



TM-359G

2010-03

Eff. w/Serial Number LA349426

Processes



TIG (GTAW) Welding



Stick (SMAW) Welding

Description



Arc Welding Power Source

Syncrowave[®] 250 DX

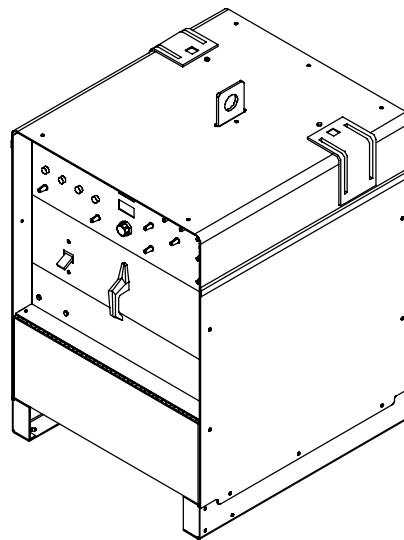
For the units listed below, use the machine stock number (on rating label) to determine the correct Technical Manual for service and parts information.

- Syncrowave 250 DX units with serial numbers LE282983 thru LE468216

Use TM-359 for stock numbers 903726, 903757, 903758, 903759, 903765, 907159.

Use TM-363 for stock numbers 907194, 907195, 907197

Also verify you are using the correct Technical Manual by comparing the unit to the cover illustration.



And Non-Ce Models

TECHNICAL MANUAL



Visit our website at
www.MillerWelds.com

File: TIG (GTAW)



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Declaration of Conformity for European Community (CE) Products

NOTE



This information is provided for units with CE certification (see rating label on unit).

Manufacturer:

Miller Electric Mfg. Co.
1635 W. Spencer St.
Appleton, WI 54914 USA
Phone: (920) 734-9821

European Contact:

Mr. Danilo Fedolfi,
Managing Director
ITW Welding Products Italy S.r.l.
Via Privata Iseo 6/E
20098 San Giuliano
Milanese, Italy
Phone: 39(02)98290-1
Fax: 39(02)98290203

European Contact Signature: _____

Declares that the product:

Syncrowave® 250DX

conforms to the following Directives and Standards:

Directives

Low Voltage Directive: 73/23/EEC

Machinery Directives: 89/392/EEC, 91/368/EEC, 93/C 133/04, 93/68/EEC

Electromagnetic Capability Directives: 89/336, 92/31/EEC

Standards

Safety Requirements for Arc Welding Equipment part 1: EN 60974-1: 1990

*Arc Welding Equipment Part 1: Welding Power Sources: IEC 60974-1
(November 1997 – Draft revision)*

Degrees of Protection provided by Enclosures (IP code): IEC 529: 1989

*Insulation coordination for equipment within low-voltage systems:
Part 1: Principles, requirements and tests: IEC 664-1: 1992*

Electromagnetic compatibility (EMC) Product standard for arc welding equipment:
EN50199: August 1995

SECTION 1 – SAFETY PRECAUTIONS FOR SERVICING

1-1. Symbol Usage

safety_stm 8/03



Means Warning! Watch Out! There are possible hazards with this procedure! The possible hazards are shown in the adjoining symbols.

▲ Marks a special safety message.

☞ Means "Note"; not safety related.



This group of symbols means Warning! Watch Out! possible ELECTRIC SHOCK, MOVING PARTS, and HOT PARTS hazards. Consult symbols and related instructions below for necessary actions to avoid the hazards.

1-2. Servicing Hazards

▲ The symbols shown below are used throughout this manual to call attention to and identify possible hazards. When you see the symbol, watch out, and follow the related instructions to avoid the hazard.

▲ Only qualified persons should service, test, maintain, and repair this unit.

▲ During servicing, keep everybody, especially children, away.



ELECTRIC SHOCK can kill.

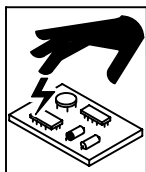
- Do not touch live electrical parts.
- Turn Off welding power source and wire feeder and disconnect and lockout input power using

line disconnect switch, circuit breakers, or by removing plug from receptacle, or stop engine before servicing unless the procedure specifically requires an energized unit.

- Insulate yourself from ground by standing or working on dry insulating mats big enough to prevent contact with the ground.
- Do not leave live unit unattended.
- If this procedure requires an energized unit, have only personnel familiar with and following standard safety practices do the job.
- When testing a live unit, use the one-hand method. Do not put both hands inside unit. Keep one hand free.
- Disconnect input power conductors from deenergized supply line BEFORE moving a welding power source.

SIGNIFICANT DC VOLTAGE exists after removal of input power on inverters.

- Turn Off inverter, disconnect input power, and discharge input capacitors according to instructions in Maintenance Section before touching any parts.



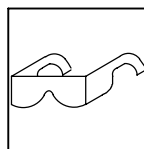
STATIC (ESD) can damage PC boards.

- Put on grounded wrist strap BEFORE handling boards or parts.
- Use proper static-proof bags and boxes to store, move, or ship PC boards.



FIRE OR EXPLOSION hazard.

- Do not place unit on, over, or near combustible surfaces.
- Do not service unit near flammables.



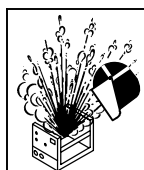
FLYING METAL can injure eyes.

- Wear safety glasses with side shields or face shield during servicing.
- Be careful not to short metal tools, parts, or wires together during testing and servicing.



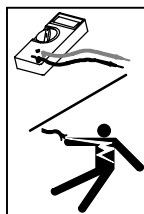
HOT PARTS can cause severe burns.

- Do not touch hot parts bare handed.
- Allow cooling period before working on welding gun or torch.



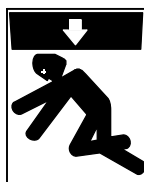
EXPLODING PARTS can cause injury.

- Failed parts can explode or cause other parts to explode when power is applied to inverters.
- Always wear a face shield and long sleeves when servicing inverters.



SHOCK HAZARD from testing.

- Turn Off welding power source and wire feeder or stop engine before making or changing meter lead connections.
- Use at least one meter lead that has a self-retaining spring clip such as an alligator clip.
- Read instructions for test equipment.



FALLING UNIT can cause injury.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.



MOVING PARTS can cause injury.

- Keep away from moving parts such as fans.
- Keep all doors, panels, covers, and guards closed and securely in place.



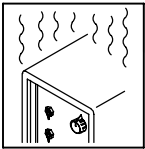
MOVING PARTS can cause injury.

- Keep away from moving parts.
- Keep away from pinch points such as drive rolls.



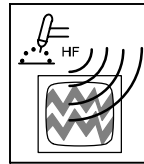
MAGNETIC FIELDS can affect pacemakers.

- Pacemaker wearers keep away from servicing areas until consulting your doctor.



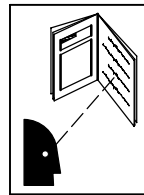
OVERUSE can cause OVERHEATING.

- Allow cooling period; follow rated duty cycle.
- Reduce current or reduce duty cycle before starting to weld again.
- Do not block or filter airflow to unit.



H.F. RADIATION can cause interference.

- High-frequency (H.F.) can interfere with radio navigation, safety services, computers, and communications equipment.
- Have only qualified persons familiar with electronic equipment install, test, and service H.F. producing units.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.



READ INSTRUCTIONS.

- Use MILLER Testing Booklet (Part No. 150 853) when servicing this unit.
- Consult the Owner's Manual for welding safety precautions.
- Use only genuine MILLER replacement parts.

1-3. California Proposition 65 Warnings

- ▲ **Welding or cutting equipment produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code Section 25249.5 et seq.)**
- ▲ **Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling.**

For Gasoline Engines:

- ▲ **Engine exhaust contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.**

For Diesel Engines:

- ▲ **Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.**

1-4. EMF Information

Considerations About Welding And The Effects Of Low Frequency Electric And Magnetic Fields

Welding current, as it flows through welding cables, will cause electromagnetic fields. There has been and still is some concern about such fields. However, after examining more than 500 studies spanning 17 years of research, a special blue ribbon committee of the National Research Council concluded that: "The body of evidence, in the committee's judgment, has not demonstrated that exposure to power-frequency electric and magnetic fields is a human-health hazard." However, studies are still going forth and evidence continues to be examined. Until the final conclusions of the research are reached, you may wish to minimize your exposure to electromagnetic fields when welding or cutting.

To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around your body.
4. Keep welding power source and cables as far away from operator as practical.
5. Connect work clamp to workpiece as close to the weld as possible.

About Pacemakers:

Pacemaker wearers consult your doctor first. If cleared by your doctor, then following the above procedures is recommended.

SECTION 2 – DEFINITIONS

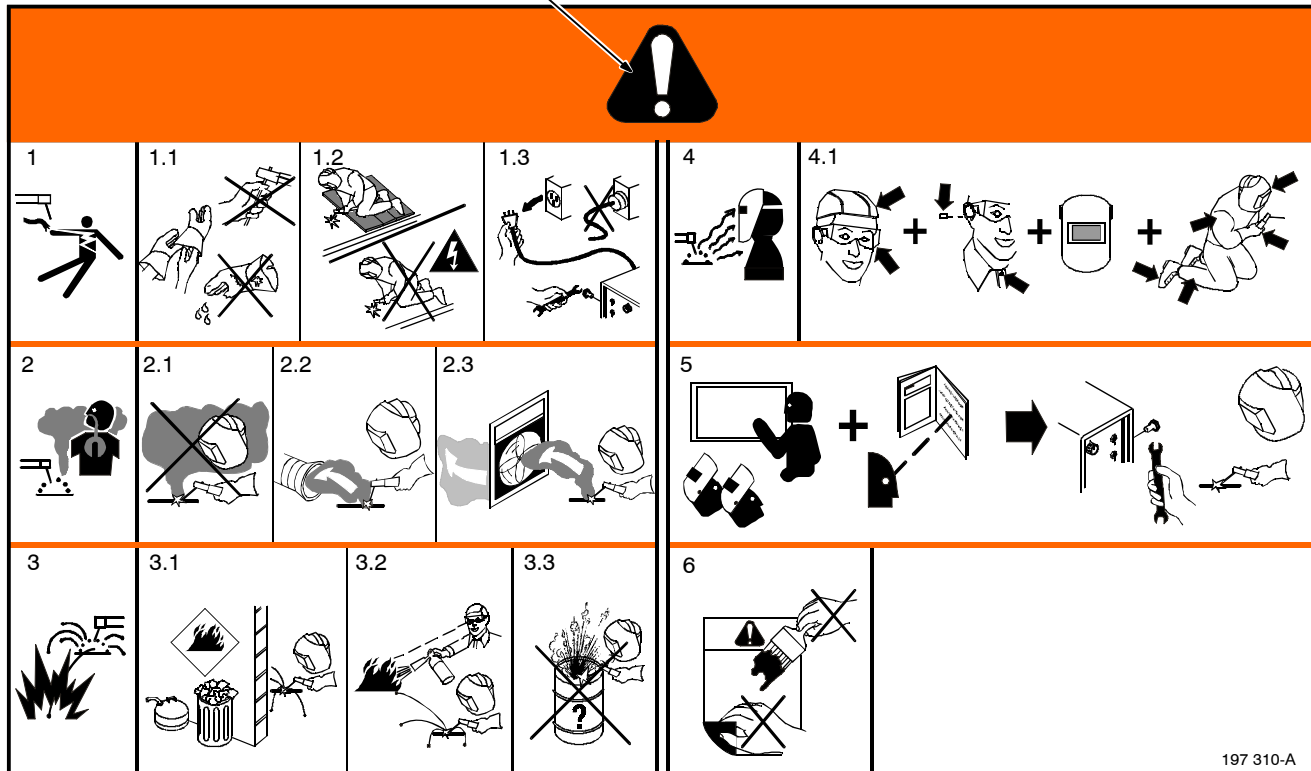
2-1. Warning Label Definitions

Warning! Watch Out! There are possible hazards as shown by the symbols.

- 1 Electric shock from welding electrode or wiring can kill.
- 1.1 Wear dry insulating gloves. Do not touch electrode with bare hand. Do not wear wet or damaged gloves.
- 1.2 Protect yourself from electric shock by insulating yourself from work and ground.
- 1.3 Disconnect input plug or power before working on machine.

