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<b>This manual applies to the following model numbers</b>	154-001

## ***MK2000A Inverter Power Supply***



# SAFETY CONSIDERATIONS

## ELECTRIC ARC WELDING EQUIPMENT

**CAUTION : READ BEFORE ATTEMPTING INSTALLATION, OPERATION OR MAINTENANCE OF THIS EQUIPMENT**

### 1-1 INTRODUCTION

This equipment is intended for ultimate application by commercial/industrial users and for operation by persons trained and experienced in the use and maintenance of welding equipment. Operation should not be undertaken without adequate training in the use of such equipment. Training is available from many public and private schools or similar facilities.

Safe practices in the installation, operation and maintenance of this equipment requires proper training in the art, a careful study of the information provided with the equipment, and the use of common sense. Rules for safe use are generally provided by suppliers of welding power sources, compressed gas suppliers, and electrode suppliers. Careful compliance with these rules will promote safe use of this equipment.

The following Safety Rules cover some of the more generally found situations. **READ THEM CAREFULLY.** In case of any doubt, obtain qualified help before proceeding.

### 1-2 GENERAL PRECAUTIONS

#### A. Burn Prevention

**ELECTRIC ARC WELDING PRODUCES HIGH INTENSITY HEAT AND ULTRAVIOLET RADIANT ENERGY WHICH MAY CAUSE SERIOUS AND PERMANENT EYE DAMAGE AND WHICH MAY DAMAGE ANY EXPOSED SKIN AREAS.**

Wear helmet with safety goggles or glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass). This is a must for welding or cutting (and chipping) to protect the eyes from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered.

Medical first aid and eye treatment. First aid facilities and a qualified first aid person should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Wear protective clothing - leather (or asbestos) gauntlet gloves, hat, and high safety-toe shoes. Button shirt collar and pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag.

Avoid oily or greasy clothing. A spark may ignite them.

Flammable hair preparations should not be used by persons intending to weld or cut.

Hot metal such as electrode stubs and work pieces should never be handled without gloves.

Ear plugs should be worn when working on overhead or in a confined space. A hard hat should be worn when others work overhead.

#### B. Toxic Fume Prevention

**WARNING:** The use of this product may result in exposure to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Adequate ventilation. Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Prevent them with adequate ventilation. **NEVER** ventilate with oxygen.

Lead-, cadmium-, zinc-, mercury-, beryllium-bearing and similar materials, when welded or cut, may produce harmful concentrations of toxic fumes. Adequate local exhaust ventilation must be used, or each person in the area, as well as the operator, must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from the work surface, the area is well ventilated, or the operator wears an air-supplied respirator.

Work in a confined space only while it is being ventilated and, if necessary, while wearing an air-supplied respirator.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

Leaving confined space, shut OFF gas supply at source to prevent possible accumulation of gases in the space if downstream valves have been accidentally opened or left open. Check to be sure that the space is safe before reentering it.

Vapors from chlorinated solvents can be decomposed by the heat of the arc (or flame) to form PHOSGENE, a highly toxic gas, and other lung and eye irritating products. The ultraviolet (radiant) energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. **DO NOT WELD** or cut where solvent vapors can be drawn into the welding or cutting atmosphere or where the radiant energy can penetrate to atmospheres containing even minute amounts of trichloroethylene or perchloroethylene.

#### C. Fire and Explosion Prevention

Causes of fire and explosion are: com-

busibles reached by the arc, flame, flying sparks, hot slag, or heated material, misuse of compressed gases and cylinders, and short circuits.

**BE AWARE THAT** flying sparks or falling slag can pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the goggled operator. Sparks can fly many feet.

To prevent fires and explosion:

Keep equipment clean and operable, free of oil, grease, and (in electrical parts) of metallic particles that can cause short circuits.

If combustibles are in area, do **NOT** weld or cut. Move the work if practicable, to an area free of combustibles. Avoid paint spray rooms, dip tanks, storage areas, ventilators. If the work cannot be moved, move combustibles at least 35 feet away, out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls touching combustibles on opposite sides should not be welded on (or cut). Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

Fire watcher must be standing by with suitable fire extinguishing equipment during and for some time after welding or cutting if:

1. Appreciable combustibles (including building construction) are within 35 feet.
2. Appreciable combustibles are further than 35 feet, but can be ignited by sparks.
3. Openings (concealed or visible) in floors or walls within 35 feet may expose combustibles to sparks.
4. Combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

Hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

After work is done, check that area is free of sparks, glowing embers, and flames.

An empty container that held combustibles, or that can produce flammable or toxic vapors when heated, must never be welded on or cut, unless container has first been cleaned in accordance with industry standards.

This includes: a thorough steam or

caustic cleaning (or a solvent of water washing, depending on the combustible's solubility), followed by purging and inerting with nitrogen or carbon dioxide, and using protective equipment.

Water-filling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see paragraph above). Do NOT depend on sense of smell or sight to determine if it is safe to weld or cut.

Hollow castings or containers must be vented before welding or cutting. They can explode.

Explosive atmospheres. NEVER weld or cut where the air may contain flammable dust, gas, or liquid vapors (such as gasoline).

#### D. Compressed Gas Equipment

The safe handling of compressed gas equipment is detailed in numerous industry publications. The following general rules cover many of the most common situations.

##### 1. Pressure Regulators

Regulator relief valve is designed to protect only the regulator from over-pressure; it is not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve). The following symptoms indicate a faulty regulator:

Leaks - if gas leaks externally.

Excessive Creep - if delivery pressure continues to rise with downstream valve closed.

Faulty Gauge - if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Repair. Do NOT attempt repair. Send faulty regulators for repair to manufacturer's designated repair center, where special techniques and tools are used by trained personnel.

##### 2. Cylinders

Cylinders must be handled carefully to prevent leaks and damage to their walls, valves, or safety devices:

Avoid electrical circuit contact with cylinders including third rails, electrical wires, or welding circuits. They can produce short circuit arcs that may lead to a serious accident. (See 1-3C)

ICC or DOT marking must be on each cylinder. It is an assurance of safety when the cylinder is properly handled.

Identifying gas content. Use only cylinders with name of gas marked on them; do not rely on color to identify gas content. Notify supplier if unmarked.

NEVER DEFACE or alter name, number, or other markings on a cylinder. It is illegal and hazardous.

Empties: Keep valves closed, replace caps securely; mark MT; keep them separate from FULLS, and return promptly.

Prohibited use. Never use a cylinder or its contents for other than its intended use, NEVER as a support or roller.

Locate or secure cylinders so they cannot be knocked over.

Passageways and work areas. Keep cylinders clear of areas where they may be stuck.

Transporting cylinders. With a crane, use a secure support such as a platform or cradle. Do NOT lift cylinders off the ground by their valves or caps, or by chains, slings, or magnets.

Do NOT expose cylinders to excessive heat, sparks, slag, and flame, etc. that may cause rupture. Do not allow contents to exceed 55 degrees C (130 degrees F.) Cool with water spray where such exposure exists.

Protect cylinders, particularly valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Stuck valve. Do NOT use a hammer or wrench to open a cylinder valve that cannot be opened by hand. Notify your supplier.

Mixing gases. NEVER try to mix any gases in a cylinder.

NEVER refill any cylinder.

Cylinder fittings should never be modified or exchanged.

##### 3. Hose

Prohibited use. Never use hose other than that designed for the specified gas. A general hose identification rule is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for the hose (not ordinary wire or other substitute) as a binding to connect hoses to fittings.

No copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Suspend hose off ground to keep it from being run over, stepped on, or otherwise damaged.

Coil excess hose to prevent kinks and tangles.

Protect hose from damage by sharp edges, and by sparks, slag, and open flame.

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in water; bubbles indicate leaks

Repair leaky or worn hose by cutting area out and splicing. Do NOT use tape.

##### 4. Proper Connections

Clean cylinder valve outlet of impurities that may clog orifices and damage seats before connecting regulator. Except for hydrogen, crack valve momentarily, pointing outlet away from people and sources of ignition.

Wipe with a clean, lintless cloth.

Match regulator to cylinder. Before connecting, check that the regulator label and cylinder marking agree, and that the regulator inlet and cylinder outlet match. NEVER Connect a regulator designed for a particular gas or gases to a cylinder containing any other gas.

Tighten connections. When assembling threaded connections, clean and smooth seats where necessary. Tighten. If connection leaks, disassemble, clean, and retighten, using properly fitting wrench.

Adapters. Use a CGA adapter (available from your supplier) between cylinder and regulator, if one is required. Use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

##### 5. Pressurizing Steps:

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw in (clockwise). Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.

Stand to side of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure increases slowly. When gauge is pressurized (gauge reaches regulator maximum) leave cylinder valve in following position: for oxygen and inert gases, open fully to seal stem against possible leak; for fuel gas, open to less than one turn to permit quick emergency shut-off.

Use pressure charts (available from your supplier) for safe and efficient recommended pressure settings on regulators.

Check for leaks on first pressurization and regularly thereafter. Brush with soap solution. Bubbles indicate leaks. Clean off soapy water after test; dried soap is combustible.

##### E. User Responsibilities

Follow all Safety Rules.

Remove leaky or defective equipment from service immediately for repair. Read and follow user manual instructions.

##### F. Leaving Equipment Unattended

Close gas supply at source and drain gas.

##### G. Rope Staging-Support

Rope staging-support should not be used for welding or cutting operation; rope may burn.

##### 1-3 ARC WELDING

Comply with precautions in 1-1, 1-2,

and this section. Arc Welding, properly done, is a safe process, but a careless operator invites trouble. The equipment carries high currents at significant voltages. The arc is very bright and hot. Sparks fly, fumes rise, ultraviolet and infrared energy radiates, weldments are hot, and compressed gases may be used. The wise operator avoids unnecessary risks and protects himself and others from accidents.

#### A. Burn Protection

Comply with precautions in 1-2.

The welding arc is intense and visibly bright. Its radiation can damage eyes, penetrate lightweight clothing, reflect from light-colored surfaces, and burn the skin and eyes. Skin burns resemble acute sunburn; those from gas-shielded arcs are more severe and painful. **DON'T GET BURNED; COMPLY WITH PRECAUTIONS.**

##### 1. Protective Clothing

Wear long-sleeve clothing in addition to gloves, hat, and shoes. As necessary, use additional protective clothing such as leather jacket or sleeves, flameproof apron, and fire-resistant leggings. Avoid outer garments of untreated cotton.

Bare skin protection. Wear dark, substantial clothing. Button collar to protect chest and neck, and button pockets to prevent entry of sparks.

