



sunstone

Sunstone Capacitive Discharge Welders **CD Dual Pulse Systems**



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Sunstone Capacitive Discharge Welders

CD Dual Pulse

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Foreword:

Thank You for Choosing Sunstone Welders and congratulations on your purchase!

You are now the proud owner of a Sunstone Capacitive Discharge (CD) Dual Pulse (DP) Welder. Sunstone CD Welders have single pulse and dual pulse resistance welding capabilities. This manual was designed to have you welding safely within minutes of unpacking your new welder. Please read and follow all safety precautions before proceeding with the welding process.

At Sunstone Engineering we are committed to producing quality products and ensuring complete owner satisfaction. If you require assistance after reading this manual please contact us with the information provided below.

Sunstone Engineering R&D Corp.
1693 American Way Suite #5
Payson, UT 84651
Email: sales@SunstoneEngineering.com
Voice: 801-658-0015
Fax: 866-701-1209

NOTE: The information contained in this manual is subject to change as improvements are made to our products. Visit www.SunstoneSpotWelders.com for the latest version of this document.

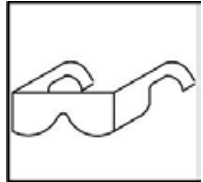


Welding Safety & Precautions

Read Before Welding

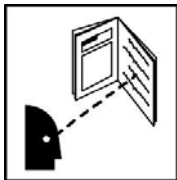
The following safety advice is generalized advice for the welding industry. These safety precautions are not all inclusive. All users should exercise caution while using this device. The following groups of symbols are warning symbols:

CAUTION ELECTRIC SHOCK HAZARD, EYE PROTECTION REQUIRED.



Consult these symbols and the related instructions listed next to the symbols for proper action when dealing with these hazards.

READ INSTRUCTIONS



- Read the owner's manual before using the welder.
- Only personnel trained and certified by the manufacturer should service the unit.
- Use only genuine replacement parts from the manufacturer.
- Never open welder to perform any maintenance operation inside the unit.

SAFETY PRECAUTIONS FOR FIRE OR EXPLOSION



There is a possibility that flying sparks, hot work pieces, and/or hot equipment can cause fires and burns. Ensure that your work area is clean and safe for welding before starting any weld job.

- Wear appropriate eye protection at all times while using the welder.
- Do not install or operate unit near combustible surfaces.
- Do not install or operate unit near flammables.
- Do not weld where flying sparks can strike flammable material.
- Remove all flammable materials from the welding area. If this is not possible, tightly cover them with approved covers.
- Protect yourself and others from flying sparks and hot metal.
- Do not weld where the atmosphere may contain flammable dust, gas, or vapors.
- Remove any combustibles, such as butane lighters or matches, from your person before doing any welding.
- Watch for fire and keep a fire extinguisher nearby.
- Do not overload your building's electrical wiring – be sure the power distribution system is properly sized, rated, and protected to handle this unit.
- Do not exceed the equipment's rated capacity.
- Use only correct fuses or circuit breakers. Do not oversize or bypass them.

SAFETY PRECAUTIONS FOR ELECTRICAL SHOCK



Sunstone capacitive dual pulse welders are equipped with universal power supplies and can be used with both 110/220V AC wall power. No voltage selection is required prior to connecting and powering on the welder. The welder

will detect the voltage, and make the appropriate adjustments automatically. Touching live electrical parts can cause fatal shocks or severe burns. The input power circuit and the internal circuits of the Sunstone welder are live when the power switch is turned on. Additionally the internal capacitors remain charged for a period of time after the welder is turned off and/or power is disconnected. Incorrectly installed or improperly grounded equipment is a hazard. Do not operate welder in a wet/damp environment.

