

# PARALLEL GAP WELDERS

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THE WORLD'S BEST ENAMELED WIRE & RIBBON WELDER



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Equipment, Inc.

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## About Us

**SW Tech Equipment, Inc.** is a distribution and service subsidiary of Jingyi Welding Equipment Co. Ltd. for the worldwide market with focus on South and North America territory.

Jingyi Welding Equipment Co. Ltd. was founded in 2006. The company is an ISO9001: 2008 registered company and is the original technology creator of **One Step Stripping/Welding Enameled Wires**. Its Parallel Gap Welders (PG Welders) can also weld metal wires, metal strips, gold wires and gold ribbons to various surfaces. Based on the resistance welding principle, the machines can provide the most reliable welding joints of many electronics and mechanical components for automotive, medical, computers, electronics, tele-communications, defense and aerospace applications. Since there are no toxic soldering materials involved in the process, the products manufactured meet **RoHS** requirements, naturally.

As a technology driven company, Jingyi Welding Equipment Co. Ltd. has many patents to protect its intellectual properties. The company has delivered several thousand various Parallel Gap welders to domestic and international markets since its inception.

## Vision Statement

Expand Jingyi Welding Equipment Co. Ltd.'s products and service to worldwide market with focus on South and North America. Offer superior sales and customer service to its global customers.

## Mission Statement

To satisfy our customers by providing high quality products and superior customer service.

## Product Offering



SMAPRO100 PG Welder



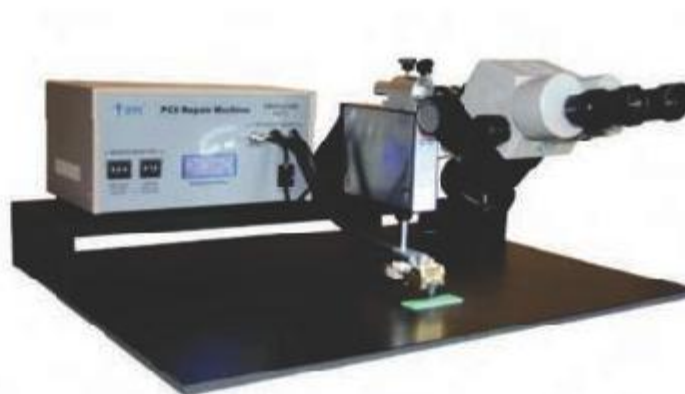
SMAPRO580 Digital Microscope



SMAPRO180 PG Welder



SMAPRO510 Stereo Microscope



SMAPRO200 PCB Repair Machine



SW-ETD Series Electrodes

## General Introduction

(Parallel Gap Welder)

Parallel gap welding is based on resistance or ohmic welding principles. Resistance welding is realized when current is caused to flow through the left and right halves of the electrode and separate pieces of the metal to be joined. The resistance of the base metal to electrical current flow causes localized heating in the joint, and a weld is made. In all cases, the current must flow in order to make a weld. The pressure of the electrode tip on the work piece holds the part in close and intimate contact during the formation of a weld. Therefore, four factors, power (amperage or amplitude and time or duration of the electronic pulse), resistance and pressure are the key factors in making an optimal welding joint.

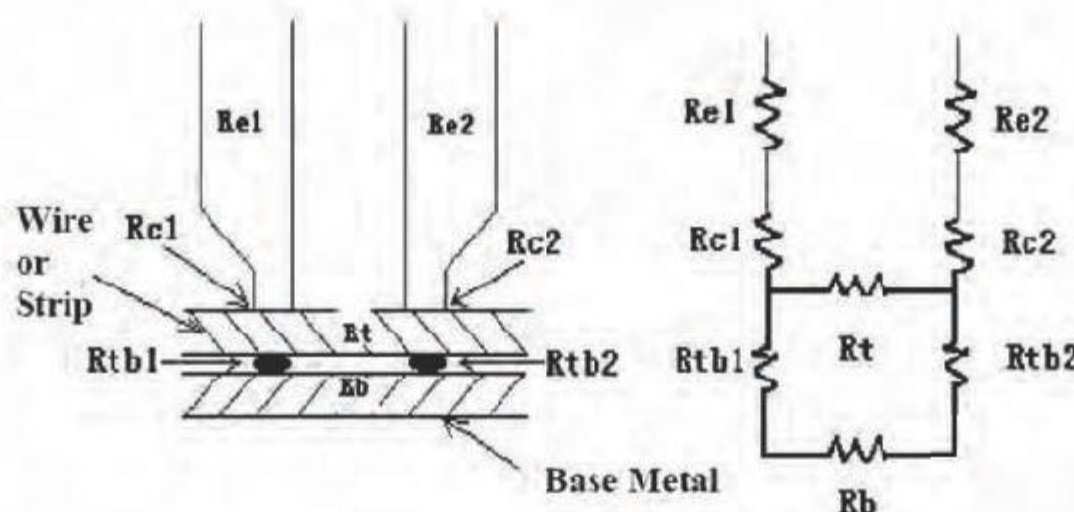
**Heat Generation:** The basic formula for heat generation is based on a modified Ohm's Law.

$$H = I^2R, \text{ Where } H = \text{Heat}$$

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and  $I = \text{Welding Current}$   
 $R = \text{Total Resistance of the Welding Path}$

The total resistance of the welding path is shown in the figure below



Where  $R_{e1}$  and  $R_{e2}$  are the resistance of the left and right halves of the electrode,  $R_{c1}$  and  $R_{c2}$  are the contact resistance of the electrode and the wire or strip,  $R_t$  is the wire or strip resistance,  $R_{tb1}$  and  $R_{tb2}$  are contact resistance between the wire or strip and the base metal, and  $R_b$  is the resistance of the base material. The parallel gap welder and electrode are constructed so that the path of resistance is fixed and minimized. Therefore, the resistance of the wire or strip, the base material and contact resistance are the only variables during the welding process. Therefore, the total heat generated is dependent on this formula and the welding parameters having to be adjusted case by case.

**The Time Factor:** To make good resistance welding joints, it is necessary to have a close control of the time and current flow. Therefore, the heat generation formula is modified to

$$H = I^2RTK, \text{ Where } H = \text{Heat}$$

and  $I = \text{Welding Current}$   
 $R = \text{Total Resistance of the Welding Path}$   
 $T = \text{Time}$   
 $K = \text{Heat Losses}$

**Time control** is important. If the duration is too long, the temperature generated at the joint may exceed the melting point of the materials (metal wire or strip and base metal) and cause damage.

