LINCOLN® WELDERS

IM-361-A

IM361
Square Wave TIG 300 & 300 FF
January, 1989
9173; 9182; 9191; 9192; 9193; 9298; 9299; 9300; 9301; 9302; 9352; 9411; 9413; 9453; 9458; 9507; 9508; 9509; 9510; 9511; 9523

OPERATING MANUAL

SQUARE WAVE TIG 300 and SQUARE WAVE TIG 300 FF

This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.

LINCOLN® ELECTRIC

THE LINCOLN ELECTRIC COMPANY
World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors
Sales and Service Worldwide
Cleveland, Ohio 44117-1199 U.S.A.

ARC WELDING SAFETY PRECAUTIONS

WARNING: PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH.

ELECTRIC SHOCK can kill.

1. a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

   b. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".

   c. Insulate yourself from work and ground using dry insulation. When welding in damp locations, on metal framework such as floors, gratings or scaffolds, and when in positions such as sitting or lying, make certain the insulation is large enough to cover your full area of physical contact with work and ground.

   d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

   e. Ground the work or metal to be welded to a good electrical (earth) ground.

   f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

   g. Never dip the electrode in water for cooling.

   h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

   i. When working above floor level, protect yourself from a fall should you get a shock.

   j. Also see Items 4c and 6.

ARC RAYS can burn.

2. a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87.1 standards.

   b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

   c. Protect other nearby personnel with suitable non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES can be dangerous.

3. a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding on galvanized, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.

   b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

   c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

   d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices.

   e. Also see item 7b.

WELDING SPARKS can cause fire or explosion.

4. a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Have a fire extinguisher readily available.

   b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

   c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

   d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned." For information purchase "Recommended Safe Practices for the Preparation for

Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1-80 from the American Welding Society (see address below).

e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

h. Also see item 7c.

CYLINDER may explode if damaged.

5. a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

c. Cylinders should be located:
- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

d. Never allow the electrode, electrode holder, or any other electrically "hot" parts to touch a cylinder.

e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

f. Valve protection caps should always be in place and handtight except when the cylinder is in use or connected for use.

g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

FOR ELECTRICALLY powered equipment.

6. a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

b. Install equipment in accordance with the National Electrical Code, all local codes and the manufacturer's recommendations.

c. Ground the equipment in accordance with the National Electrical Code and the manufacturer's recommendations.

FOR ENGINE powered equipment.

7. a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

c. Do not add the fuel near an open flame, welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR WORK performed by qualified people.

For more detailed information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting — ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135.

SPECIFICATION SUMMARY

Model	Basic	Full Function	Basic	Full Function
Type	K1340	K1341	K1342	K1343
Input Frequency	60 Hertz		50 Hertz	
Output Ratings (AC & DC, Stick & TIG, 50 & 60 Hz)	**NEMA Class I (60)** 300 Amps, 32 Volts, 60% Duty Cycle 375 Amps, 35 Volts, 30% Duty Cycle 300 Amps, 40 Volts (Lincoln Plus Rating			
Current Range: Maximum O.C.V.: Normal O.C.V's:	2-400 Amps AC and DC 80 Stick: 5-15 / TIG: 60-70			
Input Power Standard Voltage Nameplate Amps[1] Other Voltages	208/230/460/1/60 88/80/40 230/575/1/60		200/220/440/1/50 92/84/42 220/380/440/1/50 380/415/500/1/50	
Idle Current[2] Idle Power Power Factor[2] @ Rated Load	62 Amps @ 230V/60 Hz 1.10 KW Max. 0.88 Min.		50 Amps @ 220V/50 Hz 1.10 KW Max. 0.76 Min.	
Auxiliary Power	115 Volts AC, 15 amps continuous Duplex Grounded NEMA 5-15R Receptacle Plus 15 Amp Circuit Breaker			
Net Weight Dimensions (inches)	510 lbs 34.81 H × 22.25 W × 26.00 D (Lift Hook, add 3.44)			

[1] Unbalanced AC TIG welding above 230 amps will draw higher input currents; See Table 2 Section 1.4

[2] Power factor correction capacitors are standard on all models. The capacitors cause high idle currents but idle power is low.

INDEX

GENERAL DESCRIPTION

The Square Wave TIG 300 is a constant current, single range square wave AC/DC TIG (GTAW) and Stick (SMAW) arc welding power source with built-in high frequency stabilization. It is available from the factory in two models: Basic and Full Function. There are no factory installed options other than different input voltages and frequency.

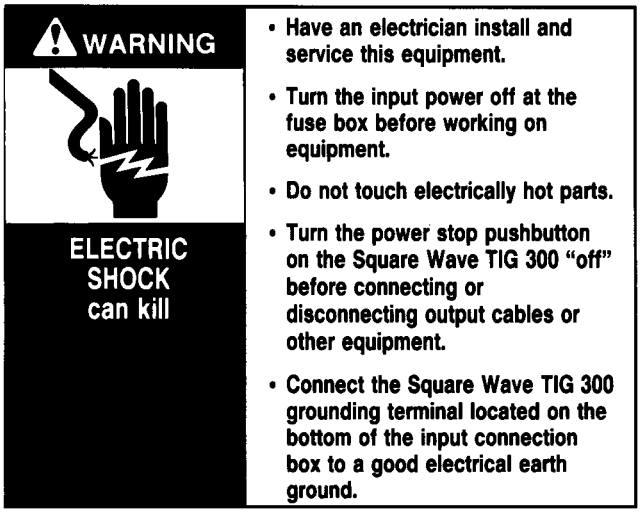
The Basic model allows full control of the welding current by the operator plus the ability to preset weld and start currents.

The Full Function model has all of the Basic model controls and can be used for the same purposes; in addition, it includes a gas and water preflow timer, a spot timer, a start time control, pulsing controls, crater fill controls and status indicator lights. The additional controls of the Full Function model allow all or part of the weld cycle to be preset or "programmed"

INSTALLATION

Read **all** sections from Safety Precautions to Output Connections

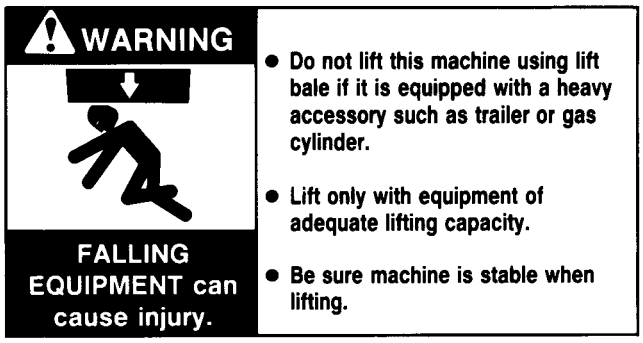
SAFETY PRECAUTIONS



LOCATION

Place the welder where clean cooling air can freely circulate in through the side louvers and out through the rear louvers. Dirt, dust or any foreign material that can be drawn into the welder should be kept at a minimum. Failure to observe these precautions can result in excessive operating temperatures and nuisance welder trips off the line. Before planning the installation, read the section entitled "High Frequency Interference Protection".

Square Wave TIG 300's may be stacked two-high provided the bottom machine is on a stable, hard, level surface. Be sure the two pins in the roof fit into the holes in the base of the Square Wave TIG 300 above it.



HIGH FREQUENCY INTERFERENCE PROTECTION

Since the spark gap oscillator in the high frequency generator in the welder is similar to a radio transmitter, improper welder installation can result in radio and TV interference or problems with nearby electronic equipment. The Square Wave TIG 300 has been field tested under recommended installation conditions and has been found to comply with the F.C.C. allowable radiation limits. A certificate is being sent with each welder for customer convenience. If he desires or is required to obtain certification of compliance with F.C.C. RF Energy Radiation Limits, this certificate can be used. It is the customer's responsibility to obtain this certification. This welder has also been found to comply with NEMA standards for high frequency stabilized power sources.

Radiated interference can develop in the following four ways:

1. Direct interference radiated from the welder.
2. Direct interference radiated from the welding leads.
3. Direct interference radiated from feedback into the power lines.
4. Interference from reradiation of "pickup" by ungrounded metallic objects.

Keeping these contributions factors in mind, installing equipment per the following instructions should minimize problems.

1. Keep the welder power supply lines as short as possible and completely enclose them in rigid metallic conduit or equivalent shielding for a minimum distance of 50 feet. There should be good electrical contact between this conduit and the welder. Both ends of the conduit should be connected to a driven ground and the entire length should be continuous.
2. Keep the work and electrode leads as short as possible and as close together as possible. Lengths should not exceed 25 feet. Tape the leads together when practical.
3. Be sure the torch and work cable rubber coverings are free of cuts and cracks that allow high frequency leakage. Cables with high natural rubber content, such as Lincoln Stable-Arc® better resist high frequency leakage than neoprene and other synthetic rubber insulated cables.
4. Keep the torch in good repair and all connections tight to reduce high frequency leakage.
5. The work terminal must be connected to a ground within ten feet or the welder, using one of the following methods:

   a. A metal underground water pipe in direct contact with the earth for ten feet or more.

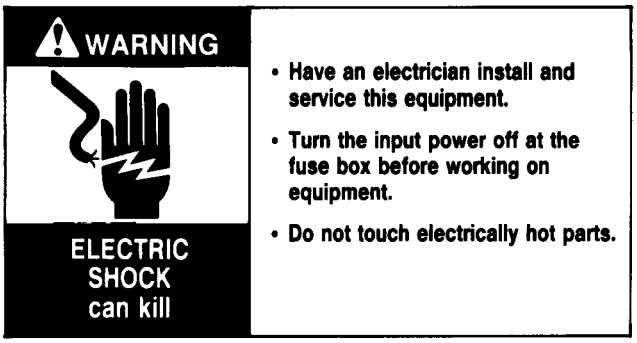
   b. A 3/4" galvanized pipe or conduit or a 5/8" solid galvanized iron or steel or copper rod driven at least eight feet into the ground.

   The ground should be securely made and the grounding cable should be as short as possible using cable of the same size as the work cable, or larger. Grounding to the building frame electrical conduit or a long pipe system can result in reradiation, effectively making these members radiating antennas.

   NOTE: The welder frame MUST also be grounded — see paragraph under "Input Connection". The work terminal ground does not ground the welder frame.
6. Keep all access panels and covers securely in place.
7. All electrical conductors within 50 feet of the welder should be enclosed in grounded rigid metallic conduit or equivalent shielding. Flexible helically-wrapped metallic conduit is generally not suitable.
8. When the welder is enclosed in a metal building, several good earth driven electrical grounds (as in 5b. above) around the periphery of the building are recommended.

Failure to observe these recommended installation procedures can cause radio or TV interference problems and result in unsatisfactory welding performance resulting from lost high frequency power.

INPUT CONNECTIONS



Be sure the voltage, phase, and frequency of the input power is as specified on the welder nameplate.

Welder supply line entry provision is in the case rear panel with a removable cover over the input connection panel area.

Have a qualified electrician connect the input leads to L1 and L2 of the input contactor in accordance with the National Electrical Code, all local codes and the connection diagram located on the inside of the cover. Use a single phase line or one phase of a two or three phase line.

The frame of the welder must be grounded. A grounding stud marked with the symbol ⏚ located at the bottom of the input box is provided for this purpose. See the National Electrical Code for details on proper grounding methods. Follow other grounding instructions per the paragraph under "High Frequency Interference Protection".

On multiple input voltage welders, be sure the reconnect panel is connected per the following instructions for the voltage being supplied to the welder.

WARNING: Failure to follow these instructions can cause immediate failure of components within the welder.

Welders are shipped connected for the highest nameplated input voltage. To change this connection for a different input voltage, reconnect both power strap (P) and control lead (C) to their respective terminals corresponding to the input voltage used. Designations on reconnect panel, LOW, MID and HIGH correspond to the nameplated input voltages of a triple voltage welder. Dual voltage welders use only LOW and HIGH. Single voltage welders use only HIGH.

Example: On a 208/230/460 volt welder, LOW is 208V, MID is 230V, and HIGH is 460V.

Fuse the input circuit with the recommended super lag fuses. Choose an input and grounding wire size according to local codes or use the following tables. "Delay type"[1] circuit breakers may be used in place of fuses. Using fuses or circuit breakers smaller than recommended may result in "nuisance" tripping from welder inrush currents even if not welding at high currents.

Unbalanced AC TIG welding draws higher input currents than those for Stick, DC TIG, or Balanced AC TIG welding. The welder is designed for these higher input currents; however, where unbalanced AC TIG welding above 230 amps is planned, the higher input currents require larger input wire sizes and fuses per Table 2.

[1] Also called "inverse time" or "thermal/magnetic" circuit breakers; circuit breakers which have a delay in tripping action that decreases as the magnitude of the current increases.

TABLE 1

RECOMMENDED INPUT WIRE AND FUSE SIZES FOR ALL STICK, DC TIG, AND BALANCED AC TIG WELDING

Based on the 1987 National Electric Code[1] — 60% Duty Cycle

Input Volt/Freq.	Input Ampere Rating on Nameplate	Type 75°C Wire in Conduit AWG Copper Cond.	Grounding Wire AWG Copper Cond.	Fuse Size (Super Lag)
208/60	88	4	6	150
230/60	80	4	6	125
460/60	40	8	10	60
200/50	92	4	6	150
220/50	84	4	6	125
440/50	42	8	8	60

[1] Article 630 of the 1987 National Electric Code allows the rated ampacity of the supply conductors to be determined by multiplying the nameplate rating by the appropriate multiplier depending on the duty cycle of the welder.

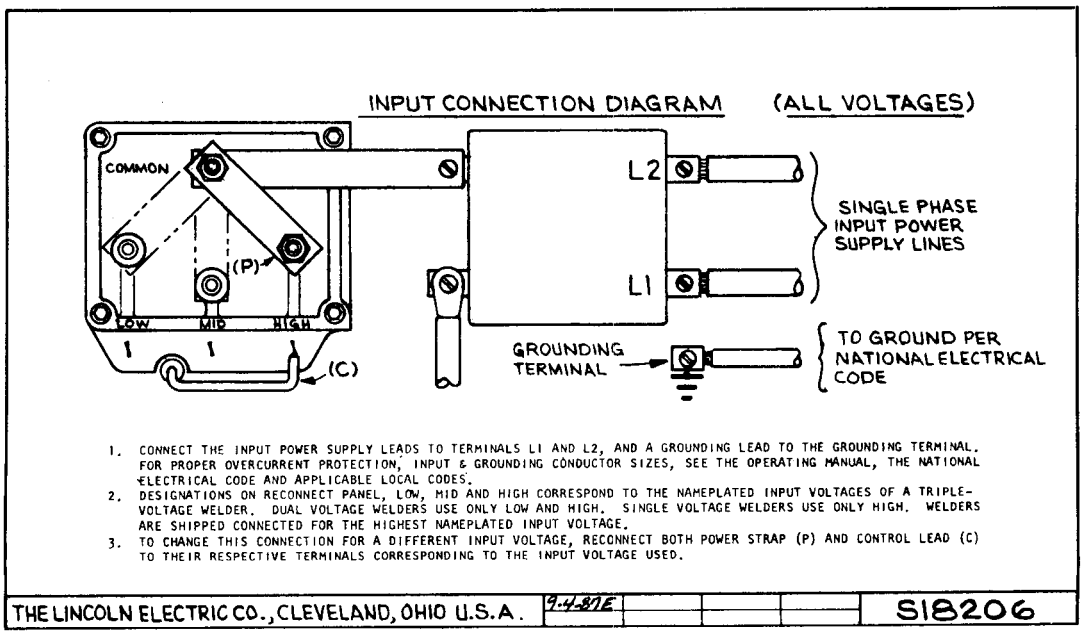
TABLE 2

RECOMMENDED INPUT WIRE AND FUSE SIZES FOR UNBALANCED AC TIG WELDING ABOVE 230 AMPS

Based on the 1987 National Electric Code[1] — 60% Duty Cycle

Input Volt/ Freq.	Input Ampere at 300 Amp Unbalanced AC Output	Type 75°C Wire in Conduit AWG Copper Cond.	Grounding Wire AWG Copper Cond.	Fuse Size (Super Lag)
208/60	122	3	6	200
230/60	110	3	6	175
460/60	55	8	8	80
200/50	134	2	6	200
220/50	122	3	6	200
440/50	61	8	8	90

[1] Article 630 of the 1987 National Electric Code allows the rated ampacity of the supply conductors to be determined by multiplying the nameplate rating by the appropriate multiplier depending on the duty cycle of the welder.