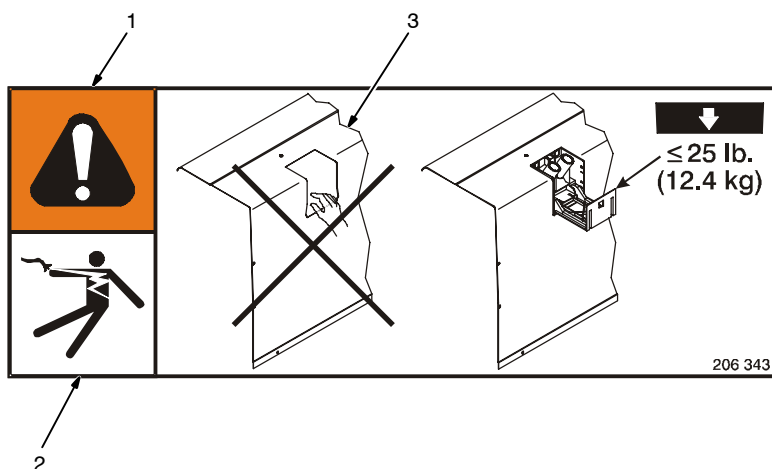
- 2 Breathing welding fumes can be hazardous to your health.
- 2.1 Keep your head out of the fumes.
- 2.2 Use forced ventilation or local exhaust to remove the fumes.
- 2.3 Use ventilating fan to remove fumes.
- 3 Welding sparks can cause explosion or fire.
- 3.1 Keep flammables away from welding. Do not weld near flammables.
- 3.2 Welding sparks can cause fires. Have a fire extinguisher nearby, and have a watchperson ready to use it.
- 3.3 Do not weld on drums or any closed containers.

- 4 Arc rays can burn eyes and injure skin.
- 4.1 Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.
- 5 Become trained and read the instructions before working on the machine or welding.
- 6 Do not remove or paint over (cover) the label.



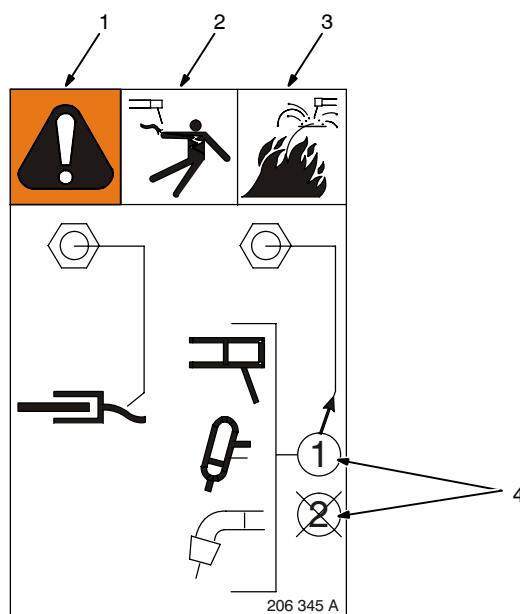
197 310-A

2-2. Torch/Cable Holder Label



- 1 Warning! Watch Out! There are possible hazards as shown by the symbols.
- 2 Electric shock from wiring can kill.
- 3 Do not operate unit or reach inside when torch/cable holder is removed.
- 4 Do not exceed 25 lb (12.4 kg) maximum load on gun/cable holder or holder may break.

2-3. Weld Cable Connection Label






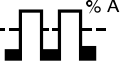
















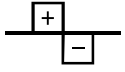








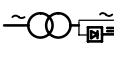

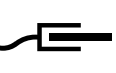
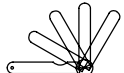
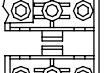



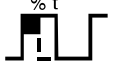


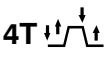
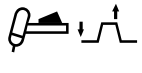




- 1 Warning! Watch Out! There are possible hazards as shown by the symbols.
- 2 Electric shock from welding electrode or wiring can kill.
- 3 Welding sparks or arcing from unused electrode can cause explosion or fire.
- 4 Do not connect more than one electrode cable to any single weld output terminal. Disconnect cables for process not in use. Have only one welding circuit (process) connected at any given time — never two.

2-4. Symbols And Definitions

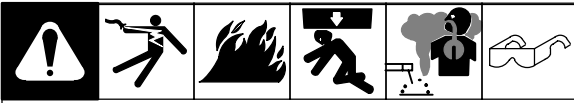
NOTE

Some symbols are found only on CE products.

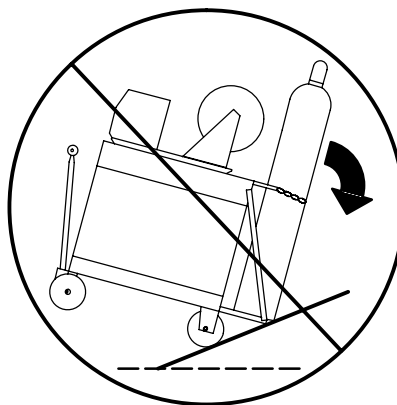
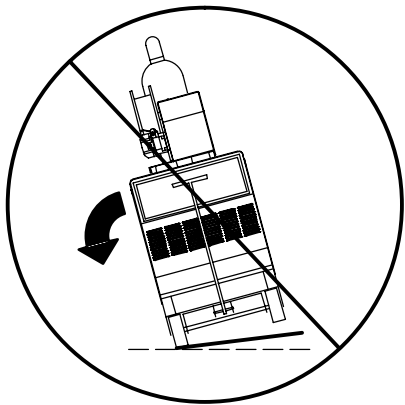
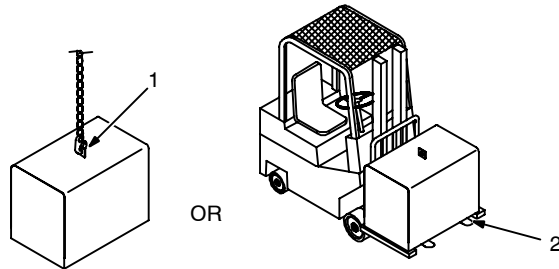
A	Amperes		Panel-Local		Gas Tungsten Arc Welding (GTAW)		Shielded Metal Arc Welding (SMAW)
V	Volts		Do Not Switch While Welding		Arc Force (DIG)		Background Amps
	Output		Circuit Breaker		Remote		Temperature
	Protective Earth (Ground)		Alternating Current		High Frequency - Start		Input
	Postflow Timer		Preflow Timer		High Frequency - Continuous		
	Gas (Supply)		Gas Input		Gas Output		Increase/Decrease Of Quantity
I	On	O	Off	%	Percent		Direct Current
	Balance Control		Maximum Cleaning		Maximum Penetration		Electrode Positive
	Electrode Negative		Final Slope		Meter		Single-Phase
U₀	Rated No Load Voltage (Average)	U₁	Primary Voltage	U₂	Conventional Load Voltage		Line Connection
I₁	Primary Current	I₂	Rated Welding Current	X	Duty Cycle		Single-Phase Combined AC/DC Power Source
IP	Degree Of Protection	I_{1eff}	Maximum Effective Supply Current	I_{1max}	Rated Maximum Supply Current	Hz	Hertz
	Electrode		Work		Thickness Gauge		Spark Gap
S	Seconds		Final Amperage		Initial Time		Initial Amperage
	Pulse Percent On Time		Spot Time		Lift-Arc™		4 Step Trigger Operation Sequence
	Trigger Hold		Pulser On-Off		Pulse Frequency		

SECTION 3 – INSTALLATION

3-1. Selecting A Location



Movement



▲ Falling Unit Can Cause Injury.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.

1 Lifting Eye

2 Lifting Forks

Use lifting eye or lifting forks to move unit.

If using lifting forks, extend forks beyond opposite side of unit.

3 Rating Label

Use rating label to determine input power needs.

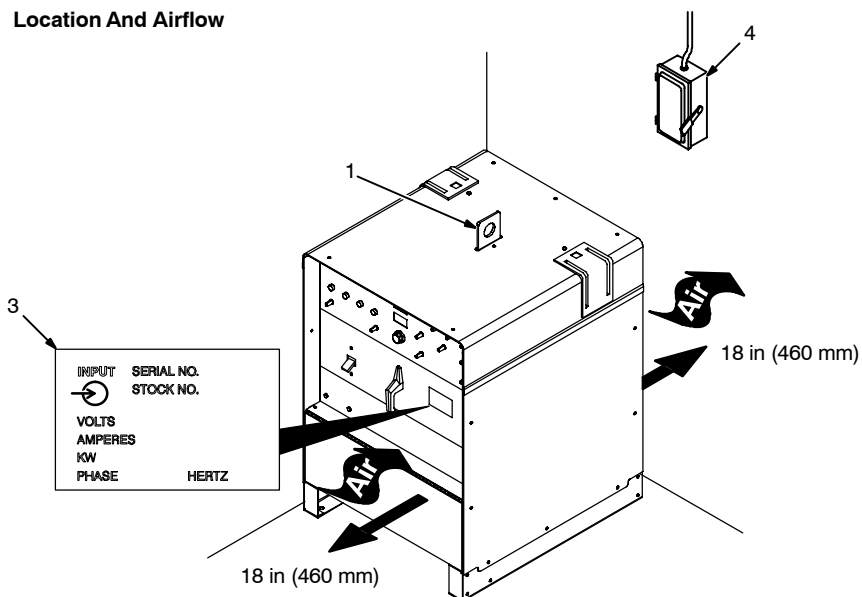
4 Line Disconnect Device

Locate unit near correct input power supply.

▲ Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.

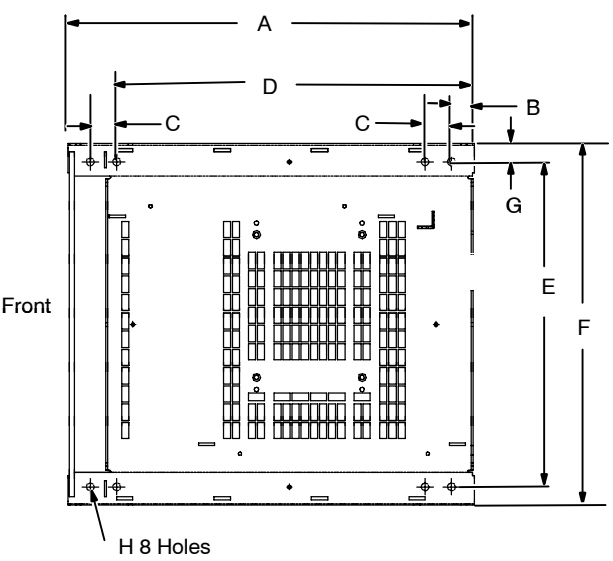
▲ Be careful when placing or moving unit over uneven surfaces.

Location And Airflow



Ref. 117 264-C / 802 455-C

3-2. Dimensions And Weights

 <p>Front</p> <p>H 8 Holes</p> <p>Ref. 207 559</p>	Dimensions	
	Height	33-1/4 in (845 mm)
	Width	22-1/2 in (572 mm)
	Length	25 in (635 mm)
	A	25 in (635 mm)
	B	1-25/64 in (35 mm)
	C	1-5/8 in (41 mm)
	D	20-5/8 in (524 mm)
	E	19-15/16 (506 mm)
	F	22-1/4 (565 mm)
	G	1-5/32 in (30 mm)
	H	1/2 in (13 mm) Dia
	Weight	
	389 lbs (176 kg)	

3-3. Specifications

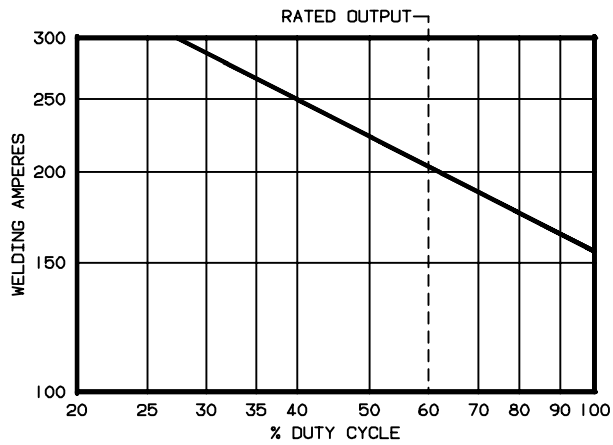
Rated Welding Output	PFC**	Amperes Input at AC Balanced Rated Load Output, 60 Hz, Single-Phase				KVA	KW	Amperage Range	Max OCV
		200V	230V	460V	575V				
NEMA Class I (40) – 200 Amperes, 28 Volts AC, 60% Duty Cycle	No PFC	88 *3.3	77 *2.8	38 *1.5	31 *1.1	17.6 *.59	8.6 *.29	5 – 310A	80V
NEMA Class I (40) – 200 Amperes, 28 Volts AC, 60% Duty Cycle	With PFC	60 *55.3	52 *49.5	26 *24.5	21 *19.6	12.06 *11.2	8.11 *.39	5 – 310A	80V
NEMA Class II (40) – 250 Amperes, 30 Volts AC, 40% Duty Cycle	No PFC	110 *3.3	96 *2.8	48 *1.5	38 *1.1	21.98 *.59	11.76 *.29	5 – 310A	80V
NEMA Class II (40) – 250 Amperes, 30 Volts AC, 40% Duty Cycle	With PFC	82 *55.3	71 *49.5	35 *24.5	28 *19.6	16.32 *11.2	11.81 *1.93	5 – 310A	80V
*While idling									
**Power Factor Correction									