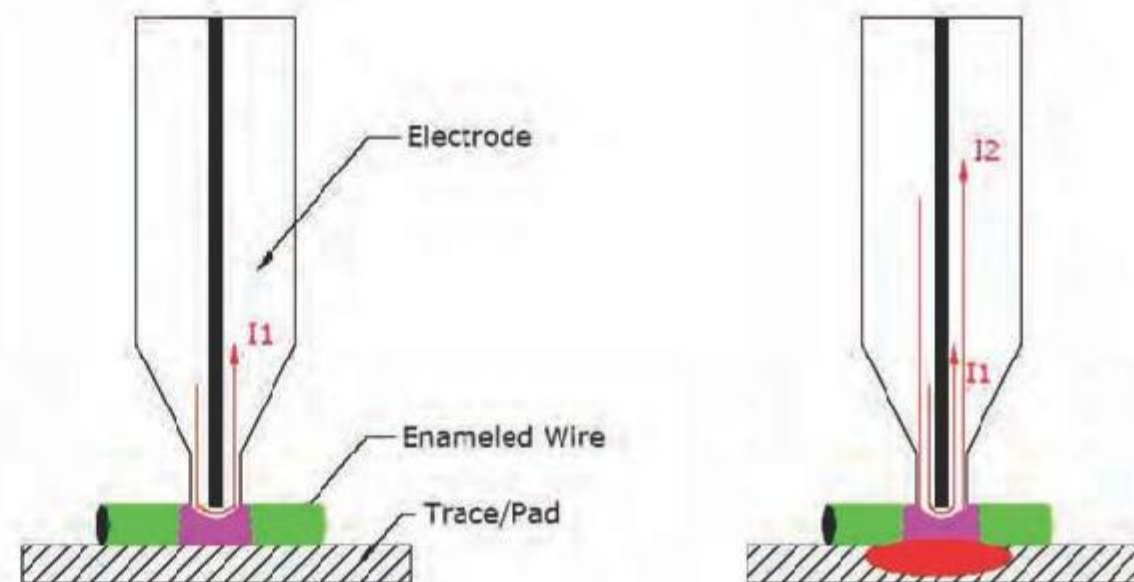
**Pressure:** The effect of pressure on the resistance weld should be carefully considered. The primary purpose of the pressure is to hold the parts to be welded. This action assures a consistent electrical contact of the materials, i.e., stable resistance and conductivity at the point of weld. Investigations have shown that high pressures exerted on the weld joint decrease the resistance at the point of contact between the electrode tip and the work piece surface. The higher the pressure and lower the resistance, the less power and time are required. On the other hand, intimate contact of the electrode tip and the work piece may tend to conduct heat away from the weld. In this case, higher current and longer time may be necessary to complete the weld. In addition, higher pressure may cause deforming of the work piece, especially, if the base metal is on the softer substrate, such as FR4 or Duriod board.

**Parallel Gap Welders** offered by SW Tech Equipment are based on above mentioned resistance or ohmic spot welding principle. Through a special consideration of current or voltage and pulse width generation and control, it can not only weld metal strips and ribbons, but also enameled wires without insulation layer stripping to various conductive materials and plated surfaces, including, but not limited to nickel, tin, silver and gold.

The required welding power is generated through a *transformer* style power supply, which converts the high voltage electricity from the utility line into a high current and low voltage stable output. A capacitive energy storage device is implemented to guarantee constant large current demand during the welding process. In order to deliver an accurate welding power (amperage and duration), a modulation or control circuit is included to control or set the pulse with proper pulse amplitude and duration. In order to perform the enameled wire welding, stripping pulse and welding pulse are generated as pulse 1 and pulse 2 in a short period, but in a sequential manner. The enameled wire welding process is shown in the figure below. The amplitude and duration of the first pulse is typically low and short, but enough to cause the insulation layer of the enameled wire to burn and shrink back to have the metal exposed. Then the second pulse with larger power and proper duration completes the welding.

**Configuration:** Parallel Gap Welder is composed of *four* main parts: Control Unit (Power Supply), Welding Head with Foot Pedal, Welding Table and Electrode. Due to the small size of working components in most cases, an optional optical magnification device is required.

- **Control Unit** is the brain of the welder. It not only supplies the power to the welder, but also controls the welding parameters to guarantee optimal welding joints.
- **Welding Head** is a key mechanical setup of the Parallel Gap Welders. Proper installation and alignment of the welding head and foot pedal is critical for the welder performance. Foot pedal provides a man/machine interface point. The welding is performed when the foot pedal is pressed.
- **Welding Table** is a physical working area, where the work piece is placed and supported.
- **Electrode** is the welding tool. Proper selection of the electrode plays key role to achieve a successful welding.



The outline drawings of the completed parallel gap welder setups with either stereo microscope or digital monocular microscope are illustrated in the next page.

## Parallel Gap Welder Pro, Model # SMAPRO100



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### FEATURES:

- Patented technology
- Rugged design
- Parallel gap welding
- No solder involved, RoHS compliant
- Reliable welding joint
- Large welding parameter range
- Custom design available

### APPLICATIONS:

- **Gold and silver ribbon welding**
- **Enameled wire welding**
- Metal wire welding
- Metal strip welding
- RF and microwave circuits tuning

### DESCRIPTION:

**SMAPRO100 Parallel Gap Welder Pro** is one of the company's flagship products. It is configured with push buttons for output voltage amplitude and pulse duration selections. The welding schedule is displayed on a large LED screen located on the front panel of the welding control unit.

As stated in the introduction section, the most prominent feature of Model **SMAPRO100** is that it can not only weld the gold or silver ribbons, bare metal strips and wires, but also can weld enameled wires without additional coating layer stripping steps. Thus, it eliminates the expensive and difficult stripping process. Since there is no toxic soldering materials involved, the products manufactured meet **RoHS** requirements naturally.

Model **SMAPRO100** is offered in TWO output power levels to handle various wire diameters. While **Type S** is a lower power output model mainly for gold/silver ribbons and smaller wire diameters or metal strip sizes, **Type L** is a higher power output model for larger wire diameters or strip sizes.

Model **SMAPRO100** comes with 5 electrodes free of charge for customer's convenience. Customer may select the model number) from the catalog models offered in the catalog when the order is placed.

### OPTICAL Devices:

The optical devices are not included in the base model of **SMAPRO100**. The photos shown are for illustration only. The stereo microscope, digital monocular and Trinocular microscope assemblies designed especially for the parallel welders are offered under part number SW-SMA-5PG, SW-DMA-58N and SW-TMA-52N. Consult factory for using customer's own optical devices.

# The World's Best Enameled Wire and Ribbon Parallel Gap Welders



The photos of the microscope assemblies are shown below. For Model SW-DMA-58N and SW-TMA-52N, a LCD monitor accepting NTSC video mode is required for image display.

SW-SMA-5PG



SW-DMA-58N



SW-TMA-52N



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## KEY SPECIFICATIONS:

NAME	PARAMETERS	
	Type S	Type L
Type		
Input Power	110 VAC/60 Hz or 220 VAC/50 Hz	
Output Pulse Power	400 W (Max)	800 W (Max)
Output Pulse Amplitude	0 to 1.99 V adjustable	0 to 2.99 V adjustable
Output Pulse Width	0 to 29.9 ms (Step Size: 0.1 ms)	
Welding Head Force	1 to 100 ounces (30 to 3,000 grams) adjustable	
Welding Speed	120 Strokes/Minute (Max)	100 Strokes/Minute (Max)
Gold Ribbon (W x T)*	2 to 25 x 0.25 to 5 mils (0.05 to 0.65 x 0.006 to 0.13 mm), <b>Type S</b>	
Wire Diameter Range	0.8 to 10 mils (0.02 to 0.250 mm)	3 to 16 mils (0.08 to 0.40 mm)
Control Unit Size	13" (W) x 7" (H) x 8" (D) or 330mm (W) x 180mm (H) x 200mm (D)	
Control Unit Weight	35 Lbs or 16 Kg	

\*Recommendation: Choose Type S for Gold Ribbon welding.

## ELECTRODES:

In addition to the output power and welding parameter setting, proper electrode selection is another key factor to deliver a successful and reliable welding joint. Nine electrode families with various electrode head shapes and materials are offered for different applications. The key parameters of the electrodes and their applications are summarized in the **Parallel Gap Welder Electrodes** datasheet.

## Parallel Gap Welder Premium, Model # SMAPRO180



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### FEATURES:

- Patented technology
- Parallel gap welding
- No solder involved, RoHS compliant
- Auto welding power adjustment
- Large welding parameter range
- Store up to 20 welding schedules with recall ability
- RS232 and RS485 communication ports

### APPLICATIONS:

- **Gold and silver ribbon welding**
- **Enameled wire welding**
- Metal wire welding
- Metal strip welding
- Auto or volume production line ready
- RF and microwave circuits tuning

### DESCRIPTION:

**SMAPRO180, Parallel Gap Welder Premium** is one of the company's next generation welding machine, which incorporates the most advanced hardware and software technologies. In addition to what Model **SMAPRO100** can offer, **SMAPRO180** is engineered to include more functionalities for low and large volume production and automatic production lines. Through RS232, **SMAPRO180** can communicate with center computer and robotic arms in a production environment, as RS485 offers real time welding parameters for production flow monitoring. In addition, it can store up to 20 welding schedules in its flash memory for recall and the welding power is adjusted automatically to realize finer control of the welding joints.