OUTPUT CONNECTIONS

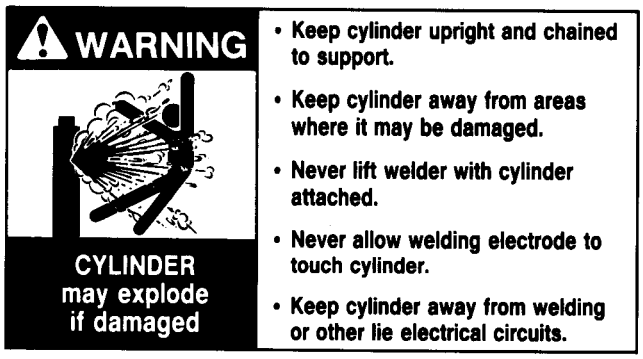
WARNING: To avoid being startled by a high frequency shock keep the TIG torch and cables in good condition.

TIG Torch Connection

TIG welding torches come with 15′ and 25′ cables. Use the shorter length whenever possible to minimize possible radio interference problems. With power source off, connect the torch cable to the "Electrode" stud on the welder. Connect a separate work cable to the "To Work" stud of the welder. Both work and electrode cable should be routed through the cable strain relief holes provided in the base directly below the welding output terminals.

TIG torches include the necessary gas and, when designed for water cooling, water hoses. Connect the fittings on these hoses to the welder. Any torch conforming to Compressed Gas Association (CGA) standards can be connected. The fitting have the following threads: Gas Inlet and Outlet: 5/8″-18 left-hand female.

The cylinder of inert shielding gas must be equipped with a pressure regulator and flowmeter. Install a hose between the flowmeter and gas inlet on the welder.



DO NOT operate a water-cooled torch unless water is flowing.

If using a water-cooled torch with a water recirculator, connect the recirculator water outlet directly to the torch water hose. Do not install the optional Water Valve Kit; the welder water valve would unnecessarily stop the recirculator water flow, possibly damaging the recirculator pump. See the manufacturer's instructions for installation and hook up of the water circulator.

If using a water-cooled torch with a free-running water supply, install the optional K844 Water Valve Kit. Install a water line between the welder water inlet and the supply. Include a strainer in the water supply line to prevent dirt particles from obstructing water flow in the valve and cooling chamber of the TIG torch. Failure to do so could result in water valve malfunction and overheating of the water-cooled torch. Connect the torch water line to the welder "Water Outlet" fitting. Use a non-metallic drain line from the electrode connection to the drain or water recirculating pump.

Stick Electrode Cable Connection

Turn the power source off. Run the electrode and work cables through the strain relief holes below the welding output terminals and connect the cables to the proper terminals. This strain relief prevents damage to the welding output terminals if the cables are pulled excessively. Select cable size according to Table 3.

WARNING: Disconnect stick electrode welding cable when TIG welding as it will be electrically hot.

TABLE 3

CABLE SIZES FOR COMBINED LENGTHS OF COPPER ELECTRODE AND WORK CABLE

Machine Size	Lengths up to 100 Ft	100 to 200 Ft	200 to 250 Ft
300	#1	1/0	2/0

MODELS

K1340: Basic 60 Hz
K1341: Full Function 60 Hz

K1342: Basic 50 Hz
K1343: Full Function 50 Hz

The Basic model allows full control of the welding current by the operator plus the ability to preset weld and start currents.

The Full Function model has all of the Basic model controls and can be used for the same purposes; in addition, it includes a gas and water preflow timer, a spot timer, a start time control, pulsing controls, crater fill controls and status indicator lights. The additional controls of the Full Function model allow all or part of the weld cycle to be preset or "programmed".

OPTIONAL FIELD INSTALLED KITS

AMPTROL™ (K813 or K812)

The Amptrol™ remote current control is used for most TIG welding applications. It is available in either hand (K812) or foot (K813) operated models. Both plug into the Remote Receptacle. With the Current Control Switch in the **LOCAL** position, the output current is controlled by the rheostat on the front panel of the welder. With the Current Control Switch in the **REMOTE** position, the output current is controlled by the Amptrol. The range of control by the Amptrol is from 2 amps up to the current set on the control panel. The Amptrols also contain a switch which starts the welding sequence. Both hand and foot Amptrols have a 25 foot cable. It is recommended that this cable be taped alongside the work and electrode cables between the welder and the work table with the excess length tucked under the welder. This will minimize the possibility of accidental cut-through of the control cable by using the heavier cables as a buffer.

Depress the Amptrol to start the welding sequence. Depressing the pedal increases the current. Depress it fully to get the maximum set current. Raise the foot to reduce the current. Fully raising the pedal stops the weld and starts the Afterflow time.

Tape the Hand Operated Amptrol to the TIG torch in a position so the control can be extended conveniently by the thumb. A slight movement starts the gas and the water flow and allows output current. Extending the control raises the current. Extend the control fully to get the maximum set current. Reducing thumb pressure allows the spring-loaded control to return, reducing the current. Completely returning to the start position stops the weld and starts the Afterflow time.

CAUTION: Since the full output of the current setting is available when the Amptrol is fully depressed, care must be taken not to set a current which will exceed the current carrying capacity of the tungsten. When in doubt, use a lower current setting first, then increase.

NOTE: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just "cracked", the minimum current (2 Amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems.

With the Current Control Switch in the **LOCAL** position, only the switch in the Amptrol is active — it functions as an Arc Start switch but does not control current.

ARC START SWITCH (K814)

The Arc Start Switch, complete with a 25 foot cable, is available if remote current control for TIG welding is not desired. It plugs into the Remote Receptacle and serves the purpose of starting the welding sequence. The Current Control switch must be in the LOCAL position; if in REMOTE, only minimum current (2 amps) will be available.

Tape the Arc Start Switch to the TIG torch where it can be conveniently pressed by the finger or thumb when holding the torch in position for welding.

PUMP MOUNTING PLATFORM (K827)

A formed metal platform, which fits on top of the welder and provides a mounting surface suitable for certain water recirculating pumps.

UNDERCARRIAGE (K841)

Includes platform wheels and brackets for supporting the welder and two gas cylinders.

FUNCTION UPGRADE KIT (K845)

Converts Basic model machines to Full Function models.

INTERFACE KIT (K846)

For use with Full Function Model. Mounts to back of LED status PC board. Provides six isolated circuits which can be closed when each of the following functions is active: High Frequency, Arc Established, Start, Pulse Peak, Pulse Background and Crater Fill. Each circuit consists of two positions on a terminal strip, a fuse and fuse holder and sockets of two positions on a terminal strip, a fuse and fuse holder and sockets for an industry standard optically isolated Solid State Relay (SSR) module. The SSR's are purchased separately (see below) and are plugged into the sockets of those functions for which a remote status indication is needed.

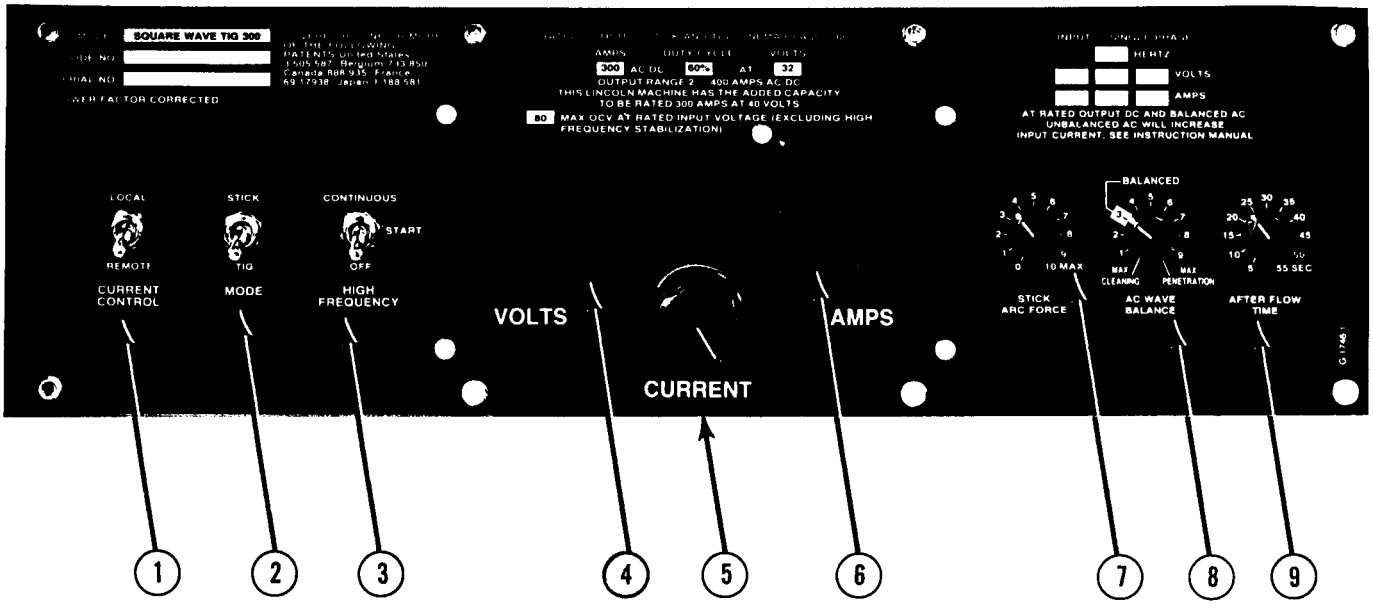
Solid State Relays (SSR): Single pole, normally open, optically isolated SSR modules plug into K846 Interface Kit. Customer must provide current and voltage limiting of circuitry connected to relay.

K847-DC: Can switch up to 40 VDC, 2 Amp Maximum Load. Package of two DC SSR modules.

K847-AC: Can switch up to 130 VAC, 2 Amp Maximum Load. Package of two AC SSR modules.

WATER VALVE KIT (K844)

Includes all parts needed to add a water valve.



TOP PANEL CONTROLS

1 — Current Control Switch
2 — Mode Switch
3 — High Frequency Switch
4 — Digital Voltmeter
5 — Peak Current Control
6 — Digital Ammeter
7 — Arc Force
8 — AC Wave Balance
9 — Afterflow

TOP PANEL CONTROLS

(See picture, also)

The Top Panel Controls are the same on both Basic and Full Function models. They are the controls used for manual TIG and stick welding.

CURRENT CONTROL SWITCH

A two-position toggle switch:

LOCAL: Current is controlled by the machine settings; a remote Amptrol has no affect on current.

REMOTE: Current is controlled by a remote Amptrol up to the current set on the machine.

MODE SWITCH

A two-position toggle switch:

STICK: For stick electrode welding (SMAW), the position makes the Stick Arc Force control and the Reduced Voltage System (RVS) active. Open circuit voltage at idle will be low (less than 25 volts) until the arc is struck. About ½ second after arc is broken the machine will return to the low open circuit voltage. This switch locks out high frequency, the gas and water valves, and the AC Wave Balance control. On Full Function models, the STICK position also locks out the Spot Time, Start Time and Crater Fill controls; the Pulse controls are locked out except when an Arc Start switch connected to the Remote Receptacle is closed.

TIG: For TIG welding (GTAW), this position locks out the Stick Arc Force control and the RVS. It makes all other controls active. To start and stop the welding sequence and to get output current, an Amptrol or Arc Start switch must be used when this switch is in the TIG position.

HIGH FREQUENCY SWITCH

A three-position toggle switch: (Locked out in STICK mode).

CONTINUOUS: High frequency will come on after the gas Preflow time and remain on until the weld is stopped.

START: High frequency will come on for 1-2 seconds after an arc is established, then go off. (When AC TIG welding on Full Function models, the high frequency will stay on until after the Start period and come on again during the Crater Fill period.)

OFF: No high frequency.

DIGITAL VOLTMETER

Displays the output voltage of the welder.

Note that when stick welding, the open circuit voltage is reduced to a low level until the arc is struck and then returns to the low level after the arc is broken. The full open circuit voltage is available while striking the arc and welding.

Unlike analog movement type meters, the digital meter P.C. board calibration should not change. If changing calibration, trimmers are clearly marked for this purpose on the front side of the meter P.C. board.

PEAK CURRENT CONTROL

Presets the maximum welding current the machine will produce, from 2 through 400 amps. The preset current is displayed on the digital ammeter when not welding.

NOTE: The ammeter display indicates the preset current. Actual welding current will be slightly different than the preset display.

If an Amptrol is used, it will control the current from 2 amps up to the current preset by the Peak Current control. (See Hand and Foot Amptrol Operation Section, "Hand and Foot Amptrol Operation", for proper use of hand and foot Amptrols.)

If pulsing, the peak current is the current set and controlled by the Peak Current control and the Amptrol.

DIGITAL AMMETER

When not welding, the ammeter displays the value preset by the Peak Current control.

When not welding, and the Start Current Display pushbutton is pressed, the ammeter will display the preset Start current. (See Start Current Control on Basic Model or Full Function Model,"Hand and Foot Amptrol Operation", for proper use of hand and foot Amptrols.)

NOTE: The ammeter display indicates the preset current. Actual welding current will be slightly different than the preset display.

While welding, the ammeter displays the actual welding current. The ammeter is accurate within $\pm 3\%$ of its reading or ± 2 amps, whichever is greatest. The ammeter displays RMS current. (RMS current is the actual "heating value" of the arc.) **NOTE:** Some types of ammeters will not accurately read true RMS currents, particularly when AC TIG welding aluminum; AC only ammeters may read as much as 40% low when measuring AC TIG welding currents.

Unlike analog, movement type meters, the digital meter P.C. board calibration should not change. If changing calibration, trimmers are clearly marked for this purpose on the front side of the meter P.C. board.

ARC FORCE

This control is active only in Stick mode. It controls the amount of current which is added to welding current when the electrode shorts to the work.

At Minimum, no extra short circuit current is added. The arc will be softer and will have less spatter, but may be more prone to sticking.

At Maximum, the arc will be more forceful and less prone to sticking, but will produce more spatter.

AC WAVE BALANCE

This control is active only in AC TIG mode. It controls the amounts of positive and negative in the AC current. It has no effect on stick or DC TIG welding.

BALANCED: The amounts of positive and negative are the same.

MAX CLEANING: Provides more positive current than negative current. Since the positive current produces the "cleaning" or oxide removal on aluminum, this setting is used for heavily oxidized aluminum.

> **CAUTION:** Use only the amount of "cleaning" required because the greater amount of positive current will heat the tungsten more and possibly cause it to melt or "spit". Also, the arc is usually more flared and less stable with more positive "cleaning" current.

MAX PENETRATION: Provides more negative current than positive current. The "cleaning" effect will be reduced, but the arc plasma will be more concentrated and more easily directed to where the heat is needed. The reduced amount of positive current allows the tungsten to run cooler at a given current than when set balanced.

In general, use just enough "cleaning" to remove oxides and to give good wetting of the puddle.