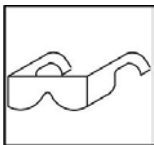
- Care should be taken not to short across the positive and negative terminals. At full power, the weld current carries thousands of amps and is dangerous if the terminals are accidentally bridged.
- All welds are performed at low voltage for increased safety of operation.
- Do not wear metal jewelry when welding. The terminals are safe to touch without fear of arcing as long as no metal is on your hands.
- When altering or maintaining any part of the welding path (such as swapping electrodes or cables), turn the unit off.
- Do not touch live electrical parts.
- Wear dry, hole-free insulating gloves and body protection.
- Properly install and ground this equipment. (refer to the grounding codes and specifications of the area you live in)
- Do not weld with wet hands or wet clothing.
- Always verify the supply ground – check and be sure that the input power cord ground wire is properly connected to a ground terminal in the disconnect box or that the input power cord plug is connected to a properly grounded receptacle outlet. Do not remove or bypass the ground prong.
- Keep cords dry, free of oil and grease, and protected from hot metal and sparks.
- Frequently inspect the input power cord and ground conductor for



damage or bare wiring – replace immediately if damaged – bare wiring can kill. Check ground conductor for continuity.

- Turn off all equipment when not in use.
- Use only well-maintained equipment and repair or replace damaged parts at once.

PERSONAL PROTECTIVE EQUIPMENT RECOMMENDATIONS FOR FLYING SPARKS AND ARC RAYS



It is essential for every person in the immediate work area to wear/utilize proper Personal Protection Equipment. There is a possibility that sparks can fly off from the weld joint area; therefore, take the necessary precautions to avoid trapping a spark within your own clothing.

- Wear protective garments such as oil-free, flame-resistant leather gloves, heavy shirt, cuff-less trousers, high shoes, and a cap. Avoid synthetic fibers as they melt easily.
- Use an approved face shield or safety goggles with side shields when welding or when observing others performing welds.

SAFETY PRECAUTIONS FOR HOT METAL AND CABLES



Welding material that has a high thermal conductivity will cause metal to heat rapidly. Repetitive welds in the same location can also cause metal to heat rapidly.

- Avoid touching weld spots immediately after the weld has been performed as they will be hot.
- Do not touch hot weld areas barehanded.
- Allow sufficient cooling time before handling welded pieces.

- Welding cables can become extremely hot. After extended use, be cautious when handling the weld cables.

SAFETY PRECAUTIONS FOR FUMES AND GASES



Welding can produce fumes and gases. Breathing these fumes and gases can be hazardous to your health. Sunstone welders produce minimal fumes and gases when compared to large-scale welders. Though not required, some form of ventilation is recommended.

- Keep fumes away from face.
- Do not breathe the fumes.
- Ventilate the area and/or use local forced ventilation at the weld spot to remove welding fumes.
- If ventilation is poor, wear an approved air-supplied respirator.
- Read and understand the Material Safety Data Sheets (MSDS) and the manufacturer's instructions for metals, consumables, coatings, cleaners, and degreasers.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the weld can react with vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium-plated steel, unless the coating is removed from the weld area, the work area is well ventilated, and the operator is wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.



SAFETY PRECAUTIONS FOR FALLING EQUIPMENT



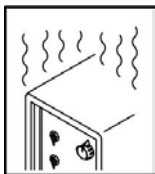
- Use a working surface of adequate physical strength to support the welding unit during operation or storage.
- Secure welding unit during transport so that it cannot tip or fall.

MAGNETIC FIELDS CAN AFFECT IMPLANTED MEDICAL DEVICES



- Wearers of pacemakers and other implanted medical devices should keep away.
- Implanted medical device wearers should consult their doctor and the device manufacturer before going near arc welding, spot welding, gouging, plasma arc cutting, or induction heating operations.

OVERUSE CAN CAUSE OVERHEATING



- Allow a cooling period between strenuous welding schedules; follow rated duty cycle.
- If overheating occurs often, reduce duty cycle before starting to weld again.

PRINCIPAL SAFETY STANDARDS

Safety in Welding, Cutting, and Allied Processes, ANSI Standard Z49.1, from Global Engineering Documents (phone: 1-877-413-5184, website: www.global.ihc.com).

OSHA, Occupational Safety and Health Standards for General Industry, Title 29, Code of Federal Regulations (CFR), Part 1910, Subpart Q, and Part 1926, Subpart J, from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh,

PA 5250-7954 (phone: 1-866-512-1800) (there are 10 Regional Offices—phone for Region 5, Chicago, is 312-353-2220, website: www.osha.gov).