As stated in the introduction section, the most prominent capacity of **SMAPRO180** is that it can not only weld the gold or silver ribbons, bare metal strips and wires, but it also can weld enameled wires without additional coating layer stripping steps. Thus, it eliminates the expensive and difficult stripping process. Since there is no toxic soldering materials involved, the products manufactured meet **RoHS** requirements naturally.

Similarly, Model **SMAPRO180** is offered in TWO output power levels to handle various wire diameters. While **Type S** is a lower power output model mainly for gold/silver ribbons and smaller wire diameters or metal strip sizes, **Type L** is a higher power output model for larger wire diameters or strip sizes.

Model **SMAPRO180** comes with 5 electrodes for customer's convenience. Customer may select the model number from the catalog models offered in the catalog when the order is placed.

## OPTICAL DEVICES:

The optical devices are not included in the base model of **SMAPRO180**. The photos shown are for illustration only. The stereo microscope, digital monocular and Trinocular microscope assemblies designed especially for the parallel gap welders are offered under part number SW-SMA-5PG, SW-DMA-58N and SW-TMA-52N. Consult factory for using customer's own optical devices.

The photos of the microscope assemblies are shown below. For Model SW-DMA-58N and SW-TMA-52N, a LCD monitor accepting NTSC video mode is required for image display.

SW-SMA-5PG



SW-DMA-58N



SW-TMA-52N



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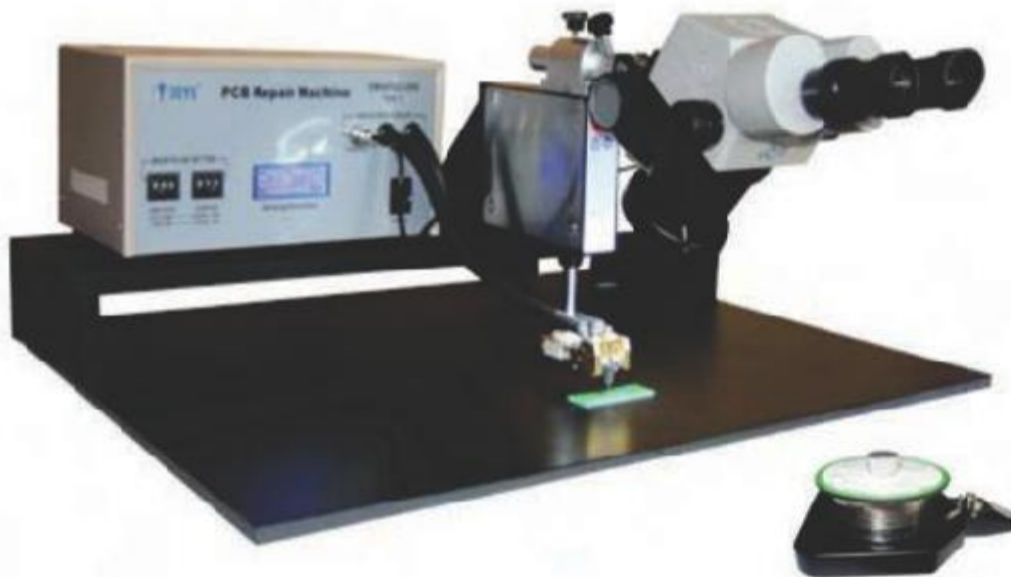
## KEY SPECIFICATIONS:

NAME	PARAMETERS	
	Type S	Type L
Input Power	110 VAC/60 Hz or 220 VAC/50 Hz	
Output Pulse Power	400 W (Max)	800 W (Max)
Output Pulse Amplitude	0 to 1.99 V adjustable	0 to 2.99 V adjustable
Output Pulse Width	0 to 29.9 ms (Step Size: 0.1 ms)	
Welding Head Force	1 to 100 ounces (30 to 3,000 grams) adjustable	
Welding Speed	120 Strokes/Minute (Max)	100 Strokes/Minute (Max)
Gold Ribbon (W x T)*	2 to 25 x 0.25 to 5 mils (0.05 to 0.65 x 0.006 to 0.13 mm), <b>Type S</b>	
Wire Diameter Range	0.8 to 10 mils (0.02 to 0.250 mm)	3 to 16 mils (0.08 to 0.40 mm)
Storage Capacity	Up to 20 schedules	
Communication Ports	RS232 and RS485	
Control Unit Size	13"(W) x 7.5"(H) x 8"(D) or 330mm (W) x 190mm (H) x 200mm (D)	
Control Unit Weight	35 Lbs or 16 Kg	

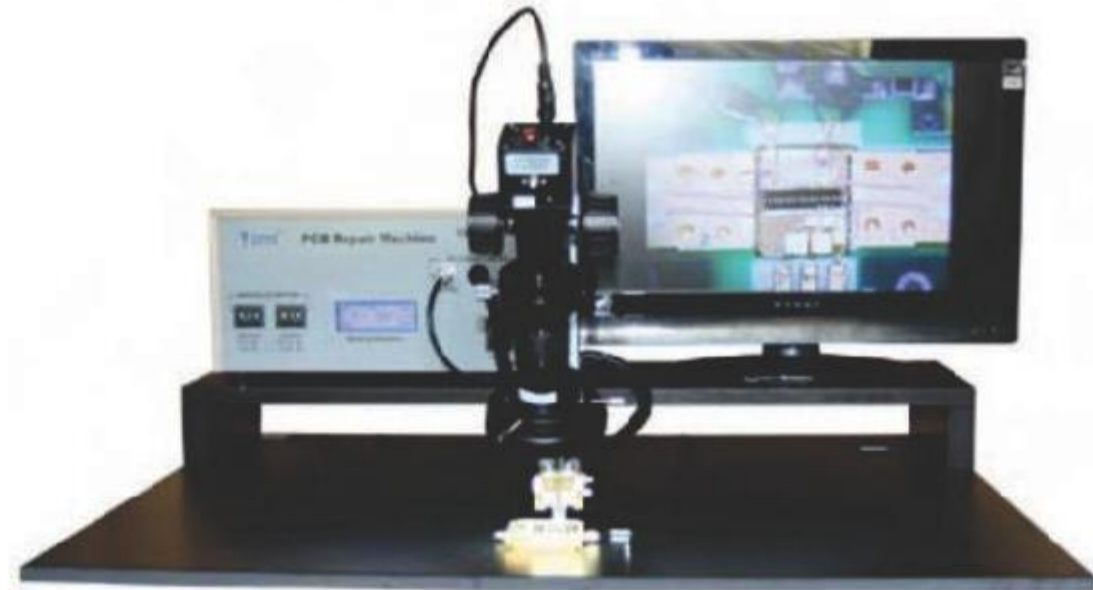
\*Recommendation: Choose Type S for Gold Ribbon welding.