##### 2. Eye and Head Protection

Protect eyes from exposure to arc. Eyes may be damaged by radiant energy when exposed to the electric arc, even when not looking in the direction of the arc. Never look at an electric arc without protection.

Welding helmet or shield containing a filter plate shade no. 12 or denser must be used when welding. Place over face before striking arc.

Protect filter plate with a clear cover plate.

Cracked or broken helmet or shield should NOT be worn; radiation can be passed through to cause burns.

Cracked, broken, or loose filter plates must be replaced IMMEDIATELY. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields MUST be worn under the helmet to give some protection to the eyes should the helmet not be lowered over the face before an arc is struck. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause a retinal burn that may leave a permanent dark area in the field of vision.

##### 3. Protection of Nearby Personnel

Enclose the welding area. For production welding, a separate room or enclosed bay is best. In open areas, surround the operation with low-reflective, noncombustible screens or panels. Allow for free

air circulation, particularly at floor level.

Viewing the weld. Provide face shields for all persons who will be looking directly at the weld.

Others working in area. See that all persons are wearing flash goggles.

Before starting to weld, make sure that screen flaps or bay doors are closed.

#### B. Toxic Fume Prevention

Comply with precautions in 1-2B.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

#### C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

Equipment's rated capacity. Do not overload arc welding equipment. It may overheat cables and cause a fire.

Loose cable connections may overheat or flash and cause a fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to such a rupture later under rough handling.

#### D. Compressed Gas Equipment

Comply with precautions in 1-2D.

#### E. Shock Prevention

Exposed electrically hot conductors or other bare metal in the welding circuit, or in ungrounded, electrically-HOT

equipment can fatally shock a person whose body becomes a conductor. **DO NOT STAND, SIT, LIE, LEAN ON, OR TOUCH** a wet surface when welding without suitable protection.

To protect against shock:

Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat cannot be avoided. Sweat, sea water, or moisture between body and an electrically HOT part - or grounded metal - reduces the body surface electrical resistance, enabling dangerous and possibly lethal currents to flow through the body.

##### 1. Grounding the Equipment

When installing, connect the frames of each unit such as welding power source, control, work table, and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made electrically HOT by stray currents may shock, possibly fatally. **DO NOT GROUND** to electrical conduit, or to a pipe carrying ANY gas or a flammable liquid such as oil or fuel.

Three-phase connection. Check phase requirement of equipment before installing. If only three-phase power is available, connect single-phase equipment to only two wires of the three-phase line. **DO NOT** connect the equipment ground lead to the third (live) wire, or the equipment will become electrically HOT - a dangerous condition that can shock, possibly fatally.

Before welding, check ground for continuity.

Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switch box, connect the ground lead to the grounded switch box. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken ground prong.

##### 2. Connectors

Fully insulated lock-type connectors should be used to join welding cable lengths.

##### 3. Cables

Frequently inspect cables for wear, cracks, and damage. **IMMEDIATELY REPLACE** those with excessively worn or damaged insulation to avoid possibly lethal shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable.

Keep cable dry, free of oil and grease, and protected from hot metal and sparks.

##### 4. Terminals and Other Exposed Parts

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

##### 5. Electrode Wire

Electrode wire becomes electrically HOT when the power switch of gas metal-arc welding equipment is ON and welding gun trigger is pressed. Keep hands and body clear of wire and other HOT parts.

##### 6. Safety Devices

Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.

Before installation, inspection, or service of equipment, shut OFF all power, and remove line fuses (or lock or red-tag switches) to prevent accidental turning ON of power. Disconnect all cables from welding power source, and pull all 115 volts line-cord plugs.

Do not open power circuit or change polarity while welding. If, in an emergency, it must be disconnected, guard against shock burns or flash from switch arcing.

Leaving equipment unattended. Always shut OFF, and disconnect all power to equipment.

Power disconnect switch must be available near the welding power source.

*Thank You*

For selecting a quality product. We want you to take pride in operating this product...as much pride as we have in bringing the product to you!

**Please Examine Carton and Equipment For Damage Immediately**

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

Please record your equipment identification information below for future reference. This information can be found on your machine nameplate.

Model Name & Number \_\_\_\_\_

Code & Serial Number \_\_\_\_\_

Date of Purchase \_\_\_\_\_

Whenever you request replacements parts for, or information on this equipment always supply the information you have recorded above.

Read this Owner's Manual completely before attempting to use this equipment. Save this manual and keep it handy for quick reference. Pay particular attention to the safety instructions we have provided for your protection.



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## Section 1

## SPECIFICATIONS

### Primary Input Power

- 50/60 Hz 3 phase** 208-277 Volts 36 Amps source must have 15 KVA rating.
- 3 phase** 380-460 Volts 4 wire wye 36 Amps source must have 15 KVA rating.
- 1 Phase** 208-240 Volts 50 Amps 50% duty cycle on 12 KVA source 100% duty cycle on 25 KVA source.

### Output

**DC 6-50 volts**

**30-300 amperes** 100% duty cycle at 10 KVA out (eg. 33 @300a)

**Slope Control** Flat to Vertical, Provides constant (potential) to constant current operation.

**Inductance** Electronically provided 0-3 millihenries

**Dual Slope**

**Capability** (eg. CV during normal use - CC during Short circuit transfer)

**Idle Power** Unit "On" contactor open - 80 watts (22w with fan off)  
Unit "On", contactor closed no arc - 100 watts

**Efficiency** 92% at Full rated power

### Pulse Output

Pulse adds to background level setting providing 0 to 100% output during pulse.

Pulse "On Time" may be 0% to 100% of total pulse interval. Pulse repetition rate variable from 20 pulse per second to 2000 pulse per second.

Pulse rise time - variable (external only) - 100usec min. - sym rise and fall.

### Controls

All functions are calibrated in 0-100% of full scale and may be controlled remotely with 0-10 volts signals. For use with Robot Control Computers, desired functions may be commanded from the control computer with remaining function locally controlled at the power supply.

### Size

16-1/4" x 8-1/2" x 24" (41.3 cm x 21.6 cm x 61 cm)

### Weight

78 lbs. (35.4 KG)

### Maximum Heat Dissipation

900 watts

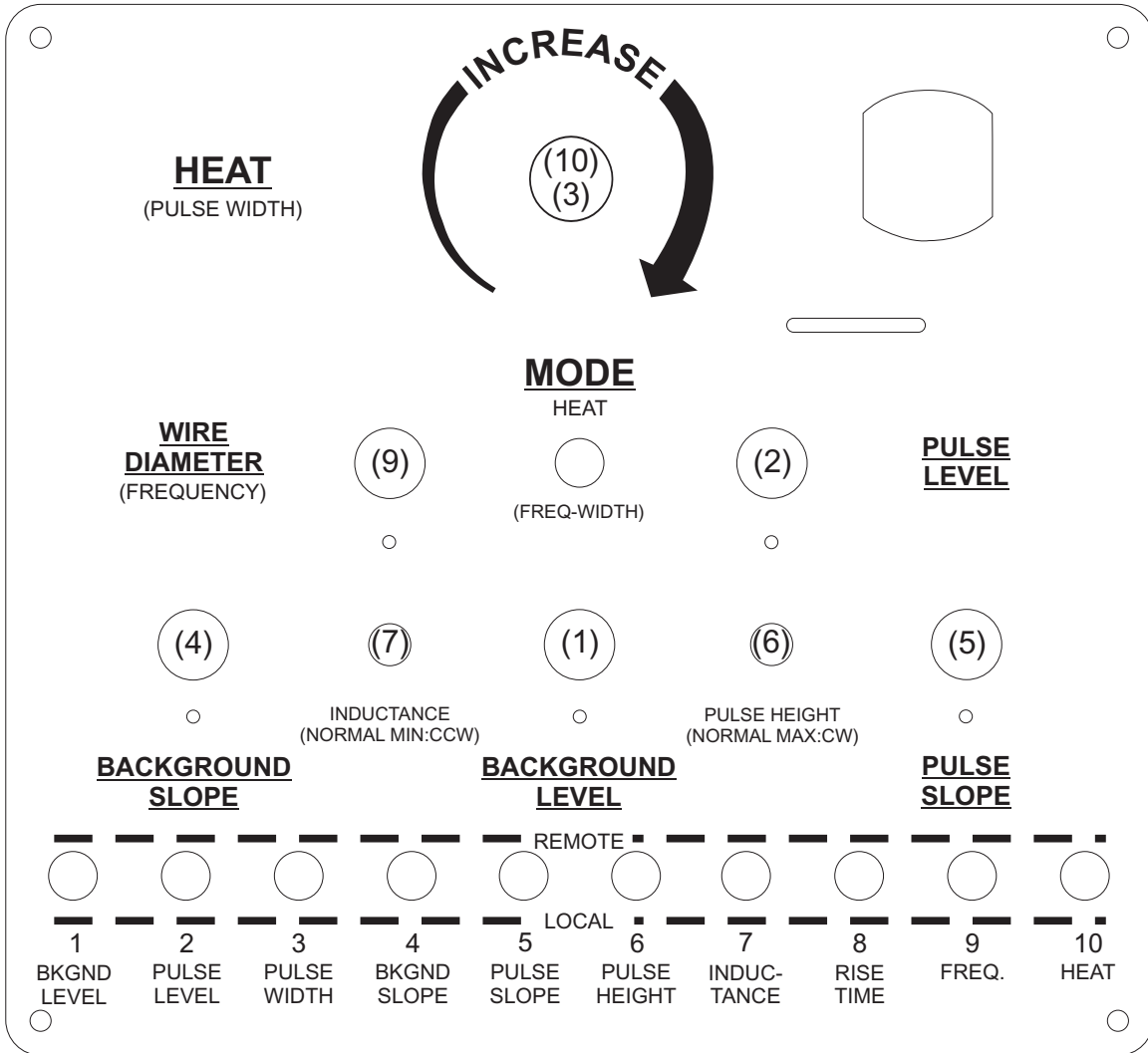
### Environment

-20°F to +110°F (-30°C to + 44°C) 90% humidity without condensation. 0 - 10,000 ft. elevation. Normal handling for electrical equipment, units may be stacked or mounted side-by-side. Access required to rear of unit to connect primary power cable. Cooling air inlet in rear - needs at least 4" clearance from wall. Auto Over-temp shut down.



## Section 2

## SYSTEM CONTROLS AND FRONT PANEL



Set Mode switch to "HEAT". Set Wire Diameter, Pulse Level (process) and background level per chart. Control weld heat with "HEAT" control. Trim arc length with wire feeder rate control.

