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CD SPM Welder

User Manual

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A PRODUCT OF SUNSTONE ENGINEERING

CD100 SPM CD200 SPM

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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.

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.

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Safety Procedures and Precautions

- **Never** open welder to perform any maintenance operation inside the unit.
- Wear appropriate eye protection at all times while using the welder.
- Care should be taken not to short across the positive and negative terminals. At full power, the weld current is many thousands of amps and is dangerous if the terminals are accidentally bridged.
- 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.
- Welding cables can become extremely hot. After extended use, be cautious when removing the weld cables.
- When altering any part of the welding path (such as swapping electrodes or cables), turn the unit off or enter the menu to ensure no accidental triggering of a weld occurs.
- The CD100 SPM / CD200 SPM was designed for indoor use only.

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.ihs.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 5NS (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:

Features:

- Energy Storage from 0.1 watt-seconds to 200 watt-seconds
- Adjustable Pulse Width (Energy Released During Weld)
- Micro-processor Controlled
- Available in 100 and 200 watt-second Versions
- Peak Repetition Rates of 120 Welds/Minute
- Rates of up to 40 or 20 Welds/Minute (100ws or 200ws, Respectively) Operating at Maximum Power
- Audible "Ready" Notification
- Simple and Intuitive Welder Interface
- Screen Displays 0.1 ws Increments Below 10ws
- Up and Running in Minutes Without Any Prior Welding Experience

The CD100 SPM / CD200 SPM Capacitive Discharge Fine-Spot Resistance Welder

SUNSTONE ENGINEERING SINGLE PULSE RESISTANCE WELDERS

Sunstone Single Pulse research and light production resistance welders are engineered to provide a wide range of welding flexibility. They can provide as little as 0.1 joules of energy for welding microscopic wires and parts, or can deliver up to 100 or 200 Joules for larger welds. The Sunstone welder is versatile and easy to use. Its interface lets the user quickly select weld settings for a wide variety of welding projects. The welder is designed for use in a research laboratory or light production environment and can be actuated up to 120 welds/minute. At Sunstone, our goal is to provide quality resistance welding products at affordable prices for small and large businesses.

ADVANTAGES OF CD SPOT WELDERS

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 such as copper
- Small heat affected weld zones
- Repeatable energy release independent of line voltage fluctuations
- Capable of extremely fine energy adjustment

CD welders are one of the most cost-effective welding solutions for fine-spot resistance welding. Whether you are manufacturing performing microscopic assemblies, Sunstone CD resistance welders are the most affordable, precision fine-spot resistance welders on the market.

FUNDAMENTALS OF CD, FINE-SPOT RESISTANCE WELDING

During resistance welding, a large electrical current is used to fuse weld metals in one location, or spot, hence the term “spot weld”. This weld spot or “nugget” forms during the first few milli-seconds of the welding process. A CD welder performs strong and repeatable spot welds for several reasons. It allows extremely fast energy release with large peak currents. The discharge speed of a CD welder allows more of the energy to go into weld formation and less into heating the surrounding material. CD welders also keep the heat affected zone – the area where the properties of the metal have been changed - localized to a small area around the weld spot. Fast energy discharge allows electrically and thermally conductive materials, such as copper or aluminum, to be welded. In addition to these

features, capacitive welders deliver repeatable welds even during line voltage fluctuations because weld energy is stored before use. Figure 1 shows an example capacitive discharge curve.

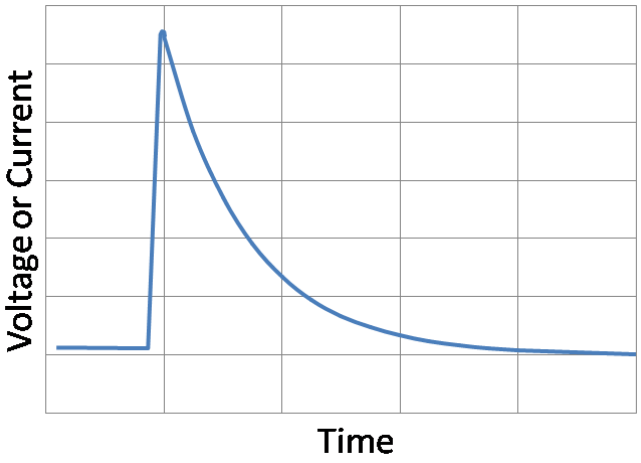

FIGURE 1: Sample capacitor discharge curve.

UNDERSTANDING WELD RESISTANCE

Spot welding relies on metal resistivity (resistance) to heat and fuse metal. During the welding process an electrical current is passed through the weld materials. The metals' resistance causes it to heat and melt. There are two distinct phases in the melting process, namely: heating due to the weld materials' contact resistance and heating due to bulk material resistance.

