PowerStream Technology

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Dual Pulse Resistance Welder Instruction Pamphlet

CD125DP/CD250DP/CD375DP

High Accuracy CD Welders

- Dual Pulse operation removes surface Inconsistencies and contaminants
- Adjustable pulse width
- Single or dual pulse operation
- Available from 125ws to 375ws
- Adjustable from 0.1% to 100% energy discharge
- Up to 166 welds/min at 70% energy set-point
- Simple, user-friendly interface

CD125DP

CD250DP

CD375DP

Fundamentals of Capacitive Discharge Resistance Welding

Capacitive discharge resistance welding uses large capacitors to store energy for quick release. Figure 1 shows a typical capacitor discharge curve.

Capacitive resistance welders have many advantages. Weld nugget formation takes place during the first few milli-seconds. Capacitive discharge welders allow 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 the properties of the metal have been changed from rapid heating and cooling, is localized to small area around the weld spot. The quick discharge rate of CD welders also allows electrically and thermally conductive materials, such as copper or aluminum, to be welded. Capacitive welders deliver repeatable welds even during line voltage fluctuations.

Spot welding relies on the principle of metal resistivity to heat and fuse metal. A large current is passed through the work piece.

Energy is dissipated due to the metal resistance in the form of heat which melts and fuses weld materials. There are two phases to

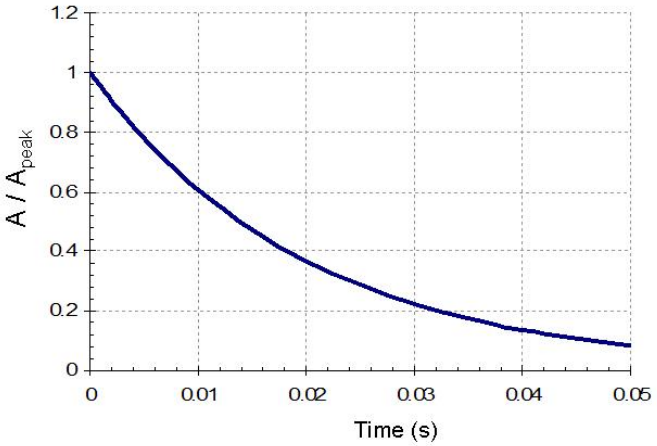

Figure 1: Sample capacitor discharge curve.

the melting process. The welder must overcome the material contact resistance and the bulk resistance of the material. Figure 2 shows an example micro-scale surface profile. On the micro-scale, material surfaces are ruff and only contact in a limited number of locations. In the first few milli-seconds of weld formation these high resistance, microscopic metal bridges melt allowing other bridges to come into contact and melt. When all of the bridges have fused the contact resistance equals zero. The bulk resistance of the metal then plays the final role in the weld formation.

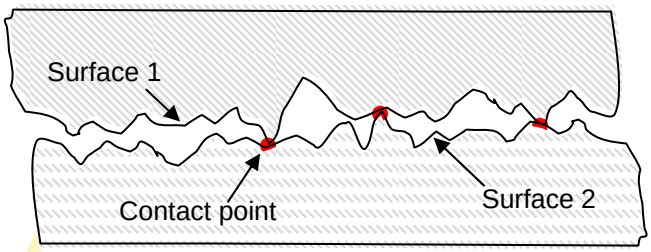

Figure 2: On the micro-scale surface roughness limits surface to surface contact. More contact points results in a lower contact resistance.

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 cooler weld. Conversely, light electrode pressure results in less metal contact, higher resistance, and a hotter weld.

Figure 3 shows several different electrode configurations used in resistance welding. Figure 3a is called a direct weld. Current is passed from one electrode, through both work pieces 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 work piece 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.

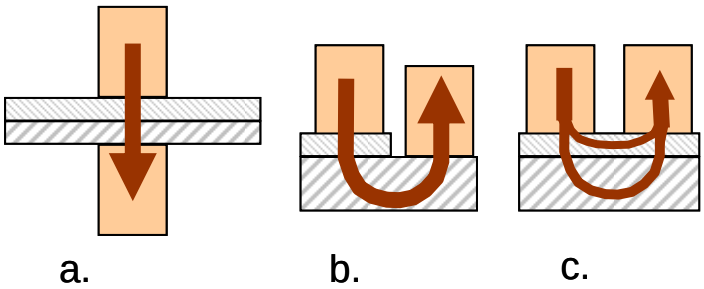

Figure 3. Examples of resistance welding electrode configurations; a.) direct, b.) step, c.) series.