Wire In %				Process	Background level	Factory Set
Dia.	AL	SS	ST	Pulse Level	Thin Material 23% Avg. Material 26% Thick Material 32%	Inductance 15% Rise Time 100% Pulse Height 100%
.020	94	56	25	4043 AL 60%		
.030	75	38	22	5356 AL 71%		
.035	56	28	20	Stainless 75%	<b>Slope</b>	
.045	38	20	20	Mild Steel 84%		
.052	28	20	18		Background slope 20% Pulse slope 20%	See manual for additional data and examples
.062	18	18	16			

## Section 3

### GENERAL

The MK2000A Electronic Pulsed Welding Power Supply is designed to provide precision controlled, highly efficient welding power in a compact, extremely reliable form.

The demands of modern fabrication techniques, with well- designed parts accurately fitted together, require exceptionally well controlled welding wire feed and welding power control. The MK Cobramatic Wire Feed Systems, long known for precision wire feeding for critical applications are now matched with a precision power supply. The combination is exceptionally well suited for fixtured or robotic welding, although the exceptionally stable characteristics also make hand welding much easier.

The welding engineer will appreciate the flexibility to utilize constant voltage, constant current, pulsed welding and unique combinations of all in a single compact, efficient unit.

## Section 4

### DESIGN

#### Electrical

The MK2000A is a transistorized inverter power supply intended for use on three phase 208 to 277 volt and 380 to 460 volt, 4 wire wye (with neutral), 50/60 Hertz supply circuits. (See page 24 for more details) The unit will also operate on single phase 208 to 277 volt circuits, although the reduced power factor may require limiting the duty cycle based on the volt ampere capacity of the primary wiring.

The input power is converted to direct current and a switching inverter utilized to generate alternating current at 20,000 hertz.

A compact, low-loss transformer steps the high voltage down to the welding voltage range where it is rectified and filtered for output.

The inverter is controlled by a digital/analog control system which permits an exceptional range of voltage, current and waveform controls.

For constant voltage (CV) operation, the output voltage is sensed and compared with a digital reference. The inverter switch is controlled on a cycle by cycle basis to hold the output at the reference value over the entire load range. To provide spatter free welding conditions, slope may be added so that the output voltage decreases with increasing current. Any slope from 0 volts per 100 amperes to vertical (constant current) may be set.

For constant current (CC) operation, the output current is sensed and compared with a digital reference. The inverter switch is controlled on a cycle by cycle basis to hold the output at the reference value over the entire load range.

Pulsed operation is provided whereby the background voltage set by the background level control is increased periodically. These pulses may increase the output by any amount up to 100% of the power supply capacity. Pulse rates may be any frequency from 20 pulses per second to 2000 pulses per second. This, of course, includes the common pulse frequencies of 60 and 120 pulses per second available from thyristor supplies operated at line frequency. Pulse widths may be any value from 0 to 100% of the pulse period. In addition, the pulse shape may be controlled to provide a gradual rise and fall (symmetrical), when an external control computer is used.

An exceptional capability is provided by the MK2000A through the use of the Pulse Level and Pulse Slope controls in conjunction with the Background Level and Background Slope. These two sets of controls function identically except that the pulse modulation is only added to the Background Control.

The combination may be used to create a wide range of welding characteristics. For example, when welding thick aluminum sections, CC operation is often desired due to the increased penetration. In this instance the Background Level is set to the desired operating voltage (e.g. 20 volts) and the Background Slope set to a typical CV slope of 4 volts per 100 amperes (19% on dial); the welding condition will be standard CV. To limit the current increase during the short circuit transfer interval, the Pulse Level may be set to the desired maximum current (e.g. 240 amps) with a Pulse Slope of 32 volts per 100 amps (66% on dial) or typically CC.

Another application of the Pulse Level Control is Pulsed Welding Operation. Conventional pulsed supplies provide increased voltage during the pulse interval, resulting in a current peak. Since the operating mode is that of constant voltage, the actual current peak depends very critically on the load impedance (wire feed rate and tip-to-work distance).

Using the Pulse Level Control with the Pulse Slope set for Constant Current operation, the pulses on the pulse height may be set to 100%, permitting the power supply to go to maximum output voltage. The pulse current is then controlled by the Pulse Level, which is set to the desired peak current. Under these conditions, the welding condition during the pulse is constant current, and largely independent of wire feed rate and tip-to-work distance.

The MK2000A has built in protective circuitry to protect it from excessively high or low input voltage and from any load condition. Under overload conditions, the unit will automatically shut down and reset when conditions are normal.

The physical layout logically separates input, switching, output and control functions for ease of fault isolation and sub-assembly replacement. All components are very conservatively rated and reliability is exceptional.

## **Mechanical**

Careful attention has been given to the mechanical and thermal design of the power supply. Recognizing the difficult environment in which such equipment must operate, the MK2000A utilizes a heat exchanger design to eliminate dust and dirt from the electronic components.

Although the circuit design is exceptionally efficient, it is necessary to remove heat from the high current devices. This is accomplished by mounting the input and output rectifiers, switching transistors, main transformer and output inductor on finned aluminum heat sinks which conduct the heat directly out of the enclosure and into the air stream from a rear mounted cooling fan. Outside air is not passed through the electronic enclosure.

All components are securely mounted to insure circuit integrity in spite of the inevitable rough handling.

The compact size and light weight of this ten kilowatt power supply makes handling much easier - never requiring hoists or fork lifts to position the unit.

## **Section 5**

### **MK2000A CONTROL PANEL \*\***

Background Level: Relates to the background level. This is background voltage for a slope setting of 'O' (CV) and background current for a slope setting of 100 (CC).

Pulse Level: Also relates to the background level and slope. It is normally set to establish a limiting value of current (slope near 100) when in short circuit transfer mode or in pulse mode.

Pulse Width: This control may be set to make the actual pulse length 0% to 100% of the pulse interval.

Background Slope: Adjustable from Constant Voltage to Constant Current.

Pulse Slope: Adjustable from Constant Voltage to Constant Current.

Pulse Height: This control determines the height of the output pulse. The pulse is added on top of the background level so the total output during the pulse is the sum of the Background Level setting plus the Pulse Height setting.

Inductance: This control creates the electronic equivalent of output inductance. This limits the rate of rise of current during short circuit transfer without limiting the peak current. This control is factory set to 15%; however, when -0- inductance is required, it may be disabled by placing the inductance switch to remote.

Pulse Rise Time: This control determines the rise (and symmetrical fall) time of the pulse. It may be used to change the rectangular pulse to a trapezoidal or triangular shape. This control is adjustable through an external control computer only.

Pulse Frequency: This control may be set to provide pulses at any repetition rate from 20 pulses per second to 2000 pulses per second.

Heat: This control adjusts the pulse frequency while maintaining a preset pulse width. The "ON TIME" (pulse width) is determined by the wire diameter control.

Mode Selector: The mode selector switch allows the frequency and pulse width to be controlled independently of each other or operate in the "Heat" Mode.

\*\* See Control Panel Detail (Section 2)

## Section 6

## OPERATING CHARACTERISTICS

The operating characteristics of the MK2000A cover a very wide spectrum, however the operation may be easily understood by considering it in relationship to conventional supplies.

### Non-Pulsed Operation

#### Constant Voltage

Operation as a Constant Voltage (potential) power supply is shown in Figure 1. This is the operation obtained when the Pulse Height control is set to -0- and the Pulse Level is disabled by setting it to 100% with the Pulse Slope set to -0-.

With the Background Slope control set to -0-, the Background Level control

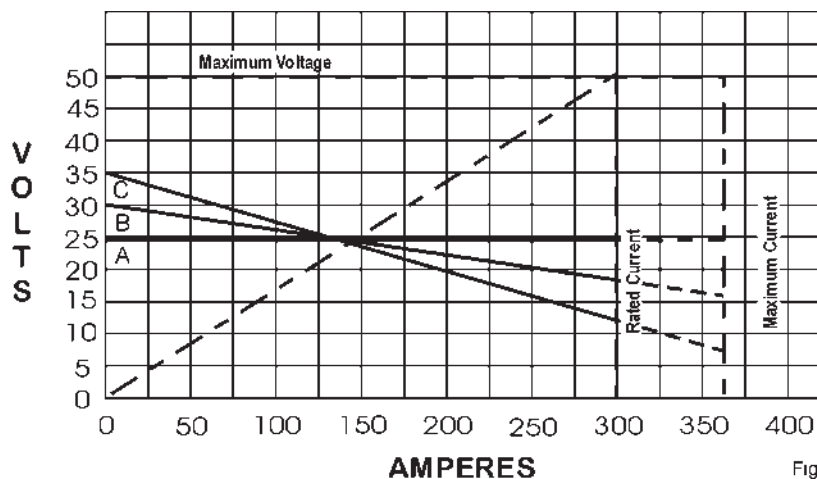


Fig.1

sets the power supply voltage output. This is shown as line 'A' as set to 24 volts. There is no slope and thus the voltage remains constant from below 50 amperes to over 300 amperes. The resulting harsh arc may be softened by providing some slope as shown in lines 'B' & 'C'. Setting the Background slope to 15% results in a slope of just slightly more than 3 volts per 100 amperes - a commonly used value (line B). The slope may be increased continuously until at 100% on the Background Slope control the line becomes vertical and the power supply is operating as a very stiff Constant Current (CC) source.

A notable feature of the MK2000A is that the slope control is referenced to the diagonal 'control line' so that the operating voltage stays relatively constant when the slope is changed. Therefore, there is no need to calculate open circuit voltage regardless of the slope setting.

While welding, the output voltage and current follow the appropriate line (A,B,C,etc.) up to the full 360 ampere capability of the supply.

### Constant Current

Operation as a Constant Current power supply is shown in Figure 2. This is the operation obtained when the Pulse Height control is set to -0- and the Pulse Level disabled by setting it to 100% with the Pulse Slope set to -0-.

With the Background Slope control set to 100%, the Background Level control sets the power supply current output. This is shown as line "A" as set to 170 amperes. There is no slope and the current remains constant from short circuit conditions (zero volts) to the maximum capability of the power supply at 50 volts. A more typical "drooper" curve is obtained by setting the Background Slope control to less than 100% as shown in curves "B" and "C". Curve "C" at approximately 33 volts per 100 amperes is obtained with a Background Slope setting of 66%.

The output characteristic curves just described for CV and CC welding may be compared with "typical" curves representing the majority of presently available CV and CC welding power sources, as obtained from supplier catalogs, actual equipment measurements and the AWS Welding Handbook. Typical curves are shown in Figure 3.

