector pinouts):

Ethernet Port

The Ethernet Port (A) allows you to connect the Pico to a computer network via an Ethernet connection, a feature to be available in the future.

Accessory Port

The Accessory Port (B) is used to communicate with external accessories such as the Micro E weld head.

PLC Port

The PLC Port (C) includes logic inputs and outputs that can be used to communicate with a PLC.

E-Stop

The E-Stop Bypass Plug must be plugged into the unit if you're not using an E-Stop button. The E-Stop (D) circuit is normally open and engaged. To disengage it is necessary to close the circuit (in other words, if nothing is plugged into this port, the E-Stop is engaged). If the Power Button and Weld On/Off Button are not illuminated, but the display is on, the E-Stop is activated and must be disengaged before the Pico will operate. Pinout information can be found in Appendix B on page 57.

Weld Head Control

At time of press, the Pico does not use the Weld Head Control Port (E). Rather the weld held is connected using the Accessory Port (B).

Primary Trigger

Use the Primary Trigger Port (F) to connect an analog foot pedal, or other switch, to the Pico to initiate a weld.

Secondary Trigger

Use the Secondary Trigger Port (G) to connect a foot pedal, or other switch, to initiate a weld.

Positive and Negative Weld Terminals

Use the Positive and Negative Weld Terminals (H) to connect the weld cables from a weld head or hand attachment to the Pico to deliver weld energy. See Figure 9.1. Make sure weld cable resistance is greater than or equal to 1 milliohm (1mΩ) of resistance.

Cooling Fans

The Pico's cooling fans (I) are internally powered and controlled. Make sure the fans are free from obstruction and have at least two inches of free space behind the welder for optimum airflow.

Fuse

For safety, the Pico uses a 5mm x 20mm 15amp fuse (J) rated for up to 250VAC.

Power Inlet

The Pico Power Inlet (K) requires an IEC 320 C13 power cord and can accept 90-250VAC, 50-60Hz.

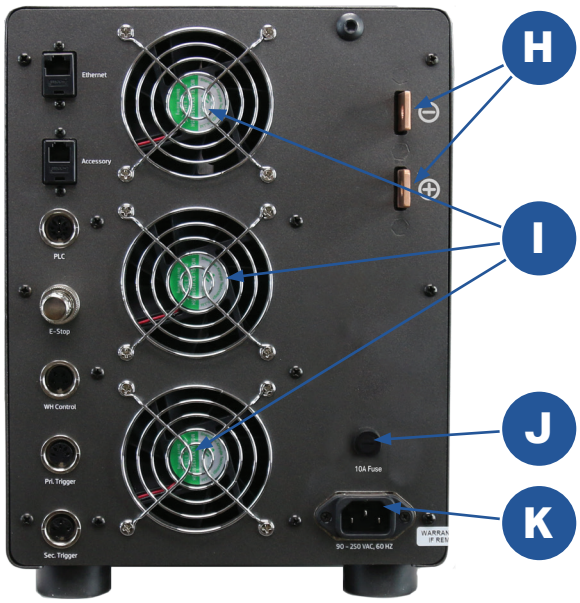


Figure 9.1. Additional plugs and connections on the Pico's back panel.

Exploring the Side Panel

The welder features a USB port on the left side, near the front. See (L) in Figure. 9.2. The USB port can be used for three purposes:

1. Update the firmware and software of the welder (see Chapter 3 for software update instructions).
2. Export and import saved schedules, welder settings, and historical weld data (see the section on Import/Export tab on page 27).
3. Connect a USB mouse and use the mouse to navigate the interface.

Figure 9.2. Use the USB port (L) on the left side of the Pico to update firmware/software, export/import saved welding data, or to connect a mouse to navigate the interface.

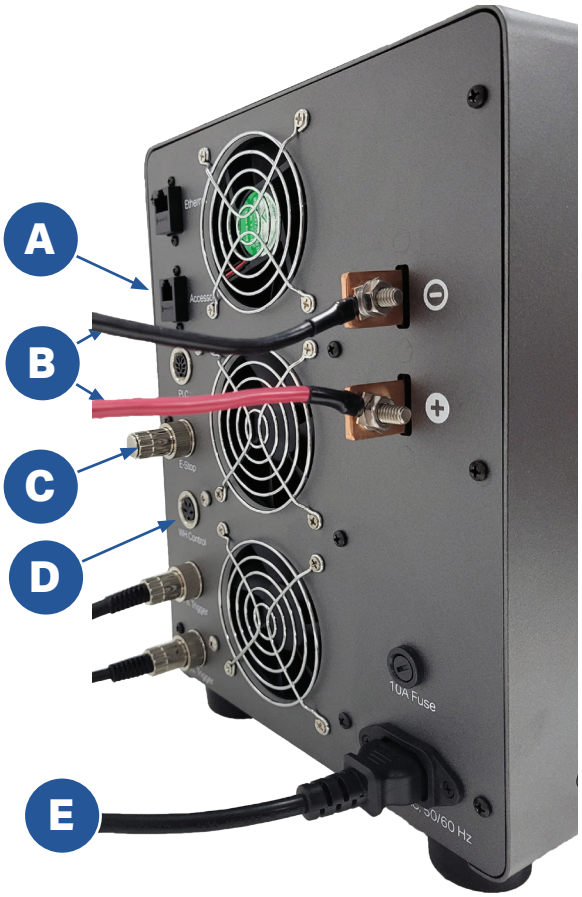


Figure 10.1. Unbox the Pico and make sure these basic connections are completed: Power (E), weld cables (B), E-Stop (C), and Accessory Port (A).

How to Set Up Your Welder

- Unbox the welder and place on a stable surface.
- Connect the E-Stop Bypass Plug or an E-Stop switch into the E-Stop Port on the back of the welder. See (C) in Figure 10.1.
- Connect the female end of the power cord into the Pico's Power Inlet and connect the male end into an AC power outlet (90-220VAC). See (E) in Figure. 10.1.
- Connect the weld cables (B) from the weld head or hand attachment to the positive and negative weld terminals.
    - Use the included ¼-20 socket cap screw with lock washer and hex nut.
    - Attach the ends of the weld cables coming from the weld head or hand piece firmly to the copper terminals on the back panel of the welder. One cable should be attached to the negative, one cable should be attached to the positive.
- If you are using the Sunstone Micro E weld head, attach one end of the CAT 5 cable to the Accessory Port (A) on the back of the Pico welder. Connect the other end of the cable to the Comm Port on the Sunstone Mirco E weld head. See also the Micro E users guide.
- If you are NOT using the Sunstone Micro E weld head, connect the Weld Head Control cable to the Weld Head Control Port (D).
- Determine which weld trigger configuration is best for your setup and connect accordingly. Options include:
    - Direct Control using an Analog foot pedal
    - Auto Mode

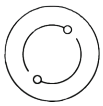
The system is now properly connected and ready to weld.

Chapter 3: How to Use the Pico Software Interface

The Pico's secret sauce is its digital interface. The Pico lets you set energy, force, displacement, timing, and other weld parameters to an exact number, something you can't do with other welders. In this chapter you'll learn how the software is organized and how to use each feature.

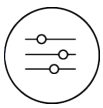
Navigation Bar

The Navigation Bar at the top of the screen allows you to quickly access other parts of the welder's systems by touching each icon with your finger (see Figure 11.1). The Navigation Bar includes six icons representing the welder's main systems: Run, Servo Control, Weld Settings, Communications, Save/Load, and System Settings.



Run Screen (A)
Touch the Run Screen icon (A) in the Navigation Bar to display the current settings of the weld discharge and servo weld head. See page 12 to learn how to use the Run Screen.

Weld Head Control Screen (B)
Touch the Weld Head Control Screen icon (B) to be guided through the set-up of a weld head. On page 14 you'll learn how to use the Weld Head Control Screen. The Weld Head Control Screen icon only appears when the weld head is connected and powered on.



Weld Settings Screen (C)
Touch the Weld Settings Screen icon (C) to set the parameters of the weld discharge. See page 20 for additional details regarding pulse settings and weld control.

Save/Load Screen (D)
Touch the Save/Load Screen icon (D) to save weld settings or load weld settings from a previously saved weld. See page 22.

Communications Screen (E)
Touch the Communications Screen icon (E) to access PLC controls for automation, settings for alarms, and features for importing/exporting pre-set welds. See page 23 for PLC instructions.

Systems Settings Screen (F)
Touch the Settings Screen icon (F) to modify the Pico's basic settings, such as language, date and time, and more. See page 28 to learn how to make system changes.

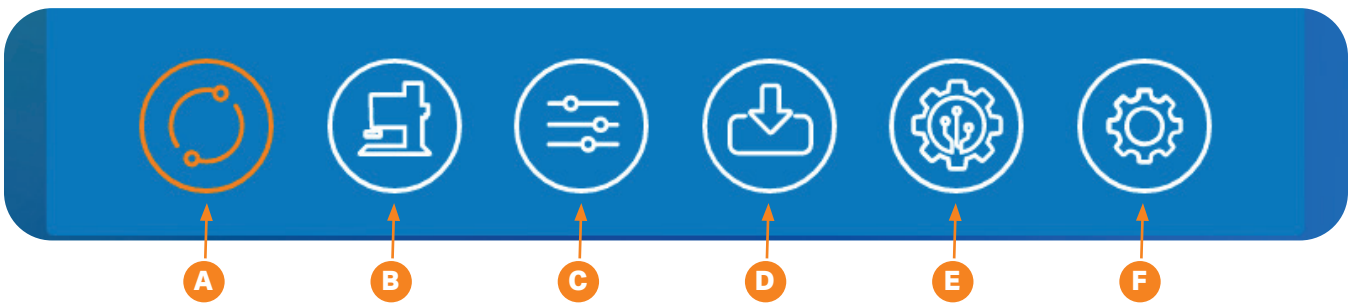


Figure 11.1. The Navigation Bar allows you to access the Pico's six main operational screens: (A) Run Screen; (B) Weld Head Control Screen; (C) Weld Settings Screen; (D) Save/Load Screen; (E) Communications Screen for PLC features; and (F) Systems Setting Screen.