3-5. Specifications(continued)

Rated Welding Output	PFC**	Amperes Input at AC Balanced Rated Load Output, 50/60 Hz, Single-Phase				KVA	KW	Amperage Range	Max OCV
		220V	400V	440V	520V				
NEMA Class I (40) – 200 Amperes, 28 Volts AC, 60% Duty Cycle	No PFC	82 *3.0	45 *1.6	41 *1.4	35 *1.2	17.6 *59	8.6 *29	5 – 310A	80V
NEMA Class I (40) – 200 Amperes, 28 Volts AC, 60% Duty Cycle	With PFC	61 *45.9	34 *25.1	31 *22.8	26 *23.2	12.06 *11.2	8.11 *39	5 – 310A	80V
NEMA Class II (40) – 250 Amperes, 30 Volts AC, 40% Duty Cycle	No PFC	100 *3.0	55 *1.6	50 *1.4	42 *1.2	21.98 *59	11.76 *29	5 – 310A	80V
NEMA Class II (40) – 250 Amperes, 30 Volts AC, 40% Duty Cycle	With PFC	81 *45.9	44 *25.1	40 *22.8	34 *23.2	16.32 *11.2	11.81 *1.93	5 – 310A	80V
*While idling **Power Factor Correction									

Rated Welding Output	PFC**	Amperes Input at AC Balanced Rated Load Output, 50 Hz, Single-Phase				KVA	KW	Amperage Range	Max OCV
		200V	230V	460V	575V				
NEMA Class I (40) – 175 Amperes, 27 Volts AC, 60% Duty Cycle	No PFC	80 *3.3	69 *2.8	35 *1.5	28 *1.1	15.9 *59	7.4 *29	5 – 310A	80V
NEMA Class I (40) – 175 Amperes, 27 Volts AC, 60% Duty Cycle	With PFC	52 *55.3	45 *49.5	22 *24.5	18 *19.6	10.3 *11.2	7.3 *39	5 – 310A	80V
NEMA Class II (40) – 225 Amperes, 29 Volts AC, 40% Duty Cycle	No PFC	101 *3.3	88 *2.8	44 *1.5	35 *1.1	20.2 *59	10.2 *29	5 – 310A	80V
NEMA Class II (40) – 225 Amperes, 29 Volts AC, 40% Duty Cycle	With PFC	74 *55.3	64 *49.5	32 *24.5	26 *19.6	14.7 *11.2	10.1 *1.93	5 – 310A	80V
*While idling **Power Factor Correction									

3-4. Duty Cycle And Overheating

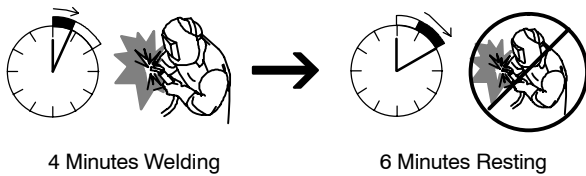


Duty Cycle is the percentage of 10 minutes that the unit can weld at rated load without overheating.

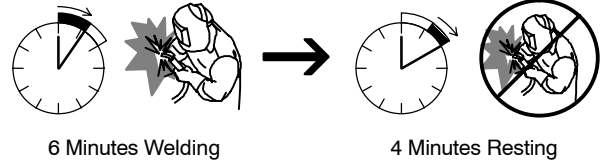
If unit overheats, output stops, front panel voltmeter/ammeter displays a HLP3 or HLP5 message (see Section 6-2), and cooling fans run. Wait fifteen minutes for unit to cool. Reduce amperage or duty cycle before welding.

▲ Exceeding duty cycle can damage unit and void warranty.

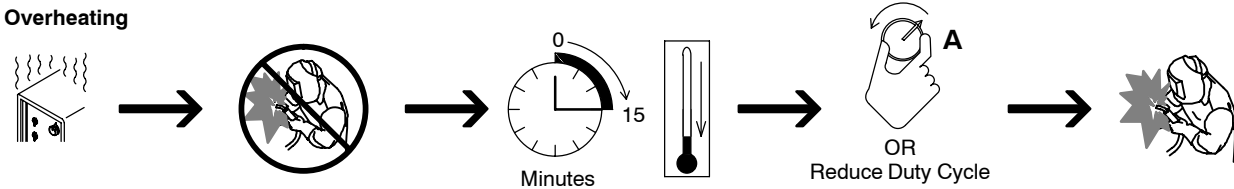
40% Duty Cycle At 250 Amperes



60% Duty Cycle At 200 Amperes



Overheating

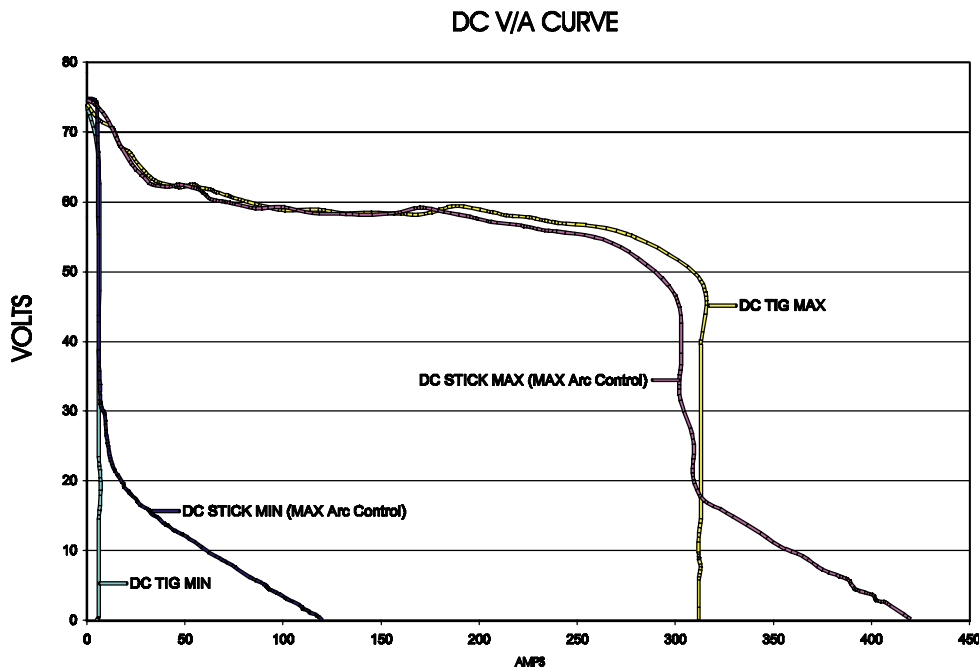
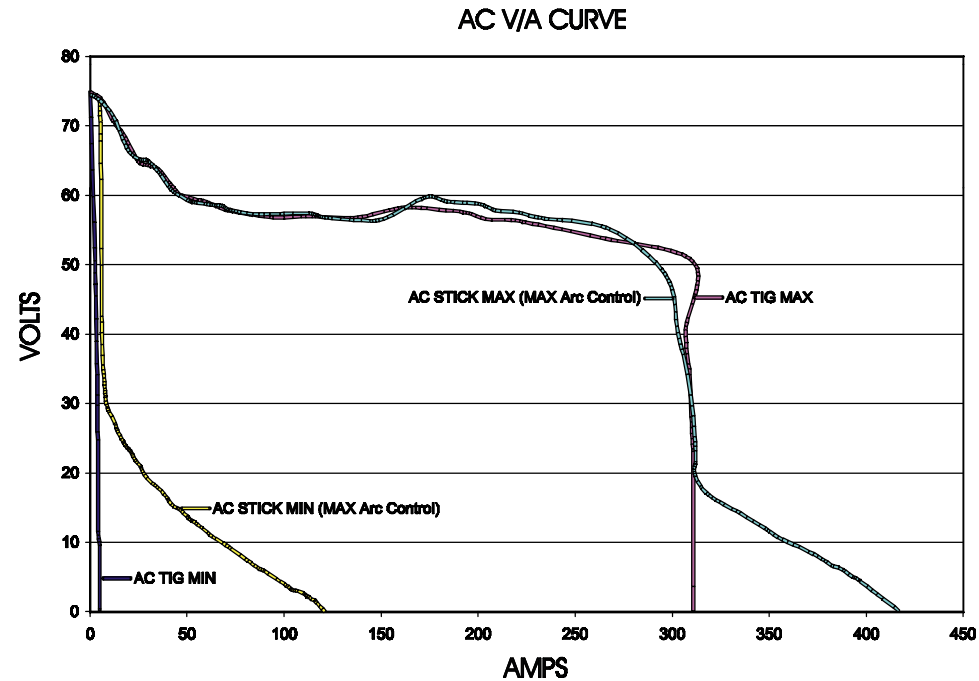


duty1 4/95 / 116 198

3-5. Volt-Ampere Curves

The volt-ampere curves show the minimum and maximum voltage and amperage output capabilities of the welding power source. Curves of other settings fall between the curves shown.

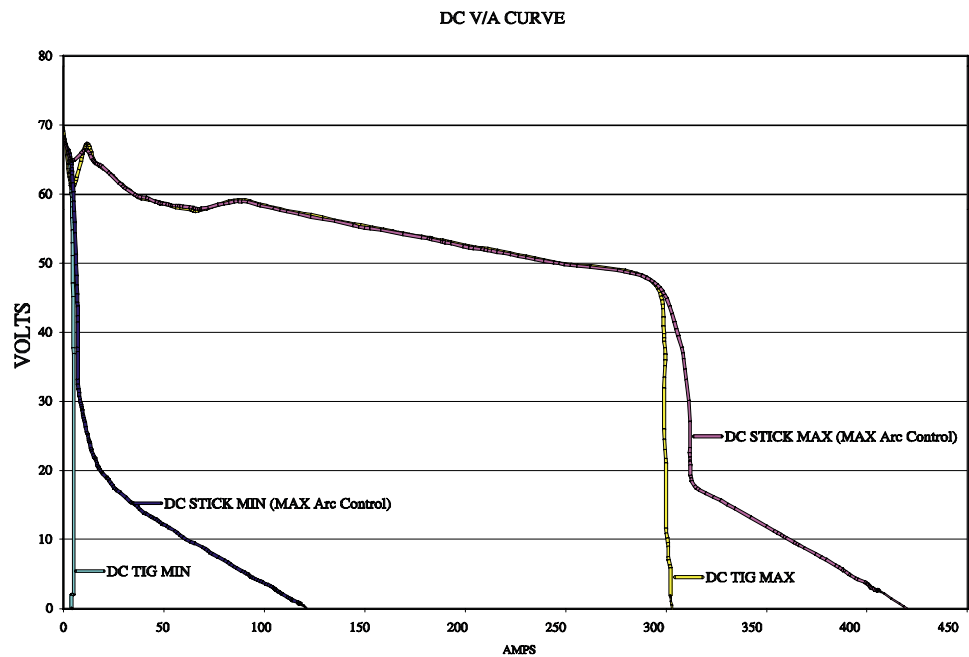
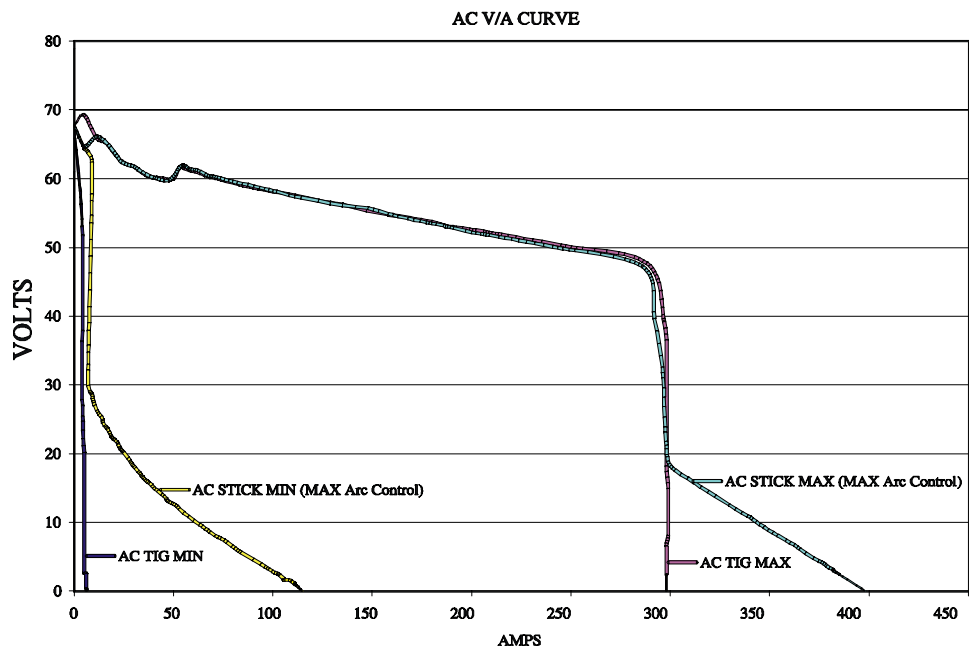
Non CE Models



3-5. Volt-Ampere Curves (Continued)

The volt-ampere curves show the minimum and maximum voltage and amperage output capabilities of the welding power source. Curves of other settings fall between the curves shown.