The Constant Current supplies usually start with a high open circuit voltage and 'droop' steeply on the volt/ampere plot. As the output current setting is decreased, the slope tends to become steeper. Supplies with lower open circuit voltages (eg 60 volts) have substantially less slope, particularly at higher currents.

The MK2000A may be set to closely match any of the slopes shown within the limits of 50 volts and 360 amperes, since the slope is electronically controlled and not just the result of a high open circuit voltage combined with a high resistance circuit.

The conventional constant voltage supplies provide an open circuit voltage

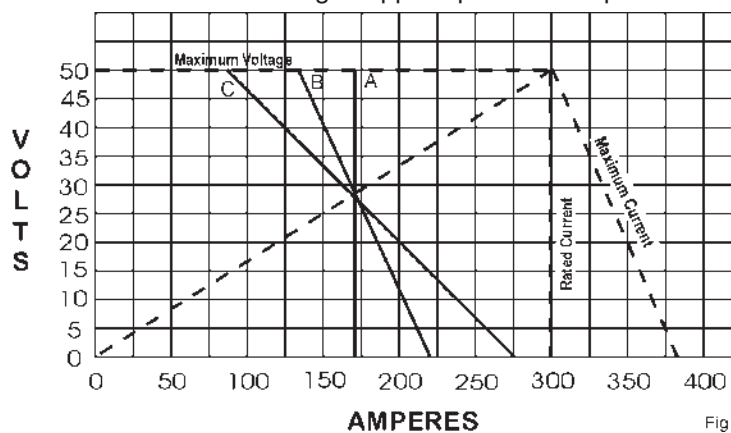


Fig 2

slightly higher than the desired welding voltage. A small amount of circuit resistance is utilized to provide the desired slope. This is a power absorbing element and reduces the efficiency of the supply.

The MK2000A achieves its slope by an electronic control which does not add loss to the circuit. It is thus substantially more efficient than the conventional supply. The output voltage is set along the diagonal 'control line' and thus is much more representative of the desired welding voltage. As may be seen, changing the slope has a smaller effect on the output voltage at welding current, although significant changes in slope may require output voltage readjustment.

With a CV power supply, it is often necessary to use more slope than desired to avoid excessive current surges during arc initiation and short circuit transfer. Some supplies are provided with a variable (or tapped) inductor which limits the rate of change of current, however this makes the supply both larger and more expensive. The MK2000A has an 'electronic inductor' which provides the same output waveform, under short circuit conditions, as would exist with an iron cored inductor. The inductor covers the equivalent range of 0 to 3 millihenries.

A second method exists to provide for current limiting on short circuit - called Dual Slope control. This is shown in Figure 4. The Background Slope control is set for CV operation at 3 volts per 100 amperes (15%) and the Background Level at the desired welding voltage - here shown as 18 volts at pivot point 'A'.

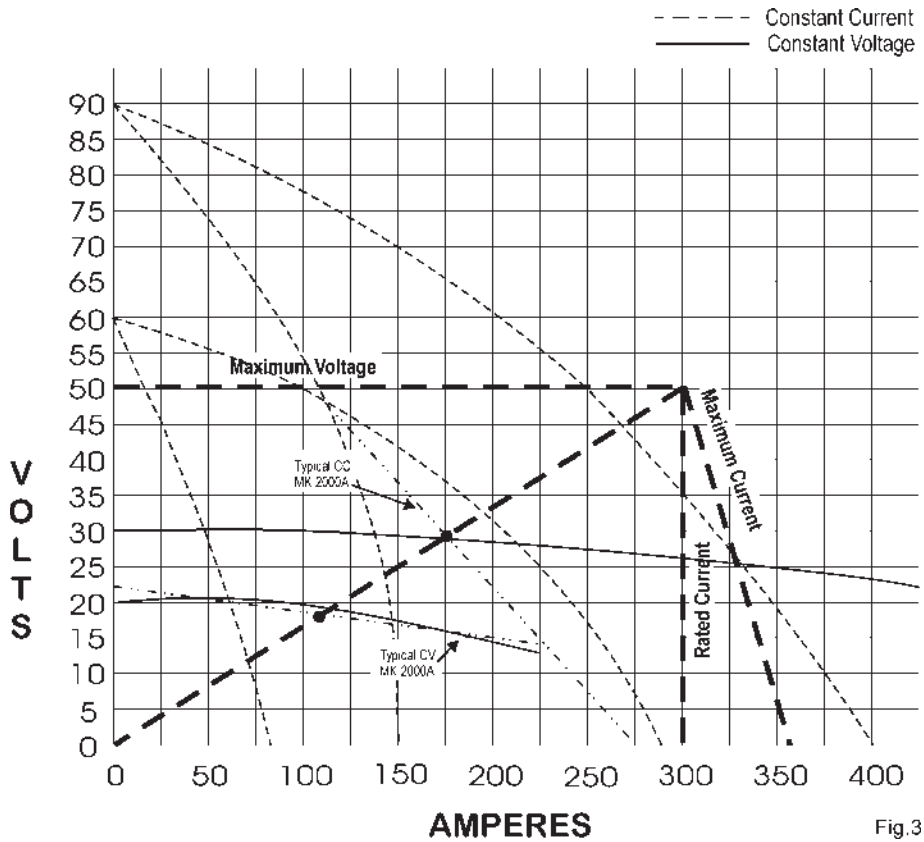


Fig.3



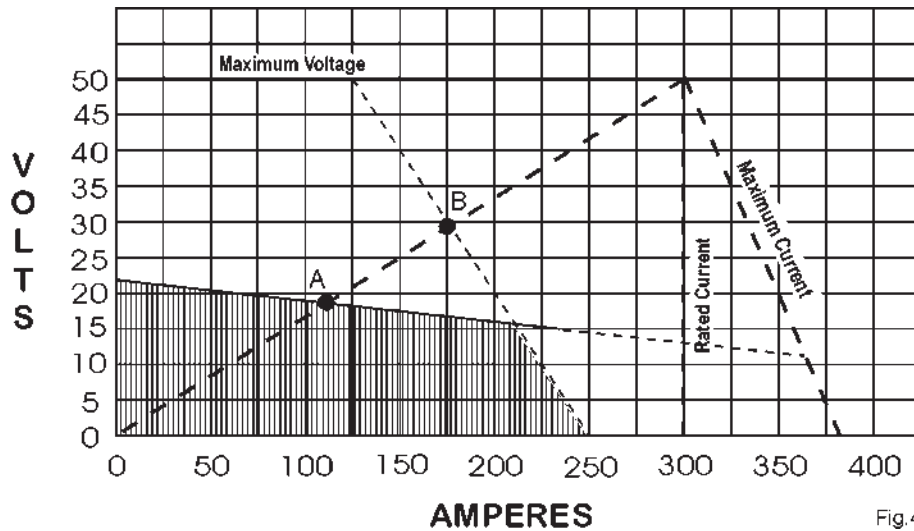


Fig.4

The 'Pulse Slope' is set for CC operation at 38 volts/100 amperes (70%) and the Pulse Level is set to 175 amperes at pivot point "B".

Welding at these settings results in a CV operating mode with wire feed rates adjusted to provide any current between about 100 and 200 amperes. Short circuit current, however, is limited to 250 amperes by the Pulse Level setting.

The Pulse Level and Slope may also be adjusted to any desired values, and are independent of the Background Level and Slope. It is not necessary for point "B" to be set above point "A", although this will normally be the case.

The only difference in operation between the Background Level/Background Slope and the Pulse Level/Pulse Slope is that pulse operation adds to the Background Level and does not change the Pulse Level.

Inductance may be used with any combination of other settings.

### Pulse Operation

The MK2000A provides a range of operating capabilities not available in any general purpose welding power supply.

Pulse operation is used to provide a measure of independence in the control of heat input, current density during material transfer, and arc voltage which effects both heat and cleaning capability.

The majority of available pulsed welding power supplies operate with a background voltage and then induce extended firing of one or two thyristors to provide voltage pulses at 60 or 120 pulses per second. (360 pps with three phase operation) The current resulting from these voltages depends on the firing point which, in turn, controls the pulse duration (width). It is usually described in terms of the peak current value.

### MK2000A Parameter Set-Up

In pulsed spray welding the current is varied from the background level to a peak level. The background level is well below the transition current while the peak level is well into the spray arc region, Figure 5. During the peak level one droplet is transferred to the work. The current then drops to the background level which allows the puddle to cool, at which time no metal is transferred.

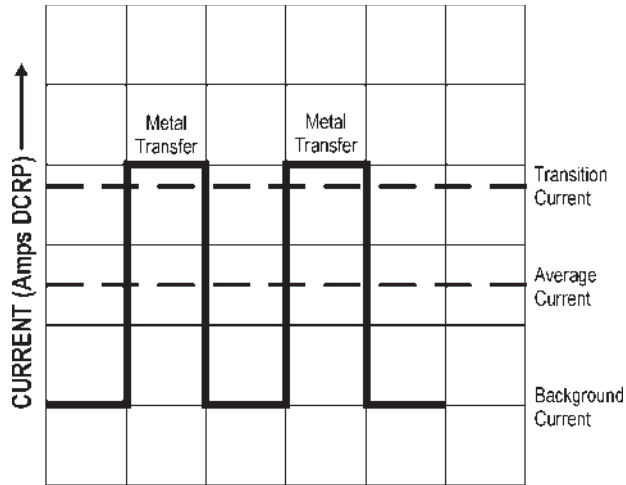


Fig. 5

### Wire Diameter

To obtain the smooth one drop transfer during the peak level the "On" time (pulse width) must be varied, depending on the wire diameter. For example, .030 requires 1/2 of a millisecond and .045 requires 1-1/2 milliseconds. The WIRE DIAMETER Control on the MK 2000A therefore sets the "ON TIME" (pulse width).

### Pulse Level

Because different alloys melt at different temperatures, the height of the pulse must also be varied. The PULSE LEVEL therefore limits the height of the pulse depending on the alloy. For example, the Pulse Level for 4043 is set to 60 (60% of 300 Amps = 180 Amps) whereas 5356 with its higher melting temperature is set to 71 (71% of 300 Amps = 213 Amps Max.).

### Heat

When changing plate size or for fine tuning, the "HEAT" Control may be adjusted. With the "ON TIME" (pulse width) preset by the Wire Diameter control the Heat control moves the pulses closer together (more heat) or further apart (less heat) without changing the pulse width. Figure 6. Keep in mind that when you increase your heat you must also increase wire speed.

Note: When operating in the Frequency Width mode the frequency and pulse width are set independently of each other. Increasing the frequency in this mode decreases the "ON TIME" (pulse width) proportionately.