A capacitive discharge welder controls the voltage of the welding capacitors. However, the energy stored in the capacitor is a function of the voltage squared ($E = ½*C*V^2$). This relation states that a small difference in voltage makes a large difference in weld energy. The energy adjustment knob on Sunstone spot welders is indicated in watts*seconds (joules) to eliminate the potential confusion between the linear voltage control and the voltage square energy relation.

Using Sunstone Dual Pulse Welders

Weld Energy Indication

Figure 4 shows the Sunstone Engineering Dual Pulse CD welder front panel. Weld energy is

indicated by a 10 level display bar and is adjusted in watt-seconds (ws). When maximum energy has been reached the display will begin flashing.

the fast charging booster power supply. The pulse widths are then adjusted to provide the appropriate weld energy.

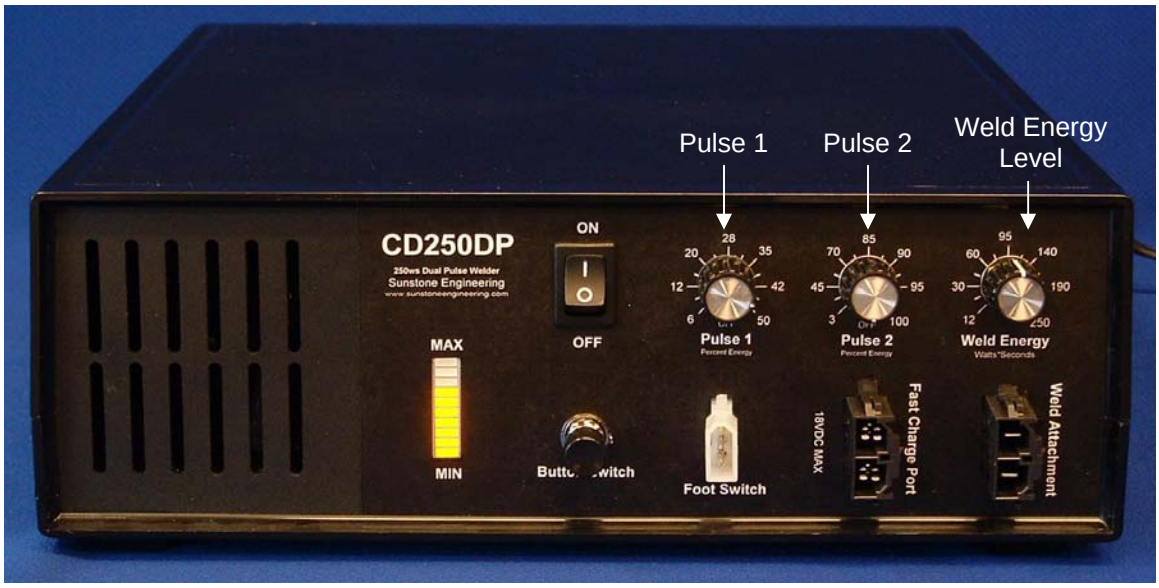

Figure 4: The Sunstone Dual Pulse

Pulse Control

Sunstone Dual Pulse welders have two knobs for pulse energy controll. Each pulse can be adjusted separately or turned off if desired. Pulse 1 is adjustable between 6% and 50% of the total stored energy. Pulse 2 is adjustable between 3% and 100% 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 of the remaining 75% of the set-point energy.

Power Adjustment

Each Sunstone welder is fully adjustable between its minimum and maximum energy. The welders have a moderate charge time if used by themselves. Welders are intended for use with an additional external power supply booster. When used in conjunction with a fast charging booster weld repetition rates of up to 166 welds/min (the hardware defined limit) are possible. The weld energy set-point is usually chosen to minimize cycle time and is typically set to around 80 percent of the maximum value. This corresponds to a 16 volt setting on

Weld Actuation

All Sunstone welders come with panel mount button switch. The welders also have a port for a foot switch or other normally open switch. The foot switch connection is made with a Molex 03-06-1038 connector and 02-06-1103 terminals.

Fast Charging Port

As discussed, the welders are intended for use with a charge booster / fast charging power supply. The fast charging port on the welder allows an external, high current power supply to speed-up the cycle time of the welder. The Sunstone Engineering PS25A power supply is adjustable between 6 and 18V (11 – 100% welder energy). The PS35A booster is adjustable from 13 to 18V (50 – 100% energy). A welder to power supply hook-up cable is included with each booster power supply. The connector on the cable is polarized for proper insertion into the welder port. On the power supply booster the red banana plug hooks into the positive supply terminal (red) and black into the negative terminal (black). When using alternate external power supplies it is critical that the user does not exceed 18VDC into the

fast charging port. Doing so will damage the welder and void its warranty.