Figure 12.1. The Run Screen.

Run Screen Operation

The Run Screen, seen in Figure 12.1, displays current settings relating to the weld discharge and weld head. Additionally, the achieved results from the previous weld are displayed here as well. The Run Screen is equivalent to a "home" screen and should be the active screen when triggering a weld.

Important: The Pico will only release energy and trigger a weld when the Run Screen or Weld Settings Screen is active. If another screen is displayed, the Pico will not trigger a weld.

SELECTING WELD SCHEDULES (G)

To quickly load an existing weld schedule from the Run Screen, tap the Select Weld Schedule button (G) in Figure 12.1 and select the schedule from the pop-up window. Existing weld schedules can also be loaded in the Save/Load Screen, further explained on page 22.

VOLTAGE/CURRENT/POWER FEEDBACK SECTION (H)

The Voltage/Current/Power Feedback section (H) shows Pulse 1 and/or Pulse 2 desired and achieved results from the previous weld. The displayed results of Voltage/Current/Power are dependent on what is selected in the Comparator section in the Weld Settings Screen. Pulse 1 and/or Pulse 2 will be grayed out if disabled in the weld pulse settings screen.

FORCE (I)

In the Force section (I) you'll see two numbers. The Desired number represents the amount of force you selected in the Weld Head Settings Screen. The Achieved number is the amount of force that was achieved in the last weld.

TRIGGER WELD (J)

You can trigger a weld in Auto mode by pressing the Trigger Weld button (J). Pressing this button will act as if you depressed a foot pedal plugged into the Secondary Trigger Port found on Pico's rear panel.

WAVEFORM DISPLAY SECTION (K)

A graph (K) at the top of the Run Screen in Figure 12.1 displays a visual representation of the last recorded weld discharge. Weld voltage/current/power (dependent on what is selected in the comparator screen) is displayed on the Y axis, and weld discharge length (time) is displayed on the X axis.

COMPARATOR MONITORING (L)

The results from the comparator are shown directly below the waveform graph of the previous weld. See (L). A green dot indicates that the previous comparator results were within set bounds. A red dot indicates something was out of bounds. The comparator can be turned on for either or both weld pulses if the weld pulses are enabled. In the Weld Settings Screen, go to the comparator section by clicking on the Comparator Button. You can place an envelope around your weld output waveform and the system will warn you if the weld output goes out of bounds. See page 20 to learn more comparator features.

DISPLACEMENT MONITORING (M)

The results from the displacement of the previous weld are shown below the Comparator Monitoring resuls. See (M). A green dot indicates that the previous displacement results were within set bounds. A red dot indicates something was out of bounds.

WELD HEAD POSITION (N)

In the lower right-hand side of the Run Screen, the weld head's current position is displayed. See (N). In Auto Control mode, the weld head can be moved directly using the up and down arrows found to the right of the current position display. In Direct Control mode, the weld head's position is controlled only by the analog foot pedal.

WELD POINT (O)

The Weld Point (O) displays the current set weld point position.

Figure 14.1. The Weld Head Control Screen in the Mode Select step. When you touch the Weld Head Control Screen icon, the Pico will want to walk you through a step-by-step process to complete the weld head setup process. When you've selected the desired settings for each step, press the right arrow button at the bottom of the screen to advance to the next step. You can press the left arrow button to go back. Press the Close button to save and end the setup process.

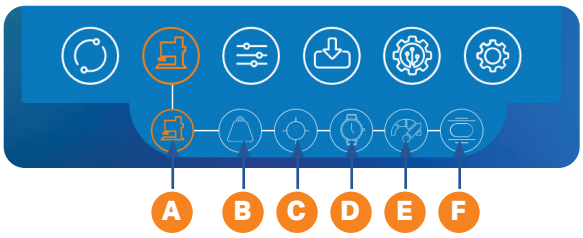


Figure 14.2. The Weld Head Control Screen sub-navigation bar contains six areas of weld head control: Mode Select (A), Force (B), Position (C), Timing (D), Speed (E), and Displacement (F).

Weld Head Control Screen Operation

The Weld Head Control Screen is used to set all parameters required for controlling a connected weld head during the weld process.

Note: The Weld Head Control Screen icon only appears when a weld head is connected and powered on.

When you press the Weld Head Control Screen Icon in the Navigation Bar, the Pico will begin a sequence of step-by-step, pop-up windows to guide you through the setup process.

You can choose to follow the step-by-step setup process or jump to any portion of the setup process by pressing any of the icons in the Weld Head Control sub-navigation bar (found under the Navigation Bar when the Weld Head Control icon is pressed). See Figure 14.2.

MODE SELECT

The first step of the set up process is choosing how you wish to control the weld head. The Mode Select icon (A) in Figure. 14.2, is identical to the Weld Head Control Screen icon due to it being an extension of the weld head controls. The weld head has two modes available: Direct Control and Automatic Control.

Direct Control

Direct Control allows operators to control the position of the weld head directly by using an analog foot pedal. The position of the weld head corresponds to the position of the foot pedal. Pressing down on the foot pedal lowers the weld head; letting up on the pedal raises the weld head.

In this mode, the operator presses the analog foot pedal to lower the weld head until contact is made with the workpiece. Once the desired force is met, the weld process is triggered. Upon completion of the sequence, the weld head will return to the Home Position, ready for the operator to initiate the next weld. User configured parameters of the Direct Control weld sequence include Force, Timing, and Displacement. You must release the foot pedal in order to make another weld.

Automatic Control

If Automatic Control mode is selected, the weld sequence is initiated by pressing the digital foot pedal switch or by pressing the Trigger Weld button on the Run screen. User configured parameters of the Automatic Control weld sequence include Force, Position, Timing, Speed, and Displacement.

Select a mode and the next popup window will appear accordingly.

FORCE

The second step in the weld head setup process is entering the desired weld force (in grams). See Figure 15.1. Touch the Desired Force box and then enter the desired force using the slider bar or number pad that will appear in a pop-up window. See Figure 15.2.

The weld head will attempt to achieve this force with each weld actuation. An upper and lower limit can be set to trigger an alert if the force lies outside the set limits for any reason. Allowed forces range from 30g to 2000g with a 100% duty cycle, and 2001g to 4000g with a 10% duty cycle.

Force Calibration

The weld head's force needs to be calibrated every time a new desired force is set. Ensure the parts to be welded are in place before performing this step.

In **Direct Control**, calibration occurs immediately after setting the desired force. The analog foot pedal is used to move the electrode to the part to be welded. Once the desired force is met, the servo is automatically calibrated, and setup is resumed.

In **Automatic Control**, calibration will need to be completed first. After changing the target force, the Auto Set button on the Position Screen (see Figure 16.1) can be used to calibrate the force. Once the play button is pressed, the weld head will travel to the part, set the Weld Point and Hover Point, then calibrate the force. The up/down arrows on the position screen can be

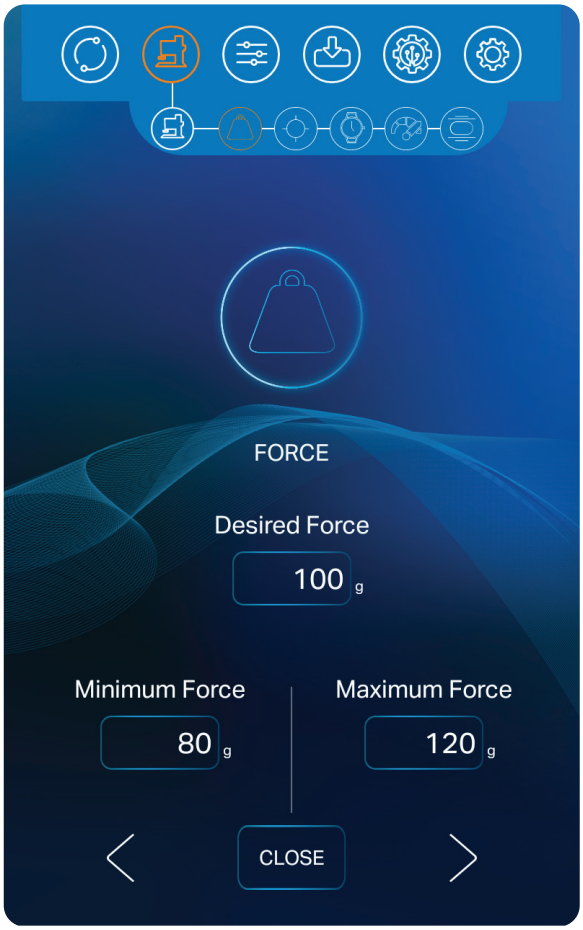


Figure 15.1. Select the desired amount of force to be delivered by the weld head in the Force Screen, the second weld head setup step.