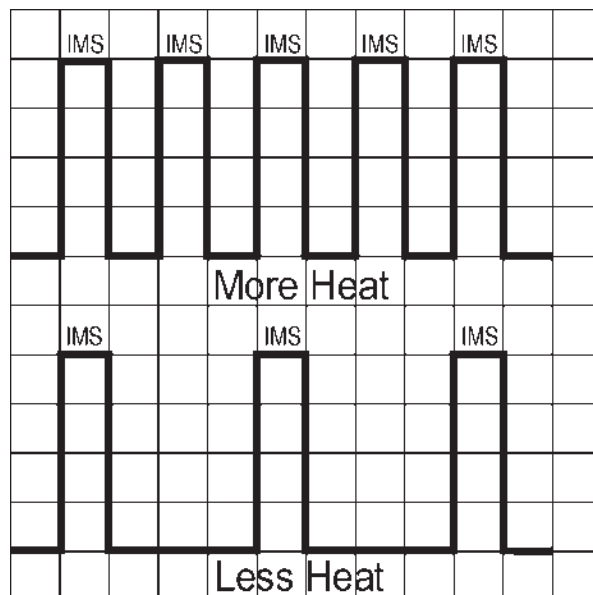


Fig. 6

### Background Level

When the pulse drops to the background level, it must be at a point high enough to maintain an arc yet low enough to cool the puddle. Normally the thickness of the material will determine the Background Level.

### Slope

The MK 2000A is capable of operating in either constant voltage (CV) or constant current (CC). Because of the problems associated with CC Mig welding, CV operation is most common. A power supply with no slope would produce a very harsh arc with excessive spatter. Adding slope reduces the voltage for the same amount of amperage, thereby softening the arc. Setting the MK2000A's slope controls to 20% will provide a common slope of 4V/100 Amps.

### Inductance

Inductance added to the MK2000A tends to round off the falling pulse. This increases the "arc on" time which makes the puddle more fluid. Because aluminum solidifies so quickly, it is recommended to add 15% (7 turns) inductance when welding aluminum whereas steel and stainless steel require little or no inductance. The MK2000A is factory set at 15% inductance. When -0- inductance is needed place the inductance switch on remote.

### Pulse Height

By leaving the Pulse Height Control at 100%, we can limit the height of the pulse with the Pulse Level Control.

Figure 7 shows the output voltage into a constant load. The pulse period is the reciprocal of the pulse frequency (16.6 milliseconds at 60 pulses per second).

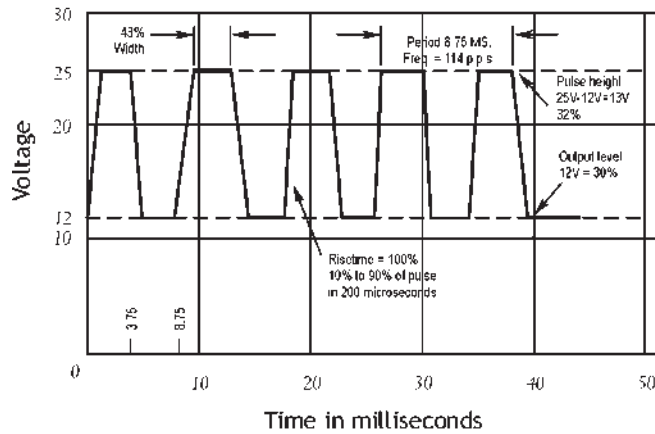


Figure 7

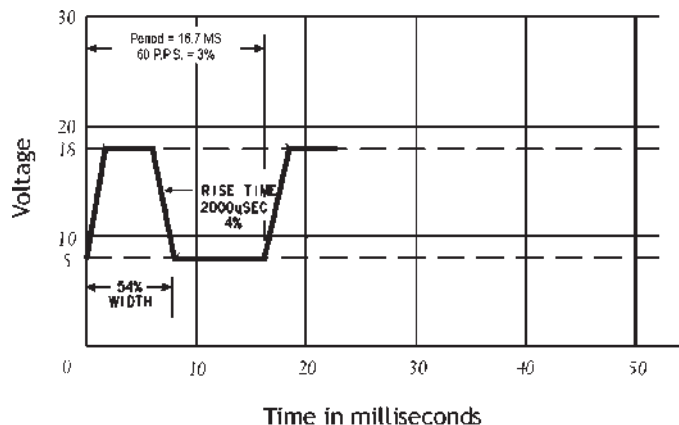


Figure 8

The effect that Rise Time has on the pulse is shown in (Figure 8). At 100% the pulse is rectangular, but by turning the rise time toward 0%, the leading and trailing edges become increasingly tapered. Slow rise times and narrow pulses will result in the output voltage never reaching the maximum voltage.

In this operating mode, the welding engineer has almost complete control of the welding conditions throughout the entire heat and metal transfer portions of the weld

### **Control Characteristics**

All controls are calibrated to provide 0- to 100% of the controlled parameter maximum value. Thus the Background Slope control provides a slope of 0- volts per ampere when set to CV (0%) and 0- amperes per volt when set to CC (100%).

With 0% slope (CV) the Background Level control provides 0-50 V output. For example 18 volts is 36% of 50 volts, or 36.0 on the dial.

With 100% slope (CC) the Background Level control provides 0-300 amperes output. For example 180 amperes is 60% of 300 amperes or 60.0 on the dial.

A control line may be drawn on a graph of voltage vs. current which connects the origin (0- volts, 0- amperes) with the maximum (50 V., 300 A.). The operating volt-ampere line will always cross this control line at the value corresponding to the dial setting. For example, an output dial setting of 60% will provide a volt-ampere line passing through 30 volts (.60 X 50V) and 180 amperes (.60 X 300A). As shown in Figure 1 and Figure 2, changing the background slope rotates this volt-ampere line around the set point and controls the no load and short circuit values of voltage and current.

The Pulse Level and Pulse Slope controls operate in an identical manner (except that the pulse operation adds to the Background Level control setting only). Both Background and Pulse controls may be used simultaneously to create an operating volt-ampere line such as shown in Figure 4.

The Inductance Control shapes the output current to approximately match that of an inductor of 0- to 3 millihenries. This is most useful in welding steel or similar metals to control the rate of use of arc current.

The Pulse Controls include Repetition Rate (frequency), Height, Width, and Rise Time. The Repetition Rate may be varied from 20 to 2000 pulses per second (pps), thus 60 pps is 3% of 2000 and 120 pps is 6% of 2000 (or 6 on the dial). The pulse Height adds to the Background level control so that, in the CV mode, the pulse height may be 0- to 50 volts. For example, if the Background Level is at 30% (15V) and the Pulse Height is set to 40% (20V) the "background" will be 15 volts and the pulses will be 35 volts (15 + 20). The discussion of current limit on the output applies equally to the output plus pulse levels.

With the Background Slope set to CC conditions (nearer 100% slope) the pulse height still adds to the background level and represents a current controlled pulse rather than a voltage controlled pulse. As indicated previously, the Pulse Level and Slope may be used to provide a constant current condition during the pulse with a constant voltage background.

The Pulse Width control provides pulse widths from nearly 0% to 100% of the pulse interval. Of course at 0- width there is no pulse and at 100% there is no background level. Within rather wide limits, the heat in the weld may be controlled by adjusting the pulse width with minimum effect on other parameters.

The Pulse Rise Time may be used to limit the rate of voltage or current rise during the pulse. The leading and trailing edges of the pulse are

symmetrically controlled. Excessive rise time may result in the pulse never reaching the set value. With the width set at a high percentage, excessive rise time will prevent the output from dropping back to the "background" value.

All functions may be remotely controlled by application of a -0- to 10 V. Direct Current level to the appropriate pins of the remote connector and placing the control switch in the "Remote" position. (See Page 20)

Control Summary - 0% to 100% dial settings (Calibration is in percent of maximum value given).

Background Level	0 to 50 volts, 0-300 amperes
Background Slope	0 volts per ampere (CV) to 0 amperes per volt (CC)
Pulse Level	0 to 50 volts, 0-300 amperes
Pulse Slope	0 volts per ampere (CV) to 0 amperes per volt (CC)
Inductance	0 to 3 millihenries equivalent
Pulse Rate	20 to 2000 pulses per second
Pulse Height	0 to 50 volts, 0 to 300 amperes
Pulse Width	0 to 1/pulse frequency
Pulse Time	200 msec to no rise

(see graph)

The following Figures show control characteristics:

Figure 9 Background Slope & Pulse Slope

Figure 10 Background Level & Pulse Level

Figure 11 Output Wave Form - 50% Pulse Width vs Frequency

Figure 12 Pulse Rise Time vs Dial Settings

### **The MK2000A and the C1-A Remote Control**

The 25 pin D connector on the front panel of the MK2000A enables the power supply to be remotely controlled through 0 to 10V analog commands. To use an existing C1-A Pendant, P/N 001-0002, with the MK2000A, the following 25 pin "D" connector cable assembly must be used: P/N 843-0306. When the C1-A pendant is used in conjunction with the MK2000A, several operating modes are available.

### **Remote Heat Only**

Set desired parameter on power supply, insuring that the mode selector switch is in the "heat" position. Placing switch 10 in the remote position now removes the heat control from the front panel to the C1-A pendant.

### **Full Pendant Operation**

Placing switches 1 - 10 in remote provides full C1-A type operation.

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#### **NOTE:**

Because the C1-A is calibrated to the MK2000's 40 volt range rather than the MK2000A's 50 volt range, it may be necessary to recalibrate the C1-A Pendant. When recalibration is necessary, consult the factory for procedure instructions.

---

## REMOTE CONNECTOR PIN ASSIGNMENTS

<u>PIN</u>	<u>FUNCTION</u>
1	Pulse Width / Heat
2	Pulse Frequency
3	Pulse Level
4	Rise Time
5	Pulse Height
6	Pulse Slope
7	Background Slope
8	Background Level
9	Contactors - Closing Contacts
10	Spare
11	Arc Establish *
12	Inductance
13	Spare
14	Ground
15	+ 10V (Source) (Contactors)
16	Spare
17	Amps Ref.
18	Volts Ref.
19	Spare
20	Spare
21	Spare
22	Spare
23	Spare
24	+ 12V Aux. Output
25	Aux. Common Output

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**NOTE:**

Contactors may be closed through 25 pin "D" connector with "closing contact only" (no 115 VAC) on pins 9 & 15.

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\* ARC EST. (PIN 11) is a logic type signal that goes from open to +10 VDC when the power supply is deliver 30 Amps or more. The load on this pin must not exceed more than 10 MA. (1000 OHMS minimum) referenced to Pin 14.



