ULTRA FLEX® 350

For the Following Specs:

- 500235-1 CC/CV
- 500237-1 Pulse

OWNER'S MANUAL Number **430429-308**
Revised January 14, 1998

IMPORTANT: Read these instructions before installing, operating, or servicing this system.

THERMAL ARC INC., TROY, OHIO 45373-1085, U.S.A.

INTRODUCTION

How To Use This Manual

This Owner's Manual usually applies to just the underlined specification or part numbers listed on the cover. If none are underlined, they are all covered by this manual.

To ensure safe operation, read the entire manual, including the chapter on safety instructions and warnings.

Throughout this manual, the words **WARNING, CAUTION**, and **NOTE** may appear. Pay particular attention to the information provided under these headings. These special annotations are easily recognized as follows:

WARNING gives information regarding possible personal injury. Warnings will be enclosed in a box such as this.

CAUTION refers to possible equipment damage. Cautions will be shown in bold type.

NOTE offers helpful information concerning certain operating procedures. Notes will be shown in italics.

Equipment Identification

The unit's identification number (specification or part number), model, and serial number usually appear on a nameplate attached to the control panel. In some cases, the nameplate may be attached to the rear panel. Equipment which does not have a control panel such as gun and cable assemblies are identified only by the specification or part number printed on the shipping container. Record these numbers for future reference.

Receipt Of Equipment

When you receive the equipment, check it against the invoice to make sure it is complete and inspect the equipment for possible damage due to shipping. If there is any damage, notify the carrier immediately to file a claim. Furnish complete information concerning damage claims or shipping errors to Thermal Arc, Order Department, 2200 Corporate Drive, Troy, Ohio 45373-1085. Include all equipment identification numbers as described above along with a full description of the parts in error.

Additional copies of this manual may be purchased by contacting Thermal Arc at the address given above. Include the Owner's Manual number and equipment identification numbers.

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DESCRIPTION OF EQUIPMENT

General

The Ultra Flex® 350 is a DC inverter power source that can be used for Constant Current (CC), Constant Voltage (CV), and Pulse welding applications. The DC output is produced by an inverter operating at 20 kHz utilizing Insulated Gate Bipolar Transistors (IGBT). The output is rated for 350 amps at 34 volts and 60% duty cycle. The power source will operate from either single or three phase input power. The input voltage is sensed, and the primary circuits are automatically configured for the correct input voltage. This eliminates the need to manually set the machine for the correct input voltage.

Controls for the following welding processes are built into the Ultra Flex® 350 power source: Shielded Metal Arc Welding (Stick) with arc force control, Gas Tungsten Arc Welding (TIG) with Lift-Arc, and Gas Metal Arc Welding (MIG/MAG) with variable inductance control. The Ultra Flex® 350 Pulse machine also has controls built in for pulsed Gas Metal Arc Welding. The pulse control includes 8 pre-programmed factory pulse schedules with the ability to override any or all eight schedules using the optional programming pendant (204180-1).

The Ultra Flex® 350 power source also contains several protection features to assure continued, reliable operation. The features include: AC input over and under voltage sensing and shutdown, output overload shutdown, overtemperature shutdown, short circuit protection, ground fault current shutdown for the remote receptacle, and single/three phase detection. During the initial power up sequence the input voltage and the inverter DC capacitor voltage are sensed. If any voltage is not correct the input circuit will be safely disabled protecting the inverter from damage.

Specifications

Input Data For Three Phase			
Output Volts Output Amps Duty Cycle	35 V 375 A 50 %	34 V 350 A 60 %	31 V 275 A 100 %
Line Volts	**Line Amps**		
200 V 230 V 400 V 460 V	58 A 52 A 29 A 24 A	52 A 48 A 26 A 22 A	38 A 36 A 19 A 17 A
Input KVA Efficiency Power Factor	20.3 KVA 87 % 0.74	18.6 KVA 86 % 0.74	13.9 KVA 85 % 0.72

Table 3-1 Input Data For Three Phase

Input Data For Single Phase			
Output Volts Output Amps Duty Cycle		31 V 275 A 60 %	29 V 225 A 100 %
Line Volts	**Line Amps**		
200 V 230 V 400 V 460 V		77 A 68 A 36 A 32 A	60 A 53 A 28 A 25 A
Input KVA Efficiency Power Factor		15.2 KVA 85 % 0.66	12.0 KVA 84 % 0.65

Table 3-2 Input Data For Single Phase

Duty Cycle

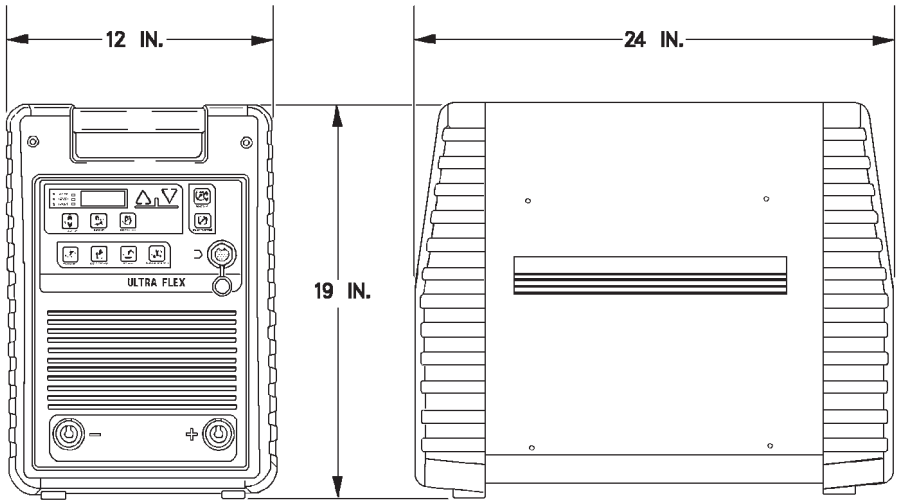
The duty cycle ratings for the Ultra Flex® 350 power source are listed in Tables 3-1 and 3-2. The output ratings are different for single and three phase operation. The duty cycle is the percentage of a ten minute period that the power source can be operated at a given output without overheating the machine. For example, the Ultra Flex® has a rating of 35 volts and 375 amps with a duty cycle of 50%. This means that the machine can be operated for five minutes at 35 Volts and 375 Amps, then it must be allowed to cool for the next five minutes at no load.

Output Data		
	Three Phase	**Single Phase**
Output Range For SMAW (Stick)	40 – 375 A	40 – 275 A
Output Range For GTAW (TIG)	5 – 375 A	5 – 275 A
Output Range for GMAW (MIG)	10 – 35 V	10 – 31 V
Overcurrent Shutdown	385 A	285 A
Maximum Short-Circuit Current	450 A	450 A
Maximum Pulse Current	450 A	450 A
Maximum Open-Circuit Voltage	80 V	80 V

Table 3-3 Output Data

Additional Specifications:

Allowable Line Voltage Variations:	±10 %
Operating Temperature Range:	0 – 40°C (32 – 104°F)
Line Regulation:	±1%
Load Regulation:	±1%



Weight 92 lbs.

Figure 3-1 Overall Dimensions

Volt-Ampere Curves

(See Figure 3-2)

Figure 3-2 shows the static operating characteristics for CC-Stick, CC-TIG, and CV-MIG modes.

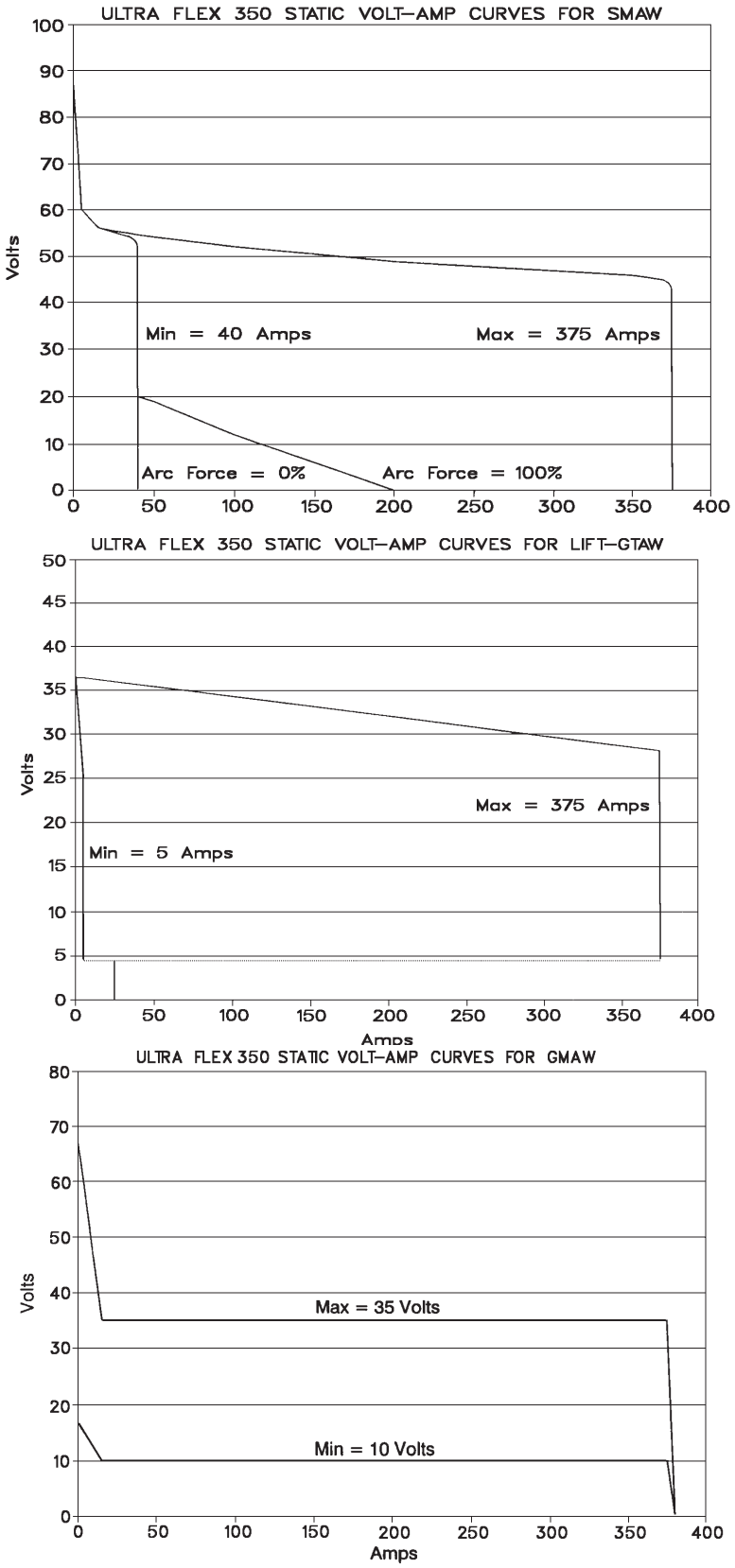


Figure 3-2 Volt-Ampere Curves

Description Of Controls And Features

(See Figure 3-3)

1 — Control Panel: The control panel consists of a membrane switch and a digital display. The Ultra Flex® 350 CC/CV and Ultra Flex® 350 Pulse have different control panels. See control panel descriptions for more details.

2 — Programming Pendant Plug: This plug is available only on the Ultra Flex® 350 Pulse unit. It is used with the optional programming pendant (204180-1) to modify the eight Pulse MIG weld programs. Any or all eight of the pulse programs can be modified and the new data saved with the pendant.

3 — Output Negative Terminal: Connection point for the negative welding lead.

4 — Output Positive Terminal: Connection point for the positive welding lead.