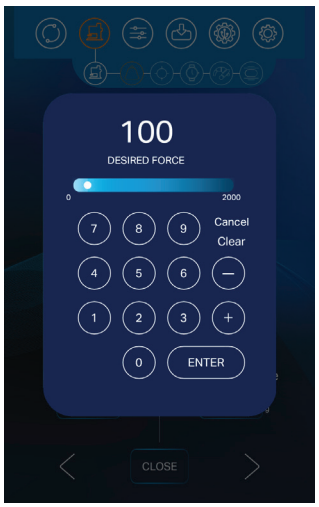


Figure 15.2. When you touch the Desired Force box a pop-up window will appear. You can use the slider bar or the number pad to enter the amount of force you desire, measured in grams.

used to move the weld head closer to the part prior to calibration.

Press the forward arrow button to advance to the next weld head setup step. You can always end the setup process by pressing the Close Button at the bottom of the screen.

POSITION

Setting the position is the third step in the setup process. In Automatic Control, there are two configurable positions: Weld Point and Hover Point.

The **Weld Point** is the position in which the weld head has contacted the part and has reached desired force.

The **Hover Point** is a position above the Weld Point to which the weld head will return after the weld process is complete.

The Hover Point value will always be smaller than the Weld Point. You cannot set a hover point that is larger than the weld point. When the Set Button (C) is pressed on either of these points, the current position of the weld head will be used for that point.

To set the position, follow these steps:

- Verify first the Pico has been calibrated for Force before continuing.
- Press the Auto Set Position Button (A). The Pico will find the Weld Point and then back off 3 mm from the Weld Point.

The current position (B) is prominently displayed and can be adjusted using the up/down buttons to the right, if needed.

Note: If you manually set the Hover Point or Weld Point, you must press the Set Button to establish those points and make them known to the Pico.

Press the forward arrow button at the bottom of the screen to advance to the next weld head setup step. You can always end the setup process by pressing the Close Button.

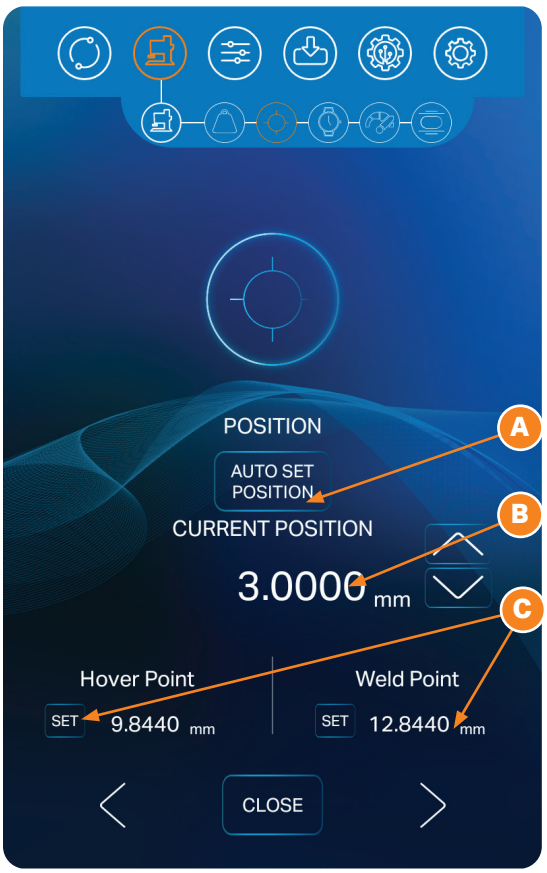


Figure 16.1. Setting the position is the third step in the setup process. Press the Auto Set Position Button A) to automatically set the Hover Point and Weld Point. You can manually adjust these points by pressing Hover or Weld Point Set Buttons (C).. Be sure to touch the Set Buttons once the desired position is achieved to establish the points.

TIMING

The fourth step in setting up the weld head is to set the desired Squeeze Time and Hold Time. These optional delay times can set up to 2000 ms.

Squeeze Time

Once the weld head reaches the weld point, it will wait the allotted time before initiating the weld discharge. This extra time can be useful to verify correct positioning.

To set the Squeeze Time, press the Squeeze Time box. A pop-up window will appear. Enter the desired time in milliseconds by using the slider bar or by entering the number using the number pad. Press the Enter Button to close the box.

Hold Time

Once the weld discharge is complete, the servo will maintain position for the allotted time before returning to hover point. This can help give the weld spot time to cool before removing pressure if necessary.

To set the Hold Time, press the Hold Time box. A pop-up window will appear. Enter the desired time in milliseconds by using the slider bar or by entering the number using the number pad. Press the Enter Button to close the box.

Once the desired Squeeze Time and Hold Time has been entered, choose the right arrow button at the bottom of the screen to continue. To end the setup process, press the Close Button.

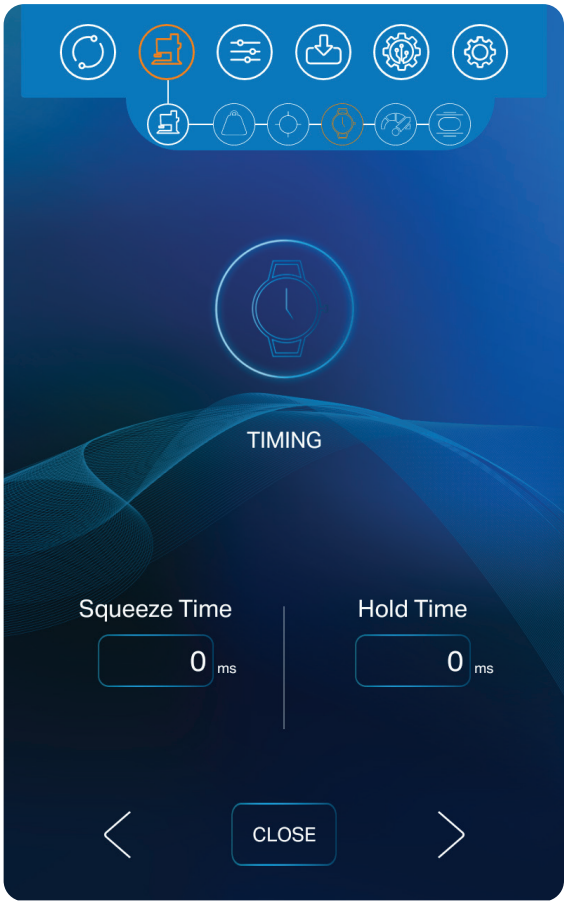


Figure 17.1. The fourth step in setting up the weld head is to set the desired Squeeze Time and Hold Time in the Timing Screen.

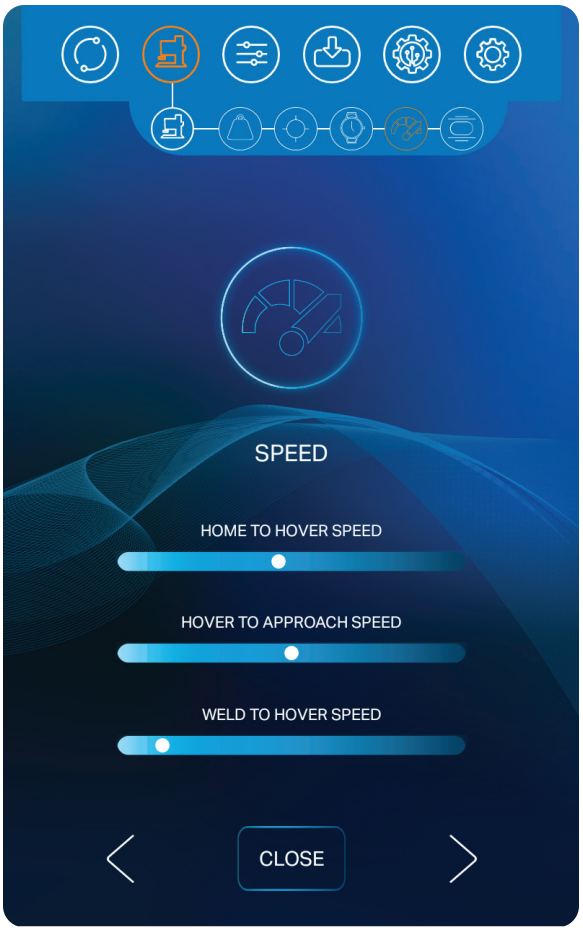


Figure 18.1. The fifth step in setting up the weld head is to set desired travel speeds, which can be individually set for transitions between three different points during the weld via three different sliders. Speeds can be set within the range of 1 to 100%.

SPEED

The fifth step in setting up the weld head is to set desired travel speeds, which can be individually set for transitions between three different points during the weld via three different sliders. Speeds can be set within the range of 1 to 100%.

Set the Total Distance Speed. Use the slider bar to set the travel speed between Home Point and the Hover Point.

Set the Hover to Approach Speed. Use the slider bar to set the travel speed between the Hover Point and the Approach Point.

Set the Weld to Hover Speed. Use the slider bar to set the travel speed between the Weld Point and the Hover Point.

Once the desired speeds have been entered, choose the right arrow button at the bottom of the screen to continue. To end the setup process, press the Close Button. To return to a previous screen, press the back arrow button on the left side of the screen.

DISPLACEMENT

The sixth and final step in setting up the weld head is to set a minimum and maximum value for weld displacement (the distance the electrode travels during the weld energy discharge).

If you wish to set a minimum and maximum displacement limit, touch and slide the Displacement On/Off Button to the On position. If you want the Pico to ignore displacement, touch and slide the Displacement On/Off Button to the Off Position.

To set displacement limits, touch the Minimum or Maximum Displacement box. A pop-up box will appear. Use the slider bar or the number pad to set the displacement limit. Press the Close Button to enter the limit.