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, P.O. Box 9101, Quincy, MA 02269-9101 (phone: 617-770-3000, website: www.nfpa.org and www.sparky.org).

Canadian Electrical Code Part 1, CSA Standard C22.1, from Canadian Standards Association, Standards Sales, 5060 Mississauga, Ontario, Canada L4W 5N5 (phone: 800-463-6727 or in Toronto 416-747-4044, website: www.csa-international.org).

Safe Practice For Occupational And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002 (phone: 212-642-4900, website: www.ansi.org).

Sunstone Experience

At Sunstone we are committed to producing quality products and ensuring complete owner satisfaction. If you require assistance after reading this manual please contact us with the information provided below.

Sunstone Engineering R&D Corp.

1693 American Way Suite #5

Payson, UT 84651

Email: custservice@SunstoneEngineering.com

Voice: 801-658-0015

Fax: 866-701-1209



Chapter 1: Welder Overview

Features

Sunstone spot welders are simple to use with an intuitive and user-friendly interface. Each of the Dual Pulse CD welders can be adjusted and fine-tuned to match the requirements of countless applications. A digital screen displays total weld energy and individual pulse length settings, ensuring detail and precision. When combined with Sunstone's line of weld heads or hand attachments, CD welders perform strong and repeatable welds for high levels of consistency and quality control.

- Dual Pulse operation removes surface inconsistencies and contaminants.
- Available with 200, 400, 600, 1,000ws of energy
- Single or dual Pulse operation.
- Microprocessor Controlled.
- Thermal Protection Circuit – Internal Monitoring.
- Audible 'Ready' Notification.
- Adjustable pulse width.
- Energy storage adjustable from 9% to 100% capacity.
- Up to 600 welds/min.
- 110/220VAC Switching Power Supply.
- Simple, user-friendly interface.
- Quick energy release for welding highly conductive metals.
- Small heat effected weld zones.
- Repeatable energy release independent of line voltage fluctuations.
- Capable of extremely fine energy adjustment.
- Infinitely adjustable pulse width



Applications

Capacitive Discharge (CD) resistance welders have many advantages over other welder types. Operators achieve quick energy release for welding highly conductive metals. This quick energy release is concentrated into a small area. This small area means that more delicate projects such as welding a battery will maintain the integrity of the cell's chemistry when using Sunstone's Dual pulse CD spot welding technology.

- Battery pack welding
- Honeycomb welding
- Aerospace welding
- Automotive welding
- Cross wire welding
- Thermocouple welding
- Electronic component welding
- **Copper, aluminum**, brass, and steel thin sheet and wire welding
- Miscellaneous resistive welding applications

Whether you are manufacturing battery packs or microscopic assemblies, Sunstone Capacitive Discharge spot welders are the most effective, precision fine-spot resistance welders on the market.

Chapter 2: Resistance Welding

What is Capacitive Discharge Resistance Welding?

Capacitive discharge resistance welding uses capacitors to store energy for quick release.



Capacitive resistance welders, also called capacitive discharge or CD welders, have many advantages over other welder types:

- Quick energy release for welding highly conductive metals.
- Small heat effected weld zones.
- Repeatable energy release independent of line voltage fluctuations.
- Capable of extremely fine energy adjustment.



Weld nugget formation takes place during the first few milliseconds of the welding process. A CD welder allows extremely fast energy release with large peak currents. More of the energy goes into weld formation and less into heating surrounding material. The heat-affected zone, where rapid heating and cooling have changed the properties of the metal, is localized to a small area around the weld spot. The quick discharge rate of CD welders also allows electrically and thermally conductive materials to be welded. Capacitive welders deliver repeatable welds even during line voltage fluctuations because weld energy is stored before use.

WELD FORMATION

Spot welding relies on metal resistivity (resistance) to heat and fuse metal. A large current is passed through the workpiece metal. Energy is dissipated due to metal resistance in the form of heat which melts and fuses the weld materials. There are two phases to the melting process. The welder must overcome both the material contact resistance and the bulk resistance of the material.