5 — AC Power On/Off Switch: This switch is used to control the single or three phase power applied to the power source. When the switch is in the ON position, the digital display should be lit.

6 — 19 Pin Remote Amphenol Receptacle: This is the connection point for various remote controls and wire feeders. It supplies 120 VAC power as well as the control signals. The pinout is as follows:

Pin A)	Contactor Ckt. (+15 V)
Pin B)	Contactor Ckt. (A-B closure turns power source on)
Pin C)	Arc Volts Signal (+1 V =+10 Arc Volts)
Pin D)	Open
Pin E)	120 VAC
Pin F)	120 VAC Neutral
Pin G)	Chassis Frame Ground
Pin H)	Remote Control Maximum (High side of remote potentiometer)
Pin J)	Remote Control Input (Wiper of remote potentiometer) Scaling: 0 to ±10 V =0 - 375 Amps 0 to ±10 V =0 - 44 Volts 0 to ±10 V =0 - 440 For Pulse
Pin K)	Remote Control Minimum (Low side of remote potentiometer)
Pin L)	Control Circuit Common
Pin M)	Arc Established Signal (+12 V)
Pin N)	Open
Pin P)	Open
Pin R)	120 VAC Neutral
Pin S)	Open
Pin T)	Open
Pin U)	Output Amps Signal (+1 V =100 Amps)
Pin V)	Open

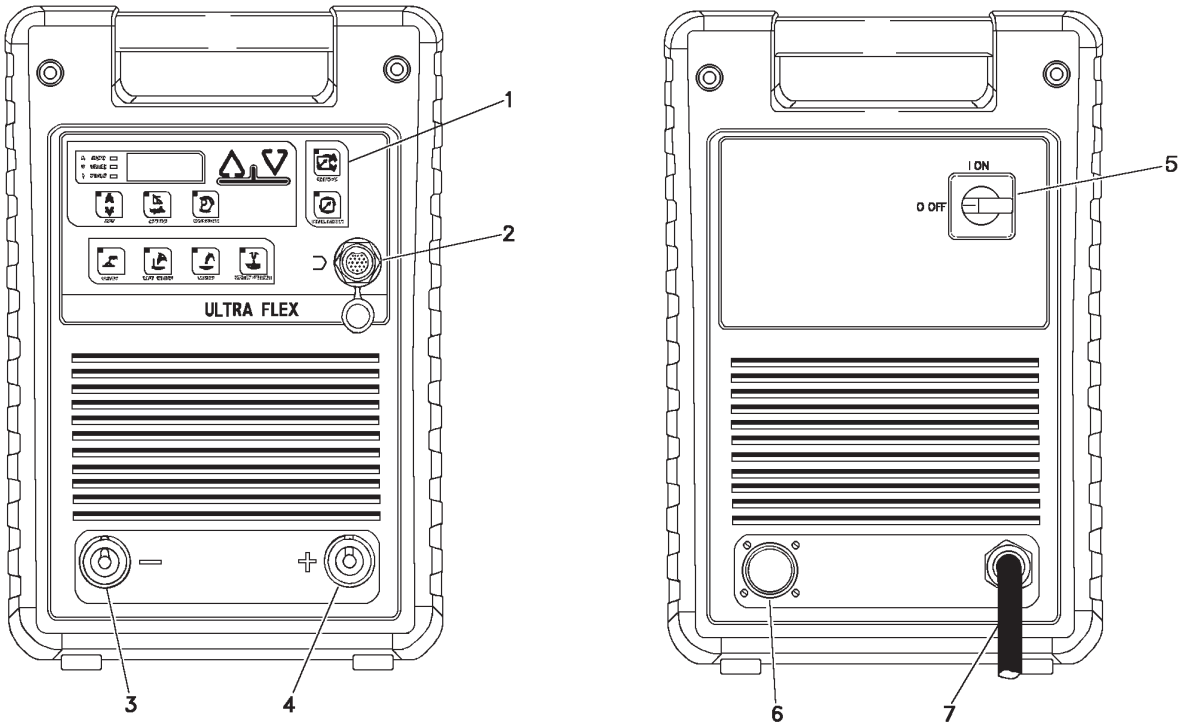


Figure 3-3 Control and Rear Panel

7 — Input Power Cable: A ten foot input cable (4 conductor) is supplied standard with the machine.

Protection Features

The Ultra Flex® has the following built-in protection features designed to assure reliability. If the machine is shutdown because of one of the protection circuits, the digital meter will display a fault code. See the Troubleshooting chapter for an explanation of the fault codes.

a. Output Short-Circuit Protection — The output terminals of this machine can be short-circuited for all modes of operation including Constant Voltage without damage to the machine. The protection circuit instantly limits the output current to a safe maximum value during short-circuit conditions.

b. Overcurrent Shutdown — If the average welding amperage exceeds the overcurrent values shown in Table 3-3, the machine will shut itself off in less than four seconds. The purpose of the overcurrent shutdown is to protect the machine from overheating if the maximum rated output amperage is exceeded. The RED fault light will come on and the digital meter will display a fault code indicating that an overload has occurred. All function buttons will also be disabled. To reset this condition it will be necessary to momentarily shut the main power switch off.

c. Overtemperature Shutdown — The machine contains a thermostat to sense an overtemperature condition. Overtemperature could occur because of exceeding the duty cycle of the machine, high ambient temperatures, blocked air flow, fan failure, etc. If an overtemperature condition is sensed, the RED fault light will come on and the digital meter will display a fault code indicating that an overtemperature has occurred. All function buttons will also be disabled. To reset this condition it will be necessary to momentarily shut the main power switch off.

d. Single/Three Phase Detector — The purpose of this circuit is to sense whether the power source is connected to single or three phase power and set the maximum output scaling accordingly. If the machine initially is powered up on three phase and later detects single phase, the machine will shut off and turn on the RED fault light. The digital meter will also display a fault code and the user interface will be disabled. This condition would most likely occur because of a blown line fuse on one of the three phases. To reset this condition it will be necessary to momentarily shut the main power switch off.

e. Input Voltage Detection — If the input voltage is too high or too low (see machine specifications for rated line voltages) the machine will not operate. This condition will also be indicated by the RED fault light and fault code on the digital meter. To reset this condition it will be necessary to momentarily shut the main power switch off.

f. Ground Fault Protection — The ground fault protection will disable the output of the machine if it senses welding current flowing through the safety ground wire in the 19 pin remote receptacle. This condition will also be indicated by the RED fault light and fault code on the digital meter. To reset this condition it will be necessary to momentarily shut the main power switch off.

Description of Control Panels

(See Figure 3-4)

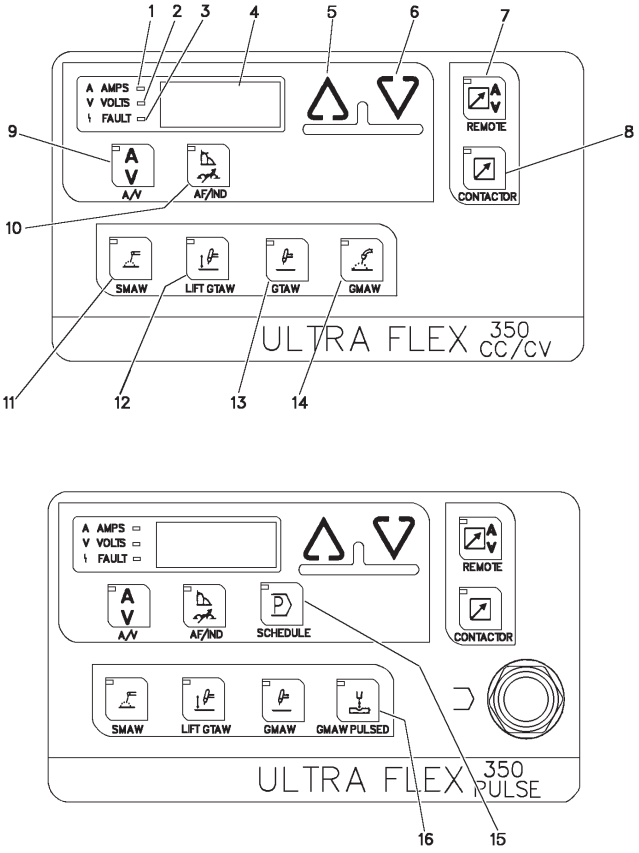


Figure 3-4 Control Panels

GENERAL: The control panel consists of a membrane switch and digital display. The control panel will give both audible and visual feedback when a button has been pressed. The UP and DOWN buttons are used to adjust all of the preset values.

If the UP or DOWN button is held down for more than two seconds the digital display will start to scroll the preset value faster, allowing for more rapid changes. Pressing any of the other preset buttons will activate that function, unless the function is not allowed for the weld process selected. For example, the arc force function is only active during the SMAW (Stick) process. When a button is active, the LED adjacent to the button will be lit.

1 — AMPS LED INDICATOR: This indicator will be lit whenever the digital meter is displaying either preset or actual weld AMPS.

2 — VOLTS LED INDICATOR: This indicator will be lit whenever the digital meter is displaying either preset or actual weld VOLTS.

3 — FAULT LED INDICATOR: This indicator will be lit whenever the digital meter is displaying a fault code, and the power source has shut itself off because of a fault condition. See Troubleshooting chapter for details on Fault codes.

4 — DIGITAL METER DISPLAY: The digital meter is used to display preset values, actual amps and volts, fault codes, and user programmable values. The preset values include amps, volts, arc force, inductance, Pulse MIG schedule number, and Pulse MIG pulse rate reference. For user programmable values see the section under OPERATION on "SAFE". The display also incorporates a meter "hold" function. For approximately five seconds after the end of a weld, the meter will display the last value "held" for either amps or volts. To toggle between "held" amps and "held" volts press the A/V button.

5 — INCREMENT UP: This button is used to increase the value of the selected parameter.

6 — DECREMENT DOWN: This button is used to decrease the value of the selected parameter.

7 — REMOTE: This button is used to activate the remote amperage/voltage control feature of the power source for use with a foot control, digital wire feeder or other remote device. Pressing the switch once activates remote control, pressing it again de-activates remote control. When remote control is active, the LED indicator next to the switch will be lit.

8 — CONTACTOR: This button is used to turn on the output of the machine. Pressing the button once will turn the machine on, pressing the button again will turn the machine off. When the output of the machine is energized, the LED on the switch will be lit. Whenever the LED is lit there will be voltage on the output terminals of the power source. The process select buttons can not be pressed when the contactor is on.

9 — A/V (Amps/Volts): This button has two main functions. Prior to striking an arc, this button is used to select AMPS, VOLTS, or PULSE rate reference, as the adjustable value shown on the display. For example, in Stick welding mode, pressing this button would bring up the preset amps. After an arc has been struck, this button is used to toggle between actual amps and actual volts. The meter will "hold" the last value of amps and volts for five seconds after the end of a weld. The A/V button can be used to toggle between the "held" values of amps and volts.

10 — AF/IND (Arc Force/Inductance): This button has two functions dependent on which welding process is being used. If stick welding is the selected process, then this button is used to select arc force as the adjustable value on the digital meter. Arc force has a value between 0 and 100, with 100 being maximum arc force. If MIG (GMAW) is the selected welding process, then this button is used to select inductance as the adjustable value on the digital meter. Inductance also has a value between 0 and 100, with 100 being the maximum inductance. If TIG or Pulse MIG is the selected welding process, then pressing this button will do nothing. After arc force or inductance has been selected, use the UP and DOWN buttons to adjust the value.

11 — SMAW: This is one of the welding process select buttons. Pressing this button will activate the Stick (CC) welding mode. The LED next to the SMAW switch will light. The process select buttons can not be pressed when the contactor is on.