Figure 2 shows an example of a micro-scale surface profile. On the micro-scale, surfaces are rough and mating surfaces only contact in a limited number of locations. Because the surfaces have limited contact area, this area has a higher electrical resistance than the metals' bulk resistance. This resistance is called contact resistance. In fine-spot welding applications, contact resistance is the most important factor in weld formation. During the first few milli-seconds 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 completes the weld.

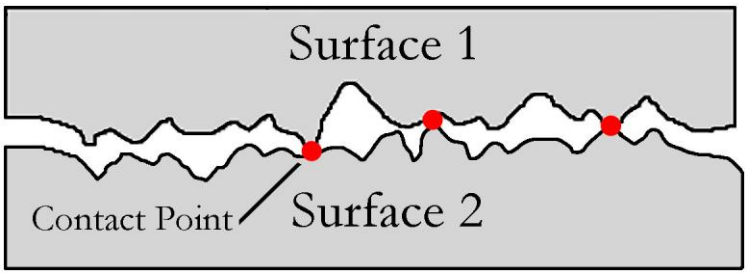

Figure 2: On the micro-scale, surface roughness limits surface-to-surface contact. More contact points result in a lower contact resistance. Weld heat is inversely proportional to contact resistance.

WELD PRESSURE

One way contact resistance can be controlled is through the pressure of the welding electrodes. High electrode pressure reduces contact resistance because the pressure creates more metal bridges or contact points (Figure 2). When contact resistance is reduced, less weld power is consumed at the material interface and therefore the weld is cooler. Conversely, less weld pressure translates to higher contact resistance and a hotter weld. Electrode pressure also contributes to weld strength. The applied pressure forces the liquid metal together during the welding process and allows the metal to mix and solidify. An appropriate amount of pressure should be used to ensure proper weld nugget formation. Table 1 demonstrates how electrode pressure affects weld formation.

Table 1: Weld properties with electrode pressure. Weld nugget strength is related to weld mixing.

Pressure	Weld Heat	Weld Strength
Up	Down	Up (down possible)
Down	Up	Down (up possible)

ELECTRODE CONFIGURATIONS

Figure 3 shows several electrode configurations used in resistance welding. Figure 3a. is called a direct or opposed weld. During welding, current passes 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 work piece and an electrode can be placed on both materials. Figure 3c. is a series or parallel configuration. It is used when electrodes can only be placed on one metal surface from one side. This weld configuration requires more weld energy because the current is divided between the two workpieces.

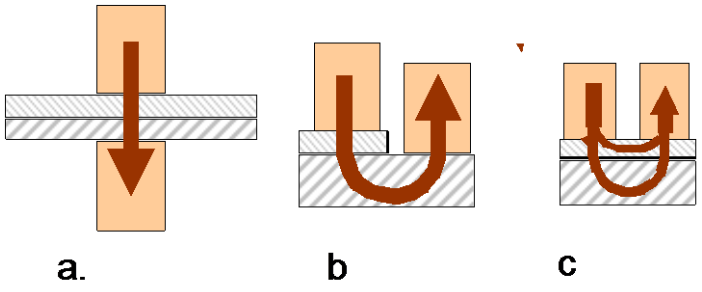

FIGURE 3: Examples of resistance welding electrode configurations: a.= Direct or Opposed, b.= Step, c.= Series.

CD WELD ENERGY

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 (See Eqn. 1). A small difference in weld voltage makes a large difference in weld energy. Peak weld currents and voltages occur at the beginning of the weld cycle and then drop off exponentially (see Figure 1).

$$E = \frac{1}{2} C \cdot V^2$$

EQN. 1.

Using Sunstone Single Pulse Spot Welders

WELD ENERGY INDICATION

Figure 4 shows the Sunstone Single Pulse CD welder front panel. The CD100 SPM and CD200 SPM welders display the actual energy of the welder in watt*seconds. Below 10ws the welder will display 0.1ws increments of energy adjustment.

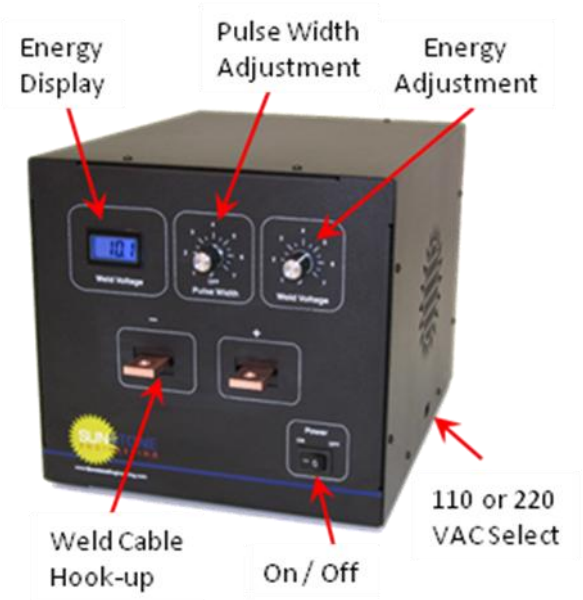

FIGURE 4: Welder front panel features: Blue LCD energy indication display, easy to use Pulse Width and Energy control interface, 110/220VAC voltage selection, hook-up bars that allow ¼" studs and an On/Off switch. The pulse dial can be turned off for Weld Head setup.