FIGURE 1: Sample Capacitor Discharge Curve.

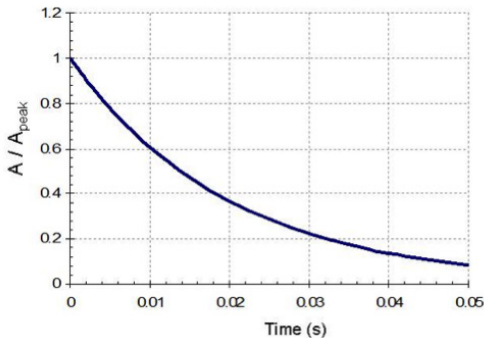


Figure 2 below shows an example of a micro-scale surface profile. On the micro-scale, material surfaces are rough and only contact in a limited number of locations. In the first few milliseconds of weld formation, the high-resistance metal bridges melt, allowing other bridges to come into contact to continue the melting process. When all of the bridges have fused, the contact resistance is zero. The bulk resistance of the metal then plays the final role in the weld formation.

Tips

WELD PRESSURE

Several other factors play a part in the contact resistance. The larger the contact resistance the hotter the resultant weld. On the micro-scale, contact resistance is reduced when more metal bridges or contact points are formed (see Figure 2). Using more electrode pressure creates more metal bridges. This results in a lower contact resistance and a cooler weld. Conversely, light electrode pressure results in less metal contact, higher resistance, and a hotter weld. An appropriate amount of pressure should be used to insure good weld strength.

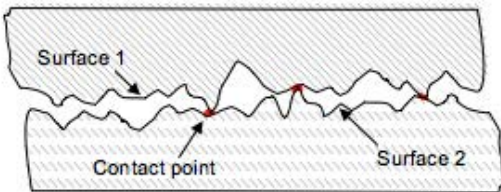


FIGURE 2: On the micro-scale, surface roughness limits surface-to-surface contact. More contact points result in a lower contact resistance.



ELECTRODE CONFIGURATIONS

Figure 3 shows several electrode configurations used in resistance welding. Figure 3a is called a direct weld. Current is passed from one electrode through both workpieces and out an opposing electrode. Figure 3b shows a step electrode configuration. This configuration is used when there is access to only one side of the workpiece and an electrode can be placed on both materials. Figure 3c is a series configuration. Electrodes can only be placed on one metal surface from one side. Current is divided between the two parts. This weld configuration requires more weld energy.

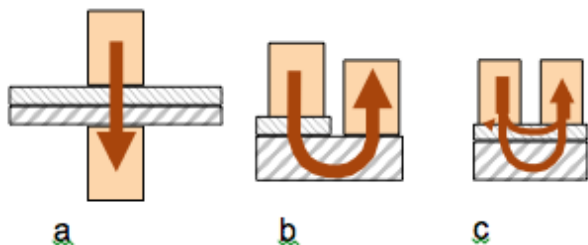


FIGURE 3:
Examples of
resistance
welding electrode
configurations:
a. direct, b. step, c.
series.

WELD ENERGY

Sunstone capacitive Dual Pulse welders allow adjustment of the stored energy via an energy adjustment dial. The energy is then displayed in watt seconds (Joules) on the front panel.



Chapter 3: Setup

Pre Setup Information

VOLTAGE AND POWER REQUIREMENTS

Sunstone Capacitive Discharge Dual Pulse (CDDP) welders are equipped with universal power supplies and can be used with both 110/220V AC wall power. No voltage selection is required prior to connecting and powering on the welder. The welder will detect the voltage, and make the appropriate adjustments automatically.

WELD ACTUATION

The CDDP welders are actuated by means of an external trigger port located on the back of the welder (see Figure 4). The trigger uses a DIN 3 connector and requires shielded wire. Figure 4 shows the proper pin placement for custom external trigger cables. The standard external trigger cable connector is an SD-30LP made by CUI Inc.

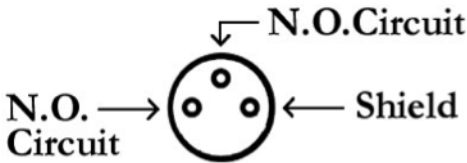


FIGURE 4: External trigger wiring diagram, looking at back of welder, for the welder back panel connector. N.O. stands for Normally Open.