12 — LIFT GTAW: This is one of the welding process select buttons. Pressing this button will activate the Lift TIG (CC) welding mode. The LED next to the LIFT GTAW switch will light. The process select buttons can not be pressed when the contactor is on.

13 — GTAW: This is one of the welding process select buttons. It is only available on the ULTRA FLEX® 350 CC/CV machine. Pressing this button will activate standard TIG (CC) mode (non-lift). The LED next to the GTAW switch will light. The process select buttons can not be pressed when the contactor is on.

14 — GMAW: This is one of the welding process select buttons. Pressing this button will activate the MIG (CV) welding mode. The LED next to the GMAW switch will light. The process select buttons can not be pressed when the contactor is on.

15 — SCHEDULE: This button is used to select the Pulse MIG schedule number. It is only available on the ULTRA FLEX® 350 PULSE machine. If this button is pressed after GMAW PULSED has been selected as the welding process, the display will show a number between 1 and 8. This is the selected pulse weld schedule number. To change the schedule selection, use the UP and DOWN buttons. The schedule selection can only be changed while not welding. If this button is pressed with any other selected weld process, nothing will happen.

16 — GMAW PULSED: This is one of the welding process select buttons. It is only available on the ULTRA FLEX® **350 PULSE machine. Pressing this button will activate the Pulsed MIG mode of welding. The LED next to the switch will be lit. The process select buttons can not be pressed when the contactor is on.**

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INSTALLATION

Location

For best operating characteristics and longest unit life, take care in selecting an installation site. Avoid locations exposed to high humidity, dust, high ambient temperature, or corrosive fumes. Moisture can condense on electrical components, causing corrosion or shorting of circuits. Dirt on components helps retain this moisture.

Adequate air circulation is needed at all times in order to assure proper operation. Provide a minimum of 12 inches (305 mm) of free air space on all sides of the unit. Make sure that the ventilator openings are not obstructed. Ventilation air flow is from rear to front.

Voltage Configuration

This machine does not require any manual changeover for different line voltages. The machine will automatically sense the input AC voltage and configure itself for the correct input voltage.

Connecting The Welding Machine To Line Voltage

The input power should be connected to the machine through a fused disconnect switch or other suitable disconnecting means furnished by the user. Table 4-1 provides minimal information for selecting line fuses.

A four conductor power cable (6/4) is provided with the machine for connection to the AC power source. It is the responsibility of the user to provide the proper plug or other means of connection to the cable.

For Single Phase Connection:

1. Connect the BLACK and WHITE wires to the AC power source.

2. Connect the GREEN wire to the power system safety GROUND.

For Three Phase Connection:

1. Connect the RED, WHITE, and BLACK wires to the AC power source.

2. Connect the GREEN wire to the power system safety GROUND.

DANGER: ELECTRIC SHOCK CAN KILL. Open the disconnect switch, or breaker, and determine that no voltage is present, before connecting wires between welding machine and power supply.

CAUTION: The method of installation, conductor size, and overcurrent protection shall conform to the requirements of the local electrical code, the National Electrical Code, or other national codes, as applicable. All installation wiring and machine reconnection shall be done by qualified persons.

Three Phase		
Line Volts	**Rated Line Amps**	**Fuse Size**
200	58	60
230	52	60
400	29	40
460	24	30
Single Phase		
200	77	80
230	68	70
400	36	40
460	32	40

Table 4-1 Recommended Fuse Size

WARNING: Never connect the safety ground screw to one of the three line phases. This would represent a serious electrical shock hazard. The wiring to this machine should be performed by a qualified person only.

Use Of Engine-Generators For Input Power

This welding power source may be powered by engine driven generators. The generator must have an adequate output power rating (20KVA minimum) to power the unit. Make sure that the generator's output voltage, frequency and phase ratings are correct by checking the nameplate of the generator or by measurement by a qualified electrician. To connect the welding machine to the generator follow the instructions in "Connecting the Welding Machine to Line Voltage."

The generator used for power should have good voltage and frequency regulation. If the generator's output voltage or frequency (engine speed) varies excessively with load, this may cause the protection circuits for high or low line voltage to shut down the welding machine and display a fault code. If this happens frequently, then the generator output regulation is not satisfactory to use as a power supply for this welding machine.

Grounding

The frame of this welding machine should be grounded for personnel safety, and to assure operation of the overcurrent protection. The grounding method, and the equipment grounding conductor size and type shall conform to local and national codes.

For the National Electrical Code, the equipment grounding conductor shall be green, green with a yellow stripe, or bare.

If flexible power cable is used, use a cable assembly which includes the equipment grounding conductor. If metallic armored cable or conduit is used, the metal sheathing or conduit must be effectively grounded per local and national codes.

Rubber-tire mounted equipment shall be grounded to conform to local and national codes. The grounding assists in providing protection against line voltage electrical shock and static shock. The grounding serves to discharge the static electric charge which tends to build up on rubber-tire mounted equipment. This static charge can cause painful shock and lead to the erroneous conclusion that an electrical fault exists in the equipment.

If a system ground is not available, consult the electrical code enforcement body for instructions. The welding machine should be connected to an adequate driven ground rod, or to a water pipe that enters the ground not more than 10 feet (3 meters) from the machine.

Welding Leads

Connect the welding leads to the output terminals of the power source. Selection of the proper size of welding leads should be based upon both the rated ampacity of the wire as well as the voltage drop on the cable. For Pulsed-GMAW welding, it is often more important to size the welding leads for voltage drop. If the voltage drop is excessive on the leads, the power source will have difficulty producing the peak pulse current with the correct voltage at the arc. When considering voltage drop, the entire loop (electrode plus work lead) must be considered.

Refer to Table 4-2 as a basic guideline to the required copper cable sizes. For Pulsed-GMAW welding, the cable size should be selected based on peak pulse current rather than average welding amps. The peak pulse current will vary with the different welding schedules.

As a general rule, the welding cables should be kept as short as possible and placed close together. When Pulse-GMAW welding with long cables (greater than 100 feet total length), try to avoid coiling up the cables if possible. A damaged or frayed cable should not be used, and all connections must be properly tightened.

To attach the plugs on the welding cables, refer to Figure 4-1. Strip the insulation off of the welding cable for about 1/2". Insert the cable into the rubber boot first, and then insert the stripped end into the metallic sleeve. Insert the sleeve and cable into the plug full and tighten the set screw. Slide the rubber boot onto the plug.

Avg. Welding Amps or Peak Pulse Amps	TOTAL LENGTH OF LEAD CIRCUIT IN FEET (AND METERS) (ELECTRODE LEAD PLUS WORK LEAD)		
	50 Feet (15.2 M)	100 Feet (30.5 M)	150 Feet (45.7 M)
100	#4	#4	#2
150	#3	#3	#1
200	#2	#2	#1/0
250	#1	#1	#2/0
300	#1/0	#1/0	#3/0
350	#2/0	#2/0	#4/0

NOTE: Lead size shown is for 90°C (194°F) insulation, 30°C (86°F) ambient, and not over 4.5 volts lead drop.

Table 4-2

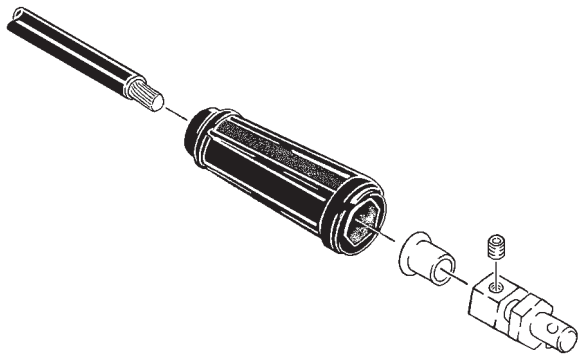

Figure 4-1

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OPERATION

General

Read and understand the safety instructions at the beginning of this manual prior to operating this machine.

WARNING: Be sure to put on proper protective clothing and eye safeguards (welding coat, apron, gloves, and welding helmet, with proper lenses installed). See Safety Instructions and Warnings chapter included in this manual. Neglect of these precautions may result in personal injury.

WARNING: Make all connections to the power source including electrode and work cables, as well as remote control cables, with the power source turned off. These connections could be electrically live with the power switch ON.

This first section on the operation of the machine will describe the general operation of the control panel and digital display. Most of this information is the same no matter what type of welding is being done. Following sections give specific instructions for each welding process or mode of operation.

The bottom group of four buttons on the control panel are used to select the welding process or mode of operation. For the Ultra Flex® 350 CC/CV the following modes are available **SMAW, LIFT GTAW, GTAW,** and **GMAW**. For the Ultra Flex® 350 Pulse the following modes are available: **SMAW, LIFT GTAW, GMAW**, and **GMAW PULSED**. The first step would be to select the correct mode depending on the welding process to be used. To select a weld mode, momentarily press the appropriate button. The light next to the switch should come on indicating that it is now the active mode.

The **A/V** button is used to select amps or volts as the adjustable value shown on the display. To preset amps or volts first press the **A/V** button and then use the **UP** and **DOWN** buttons to set the value. If the **UP** or **DOWN** button is held for more than two seconds, the display will scroll at a more rapid rate. During welding the **A/V** button is used to toggle between actual weld amps and actual weld volts. To adjust amps or volts while welding use the **UP** or **DOWN** buttons. The display will automatically switch to showing the set amps or set volts.

The **AF/IND** button is used to select arc force when Stick welding and inductance when MIG welding. Both arc force and inductance have a range of 0 to 100, with 100 being the maximum setting. To set arc force or inductance first press the **AF/IND** button and then use the **UP** and **DOWN** buttons to set the value. Arc force and inductance can also be adjusted while welding.

The **SCHEDULE** button on the Ultra Flex® 350 Pulse machine is used to select one of the eight available Pulse MIG schedules. To select the schedule, first press the **SCHEDULE** button and then use the **UP** and **DOWN** buttons to set the schedule number on the display. The schedule number can not be changed while welding.

The **REMOTE** button is used to select remote amperage/voltage control through the 19 pin receptacle on the rear of the machine. Pressing the button once will toggle remote control on, pressing the button again will toggle remote control off. When the light next to the switch is on, remote control is active. For all modes except TIG, the remote control will allow full scale adjustment of the output. For TIG modes it is necessary to first set the maximum welding amperage using the front panel of the machine. The remote control will then have control from zero to this maximum setting.

The **CONTACTOR** button is used to energize the output of the power source. There really is no contactor being energized, the solid state control uses the signal to “turn” the output on. Pressing the button once will turn the output on. Pressing it again will turn the output off. When the output is on, the light next to the **CONTACTOR** button will be lit. Normally the **CONTACTOR** button would be used for Stick or TIG welding when a torch switch or foot pedal is not being used. If a remote control, such as a hand pendant, is being used then the contactor

can be controlled at the remote control. Whenever this light is on, there will be open circuit voltage on the output terminals of the machine.

The Ultra Flex® 350 will "remember" all of the control panel settings even after power has been removed from the machine. The next time power is applied the machine will come up with the same settings. The Ultra Flex® 350 will "remember" different setting for each process. For example, the amperage could be set to 100 Amps for SMAW and 75 Amps for GTAW. When the power source is switched between the two modes, the set amperage will automatically change to the correct value.

Power Up Sequence

To power up the machine turn the AC power switch (located on the rear of the machine) to the ON position. The machine will perform some self-checks during the power up sequence. The power up sequence takes about 3 seconds to complete. The digital display will show the following during power up:

1. "350A" indicating the rating of the machine of 350 Amps.

2. "CCCV" or "PULS" indicating the type of machine. For the Ultra Flex® 350 CCCV the display should read "CCCV" and the Ultra Flex® 350 Pulse the display should read "PULS".