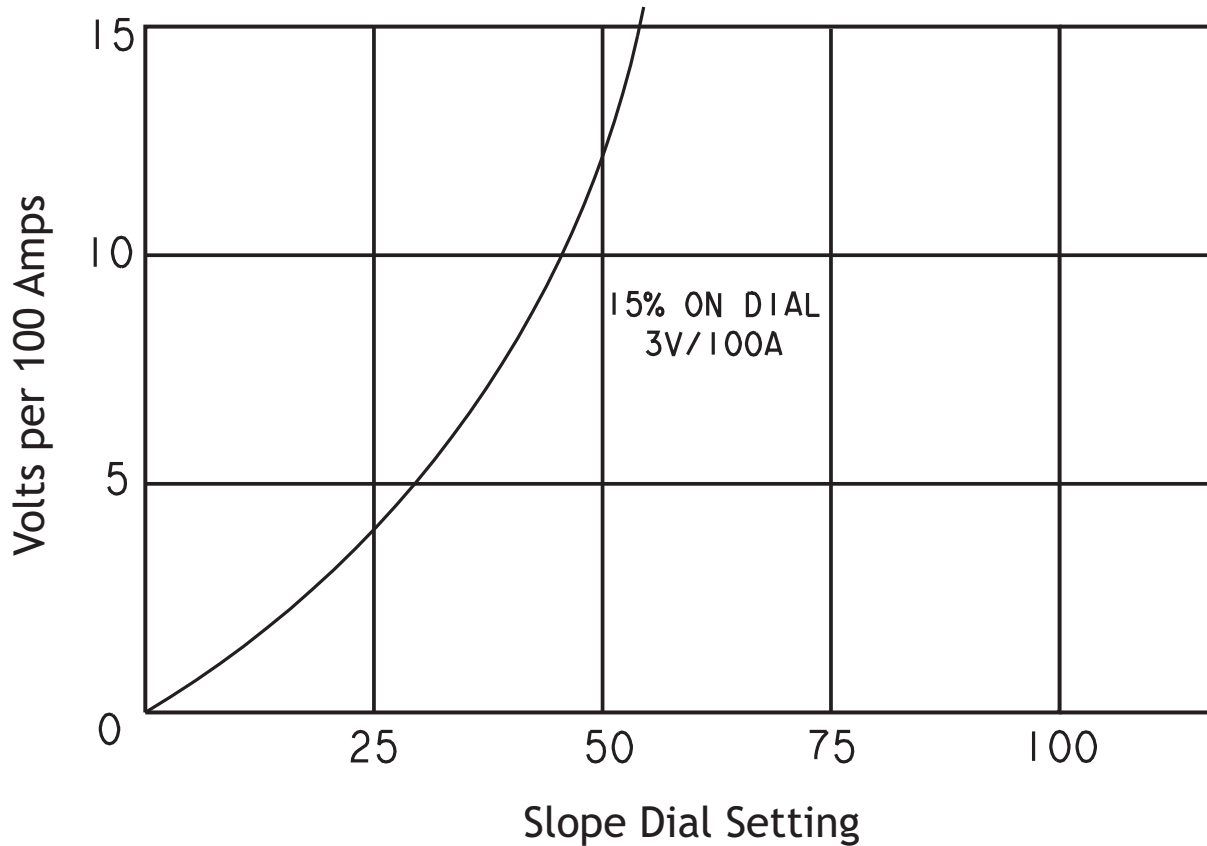


Fig. 9

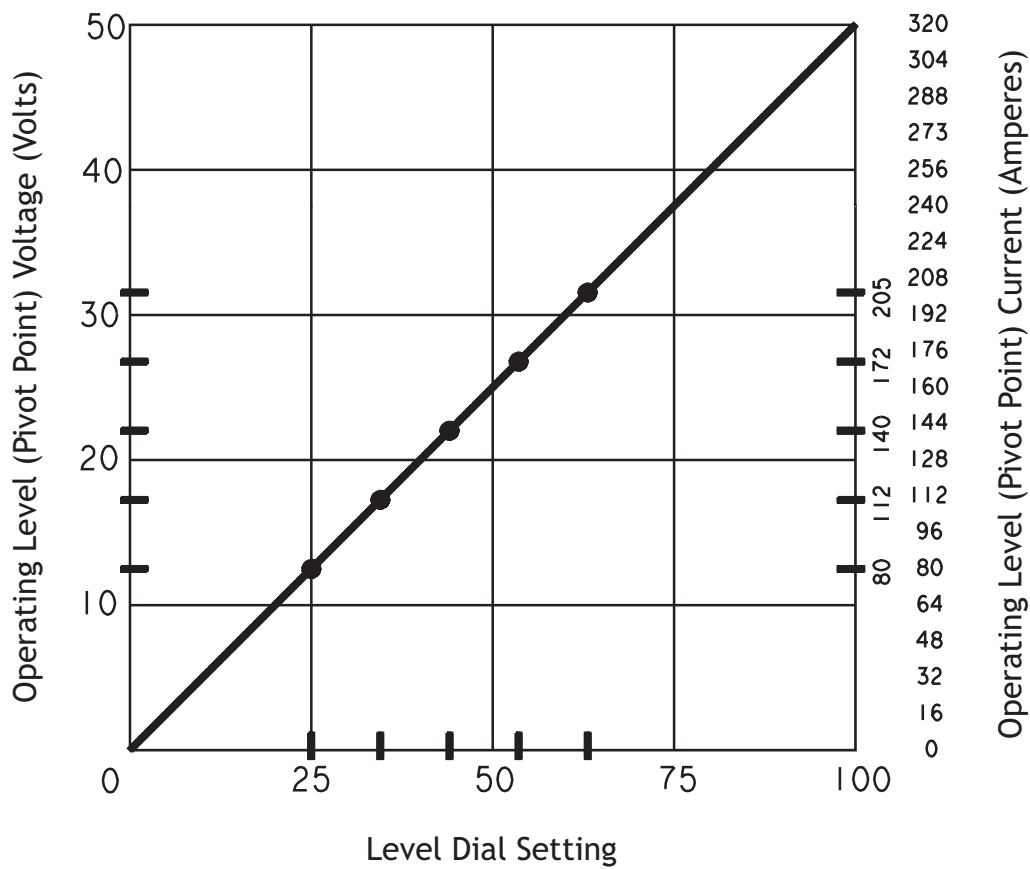


Fig. 10

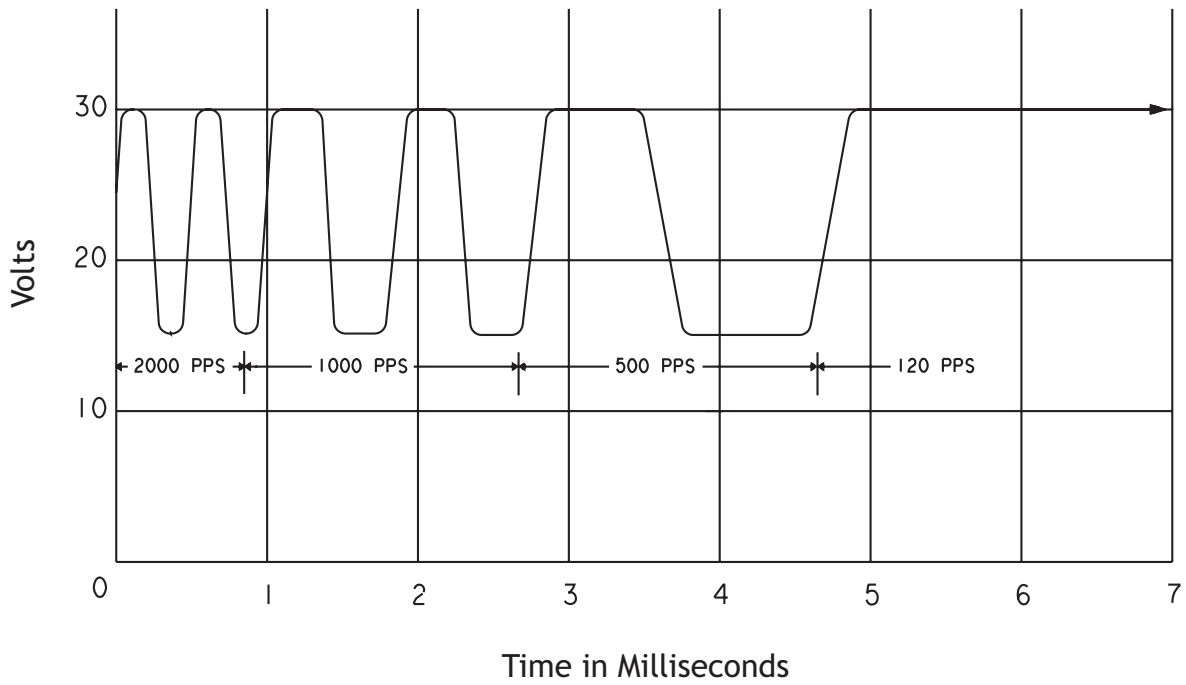


Fig. 11

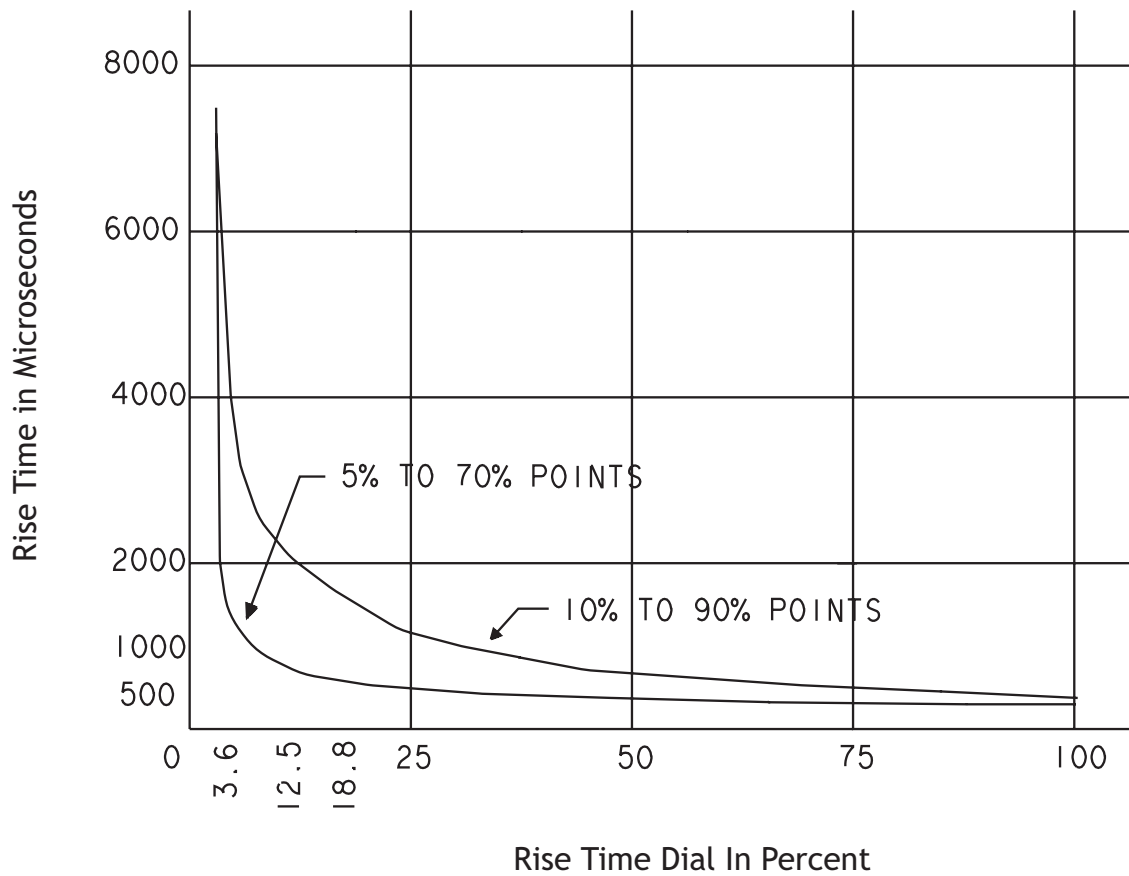


Fig. 12

### MK2000 to MK2000A Conversion

For A Slope of V/100A	Set Slope Dial To		Set level to MK2000 mult. by	Set Output Slope to % Shown Giving Desired Volts per 100 Amperes
	2000	2000A		
	%	%	.80	Set MK2000A Output Level to MK2000 Level multiplied by the number on line with Slope used. Repeat for Limit Slope and Level.
2	13	11	.82	
4	23	19	.84	
6	31	126	.85	
8	38	32	.86	
10	43	38	.88	
12	47	42	.88	
14	51	46	.89	
16	55	49	.90	
18	57	52	.90	
20	60	55	.91	

## FREQUENCY CALCULATION PROCEDURES

Given: Wire Diameter Dial Setting .....38%  
 Heat Setting .....30%

Convert "Wire Diameter" to pulse width using chart. For example, 38% equals 1.47 milliseconds.

$$\text{Formula} = \frac{\text{HEAT DIAL} \times 10}{\text{PULSE WIDTH (ms)}} = \frac{30 \times 10}{1.47} = \frac{300}{1.47} = 204 \text{ PPS}$$

WIRE DIAMETER DIAL SETTING	PULSE WIDTH IN M.SEC
.02 .....	25.25
.04 .....	12.74
.06 .....	8.57
.08 .....	6.48
.10 .....	5.23
.12 .....	4.39
.14 .....	3.79
.16 .....	3.34
.18 .....	2.98
.20 .....	2.70
.22 .....	2.47
.24 .....	2.27
.26 .....	2.11
.28 .....	1.97
.30 .....	1.84
.32 .....	1.73
.34 .....	1.64
.36 .....	1.55
.38 .....	1.47
.40 .....	1.40
.42 .....	1.34
.44 .....	1.28
.46 .....	1.22
.48 .....	1.17
.50 .....	1.13
.52 .....	1.08
.54 .....	1.04
.56 .....	1.00
.58 .....	0.97
.60 .....	0.93
.62 .....	0.90