AFTERFLOW

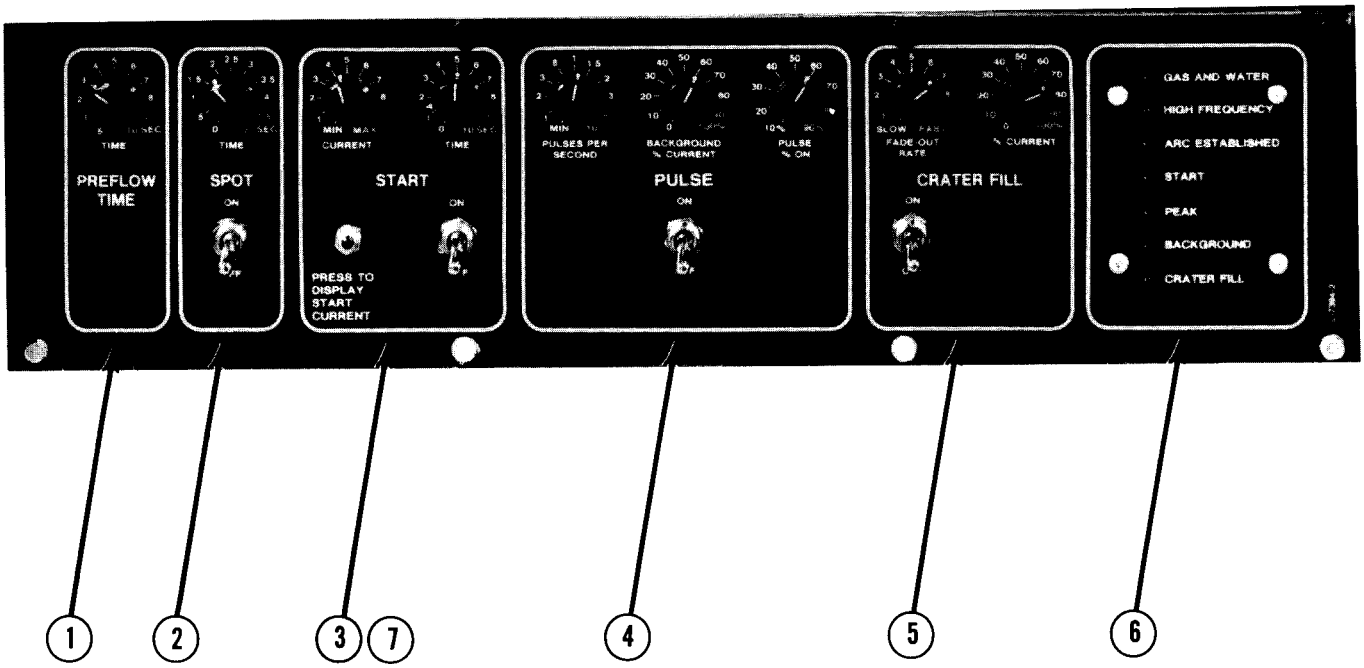
This control adjusts the amount of time the gas and water valves stay open after the end of a weld. Minimum time is approximately 5 seconds; maximum is approximately 55 seconds. Use enough Afterflow time to protect the hot tungsten with gas shielding until it cools. Too short of a time will cause the tungsten to oxidize and be contaminated. When in doubt, set a longer time, then reduce it to a time which still gives good protection.

PREFLOW (No adjustable control for this on Basic Models)

Basic models have no adjustment of preflow time; it is fixed at approximately 1/2 second.

Full Function models have an adjustable preflow time (see Preflow Timer).

If a new weld is started during the Afterflow time of a previous weld, the Preflow time is bypassed since gas shielding is already present. This allows new welds to start immediately, with no preflow delay.



FUNCTION PANEL CONTROLS

1 — Preflow Timer
2 — Spot Controls
3 — Start Controls (Full Function Models)
4 — Pulse Controls
5 — Crater Fill Controls
6 — Status Indicator LED's
7 — Function Panel Controls (Basic Models)

FUNCTION PANEL CONTROLS — Basic Model

START SWITCH

A two-position toggle switch:

ON: Start Current control is active. At the beginning of the weld, current will be the value preset by the Start Current control. The position of the Amptrol has no effect on this current.

OFF: Locks out Start Current control.

START CURRENT CONTROL — Basic Model

Locked out if Start switch is off.

Presets the current which will be provided during the first one second for TIG welding (approximately 1/2 second for Stick welding). The current can be preset from 2 to 400 amps. The position of the Amptrol has no effect on Start Current. The preset Start Current is displayed on the ammeter when the pushbutton is pressed before welding.

A "hot" start is used to heat the tungsten and work more quickly, usually on DC TIG welding. It may also be used to start stick electrodes more easily. Set the Start Current higher than what the welding current will be. After the hot start, the current will step down to the current set and controlled by the Peak Current control and Amptrol.

CAUTION: Avoid too high of a Start Current which may damage the tungsten or heat the work too rapidly.

A "soft" start is used to preheat the tungsten and work, usually on AC TIG welding. Set the Start Current lower than what the welding current will be. After one second of Start Current, the current will go to the current set and controlled by the Current control and Amptrol.

START CURRENT DISPLAY PUSHBUTTON

Press and hold in this pushbutton to display the Start Current preset by the Start Current control.

CAUTION: Do not press while welding. Doing so will cause the welding current to go to the Start Current, which may result in a poor weld. This is true even when Start Switch is "off".

FUNCTION PANEL CONTROLS — Full Function Model

(See picture, also)

PREFLOW TIMER

This control adjusts the amount of time the gas and water valves are open before the arc starts. It is adjustable from approximately 1/2 second to 10 seconds.

The Preflow time occurs only if the valves were closed (no gas flow) when the Arc Start switch or Amptrol was pressed. If a new weld is started while the gas valve is still on during the Afterflow time of previous weld, the Preflow time is bypassed since gas shielding is already present. This allows new welds to start immediately with no preflow delay.

Note that since the arc cannot start during the Preflow time, a long Preflow setting can cause complaints about arc starting. In general, the minimum Preflow time is usually satisfactory.

SPOT CONTROLS

SPOT SWITCH: A two-position toggle switch:

ON: Spot Time control is active. Once the arc is established, the Spot time begins. At the end of the Spot time (or if the Arc Start switch/Amptrol is released sooner), the arc stops. (If Crater Fill is on, downslope begins). If using the Spot timer plus Crater Fill, the Start switch must also be ON.

OFF: Locks out the Spot Time control.

SPOT TIME CONTROL: Not active if the Spot switch is off. Adjusts weld time from 0.1 to 5 seconds. Weld time is the time from when the arc is fully established until the arc is turned off (or when Crater Fill downslope is started). The Arc Start switch or Amptrol must be held down during the Spot time; if it is released before the end of the Spot time, the arc will be turned off (or Crater Fill Started).

START CONTROLS — Full Function Model

START SWITCH: A two-position toggle switch:

ON: Start Current control is active. At the beginning of the weld, current will be the value preset by the Start Current control. The position of the Amptrol has no effect on this current.

OFF: Locks out Start Current and Time controls.

START CURRENT DISPLAY PUSHBUTTON: Press and hold in this pushbutton to display the Start Current preset by the Start Current control.

> **CAUTION:** Do not press while welding. Doing so will cause the welding current to go to the Start Current, which may result in a poor weld. This is true even when Start Switch is "off".

START CURRENT CONTROL: Full Function Model

Locked out if the Start switch is off.

Presets the current which will be provided at the start of the weld. The current can be preset from 2 to 400 amps. The position of the Amptrol has no effect on the initial current. The present Start Current is displayed on the Ammeter when the pushbutton is pressed before welding.

A "hot" start is used to heat the tungsten and work more quickly, usually on DC TIG, welding. Set the Start Current higher than what the welding current will be. After the time is set on the Start Time control, the current will step down to the current set and controlled by the Peak Current control and the Amptrol.

A "soft" start is used to preheat the tungsten and work, usually on AC TIG welding. Set the Start current lower than what the welding current will be. The arc will establish at the Start Current and then ramp up to the current set and controlled by the Peak Current control and the Amptrol. The time to get up to welding current is set by the Start Time control. During the ramp up, the Amptrol will affect the current that the ramp is going towards, and thus the rate at which the current increases.

START TIME CONTROL: Locked out if the Start switch is off. Adjusts the Start Time from approximately 0.1 to 10 seconds.

PULSE CONTROLS

PULSE SWITCH: A two-position toggle switch:

ON: Pulsing will begin after the Start period and continue until the Arc Start Switch or Amptrol is released. If using Crater Fill, pulsing will continue during the downslope period.

OFF: Locks out Pulse controls.

PULSES PER SECOND CONTROL: Controls the number of pulses per second from approximately 0.1 to 10 pps. 0.1 pulses per second is slow pulsing (one pulse every 10 seconds); 10 pulses per second is fast pulsing.

BACKGROUND % PEAK CURRENT CONTROL: Controls the background (low pulse) current from zero to 100% of the peak current set and controlled by the Peak Current control and Amptrol.

Example: If the Peak Current Control is preset at 50 amps and the Amptrol is partially down, giving a peak current of 30 amps, and the Background Current control is set at 50%, the Background (low pulse) current will be 15 amps.

The Amptrol raises and lowers the Peak current; since Background current is always a percentage of Peak current, the Amptrol also raises and lowers the Background current.

PULSE % ON: Controls the percentage of the pulse cycle that is at the Peak current.

Example: If pulsing at 1 Pulse per Second with a 30% Pulse % on setting, the welding current would be at the Peak Current for 0.3 seconds and at the Background Current for the remainder of the cycle, 0.7 seconds.

CRATER FILL CONTROLS

Use the Crater Fill controls to automatically control current fade out at the end of a weld. **LOCAL** current control **MUST** be used when Crater Fill is used.

CRATER FILL SWITCH: A two-position toggle switch:

ON: Crater Fill Fade-out will begin when the Arc Start switch or Amptrol is released (or at end of Spot switch is on). The Current Control switch must be in LOCAL when using Crater Fill. When Crater Fill is used after Spot time, the Start switch must be ON for Crater Fill to work properly.

OFF: Locks out Crater Fill Controls.

FADE-OUT CONTROL: Controls how fast the current will fade when the Arc Start Switch is released. The FAST setting will cause current to ramp down the welding current toward 2 amps in approximately ½ second; the SLOW setting, in approximately 20 seconds. The time for downslope to the Crater Fill Current level depends on the difference between the weld current and the Crater fill Current.

CRATER FILL % PEAK CURRENT CONTROL: Controls the final Crater Fill current from zero to 100% of the weld current preset on the Peak Current control.

Example: With a Crater Fill % Peak Current setting of 20% and a weld current preset at 100 amps, the current will fade from 100 amps to 20 amps and then dwell at 20 amps for about 1½ seconds before the arc goes out.

The final Crater Fill current dwell time is approximately 1½ seconds, regardless of Crater Fill control settings.

STATUS INDICATOR LED'S

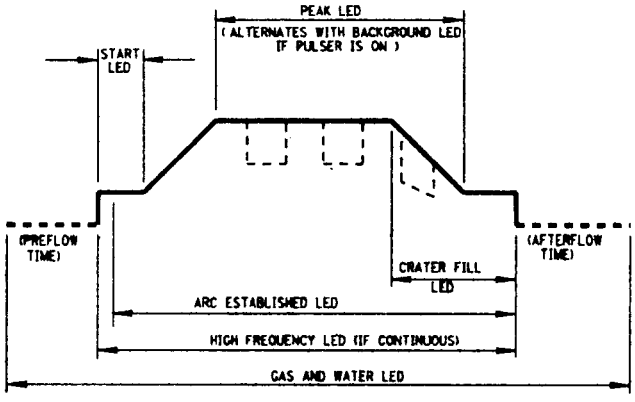
Seven Light Emitting Diodes (LED's) which light when that function is commanded by the control circuit to be active:

- *GAS & WATER LED* is on when the solenoid valves are commanded to be open, from the beginning of Preflow to the end of Afterflow.
- *HIGH FREQUENCY LED* is on when the high frequency circuit is commanded to be on.
- *ARC ESTABLISHED LED* goes on when the arc is fully established and goes out if the arc goes out.
- *START LED* is on from the time the arc is established until current begins to go up (soft start) or down (hot start). Note that the Start LED is off during upslope if a soft start is used.
- *PEAK LED* goes on after the Start period. If the Pulse switch is on, the Peak LED goes off during the Background periods. The Peak LED and Background LED's will alternate when pulsing.
- *BACKGROUND LED* is on when in the Background (low pulse) period of pulsing.
- *CRATER FILL LED* is on during the Fade Out downslope and final current periods.

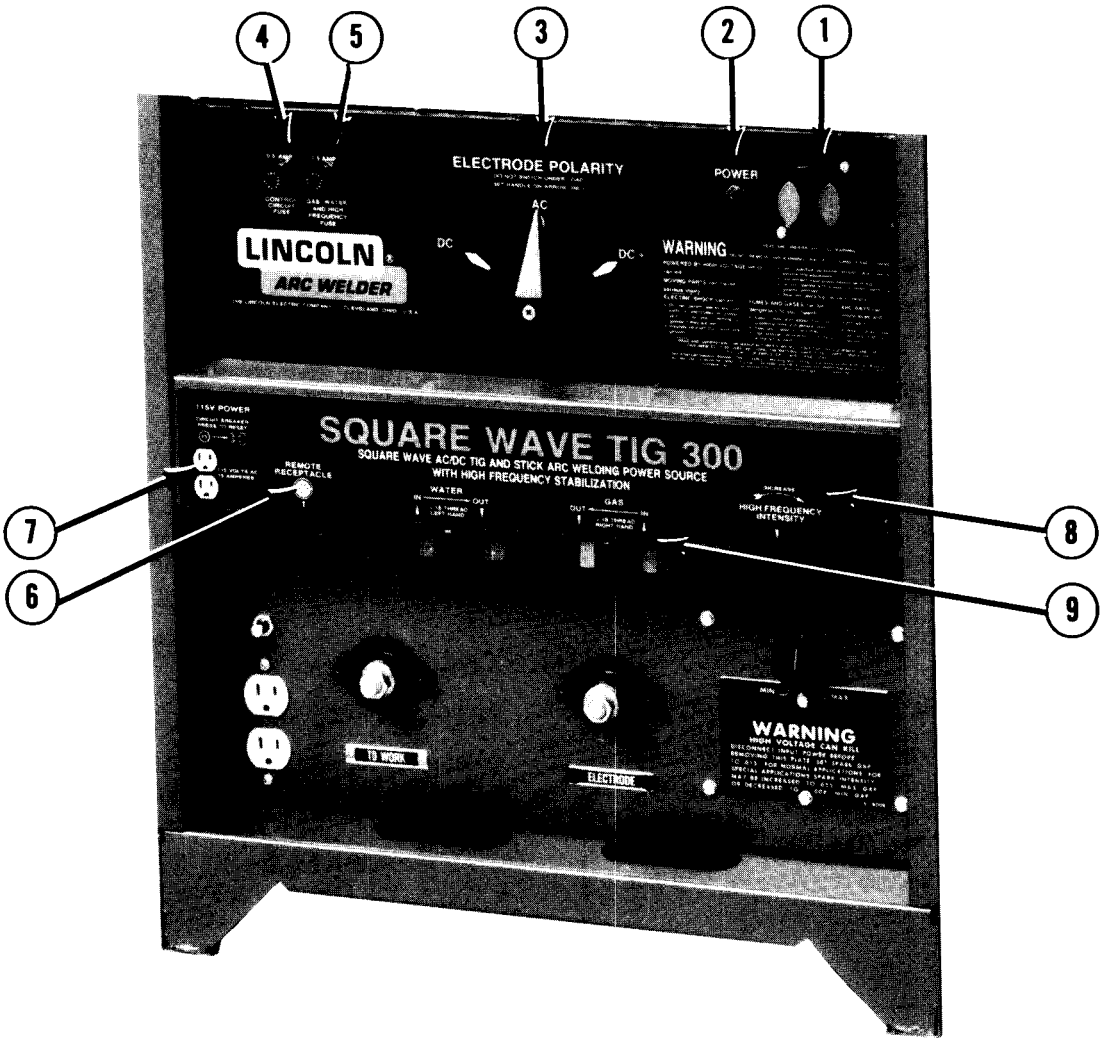
NOTE: The LED will light in response to the control circuit command, even if other components do not work. For example, if the gas supply is turned off or the gas solenoid valve malfunctions or the fuse is blown, the gas will not flow even though the Gas and Water LED lights up. Another example is the High Frequency LED which can light, yet there may not be high frequency due to a blown fuse or defective high frequency circuit or spark gaps set too large.

The Status Indicator LED's are useful for understanding which functions are active during a welding sequence and for how long. They are useful for setting times of the controls on the Function Panel.

The Status Indicator LED circuit board includes a receptacle for plugging in the circuit board included with the Optional Interface Kit.



STATUS INDICATOR LIGHT SEQUENCE SQUARE WAVE TIG 300 FULL FUNCTION MODEL



LOWER FRONT CONTROLS
(Shown with Cover Removed and with Optional Water Valve Installed)

1 — Power On/Off
2 — Pilot Light
3 — Polarity Switch
4 — Fuse F1
5 — Fuse F2
6 — Remote Receptacle
7 — 115 Volt Receptacle and Circuit Breaker
8 — High Frequency Intensity Control and Spark Gap
9 — Gas and Optional Water Valves

LOWER FRONT CONTROLS
(See picture, also)

POWER ON/OFF

A momentary start/stop pushbutton which controls the input contactor. If the input power supply goes off, or if the thermostat in the welder trips, the start pushbutton must be pressed to restart the welder.