3. "1 PH" or "3 PH" indicating whether the input AC power connected to the machine is single or three phase. If the machine recognizes single phase, the display will read "1 PH". If the machine recognizes three phase, the display will read "3 PH".

4. Preset amps or volts will then be displayed depending on the weld process. At this point the machine is ready to weld.

SMAW Operation

(See Figure 5-1)

1. Connect the welding leads to the power source with the correct polarity. Figure 5-1 shows typical connections for DCEP welding. Make sure connections are properly tightened and that ground clamp is securely attached to the workpiece.

2. Turn AC power switch to the ON position. The initial power up sequence will be complete in approximately three seconds.

3. Press the SMAW button on the control panel. This will select the Stick or SMAW process.

4. For LOCAL or front panel current control, make sure the REMOTE light is off. Pressing the REMOTE button will toggle the light on and off.

5. To set welding AMPS using front panel, first press the A/V button and then use the UP and DOWN buttons to adjust amperage.

6. For REMOTE current control, connect the remote control to the 19 pin amphenol receptacle on the rear of the machine. Make sure that the REMOTE light is on, by pressing the REMOTE button if necessary. Adjust amperage using remote potentiometer. The digital meter will display preset amperage.

7. To adjust arc force, press the AF/IND button. Use the UP and DOWN buttons to adjust the arc force value. The range is 0 to 100 with 0 being no arc force, and 100 being maximum arc force. Maxi-

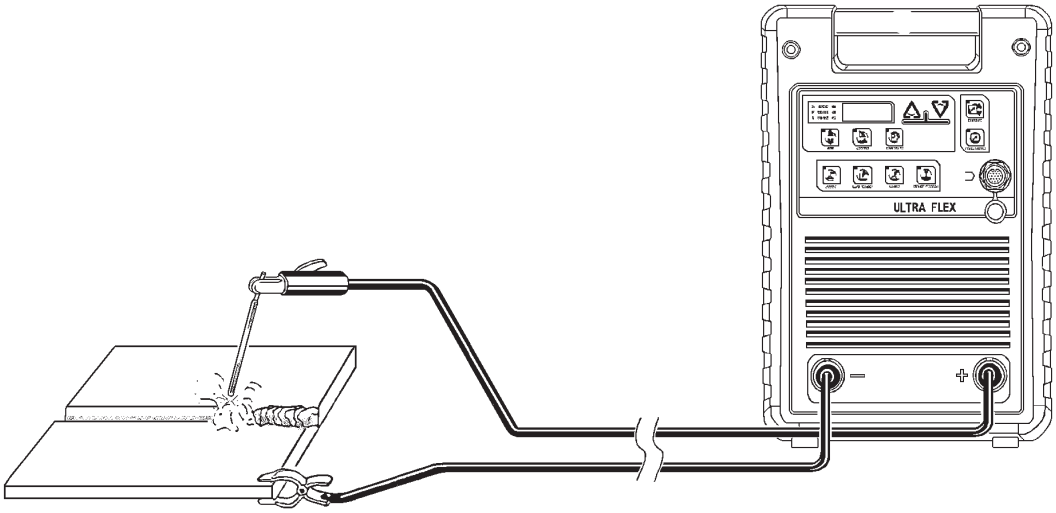

Figure 5-1

mum arc force will increase the short circuit current considerably, giving the arc more drive for out of position welding. Arc force can be adjusted while welding, or during standby.

8. To energize the output of the machine, press the CONTACTOR button so that the light comes on. If a remote control is being used, the contactor can be energized remotely using the switch on the remote control.

CAUTION: ONCE THE CONTACTOR IS ENERGIZED THERE WILL BE OPEN CIRCUIT VOLTAGE ON THE OUTPUT TERMINALS OF THE MACHINE. TO AVOID ELECTRIC SHOCK DO NOT HANDLE EXPOSED CONDUCTORS ATTACHED TO THE POWER SOURCE TERMINALS WITHOUT PROPER PROTECTIVE CLOTHING AND GLOVES.

9. The power source is now ready to weld. After the weld is complete, shut the CONTACTOR off to remove open circuit voltage from the output terminals of the machine.

While welding, the digital meter will show either actual amps or actual volts. To toggle between actual amps and actual volts use the A/V button. To adjust amperage while welding, use the UP and DOWN buttons. The digital display will automatically change to the preset amperage. After the adjustments are made, the meter will automatically switch back to showing actual amps or actual volts. To adjust arc force while welding, first press the AF/IND button, then use the UP and DOWN buttons. The digital meter will change to show the preset arc force setting. After the adjustment is complete, the meter will automatically switch back to showing either actual amps or actual volts.

LIFT GTAW Operation

(See Figure 5-2)

The purpose of Lift GTAW is to allow for striking the arc by momentarily touching the torch to the workpiece. The lift circuit functions to reduce the amperage during the arc start to a low level to give a good soft start.

1. Connect the work lead and torch lead to the power source. Figure 5-2 shows typical connections for DCEN (straight polarity). This is the normal connection for TIG welding.

2. Provide suitable shielding gas connections and controls to the torch. The power source does not provide connections for the shielding gas.

3. Select the proper tungsten size and type for the job. Table 5-1 gives a basic guideline to the amperage ranges of various tungstens.

4. If a remote control such as a foot pedal or hand control is going to be used, connect the remote control to the 19 pin amphenol receptacle on the rear of the machine.

5. Turn AC power switch to the ON position. The initial power up sequence will be complete in approximately three seconds.

6. Press the LIFT GTAW button on the control panel. This will select the Lift TIG process.

7. To set welding amps, use the UP and DOWN buttons. For local control, the display will show the preset welding amperage. For remote control, the display will show the preset maximum amperage. The foot pedal or hand control will have control from 0 to this maximum setting.

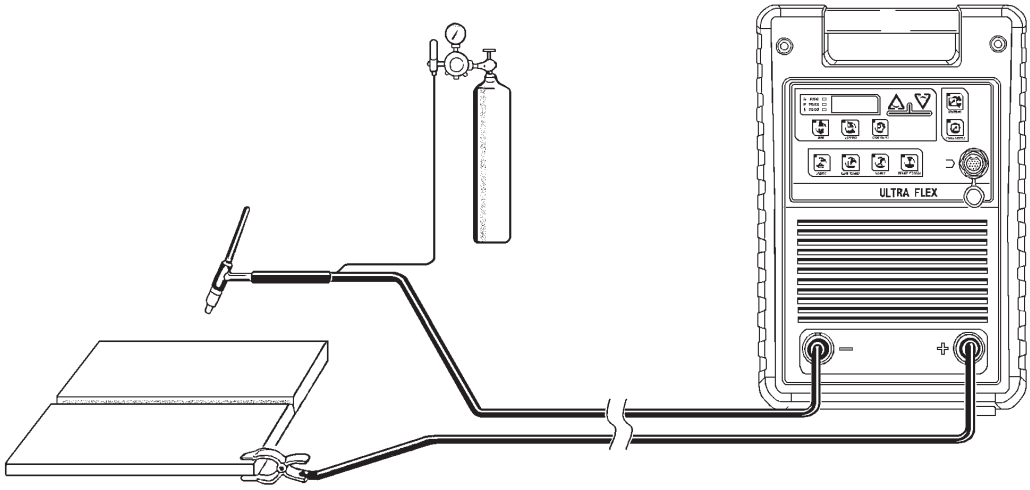

Figure 5-2

Electrode Diameter Inches	Welding Current, Amps	
	DCEN	DCEP
	Using pure or thoriated tungsten electrodes	
.020	5-35	———
.040	30-100	———
1/16	70-150	10-20
3/32	150-225	15-30
1/8	200-275	25-40
5/32	250-350	40-55

Table 5-1 Typical Current Ranges for Tungsten Electrodes

NOTE: When using a remote control such as foot pedal, momentarily switch the front panel back to LOCAL control to view the preset maximum amperage on the display. When ready to weld, switch back to REMOTE by pressing the REMOTE button on the front panel.

8. To strike an arc, first energize the power source by depressing the foot pedal, or using the torch switch, or by using the CONTACTOR button on the front panel.

9. Make sure gas flow has been initiated.

10. Gently rest the cup of the torch on the workpiece.

11. Rock the torch until the tungsten briefly contacts the work; this will initiate the “LIFT-ARC” feature of the power source. Lift or rock the tungsten back off of the work to initiate the welding arc. During the time the tungsten is touching the work, the power source will automatically limit the output current to 20 amps. As the arc is initiated, the current will automatically change to the preset value. To minimize the heating of the end of the tungsten, it should be left in contact with the work only briefly.

12. To end the weld, release the foot pedal, or turn contactor switch off. Turn off shielding gas supply.

GTAW Operation

(Non-Lift)

GTAW mode is intended to be used for non-contact arc starting such as with the use of an optional capacitor discharge arc starter. GTAW mode can also be used for scratch start TIG. This mode is standard on the Ultra Flex® 350 CC/CV unit. This mode can be made active on the Ultra Flex® 350 CC/CV Pulse unit through the SAFE. If an optional arc starter is to be used, be sure to make all connections to the arc starter with the power off. The arc starter will connect to the 19 pin amphenol receptacle on the rear of the power source. The foot pedal or remote control will then connect to the arc starter. If an optional pulser control is also used, it will need to be connected to the arc starter, and then the foot pedal connected to the pulser control.

1. Figure 5-3 shows typical connections for an Optional Arc Starter Box.

2. Provide suitable shielding gas connections and controls to the torch or Arc Starter Box. The power source does not provide connections for the shielding gas.

3. Select the proper tungsten size and type for the job. Table 5-1 gives a basic guideline to the amperage ranges of various tungstens.

4. Turn AC power switch to the ON position. The initial power up sequence will be complete in approximately three seconds.

5. Press the GTAW button on the control panel. This will select the TIG process.

6. To set welding amps, use the UP and DOWN buttons. For local control, the display will show the preset welding amperage. For remote control, the display will show the preset maximum amperage. The foot pedal or hand control will have control from 0 to this maximum setting.

NOTE: When using a remote control such as foot pedal, momentarily switch the front panel back to LOCAL control to view the preset maximum amperage on the display. When ready to weld, switch back to REMOTE by pressing the REMOTE button on the front panel.

7. Make sure gas flow has been initiated.

8. To strike an arc, depress the foot pedal, or use the torch switch. Open circuit voltage will now be present on the output of the power source. If a capacitor discharge arc starter is being used, hold the torch in close proximity to the workpiece while pressing the foot pedal. The high voltage will jump the gap to the workpiece and the arc will follow.