WELDER BEEPS

Sunstone CDDP welders are equipped with a beeper. When enabled, the welder will beep when the unit has reached its targeted weld energy. This signifies that the unit is ready to weld. Users can turn Welder Beeps on or off with a switch located on the back of the welder.



THERMAL PROTECTION

Sunstone capacitive Dual Pulse welders are equipped with temperature sensors. If the unit is close to overheating, the operator will hear six successive beeps and will not be able to weld during this time. When the unit has cooled, the operator will hear three successive beeps, signifying that the unit is again ready to weld. (*These warning beeps will still occur even if the "Welder Beeps" option is turned off.) To ensure proper cooling, the welder flow paths shown in Figure 5 should be unobstructed. Please maintain a clear space of 6+ inches around the welder vents.

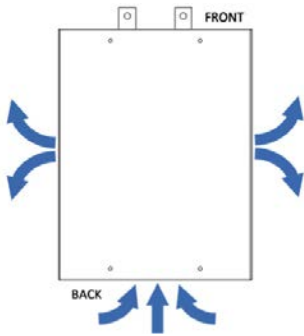


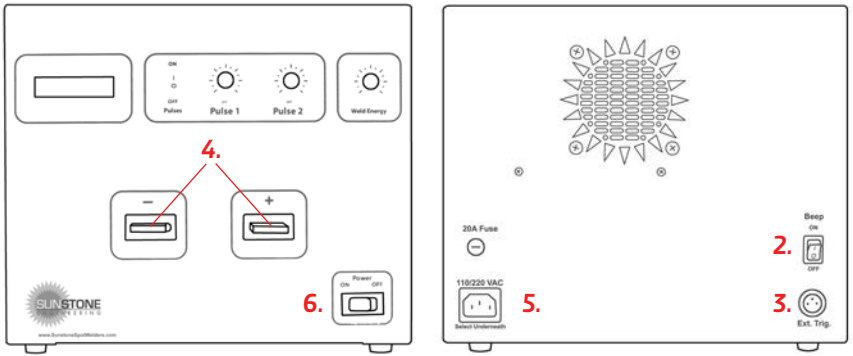
FIGURE 5: For proper cooling, ensure all vent locations are unobstructed.

Welder Setup

QUICK START SET UP OF CDDP WELDER



1. Remove the welder from the box and place it on a secure work surface.



2. Turn Beep on or off according to user preference.
3. Plug in the external Trigger.
4. Attach weld head or hand attachment cables to negative and positive terminals.
5. Plug the power cord into the back of the welder and into an AC power outlet.
6. Turn the welder on.

Weld Head Setup

QUICK START SET UP OF WELD HEADS TO CDDP WELDERS

Sunstone Engineering manufactures a variety of Weld Heads to accommodate a diverse range of welding applications. Both our parallel and opposed Weld Heads provide a great amount of control and precision.

1. Remove the Weld Head from the box and place it on a secure work surface.
2. Attach weld head cables to the negative and positive terminals.
- 3a. Manual Models – See weld head user manual for setup.
- 3b. Pneumatic Models – See weld head user manual for setup.
4. Turn the welder on, assure the weld head is actuating, then set the desired energy setting.
5. *See weld head user manual for more precise setup information.



Hand Held Attachment Setup

QUICK START SET UP OF HAND HELD ATTACHMENTS TO CDDP WELDERS

Sunstone Engineering manufactures a variety of welding hand pieces to accommodate a diverse range of welding applications. Hand piece welding attachments allow ease of use and versatility.

1. Remove the Hand Held Attachment from its package.
- 2a. **Single Probe, Dual Probe, and Tweezer Hand Held Attachments** –

Connect the Hand Held Attachment cables to the negative and positive terminals on the front of the welder, then connect the 3 pin actuation foot pedal cable to the back of the welder.



2b. Pressure Actuated Hand Attachments

– Connect the Hand Held Attachment cable to either of the terminals on the front of the welder and the grounding clip cable to the other terminal. Then attach the trigger cable to the back of the welder.