## Printed Circuit Board Repair Machine, Model # SMAPRO200



PCB Repair Strip



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### FEATURES:

- Rugged design
- Resistive parallel gap welding
- No solder involved, RoHS compliant
- Reflow and wave soldering compliant
- Large welding parameter range
- Large work area

### APPLICATIONS:

- Printed circuit board trace repairing
- Engineering or prototype alternation
- Volume production repairing

### DESCRIPTION:

**SMAPRO200, Printed Circuit Board (PCB) Repair Machine** is specially designed for PCB repairing. The core technology implemented in this machine is based on resistance or ohmic spot welding principle. It not only eliminates the costly and difficult trace repairing process, but also results neat, clean, pollution/corrosion free and more reliable traces. **The repaired traces can sustain tough cleaning process, wave solder reflow process and meet original design specifications.** In addition, the process meets **RoHS** requirements since there are no toxic soldering materials involved. Various repairing strip sizes and welding electrodes are available for different trace size and load capacity. The strip materials are typically gold or tin plated copper.

Similarly, Model **SMAPRO200** is offered in TWO output power levels to handle various trace sizes. While **Type S** is a lower power output model mainly for smaller trace sizes, **Type L** is a higher power output model for larger trace sizes.

Model **SMAPRO200** comes with 2 electrodes for customer's convenience. The model numbers of the electrodes are SW-ETD-PCB and SW-ETD-PCB. Their detailed specifications are included in page 31 of this catalog. Model **SMAPRO200** can also be configured to utilize standard and clean free parallel gap welder electrodes for more convenient electrode installation. Contact factory for details.

### OPTICAL DEVICES:

The optical devices are not included in the base model of **SMAPRO200**. Refer to Parallel Gap Welder sections for optical device selections.

**KEY SPECIFICATIONS:**

NAME	PARAMETERS	
	Type S	Type L
Input Power	110 VAC/60 Hz or 220 VAC/50 Hz	
Output Pulse Power	400 W (Max)	800 W (Max)
Output Pulse Amplitude	0 to 1.99 V adjustable	0 to 2.99 V adjustable
Output Pulse Width	0 to 29.9 ms (Step Size: 0.1 ms)	
Welding Head Force	1 to 100 ounces (30 to 3,000 grams) adjustable	
Welding Speed	120 Strokes/Minute (Max)	100 Strokes/Minute (Max)
Maximum Sheet Width	29" (740 mm)	
Repair Strip Sizes (W x T)	2 to 20 x 1.5 to 2 mils (0.05 to 0.65 x 0.04 to 0.05 mm)	
Control Unit Size	13" (W) x 7" (H) x 8" (D) or 330mm (W) x 180mm (H) x 200mm (D)	
Control Unit Weight	35 Lbs or 16 Kg	

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**PCB REPAIR STRIPS:**

Two types PCB repair strips are commonly used in the industry. They are lead free tin coated oxygen free copper strip and lead free gold plated oxygen free copper strip. The tin coated copper strips are mostly recommended since they offer the strongest welding joints. The main specifications of the strips are illustrated in the following table. Contact factory for the size not listed.

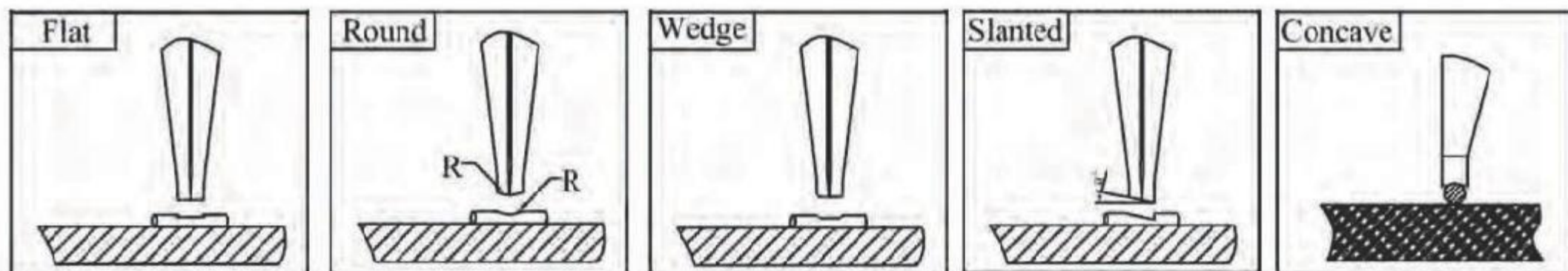
NAME	Lead Free Tin Coated Oxygen Free Copper Strip	Lead Free Gold Plated Oxygen Free Copper Strip
	SW-PCB-TXX	SW-PCB-GXX
Model Number		
Width (Tolerance)	2, 3, 4, 5, 6, 7, 8, 10, 12, 15, 16, 18 and 20 mils (+/- 0.05 mils)	
Thickness (Tolerance)	1.0, 1.5 and 2 mils (+/- 0.02 mils)	
Thermo Stability	0.000016 ppm/°C	
Conductivity	0.000045 Ω/inch	0.000040 Ω/inch
Coating Thickness	1.5 μm	
Spoon Diameter	2.0 inches	
Length in Spoon	100 Feet (30 Meters)	
Type of Finishing	Tin, Gold	
Lead Free	Yes, meet RoHS standards. Certificates issued by SGS.	

## General Introduction

### (Parallel Gap Welder Electrodes)

**Parallel gap welder electrodes** are the key components in the gap welding process. The electrode tip shape, insulator and the material are the critical factors to produce quality electrodes.

**SW Tech Equipment** offers three types of electrodes, namely, standard electrodes, clean free electrodes and PCB repair machine electrodes. The materials utilized are High Temperature Molybdenum Alloy (HTM), High Purity Molybdenum Alloy (HPM) and Molybdenum Tungsten Alloy (MTA). There are various tip shapes available for performing different ribbon and enameled wire welding tasks. The following figures illustrate the tip shapes that **SW Tech Equipment** offers.



**Parallel Gap Welder Standard Electrode:** The standard electrodes are built in two halves. The two halves are bonded together with a thin adhesive insulator layer. The tips of these electrodes are "open", i.e., the insulator layer is extended to the tip. See figure below for details. Therefore, the electrical current flows from the left half to right half must be completed through the ribbon or wire to be welded. In other words, there is no heat generated if the two halves of the electrode do not contact a conductor simultaneously. The advantage of this type of electrode is that it requires relative lower power to generate the welding heat. On the other, the tip is easier to be contaminated due to its open end nature.

**Parallel Gap Welder Clean Free Electrode:** The clean free electrodes are built in two halves. The two halves are bonded together with a thin adhesive insulator. However, the tips of these electrodes are "closed", i.e., there is a metal bridge crossing the two halves at the tip. See figure below for details. Therefore, the electrical current flow from the left half to right half can be completed without contacting any conductor. In other words, the heat is generated at the tip once there is a current flow. The advantage of this type of electrode is that it is hard to become contaminated due to its closed tip nature. Therefore, this type of electrode is more durable and hardly requires cleaning. On the other hand, they require relative higher power to generate the welding heat since there is extra mass requiring to be heated at the tip.

**PCB Repair Machine Electrode:** The PCB repair machine electrodes are consist of two pieces. Unlike parallel gap welders' electrodes, they are separate pairs.



## Parallel Gap Welder Electrodes Standard, Model # SW-ETD-XXX



### FEATURES:

- Durable configuration
- Various head shapes and sizes
- Various material selection
- Cost effective
- Custom build available

### APPLICATIONS:

- SW Tech Equipment parallel gap welders
- Industry standard parallel gap welders
- Gold and silver ribbon welding
- Enameled wire welding
- Bare metal strip and wire welding

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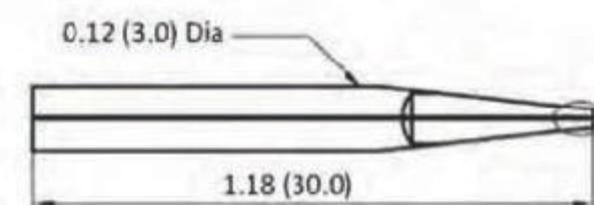
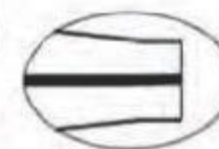
### DESCRIPTION:

**Model SW-ETD-XXX series parallel gap electrodes** are built in two halves, typically oriented in left and right positions in the electrode holder. They are bonded together with a thin adhesive insulator. The material used for these standard electrodes are High Temperature Molybdenum Alloy (HTM) and High Purity Molybdenum Alloy (HPM). While HTM electrodes are designed for iron-nickel alloy and/or gold finished surface or material, HPM electrodes can be used for tin and/or silver plated surface and material in addition to what HTM electrodes can perform on.