When you choose to have the Pico monitor displacement, you will be notified If the actual weld displacement exceeds the values you set here.

Once the desired displacement limits have been entered, choose the right arrow button at the bottom of the screen to end the weld head setup process. The Run Screen will appear when the weld head setup process is completed. To return to a previous step within the weld head setup process, press the back arrow button on the left side of the screen or press any of the icons in the weld head setup navigation bar.

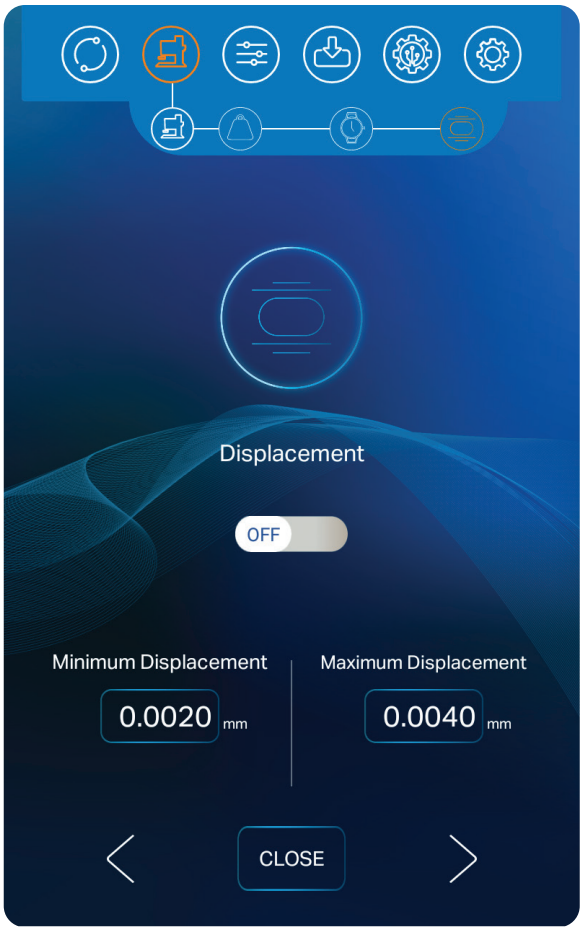


Figure 19.1. The sixth and final step in setting up the weld head is to set a minimum and maximum value for weld displacement

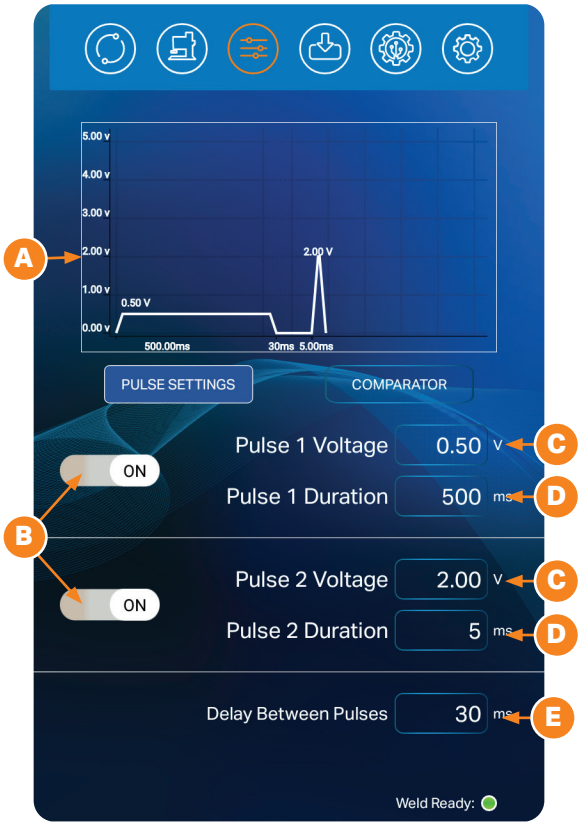


Figure 20.1. The Weld Settings Screen is used to set the desired voltage and duration of the weld discharge. The Pico can be configured to release two independently set pulses of weld energy with customizable pre-weld delay and delay between pulses. Press the Voltage and Duration boxes to change values.

Weld Settings Screen Operation

The Weld Settings Screen is used to set the desired voltage and duration of the weld discharge. The Pico can be configured to release two independently set pulses of weld energy with customizable pre-weld delay and delay between pulses.

Pulse settings dictate the amount of energy that will be released during each weld. As voltage and length increase, weld heat will increase.

WAVEFORM GRAPH (A)

A graph (A) at the top of the Weld Control Screen displays a visual representation of the expected waveform based on the weld settings and parameters you choose here. Weld voltage is displayed on the Y axis and weld discharge length (time) is displayed on the X axis.

TURN PULSES ON OR OFF (B)

A total of two weld pulses can be enabled/disabled. Using multiple pulses can increase weld quality. With both pulses enabled, the Pico will discharge two separate times with each weld trigger/initiation. The first pulse is useful to remove surface inconsistencies and contaminants which helps to displace oils, break through oxide layers, and seat the welding electrodes. The second pulse is used to fuse the metals.

To set pulse parameters, first toggle the button (B) to ON to enable the pulse, or OFF to disable the pulse for Pulse 1 or Pulse 2. If both pulses are disabled, no weld will occur and an alert will display if a weld is triggered.

SET VOLTAGE (C)

The voltage of each pulse can be adjusted from 0.1 V to 5 V. To adjust voltage, touch the Voltage box (C) of the desired pulse. A pop-up box will appear. Use the slider bar or the number pad to set the displacement limit; or incrementally adjust the value using the arrow buttons. Press the Close Button to enter the limit.

Pulse 1 voltage is generally less than Pulse 2 voltage. To help determine ideal Pulse 1 settings, turn off Pulse 2 and do a series of test welds starting at a low voltage setting. Increase the voltage about 3% each test until the welded parts barely stick together. If using thermocompression electrodes, check to see that the voltage was high enough to melt the coating of the magnet wire.

Pulse 2 Voltage will usually be set higher than Pulse 1 Voltage. Increase the Voltage incrementally until desired weld strength is achieved.

Note: If using thermocompression electrodes, always start with a low setting and work up until desired results are achieved. Setting the voltages too high at first can damage the tip.

SET PULSE DURATION (D)

The duration of each pulse can be adjusted from 0 to 500ms. Press the Length "SET" button of the desired pulse duration (D) and use the keypad to enter a value; or incrementally adjust the value using the arrow buttons.

Setting the length of the weld discharge can help fine tune weld results, especially when using thermocompression electrodes.

It is recommended to start with shorter lengths and work up with each weld test until desired results are achieved.

SET DELAY BETWEEN PULSES (E)

A delay can be set to control the amount of time between the end of Pulse 1 and the beginning of Pulse 2. The duration of a delay can be adjusted from 0 to 1000 ms. Delays are represented on the waveform display as a gap between the peaks. The delay will only be available when both pulses are enabled.

To set a delay, press the Delay box (C). A pop-up box will appear. Use the slider bar or the number pad to set the delay; or incrementally adjust the value using the arrow buttons. Press the Close Button to enter the delay.

ADDITIONAL WELD ENERGY NOTES

For new applications, a test weld should be performed, and the resulting weld should be evaluated for strength. A pull tester can be utilized for most accurate strength results, but visual examination can be useful as well.

The Pico welder allows users to fine tune the energy and length settings to dial in the ideal weld strength.

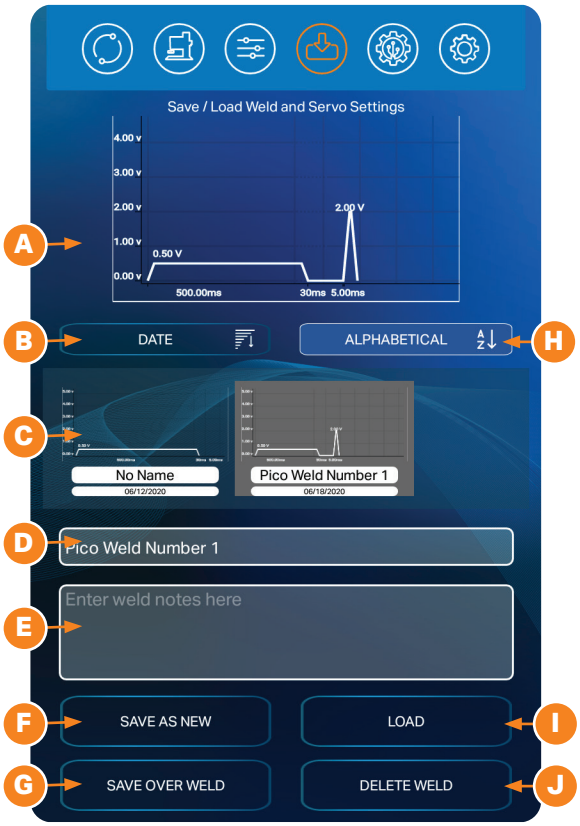


Figure 22.1. The Save/Load screen allows you to save and load weld schedules, which are a collection of all settings for a particular weld. Being able to save a schedule decreases time spent re-entering preferred settings for a particular weld.

Save/Load Screen Operation

The Save/Load screen allows you to save and load weld schedules. See Figure 22.1. A weld schedule is the collection of all settings for a particular weld, such as energy levels, delays, number of pulses, etc. Being able to save a schedule decreases time spent re-entering preferred settings for a particular weld. The save and load options are displayed on the same screen at the same time.