3. Plug the welder power cable into an AC power outlet.

4. Turn the welder on and set the desired energy settings.

Upgrade – Roll Spot Setup

QUICK START SET UP OF CDDP ROLL SPOT HAND ATTACHMENT



The roll spot upgrade allows users to perform a continuous string of welds for any prolonged time period – for as long as the trigger signal is maintained actuated. The roll spot function requires a special hand-piece that is designed specifically for roll spot welding.

1. Remove the Roll Spot Attachment from its package.

2. Connect the Roll Spot cable to either of the terminals on the front of the welder and the grounding clip cable to the other terminal. Then attach the trigger cable to the back of the welder.
3. Plug the welder power cable into an AC power outlet.
4. Turn the welder on and set the desired energy settings.
5. Switch from the standard "CD" mode to the "Roll Spot" (RS) mode. The RS mode alters the trigger and timing configurations of the welder. See details below.
 - a. The Pulse On/Off switch, which normally would turn the weld function on/off, has been re-purposed to switch between Single



Fire (SF) and Roll Spot (RS) modes – thus, the welds cannot ever be turned off while the welder is still on.

- b. In RS mode, the system has an adjustable "between-weld" delay that affects the frequency or rate of welding while a trigger signal is maintained.
- c. In RS mode, the system only performs a single pulse weld at each weld spot.
- d. The system no longer has the ability to turn welds off while in RS mode. If the welder is turned on, the welder is active and will weld if a trigger signal is sent to the welder.

- e. In SF mode, the unit will weld once per trigger signal.
- f. While in SF mode, all dials and interface options (aside from the pulse on/off switch) will operate the same as on the standard, non-upgraded, base model welder.
- g. In RS mode, however, the device will continuously weld at an adjustable rate for as long as the trigger signal is maintained. If using a foot pedal, the welder will continue to weld for as long as the foot pedal is depressed. If using a pressure actuated hand piece, the welder will continue to weld for as long as the pressure actuated switch is engaged.
- h. In RS mode, two variables will affect the time between each weld. The first is an adjustable minimum weld delay that can be set by the operator. This is accomplished by turning the "Pulse 1" dial on the front of the welder. The second factor is the recharge time between welds. This is determined based on the energy setting. The higher the weld energy, the longer the delay between welds will be.
- i. In RS mode, the "Pulse 2" dial is used to select the total weld time of each individual weld that takes place during the RS welding process.



Chapter 4: Operating Instructions

LCD Screen

LCD DISPLAYED MESSAGES

Messages are shown on the LCD display to indicate that a change is being made to the welder. Here are a list of messages and what they indicate:

POWER ON – This message is displayed when the welder has been turned on.

READY – This message is displayed after you weld and the unit is ready to weld again.

Beep On/Off – Shows up when you toggle the "Beep Enabled" switch. You will hear audible beeps when on.

Weld On/Off – Shows up when you toggle the "Pulses" switch. The welder will not weld with this switch off.

P1 On/Off – Will be displayed when pulse 1 has been switched off or on.

P2 On/Off – Will be displayed when pulse 2 has been switched off or on.

No Pulse – This indicates that both pulses have been turned off. At least one pulse has to be on in order to weld.

NEW P1/P2 – This message will display when either pulse 1 or pulse 2 is adjusted.

Cooling/Enabled – When the unit overheats, it will display "Cooling" until it has reached an operable temperature. Then the welder will display "Enabled" to let you know that it is done cooling.

Pulse Control

DUAL PULSE WELDING

Sunstone Dual Pulse welders have two pulse width energy controls. The blue back-lit LCD displays each pulse's percent of total stored energy and the

total stored energy in Joules (J). Each pulse can be adjusted separately or turned off if desired. Both pulses can be turned off without adjusting pulse values to facilitate weld attachment setup or electrode maintenance. Pulse 1 is adjustable between 1% and approximately 30% of the total stored energy. Pulse 2 is adjustable between 1% and 99% of the stored energy. Please note that when used in dual pulse mode the Pulse 2 energy level represents the percent of remaining power. For example if Pulse 1 was set to 25% the Pulse 2 setting would actually be taken from the remaining 75% of the set-point energy.