9 To end the weld, release the foot pedal, or turn torch switch off. Turn off shielding gas supply.

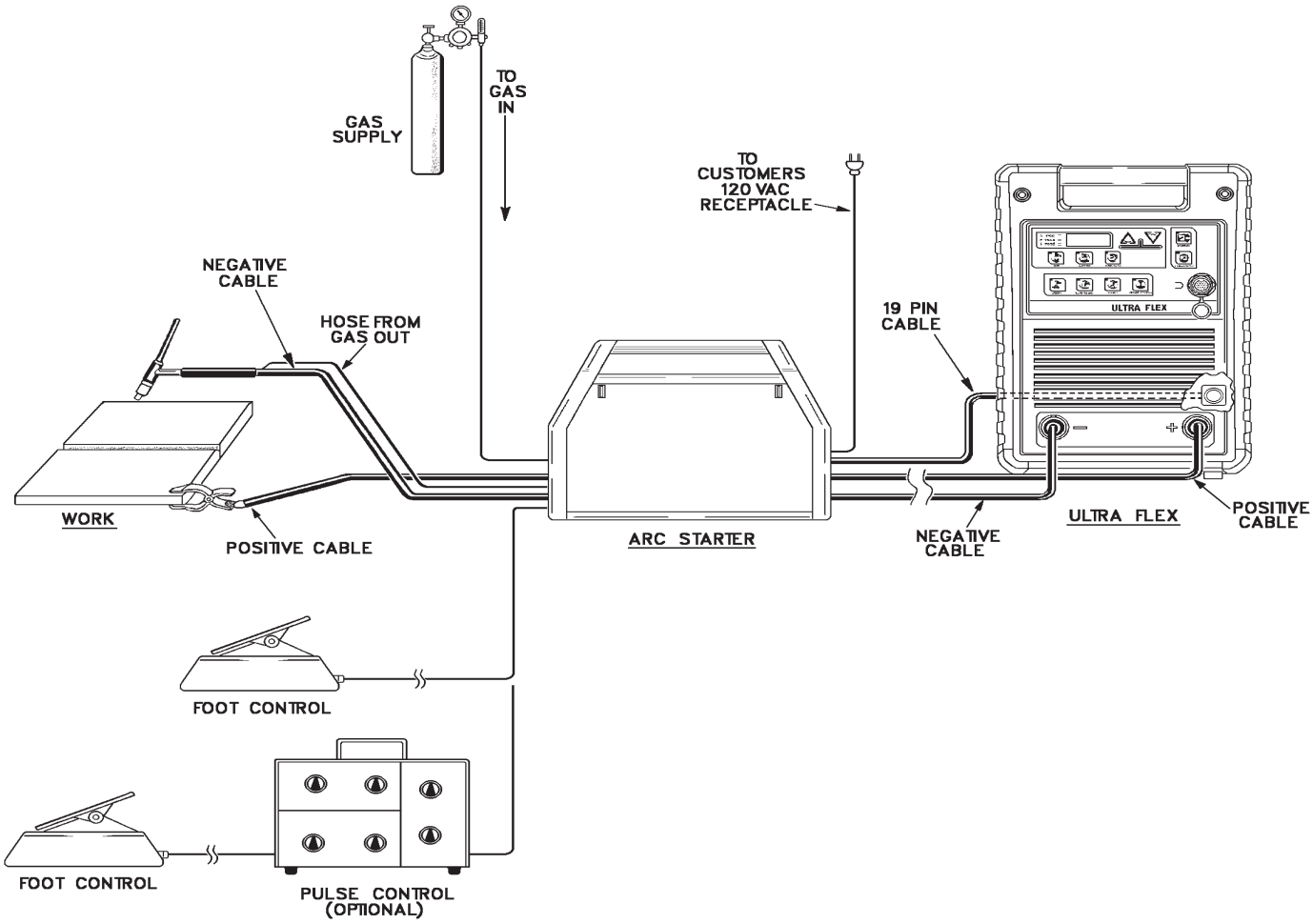

Figure 5-3

GMAW/FCAW Operation

The GMAW mode on the Ultra Flex® 350 power source provides a constant voltage output characteristic. Variable inductance is also provided.

To operate proceed as follows:

1. Connect the wire feeder to the 19 pin amphenol receptacle on the rear of the power source.

2. Connect the welding leads to the power source and wire feeder, make sure connections are tight and polarity is correct.

3. Turn AC power switch to the ON position. The initial power up sequence will be complete in approximately 3 seconds.

4. Press the GMAW button to select the GMAW process. The light next to the button should be on indicating that GMAW is now the active process.

5. For LOCAL control make sure the REMOTE light is off by pressing the REMOTE button if necessary. The light should toggle on and off as the REMOTE button is pressed repeatedly.

6. To adjust output voltage first press the A/V button and then use the UP and DOWN buttons to adjust the voltage setting. For remote control, make sure that the light next to the REMOTE button is on, by pressing the REMOTE button if necessary. Then use the voltage control on the wire feeder to preset output voltage.

7. To adjust the INDUCTANCE setting first press the AF/IND button, and then use the UP and DOWN buttons to set an inductance value between 0 and 100. The minimum inductance setting is 0. 100 is the maximum setting. Lower values give a faster cooling puddle with a “harsher” type of arc. Higher inductance settings give a very soft arc and a slower cooling puddle. As a general rule, most materials can be welded with a setting around 50. Mild steel normally runs best from minimum to mid range, stainless steel normally runs best from mid range to maximum.

NOTE: The inductance control is primarily used for the short-circuiting transfer mode of MIG welding. For globular and spray transfer modes, the inductance control has minimal effect.

8. The power source is now ready to weld. To initiate the weld, activate the torch switch on the MIG torch.

9. To end the weld, release the torch switch while holding the torch in place at the end of the weld. This will allow the wire conditioning circuit in the power source to condition the end of the wire for the next weld. The wire conditioning circuit will tend to leave the wire with a very small ball on the end of the wire, thus making the next start easier.

Pulsed GMAW

General

Pulsed-GMAW (referred to as Pulse-MIG) is a welding process that involves the pulsing of the welding current from a high value (peak current) to a low value (background current) to produce a clean spatter-free weld. The intent of this manual is not to present a comprehensive coverage of this welding process, but to give an explanation of the terms used and how they apply to the Ultra Flex® 350 power source.

Explanation of Terms: (See Figure 5-4)

I_{st}: I_{st} is the amplitude of the initial pulse of current during the arc starting interval.

I_{pk}: I_{pk} is the amplitude of the high pulse of welding current (peak current). The current is forced to this high value by the power source for a brief time (T_{peak}). The peak current melts the wire and forms a droplet. This droplet is then propelled to the weld pool.

V_{pk}: V_{pk} is the amplitude of the arc voltage during the high pulse of weld current.

T_{pk}: T_{pk} is the amount of time that is spent at the peak current. This time must be sufficient to form a droplet.

Ibak: I_{bak} (background current) is the low value of the weld current. The background current serves to preheat the wire and maintain the arc between the wire and the workpiece. The background current must not be allowed to go too low, or the arc becomes unstable and difficult to maintain.

Vbak: V_{bak} is the amplitude of the arc voltage during the background time.

Tbak: T_{bak} (background time) is the amount of time that the weld current is at the low value. Normally, this would be a larger amount of time than is spent at peak current.

Pulse Rate: The pulse rate is the number of pulses of current that are produced per second. The Ultra Flex® 350 allows a pulse rate of approximately 30–300 pulses per second.

Pulsing Frequency: Pulsing frequency is the same as pulse rate. A pulse rate of 60 Hz means that the power source produces 60 pulses of current per second.

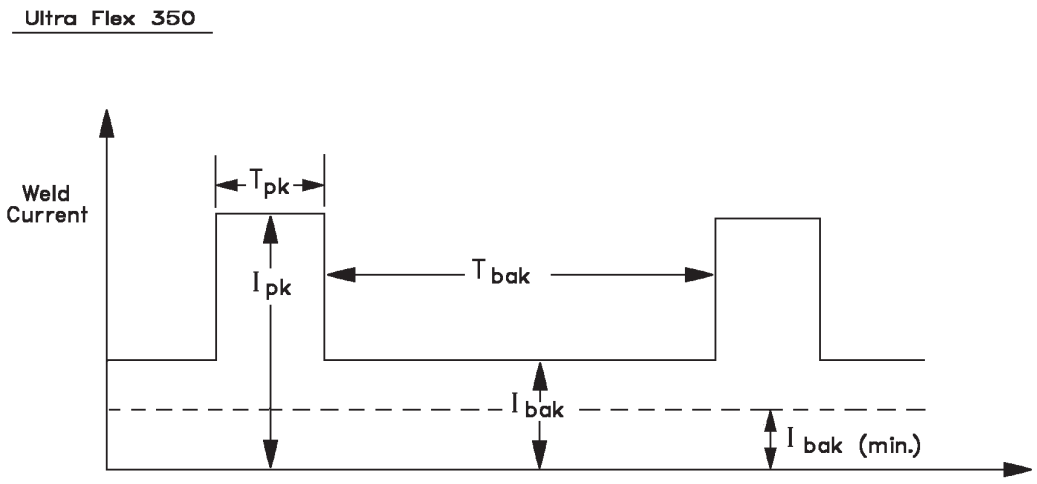

Figure 5-4 Pulse Waveforms

Ibak (min): I_{bak} (min) refers to a minimum background current level. If the current falls below this minimum level, it becomes difficult to maintain a stable arc.

Arc Length: The distance between the end of the wire electrode (the wire being fed through the torch or gun) and the weld pool. This distance is usually set to give a smooth, spatter-free weld.

The Ultra Flex® 350 Pulse machine comes with 8 pre-programmed weld schedules for use in the Pulsed MIG mode. Each schedule was developed around the particular wire/gas combination given in tables 5-2. These schedules should give good results for most applications. It is possible to use a number of other wire and gas combinations other then those listed. It will be necessary, however, for the user to determine the optimum weld schedule to use.

For welding applications where none of the 8 schedules will give adequate results, any or all 8 schedules can be changed by the operator to fit the application. In order to change them, an optional **Programming Pendant** (204180-1) is required. The programming pendant plugs into the PROGRAMMING PENDANT connector located on the front of the Ultra Flex® (Item 2, Figure 3-3). Using the Pendant, a schedule can easily be modified by changing I_{pk}, T_{pk}, and V_{BAK} to give the proper weld characteristics.

1. Connect the wire feeder to the power source using the 19 pin amphenol receptacle on the rear of the power source.

2. Connect the welding leads to the power source and wire feeder.

SCHEDULE STD	WIRE TYPE	WIRE SIZE (inches)	I_{st} (Amps)	I_{pk} (Amps)	T_{pk} (msec)	V_{Bak} (Volts)	GAS MIXTURE
1	Mild Steel	.035	350	300	2.5	20.0	92% Ar 8% CO_2
2	Mild Steel	.045	450	350	2.5	20.0	92% Ar 8% CO_2
3	Stainless Steel	.035	350	276	2.6	18.0	81% Ar 1% CO_2 18% He
4	Stainless Steel	.045	400	326	2.8	19.0	81% Ar 1% CO_2 18% He
5	Aluminum	.035	400	224	1.4	17.0	100% Ar
6	Aluminum	3/64	450	274	1.4	17.0	100% Ar
7	Metal Core	.045	450	400	1.5	16.0	92% Ar 8% CO_2
8	Nickel	.035	350	276	2.6	18.0	75% Ar 25% He

Table 5-2 Pulse MIG Schedules For The Ultra Flex® 350

3. Turn AC power switch to the ON position. The initial power up sequence will be complete in approximately three seconds.

4. Press the GMAW PULSED button to select the pulsed MIG process. The light next to the button should be on indicating that GMAW PULSED is now active.

5. Press the SCHEDULE button and then use the UP and DOWN buttons to select one of the eight schedules. See the chart in this manual or the sticker on the machine for schedule information.

6. For LOCAL control make sure the REMOTE light is off by pressing the REMOTE button if necessary. The light should toggle on and off as the REMOTE button is pressed repeatedly.

7. To set the output proceed as follows: First set the wire feed speed at the wire feeder. As in conventional MIG welding, the wire feeder will control the average amperage or heat input. Second set the correct arc length by adjusting the output of the power source. Press the A/V button to select voltage as the adjustable value. The meter will display a "reference number" between 0 and 440. The higher the "reference number" the higher the pulsing rate and arc voltage. (The actual number of pulses per second will vary between approximately 30 and 300 as the reference number varies between 0 and 440.)

To increase arc length, increase the "reference number" setting. To decrease arc length, decrease the "reference number" setting. This is essentially the same as adjusting voltage for conventional MIG welding. As with conventional MIG welding, the power source must be adjusted to correspond with the correct heat input for a given wire feed speed setting.