CE Models



3-6. Weld Output Terminals And Selecting Cable Sizes



▲ ARC WELDING can cause Electromagnetic Interference.

To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor. Locate welding operation 100 meters from any sensitive electronic equipment. Be sure this welding machine is installed and grounded according to this manual. If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

 Weld Output Terminals ▲ Turn off power before connecting to weld output terminals. ▲ Do not use worn, damaged, undersized, or poorly spliced cables.	Welding Amperes	Total Cable (Copper) Length In Weld Circuit Not Exceeding							
		100 ft (30 m) Or Less		150 ft (45 m)	200 ft (60 m)	250 ft (70 m)	300 ft (90 m)	350 ft (105 m)	400 ft (120 m)
		10 – 60% Duty Cycle	60 – 100% Duty Cycle	10 – 100% Duty Cycle					
 Ref. 801 972-C	100	4	4	4	3	2	1	1/0	1/0
	150	3	3	2	1	1/0	2/0	3/0	3/0
	200	3	2	1	1/0	2/0	3/0	4/0	4/0
	250	2	1	1/0	2/0	3/0	4/0	2-2/0	2-2/0
	300	1	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-3/0
	350	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-3/0	2-4/0
	400	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-4/0	2-4/0
	500	2/0	3/0	4/0	2-2/0	2-3/0	2-4/0	3-3/0	3-3/0

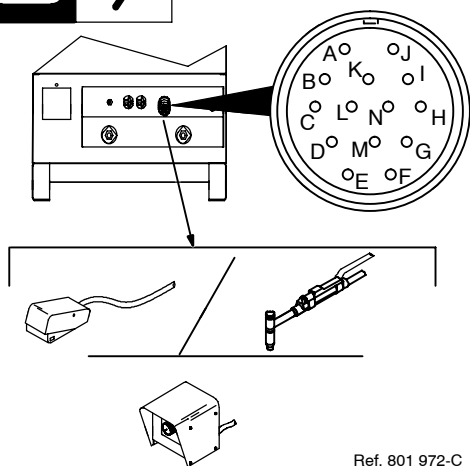
Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of at least 300 circular mils per ampere
 *Select weld cable size for pulsing application at peak amperage value..

S-0007-D

3-7. Remote 14 Receptacle Information



▲ Turn off power before connecting to receptacle.



Ref. 801 972-C



REMOTE 14

Socket*

Socket Information

24 VOLTS DC
 ➔ OUTPUT CONTACTOR

A

Contact control 24 volts dc.

B

Contact closure to A completes 24 volts dc contactor control circuit and enables output.

A
 REMOTE OUTPUT CONTROL

C

Output to remote control; 0 to +10 volts dc output to remote control.

D

Remote control/feedback circuit common.

E

0 to +10 volts dc input command signal from remote control.

A/V
 AMPERAGE VOLTAGE

F

Current feedback; +1 volt dc per 100 amperes.

H

Voltage feedback; +1 volt dc per 10 volts output.


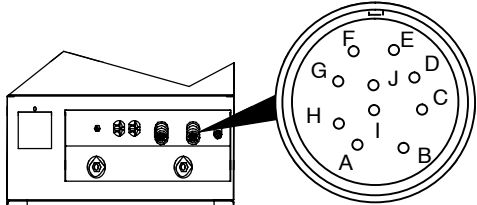
GND

K

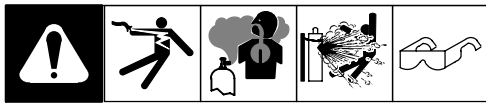
Chassis common.

*The remaining sockets are not used.

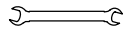
3-8. Automation 10-Pin Connection (Optional)

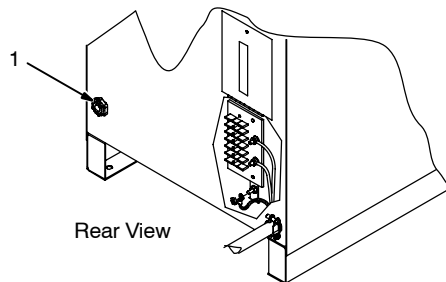
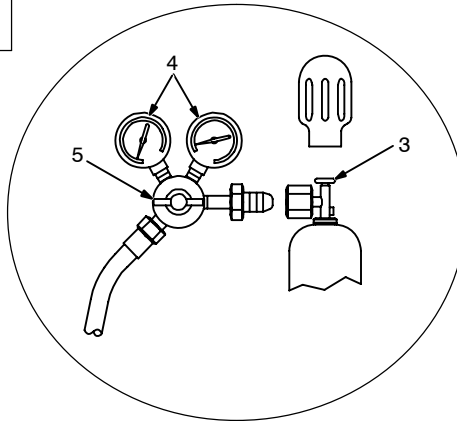
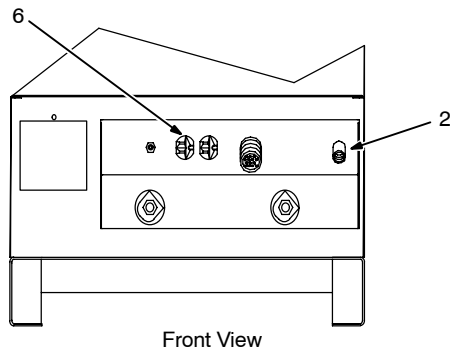
 <p>▲ Turn off power before connecting to receptacle</p>  <p>Ref. 801 972-C</p>	Socket	Socket Information For 10-Pin Receptacle RC3
	A	Start/Stop
	B	Gas
	C	Output disabled
	D	Chassis ground
	E	Final slope – collector
	F	Final slope – emitter
	G	Pulse lockout – collector
	H	Pulse lockout – emitter
	I	Valid arc – collector
	J	Valid arc – emitter
Definitions Of Inputs And Outputs		
Inputs		
A - Closure to D starts the weld cycle. Opening closure stops weld cycle. During 2T operation, a momentary closure (greater than 100ms, but less than 3/4 seconds) starts and stops weld output.		
B - Closure to D turns on gas. This input will override Postflow, but if a Prewflow time is entered, the Prewflow cycle will time out before arc initiation.		
C - Closure to D must be maintained at all times. If the closure between pins C and D is broken, an output disable occurs, Postflow begins to time out, and <i>HELP 13</i> will be displayed on the meters.		
Outputs		
Outputs are isolated open-collector transistor which are able to conduct at least 6 mA of current, with a maximum of 100 mA of current and 30 VDC.		
Final Slope - output is on when in Final Slope.		
Pulse Lockout - output is on when in Initial Amperage, Initial Slope, Final Slope, Final Amperage, and when the pulse frequency is less than 10 Hz.		
Arc On - output is on when the contactor is on and there is less than 50 load volts.		

3-9. Shielding Gas Connections And 115 Volts AC Duplex Receptacle



Tools Needed:

 5/8, 3/4, 1-1/8 in



▲ **Turn Off power before connecting to receptacle.**

1 Gas Valve In Fitting

Located on rear of unit.

2 Gas Valve Out Fitting

Fittings have 5/8-18 right-hand threads.

3 Cylinder Valve

Open valve slightly so gas flow blows dirt from valve. Close valve.

4 Regulator/Flow Gauge

Connect regulator/flow gauge to gas cylinder.

Connect customer supplied gas hose between regulator/flow gauge and gas in fitting.

5 Flow Adjust

Typical flow rate is 20 cfh (cubic feet per hour).

6 115 V 15 Amp AC Receptacle

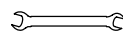
Receptacle is protected from overload by circuit breaker CB1 (see Section 7-2).

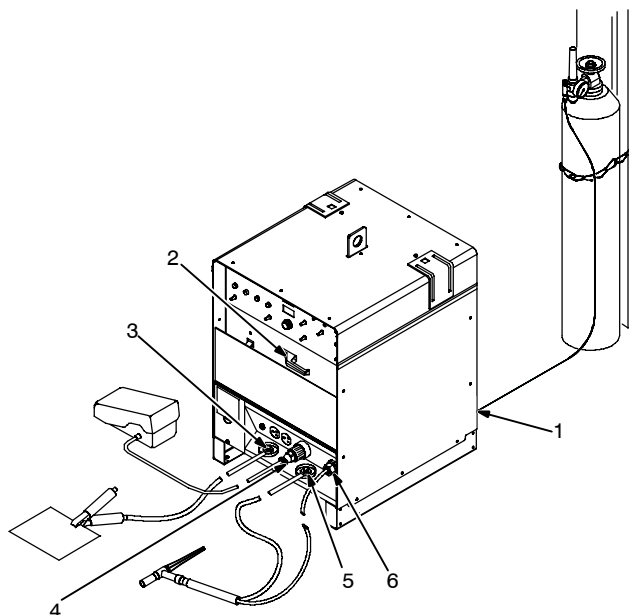
Ref. 801 972-C / Ref. 801 973 / Ref. 157 858

3-10. TIG Connections



Tools Needed:

 11/16, (21 mm), 3/4 in



▲ **Turn Off power before making connections.**

1 Gas In Connection

Connect gas hose from gas supply to gas in fitting.

2 Output Selector Switch (See Section 4-2)

Switch is shown in DCEN (direct current electrode negative) position for TIG HF Impulse DCEN welding. For front panel control display, see Section 3-11. For TIG AC welding, place switch in AC position (see Section 4-2). For TIG AC front panel control display, see Section 3-12.

3 Work Weld Output Terminal

Connect work lead to work weld output terminal.

4 Remote 14 Receptacle

Connect desired remote control to Remote 14 receptacle.

5 Electrode Weld Output Terminal

Connect TIG torch to electrode weld output terminal.

6 Gas Out Connection

Connect torch gas hose to gas out fitting.


802 734-C

3-11. Front Panel Display For TIG HF Impulse DCEN (Direct Current Electrode Negative)

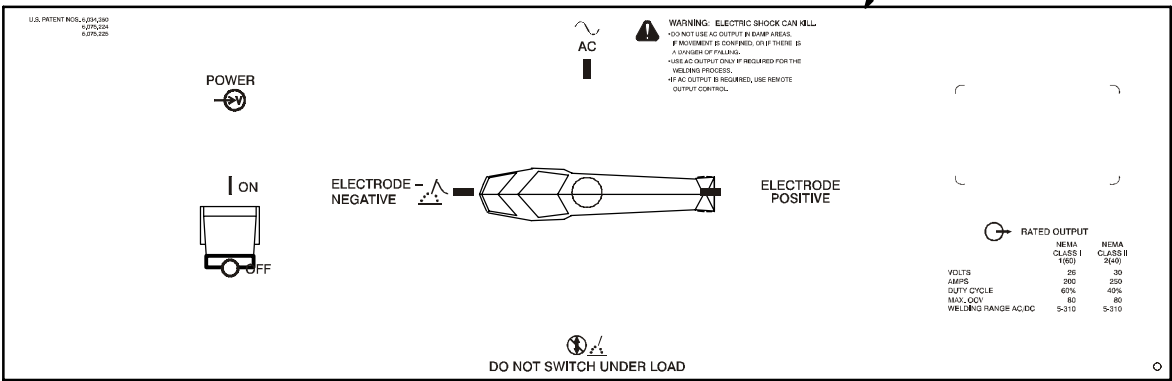
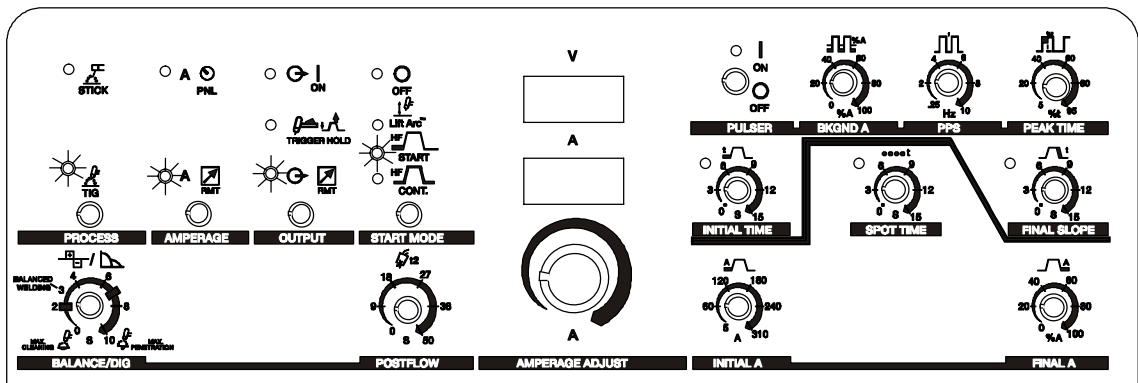