.64 .....	0.87
.66 .....	0.84
.68 .....	0.82
.70 .....	0.79
.72 .....	0.76
.74 .....	0.74
.76 .....	0.72
.78 .....	0.70
.80 .....	0.68
.82 .....	0.65
.84 .....	0.64
.86 .....	0.62
.88 .....	0.60
.90 .....	0.58
.92 .....	0.56
.94 .....	0.55
.96 .....	0.53
.98 .....	0.52
1.00 .....	0.50

## Section 7

## INPUT POWER CONNECTIONS

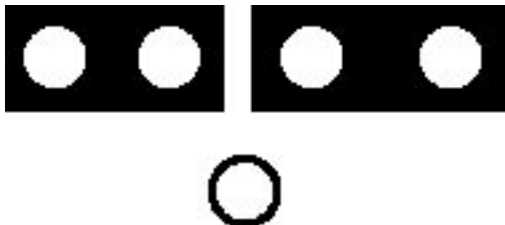
Regardless of what type of input power that you use for the MK2000A, you must provide a protected line (fused) disconnect in accordance with all applicable electrical codes. The MK2000A is equipped with an internal primary switch, but no fuses are provided. Line fuses should be 60 ampere maximum (Buss non-60 recommended). Connection cables must be sized to conform to national and local electrical code requirements.

**WARNING:**

**THE 2000A COMES SETUP FOR 208-230VAC SINGLE OR THREE PHASE (SEE BELOW). FOR HOOKUP OF 480VAC 4 WIRE WYE PLUS GROUND YOU WILL NEED A SPECIAL PLATE. CONTACT MK PRODUCTS TECHNICAL SERVICE FOR INSTRUCTION.**

### 1 PHASE 208-230 VAC

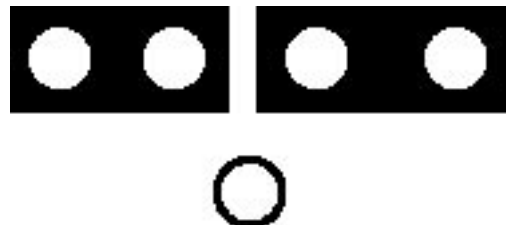
When connecting Single (1) Phase 208-230VAC, you will use only the X, Y and Ground terminals, DO NOT use the Z or NEUTRAL terminal with this input power.



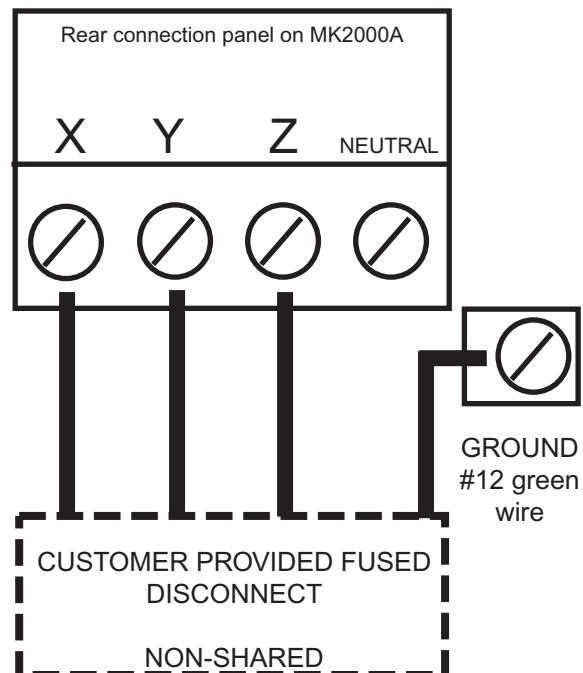
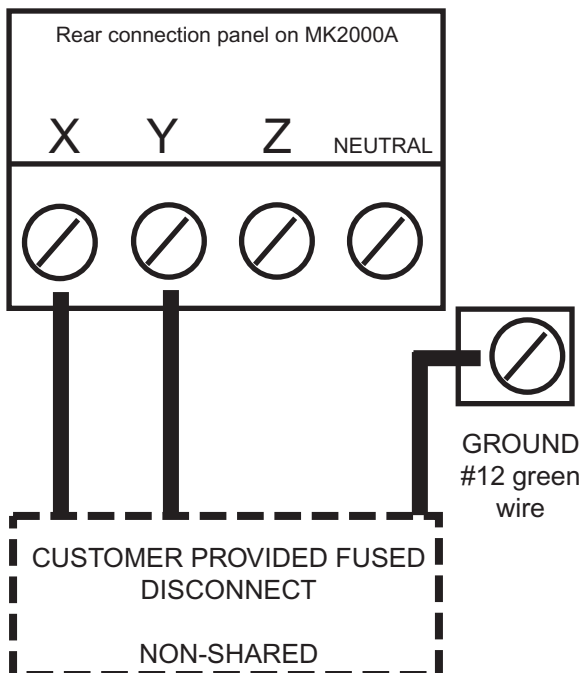
208-230 VAC ONLY  
SINGLE OR 3 PHASE

### 3 PHASE 208-230 VAC

When connecting 3 Phase 208-230VAC, you will use the X, Y, Z and Ground terminals, DO NOT use the NEUTRAL terminal with this input power.