Weld Attachments
Sunstone Engineering produces a variety of welding hand pieces and weld heads to accommodate a diverse range of welding applications. Hand piece welding attachments allow ease of use and versatility, while fixed weld heads provide control and precision. To simplify setup, all welding attachments use a high current snap-in connector. Sunstone Dual Pulse welders can also be used with other manufacturers weld heads through the use of an adapter cable. Sunstone Engineering does not recommend that the user assemble an attachment connector without proper tooling. A "pig tail" connector can be purchase with free wire ends to construct custom welding attachments.

Back Panel
All Sunstone Welders use a 24VDC power supply. A 2.1mm ID 5.5mm OD connector is located on the welder back panel. The fuse holder (located on the back panel) accepts 5 x 20mm 5A fuses.

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. This initial burst of energy displaces oils and breaks through oxide layers. The pulse also seats the welding electrodes. The second pulse is done at a much higher energy level (watt-seconds) and performs the actual weld.

Pulse 1 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. Increase the pulse energy 3-5% every test until the parts just stick together. Pulse 1 energy should then be decreased by 3-5%. Pulse 2 should then be set at a level 4 – 5 times that of pulse 1. 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. Figure 5 shows what the welder discharge curve would look like using the dual pulse setting as outlined above.

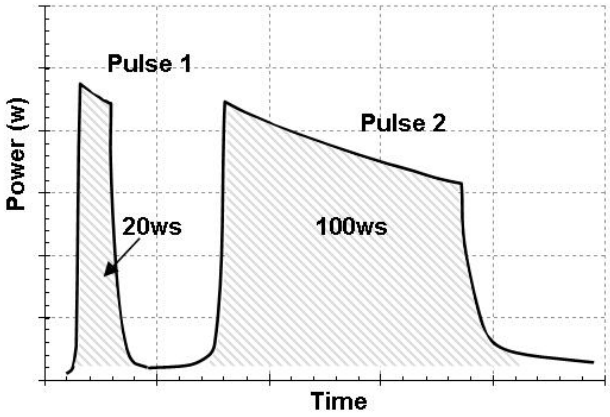

Figure 5: Capacitor discharge using the dual pulse setting.

SAFETY

Please follow these points to help insure your comfort and safety.

1. Always wear safety glasses when working with spot welders and weld heads.
2. Avoid touching welds spots immediately after the weld has been performed as they will be hot.
3. Be careful not to pinch fingers in moving weld head parts or between welding electrodes.
4. Remove hand jewelry before welding.
5. All welds are performed at low voltage for increased safety of operation.

Additional Information

For additional information and instructional videos please visit our web pages.

www.SunstoneEngineering.com

Sunstone Dual Pulse Resistance Welder Technical Specifications

Feature	CD125DP / CD250DP / CD375DP
Dual Pulse	Yes
Pulse 1 Energy Adjustment (% of set-point energy)	6% - 50%
Pulse 2 Energy Adjustment (% of set-point energy)	3%-100%
Peak Current (typical)	1200 Amps

Single Pulse Welding Speed

Pulse width at 70% welder energy set-point	Rep Rate CD125DP (welds/min)	Rep Rate CD250DP (welds/min)	Rep Rate CD375DP (welds/min)
3%	166	166	166
25%	166	152	150
50%	155	140	116
100%	150	120	80

Sunstone Dual Pulse Resistance Welder Pulse Characteristics

Model	Min Output	Max Output	Capacitor Bank	Pulse Width		Rise Time	Min Pulse Height
CD125DP	0.2 ws	125 ws	800,000 µF	Min	0.5 ms	10's of µs	4.0 V
				Max	17 ms	10's of µs	4.0 V
CD250DP	0.4 ws	250 ws	1,600,000 µF	Min	0.5 ms	10's of µs	4.0 V
				Max	30 ms	10's of µs	4.0 V
CD375DP	0.6 ws	375 ws	2,400,000 µF	Min	0.5 ms	10's of µs	4.0 V
				Max	40 ms	10's of µs	4.0 V

Physical Characteristics

	CD125DP		CD250DP		CD375DP		PS25A (booster)		PS35A (booster)	
	Inches	cm	Inches	cm	Inches	cm	Inches	cm	Inches	cm
Height	3.6	9.1	3.6	9.1	3.6	9.1	7.1	18.0	5	12.7
Width	10.3	26.2	10.3	26.2	10.3	26.2	9.1	23.1	9.2	23.4
Depth	12	30.5	12	30.5	12	30.5	11.8	30.0	14	35.6
Weight	5 lbs	(2.26 kg)	7.3 lbs	(3.3 kg)	9.3 lbs	(4.2 kg)	20 lbs	(9.1 kg)	29 lbs	(13.2 kg)

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