1 Front Panel

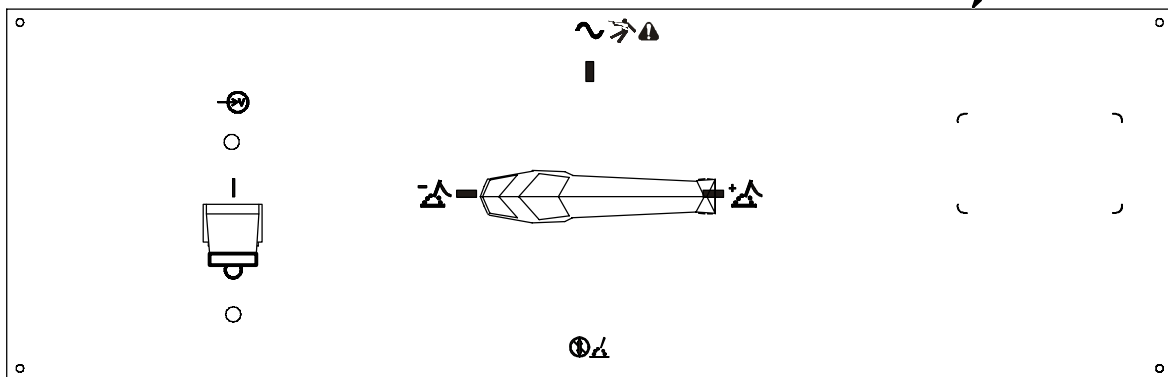
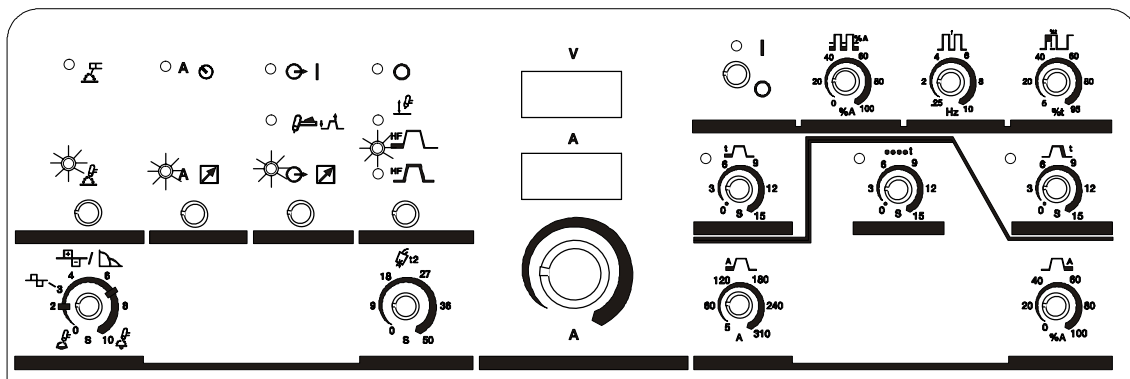
Correct front panel display for basic TIG HF Impulse DCEN welding.

 For all front panel switch pad controls: press switch pad to turn on light and enable function.

NOTE: Green on nameplate indicates a TIG function (see Section 4-1 for description of controls).



CE Models




3-12. Front Panel Display For TIG AC

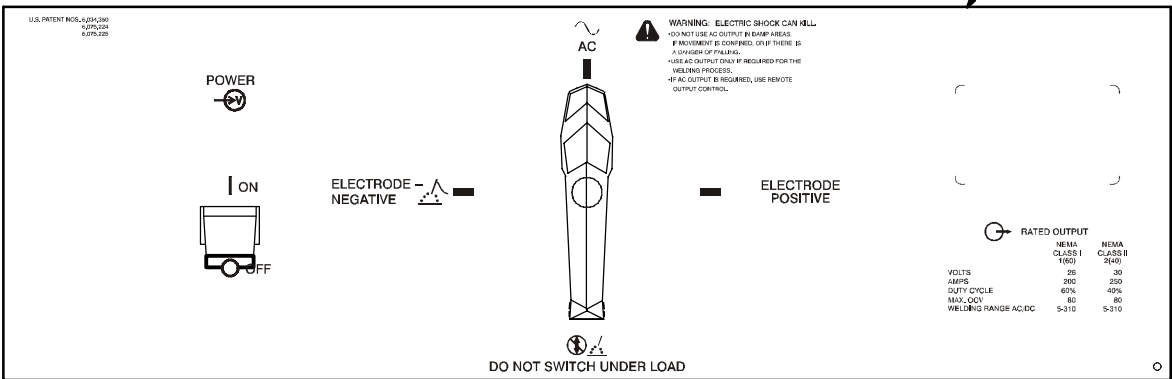
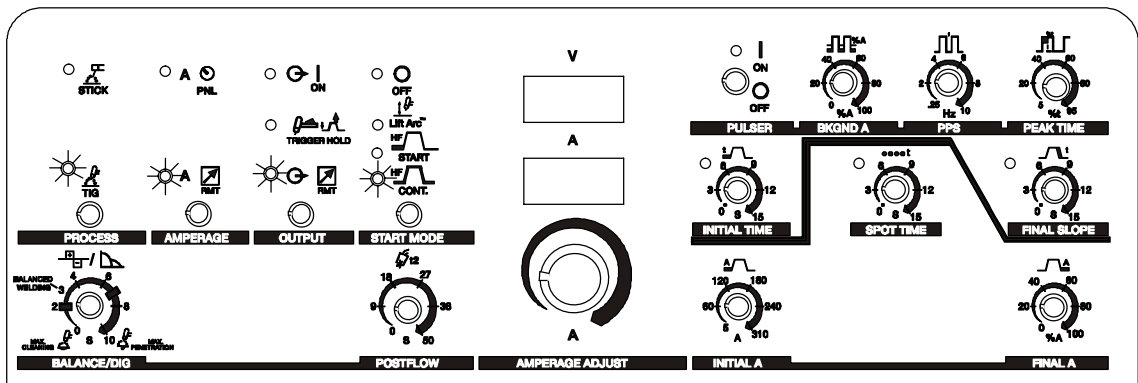


1 Front Panel

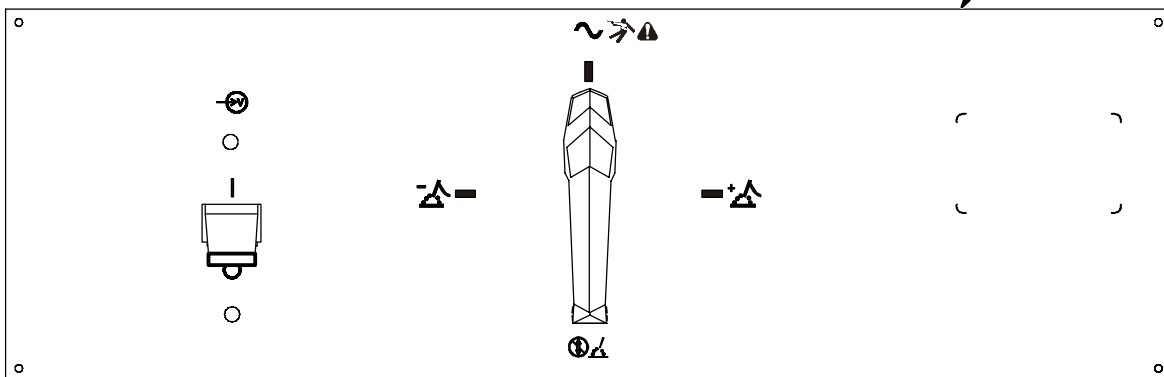
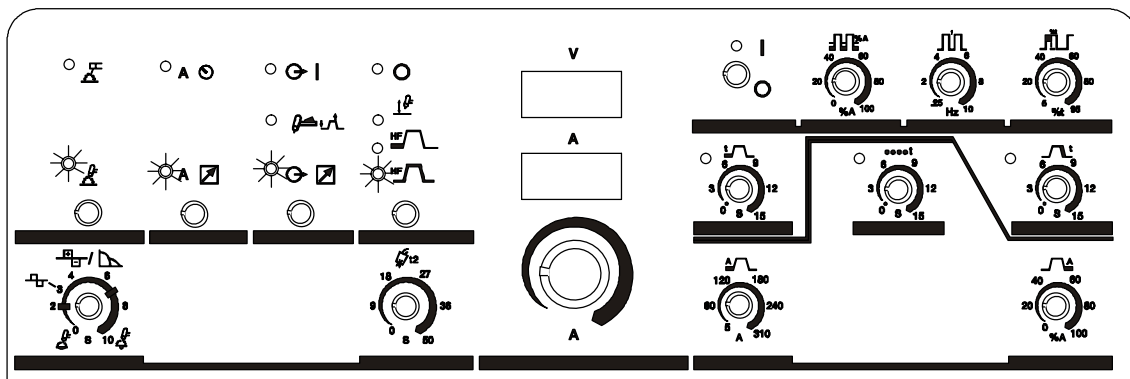
Correct front panel display for basic TIG AC welding.

 For all front panel switch pad controls: press switch pad to turn on light and enable function.

NOTE: Green on nameplate indicates a TIG function (see Section 4-1 for description of controls).

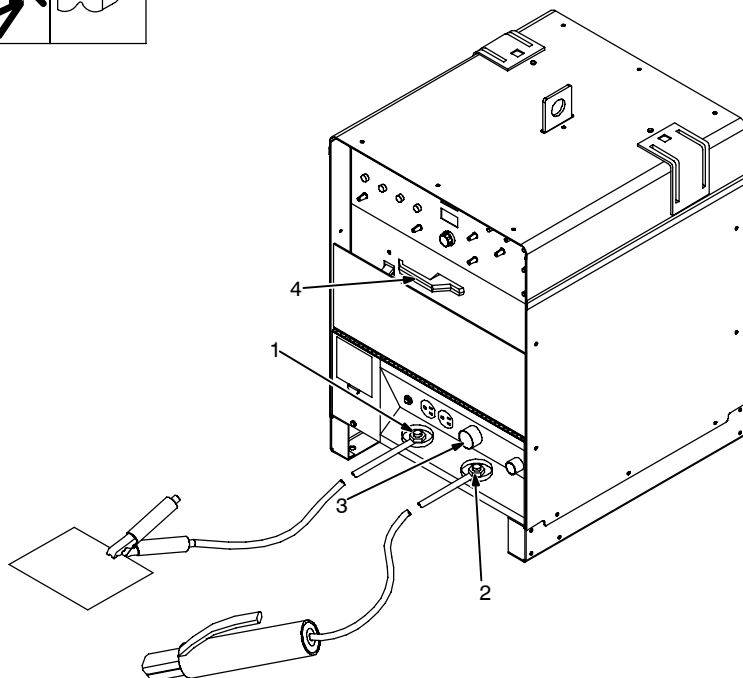


CE Models




[illegible]

3-13. Stick Connections



Tools Needed:

 11/16, (21 mm), 3/4 in

▲ Turn Off power before making connections.

1 Work Weld Output Terminal
Connect work lead to work weld output terminal.

2 Electrode Weld Output Terminal

Connect electrode holder to electrode weld output terminal.

3 Remote 14 Receptacle

If desired, connect remote control to Remote 14 receptacle.

4 Output Selector Switch (See Section 4-2)

Switch is shown in DCEP (direct current electrode positive) position for Stick DCEP welding. For front panel control display, see Section 3-14. For Stick AC welding, place switch in AC position (see Section 4-2). For Stick AC front panel control display, see Section 3-15.