208-230 VAC ONLY  
SINGLE OR 3 PHASE



			
<b>WARNING</b>	<ul style="list-style-type: none"> <li>● Do not touch electrically live parts or electrode with skin or wet clothing.</li> <li>● Insulate yourself from work and ground.</li> </ul>	<ul style="list-style-type: none"> <li>● Keep flammable materials away.</li> </ul>	<ul style="list-style-type: none"> <li>● Wear eye, ear and body protection.</li> </ul>
Spanish <b>AVISO DE PRECAUCION</b>	<ul style="list-style-type: none"> <li>● No toque las partes o los electrodos bajo carga con la piel o ropa mojada.</li> <li>● Aislase del trabajo y de la tierra.</li> </ul>	<ul style="list-style-type: none"> <li>● Mantenga el material combustible fuera del área de trabajo.</li> </ul>	<ul style="list-style-type: none"> <li>● Protéjase los ojos, los oídos y el cuerpo.</li> </ul>
French <b>ATTENTION</b>	<ul style="list-style-type: none"> <li>● Ne laissez ni la peau ni des vêtements mouillés entrer en contact avec des pièces sous tension.</li> <li>● Isolez-vous du travail et de la terre.</li> </ul>	<ul style="list-style-type: none"> <li>● Gardez à l'écart de tout matériel inflammable.</li> </ul>	<ul style="list-style-type: none"> <li>● Protégez vos yeux, vos oreilles et votre corps.</li> </ul>
German <b>WARNUNG</b>	<ul style="list-style-type: none"> <li>● Berühren Sie keine stromführenden Teile oder Elektroden mit Ihrem Körper oder feuchter Kleidung!</li> <li>● Isolieren Sie sich von den Elektroden und dem Erdboden!</li> </ul>	<ul style="list-style-type: none"> <li>● Entfernen Sie brennbares Material!</li> </ul>	<ul style="list-style-type: none"> <li>● Tragen Sie Augen-, Ohren- und Körperschutz!</li> </ul>
Portuguese <b>ATENÇÃO</b>	<ul style="list-style-type: none"> <li>● Não toque partes elétricas e electrodos com a pele ou roupa molhada.</li> <li>● Isole-se da peça e terra.</li> </ul>	<ul style="list-style-type: none"> <li>● Mantenha inflamáveis bem guardados.</li> </ul>	<ul style="list-style-type: none"> <li>● Use proteção para a vista, ouvido e corpo.</li> </ul>
Japanese <b>注意事項</b>	<ul style="list-style-type: none"> <li>● 通電中の電気部品、又は溶材にヒフやぬれた布で触れないこと。</li> <li>● 施工物やアースから身体が絶縁されている様にして下さい。</li> </ul>	<ul style="list-style-type: none"> <li>● 燃えやすいものの側での溶接作業は絶対にしてはなりません。</li> </ul>	<ul style="list-style-type: none"> <li>● 目、耳及び身体に保護具をして下さい。</li> </ul>
Chinese <b>警告</b>	<ul style="list-style-type: none"> <li>● 皮肤或湿衣物切勿接觸帶電部件及焊條。</li> <li>● 使你自已與地面和工件絕緣。</li> </ul>	<ul style="list-style-type: none"> <li>● 把一切易燃物品移離工作場所。</li> </ul>	<ul style="list-style-type: none"> <li>● 佩戴眼、耳及身體勞動保護用具。</li> </ul>
Korean <b>위험</b>	<ul style="list-style-type: none"> <li>● 전도체나 용접봉을 젖은 장갑 또는 피부로 절대 접촉치 마십시오.</li> <li>● 모재와 접지를 접촉치 마십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 인화성 물질과 접근 시키지 마십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 눈, 귀와 몸에 보호장구를 착용하십시오.</li> </ul>
Arabic <b>تحذير</b>	<ul style="list-style-type: none"> <li>● لا تلمس الأجزاء التي يسري فيها التيار الكهربائي أو الأقطاب بجلد الجسم أو بالملابس المبللة بالماء.</li> <li>● ضع عزلاً على جسمك خلال العمل.</li> </ul>	<ul style="list-style-type: none"> <li>● ضع المواد القابلة للاشتعال في مكان بعيد.</li> </ul>	<ul style="list-style-type: none"> <li>● ضع أدوات وملابس واقية على عينيك وأذنيك وجسمك.</li> </ul>

READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTION FOR THIS EQUIPMENT AND THE CONSUMABLES TO BE USED AND FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES.

SE RECOMIENDA LEER Y ENTENDER LAS INSTRUCCIONES DEL FABRICANTE PARA EL USO DE ESTE EQUIPO Y LOS CONSUMIBLES QUE VA A UTILIZAR, SIGA LAS MEDIDAS DE SEGURIDAD DE SU SUPERVISOR.

LISEZ ET COMPRENEZ LES INSTRUCTIONS DU FABRICANT EN CE QUI REGARDE CET EQUIPMENT ET LES PRODUITS A ETRE EMPLOYES ET SUIVEZ LES PROCEDURES DE SECURITE DE VOTRE EMPLOYEUR.

LESEN SIE UND BEFOLGEN SIE DIE BETRIEBSANLEITUNG DER ANLAGE UND DEN ELEKTRODENEINSATZ DES HERSTELLERS. DIE UNFALLVERHÜTUNGSVORSCHRIFTEN DES ARBEITGEBERS SIND EBENFALLS ZU BEACHTEN.



			
<ul style="list-style-type: none"> <li>● Keep your head out of fumes.</li> <li>● Use ventilation or exhaust to remove fumes from breathing zone.</li> </ul>	<ul style="list-style-type: none"> <li>● Turn power off before servicing.</li> </ul>	<ul style="list-style-type: none"> <li>● Do not operate with panel open or guards off.</li> </ul>	<b>WARNING</b>
<ul style="list-style-type: none"> <li>● Los humos fuera de la zona de respiración.</li> <li>● Mantenga la cabeza fuera de los humos. Utilice ventilación o aspiración para gases.</li> </ul>	<ul style="list-style-type: none"> <li>● Desconectar el cable de alimentación de poder de la máquina antes de iniciar cualquier servicio.</li> </ul>	<ul style="list-style-type: none"> <li>● No operar con panel abierto o guardas quitadas.</li> </ul>	Spanish <b>AVISO DE PRECAUCION</b>
<ul style="list-style-type: none"> <li>● Gardez la tête à l'écart des fumées.</li> <li>● Utilisez un ventilateur ou un aspirateur pour ôter les fumées des zones de travail.</li> </ul>	<ul style="list-style-type: none"> <li>● Débranchez le courant avant l'entretien.</li> </ul>	<ul style="list-style-type: none"> <li>● N'opérez pas avec les panneaux ouverts ou avec les dispositifs de protection enlevés.</li> </ul>	French <b>ATTENTION</b>
<ul style="list-style-type: none"> <li>● Vermeiden Sie das Einatmen von Schweißrauch!</li> <li>● Sorgen Sie für gute Be- und Entlüftung des Arbeitsplatzes!</li> </ul>	<ul style="list-style-type: none"> <li>● Strom vor Wartungsarbeiten abschalten! (Netzstrom völlig öffnen; Maschine anhalten!)</li> </ul>	<ul style="list-style-type: none"> <li>● Anlage nie ohne Schutzgehäuse oder Innenschutzverkleidung in Betrieb setzen!</li> </ul>	German <b>WARNUNG</b>
<ul style="list-style-type: none"> <li>● Mantenha seu rosto da fumaça.</li> <li>● Use ventilação e exaustão para remover fumaça da zona respiratória.</li> </ul>	<ul style="list-style-type: none"> <li>● Não opere com as tampas removidas.</li> <li>● Desligue a corrente antes de fazer serviço.</li> <li>● Não toque as partes elétricas nuas.</li> </ul>	<ul style="list-style-type: none"> <li>● Mantenha-se afastado das partes moventes.</li> <li>● Não opere com os painéis abertos ou guardas removidas.</li> </ul>	Portuguese <b>ATENÇÃO</b>
<ul style="list-style-type: none"> <li>● ヒュームから顔を離すようにして下さい。</li> <li>● 換気や排煙に十分留意して下さい。</li> </ul>	<ul style="list-style-type: none"> <li>● メンテナンス・サービスに取りかかる際には、まず電源スイッチを必ず切って下さい。</li> </ul>	<ul style="list-style-type: none"> <li>● パネルやカバーを取り外したまま機械操作をしないで下さい。</li> </ul>	Japanese <b>注意事項</b>
<ul style="list-style-type: none"> <li>● 頭部遠離煙霧。</li> <li>● 在呼吸區使用通風或排風器除煙。</li> </ul>	<ul style="list-style-type: none"> <li>● 維修前切斷電源。</li> </ul>	<ul style="list-style-type: none"> <li>● 儀表板打開或沒有安全罩時不準作業。</li> </ul>	Chinese <b>警告</b>
<ul style="list-style-type: none"> <li>● 얼굴로부터 용접가스를 멀리하십시오.</li> <li>● 호흡지역으로부터 용접가스를 제거하기 위해 가스제거기나 통풍기를 사용하십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 보수전에 전원을 차단하십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 판넬이 열린 상태로 작동하지 마십시오.</li> </ul>	Korean <b>위험</b>
<ul style="list-style-type: none"> <li>● أبعد رأسك بعيداً عن الدخان.</li> <li>● استعمل التهوية أو جهاز ضغط الدخان للخارج لكي تبعد الدخان عن المنطقة التي تتنفس فيها.</li> </ul>	<ul style="list-style-type: none"> <li>● قطع التيار الكهربائي قبل القيام بأية صيانة.</li> </ul>	<ul style="list-style-type: none"> <li>● لا تشغيل هذا الجهاز إذا كانت الاغطية الحديدية الواقيّة ليست عليه.</li> </ul>	Arabic <b>تحذير</b>

**LEIA E COMPREENDA AS INSTRUÇÕES DO FABRICANTE PARA ESTE EQUIPAMENTO E AS PARTES DE USO, E SIGA AS PRÁTICAS DE SEGURANÇA DO EMPREGADOR.**

使う機械や溶材のメーカーの指示書をよく読み、まず理解して下さい。そして貴社の安全規定に従って下さい。

請詳細閱讀並理解製造廠提供的說明以及應該使用的鐵棒材料，並請遵守貴方的有關勞動保護規定。

이 제품에 동봉된 작업지침서를 숙지하시고 귀사의 작업자 안전수칙을 준수하시기 바랍니다.

اقرأ بتمعن وافهم تعليمات المصنع المنتج لهذه المعدات والمواد قبل استعمالها واتبع تعليمات الوقاية لصاحب العمل.

# LIMITED WARRANTY

Effective March 1, 2001

This warranty supersedes all previous MK Products warranties and is exclusive, with no other guarantees or warranties expressed or implied.

LIMITED WARRANTY - MK Products, Inc., Irvine, California warrants that all new and unused equipment furnished by MK Products is free from defect in workmanship and material as of the time and place of delivery by MK Products. No warranty is made by MK Products with respect to trade accessories or other items manufactured by others. Such trade accessories and other items are sold subject to the warranties of their respective manufacturers, if any.

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In the case of MK Products' breach of warranty or any other duty with respect to the quality of any goods, the exclusive remedies therefore shall be at MK Products' option: (1) repair; (2) replacement; (3) where authorized in writing by MK Products, the reasonable cost of repair or replacement at our Irvine, California plant; or (4) payment of or credit for the purchase price (less reasonable depreciation based upon actual use) upon return of the goods at customer's risk and expense. Upon receipt of notice of apparent defect or failure, MK Products shall instruct the claimant on the warranty claim procedures to be followed.

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1. Torches, Weldheads, and Water Recirculators..... 1 year
2. All Other Equipment ..... 3 years
3. Repairs ..... 90 days

Classification of any item into the foregoing categories shall be at the sole discretion of MK Products. Notification of any failure must be made in writing within 30 days of such failure.

A copy of the invoice showing the date of sale must accompany products returned for warranty repair or replacement.

All equipment returned to MK Products for service must be properly packaged to guard against damage from shipping. MK Products will not be responsible for any damages resulting from shipping.

Normal surface transportation charges (both ways) for products returned for warranty repair or replacement will be borne by MK Products, except for products sold to foreign markets.

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