The top portion of the screen displays the waveform of the current pulse settings (A); or, if the operator taps on or highlights a previously saved schedule, the selected settings of the previously saved schedule will be displayed as a waveform.

You can choose to list the saved schedules by date or in alphabetical order by pressing the Date Button (B) or Alphabetical Button (H) found under the waveform graph (A).

The center of the screen displays any previously saved schedules (C). You can scroll through the list by swiping left or right.

To save a new schedule:

- Type the desired name in the Enter Weld Name Here box (D).
- Enter custom notes in the Enter Notes on Weld Here box (E).
- Press the Save as New Button (F) to save the schedule. The schedule will now be added and displayed in the list of saved schedules (C).

If you attempt to save a new schedule with the same name as a previously saved schedule, a message will pop up to notify the operator that a "1" was attached to the end of the name before being saved. If this occurs, tap the Okay button. To edit the name, select the newly saved schedule (with the "1" at the end), change the name, and tap the Save Over Selected Weld button (G).

To save over an existing weld:

- Tap on the previously saved schedule.

- Edit the name and or notes.
- Press the Save Over Selected Weld Button (G).
- A message will pop up on the screen asking for confirmation before allowing the weld to be edited and saved.

To load an existing weld schedule:

- Tap on a previously saved schedule, so the scheduled is highlighted.
- Press the Load button (I). The weld schedule is now loaded and ready to be used.

To delete an existing weld schedule:

- Select the schedule you wish to delete by tapping on a previously saved schedule, which will highlight the schedule.
- Press the Delete Selected Weld Button (J).
- A message will pop up on the screen asking for confirmation before deleting the weld schedule.

Communications Screen Operation

Select the Communications Screen icon in the Navigation Bar to access the Pico's automation features. The Communications Screen has three sub sections: The PLC tab, the Alarms tab, and the Import/Export tab, as shown in Figure 23.1.

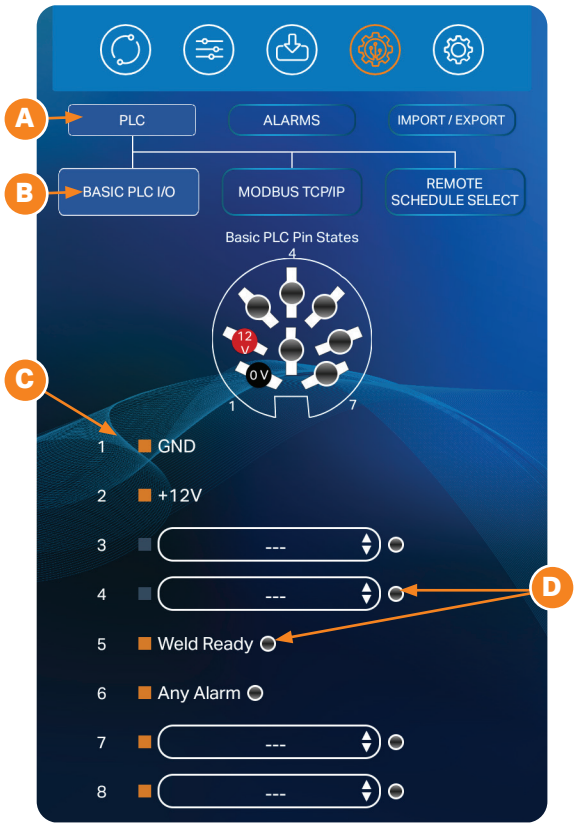


Figure 23.1. Select the Communications Screen icon in the Navigation Bar to access the Pico's automation features. The Communications Screen has three sub sections: The PLC tab, the Alarms tab, and the Import/Export tab.

PLC (A)

Under the PLC Tab (A) you'll review pin states for the 8DIN connector on the back of the Pico and also program up to four schedules. Each of these features are access via two sub-tabs: Basic PLC I/O and Remote Schedule Select.

Basic PLC I/0 (B)

The Basic PLC I/O tab (B) shows the pin states for the 8DIN connector on the back of the power supply (labeled PLC). Some pins are hard-coded (pins 1, 2, 5, and 6), while others have a drop-down list of options from

which operators can choose (pins 3, 4, 7, and 8). The pins are labeled 1-8 and each has a color coded box (C). Blue boxes indicate the pin is used for inputs, while orange boxes indicate outputs. Some pins have a color coded circle (D) on the right side. Green circles indicate the pin is "High" and black circles indicate the pin is "Low". The circles match the circles see in the diagram in Figure 23.1.

Pin Functions

- Pin 1 is hard coded as the ground signal.
- Pin 2 is hard coded as a +12V signal.
- Pin 3 and Pin 4 can each be configured to one of the following INPUT options:
    - Trigger
    - Reset Weld Count
    - Lockout
    - Remote Schedule Select.

Note: If remote schedule select is chosen, both Pin 3 and Pin 4 will be used.

- Pin 5 is hard coded as the Weld Ready Signal
- Pin 6 is hard coded as the Any Alarm Signal
- Pin 7 and Pin 8 can each be configured to one of the following OUTPUT options:

    - Weld Good
    - Weld No Good
    - Any Warning
    - Emergency Stop
    - Displacement Out of Bounds
    - Weld Head Error
    - Alarm: Temperature
    - Alarm: Comparator Failures in a Row
    - Alarm: Weld Counter Preset Limit
    - Alarm: Invalid Remote Schedule Selection
    - Alarm: Trigger in No Weld State
    - Alarm: Wrong Trigger Detected
    - Alarm: Displacement failures in a row
    - Warning: Temperature
    - Warning: Comparator Failures in a Row
    - Warning: Displacement failures in a row
    - Warning: Weld Counter Preset Limit

For More information on pin-out and connections, see Appendix B.

Remote Schedule Select

The Remote Schedule Select feature allows you to program up to 128 pre-saved schedules, recall them, and switch between them via the built in PLC capabilities. To do so, press the Remote Schedule Select Button (A), as seen in Figure 25.1.

Next, toggle the Remote Schedule Select Enabled Switch (B) to the basic position.

Enabling the Remote Schedule Select feature will automatically change Pin3 and Pin4 on the Basic PLC I/O tab to use the remote schedule select. If the Remote Schedule Select button is later disabled, the pins will return to an unassigned state.

Next, Program the first four drop-down menus (C) to the desired pre-saved schedule, as seen in Figure 25.1.

To select pre-saved schedules:

- Click on the drop-down menus and select the desired saved schedule. You can choose four different schedules that are selectable through the two PLC input pins on the 8DIN PLC connector on the back panel:
    - Schedule 0 - Pin3 High(0) and Pin4 High(0)
    - Schedule 1 - Pin3 High(0) and Pin4 Low(1)
    - Schedule 2 - Pin3 Low(1) and Pin4 High(0)
    - Schedule 3 - Pin3 Low(1) and Pin4 Low(1)
- The selected schedules will be passed in using a bit mapping. Keep in mind that the inputs are reverse logic, so a low will actually be a “1” and a high will be a “0”.

To disable the remote schedule, toggle the Remote Schedule Select Enabled Switch to the Off position.

When in Advanced Mode, all 128 schedules can be loaded via Modbus. See Appendix C.

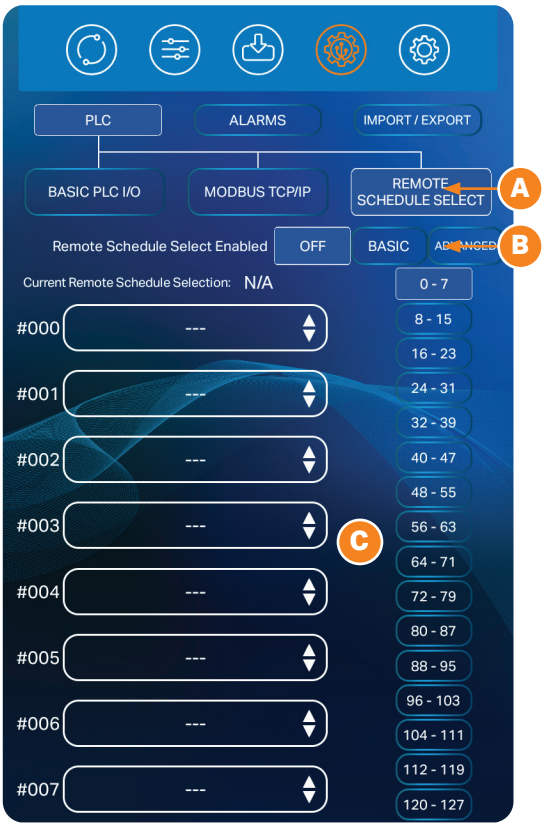


Figure 25.1. Select the Communications Screen icon in the Navigation Bar to access the Pico’s automation features. The Communications Screen has three sub sections: The PLC tab, the Alarms tab, and the Import/Export tab.