ENERGY ADJUSTMENT AND PULSE CONTROL

Sunstone Single Pulse welders allow a large degree of control over the entire welding process. The energy stored and released with each weld discharge can be adjusted down to very fine increments for welding very small parts. The pulse width dial allows fine control over the duration of the weld pulse and the energy released with each pulse. The weld energy knob controls the total welder energy storage (see Table 2 and Eqn. 1) and also sets the peak weld current. Typical values of peak current with weld energy and load are given in Table 3. The amount of energy released for each pulse width setting is shown in Table 3 and is also a function of the welding load (resistance).

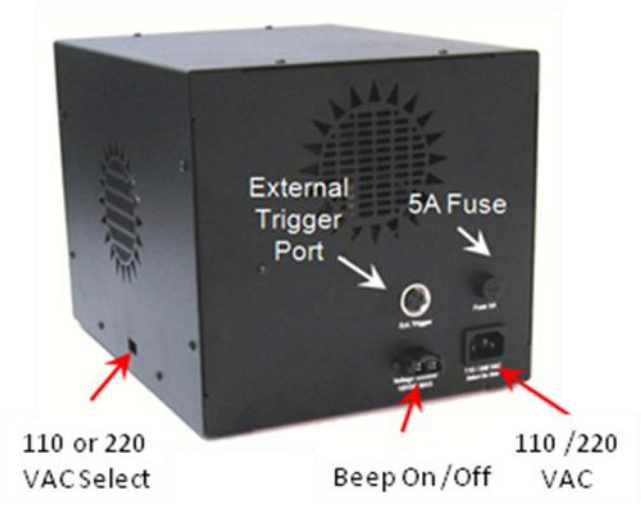

FIGURE 5: Welder back panel: External trigger port, 5A fuse, 110 or 220VAC voltage input, and Beep On/Off "ready" notification.

Sunstone Single Pulse welders have weld repetition rates of up to 120 welds/min at short pulse widths. At maximum power the CD100 SPM and CD200 SPM can operate at 40 and 20 welds/min respectively. Table 4 gives additional details of repetition rates with weld voltage.

HOW TO USE THE PULSE WIDTH DIAL

Controlling energy storage and pulse width allows the user to manage both the energy released during the welding process and the peak electrical current experienced by the weld material. These parameters are important when welding materials that have diverse thermal and electrical properties.

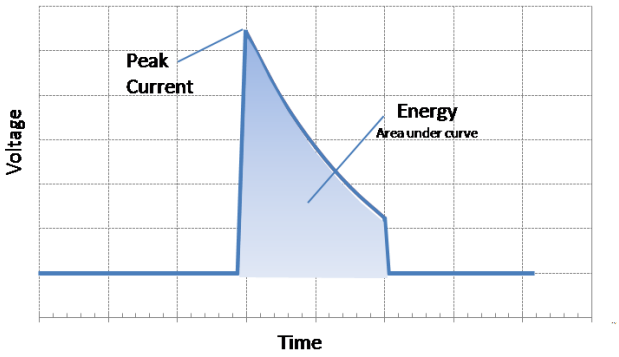

FIGURE 6: A single pulse capacitive discharge curve. The pulse width setting allows both the peak current and total energy discharged to be specified.

There are several factors that should be considered when selecting the correct pulse width setting. For example, when welding highly conductive materials such as copper, the peak weld current must be higher than resistive materials (e.g. steel). Thus welding a thin copper part may require high weld energy displayed on the screen (high peak current) but a small pulse width (to produce a small total energy released). Conversely a thin steel part may require a lower displayed weld energy (peak current) and longer pulse width (to provide enough energy). Figure 6 shows how voltage, peak current and energy relate. It should be noted that the energy stored can also be thought of as capacitor voltage in this diagram.

WELD ACTUATION

The welders are actuated by means of an external trigger port located on the back of the welder (see Figure 5). The trigger uses a DIN 3 connector and requires shielded wire. Figure 7 shows the proper pin placement for custom external trigger cables. The diagram is shown as if looking at the back panel. The standard external trigger cable connector is an SD-30LP (manufactured by CUI Inc).