PILOT LIGHT

Indicates when the input contactor is energized (power is on).

POLARITY SWITCH

Selects DC(−)/AC/DC(+).

CAUTION: Do not switch under load.)

FUSE F1

0.5 amp Control Circuit Fuse protects the control transformer from overloads. Input overvoltage protection circuitry will blow this fuse to protect electronic components if the input voltage to the welder is too high (more than 40% over rated voltage). If this fuse blows, the digital meters will not light and the input contactor will not latch when the Power On/Off Start pushbutton is pressed and released.

FUSE F2

1.5 amp Gas & Water & High Frequency Fuse protects the circuitry which drives the gas and water valves and the high frequency supply transformer. If this fuse blows, the valves and high frequency will not work. However, on Full Function models, the LED's for Gas & Water and High Frequency will still light.

REMOTE RECEPTACLE

A six-pin circular connector for an Arc Start switch or an Amptrol™ remote current control.

115 VOLT RECEPTACLE & CIRCUIT BREAKER:

A duplex 15 amp grounded NEMA 5-15R receptacle and 15 amp circuit breaker. 15 amps of 115 volt AC power is available continuously whenever the power is on. The circuit breaker button will pop out if it trips. Reset by pushing it in after the circuit breaker cools, and the overload has been removed.

HIGH FREQUENCY INTENSITY CONTROL & SPARK GAP

This control changes the high frequency intensity. Use the lowest intensity which still gives good arc starting to minimize Radio Frequency Interface (RFI). The spark gap is set at the factory to the nominal setting marked on the cover plate. Instructions for larger or smaller gap settings are also on the cover plate.

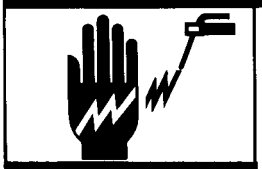
GAS & OPTIONAL WATER VALVES

Solenoid valves which open at the beginning of the Preflow time and close at the end of the Afterflow time.

The gas valve inlet and outlet are standard $^5/_8$-18 right hand female fittings. The optional water valve inlet and outlet are standard $^5/_8$-18 left hand female fittings. The fittings conform to CGA (Compressed Gas Association) standards. Use a water line strainer to prevent particles from jamming the water valve.

OPERATION

⚠ WARNING



ELECTRIC SHOCK can kill.

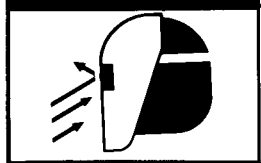
- **Do not touch electrically live parts or electrode with skin or wet clothing.**
- **Insulate yourself from work and ground.**

FUMES AND GASES can be dangerous.

- **Keep your head out of fumes.**
- **Use ventilation or exhaust to remove fumes from breathing zone.**

WELDING SPARKS can cause fire or explosion.

- **Keep flammable material away.**



ARC RAYS can burn.

- **Wear eye, ear and body protection.**

INITIAL STARTUP

Be sure the welder has been installed correctly with respect to location, high frequency protection, input power, and output connections.

If TIG welding, connect a K813 or K812 Amptrol or a K814 Arc Start switch to the Remote Receptacle. Check that the gas supply is on. Check for the correct type and size. If using a water cooled torch, check that the water supply is on.

Press the Start (green) Power pushbutton. The input contactor will pull in, the pilot light will come on, the meter displays will light up, and the fans will start. If in TIG mode, the gas and water valves will open for one Afterflow period to purge the lines. The ammeter will display the preset current (if there is no load on the welder output terminals). The voltmeter will read zero if in TIG mode, or from 5 to 15 if in STICK mode.

Select the Electrode Polarity needed [DC(−)/AC/DC(+)].

Set the controls by going from left to right across the top row and then the bottom row, choosing the correct setting for each. Note that the bottom row of controls includes on/off switches to easily lock out the controls within that block (Spot, Start, Pulse, or Crater Fill) without changing the settings. Also, note that some of the controls are automatically locked out internally if they do not apply in STICK mode or do not apply in TIG mode. This reduces the number of controls which must be set. Appendix A gives examples of the effects of the Function control on TIG welding.

DUTY CYCLE

The Square Wave TIG 300 is NEMA Class I (60) rated

300 amps at 32 volts, 60% duty cycle. The duty cycle is based upon a 10 minute time period; i.e., for 60% duty cycle, it is 6 minutes on and 4 minutes off. The overload capacity is 375 amps at 35 volts, 30% duty cycle.

The "Lincoln Plus" rating of 300 amps at 40 volts provides additional voltage to overcome voltage drops in long cables when stick welding at high currents.

STICK WELDING OPERATION

1. Remove the Amptrol or Arc Start switch from the Remote Receptacle (or be sure it is not pressed when not welding — this will cause machine to turn off).
2. Turn the welder on. The pilot light on the front panel indicates when the power is on.
3. Select LOCAL current control;
   Select STICK mode; (High Frequency switch has no effect in STICK mode)
   Select DC(+) or AC electrode polarity.
4. Preset the current with the Peak Current Control and Ammeter.
5. Set the desired Arc Force (See Arc Force Instructions). (The AC Wave Balance and Afterflow controls have no effect on STICK mode.)
6. Turn the Start switch OFF, or set the Start controls for a hot start if needed (See Function Panel Controls or Start Controls).
7. Strike an arc and weld. (There will be a buzzing sound from the arc if AC welding, due to the faster rate of current reversal of the Square Wave.)
8. After the end of a weld, the open circuit voltage will stay high for about 1/2 second, then will go down to a low voltage (less than 25) and stay there until an arc is struck again.

NOTE: The open circuit voltage is low (5-15 volts) when not welding; however, the full open circuit voltage is available, while striking the arc and welding, for excellent stick characteristics.

TIG WELDING GUIDELINES

Recommended tungsten electrode sizes, stickouts, currents, cup or nozzle sizes and gas flow are shown in Table 4. SINCE TIG APPLICATIONS CAN VARY, THIS TABLE IS INTENDED AS A GUIDE ONLY.

Aluminum Welding: Set the Electrode Polarity switch to AC, the High Frequency switch to Continuous, and the Mode switch to TIG. All other control settings will be made to suit the size tungsten and current. In general, pure or zirconiated tungsten electrode is best for aluminum and should have a "balled" end not exceeding the diameter of the tungsten. A buzzing sound will occur in the arc when AC TIG welding aluminum. See AC Wave Balance Section for details.

Stainless or Mild Steel Welding: Set the Electrode Polarity switch to DC(−), the High Frequency switch to START, and the Mode switch to TIG. In general, 1% or 2% thoriated tungsten electrode is best for stainless or mild steel and should have the end ground to a point. If there is difficulty starting the arc, the tungsten may be contaminated or it may be too large to get up to operating temperature.

TABLE 4

TYPICAL CURRENT RANGES FOR TUNGSTEN ELECTRODES

Electrode Diameter	DC(−) (DCSP)	DC(+) (DCRP)	Max Penetration Unbalanced AC		Square Wave Balanced AC		Approx. Argon Gas Flow Rate C.F.H.		Cone I.D.
	Pure, 1%, 2%	Pure, 1%, 2%	Pure	1%, 2%, Zr	Pure	1%, 2%, Zr	Aluminum	Stain. Steel	
.010	2-15	—	2-15	2-15	2-15	—	3-8	3-8	5/32-3/8
0.020	5-20	—	5-15	5-20	10-20	5-20	5-10	5-10	
0.040	15-80	—	10-60	15-80	20-30	20-60	5-10	5-10	
1/16	70-150	10-20	50-100	70-150	30-80	60-120	5-10	9-13	5/16-3/8
3/32	150-250	15-30	100-160	140-235	60-130	100-180	13-17	11-15	3/8-1/2
1/8	250-400	25-40	150-210	225-325	100-180	160-250	15-23	11-15	
5/32	400-500	40-55	200-275	300-400	100-240	200-320	21-25	13-17	1/2-5/8
3/16	500-750	55-80	250-350	400-500	190-300	290-390	23-27	18-22	
1/4	750-1000	80-125	325-450	500-630	250-400	340-525	28-32	23-27	

Pure = EWP 2% = EWth-2
1% = EWth-1 Zr = EWZr

NOTE: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just "cracked", the minimum current (2 amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems.

TIG WELDING SEQUENCE OF OPERATION

WARNING: Do not leave stick electrode welding cable connected as it will be electrically hot when TIG welding.

1. Connect an Amptrol or Arc Start switch to the Remote Receptacle.
2. Turn the welder, water supply (if so equipped) and gas supply on. The pilot light on the front panel indicates when the power is on.
3. Select REMOTE or LOCAL current control (REMOTE requires an Amptrol); Select TIG mode; Select Continuous or Start high frequency; Select AC or DC(−) electrode polarity:

TABLE 5

RECOMMENDED SETTINGS FOR TIG WELDING

Type of Welding	Electrode Polarity	High Frequency Switch
Stainless Steel	DC(−)	Start
Aluminum and Magnesium	AC	Continuous
Other Metals	DC(−)	Start

4. Preset the maximum current with the Peak Current control and Ammeter.
5. (Arc Force control has no effect in TIG mode.)
6. If in AC, set AC Wave Balance control. (See AC Wave Balance instructions for details.) (This control has no effect in DC.)
7. Set Afterflow time.
8. Set Function Panel controls as needed. (See Function Panel Controls basic model or full function model for further details.)
9. Press the Arc Start switch or Amptrol and set the gas flowmeter. The welder is now ready for welding.
10. Position the tungsten electrode at the start of the weld at a 65° to 75° angle with the horizontal so that the electrode is approximately 1/8" above the work piece. Press the Arc Start Switch or operate the Amptrol. This opens the gas and water valves to automatically purge air from the hose and torch. After the Preflow time of about 1/2 second (longer if set on Full Function models) the high frequency becomes available to strike the arc.
11. Hold the Arc Start Switch down or operate the Amptrol until the weld is completed. Release the Arc Start Switch or the Amptrol to stop the arc. When the Afterflow timer completes the cycle, the gas and water valves close. To make another weld, repeat steps 10-11.

NOTE: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just "cracked", the minimum current (2 Amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems.

HAND AND FOOT AMPTROL OPERATION

Both the Hand and Foot Amptrol work in a similar manner. They are meant to be used for remote current control when the Square Wave TIG Current Control switch is in the REMOTE position. As explained below, both can also be use as start switches if the Current Control switch is in the LOCAL position.

For simplicity, the following explanation will refer only to "Amptrols", meaning both Foot and Hand models. The term "minimum" refers to a Foot pedal in the "up" position, as it would be with no foot pressure. "Maximum" refers to a fully depressed Foot Amptrol, or a fully extended Hand Amptrol. See the diagram which follows.

The Amptrol is capable of controlling the output current from 2 amps to whatever current is preset on the digital ammeter. For example, if the ammeter is preset for 200 amps and the Current Control switch is in the REMOTE position, the Amptrol, when depressed just past its minimum position, will cause the Square Wave to weld at 2 amps. At the Amptrol's maximum position, the output will be near 200 amps.

It is important to note that, for many applications, the tungsten will not start an arc at only 2 amps. (Refer to the chart in TIG Welding Guidelines for recommended tungsten currents.) To start an arc reliably, it is important to depress the Amptrol far enough so that the machine output current is near the tungsten operating range. In the example above, a 3/32" tungsten may be used on DC(−) to weld near 200 amps. To start the weld, the operator will have to depress the Amptrol approximately 1/4 of the way down, or to nearly 70 amps, in order to start the arc. Merely depressing the Amptrol to its 2 amp minimum position will not start the arc.

A similar situation occurs when the START controls are used. For example, a 3/32" tungsten is again used for welding DC(−) up to 200 amps (preset on the ammeter). A Start Current of 50 amps is set on the Start Level control. Upon depressing the Amptrol, the start circuitry sets the output current to 50 amps. If the Amptrol is kept near the minimum position, at the end of the start period, the output current will drop to 2 amps, causing the arc to go out in most

cases. Depress the Amptrol at least 1/4 of the way down, or to around 70 amps so that the tungsten remains lit when the start period ends.

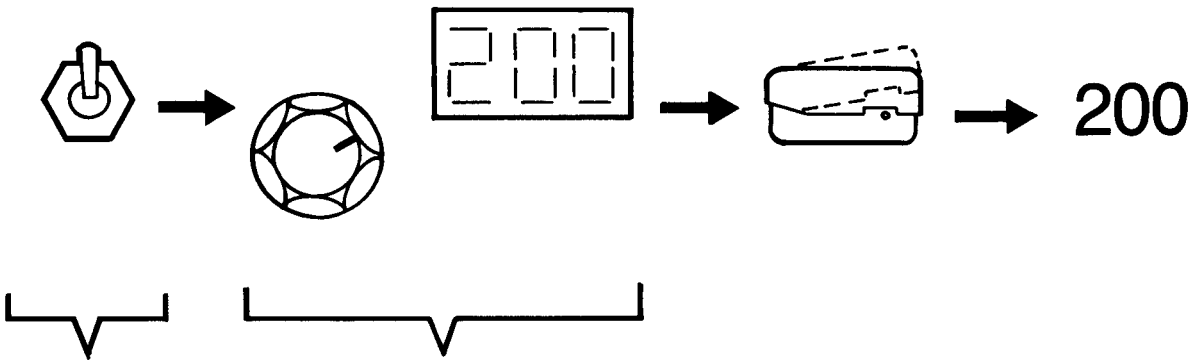
The same holds true for a "hot" start, or one in which the Start Current is set to a current higher than the current preset on the ammeter. Again, at the end of the start period, the Amptrol must be depressed far enough so that the machine output will be high enough to keep the arc lit.

The best technique when using the start controls and an Amptrol is to press the Amptrol to maximum at the beginning of the weld, wait until the end of the start period, and then back off on the Amptrol **only** if the current is too high.

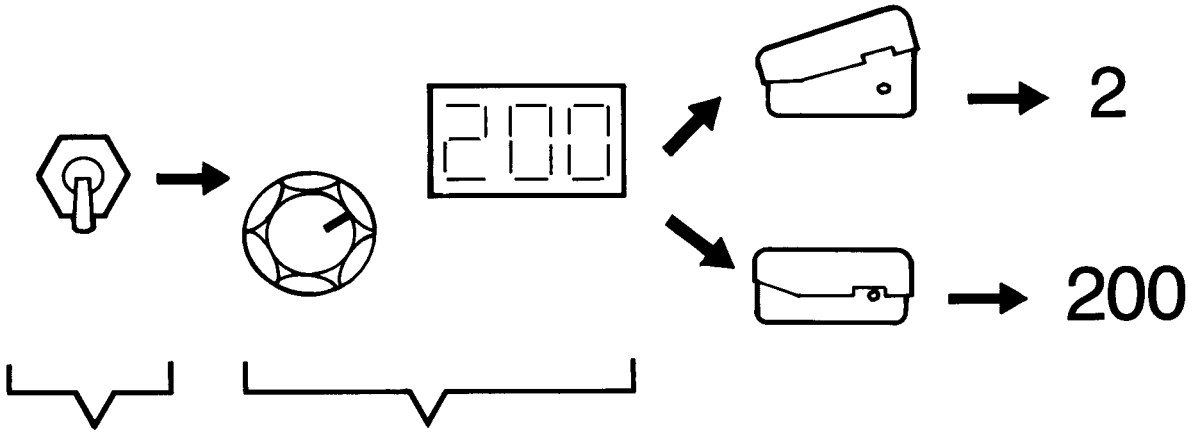
If the Current Control switch is set to the LOCAL position, and Amptrol can be used as an arc start switch. Depressing the Amptrol just past minimum will cause the Amptrol's built-in arc start switch to open. The Amptrol will have no effect on the welding current when used as an arc start switch.

Amptrols can also be used in stick-mode if the start switch is disabled.

NOTE: Activating the arc start switch in the stick mode will cause the machine to automatically shut off.