8. For REMOTE control make sure the REMOTE light is on by pressing the REMOTE button if necessary. Now the arc voltage can be controlled at the wire feeder (if the feeder is equipped with a voltage control). See Step 6 for an explanation of how to set the output of the power source. If the wire feeder is equipped with a digital meter, it will also display the preset "reference number", however it will show a decimal point. For example, if the wire feeder displays 23.5 the power source will display 235.

9. The power source is now ready to weld. To initiate the weld, activate the torch switch on the MIG torch.

10. To end the weld, release the torch switch. As with conventional MIG welding, a wire conditioning sequence will leave the wire with a very small ball on the end, thus making the next arc strike easier.

Optional Programming Pendant

An optional programming pendant allows any or all eight of the factory pulse schedules to be over-ridden. To use the pendant, turn the power source OFF, and plug the pendant into the pendant plug on the front of the power source. Then turn the power source back ON. To work properly, the pendant must only be plugged into the power source with the power source turned off.

1. Select the GMAW PULSED mode on the front panel.

2. Select the schedule to be over-ridden by pressing the SCHEDULE button and then using the UP and DOWN buttons. The schedule number will appear on the programming pendant.

3. Select the parameter to be adjusted on the pendant. The parameters are I_{st}, T_{pk}, I_{pk}, and V_{bak}.

4. Use the increase and decrease buttons to adjust the value.

NOTE: It is not the intent of this manual to try to describe how to arrive at the correct values for a "good" schedule. This manual just provides the procedure.

5. Select the next parameter to be changed.

6. After all parameters have been changed, press the SAVE button on the pendant. This will "permanently" save the new data into the memory on the power source. It will retain the new data even after power has been removed from the machine. The new data can still be over-ridden with the programming pendant.

7. To restore the factory settings for the selected schedule, press the RESET button on the pendant.

8. After all changes have been made, the power source should be turned off and the pendant removed.

SAFE

SAFE (Special Application Function Environment) is a mode of operation that the Ultra Flex® series of welding power sources can enter in order to customize the welder for a special application. In most cases this power source feature can be ignored. The factory default settings are expected to be sufficient for most of our customers. In the few cases that the factory default settings are not adequate, the Ultra Flex® can be programmed to meet special specifications.

There are two separate safes, one for single phase operation and one for three phase operation. These safes are independent of each other, and are accessed automatically when the machine is powered up in either the single or three phase mode. Any changes to one will not affect the other.

The following parameters are programmable in the SAFE:

OPTION NUMBER	OPTION	FACTORY DEFAULT		DISPLAY FORMAT
		1 PHASE	3 PHASE	
0	RESET THE SYSTEM. This option resets all SAFE parameters to their factory default settings. “nO” means do not reset the system to factory default while “rES” means reset the system to factory default settings. Only the single phase settings will be reset if the machine is hooked up to single phase power. Likewise, only the three phase settings will be reset when hooked to three phase power. *NOTE: THE SAVE BUTTON MUST BE DEPRESSED WHEN EXITING THE SAFE IN ORDER FOR THE RESET TO OCCUR.*	nO	nO	0XXX
1	WIRE SHARP VOLTAGE SETTING. This is the voltage that will be present on the wire following a GMAW or Pulsed GMAW weld. This feature “sharpens” the wire by burning off the ball of filler metal that often forms on the end of the wire following a GMAW weld. The voltage can be set to any value between 0 and 20 volts in increments of 1 volt.	10	10	1_XX
2	WIRE SHARP TIME. Wire sharp time is the length of time following a GMAW or Pulsed GMAW weld that the wire sharp voltage will remain on the filler wire. This variable time is adjustable between 0 and 1 second in increments of 0.01 seconds. Longer times will give more of a burnback effect.	.25	.25	2XXX
3	MAXIMUM SELECTABLE AMPERAGE. Maximum selectable amperage is the largest amperage value that the user is capable of setting in SMAW, Lift GTAW, or GTAW local mode. This feature is effective when the user would like to insure that the amperage is never set above a particular amperage level. The range of values permitted is 5-275 amps (single phase) and 5-375 amps (three phase). The maximum selectable amperage is never permitted to be set less than the minimum selectable amperage.	275	375	3XXX
4	MINIMUM SELECTABLE AMPERAGE. Minimum selectable amperage is the lowest amperage value that the user is capable of setting in SMAW, Lift GTAW, or GTAW local mode. This feature is effective when the user would like to insure that the amperage is never set below a particular amperage level. The range of values permitted is 5-275 amps (single phase) and 5-375 amps (three phase). The minimum selectable amperage is never permitted to be set greater than the maximum selectable amperage.	5	5	4XXX
5	MAXIMUM SELECTABLE VOLTAGE. This voltage is the largest value that the user is capable of setting in GMAW local welding mode. Voltages above this value can not be entered by the user in local mode. This voltage value can be exceeded in remote by using a feeder with voltage setting capability. The range of values permitted is 10-31 volts (single phase) and 10-35 volts (three phase). The maximum selectable voltage is never permitted to be set less than the minimum selectable voltage.	31.0	35.0	5XX.X

OPTION NUMBER	OPTION	FACTORY DEFAULT		DISPLAY FORMAT
		1 PHASE	3 PHASE	
6	MINIMUM SELECTABLE VOLTAGE. This voltage is the lowest value that the user is capable of setting in GMAW local welding mode. Voltages below this value can not be entered by the user in local mode. This voltage value can be overridden in remote by using a feeder with voltage setting capability. The range of values permitted is 10-31 volts (single phase) and 10-35 volts (three phase). The minimum selectable voltage is never permitted to be set greater than the maximum selectable voltage.	10.0	10.0	6XX.X
7	MAXIMUM SELECTABLE REFERENCE. This reference is the largest value that the user is capable of setting in Pulsed GMAW local welding mode. References above this value can not be entered by the user in local mode. The reference value can be exceeded in remote by using a feeder with voltage setting capability. The range of values permitted are between 0 and 440 in increments of 1. The maximum selectable reference is never permitted to be set less than the minimum selectable reference.	440	440	7XXX
8	MINIMUM SELECTABLE REFERENCE. Minimum reference is the lowest value that the user is capable of setting in Pulsed GMAW local welding mode. A reference value less than the minimum reference can not be entered by the user in local mode. This reference value can be overridden in remote by using a feeder with voltage setting capability. Minimum selectable reference can have a range of values between 0 and 440 in increments of 1. The minimum selectable reference is never permitted to be set greater than the maximum selectable reference.	0	0	8XXX
9	LIFT START INITIAL AMPS VALUE. The purpose of Lift GTAW is to allow for striking the arc by momentarily touching the electrode to the workpiece. The lift circuit functions to reduce the amperage during the arc start to a low level to give a good soft start. This initial start amperage is adjustable between 5 and 100 amps in increments of 1 amp.	20	20	9XXX
A	METER HOLD TIME Meter hold time is the time following a successful arc that the actual weld amps and volts are held in memory and displayed (Use the A/V button to toggle between amps and volts). This parameter is adjustable between 0 and 60 seconds in increments of 1 second. A time of 0 seconds disables meter hold.	5	5	A_XX
B	AVC ON/OFF AVC (Automatic Voltage Control) is available in the Ultra Flex® 350 Pulse unit only. By turning on this function an additional 8 AVC schedules are made available in addition to the 8 standard schedules.	OFF	OFF	BXXX
C	LIFT GTAW ON/OFF Lift GTAW ON/OFF changes Lift GTAW into standard GTAW. In the ON mode, Lift GTAW is operational. In the OFF mode, depresson of the Lift GTAW process selection switch will put the Ultra Flex® in GTAW mode with the lift circuit disabled. Starts will have to be done with an external arc starter or by scratch methods.	ON	ON	CXXX

OPTION NUMBER	OPTION	FACTORY DEFAULT		DISPLAY FORMAT
		1 PHASE	3 PHASE	
D	CODE Code is the password code that the user must enter prior to entering the SAFE. The acceptable range of values is between 0 and 999. *NOTE: In the case that you change and forget the code, contact Thermal Arc for instructions on how to access the SAFE and retrieve/change the code.*	350	350	DXXX

To enter the SAFE, press the button labeled A/V within several seconds of turning on the power to the Ultra Flex®. Continue to press the button until the meter displays the word “SAFE”. “COdE” will be displayed for two seconds upon releasing the A/V button, followed by “0” being displayed. The SAFE is waiting for the correct password code to be entered using the up and down arrow buttons. The correct code (350 by factory default) must be entered and remain on the display for five seconds. This code insures that inadvertent access to the SAFE is not possible. A correct code will cause the Ultra Flex® to display “OPEn” “SAFE”.

Access to the SAFE has now been established. The meter will display a series of flashing and non-flashing digits. The first digit, reading left to right, is the option number of the parameter that is currently being set. It will not flash. An explanation and description of this option can be found in the preceding table. The following three digits correspond to the parameter values. These digits will flash. Changes to the displayed parameter value can be made by pressing the UP or DOWN arrow buttons.

To gain access to the next option number press the CONTACTOR button. The CONTACTOR button will always advance to the next option. At each option proceed as described in the previous paragraph.

After all changes have been made to the SAFE, the REMOTE button must be pressed in order to save the new parameters and restart the system. A successful saving of the information will be indicated by “SAVE” being displayed for 1 second followed by the Ultra Flex® re-starting and entering into the “normal” weld mode. Failure to save will cause all changes to be lost. A power down prior to saving will also cause all changes made while in the SAFE to be lost.

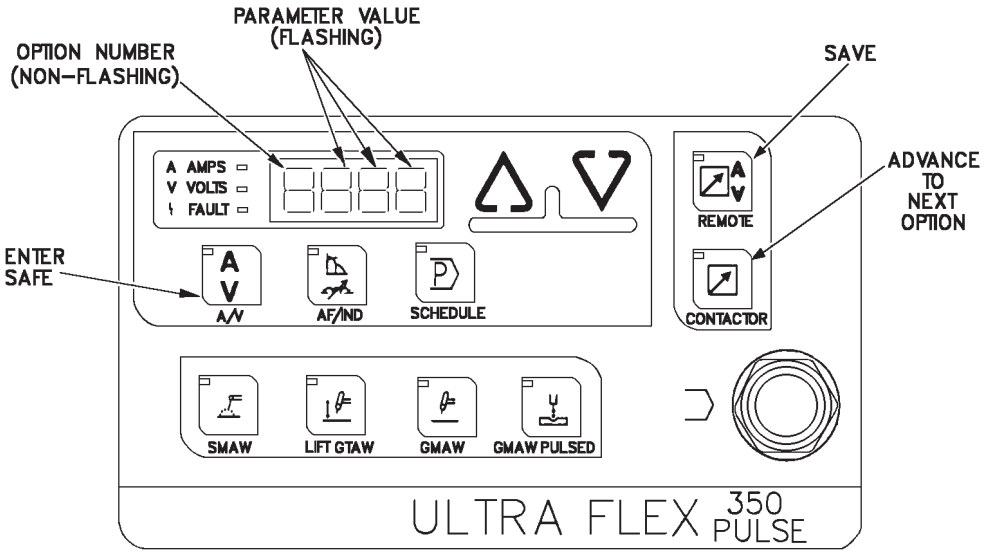

Figure 5-5

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MAINTENANCE

If this equipment does not operate properly, stop work immediately and investigate the cause of the malfunction. Maintenance work must be performed by an experienced, qualified person only. Any electrical work must be performed by an electrician or other person properly trained in servicing electrical equipment. Do not permit untrained persons to inspect, clean or repair this equipment. Use only recommended replacement parts when servicing this machine.

DANGER: HIGH VOLTAGE may be present internally even with the power switch in the OFF position. Before inspecting, cleaning, or servicing, disconnect and lock out input power to the power source.