USING THE DUAL PULSE WELD FUNCTION

Using multiple current pulses increases weld quality. In dual pulse mode Sunstone welders will fire twice from a single actuation. The first pulse is used to remove surface inconsistencies and contaminants which helps to displace oils, break through oxide layers, and seat the welding electrodes.

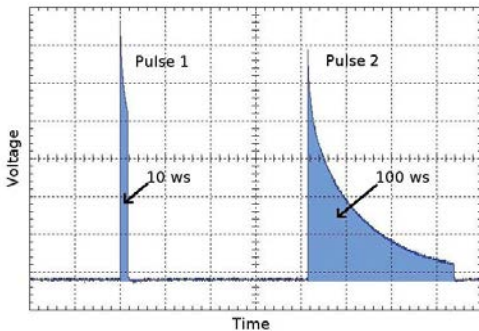


FIGURE 6: This shows what the welder discharge curve would look like when using the dual pulse setting as outlined above.

SETTING PULSE 1 AND 2

The Pulse 1 energy setting should be chosen such that the parts adhere weakly. To determine Pulse 1, turn off Pulse 2 and do a series of test welds



starting at a low pulse energy setting. Increase the pulse energy about 3% every test until the parts stick together to achieve maximum heat. Pulse 1 energy is typically below 10%. Pulse 2 energy is typically between 50% and 70%. A test weld should be performed and pulled apart to determine weld strength. A nickel strip to nickel plated steel weld, typically seen in battery pack manufacturing, should pull apart leaving holes in the thin nickel metal and leaving the weld nuggets on the battery terminal. Thicker materials should be pulled with a specific pull force requirement in mind.

ENERGY ADJUSTMENT

Each Sunstone welder is fully adjustable between its minimum and maximum energy. Sunstone Capacitive Dual Pulse welders have weld repetition rates of up to 600 welds/min. See Table 3 for additional details on weld repetition rates. The weld energy knob is used to set the total welder energy storage and is also used to set the peak weld current. The pulse widths are then adjusted to provide the appropriate weld energy released during each weld.

CDDP Data Sheet Info

WELDER DATA

Cabling between welder and Weld Head is important in determining peak weld current and adjusting weld pulse timing. Table 1 indicates peak currents that can be expected with 3 to 4 foot sections of these cables. Typically, hand pieces will use 4 to 8 AWG wire while Weld Heads will be hooked up with 0 or 4 AWG wire.

Table 1: Peak weld current shown by model number and external cabling gauge number (AWG). Four and eight AWG cabling is typically seen when using hand held attachments.

	CD200DP	CD400DP	CD600DP	CD1000DP
1 AWG 4 Ft	7905	9130	11180	10250
4 AWG 6 Ft	6081	7023	8600	7885
8 AWG 6 Ft	3162	3652	4472	4100
*Minimum Load = 1mOhm, using a smaller load may damage the welder.				

Table 2: Weld speed in welds per minute by Dual Pulse model number at maximum energy.

Pulse width (max energy set-point)	Rep Rate CD200DP Welds/Min (pulse energy)	Rep Rate CD400DP Welds/Min (pulse energy)	Rep Rate CD600DP Welds/Min (pulse energy)	Rep Rate CD1000DP Welds/Min (pulse energy)
10%	150 (20ws)	240 (40ws)	140 (60ws)	120 (100ws)
25%	107 (50ws)	150 (100ws)	90 (150ws)	76 (250ws)
50%	79 (100ws)	100 (200ws)	55 (300ws)	60 (500ws)
100%	50 (200ws)	60 (400ws)	27 (600ws)	36 (1000ws)



Table 3: Sunstone Dual Pulse General Technical Specifications

Feature	All CD Welders
Single and Dual Pulse	Yes
Pulse 1 Energy Adjustment (% of set-point energy)	0% - 30%
Pulse 2 Energy Adjustment (% of set-point energy)	0% - 99%
Peak Current	790S - 11,180 Amps