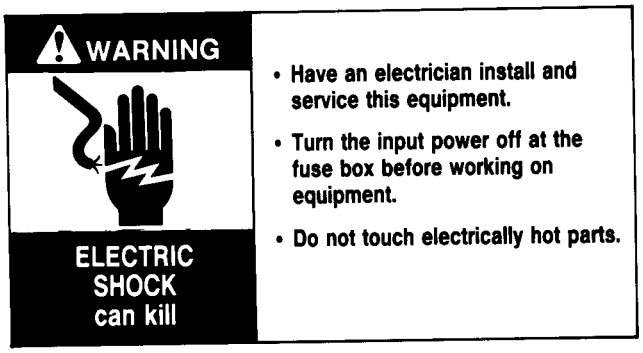


Amptrols Used With Current Control Switch in the Local Position



Amptrols Used With Current Control Switch in the Remote Position

MAINTENANCE



ROUTINE MAINTENANCE

WARNING: To avoid being startled by a high frequency shock, keep the TIG torch and cables in good condition.

1. Periodically blow out dust and dirt which may accumulate within the welder using an air stream.
2. Inspect welder output and control cables for fraying, cuts, and bare spots.
3. Inspect spark gap spacing at regular intervals to maintain gap marked on cover plate. If more intensity is needed than is available with the "High Frequency" set to MAXIMUM, the spark gap may be increased as noted on the cover plate. (The Smallest possible air gap consistent with good welding is desirable to minimize R.F.I. problems.) Removal of the nameplate located on the lower right section of the output panel provides access to the spark gap. Dressing or any re-finishing of the spark gap contacts is not recommended. If the contact surfaces become irregular or completely eroded, replacement of both electrodes is recommended.
4. The fan motor has sealed ball bearings which require no maintenance.

OVERLOAD PROTECTION

This welder has thermostatic protection from overloads, loss of cooling, and high ambient temperatures. When the welder is subjected to an overload or loss of cooling, a thermostat will open.

If the **secondary** thermostat opens, the effect will be the same as pushing the Stop power pushbutton: the power will go off, the pilot light and meters will go out, and the fans will stop. Pressing the Start power pushbutton after the thermostat cools and resets will restart the welder.

If the **primary** thermostat opens, the power will stay on (pilot light and meters on and fans running) but no more than 5 amps DC output current will be available. This allows the fans to cool the machine. Depending on the amount of welder overload, the thermostat should reset within five minutes with the fan motor running. When the primary thermostat cools and resets, normal output current will be available.

TROUBLESHOOTING

- **Have an electrician install and service this equipment.**
- **Turn the input power off at the fuse box before working on equipment.**
- **Do not touch electrically hot parts.**

HOW TO USE THIS GUIDE: Carefully read through each applicable section listed below. Remember that most problems are caused by improper setup, such as switch settings, control settings, electrode sizes, improper shielding gases, etc.

If you believe the setup is correct and the problem still exists, first check for the obvious: input power, blown fuses, loose P.C. board connectors, broken wires and the like. The sections listed below are intended to help you find the less obvious sources of trouble.

WARNING: Be absolutely certain that the high frequency circuit is not ACTIVATED if control section of the machine is opened. Turn the spark switch "OFF" or remove fuse F2. Failure to observe this precaution will result in circuit board damage.

GENERAL		
Trouble	**Causes**	**What To Do**
Machine will not turn on.	a. Input supply lines not "hot". b. Blown control circuit fuse (F1). c. Defective Interlock P.C. board. d. Thermostat (secondary) has opened.	a. Check input supply line fuses. b. Replace. c. Replace. d. Allow machine to cool before restarting.
Control circuit fuse (F1) keeps blowing.	a. Machine reconnect panel hooked up for wrong voltage. b. Fuse is too small. c. Shorted control transformer (T5). d. Defective power, interlock, meter, function, control or feedthru P.C. board.	a. Connect per connection diagram in this manual. b. Use ½ amp fuse. c. Unplug from power board, replace fuse and hold in start button for approximately 10 seconds. If fuse blows, replace T5. d. Unplug all boards and reconnect one at a time in the sequence given. After reconnecting each board, test with start button as in Step c. When fuse blows, replace the last board that was reconnected.
Digital meters do not light, but welder turns on as indicated by the Pilot Light and fan operation	a. Defective Meter P.C. Board. b. Defective Power P.C. board.	a. Replace. b. Replace.
Accessories plugged into 115 volt receptacle do not work	a. Plug it into a known "hot" receptacle to check it if works. b. Circuit Breaker CB1 is open. Before resetting the Circuit Breaker, find out why it opened.	a. Is accessory defective. b. Is the accessory exceeding the 15 amp maximum load? Is the accessory defective?
Cannot preset a current, but ammeter lights up. Set control knob to 12 o'clock position. Switch Start function OFF. Machine should weld at approximately 80 amps. If machine welds okay but ammeter does not display the welding current while welding: If machine does not weld:	a. The Meter P.C. board may be defective. b. The Control P.C. board may be defective. c. On Full Function machines, Function P.C. board may be defective. a. Current control pot may be defective. b. Feedthru P.C. board may be defective. c. The Control P.C. board may be defective. d. On Full Function machines, Function P.C. board may be defective.	a. Replace. b. Replace. c. Replace a. Replace b. Replace. c. Replace. d. Replace.

STICK WELDING

Machine shuts off in Stick mode.	a. Arc Start Switch is plugged into the Remote Receptacle.	a. Unplug it or be sure that it is not being pressed (closed) in the Stick mode when there is not a load on the machine. This also applies to hand and foot Amptrols which contain a built-in arc start switch.
	b. Welder has overheated and secondary thermostat has opened.	b. Allow welder to cool before attempting to turn on. Be sure to provide adequate ventilation around welder to prevent recurrence.
	c. The Interlock P.C. board may be defective.	c. Replace.
	d. If the voltmeter displays more than 25 open circuit volts in the Stick mode for more than 1 second before machine shuts off, the Control P.C. board may be defective.	d. Replace. (In Full Function machines, Function Board may be defective. Replace.)
Stick electrode "blasts off" when touched to workpiece.	a. Weld current is set too high for electrode size.	a. Reduce weld current.
	b. Start Switch is "On", and Start Current is set too high for electrode size.	b. Either turn Start Switch OFF, or reduce Start Current.
	c. Arc Force control is set too high.	c. Turn to minimum.
Arc seems too hot, and reducing current pot does not help.	a. Arc Force control is set too high.	a. Turn to minimum.
	b. Start Switch is ON and Start Current is set too high. Start time may be set too long on Full Function machines.	b. Reduce or turn Start Switch OFF.
Machine welds at very low output, regardless of Current pot setting.	a. Current Control switch is in REMOTE.	a. Switch to LOCAL.
	b. Start Switch is ON, and Start Current is set too low for the electrode size.	b. Either turn Start Switch OFF, or set Start Current to proper level for the electrode size.
	c. Does machine have correct output in TIG mode?	c. If not, see "Machine has gas flow and high frequency but no open circuit voltage when the Arc Start Switch or Amptrol is pressed": (in TIG troubleshooting section).
	d. If TIG welding output is OK, Control P.C. board is defective.	d. Replace. (In Full Function machines, the Function P.C. board may be defective. Replace.)
Machine welds at very high output, regardless of Current pot setting.	a. Are the Start controls set correctly?	a. See "Stick electrode blasts off" above.
	b. Are the TIG welding outputs OK?	b. If not, TIG troubleshooting section.
	c. If TIG welding output is OK, Control P.C. board is defective	c. Replace. (In Full Function machines, the Function P.C. board may be defective. Replace.)
Arc Force control has no effect.	a. The effect of the Arc Force Control will be less noticeable at high welding currents.	a. Weld at low current (less than 150 amps), and check Arc Force effect.
	b. If no effects are seen at low currents, the Arc Force control potentiometer may defective.	b. Replace.
	c. Control P.C. board may be defective.	c. Replace.
Gas and water do not flow even though Gas and Water LED is lit (Full Function Models only) in Stick mode.	a. Machine is operating properly; gas and water solenoids, as well as the high frequency circuit, are disabled in the Stick mode.	a. No corrective action necessary.

TIG WELDING

Machine does not respond (no gas flow, no high frequency, no open circuit voltage) when Arc Start Switch or Amptrol is pressed.	a. Defective Arc Start Switch or Amptrol.	a. Check for continuity between pins D and E on cable connector when Arc Start Switch or Amptrol is pressed.
	b. Defective Remote Receptacle P.C. board.	b. Replace.
	c. Defective Control P.C. board.	c. Replace. (On Full Function machines, the Function P.C. board may be defective. Replace.)
No gas or water flow when Arc Start Switch is closed in TIG mode.	a. Gas supply is empty or not turned on.	a. Replenish or turn on gas.
	b. Pinched gas or water hose.	b. Correct blockage.
	c. Gas and High Frequency fuse (F2) blown.	c. Replace fuse.
	d. Gas and High Frequency fuse (F2) is too small.	d. Use 1.5 amp fuse.
	e. Gas and water lines or solenoids are blocked with dirt.	e. Clean out and use filters to prevent recurrence.
	f. Power P.C. board is defective.	f. Replace.
No High Frequency	a. High Frequency switch S12 must be in either START or CONTINUOUS position for high frequency to function.	a. Set switch S12 correctly
	b. Preflow control is set too long (Full Function machines only).	b. Reduce Preflow setting. (High Frequency does not come on until end of preflow period.)
	c. Gas and High Frequency fuse (F2) blown.	c. Replace fuse F2.
	d. Gas and High Frequency fuse (F2) is too small.	d. Use 1.5 amp fuse.
	e. Spark Gap is too large.	e. Set to gap specified on cover plate.
	f. Power P.C. board is defective.	f. Replace.
Weak high frequency	a. Spark gap is set too close.	a. Set to 0.015 inches gap for most applications.
	b. High Frequency Intensity control set too low.	b. Increase to suit.
	c. Work and electrode cables in poor condition, allowing high frequency to "leak" to ground.	c. Use good quality cables, preferably those with a high natural rubber content, as short as possible.
	d. No shielding gas.	d. Adjust gas flow for 10 to 30 CFH for most applications. (High frequency will not jump from the tungsten to the work without shielding gas.)
Machine shuts down (pilot lights goes out and fans stop) when Arc Start Switch or Amptrol is pressed.	a. If open circuit voltage is greater than 75 volts before shutdown occurs, Control P.C. board is defective.	a. Replace.
	b. If open circuit voltage is less than 75 volts before shutdown occurs, Interlock P.C. board is defective.	b. Replace.
Cannot preset a current on Ammeter when the Arc Start Switch or Amptrol is **not** pressed.	a. There should be **no** continuity between pins D and E of cable connector when Arc Start Switch or Amptrol is **not** pressed.	a. Defective Arc Start Switch.
	b. Defective Current Control pot.	b. Replace.
	c. Defective Control P.C. board.	c. Replace
	d. Defective Feedthru P.C. board.	d. Replace.
	e. Full Function machines only: Defective Function P.C. board.	e. Replace.

Machine has gas flow and high frequency but no open circuit voltage when the Arc Start Switch or Amptrol is pressed. Turn High Frequency Switch OFF. Look at the two LED's in the upper left corner of the Power P.C. board. They should glow when the Arc Start Switch is pressed.	a. If the LED's do glow: Leads 232A and 233A may be reversed on the primary of control transformer T5 in control box. b. If this does not fix the problem. c. If the LED's do not glow, the Power P.C. board may be defective. d. If the problem still exists, the Control P.C. board may be defective.	a. Turn the machine off. Reverse the leads. Turn back on and check for open circuit voltage. b. Restore wires 232A and 233A to their original positions. c. Replace d. Replace.
Difficulty in getting tungsten to "light off".	a. Current Control switch is in REMOTE but machine is being used with an Arc Start Switch and no Amptrol. b. Start switch is ON, and Start Current is set too low for tungsten size. c. Current control is set too low, or Amptrol is not being pressed far enough for the tungsten size being used. d. Contaminated tungsten. e. Incorrect tungsten type. f. No shielding gas (or not enough).	a. Set switch to LOCAL. b. Either turn Start switch OFF, or increase Start Current to proper level for tungsten size. c. Try in LOCAL Current Control at a higher current setting. SEE NOTE BELOW. d. If tungsten becomes contaminated with foreign materials, grind off end of tungsten to expose fresh electrode. Grind to a point for DC work and leave an end for AC work. e. Pure or zirconiated tungsten is recommended for AC welding; thoriated tungsten is required for DC welding. f. Adjust gas flow for 10 to 30 CFH for most applications.
NOTE: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just "cracked", the minimum current (2 amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems. Refer to Hand and Foot Amptrol Operation section for details.		
Machine welds only at minimum output when the Current Control switch is in the REMOTE position.	a. Current Control switch is in REMOTE but machine is being used with an Arc Start Switch and no Amptrol. b. Use LOCAL Current Control. If problem goes away, Amptrol may be defective. c. Current Control switch may be defective. d. Can machine be preset for currents from 2 to 400 amps?	a. Set switch to LOCAL. b. Replace or repair Amptrol. c. Replace. d. If not, see "Cannot preset a current" in General Troubleshooting section.
Arc goes out soon after it is lit.	a. Current Control is set too low, or Amptrol is not being pressed far enough for the tungsten size being used. b. It is in AC.	a. See NOTE below. b. Use Continuous High Frequency.
Tungsten is eroding quickly.	a. Current pot is set too high for tungsten size. b. It is in AC.	a. Reduce welding current or increase tungsten size. b. Wave Balance control may be set too far towards CLEANING. Turn Balance pot towards PENETRATION, or increase tungsten size.
Tungsten seems to "split" when Arc Start Switch or Amptrol is pressed at high currents.	a. High welding current is thermally "shocking" the cold tungsten, causing pieces	a. Turn Start Switch ON, and set Start Current to a value lower than the welding current to give a "soft" start.
NOTE: Starting difficulties may often be due to not pressing the Amptrol far enough. When the Amptrol is just "cracked", the minimum current (2 amps) is produced. Pressing the Amptrol more at the start of the weld will often solve starting problems.		

FUNCTION CONTROL

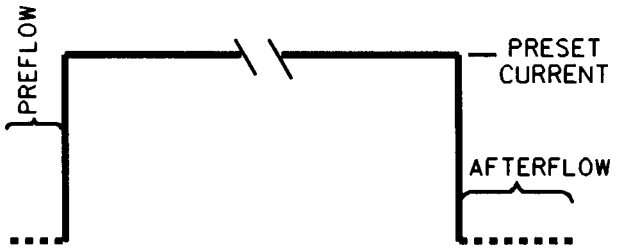
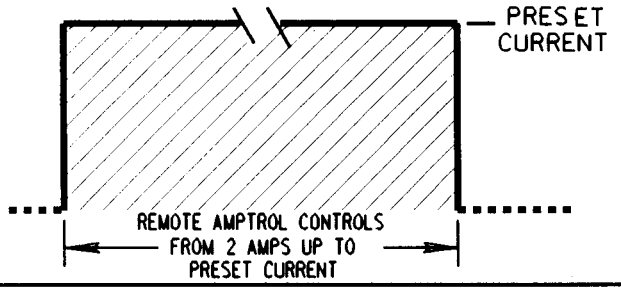
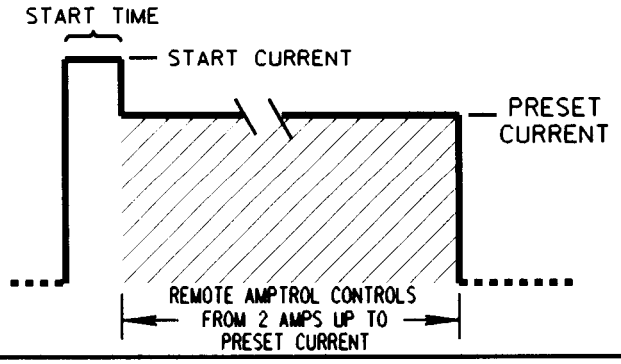
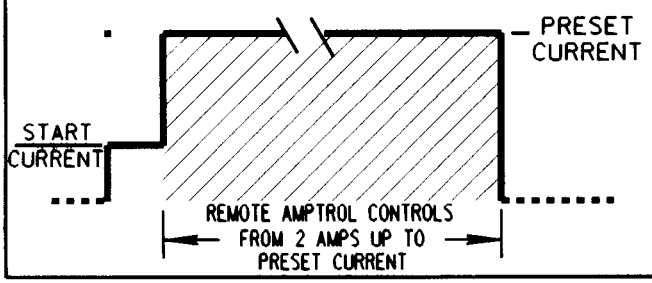
Machine does not always wait for Preflow time when starting arc.	a. Machine is operating correctly; it does not go through a Preflow period if the Arc Start Switch or Amptrol is pressed during the Afterflow period.	a. No corrective action necessary.
The Spot Time does not last as long as the nameplate setting.	a. Releasing the Arc Start Switch before the Spot Timer has timed out will cause the arc to go out.	a. Be sure to keep the Arc Start Switch or Amptrol pressed until the Spot Time is completed.
The Spot Time lasts much longer than the nameplate setting.	b. If the Crater Fill switch is left ON, the actual weld time will be the spot time plus the crater fill time.	b. The switch should be turned OFF.
The Start Current seems very hot.	a. The Start Current dial is labeled MIN to MAX of the welder output, or 2 to 400 amps.	a. Always be sure to use the Start Read pushbutton to check the Start Current preset reading on the digital ammeter before welding.
The Pulser does not seem to operate.	a. Check the Pulses Per Second control. If it is set near minimum, each pulse may be as long as ten seconds.	a. Set all three of the pulse controls near the midpoints to see the Pulser's effects.
If Start Controls are used, pulsing does not begin until the end of the start time, which can be as much as 10 seconds.	b. The Pulse % On control may be set at either extreme. If that is the case, the pulses may be too short to be seen, depending on the setting of the Current and Background % Current controls.	b. Set all three of the pulse controls near the midpoints to see the Pulser's effects.
When using Crater Fill, the arc goes out before the final Crater Fill Current level is reached.	a. The Crater Fill % Current control may be set too low for the tungsten being used.	a. Increase the Crater Fill % Current control until the final Crater Fill current is within the tungsten's operating range.
	b. If using the Pulser in conjunction with the Crater Fill, the Background % Current may be too low for the tungsten as the current is downsloping in Crater Fill.	b. The best solution is to increase the Background % Current level.
	c. Welding with AC.	c. Use CONTINUOUS High Frequency. The high frequency will stabilize the arc as the current goes down.