For uninterrupted, satisfactory service from this welding machine, it is necessary to keep the machine clean, dry, and well ventilated. At least every three months, or more often as necessary, wipe and blow out all dirt from the machine's interior, with air pressure of not over 25 psi.

As normal preventive maintenance, at the time of the three-month cleaning, a full inspection of the welding machine and setup should be performed. Check warning labels on the machine for readability; replace if necessary. Check input and output connections as well as frame ground connections to the machine to insure that they are tight and the wires are not frayed or overheated. Inspect internal wiring of machine for loose or frayed connections; tighten or repair as necessary. It would also be advisable to check connections to wire feeders, fixtures, etc., at this time. Any damaged cables or hoses should be replaced.

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TROUBLESHOOTING

WARNING: Disconnect the power source from the input power source before carrying out any service or repair work. Hazardous voltages can be present in the machine whenever input power is connected.

WARNING: ALL SERVICE SHOULD BE PERFORMED BY TRAINED PERSONNEL ONLY.

General

1. Safety Practices, Precautions, and Warnings.

Caution should be used when troubleshooting and working inside inverter power supplies. Many circuits inside the machine handle high voltages or currents. Some circuits will retain their charge for several seconds after power to the machine has been turned off. Before touching, diagnosing, or servicing the machine or its subsystems, measure the circuit in question for decaying voltage levels. Do not touch, service, or attempt to diagnose any part of the machine unless you are certain of the function of the circuit and the voltage level present in the circuit.

During certain machine failures, abnormally high voltage levels may be present in circuits that usually contain low voltage levels. Check the voltage level in the circuit before touching or servicing the circuit.

2. Wiring.

Prior to disassembly or servicing of the machine, note the wiring and connections in the machine. Reassembling should place the wires in the same location and routing as received from the factory. Keep wires and leads away from hot parts and sharp edges. Keep the primary side of the machine (input power side) away from the secondary side (welding and control circuits).

Examine connections for proper assembly and contact. Lugs should be in tight contact with the lead's conductor and should be crimped to the lead's insulation. The mating surfaces of the connection should be clean and free of oxidation or debris.

Do not pull on leads or cables to disassemble connections. Firmly grasp each lug or connector. Use appropriate tools to enhance leverage if needed. Pulling on leads and cables for disassembly can damage the integrity of the connection and cause future malfunctions.

3. PC Board Handling and Checking.

Most of the PC boards in the machine contain static sensitive components. Use a grounding strap or other suitable grounding means before attempting to service PC boards. When a PC board is removed from the machine, it should be immediately placed on a grounded anti-static mat for examination or placed in an anti-static bag for transportation or further handling.

Before replacing a suspect PC board, disconnect all wires and cables from the board. Firmly reconnect the board and retest the machine to determine if the problem persists. Faulty connections or wiring problems are often the source of poor PC board performance.

If a PC board replacement has appeared to correct a problem, the machine should be retested with the old PC board to recreate the problem. If the original symptoms reappear, then the original PC board created the problem. If the original symptoms do not reappear, then it is likely that the wiring or connections were the source of the problem and these, or other sources, should be examined to insure that the problem doesn't reappear later.

4. Optional Equipment or Accessories.

Disconnect any optional or compatible equipment to verify that the power source is creating the problem. Disconnect any wire feeders from the machine and trigger the power source on from the back Amphenol or use the SMAW mode to verify proper power source triggering. Disconnect optional equipment or accessories to determine if they are placing excessive demands on the power source's auxiliary supplies.

5. Troubleshooting Hints.

Carefully note all operating conditions and problem symptoms for effective troubleshooting diagnosis. During problem analysis, bear in mind that the total *welding system* includes not only the power source but may also include a wire feeder, control cables, welding gun or torch, gun liner, gun contact tip, gun trigger, remote controls, water coolers, ground cables and connections, electrode cables and connections, electrodes, shielding gas type and flow, weld plate quality and composition, weld process, control settings, chassis grounding, input cables and connections, input fuses or breakers, input voltage, and effects of nearby equipment.

Troubleshooting should begin with an assessment of the welding process and control settings being used. Are they appropriate for the weldment? Is the correct electrode and gas being used? Is the optimal technique being used?

Next, an examination of the welding system should be made to determine that all equipment is compatible and connected correctly. Determine that all input fuses are intact and that the input power is correct. Examine cables and connections for possible faults.

Examine and eliminate external equipment as the problem source. Are the wire feeder drive rolls tight? Is the gun liner worn or plugged? Does the gun trigger work? Are the control cables connected correctly and in good condition? Disconnect as much external equipment as possible to determine its' impact on the problem.

Examine the power source externally and internally for signs of possible damage. Inspect the wiring and connections.

Lastly, begin diagnosis of the machine and it's sub-systems.

An effective troubleshooting approach is often to eliminate symptoms or possible causes by determining what is working correctly.

A few typical questions whose answers might be of benefit in troubleshooting are:

Is the input voltage correct? Are fuses blown?

Does the machine have the proper input voltage for what the machine is configured for, or vice versa?

Are accessories connected properly?

Are accessories compatible with the power source?

Are the power source's accessory circuit breakers tripped?

Are accessories in good condition and properly set? Is the wire feed speed correct? Does the wire feed smoothly? Is the contact tip or gun liner worn? Are the drive rolls properly tensioned? While welding, is the gun cable kinked?

Are the ground cables and connections in good condition and of the correct size?

Are the electrode cables and connections in good condition and of the correct size?

Is the welding procedure being used within the capabilities of the machine? Does the welding duty cycle match the power source's duty cycle?

Will adjustments in the control settings eliminate the problem?

Will adjustments in torch or electrode stickout, angle, or movement eliminate the problem?

Does the problem exist in all operating modes?

If appropriate, does the problem persist with wire feeders and other equipment disconnected from the machine?

Which indicators are on and which are off as a result of this problem?

What are all of the control panel settings during the problem?

How often and in what manner is the machine serviced or maintained?

Is the machine clean and dry? Does moisture condense in or on the machine during operation or during idle?

Is air flow in and around the machine unobstructed?

Has the machine been dropped?

Does the problem consistently occur at the same time of day or when other equipment is operated?

A few minutes spent assessing the condition of the *welding system* and symptoms of the problem can greatly facilitate the troubleshooting process.

Fault Codes

The Ultra Flex® 350 power source has several standard protection circuits designed to assure the reliability of the machine. Whenever one of these circuits senses a fault, it will shut the output of the power source off and display a fault code on the digital display. The fault light next to the display will also come on. To clear a fault, it will be necessary to reset the machine by turning the main power switch off briefly.

Prior to resetting the machine, make sure that the cause of the fault has been identified and corrective action taken where appropriate. The following is an explanation of the fault codes.

"**E008**" — Overtemperature. This fault code indicates that the overtemperature thermostat has operated. Overheating of the machine could occur because of exceeding the duty cycle rating, excessive high ambient temperature, blocked air flow, fan failure, etc.

"**E012**" — Ground Fault. This fault code indicates that excessive current was flowing through the chassis frame ground wire in the amphenol receptacle. This would normally be caused by welding current flowing through this connection because of improper grounding of the workpiece being welded on. Check all connections from the power source terminals to the work and wire feeder. Check to make sure that feed head at the wire feeder is not shorted out to ground or to the control box.

"**E014**" — Inverter bus voltage too high or too low. This could be caused by the AC input voltage being too high or too low. It could also be caused by "spikes" or "sags" on the AC line. Check AC line voltage. If line voltage is ok, reset the machine by turning the main power switch off and back on. If voltage is ok and machine will not reset, service will be required.

"**E015**" — Over/under voltage of the AC line. This fault code is caused by an input AC voltage that is too high or too low. Check AC line voltage. Reset the machine by turning the main power switch off and back on.

"**E016**" — Could not "read" setup. This is an internal fault to the machine. Reset power source by turning the main power switch off and back on. If fault persists, machine will require service.

"**E017**" — Could not save data. This is an internal fault to the machine. Reset power source by turning the main power switch off and back on. If fault persists, machine will require service.

"**E018**" — Overcurrent. This fault code is caused by excessive welding current. If the welding current exceeds the overcurrent values shown in Table 3-3 for a couple of seconds, the machine will shut off. The overcurrent limit is lower for single phase than it is for three phase. Reduce wire feed speed and/or welding amperage. Reset the machine.

"**E019**" — Single phase error. This fault code means that the power source has sensed a change in the input power, from three phase to single phase. Check line fuses. Check AC voltage at the power source.

"**E020**" — Machine ID error. At power up the Ultra Flex® senses the type of machine, CCCV or PULSE. If the power source senses a change in the ID of the machine after power up, it will shut down. Check all connections internally for loose connections at the PC boards.

"**E999**" — General Fault. If the power source is not able to identify the specific fault, it will signal a general fault. Reset the power source by turning the main power switch off.

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PARTS LIST

Equipment Identification

All identification numbers as described in the Introduction chapter must be furnished when ordering parts or making inquiries. This information is usually found on the nameplate attached to the equipment. Be sure to include any dash numbers following the Specification or Assembly numbers.

How To Use This Parts List

The Parts List is a combination of an illustration (Figure Number) and a corresponding list of parts which contains a breakdown of the equipment into assemblies, subassemblies, and detail parts. All parts of the equipment are listed except for commercially available hardware, bulk items such as wire, cable, sleeving, tubing, etc., and permanently attached items which are soldered, riveted, or welded to another part. The part descriptions may be indented to show part relationships.

To determine the part number, description, quantity, or application of an item, simply locate the item in question from the illustration and refer to that item number in the corresponding Parts List.

An “Application Code” is used to distinguish parts that are applicable only to certain Specifications and/or Assemblies. This code is found in the rightmost column of the Parts List. If an item in the Parts List applies to all Specifications or Assemblies, the word “ALL” will be in the Application Code column. Refer to the following list to determine the appropriate Application Codes for the Specifications or Assemblies covered by this manual. If only the assembly or specification number is listed, the use of an Application Code does not apply to this manual.

How To Select Recommended Spares

The first two columns of the Parts List are used to show the recommended quantity of parts which are typically required for spares or replacement purposes. The quantities under Class 1 are for parts that are consumed or that may need replacement in two years or less depending on operating hours. Class 2 quantities are for parts that may need replacement under unusual service conditions or additional operating hours. These are suggested quantities based on expected usage or the minimum package quantity. Class 1 spares are repeated under Class 2 but the quantities may be larger to allow for additional operating hours. Contact your equipment dealer for assistance in establishing the spare parts program best suited for your needs.