The standard models are grouped into 5 families according to their tip sizes and type of material to suit different types of applications and different wire diameters or strip sizes. Each family has 5 different head shapes for user to choose. The diameter and length of these standard electrodes are 0.12" x 1.18" (3.0 mm x 30.0 mm). The outlines of these electrodes are designed to meet the industry standard and can be used in many other manufacturers' welders. The detailed outline drawings and tip shapes of these electrodes are shown in the introduction section and here. While standard models can cover most of customers' needs, custom designs are also available.

- **Flat :** Mainly used for gold, silver, metal ribbons and wires. It is recommended for softer base material, such as FR4 and Duroid boards. It has moderate durability.
- **Wedge:** Mainly used for gold, silver, metal ribbons and wires. It is designed for large diameter wires and bigger ribbon strips. It has good durability.
- **Round:** Mainly used for gold, silver, metal ribbons and wires. It is the most durable electrode.
- **Slanted:** Mainly used for wires and ribbons when cutting is needed at the finish.
- **Concave:** It is also known as "V" shaped electrode sometimes. It is mainly designed for capturing the round shaped wires. It may have the shortest longevity among all five shapes.

Unit: Inch (mm)



**SPECIFICATIONS:**

Model No.	Head Shape	Head Size (A x B)	Material	Recommended Setting
SW-ETD-Q1R	Round	20 x 22 mils <sup>2</sup> (0.50 x 0.55 mm <sup>2</sup> )	HTM	Amplitude (Power): 0.60 V Time (Duration): 5.0 ms Force: 10±3 ounces (300±100 grams)
SW-ETD-Q1F	Flat	19 x 21 mils <sup>2</sup> (0.47 x 0.53 mm <sup>2</sup> )		
SW-ETD-Q1S	Slanted	19 x 20 mils <sup>2</sup> (0.47 x 0.50 mm <sup>2</sup> )		
SW-ETD-Q1W	Wedge	17 x 19 mils <sup>2</sup> (0.42 x 0.48 mm <sup>2</sup> )		
SW-ETD-Q1C	Concave	N/A		
SW-ETD-E2R	Round	21 x 22 mils <sup>2</sup> (0.53 x 0.64 mm <sup>2</sup> )	HTM	Amplitude (Power): 0.70 V Time (Duration): 6.0 ms Force: 13±3 ounces (400±100 grams)
SW-ETD-E2F	Flat	20 x 24 mils <sup>2</sup> (0.50 x 0.62 mm <sup>2</sup> )		
SW-ETD-E2S	Slanted	20 x 26 mils <sup>2</sup> (0.50 x 0.67 mm <sup>2</sup> )		
SW-ETD-E2W	Wedge	18 x 23 mils <sup>2</sup> (0.45 x 0.60 mm <sup>2</sup> )		
SW-ETD-E2C	Concave	N/A		
SW-ETD-E4R	Round	26 x 24 mils <sup>2</sup> (0.65 x 0.62 mm <sup>2</sup> )	HPM	Amplitude (Power): 0.80 V Time (Duration): 7.0 ms Force: 20±3 ounces (600±100 grams)
SW-ETD-E4F	Flat	24 x 23 mils <sup>2</sup> (0.62 x 0.60 mm <sup>2</sup> )		
SW-ETD-E4S	Slanted	24 x 25 mils <sup>2</sup> (0.62 x 0.65 mm <sup>2</sup> )		
SW-ETD-E4W	Wedge	22 x 23 mils <sup>2</sup> (0.56 x 0.58 mm <sup>2</sup> )		
SW-ETD-E4C	Concave	24 x 23 mils <sup>2</sup> (0.62 x 0.60 mm <sup>2</sup> )		
SW-ETD-E7R	Round	29 x 28 mils <sup>2</sup> (0.73 x 0.72 mm <sup>2</sup> )	HPM	Amplitude (Power): 1.10 V Time (Duration): 8.0 ms Force: 30±3 ounces (1,000±100 grams)
SW-ETD-E7F	Flat	27 x 27 mils <sup>2</sup> (0.70 x 0.70 mm <sup>2</sup> )		
SW-ETD-E7S	Slanted	27 x 30 mils <sup>2</sup> (0.70 x 0.75 mm <sup>2</sup> )		
SW-ETD-E7W	Wedge	23 x 26 mils <sup>2</sup> (0.60 x 0.68 mm <sup>2</sup> )		
SW-ETD-E7C	Concave	27 x 29 mils <sup>2</sup> (0.70 x 0.73 mm <sup>2</sup> )		
SW-ETD-E9R	Round	33 x 37 mils <sup>2</sup> (0.83 x 0.94 mm <sup>2</sup> )	HPM	Amplitude (Power): 1.10 V Time (Duration): 8.0 ms Force: 60±3 ounces (1,800±100 grams)
SW-ETD-E9F	Flat	32 x 36 mils <sup>2</sup> (0.80 x 0.92 mm <sup>2</sup> )		
SW-ETD-E9S	Slanted	32 x 38 mils <sup>2</sup> (0.80 x 0.96 mm <sup>2</sup> )		
SW-ETD-E9W	Wedge	30 x 34 mils <sup>2</sup> (0.75 x 0.85 mm <sup>2</sup> )		
SW-ETD-E9C	Concave	32 x 36 mils <sup>2</sup> (0.80 x 0.92 mm <sup>2</sup> )		

Note: Contact factory for other models and customers' own models.

**OUTLINE:**

For dimension "A" and "B", see detailed outline on Page 30.

## Parallel Gap Welder Electrodes Clean Free, Model # SW-ETD-NXX



### FEATURES:

- Durable configuration
- Various head shapes and sizes
- Various material selection
- Cost effective
- Custom build available

### APPLICATIONS:

- SW Tech Equipment parallel gap welders
- Industry standard parallel gap welders
- Gold and silver ribbon welding
- Enameled wire welding
- Bare metal strip and wire welding

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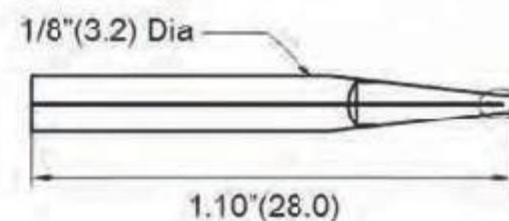
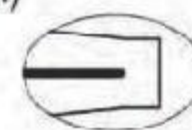
### DESCRIPTION:

**Model SW-ETD-NXX series parallel gap electrodes** are built in two halves, typically oriented in left and right positions in the electrode holder. They are bonded together with a thin adhesive insulator. Unlike standard electrodes, the tip of the clean free electrodes is closed. The advantage of this type of electrodes is that it prevents the residual material build up during the welding process. Therefore, it is also referred as "clean free" electrodes. The material used for these clean free electrodes is Molybdenum Tungsten Alloy (MTA).

The standard models of clean free electrodes are also grouped into 5 families according to their tip sizes and type of material to suit different types of applications and different wire or strip sizes. Each family has 5 different head shapes for user to choose. The diameter and length of these standard electrodes are 1/8" x 1.10" (3.2 mm x 28.0 mm). The outlines of these electrodes are designed to meet the industry standard and can be used in many other manufacturers' welders. The detailed outline drawings and tip shapes of these electrodes are shown in the introduction section and here. While standard models can cover most of customers' needs, custom designs are also available.