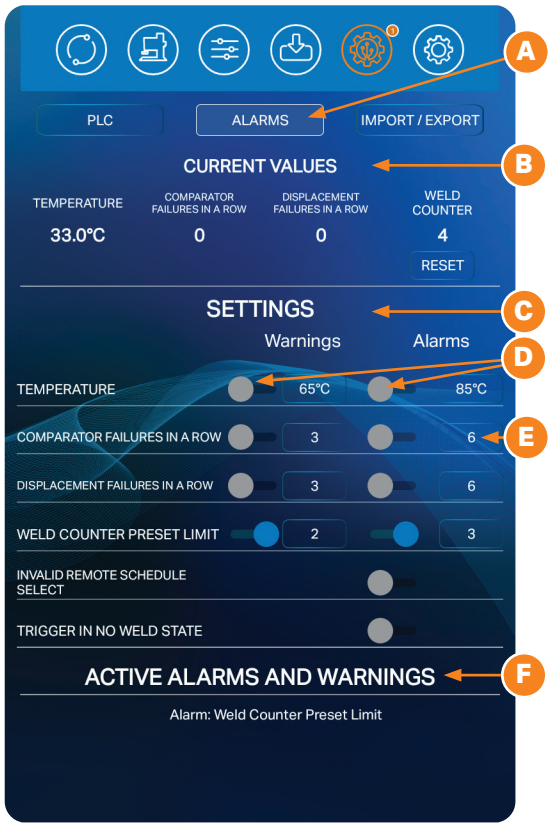


Figure 26.1. The Pico alarms control panel will display certain power supply statuses, active warnings, active alarms, and other alarm-related settings.

ALARMS

To access the Pico alarms control panel, press the Alarms Button (A) in the Communications Screen, as shown in Figure 26.1. The Alarms control panel will display certain power supply statuses, active warnings, active alarms, and other alarm-related settings.

The top portion of the screen displays Current Values (B) for temperature, comparator failures in a row, displacement failures in a row and weld count. The weld count can be reset by pressing the Reset Button below the displayed weld count number.

The Settings portion of the screen (C) can be used to enable or disable the listed alarms and set limits for certain alarms/warnings.

The switch (D) next to each parameter toggles to blue to enable, gray to disable.

The following alarm is enabled by default:

- Trigger in No Weld State

The bottom portion of the screen will show a list of active alarms and warnings (F). If there are more active alarms and warning than can be displayed at one time, you'll be able to scroll up and down to see all the different warnings and alarms.

To set and activate a warning or alarm:

- Find the setting for which you wish to set a warning or alarm.
- Press the round switch (D) or warning or alarm next to the setting. The switch will be gray if the warning or alarm is already off; blue if the warning or alarm is already on.
- Enter a warning or alarm value. Touch the box (E) in the Warnings or Alarms column on the same row for the setting you wish to activate. A pop-up box will appear: Enter the desired value. Whenever that value is reached during operation, a warning or alarm message will appear.

Note: If a warning and its corresponding alarm are both enabled and active, then only the alarm will be displayed. Warnings are active until the corresponding alarm is also active.

Active warnings and alarms can be cleared and reset by toggling the switch next to the alarm or by using the PLC inputs (Pin 3 or Pin 4).

IMPORTING/EXPORTING WELD SETTINGS

The Pico allows you to import or export weld schedules. In the Communications Screen, press the Import/Export Tab (A) to get started. The Import/Export control panel contains six weld schedule features to help you manage this helpful feature. See Figure. 27.1.

Export History (B)
Press the Export History Button (B) to export the past weld results history to a USB drive. The exported CSV file will include all weld parameters and comparator values. Make sure a USB drive is attached to the USB port found on the Pico's left panel. (See Appendix A)

Clear Weld History (C)
Press the Clear Weld History Button (C) to clear the past weld results history.

Export Clone Settings (D)
The Export Clone Setting feature saves all the welder settings, including all saved schedules, to a USB drive. This feature is beneficial for operators who need to implement multiple identically configured welders. After you've exported a cloned file, remove the USB drive, insert the USB drive into another Pico welder, and use the Clone Import feature to upload the saved schedules and clone the new welder. (See Appendix A)

Import Clone Settings (E)
The Import Clone Settings feature uploads the exported welder settings and schedules from a USB drive and saves them onto another welder. (See Appendix A)

Export Saved Welds (F)
The Export Saved Welds features copies all the saved weld schedules to a USB drive. Unlike cloning, the Export Welds feature does not copy system settings from one welder to another, only weld schedules. (See Appendix A)

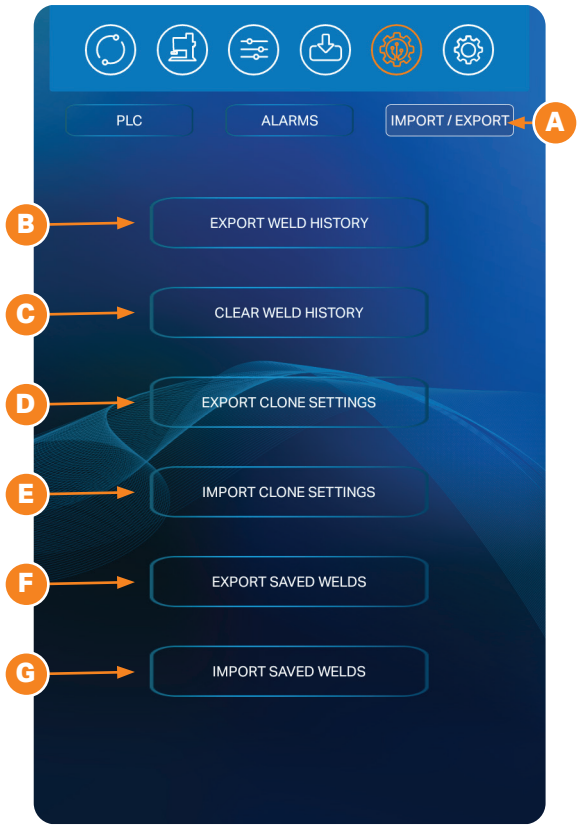


Figure 27.1. The Pico alarms control panel will display certain power supply statuses, active warnings, active alarms, and other alarm-related settings.

Import Saved Welds (G)
After you've exported saved weld schedules using the Export Welds feature, use the Import Welds feature to import the files from a USB drive to the welder. (See Appendix A)

Settings Screen Operation

Use the Settings Screen to make changes to the Pico's general system settings, such as language, defaults, Wi-Fi, and locks. To make changes to the welder's general settings, press the Settins Screen Button (K) in the Navigation Bar. The Settings Screen will appear (see Figure 28.1).

Figure 28.1. Use the Settings Screen to make changes to the Pico's general system settings, such as language, defaults, Wi-Fi, and locks.

INTERFACE PANEL

Tap the Interface Button (H) to choose the desired language, speaker volume, and system date and time.

To change the language:

- Touch the Language box (I). A list of available languages will appear.
- Press the desired language. The Pico's software will now use the selected language.

To Set the Date and Time:

- Press the Set Button (J) under the current displayed system date and time.
- A pop-up box will open with place to change the time and a calendar for choosing the time. Scroll the time and calendars to find the desired times and dates.
- When time and date are selected the Pico will now use the new time and date.

LOCK OUT PANEL (A)

With the Pico you can prevent other operators from making changes to welder settings. See Figure 29.1. To access these features, press the Lock Out Button (A).

Lock

The Lock feature blocks the operator from making changes to the welder settings, with the exception that operators can load previously saved weld schedules. The Lock option is best when operators need to weld with different schedules throughout the shift but are not allowed to make changes to the settings within the schedules.

The current lock state is displayed on this screen below the blue button. If the lock option is turned off, the welder will display that it is "Unlocked" (C).

How to Lock the Welder

- Press the Toggle Lock Mode Button (B). See Figure 29.1
- A popup message will appear and will show the different lock options.
- Tap on the desired option and follow the screen prompts. The options include: Limited Lockout, Change Pin, and Cancel.
- The Pico will ask for a PIN (Personal Identification Number) when Lock or Change PIN is selected. The PIN must be a 4 digit number. To bring up the number pad, tap on the white space or the "Enter PIN Here" text.
- Next, enter a PIN and select "Okay".
- Press the Cancel button to go back to the lock screen.

If the Lockout mode is enabled and an operator tries to make changes a weld schedule, a popup message will appear. Operators can dismiss the message or navigate directly to the lock screen where the PIN can be input to unlock the welder.

If a PIN is forgotten, call Sunstone Customer Service at +1 801-658-0015 for assistance.

Figure 29.1. With the Pico you can prevent other operators from either making changes to welder settings.

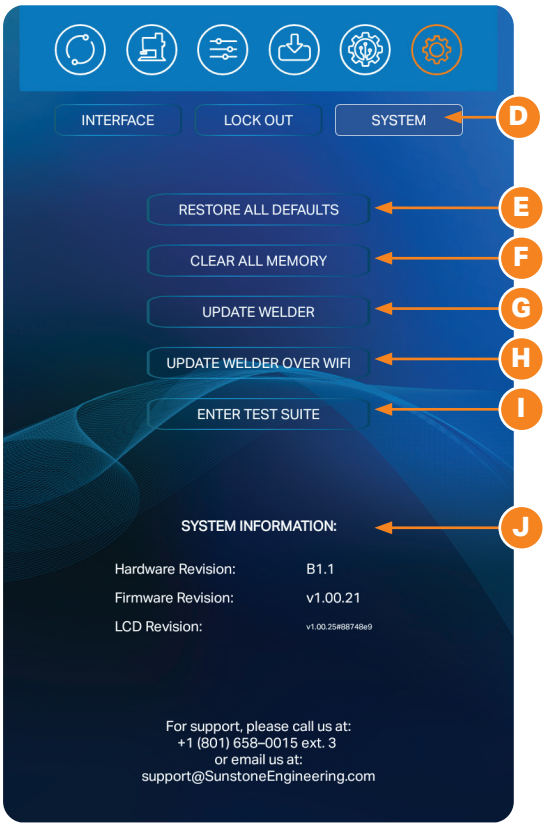


Figure 30.1. Use the features on the System Panel to manage welder memory, update the welder's software, or enter the Test Suite.