802 733-C

3-14. Front Panel Display For Stick DCEP (Direct Current Electrode Positive)

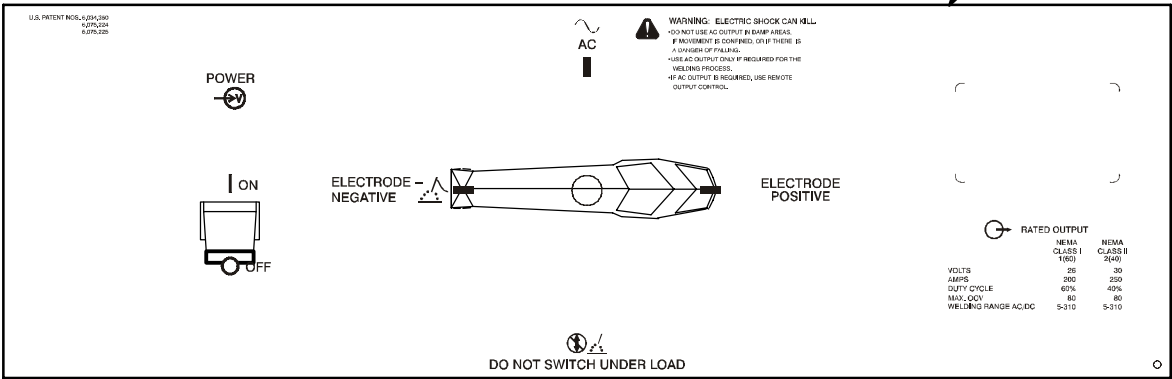
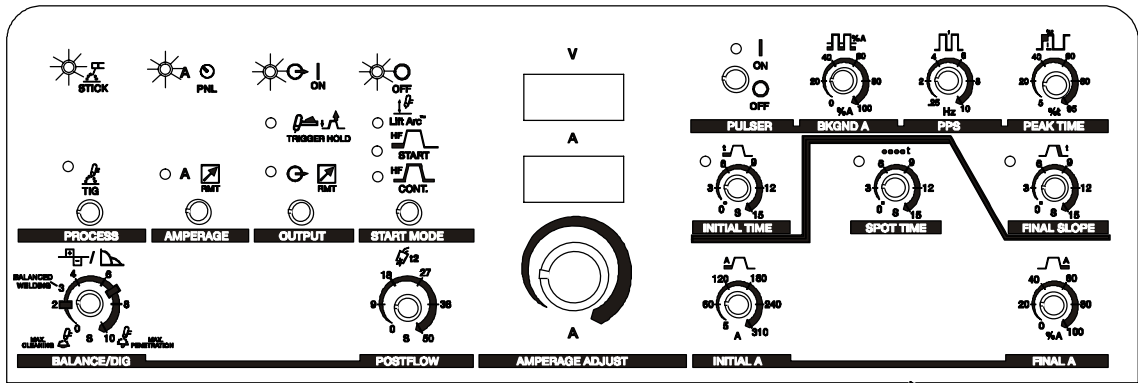


1 Front Panel

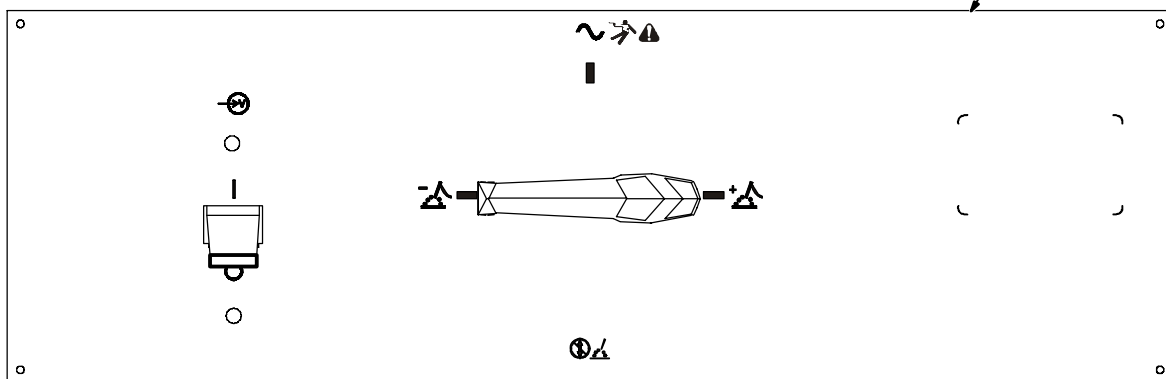
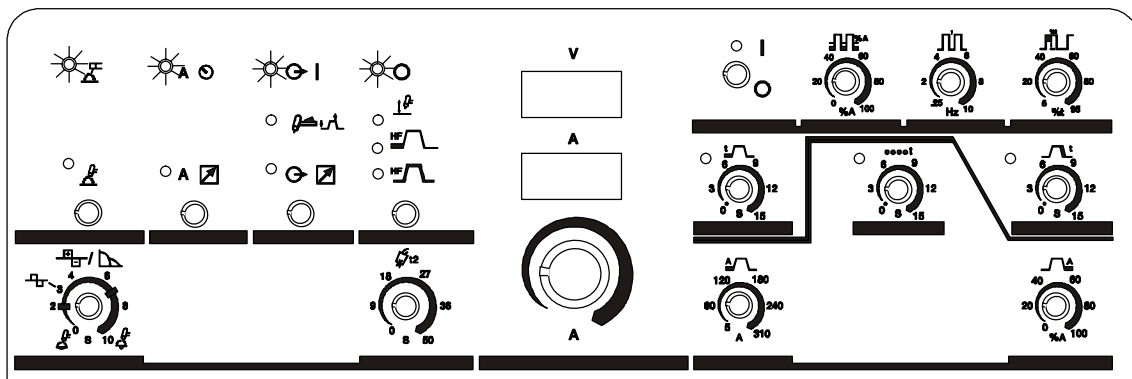
Correct front panel display for basic Stick DCEP welding.

 For all front panel switch pad controls: press switch pad to turn on light and enable function.

NOTE: Gray on nameplate indicates a Stick function (see Section 4-1 for description of controls).



CE Models




3-15. Front Panel Display For Stick AC

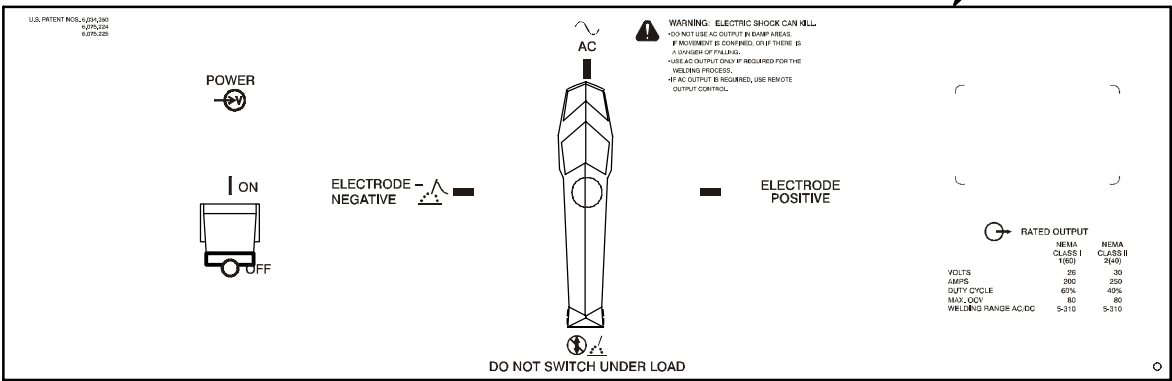
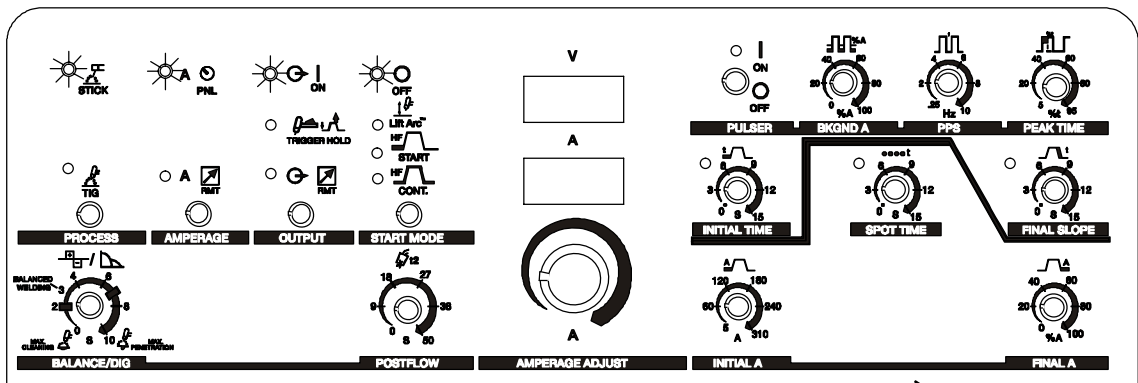


1 Front Panel

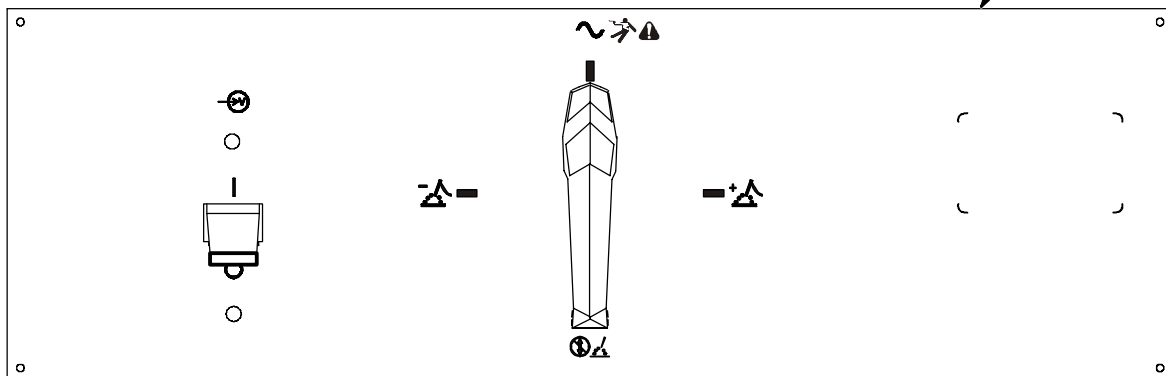
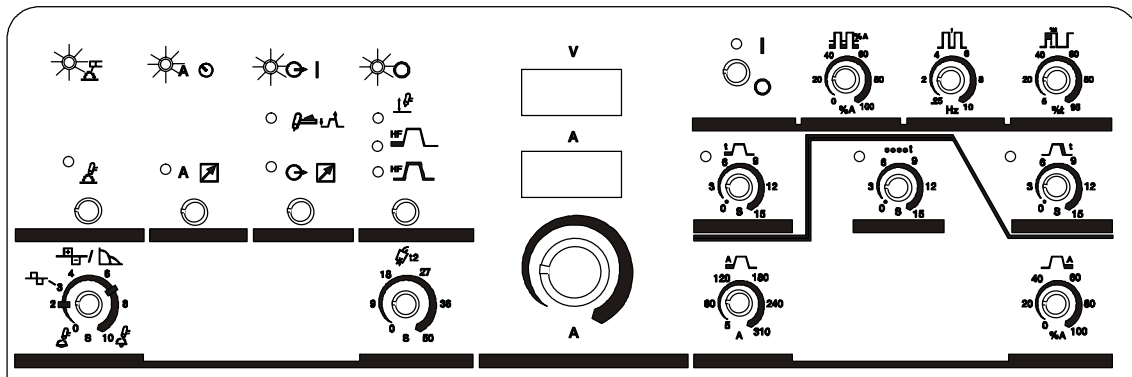
Correct front panel display for basic Stick AC welding.

 For all front panel switch pad controls: press switch pad to turn on light and enable function.

NOTE: Gray on nameplate indicates a Stick function (see Section 4-1 for description of controls).



CE Models



3-16. Electrical Service Guide

NOTE

All values in both tables were calculated at 60% duty cycle.

50/60 Hertz Models	Without Power Factor Correction							
Input Voltage	200	220	230	400	440	460	520	575
Input Amperes At Rated Output	88	82	77	45	41	38	35	31
Max Recommended Standard Fuse Or Circuit Breaker Rating In Amperes								
Circuit Breaker ¹								
Time-Delay Fuse ²	125	125	125	70	60	60	50	45
Normal Operating (Fast) Fuse ³	125	125	125	70	60	60	50	45
Min Input Conductor Size In AWG ⁴	4	6	6	8	8	10	10	10
Max Recommended Input Conductor Length In Feet (Meters)	167 (51)	137 (42)	153 (47)	305 (93)	369 (112)	281 (86)	352 (107)	439 (134)
Min Grounding Conductor Size In AWG ⁴	6	6	6	8	10	10	10	10

Reference: 2005 National Electrical Code (NEC)

1 Choose a circuit breaker with time-current curves comparable to a time-delay fuse.

2 "Time-Delay" fuses are UL class "RK5".

3 "Normal Operating" (fast) fuses are UL class "K5" (up to and including 60 amp), and UL class "H" (65 amp and above).

4 Conductor data in this section specifies conductor size (excluding flexible cord or cable) between the panelboard and the equipment per NEC Table 310.16. If a flexible cord or cable is used, minimum conductor size may increase. See NEC Table 400.5(A) for flexible cord and cable requirements.