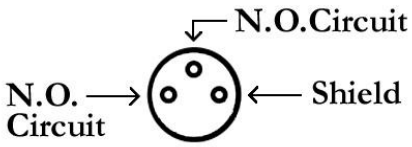

FIGURE 7: External trigger wiring diagram. N.O. stands for Normally Open. The diagram is shown as if looking at the back panel connector.

WELD ATTACHMENTS

Sunstone Engineering offers a variety of welding hand pieces and Weld Heads to accommodate a diverse range of welding applications. Hand piece welding attachments allow flexibility in electrode placement, while fixed Weld Heads provide control and precise repeatability. Table 3 indicates the pulse settings to be used with different cabling (loads). Table 3 indicates peak currents that can be expected with cable sections totaling 6 feet. Typically, hand pieces will use 4 or 8 AWG gauge wire

(1.5mOhm or 4mOhm) while Weld Heads will be connected with 1 or 4 AWG gauge wire (1.0mOhm or 1.5mOhm). The copper connection bars accept ¼" (6mm) studs.

VOLTAGE AND POWER REQUIREMENTS

Sunstone Single Pulse welders can be configured by the user to accept 110 or 220VAC wall power. Please select the appropriate setting (110 or 220 VAC) on the side of the welder as indicated in Figure 4 & 5. The welder uses a 5mm x 20mm 5A fuse. A 300W wall circuit should be used to run the welder. The user must ensure that the appropriate voltage is selected (110 or 220) before turning on the welder to prevent damage to the welding unit. Incorrect voltage selection will damage the welder and void the warranty.

TABLES

Quick-reference Tables 2 – 6 provide useful information for using Sunstone Single Pulse welders.

ADDITIONAL INFORMATION

For additional information and instructional videos please visit our web page:
www.SunstoneSpotWelders.com

TABLE 2: Percent energy release as a function of weld load and pulse dial setting.

	CD100 SPM				CD200 SPM			
Pulse Width Dial Marker	Pulse Time (ms)	1.0mΩ Load (% discharge of energy setting)	1.5mΩ Load (% discharge of energy setting)	4.0mΩ Load (% discharge of energy setting)	Pulse Time (ms)	1.0mΩ Load (% discharge of energy setting)	1.5mΩ Load (% discharge of energy setting)	4.0mΩ Load (% discharge of energy setting)
1	0.26	27%	20%	12%	0.47	25%	19%	10%
1.5	0.28	29%	22%	12%	0.50	26%	20%	11%
2	0.45	42%	33%	19%	0.81	39%	30%	17%
2.5	0.59	51%	40%	24%	1.07	48%	37%	22%
3	0.75	60%	48%	29%	1.34	56%	44%	27%
3.5	0.90	67%	55%	35%	1.63	63%	51%	32%
4	1.06	72%	60%	39%	1.90	69%	56%	36%
4.5	1.43	82%	71%	49%	2.57	79%	67%	45%
5	2.23	93%	86%	65%	4.02	91%	83%	61%
5.5	3.54	99%	95%	81%	6.37	98%	94%	78%
6	4.80	100%	98%	89%	8.65	99%	98%	87%
6.5	5.51	100%	99%	92%	9.92	100%	99%	90%
7	5.54	100%	99%	93%	9.98	100%	99%	90%

TABLE 3: Peak weld current as a function of weld energy and external welding load.

Energy (ws) (100ws / 200ws)	1.0mΩ Load (Amps)	1.5mΩ Load (Amps)	4.0mΩ Load (Amps)
0.1 / .2	250	200	100
25 / 50	3953	3162	1581
50 / 100	5590	4472	2236
75 / 150	6847	5477	2739
100 / 200	7906	6325	3162

TABLE 4: Weld speed in welds per minute.

Energy Set-point (% of maximum energy)	NOMINAL Rep Rate CD100 SPM welds/min	NOMINAL Rep Rate CD200 SPM welds/min
100%	40 (100ws)	20 (200ws)
75%	50 (75ws)	25 (150ws)
50%	60 (50ws)	30 (100ws)
25%	85 (25ws)	42 (50ws)
2.5%	120 (2.5ws)	120 (5ws)

TABLE 5: Weld pulse characteristics.

Model	Min and Max Energy Set-point	Pulse Width		Min Pulse Height
CD100 SPM	0.1 ws - 100 ws	Min	0.26 ms	0.2 V
		Max	5 ms	
CD200 SPM	0.1 ws - 200 ws	Min	0.47 ms	0.2 V
		Max	10 ms	

TABLE 6: Sunstone Single Pulse welder physical characteristics.

	CD100 SPM		CD200 SPM	
	Inches	cm	Inches	Cm
Height	8	20.3	8	20.3
Width	8.5	21.6	8.5	21.6
Depth	11	28	11	28
Weight	17 lbs	(8 kg)	19 lbs	(9 kg)

Other Information: Welder is RoHs compliant.

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