SYSTEM PANEL (D)

Tap the System Button to access the following tools (as shown in Figure 30.1):

Restore All Defaults (E)

Press the Restore All Defaults Button (E) to set all welder settings to factory default status.

Clear All Memory (F)

Press the Clear All Memory Button (F) to erase all memory including saved schedules and weld history.

Update Welder (G)

To update the Pico's software using a USB drive, press the Update Welder Button (G) and follow the instructions that appear on the screen or see instructions below.

Update Welder Over Wi-Fi (H)

To update the Pico's software over a Wi-Fi connection, press the Update Welder Over Wi-Fi Button (H) and follow the instructions that appear on the screen. See detailed instructions below.

Note: The Pico must be connected to a Wi-Fi connection with Internet access. A popup message will appear with prompts and inputs to connect to Wi-Fi.

Enter Test Suite (I)

The Test Suite is helpful for diagnostics and technical support and can only be accessed with a password. Contact Sunstone Support if this password is needed.

System Information (J)

System Information (J) is displayed at the bottom of the Settings Screen.

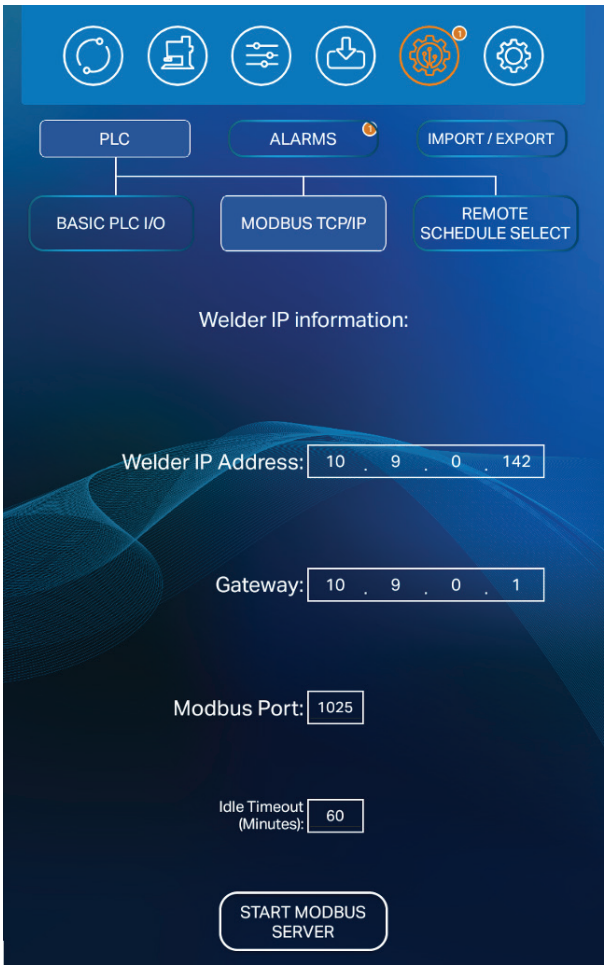


Figure 34.1. Modbus UI Screen.

Modbus UI Screen

The Sunstone PICO2 welder can be connected to and controlled by a computer using an Ethernet connection. A Sunstone weld head connected to the welder can also be controlled by this connection. Follow the instructions below to setup and configure the Ethernet connection. Additional Ethernet information, specific to the Modbus messaging software, can be found in Appendix C.

Setup and Configuration

1. Power on the CDDP-A welder.
2. Touch the Communications Button in the Navigation Bar to open the Communication Screen.
3. Select the PLC tab and then select the Modbus TCP/IP sub tab. See Figure 34.1.
4. Enter 1025 as the default modbus port number
5. Enter the Idle Timeout value, in minutes. The Idle Timeout is the amount of time that elapses after a connection has been lost and before the Modbus will close the connection, typically one minute.
6. Once the above settings have been entered, press the Submit Modbus Settings button to submit and save all settings. At this point the CDDPA is ready to connect and communicate through the Ethernet/ IP connection.
7. Plug the CDDPA Ethernet port into the network using a Cat5e/Cat6 cable.

Appendix B: Pinout Details

The following information details the Pico's DIN connections, displayed here as if viewed from the pack panel. Refer to Appendix B for pinout configurations.

PLC

The PLC port (see Figure 57.1) mates to SD-80LP, used to connect PLC for basic functions, such as the following:

1 GND/Shield

2 +12V Current Limited

3 PLC Input 1. Short this pin with Pin1/GND to trigger an action.

4 PLC Input 2. Short this pin with Pin1/GND to trigger an action.

5 Weld Ready. Pull this pin up to +12V by connecting it with Pin 2/+12V. Signal will go low 0V, when weld is ready.

6 Alarm. Pull this pin up to +12V by connecting it with Pin 2/+12V. Signal will go low 0V, when alarm has occurred.

7 PLC Output 1. Pull this pin up to +12V by connecting it with Pin 2/+12V. Signal will go low 0V, when this output has been enabled.

8 PLC Output 2. Pull this pin up to +12V by connecting it with Pin 2/+12V. Signal will go low 0V, when this output has been enabled.

Figure 57.1. PLC pinout diagram.

E-Stop

The E-Stop port (see Figure 57.2) mates to SD-60 LP, used to connect an E-stop Switch or bypass.

1 GND/Shield

2 & 3 Normally open; ESTOP enabled. Close circuit to disable ESTOP.

4-6 Not Used

Figure 57.2. E-Stop pinout diagram.

Figure 58.1. WH Control pinout diagram.

Figure 58.2. Primary Trigger pinout diagram.

Figure 58.3. Secondary Trigger pinout diagram.

WH Control

The WH Control port (see Figure 58.1) mates to SD-40LP. At time of publication, this port is not configured; could be used to control pneumatic head with future upgrade.

1 GND/Shield

2 Weld Head Actuation 1. +12VDC(0.5A Max) is sent when weld head needs to actuate.

3 Weld Head Actuation 2. +12VDC(0.5A Max) is sent when weld head needs to actuate.

4 GND/Shield

Primary Trigger

The Primary Trigger port (see Figure 58.2) mates to SD-50LP, connects to analog foot pedal.

1 Variable Foot Pedal. Connect this to Pin5/+-12VDC with a 10Kohm potentiometer.

2 Primary Trigger. Connect this pin3/GND when trigger is desired.

3 GND/Shield

4 Secondary Trigger. Connect this pin3/GND when trigger is desired.

5 +12VDC limited

6 Not Used

Secondary Trigger

The Secondary Trigger port (see Figure 58.3) mates to SD-30LP, connects to normal foot pedal

1 Not Connected

2 Primary Trigger. Connect this pin3/GND when trigger is desired.

3 GND/Shield

Appendix C: Modbus Documentation

Supported Function Codes

Function Code (dec)	Function Code (hex)	Name	Read/Write
1	0x01	Read Coils	
2	0x02	Read Discrete Inputs	
3	0x03	Read Holding Registers	
4	0x04	Read Input Registers	
5	0x05	Write Single Coil	
6	0x06	Write Single Register	
15	0x0F	Write Multiple Coils	
16	0x10	Write Multiple Registers	
20	0x14	Read File Record	
22	0x16	Mask Write Register	
23	0x17	Read/Write Multiple Registers	

Data Structures

Data Structures	Size	Count	Type
Coil	1-Bit	25	R/W
Discrete Input	1-Bit	17	R
Holding Register	16-Bit	47	R/W
Input Register	16-Bit	59	R

Coils

Index (dec)	Index (hex)	Coil
0	0x0000	Pulse 1 Power Comparator Enable
1	0x0001	Pulse 2 Power Comparator Enable
2	0x0002	Pulse 1 Current Comparator Enable
3	0x0003	Pulse 2 Current Comparator Enable
4	0x0004	Pulse 1 Voltage Comparator Enable
5	0x0005	Pulse 2 Voltage Comparator Enable
6	0x0006	Pulse 1 Enable
7	0x0007	Pulse 2 Enable
8	0x0008	Comparator Action after Pulse 1
9	0x0009	Alarm - Temperature Enable
10	0x000A	Alarm - Comparator Enable
11	0x000B	Alarm - Displacement Enabled
12	0x000C	Alarm - Weld Counter Enable
13	0x000D	Alarm - Trigger Enable
14	0x000E	Alarm - Invalid Selection Enable
15	0x000F	Warning - Temperature Enable
16	0x0010	Warning - Comparator Enable
17	0x0011	Warning - Displacement Enable
18	0x0012	Warning - Weld Counter Enable
19	0x0013	Weld Triggered (write only)
20	0x0014	Modbus E-Stop (write only)
21	0x0015	Weld Head Displacement Enable
22	0x0016	Auto Set Position (write only)
23	0x0017	Hover Point Set (write only)
24	0x0018	Weld Point Set (write only)

Discrete Inputs

Index	Discrete Input	Note
0	PLC Pin 3 - State	Active Low
1	PLC Pin 4 - State	Active Low
2	PLC Pin 5 - State	Active Low
3	PLC Pin 6 - State	Active Low
4	PLC Pin 7 - State	Active Low
5	PLC Pin 8 - State	Active Low
6	Alarm - Temperature State	
7	Alarm - Comparator Failures in a Row State	

8	Alarm – Displacement Failures in a Row State	
9	Alarm - Weld Counter Preset Limit State	
10	Alarm - Remote Schedule Selection Invalid State	
11	Alarm - Trigger in no Weld State State	
12	Warning - Comparator Failures in a Row State	
13	Warning - Temperature State	
14	Warning - Weld Counter Preset Limit State	
15	Warning – Displacement Failures in a Row State	
16	E-Stop State	