Table 4: Power Specifications

	CD200DP	CD400DP	CD600DP	CD600DP
Input Voltage	85 - 260 VAC	85 - 260 VAC	85 - 260 VAC	85 - 260 VAC
Frequency Range	47-63Hz	47-63Hz	47-63Hz	47-63Hz
Power Factor (typ.)	PF>0.94/230VAC PF>0.99/115VAC	PF>0.94/230VAC PF>0.99/115VAC	PF>0.94/230VAC PF>0.99/115VAC	PF>0.94/230VAC PF>0.99/115VAC
AC Current (typ.)	8.5A/115VAC 5A/230VAC	8.5A/115VAC 5A/230VAC	8.5A/115VAC 5A/230VAC	8.5A/115VAC 5A/230VAC

Table 5: Weld Pulse Characteristics

Model	Min and Max Output	Pulse Width		Rise Time (to max voltage)	Min Pulse Height	Max Pulse Height
		Min	Max			
CD200DP	5 ws - 200 ws	Min	0.53 ms	0.2 ms	2.5 V	15.8 V
		Max	43.2 ms			
CD400DP	5 ws - 400 ws	Min	0.37 ms	0.2 ms	2.04 V	18.3 V
		Max	48.1 ms			
CD600DP	5 ws - 600 ws	Min	0.29 ms	0.2 ms	2.04 V	22.4 V
		Max	51.1 ms			
CD1000DP	30 ws - 1000 ws	Min	0.23 ms	0.2 ms	2.2 V	20.5 V
		Max	54.7 ms			

Table 6: Welder Physical Characteristics

	CD200DP		CD400DP		CD600DP		CD1000DP	
	Inches	cm	Inches	cm	Inches	cm	Inches	cm
Height	10.5	26.7	10.5	26.7	10.5	26.7	11	28
Width	12	30.5	12	30.5	12	30.5	18.75	47.6
Depth	13.5	34.3	13.5	34.3	13.5	34.3	14	35.6
Weight	34 Lbs	16 Kg	39 Lbs	18 Kg	39 Lbs	18 Kg	55lbs	26kg

Appendix A: Glossary

AWG: American Wire Gauge is the standardized wire gauge system.

FAYING: Faying surfaces are those that have been joined by a weld.

PULSE: A burst of electrical energy.

RESISTANCE: Welders rely on a resistance between its terminals to generate the heat needed to melt metals. Ohm's law states that Voltage = Current X Resistance.

SPOT WELD: A small weld done with two electrodes that leaves a circular (or spot) shaped weld nugget.

TERMINALS: The copper bars protruding from the case marked with a '+' and '-' are the terminals.



Appendix B: Warranty

All Sunstone Products come with a 1 year warranty. Sunstone Engineering will repair all defects in craftsmanship without charge during this time period (excluding the cost of shipping). This warranty does not cover damage caused by improper use of Sunstone products. This warranty does not include consumable items, such as welding electrodes. Sunstone Engineering is dedicated to keeping our products operating at peak performance for years to come. Any repairs needed after the 1 year warranty period are performed at cost, typically less than \$100 USD.

Sunstone Engineering offers a 30 day return policy on all of our products. Before sending a product back, please contact Sunstone Engineering to receive an RMA number. The RMA number should appear clearly on the outside of the package. Customer refunds are accomplished via check. Please note that a 10% restocking fee will apply to all returns. Equipment damaged by improper use or insufficient shipping precautions will be charged additional fees.

Sunstone Engineering is dedicated to providing quality products and support. Please feel free to call with any questions before or after purchasing our products.

Phone: 1-801-658-0015

Fax: 1-866-701-1209

E-mail: Sales sales@sunstoneengineering.com

Technical Support: tech@sunstoneengineering.com

Customer Service: custservice@sunstoneengineering.com

Web: www.SunstoneSpotWelders.com

Mail: Sunstone Engineering R&D Corporation

1693 W. American Way Unit 5

Payson, UT 84651





sunstone

Sunstone Engineering R&D Corporation

1693 American Way Suite #5

Payson, UT 84651

1.877.786.9353

sunstoneengineering.com