SPEC NUMBER	APPLICATION NUMBER
500237-1	A
500235-1	B

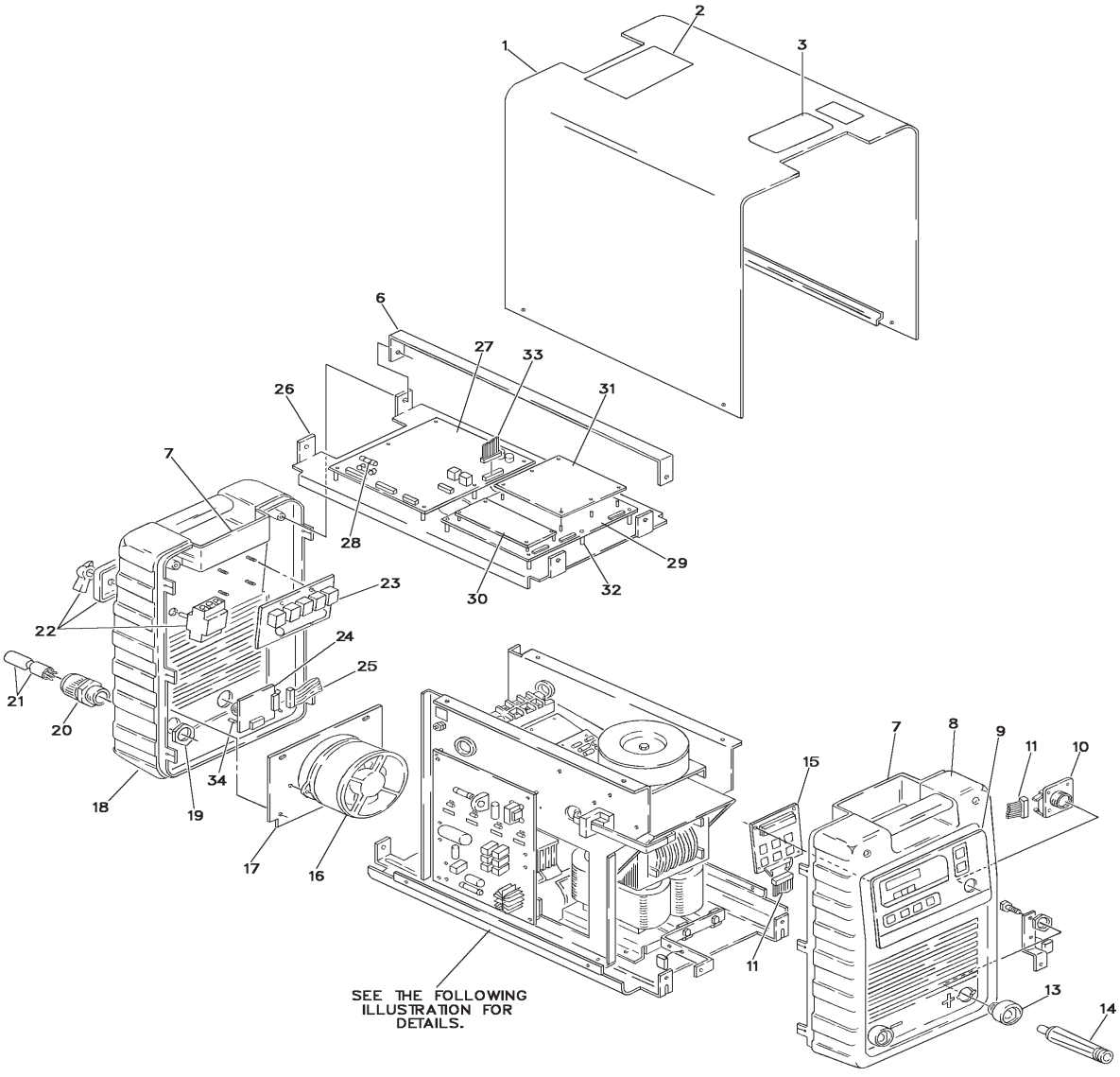

Figure 8-1 Ultra Flex® Welder Assembly

Parts List for Figure 8-1

Quantity Recomm. Spares Class 1	Quantity Recomm. Spares Class 2	Item No	Part Number	Description	Qty per Assy	Application Code
			500237-1	Welder - Ultra Flex® (Pulse)	1	A
			500235-1	Welder - Ultra Flex® (CC/CV)	1	B
		1	205189	. Wrapper	1	All
		2	204036	. Label - Precautionary	1	All
		3	205120A	. Label - Programs	1	A
		4		. Deleted		
		5		. Deleted		
		6	205149	. Brace - Endcaps	2	All
		7	205141	. Cover - Handle, Plastic	2	All
		8	205143	. Panel - Endcap, Front	1	A
			205142	. Panel - Endcap, Front	1	B
		9	205006A-3	. Switch - Overlay, Membrane	1	A
			205006A-2	. Switch - Overlay, Membrane	1	B
		10	204982	. Board - PC, Pendant Interconnection	1	A
		11	205118-2	. Cable - 16 Pin, Ribbon Assy. (9")	2	A
			205118-2	. Cable - 16 Pin, Ribbon Assy. (9")	1	B
		12		. Deleted		
		13	408049-1	. Connector - Locking	2	All
		14	205785-1	. Connector - Male	1	All
		15	204841	. Board - Display	1	All
		16	205019-1	. Fan	1	All
		17	205147	. Plate - MTG. Fan	1	All
		18	205144	. Panel - Endcap, Rear	1	All
		19	205091-1	. Nut - Strain Relief	1	All
		20	204943-1	. Bushing - Strain Relief	1	All
		21	205123	. Cable - Power Input	1	All
		22	203163-3	. Switch - Rotary, Power	1	All
		23	205089	. Board - PC Assy. Auto Link Relay	1	All
		24	204826	. Board - PC Amphenol, Interface	1	All
		25	171370-2	. Cable - 16 Pin Ribbon Assy.	1	All
		—	205128A	. Label - Rear	1	All
		26	205058	. Tray - Upper	1	All
		27	205077B	. Board - PC Assy., Auto Link Control (Rear)	1	All
		28	401972-3	. Fuse - MDX, 3 Amp, 250 V, FL	1	All
		29	204996	. Board - PC Assy. Weld Control (Front Bottom)		1
		30	204777	. Board - PC Assy. MIG Circuit (Front Top)	1	All
		31	204979	. Board - PC Assy. Pulse MIG (Front Top)	1	A
		32	404460-1	. Support - PC Board	24	A
			404460-1	. Support - PC Board	18	B
		33	205118-1	. Cable - 16 Pin Ribbon Assy. (4")	3	A
			205118-1	. Cable - 16 Pin Ribbon Assy. (4")	2	B
		34	409990-2	. Spacer - Board, PC	1	All

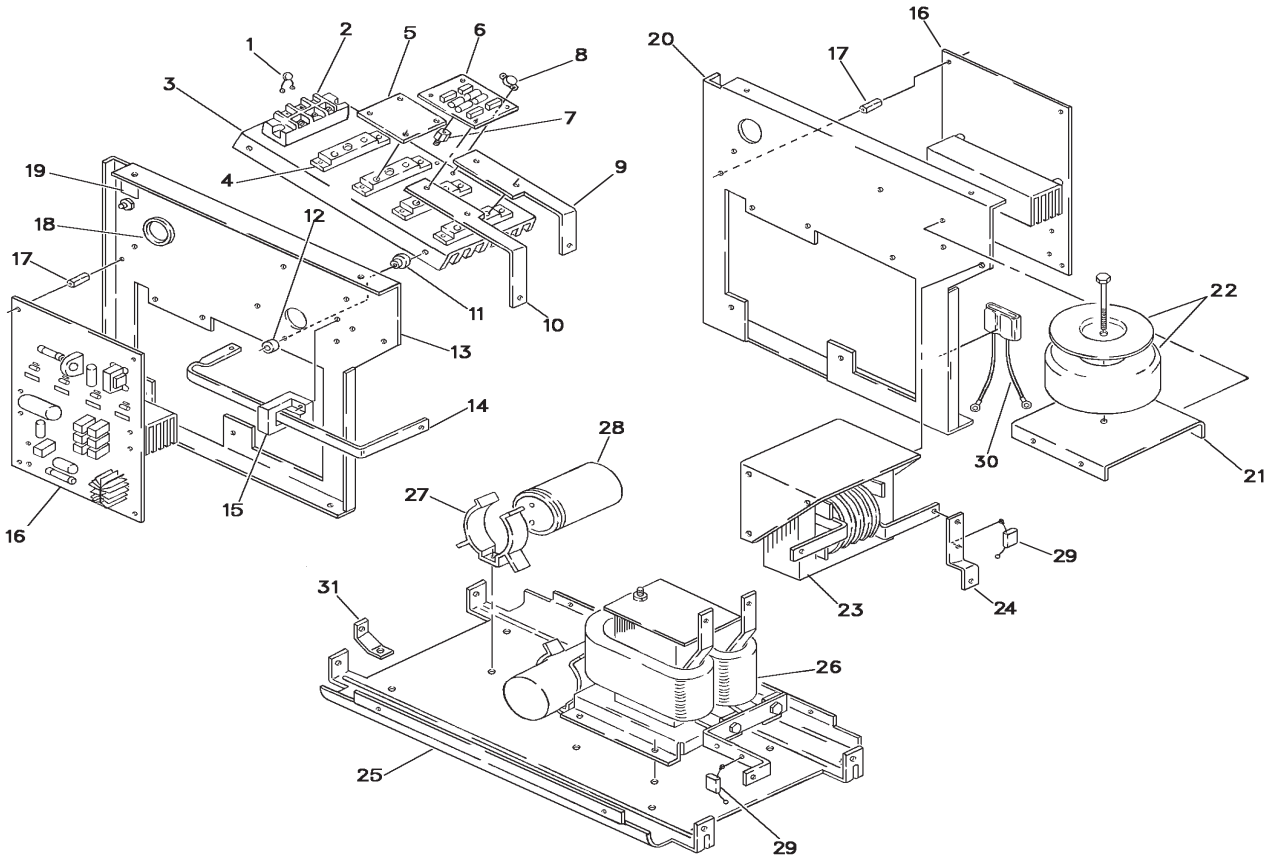
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Figure 8-2

Parts List for Figure 8-2

Quantity Recomm. Spares Class 1	Quantity Recomm. Spares Class 2	Item No	Part Number	Description	Qty per Assy	Application Code
			500237-1	Welder - Ultra Flex® (Pulse) (Continued)	Ref.	A
			500235-1	Welder - Ultra Flex® (CC/CV) (Continued)	Ref.	B
		1	202258-6	. Suppressor - W/Lug Assy.	3	All
		2	205005-1	. Rectifier - Power	1	All
		3	204944	. Heat Sink	1	All
		4	203205	. Diode - Ultra Fast Recovery	4	All
		5	205115	. Bus - Plate	1	All
		6	205139	. Board - PC, Suppressor	1	All
		7	203199-2	. Spacer - Board PC	1	All
		8	404044-7	. Thermostat - OverTemperature	1	All
		9	205136	. Bus - Bar	1	All
		10	205116	. Bus - Bar	1	All
		11	409838	. Grommet - MTG. Nylon	4	All
		12	409837	. Spacer - MTG. Nylon	4	All
		13	204919	. Bracket - Left Side	1	All
		14	205146	. Bus - Bar, Current Sensor	1	All
		15	205018-1	. Current - Sensor	1	All
		16	205074	. Board - PC Assy, Power IGBT	2	All
		17	404915-2	. Stand - Off	12	All
		18	405362-1	. Bushing - Snap	2	All
		19	830116	. Label - Frame Ground	1	All
		20	205048	. Bracket - Right Side	1	All
		21	205062	. Bracket - Transformer	1	All
		22	205043-1	. Transformer - Control	1	All
		23	205092	. Choke	1	All
		24	205134	. Bus - Bar	1	All
		25	204918	. Base	1	All
		26	205095	. Transformer - Power	1	All
		27	205121-1	. Bracket - Capacitor	2	All
		28	205016-1	. Capacitor - Electrolytic	2	All
		29	368705-38	. Capacitor - W/Leads	2	All
		30	830000	. Capacitor - Assembly, W/Leads	1	All
		31	830104	. Support - Tray	4	All

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DIAGRAMS

- Note the model and specification number shown on the equipment nameplate.
- Locate these numbers in the model and specification number columns below.
- Use only those diagrams and instructions that are applicable.

SPECIFICATION NUMBER	MODEL	SCHEMATIC AND CONNECTION DIAGRAM
500235-1	ULTRA FLEX® 350 CC/CV	205165 Sheets 1 and 2
500237-1	ULTRA FLEX® 350 PULSE	205148 Sheets 1 and 2