ACCESSORY

K813 Foot Amptrol or K812 Hand Amptrol Amptrol does not control welder output with Current Control switch in REMOTE and Mode switch in TIG.	a. Check continuity between pins D and E in the cable connector. There should be an open circuit when the Amptrol is not pressed and a short circuit when it is pressed part way. a. Using an ohmmeter, check the resistance between pins A and B in the Amphenol connector. The resistance should be 10K ohms when the pedal is up, and near zero ohms when the pedal is fully depressed.	a. If this is not the case, check the Amptrol cable for breaks. The microswitch in the Amptrol may not be operating properly. Repair or replace as necessary. b. An open circuit would indicate a bad cable or defective potentiometer. Check for breaks and repair or replace the damaged cable or potentiometer.
K814 Arc Start Switch Arc Start Switch does not start welder output in TIG Mode and LOCAL Current Control.	a. Check continuity between pins D and E of the cable connector. There should be an open circuit when the switch is not pressed, and a short circuit when the switch is pressed.	a. Check the cable for breaks, and repair or replace as necessary. Check the switch and its connections.
K846 Interface Kit (Option) Solid State Relay Module output does not close when corresponding Status P.C. board LED lights.	a. Is the correct type of solid state relay module installed? b. Is the corresponding fuse (F1 for CR1, F2 for CR2, etc.) blown? c. Are the Interface and Status P.C. boards correctly mated to one another? d. Is harness connector P601 plugged into J701 on the Interface P.C. board? e. Is Terminal Strip (TS701) wired correctly (terminals 3 and 4 for CR1, terminals 5 and 6 for CR2, etc.)? f. Is DC polarity of terminal strip connection correct? g. Defective solid state relay.	a. AC modules work only for AC circuits, and DC modules only for DC circuits. b. If so, find cause and replace with a 2 amp fuse. c. Be sure that all 10 pins on P701 are inserted into J602 on the Status P.C. board. d. If not, do so. e. If not, do so. f. Should have odd numbers (+), even numbers (−). g. Replace.
Solid State Relay Module output seems to make contact at wrong times.	a. High Frequency pickup may be a problem. b. Use shielded cables to make connections to the Interface P.C. board terminal strip. c. Be sure that the white ground lead is on the Interface P.C. board tab terminal and is connected to the welder chassis screw.	a. Reroute leads going to Interface terminal strip away from welding cables which carry high frequency. b. Ground the shield to terminal 1 or 2 on TS701. c. If not, do so.

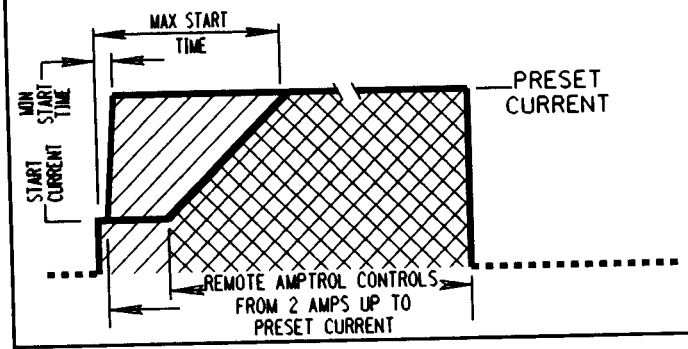
APPENDIX A1

EFFECT OF CONTROLS ON TIG WELDING

CLOSE ARC START SWITCH / WELD BEGINS / OPEN ARC START SWITCH		
	BOTH MODELS **LOCAL** CURRENT CONTROL ALL FUNCTION PANEL SWITCHES **OFF**	NO FUNCTION CONTROLS
	BOTH MODELS **REMOTE** CURRENT CONTROL ALL FUNCTION PANEL SWITCHES **OFF**	
	BOTH MODELS **LOCAL** OR **REMOTE** CURRENT CONTROL **START** SWITCH **ON** **START CURRENT** SET HIGHER THAN PRESET CURRENT (HOT START) **START TIME** (BASIC): ~ 1 SEC. FIXED (FULL): VARIABLE ALL OTHER FUNCTION PANEL SWITCHES **OFF**	HOT START
	BASIC MODEL **LOCAL** OR **REMOTE** CURRENT CONTROL **START** SWITCH **ON** **START CURRENT** SET LOWER THAN PRESET CURRENT (SOFT START) **START TIME** ~ 1 SEC.	SOFT START (BASIC)

APPENDIX A2

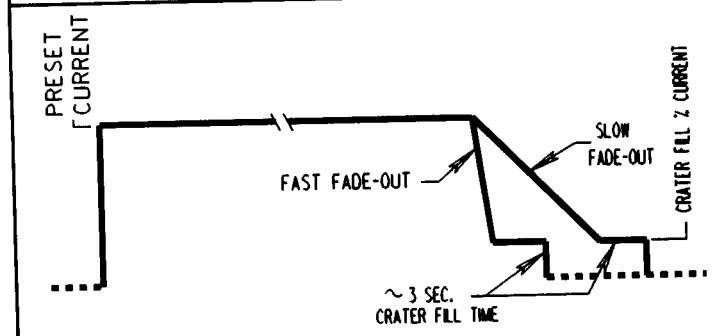
EFFECT OF CONTROLS ON TIG WELDING



FULL FUNCTION MODEL

LOCAL OR **REMOTE** CURRENT CONTROL
START SWITCH **ON**
START CURRENT SET LOWER THAN PRESET CURRENT (SOFT START)
START TIME VARIABLE
ALL OTHER FUNCTION PANEL SWITCHES **OFF**

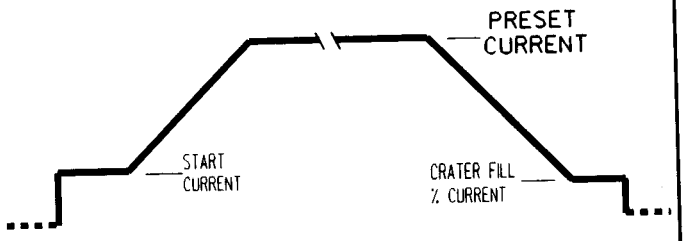
SOFT START (FULL FUNCTION)



FULL FUNCTION MODEL

LOCAL CURRENT CONTROL
CRATER FILL SWITCH **ON**
CRATER FILL % CURRENT VARIABLE
FADE-OUT VARIABLE
ALL OTHER FUNCTION PANEL SWITCHES **OFF**

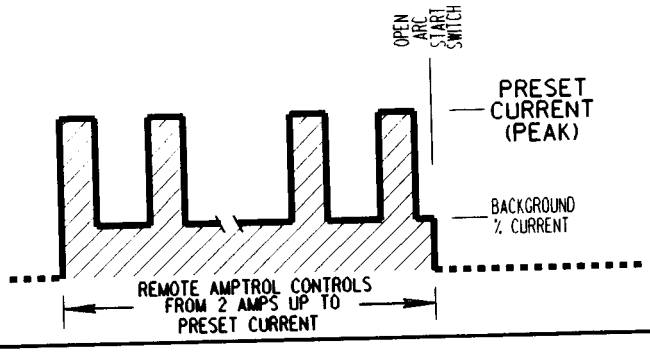
CRATER FILL



FULL FUNCTION MODEL

LOCAL CURRENT CONTROL
START SWITCH **ON**
(SOFT START SHOWN; MAY HAVE HOT START)
CRATER FILL SWITCH **ON**
ALL OTHER FUNCTION PANEL SWITCHES **OFF**

START & CRATER FILL



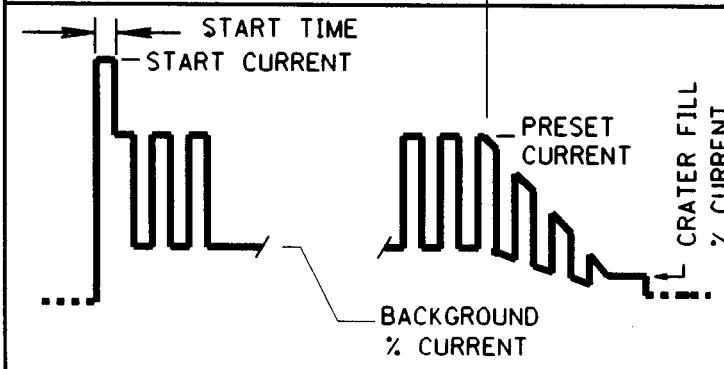
FULL FUNCTION MODEL

LOCAL OR **REMOTE** CURRENT CONTROL
PULSE SWITCH **ON**
PULSES PER SECOND
BACKGROUND % DUTY CYCLE
PULSE % ON
ALL OTHER FUNCTION PANEL SWITCHES **OFF**

PULSE

APPENDIX A3

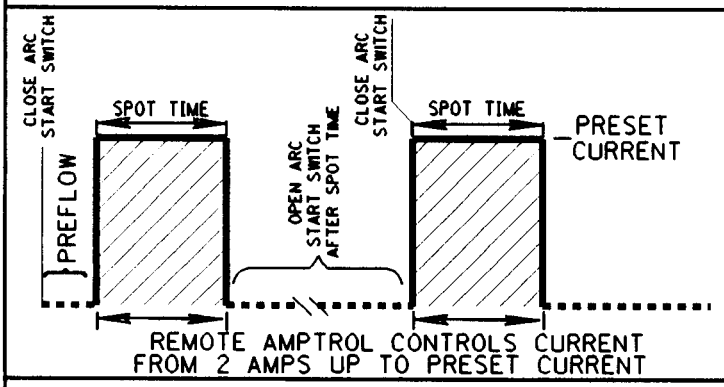
EFFECT OF CONTROLS ON TIG WELDING



FULL FUNCTION MODEL

LOCAL CURRENT CONTROL
START SWITCH **ON**
(SHORT HOT START SHOWN)
PULSE SWITCH **ON**
CRATER FILL SWITCH **ON**
(SLOW FADE-OUT SHOWN)
SPOT SWITCH **OFF**

START+PULSE+CRATER FILL



FULL FUNCTION MODEL

LOCAL OR **REMOTE**
SPOT SWITCH **ON**
ALL OTHER FUNCTION PANEL SWITCHES **OFF**

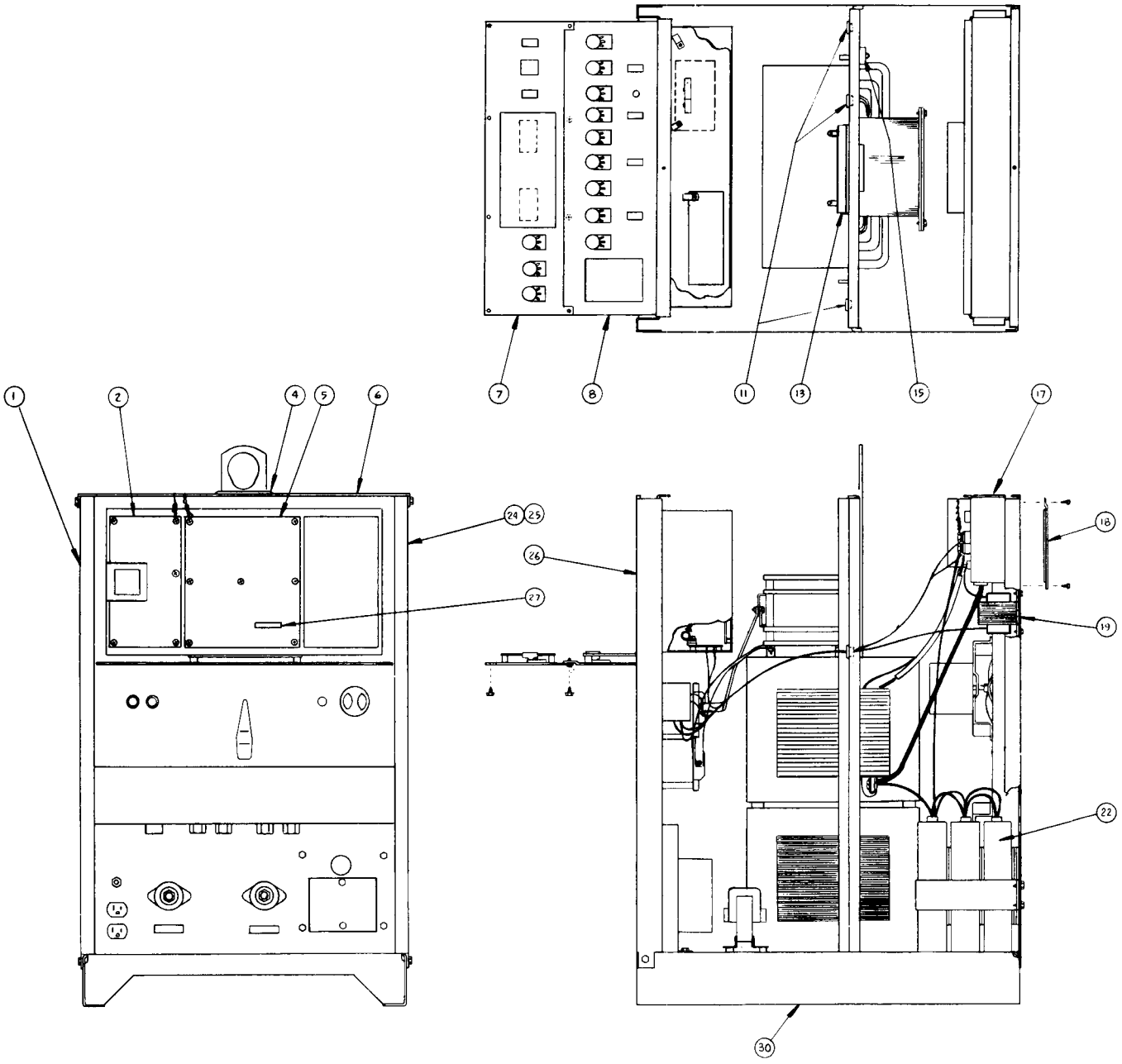
(SPOT TIME IS CUT SHORT IF ARC START SWITCH IS OPENED BEFORE END OF SPOT TIME)

SPOT

THE **SPOT** TIMER CAN BE USED TO TIME A PROGRAMMED SEQUENCE OF **START** AND/OR **PULSE** UP TO 5 SECONDS LONG, OPTIONALLY FOLLOWED BY **CRATER FILL**. IF **CRATER FILL** IS USED, **FADE-OUT** BEGINS AT THE END OF THE **SPOT** TIME. THE **START** SWITCH MUST BE **ON** WHEN USING **CRATER FILL** WITH THE **SPOT** TIMER.