- **Flat :** Mainly used for gold, silver, metal ribbons and wires. It is recommended for softer base material, such as FR4 and Duroid boards. It has moderate durability.
- **Wedge:** Mainly used for gold, silver, metal ribbons and wires. It is designed for large diameter wires and bigger ribbon strips. It has good durability.
- **Round:** Mainly used for gold, silver, metal ribbons and wires. It is the most durable electrode.
- **Slanted:** Mainly used for wires and ribbons when cutting is needed at the finish.
- **Concave:** It is also known as "V" shaped electrode. It is mainly designed for capturing the round shaped wires. It may have the shortest longevity among all five shapes.

Unit: Inch (mm)



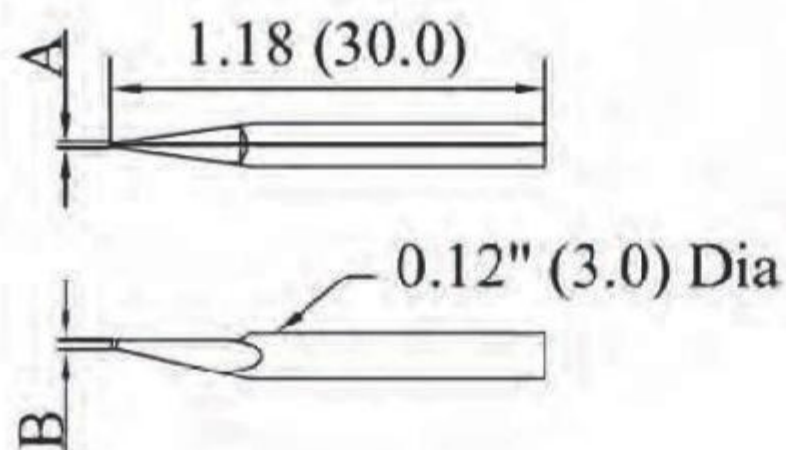
## SPECIFICATIONS:

Model No.	Head Shape	Head Size (A x B)	Material	Recommended Setting
SW-ETD-N0R	Round	41 x 41 mils <sup>2</sup> (1.05 x 1.05 mm <sup>2</sup> )	MTA	Amplitude (Power): 1.30 V Time (Duration): 8.0 ms Force: 64±3 ounces (2,000±100 grams)
SW-ETD-N0F	Flat	39 x 39 mils <sup>2</sup> (1.00 x 1.00 mm <sup>2</sup> )		
SW-ETD-N0S	Slanted	39 x 43 mils <sup>2</sup> (1.00 x 1.10 mm <sup>2</sup> )		
SW-ETD-N0W	Wedge	31 x 35 mils <sup>2</sup> (0.80 x 0.90 mm <sup>2</sup> )		
SW-ETD-N0C	Concave	39 x 39 mils <sup>2</sup> (1.00 x 1.00 mm <sup>2</sup> )		
SW-ETD-N1R	Round	32 x 32 mils <sup>2</sup> (0.82 x 0.82 mm <sup>2</sup> )	MTA	Amplitude (Power): 1.20 V Time (Duration): 8.0 ms Force: 20±3 ounces (600±100 grams)
SW-ETD-N1F	Flat	31 x 33 mils <sup>2</sup> (0.80 x 0.85 mm <sup>2</sup> )		
SW-ETD-N1S	Slanted	31 x 33 mils <sup>2</sup> (0.80 x 0.85 mm <sup>2</sup> )		
SW-ETD-N1W	Wedge	28 x 31 mils <sup>2</sup> (0.70 x 0.75 mm <sup>2</sup> )		
SW-ETD-N1C	Concave	31 x 31 mils <sup>2</sup> (0.80 x 0.80 mm <sup>2</sup> )		
SW-ETD-N2R	Round	28 x 28 mils <sup>2</sup> (0.72 x 0.72 mm <sup>2</sup> )	MTA	Amplitude (Power): 1.00 V Time (Duration): 6.0 ms Force: 16±3 ounces (500±100 grams)
SW-ETD-N2F	Flat	27 x 27 mils <sup>2</sup> (0.70 x 0.70 mm <sup>2</sup> )		
SW-ETD-N2S	Slanted	27 x 29 mils <sup>2</sup> (0.70 x 0.75 mm <sup>2</sup> )		
SW-ETD-N2W	Wedge	24 x 26 mils <sup>2</sup> (0.60 x 0.65 mm <sup>2</sup> )		
SW-ETD-N2C	Concave	27 x 27 mils <sup>2</sup> (0.70 x 0.70 mm <sup>2</sup> )		
SW-ETD-N3R	Round	24 x 24 mils <sup>2</sup> (0.62 x 0.62 mm <sup>2</sup> )	MTA	Amplitude (Power): 0.80 V Time (Duration): 5.0 ms Force: 13±3 ounces (400±100 grams)
SW-ETD-N3F	Flat	23 x 23 mils <sup>2</sup> (0.60 x 0.60 mm <sup>2</sup> )		
SW-ETD-N3S	Slanted	23 x 25 mils <sup>2</sup> (0.60 x 0.65 mm <sup>2</sup> )		
SW-ETD-N3W	Wedge	20 x 22 mils <sup>2</sup> (0.50 x 0.55 mm <sup>2</sup> )		
SW-ETD-N3C	Concave	23 x 23 mils <sup>2</sup> (0.60 x 0.60 mm <sup>2</sup> )		

Note: Contact factory for other models and customers' own models.

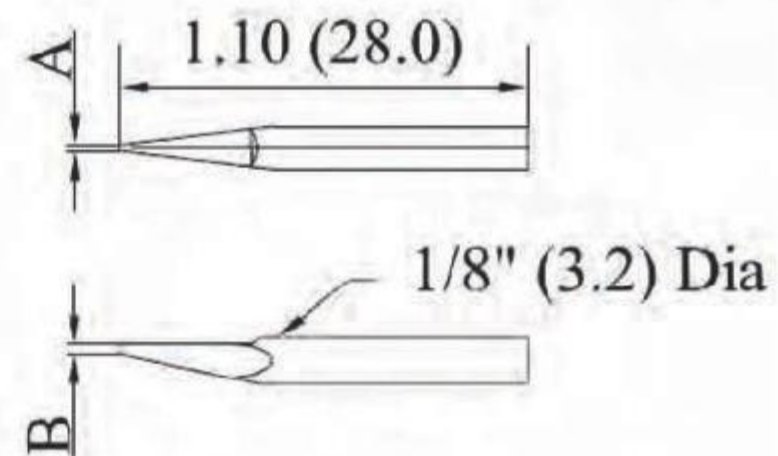
## OUTLINES:

Unit: Inch (mm)



Standard

Unit: Inch (mm)



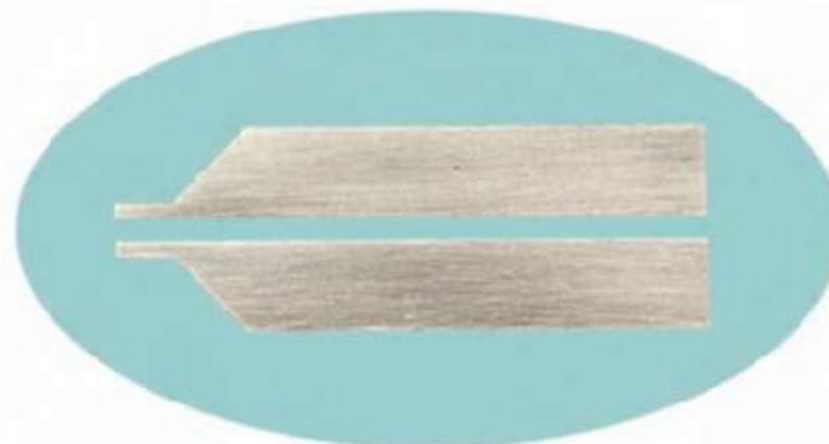
Clean Free

Parallel Gap Welder Electrodes For PCB Repair Machine, Model # SW-ETD-PCX

SW-ETD-PCA



SW-ETD-PCB



**FEATURES:**

- Durable configuration
- Two models available
- Gold plated
- Cost effective
- Custom build available