Holding Registers

Index	Holding Register	Length	Minimum	Maximum	Note
0	Remote Schedule Select Mode	1	See Table	See Table	
1	Pulse 1 Power Comparator Limit Upper	2	0x0000	0x00013880	daW
3	Pulse 1 Power Comparator Limit Lower	2	0x0000	0x00013880	daW
5	Pulse 2 Power Comparator Limit Upper	2	0x0000	0x00013880	daW
7	Pulse 2 Power Comparator Limit Lower	2	0x0000	0x00013880	daW
9	Pulse 1 Current Comparator Limit Upper	1	0x0000	0xC350	A
10	Pulse 1 Current Comparator Limit Lower	1	0x0000	0xC350	A
11	Pulse 2 Current Comparator Limit Upper	1	0x0000	0xC350	A
12	Pulse 2 Current Comparator Limit Lower	1	0x0000	0xC350	A
13	Pulse 1 Voltage Comparator Limit Upper	1	0x0032	0x01F4	mV
14	Pulse 1 Voltage Comparator Limit Lower	1	0x0000	0x0032	mV
15	Pulse 2 Voltage Comparator Limit Upper	1	0x00C8	0x01F4	mV
16	Pulse 2 Voltage Comparator Limit Lower	1	0x0000	0x00C8	mV
17	Weld Head Settings Squeeze Delay	1	0x0000	0x07D0	ms
18	Weld Head Settings Hold Delay	1	0x0000	0x07D0	ms
19	Pulse 1 Voltage	1	0x000A	0x01F4	mV
20	Pulse 2 Voltage	1	0x000A	0x01F4	mV
21	Pulse 1 Duration	1	0x0001	0x01F4	ms
22	Pulse 2 Duration	1	0x0001	0x01F4	ms
23	Delay Between Pulses	1	0x0000	0x03E8	ms
24	Weld Head Control Type	1	*See Table*	*See Table*	ms
25	Alarm Temperature Value	1	0x0000	0x0064	C
26	Alarm Comparator Value	1	0x0001	0x0019	
27	Alarm Weld Counter Value	1	0x0001	0x4E20	
28	Alarm Displacement Value	1	0x0001	0x0019	
29	Warning Temperature Value	1	0x0000	0x0064	C
30	Warning Comparator Value	1	0x0001	0x0019	

31	Warning Displacement Value	1	0x0001	0x0019	
32	Warning Weld Counter Value	1	0x0001	0x4E20	
33	PLC Pin 3 - Assignment	1	See Table	See Table	PLC Input
34	PLC Pin 4 - Assignment	1	*See Table*	*See Table*	PLC Input
35	PLC Pin 7 - Assignment	1	*See Table*	*See Table*	PLC Output
36	PLC Pin 8 - Assignment	1	*See Table*	*See Table*	PLC Output
37	Current Remote Schedule Selection	1	0x0000	0x007F	When no selection is wanted, set to 0x00FF
38	Desired Force	1	0x0000	0x07D0	
39	Minimum Force	1	0x0000	0x07BC	
40	Maximum Force	1	0x0014	0x07D0	
41	Minimum Displacement	1	0x0000	0x2710	
42	Maximum Displacement	1	0x0000	0x2710	
43	Home to Hover Speed	1	0x0001	0x0064	
44	Hover to Approach Speed	1	0x0001	0x0064	
45	Weld to Hover Speed	1	0x0001	0x0064	
46	Part Check Allowance	1	See Table	See Table	

Remote Schedule Select Mode

Remote Schedule Select Mode	Value
Disabled	0x0000
Basic	0x0001
Ethernet	0x0002

Weld Head Control Type

Weld Head Control Type	Value
None	0x0000
Automatic Control	0x0001
Direct Control	0x0002

PLC Output Pin Assignment

PLC Output Pin Assignment	Value
Unassigned	0x0000
Weld Good	0x0001
Weld Not Good	0x0002
Any Warning	0x0003
Emergency Stop	0x0004
Displacement Out of Bounds	0x0005

Error – Weld Head	0x0006
Alarm - Temperature	0x0007
Alarm - Comparator Failures in a Row	0x0008
Alarm - Weld Counter Preset Limit	0x0009
Alarm - Remote Schedule Selection Invalid	0x000A
Alarm - Trigger in no Weld State	0x000B
Alarm - Wrong Trigger Detected	0x000C
Alarm – Displacement Failures in a Row	0x000D
Warning - Temperature	0x000E
Warning - Comparator Failures in a Row	0x000F
Warning – Displacement Failures in a Row	0x0010
Warning - Weld Counter Preset Limit	0x0011

PLC Input Pin Assignment

PLC Input Pin Assignment	Value
Unassigned	0x0000
Primary Trigger	0x0001
Reset Weld Count	0x0002
Lock Out	0x0003
Remote Schedule Select	0x0004

Part Check Allowance

Park Check Allowance	Value
100 µm	0x0000
200 µm	0x0001
300 µm	0x0002
400 µm	0x0003
500 µm	0x0004
1 mm	0x0005
2 mm	0x0006
3 mm	0x0007
4 mm	0x0008
5 mm	0x0009

Input Registers

Index	Input Register	Length	Notes
0	PLC Pin 5 - Assignment	1	PLC Output
1	PLC Pin 6 - Assignment	1	PLC Output
2	Foot Pedal Analog	1	
3	Charge Temperature	1	C
4	Weld Temperature	1	C
5	Bleed Temperature	1	C
6	Previous Weld Peak Voltage P1	1	mV
7	Previous Weld Peak Voltage P2	1	mV
8	Previous Weld Peak Current P1	1	A
9	Previous Weld Peak Current P2	1	A
10	Previous Weld Peak Power P1	1	daW
11	Previous Weld Peak Power P2	1	daW
12	Previous Weld Average Voltage P1	1	mV
13	Previous Weld Average Voltage P2	1	mV
14	Previous Weld Average Current P1	1	A
15	Previous Weld Average Current P2	1	A
16	Previous Weld Average Power P1	1	daW
17	Previous Weld Average Power P2	1	daW
18	Previous Weld Trough Voltage P1	1	mV
19	Previous Weld Trough Voltage P2	1	mV
20	Previous Weld Trough Current P1	1	A
21	Previous Weld Trough Current P2	1	A
22	Previous Weld Trough Power P1	1	daW
23	Previous Weld Trough Power P2	1	daW
24	Previous Weld Comparator Result	1	
25	Previous Weld Comparator Result Power P1	1	
26	Previous Weld Comparator Result Power P2	1	
27	Previous Weld Comparator Result Voltage P1	1	
28	Previous Weld Comparator Result Voltage P2	1	
29	Previous Weld Comparator Result Current P1	1	
30	Previous Weld Comparator Result Current P2	1	
31	MAC[0]	1	
32	MAC[1]	1	
33	MAC[2]	1	
34	MAC[3]	1	
35	MAC[4]	1	
36	MAC[5]	1	

37	IP[0]	1	
38	IP[1]	1	
39	IP[2]	1	
40	IP[3]	1	
41	Gateway[0]	1	
42	Gateway[1]	1	
43	Gateway[2]	1	
44	Gateway[3]	1	
45	Alternative Port	1	
46	Network Timeout	1	
47	Waveform Report Total Samples	1	
48	Waveform Report P1 Samples	1	
49	Waveform Report P2 Samples	1	
50	Waveform Report Starting Voltage	1	mV
51	Waveform Report P1 Start Time	1	
52	Waveform Report P1 End Time	1	
53	Waveform Report P2 Start Time	1	
54	Waveform Report P2 End Time	1	
55	Waveform Report Total Duration	1	
56	Waveform Report P1 Duration	1	
57	Waveform Report P2 Duration	1	
58	Lock State	1	

Comparator Result

Comparator Result (hex)	Name
0x0000	Weld Good
0x0001	Weld Bad
0x0002	Weld Bad - E-Stop
0x0003	Weld Head Error

Weld Task State

Weld Task State (hex)	Name
0x0000	Undefined
0x0001	Idle
0x0002	Pre-Weld
0x0003	Weld Head On
0x0004	Squeeze Delay
0x0005	Part Check
0x0006	Weld P1
0x0007	In-between Pulses
0x0008	Weld P2
0x0009	Hold Delay
0x000A	Weld Head Off
0x000B	Error Reporting
0x000F	Finalize

Charge Task State

Charge Task State (hex)	Name
0x0000	Undefined
0x0001	Charged
0x0002	Charging
0x0003	Draining
0x0004	Drained
0x0005	Suspended

Lock State

Lock State	Name
0x0000	Unlocked
0x0001	Locked
0x0002	Lock Disabled

KEY UNIT SPECIFICATIONS	
TABLETOP FOOTPRINT (L X W X H)	22.4x48.2x30.5 cm
UNIT WEIGHT	19.6 kg
INPUT VOLTAGE (SINGLE PHASE)	90-264 VAC
FREQUENCY RANGE	47-63 Hz
power factor (typ.)	0.95/230 VAC (0.98/115 VAC at Full Load)
OUTPUT VOLTAGE RANGE	0.10-5.00 V (0.01 V Intervals)
OUTPUT CURRENT RANGE	10.0-250 A
OUTPUT POWER RANGE	1.0-650 W
WELD TIME (EACH PULSE)	1-500 ms (1 ms intervals)
SINGLE AND DUAL PULSE	YES
PULSE 1, PULSE 2 ENERGY ADJUSTMENT	0-100%
TYPICAL RISE TIME (TO MAX VOLTAGE)	10 ms