SPOT + START + PULSE + CRATER FILL

GENERAL ASSEMBLY



G-1773
3-6-87

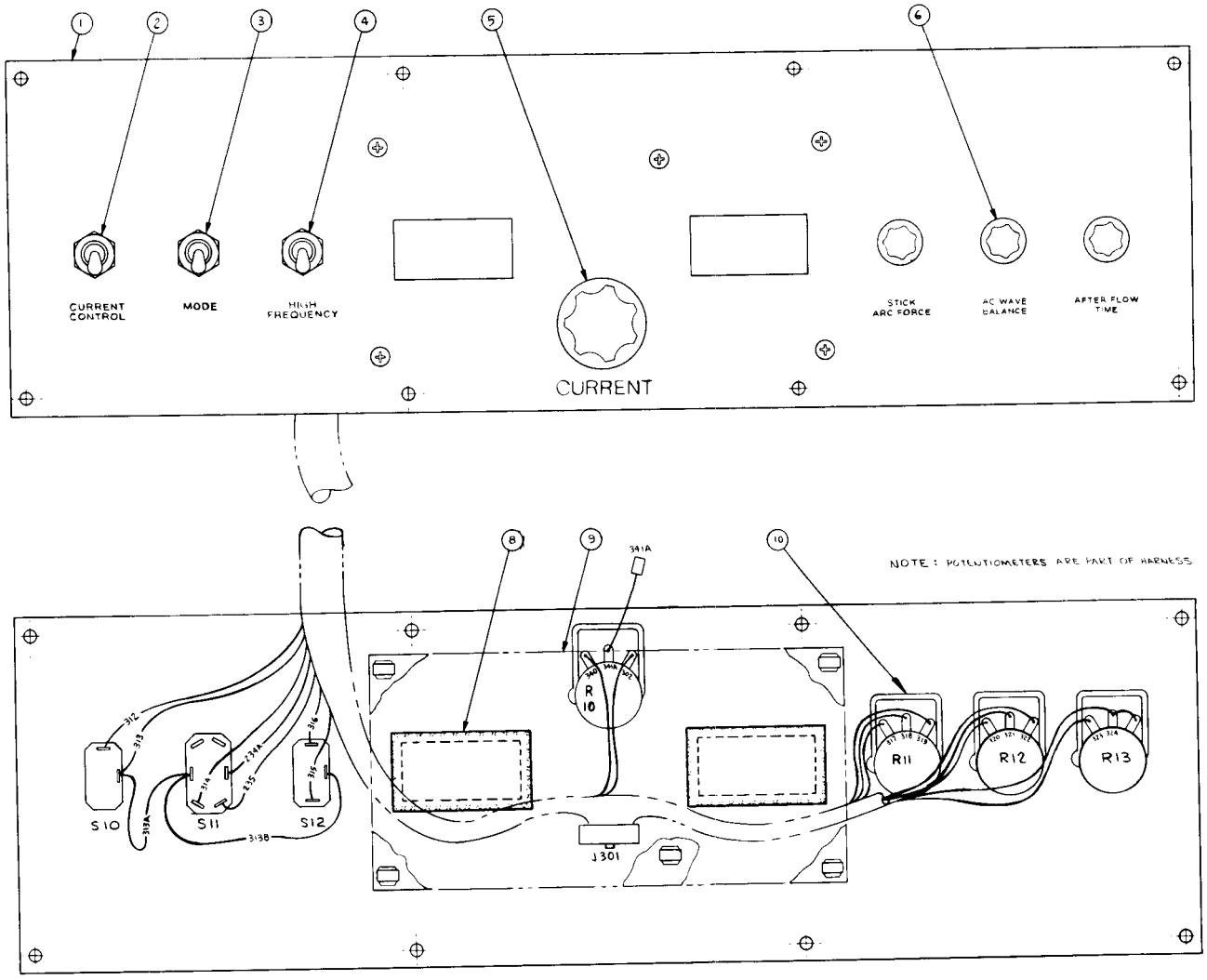
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-176-C

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Left Case Side	1
2	Function Printed Circuit Board (Full Function Only)	1
4	Cover Seal	1
5	Control Printed Circuit Board (60 Hz)	1
5	Control Printed Circuit Board (50 Hz)	1
6	Roof	1
7	Top Control Panel	1
8	Bottom Control Panel (Basic Machine Only)	1
8	Bottom Control Panel (Full Function Machine Only)	1
11	Grommet	3
13	Resistor (R3)	1
	Mounting Bracket Set	1
15	Rectifier Bridge	1
17	Case Back Assembly	1
18	Input Access Door	1
	Connection Diagram	1
19	Pilot Transformer (T2)	1
22	Power Factor Capacitor	3
	Insulation	7
	Mounting Strap	1
24	Right Case Side	1
25	Wiring Diagram	1
26	Case Front Assembly	1
27	Jumper Plug (P1004)(Basic Machines Only)	1
30	Center Assembly	1
	Optional Equipment (Not Illustrated)	
	Interface Kit	1
	DC Switch Modules See Price Page	1
	AC Switch Modules Explanation	1
	Function Upgrade Kit - Basic Machine to Full Function Machine	1

7-5-88

TOP CONTROL PANEL



WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

G-1755
10-3-86

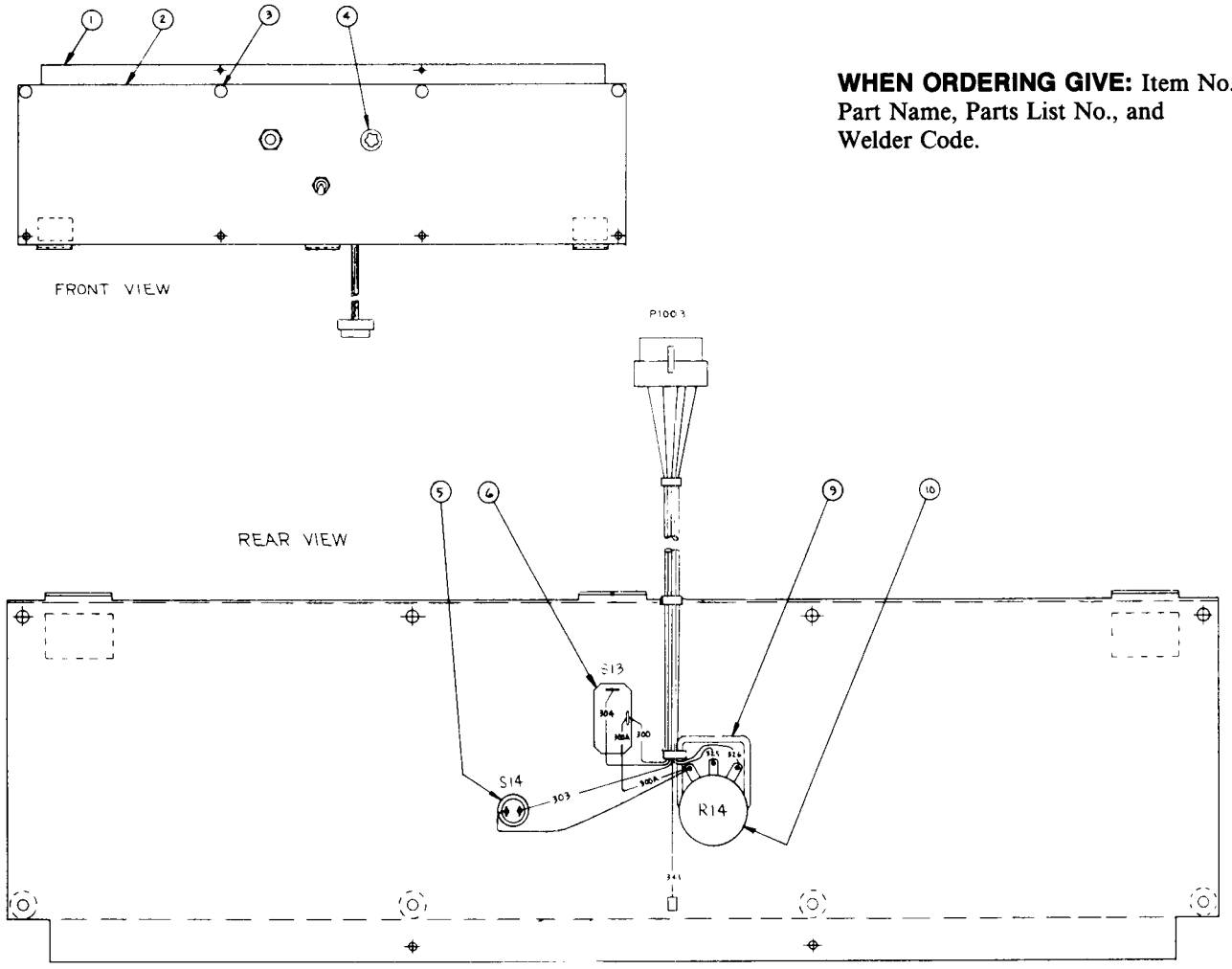
Parts List P-176-D

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Top Control Panel	1
	Nameplate	1
2	Current Control Switch (S10)	1
3	Mode Switch (S11)	1
4	High Frequency Switch (S12)	1
5	Knob	1
6	Knob	3
8	Filter Lens	2
9	Meter Printed Circuit Board	1
10	Potentiometer Spacer (R11, R12, R13)	3
11	Insulation (Potentiometer R10)	1

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
	Items that are part of harness but may be ordered separately:	
	Current Potentiometer (R10)	1
	Stick Arc Force Potentiometer (R11)	1
	AC Wave Balance Potentiometer (R12)	1
	After Flow Time Potentiometer (R13)	1

5-26-88

BOTTOM CONTROL PANEL
(Basic Machine Only)



WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

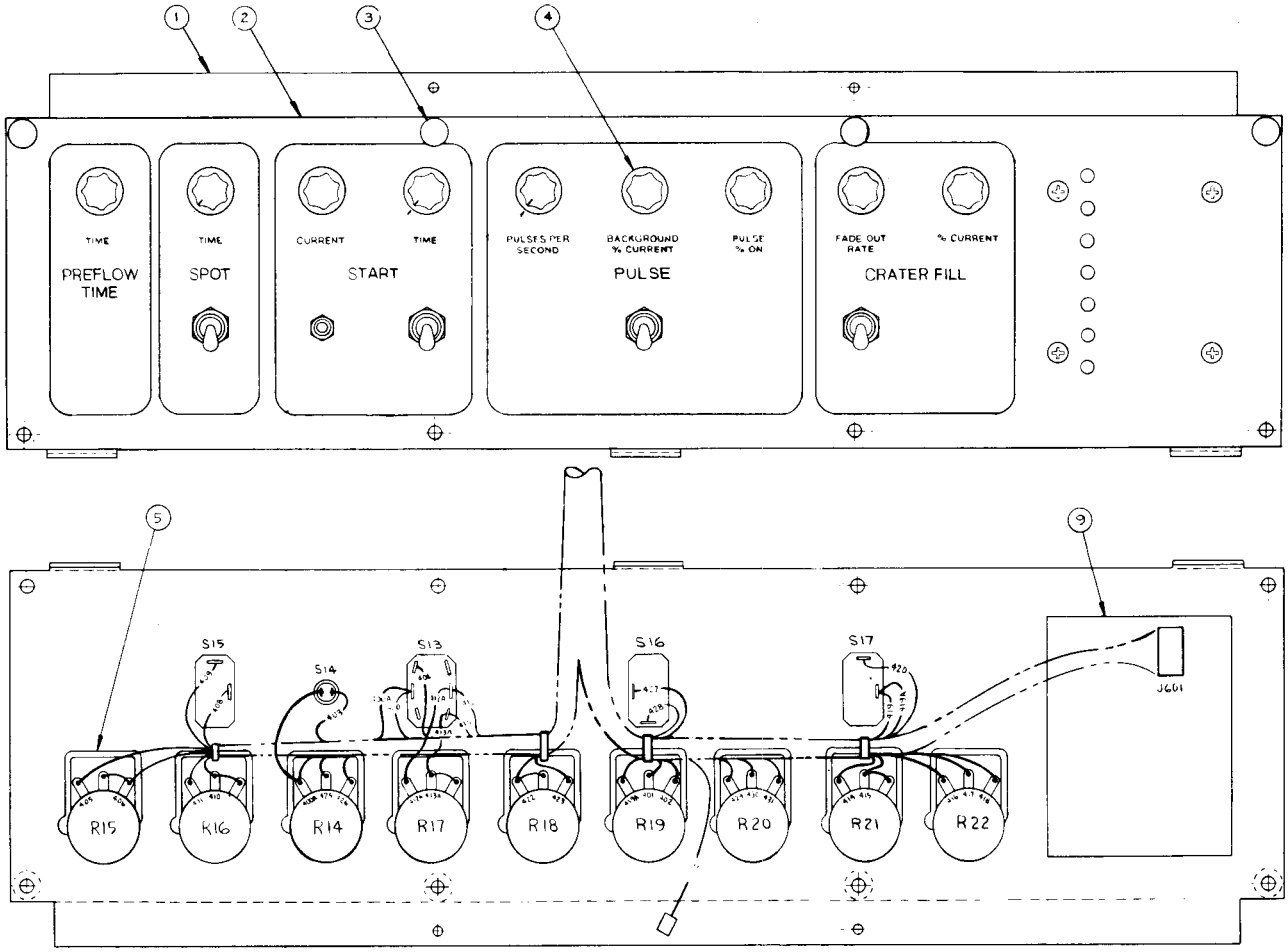
L-7385
1-23-87

Parts List P-176-E

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Control Panel	1
2	Nameplate	1
3	Fastener Button	4
4	Knob	1
5	Switch (S14)	1
6	Switch (S13)	1
9	Spacer	1
10	Potentiometer (R14)	1

5-26-88

BOTTOM CONTROL PANEL
(Full Function Machines Only)



G-1756
2-23-87

WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

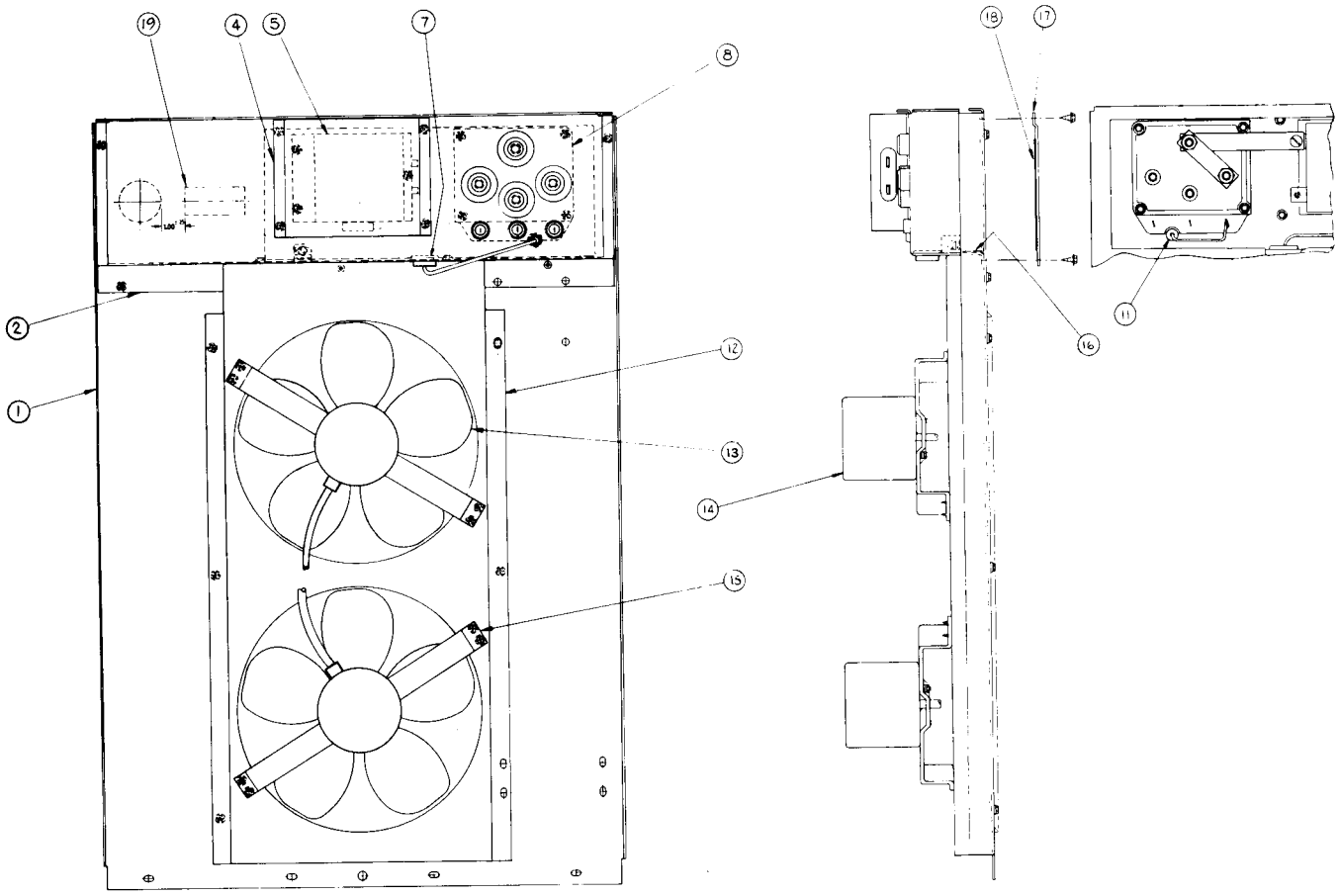
Parts List P-176-F

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Control Panel	1
2	Nameplate	1
3	Fastener Button	4
4	Knob	9
5	Spacer	9
9	Status Printed Circuit Board	1
	Start Switch (S13)	1
	Spot, Pulse & Crater Fill Switch	
	(S15, S16, S17)	3