▲ Failure to follow these fuse and circuit breaker recommendations could create an electric shock or fire hazard.

50/60 Hertz Models	With Power Factor Correction							
Input Voltage	200	220	230	400	440	460	520	575
Input Amperes At Rated Output	60	61	52	34	31	26	26	21
Max Recommended Standard Fuse Or Circuit Breaker Rating In Amperes								
Circuit Breaker ¹								
Time-Delay Fuse ²	90	90	80	50	45	40	40	30
Normal Operating (Fast) Fuse ³	90	90	80	50	45	40	40	30
Min Input Conductor Size In AWG ⁴	8	8	8	10	10	10	10	12
Max Recommended Input Conductor Length In Feet (Meters)	87 (26)	102 (31)	115 (35)	226 (69)	274 (84)	308 (94)	383 (117)	295 (90)
Min Grounding Conductor Size In AWG ⁴	8	8	8	10	10	10	10	12

Reference: 1999 National Electrical Code (NEC)

1 Choose a circuit breaker with time-current curves comparable to a time-delay fuse.

2 "Time-Delay" fuses are UL class "RK5".

3 "Normal Operating" (fast) fuses are UL class "K5" (up to and including 60 amp), and UL class "H" (65 amp and above).

4 Conductor data in this section specifies conductor size (excluding flexible cord or cable) between the panelboard and the equipment per NEC Table 310.16. If a flexible cord or cable is used, minimum conductor size may increase. See NEC Table 400.5(A) for flexible cord and cable requirements.

▲ Failure to follow these fuse and circuit breaker recommendations could create an electric shock or fire hazard.

3-17. Placing Jumper Links



▲ **Disconnect and lockout/tag-out input power before installing or moving jumper links.**

Check input voltage available at site.

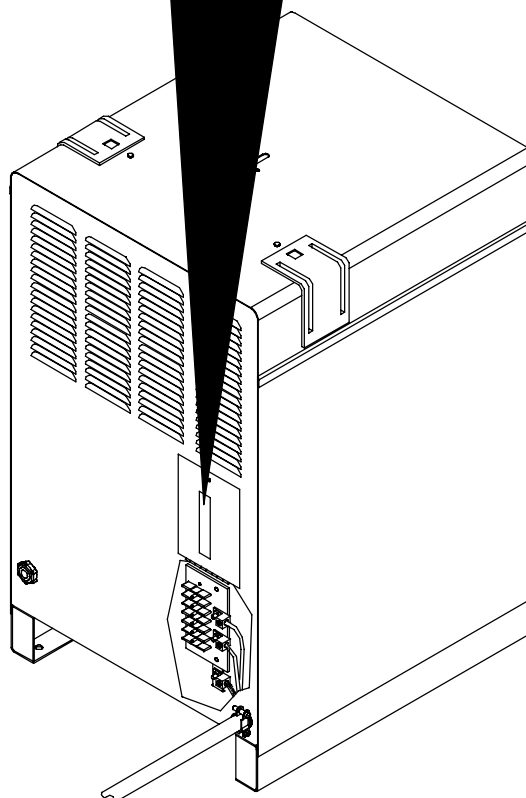
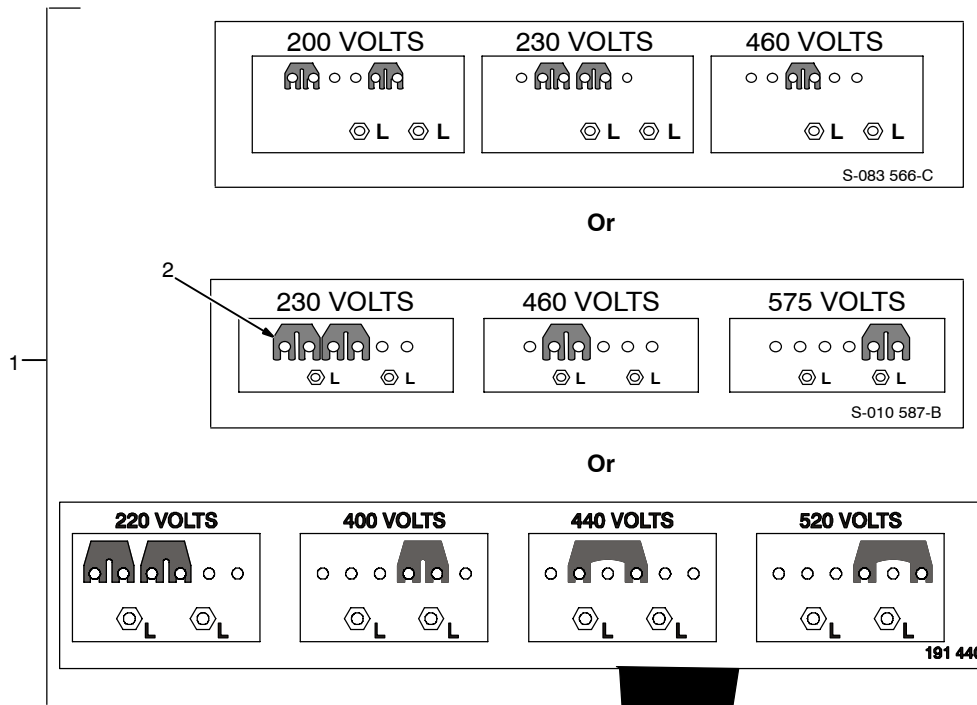
1 Jumper Link Label

Check label – only one label is on unit.

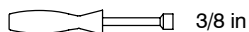
2 Jumper Links

Move jumper links to match input voltage.

Close and secure access door, or go on to Section 3-18.

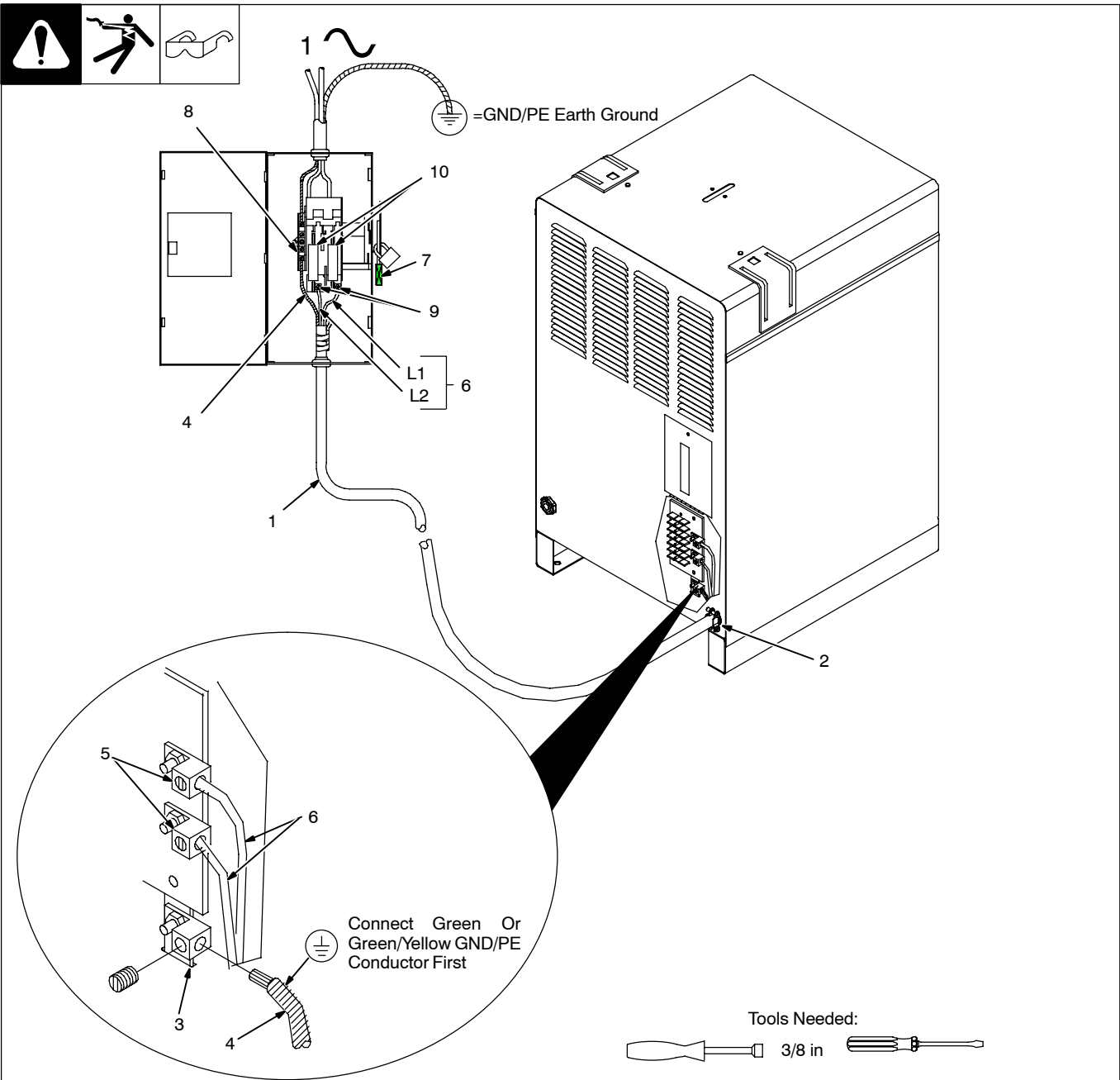


Tools Needed:



Ref. 801 973-B

3-18. Connecting Input Power



Ref. 802 136-A / Ref. 801 973-B

▲ Installation must meet all National and Local Codes – have only qualified persons make this installation.

▲ Disconnect and lockout/tagout input power before connecting input conductors from unit.

▲ Make input power connections to the welding power source first.

▲ Always connect green or green/yellow conductor to supply grounding terminal first, and never to a line terminal.

See rating label on unit and check input voltage available at site.

1 Input Power Conductors (Customer Supplied Cord)

Select size and length of conductors using Section 3-16. Conductors must comply with national, state, and local electrical codes. If applicable, use lugs of proper amperage capacity and correct hole size.

Welding Power Source Input Power Connections

2 Strain Relief

Route conductors (cord) through strain relief and tighten screws.

3 Machine Grounding Terminal

4 Green Or Green/Yellow Grounding Conductor

Connect green or green/yellow grounding conductor to welding power source grounding terminal first.

5 Welding Power Source Line Terminals

6 Input Conductors L1 (U) And L2 (V)

Connect input conductors L1 (U) and L2 (V) to welding power source line terminals.

Close and secure access door on welding power source.

Disconnect Device Input Power Connections

7 Disconnect Device (switch shown in OFF position)

8 Disconnect Device (Supply) Grounding Terminal

Connect green or green/yellow grounding conductor to disconnect device grounding terminal first.

9 Disconnect Device Line Terminals

Connect input conductors L1 (U) and L2 (V) to disconnect device line terminals.