**APPLICATIONS:**

- SW Tech Equipment PCB repair machine
- Industry standard parallel gap welders
- Gold and silver ribbon welding
- Metal strip and wire welding

**DESCRIPTION:**

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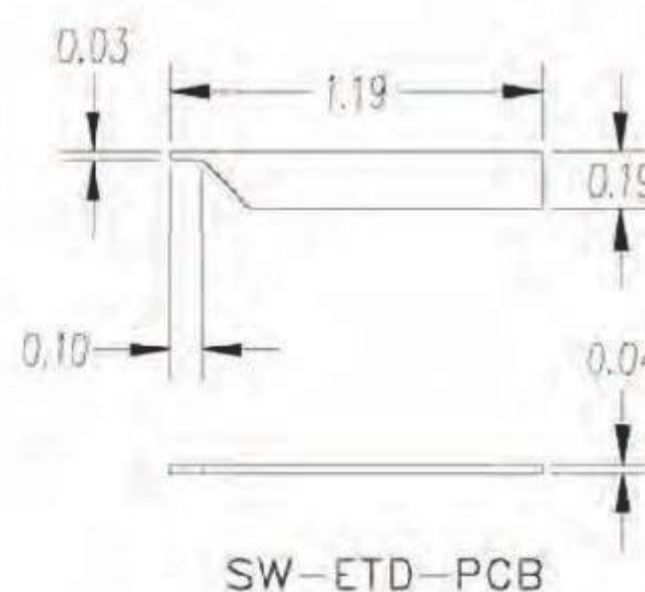
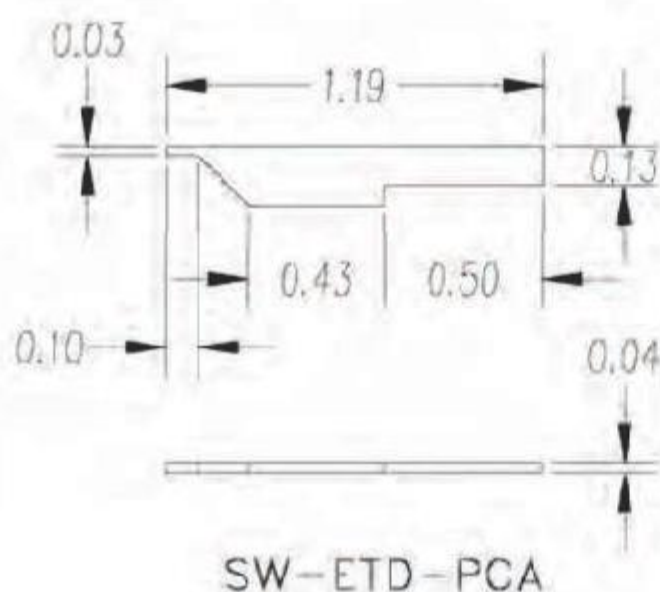
**Model SW-ETD-PCX series parallel gap electrodes** are built in two halves, typically oriented in left and right positions in the electrode holder. The material used for these PCB repair machine electrodes is High Temperature Molybdenum Alloy (HTM). The finish is gold plated. Unlike other electrodes, these electrodes are configured as separate two halves.

There are two standard models for PCB repair machine electrodes. While standard models can cover most of customers' needs, custom designs are also available.

**SPECIFICATIONS:**

Model	Tip Size	Material
SW-ETD-PCA	0.03" x 0.04" (0.70 mm x 1.00 mm)	High Temperature Molybdenum Alloy
SW-ETD-PCB	0.03" x 0.04" (0.70 mm x 1.00 mm)	High Temperature Molybdenum Alloy

**OUTLINES:**





## I. Parallel Gap Welder Selection Guide

Parallel gap welding technique was developed for applications where the parts on the same plane need to be welded together. It is very similar to the surface mount soldering process.

Industry wise, there are two types of power suppliers, **AC-DC-AC inverter power supply** and **DC power supply**, are implemented in the parallel gap welders. While the focus of the AC-DC-AC inverter power supply is to offer higher welding power, the DC power supply is for low power and fine output power control.

The parallel gap welders offered by **SW Tech Equipment** use DC power supplies since the main focus of these welders are for small parts welding applications. Therefore, the fine closed-loop feedback control and fast response time are the main concerns.

*Four* models are offered for customer selection. The table below summarizes the major considerations of each model to assist customer to select the correct model to best suit his/her applications and budget.

Item	Parameters			
	SMAPRO100		SMAPRO180	
Model	Type S	Type L	Type S	Type L
Input Power	110 VAC/60 Hz or 220 VAC/50 Hz			
Output Pulse Power	400 W (Max)	800 W (Max)	400 W (Max)	800 W (Max)
Welding Pulse Width	0.1 to 29.9 ms (Step Size: 0.1 ms)		0.1 to 19.9 ms	
Welding Pulse Amplitude	0 to 1.99 V adjustable		0 to 2.99 V adjustable	
Welding Head Force	1 to 100 ounces adjustable			
Auto Power Control	No		Yes	
Gold Ribbon (W x T)	2 to 25 mils x 0.25 to 5 mils, Type S is recommended.			
Wire Diameter Range	0.8 to 10 mils	3 to 16 mils	0.8 to 10 mils	3 to 16 mils
Welding Schedule	No		Yes	
RS232 Port	No		Yes	
RS485 Port	No		Yes	
Control Unit Dimensions	13"(W) x 7"(H) x 8"(D)		13"(W) x 7.5"(H) x 8"(D)	
Overall Weight	36 Lbs or 16 Kg			
Cost	Low		High	

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### General recommendations from SW Tech Equipment are:

1. Choose model SMAPRO100 if the basic parallel gap welding is concerned since the model is a low cost version.
2. Choose Type S if only gold/silver ribbon welding is concerned since the type offers enough power, but finer welding power control.

## II. Parallel Gap Welder Schedule Setting Guide

Parallel gap welding is based on resistance or ohmic welding principles. Resistance welding is realized when current is allowed to flow through the left and right halves of the electrode and separate pieces of the metal to be joined. The resistance of the base metal to electrical current flow causes localized heating in the joint, and a weld is made. In all cases, the current must flow in order to form a weld. The pressure of the electrode tip on the work piece holds the part in close and intimate contact during the making of the weld. Therefore, four factors, power (amperage or amplitude and time or duration of the electronic pulse), resistance and pressure are the key factors in making an optimal welding joint. In addition, the type of electrode used plays an important role as well.

On the other hand, too high level setting may damage or reduce the life of electrodes or damage the work pieces. Always start with low welding level. **The recommended initial settings are amplitude: 0.8 V, time: 6.0 ms and force: 10 ounces (300 grams).** Increase the welding parameter setting gradually to obtain the optimum welding joints.

The following three tables show the recommended settings for certain gold ribbons, enameled wires, and types of the electrodes used. As discussed earlier, four factors, voltage amplitude, voltage duration, resistance and pressure are the key factors. In general, for the same work piece and selected electrode, the higher welding power (amplitude and duration), the lower the pressure and vice versa. However, the required welding power and pressure may be different due to different work piece or electrode since the total resistance may be different. Therefore, the recommended settings given below are for reference only. The fine adjustment for each case is required in order to obtain the most reliable welding joints.