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
	Items that are part of harness but may be ordered separately:	
	Start Current Potentiometer (R14)	1
	Preflow Time Potentiometer (R15)	1
	Spot Time Potentiometer (R16)	1
	Start Time Potentiometer (R17)	1
	Pulses Per Second Potentiometer (R18)	1
	Background % Current Potentiometer (19)	1
	Pulse % On Potentiometer (R20)	1
	Fade Out Rate Potentiometer (R21)	1
	% Current Potentiometer (R22)	1
	Switch (S14)	1

5-26-88

CASE BACK ASSEMBLY



WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

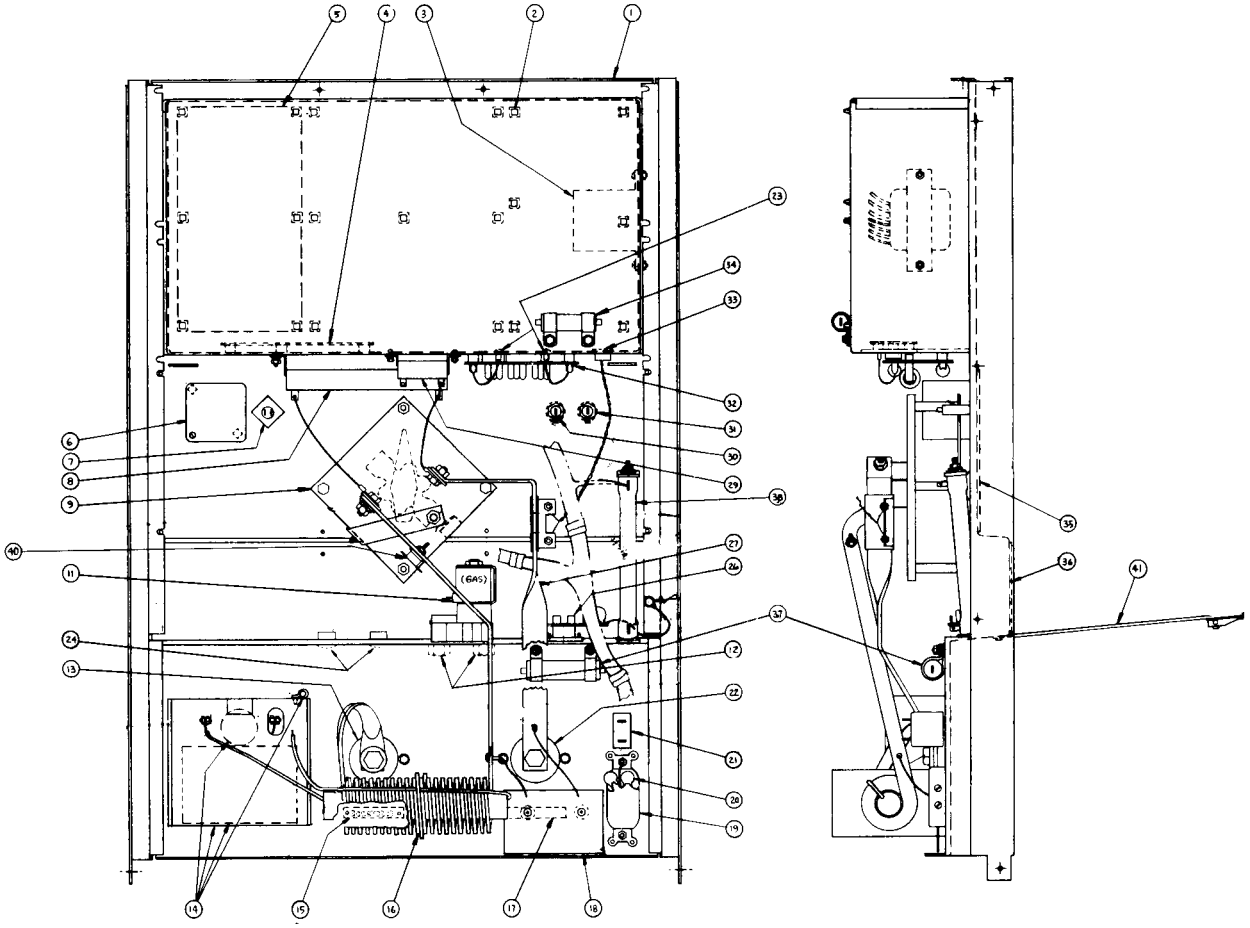
G-1767
7-25-86

Parts List P-176-G

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Rear Panel	1
2	Input Box Assembly	1
4	Contactor Mounting Bracket	1
5	Contactor	1
7	Grommet	1
8	Reconnect Panel	1
11	Grommet	1
12	Fan Baffle	1
13	Fan Blade	2
14	Fan Motor	2
15	Fan Mounting Bracket	2
16	Ground Decal	1
17	Input Access Door	1
18	Input Connection Diagram	1
19	Machine Grounding Warning Decal	1

5-26-88

CASE FRONT ASSEMBLY



G-1772
1-15-87

WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

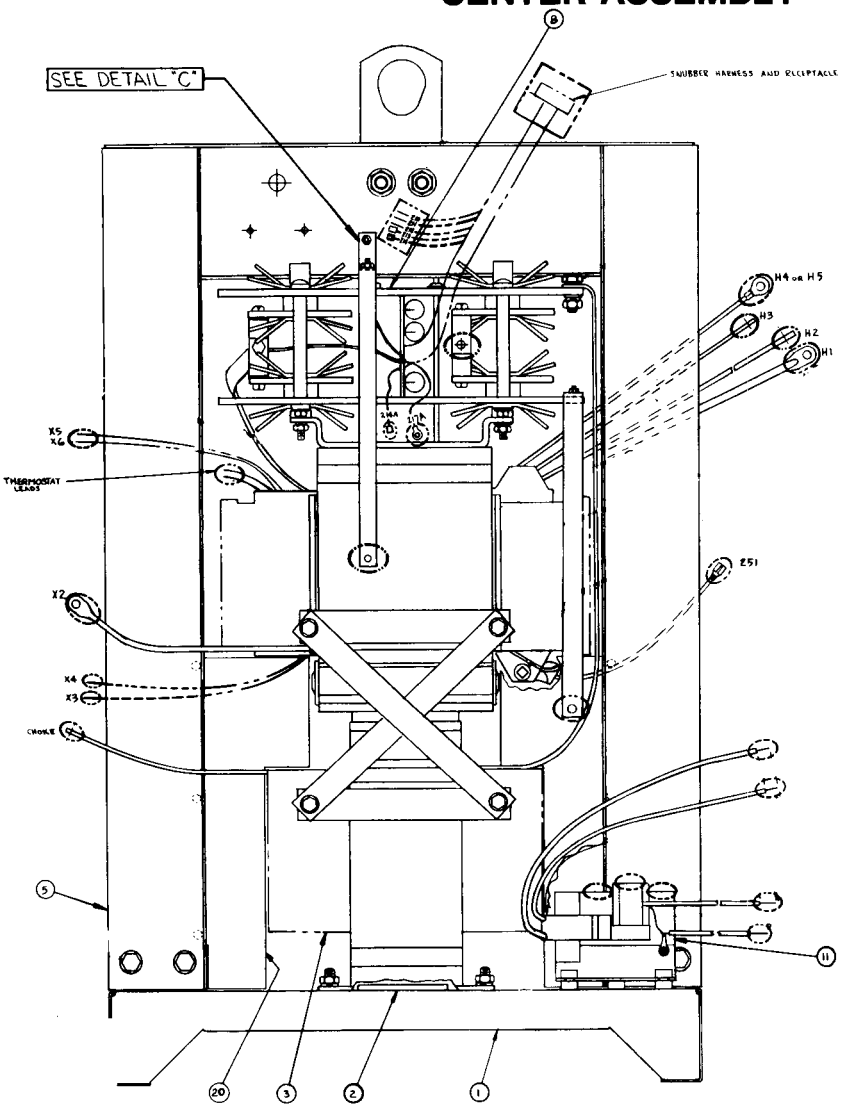
Parts List P-176-H

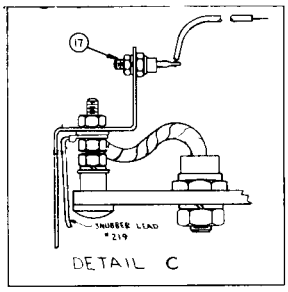
ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Case Front Panel	1
2	P.C. Board Plastic Expansion Nut	24
3	Control Transformer (T5)	1
4	Interlock Printed Circuit Board	1
5	Power Printed Circuit Board	1
6	Power Pushbutton (S2)	1
	Cover Plate	1
7	Pilot Light (PL1)	1
8	Resistor (R1)	1
	Mounting Bracket Set	1
9	Polarity Switch	1
	Handle	1
11	Gas Solenoid Valve (SV1) & Water Solenoid Valve (SV2 Optional)	1 or 2
	(Relative location may vary between codes)	
12	Right Hand Connector for Gas Valve	2
13	Output Terminal Assembly	1
	Output Terminal Nut	1
14	High Freq. Circuit Assembly, Includes:	1
	Rheostat	1
	Mounting Bracket	1
	Capacitor, Choke and Spark Gap Assembly, Includes:	1
	Capacitor	1
	Choke	2
	Spark Gap Assembly, Includes:	1
	Electrodes	2
	Spark Gap Support	2
	Base	1
	Spark Gap Cover	1
	Rheostat Knob	1
15	"ELECTRODE" Marker	1
	Fastener Button	2
16	High Freq. Transformer (T4)	1
17	"TO WORK" Marker	1
	Fastener Button	2
18	By Pass Printed Circuit Board	1
19	Duplex Receptacle (J1)	1

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
20	115V Receptacle By Pass Capacitor Assembly	1
21	Circuit Breaker (CB1)	1
22	Output Terminal	1
	Output Terminal Nut	1
24	Left Hand Connector For Water Valve (Opt.)	2
26	Remote Receptacle & Board Assembly	1
27	Shunt Assembly	1
29	Resistor (R2)	1
	Mounting Bracket Set	1
30	Fuse (F2)	1
	Fuse Holder	1
31	Fuse (F1)	1
	Fuse Holder	1
32	Feed Thru Printed Circuit Board	1
33	Grommet	1
34	Capacitor (C1) (Below Code 9200)	1
34	Capacitor (C1) (Above Code 9200)	1
	Mounting Clamp	2
35	Nameplate (Below Code 9200)	1
35	Nameplate (Above Code 9200)	1
	Fastener Button	8
36	Nameplate (Below Code 9200)	1
36	Nameplate (Above Code 9200)	1
	Fastener Button	7
37	Capacitor (C6)	1
	Mounting Clamp	2
38	Resistor (R6)	1
	Round Head Screw	1
	Insulating Washer	2
	Plain Washer	1
	Lock Washer	1
	Hex Nut	1
40	Thermostat	1
41	Output Cover Assembly	1

5-26-88

CENTER ASSEMBLY





G-1756
2-23-87

Parts List P-176-J

ITEM	PART NAME & DESCRIPTION	NO. REQ'D
1	Base	1
2	Transformer Insulation	1
3	Transformer & Choke Assembly	1
5	Lift Bail Assembly	1
8	Rectifier Assembly, Includes:	1
	Negative SCR & Heat Sink Assembly	1
	Positive SCR & Heat Sink Assembly	1
	Snubber Printed Circuit Board	1
	Background Supply Transistor	1
	Transistor Socket	1
11	High Voltage Transformer	1
	Mounting Standoff	3
17	Diode (D2)	1
20	Baffle	2

WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

5-26-88

EQUIPMENT MANUFACTURER'S CERTIFICATION

Type of Equipment _____
Model Number _____
Code Number _____
Serial Number _____
Operating Instruction Manual Number _____

This certificate indicates manufacturer's conformity to FCC Rules & Regulations. User's compliance with these regulations requires he fill out this certificate and attach to equipment or other location where it will be conveniently available for inspection.

The High Frequency Generator of the above identified equipment has been tested under field test condition standards recommended by the Joint Industry Committee on High Frequency Stabilized Arc Welding Machines. It was found to comply with the Federal Communications Commission established maximum allowable R.F. energy radiation limit of 10 micro volts per meter at a distance of 1 mile.

If this equipment is installed, operated and maintained as recommended in the accompanying operating manual, it may reasonably be expected to meet the Federal Communications Commission established R.F. energy radiation limitation.

The Lincoln Electric Company

EQUIPMENT INSTALLATION CERTIFICATION

The above identified equipment has been installed and will be operated and maintained in compliance with manufacturer's recommendations made in the accompanying operating manual.

Certifying Signature and Title _____

Date _____

THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A. S-14929

9-2-83E

LIMITED WARRANTY

STATEMENT OF WARRANTY:

The Lincoln Electric Company (Lincoln) warrants to the original purchaser (end-user) of new equipment that it will be free of defects in workmanship and material.

This warranty is void if Lincoln finds that the equipment has been subjected to improper care or abnormal operation.

WARRANTY PERIOD:

All warranty periods date from the date of shipment to the original purchaser and are as follows:

Three Years:
Transformer Welders
Motor-generator Welders
Semiautomatic Wire feeders
Plasma-cutting power source
Engine Driven Welders (except engine and engine accessories) with operating speed under 2,000 RPM

Two Years:
Engine Driven Welders (except engine and engine accessories) with operating speed over 2,000 RPM

All engine and engine accessories are warranted by the engine or engine accessory manufacturer and are not covered by this warranty.

Equipment not listed above such as guns and cable assemblies, automatic wire feeders and field-installed optional equipment is warranted for one year.

TO OBTAIN WARRANTY COVERAGE:

You are required to notify Lincoln Electric, your Lincoln Distributor, Lincoln Service Center or Field Service Shop of any defect within the warranty period. Written notification is recommended.

WARRANTY REPAIR:

If Lincoln's inspection of the equipment confirms the existence of a defect covered by this warranty, the defect will be corrected by repair or replacement at Lincoln's option.

WARRANTY COSTS:

You must bear the cost of shipping the equipment to a Lincoln Service Center or Field Service Shop as well as return shipment to you from that location.

IMPORTANT WARRANTY LIMITATIONS:

- Lincoln will not accept responsibility for repairs made without its authorization.
- Lincoln shall not be liable for consequential damages (such as loss of business, etc.) caused by the defect or unreasonable delay in correcting the defect.
- Lincoln's liability under this warranty shall not exceed the cost of correcting the defect.
- This written warranty is the **only** express warranty provided by Lincoln with respect to its products. Warranties implied by law such as the Warranty of Merchantability are limited to the duration of this limited warranty for the equipment involved.

LINCOLN ELECTRIC®

THE LINCOLN ELECTRIC COMPANY

World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors
Sales and Service Worldwide Cleveland, Ohio 44117-1199 U.S.A.
Toronto M4G 2B9 – Canada • Sydney 2211 – Australia • Rouen 76120 – France

Eff. Jan. '89 Ram 7-88 Litho in U.S.A.