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### 1. Gold Ribbons

Item	Recommended Application	Recommended Setting	Recommended Electrodes
1	Gold ribbon: 5 mils wide x 0.5 mils thick Base material and/or finish: thin film substrate and gold finish	Amplitude (Power): 0.60 V Time (Duration): 6.0 ms Force: 17 ounces (500 grams)	SW-ETD-E2F
2	Gold ribbon: 10 mils wide x 0.5 mils thick Base material and/or finish: thin film substrate and gold finish	Amplitude (Power): 0.70 V Time (Duration): 7.0 ms Force: 20 ounces (600 grams)	SW-ETD-E4F
3	Gold ribbon: 20 mils wide x 0.5 mils thick Base material and/or finish: thin film substrate and gold finish	Amplitude (Power): 0.80 V Time (Duration): 9.0 ms Force: 25 ounces (750 grams)	SW-ETD-N3W
4	Gold ribbon: 20 mils wide x 1.0 mils thick Base material and/or finish: thin film substrate and gold finish	Amplitude (Power): 1.0 V Time (Duration): 9.0 ms Force: 23 ounces (700 grams)	SW-ETD-N3W
5	Gold ribbon: 40 mils wide x 0.5 mils thick Base material and/or finish: thin film substrate and gold finish	Amplitude (Power): 1.1 V Time (Duration): 9.0 ms Force: 30 ounces (950 grams)	SW-ETD-N0F

## II. Parallel Gap Welder Schedule Setting Guide (Continued)

### 2. Enameled Wires (Standard Electrodes)

Item	Recommended Application	Recommended Setting	Recommended Electrodes
1	Enameled wire: 0.015 to 0.035 mm diameter Base material and/or finish: iron-nickel alloy and gold	Amplitude (Power): 0.60 V Time (Duration): 5.0 ms Force: 10 ounces (300 grams)	SW-ETD-Q1X Series
2	Enameled wire: 0.020 to 0.070 mm diameter. Base material and/or finish: iron-nickel alloy and gold	Amplitude (Power): 0.70 V Time (Duration): 6.0 ms Force: 13 ounces (400 grams)	SW-ETD-E2X Series
3	Enameled wire: 0.035 to 0.110 mm diameter. Base material and/or finish: tin, iron-nickel alloy, gold and silver	Amplitude (Power): 0.80 V Time (Duration): 7.0 ms Force: 20 ounces (600 grams)	SW-ETD-E4X Series
4	Enameled wire: 0.050 to 0.150 mm diameter. Base material and/or finish: tin, iron-nickel alloy, gold and silver	Amplitude (Power): 1.10 V Time (Duration): 8.0 ms Force: 33 ounces(1,000 grams)	SW-ETD-E7X Series
5	Enameled wire: 0.080 to 0.350 mm diameter. Base material and/or finish: tin, iron-nickel alloy, gold and silver	Amplitude (Power): 1.10 V Time (Duration): 8.0 ms Force: 60 ounces (1,800 grams)	SW-ETD-E9X Series

### 3. Enameled Wires (Clean Free Electrodes)

Item	Recommended Application	Recommended Setting	Recommended Electrodes
1	Enameled wire: 0.050 to 0.180 mm diameter. Base material and/or finish: iron-nickel alloy and gold	Amplitude (Power): 1.10 V Time (Duration): 8.0 ms Force: 60 ounces (2,000 grams)	SW-ETD-N0X Series
2	Enameled wire: 0.035 to 0.120 mm diameter. Base material and/or finish: tin, iron-nickel alloy, gold and silver	Amplitude (Power): 1.20 V Time (Duration): 8.0 ms Force: 20 ounces (600 grams)	SW-ETD-N1X Series
3	Enameled wire: 0.025 to 0.100 mm diameter. Base material and/or finish: tin, iron-nickel alloy, gold and silver	Amplitude (Power): 1.00 V Time (Duration): 6.0 ms Force: 17 ounces(500 grams)	SW-ETD-N2X Series
4	Enameled wire: 0.015 to 0.080 mm diameter. Base material and/or finish: tin, iron-nickel alloy, gold and silver	Amplitude (Power): 0.80 V Time (Duration): 5.0 ms Force: 13 ounces (400 grams)	SW-ETD-N3X Series

### III. Parallel Gap Welder Electrode Selection Guide

**SW Tech Equipment** offers total 45 catalog models for electrodes. There are 5 tip head shapes and each tip shape has 9 different sizes. While these catalog models cover the most application scenarios, customer may consider to either to choose the catalog models or to design their own to obtain the optimized welding joints for his/her special application time to time. Hence, some recommendations are offered below as general guidelines.

#### 1. Electrode's Tip Shape

- **Flat :** Mainly used for gold, silver, metal ribbons and wires. It is recommended for softer base material, such as FR4 and Duroid boards. It has moderate durability.
- **Wedge:** Mainly used for gold, silver, metal ribbons and wires. It is designed for large diameter wires and bigger ribbon strips. It has good durability.
- **Round:** Mainly used for gold, silver, metal ribbons and wires. It is the most durable electrode.
- **Slanted:** Mainly used for wires and ribbons when cutting is needed at the finish.
- **Concave:** It is also known as "V" shaped electrode sometimes. It is mainly designed for capturing the round shaped wires. It has the shortest longevity among all 5 tips shapes.

#### 2. Electrode's Size

- In general, the larger the tip size, the higher power it can handle.
- The tip width shall be the same or larger than the width of the ribbons or strips to be welded.

#### 3. Electrode's Material

SW Tech Equipment employs three high quality materials for its electrodes. They are high temperature molybdenum alloy (HTM), high purity molybdenum alloy (HPM) and molybdenum tungsten alloy (MTA). The table below gives their characteristics.

Items	Crystal Size	Temperature	Hardness	Oxidization	Durability	Cost
HTM	Small	Moderate	Moderate	Moderate	Moderate	Low
HPM	Small	Low	Poor	Poor	Low	Low
MTA	Small	High	Good	Good	High	High

Note: Although the molybdenum tungsten alloy offers the best performance, the drawbacks of the material are it is hard to machine and production yield is low. Therefore, the cost is higher.

#### 4. Standard vs. Clean Free Electrode

- **Standard:** It requires less welding power, but can be contaminated quicker. Therefore, it has moderate durability.
- **Clean Free:** It requires higher welding power for the same work piece, but hard to be contaminated due to its closed tip configuration. Therefore, it has the highest durability.



**SMAPRO500**  
Stereo Microscope



**SMAPRO58N**  
Digital Monocular Microscope



**SMAPRO510**  
Stereo Microscope



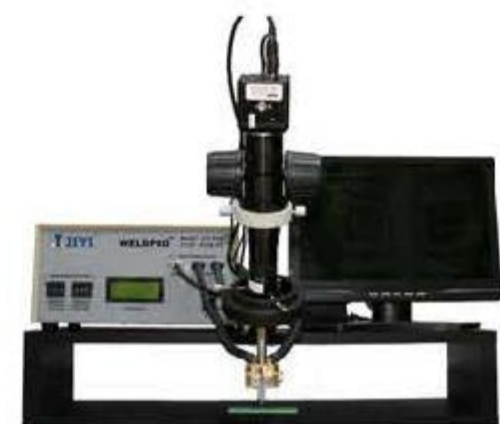
**SMAPRO180**  
Parallel Gap Welder



**SMAPRO52V**  
Trinocular Microscope



**SW-CCD-58U**  
Digital Camera



**SMAPRO200**  
PCB Repair Machine