10 Over-Current Protection

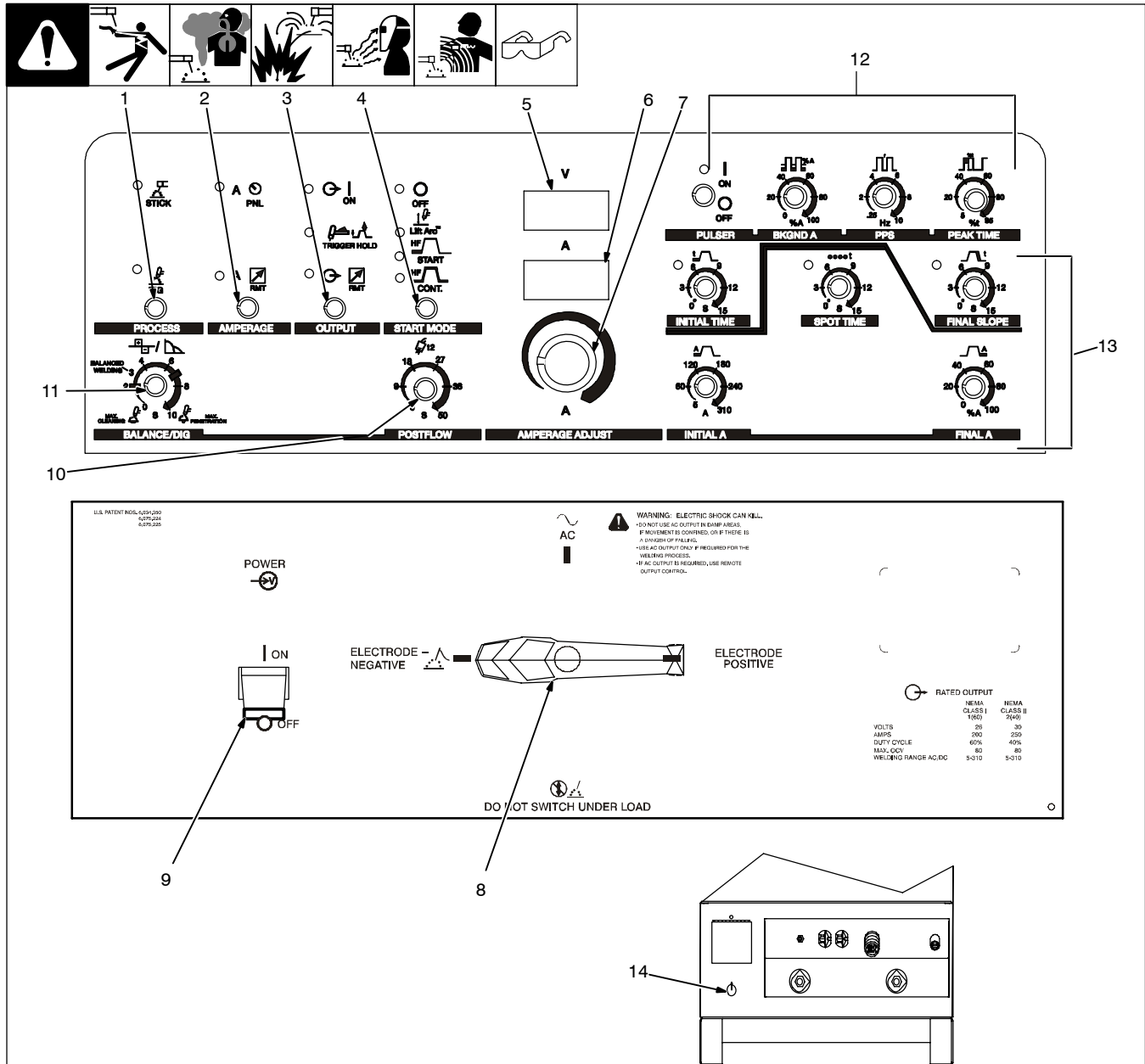
Select type and size of over-current protection using Section 3-16 (fused disconnect switch shown).

Close and secure door on line disconnect device. Remove lockout/tagout device, and place switch in the On position.

SECTION 4 – OPERATION

4-1. Controls

A. For 200/230/460 Volts And Non CE Units



☐ Top row of lights in upper left corner are On for SMAW. Bottom row are On for GTAW.

Green on nameplate indicates a TIG function, Gray indicates a Stick function.

1 Process Control

See Section 4-3.

2 Amperage Control

See Section 4-4.

3 Output Control

See Section 4-5.

4 Start Mode Control

See Section 4-9.

5 Voltmeter

See Section 4-10

6 Ammeter

See Section 4-10

7 Amperage Adjustment Control

See Section 4-11.

8 Output Selector Switch

See Section 4-2.

9 Power Switch

Use switch to turn unit Off and On.

10 Postflow Time Control

See Section 4-14.

11 Balance/DIG Control

See Section 4-12.

12 Pulser Controls (Optional)

See Section 4-15.

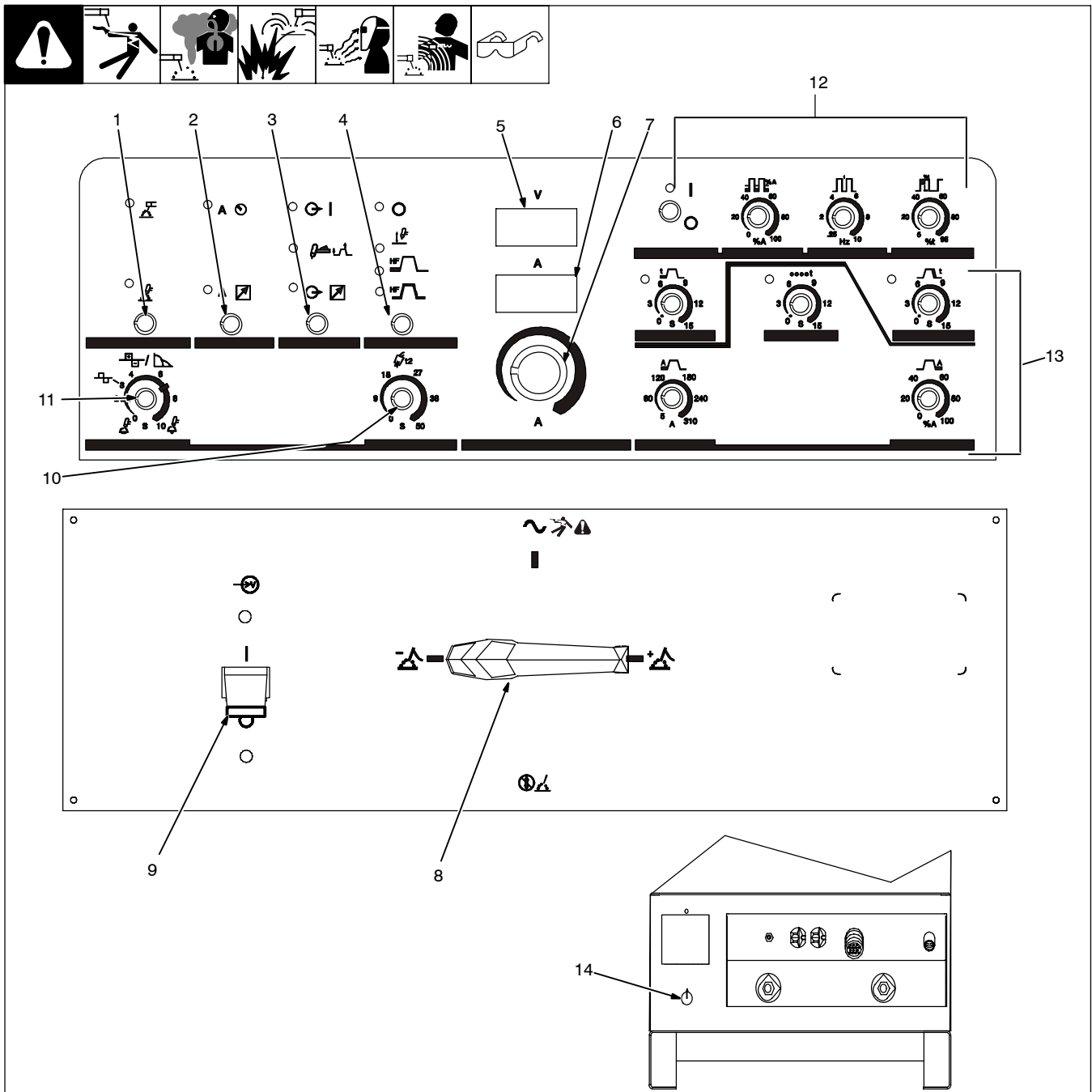
13 Sequence Controls (Optional)

See Section 4-17.

14 High Frequency Control (Prior To Serial No LC344556)

See Section 4-16.

B. For CE Units



☑ Top row of lights in upper left corner are On for SMAW. Bottom row are On for GTAW.

Green on nameplate indicates a TIG function, Gray indicates a Stick function.

1 Process Control

See Section 4-3.

2 Amperage Control

See Section 4-4.

3 Output Control

See Section 4-5.

4 Start Mode Control

See Section 4-9.

5 Voltmeter

See Section 4-10

6 Ammeter

See Section 4-10

7 Amperage Adjustment Control

See Section 4-11.

8 Output Selector Switch

See Section 4-2.

9 Power Switch

Use switch to turn unit Off and On.

10 Postflow Time Control

See Section 4-14.

11 Balance/DIG Control

See Section 4-12.

12 Pulser Controls (Optional)

See Section 4-15.

13 Sequence Controls (Optional)

See Section 4-17.

14 High Frequency Control

(Prior To Serial No LC344556)

See Section 4-16.

4-2. Output Selector Switch

1 Output Selector Switch

▲ Do not use AC output in damp areas, if movement is confined, or if there is danger of falling. Use AC output ONLY if required for the welding process, and then use a remote control.

▲ Do not change position of switch while welding or while under load.

Use switch to select (DCEN) Direct Current Electrode Negative, AC, or (DCEP) Direct Current Electrode Positive output.

NOTE: Changing position of Output Selector switch may also change Process control, Current control, and Start Mode control settings to properly function with latest Output Selector switch setting.

4-3. Process Control

1 Process Control

Use control to select Shielded Metal Arc Welding (SMAW) or Gas Tungsten Arc Welding (GTAW) process.

For SMAW, press button to toggle LED to Stick position.

For GTAW, press button to toggle LED to TIG position.

NOTE: Lit LED indicates selected mode.

When Output Selector switch position changes, LED may change position, based upon last selection.

Ref. 196 616 / Ref. 196 764

4-4. Amperage Control

1 Amperage Control

Use control to select front panel or remote amperage control.

For front panel amperage control, press button to toggle LED to Panel position.

For remote amperage control, press button to toggle LED to Remote position (see Section 3-7).

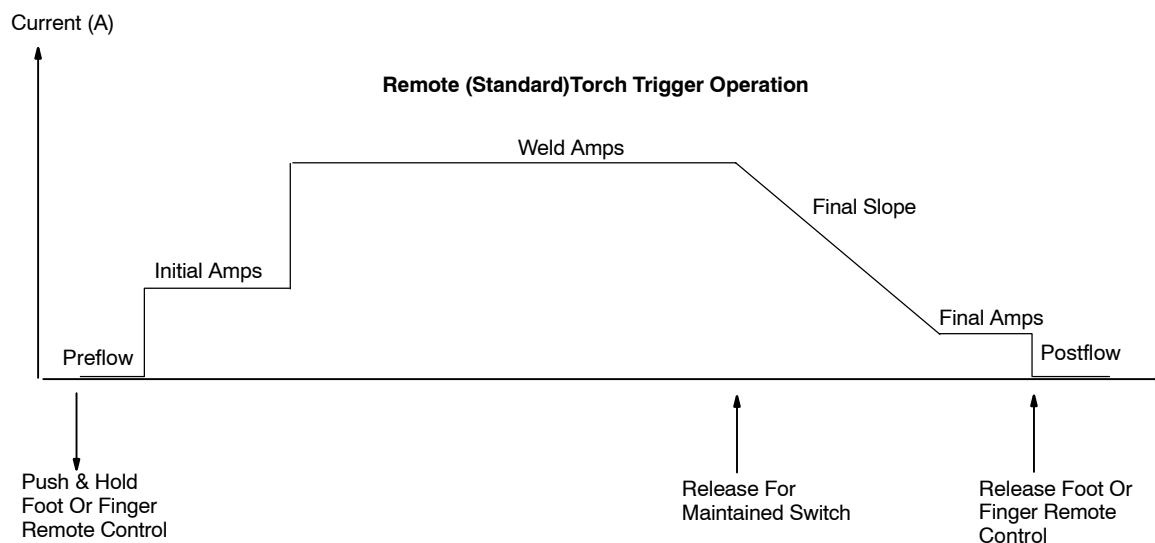
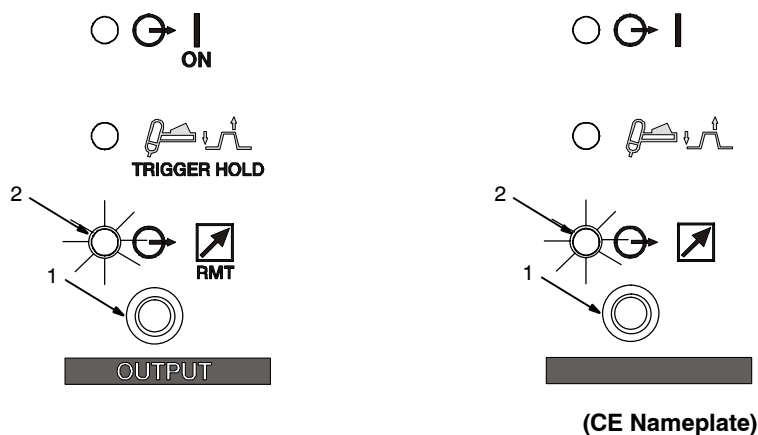
NOTE: Lit LED indicates selected mode.

When Output Selector switch position changes, LED may change position, based upon last selection.

4-5. Output Control



Remote (Standard) Torch Trigger Operation



1 Output Control

▲ **Weld output terminals are energized when power is On, and Output On LED is lit.**

Use control to select front panel, trigger hold, or remote output control.

NOTE: Lit LED indicates selected mode.

For weld output, press button to toggle LED to On position.

2 Remote Trigger (Standard) Operation

For remote output control, press button to toggle LED to Remote position (see Section 3-7).

Torch trigger operation is as shown.

NOTE: Initial weld amperage and final amperage is controlled by the remote device, not by the welding power source.

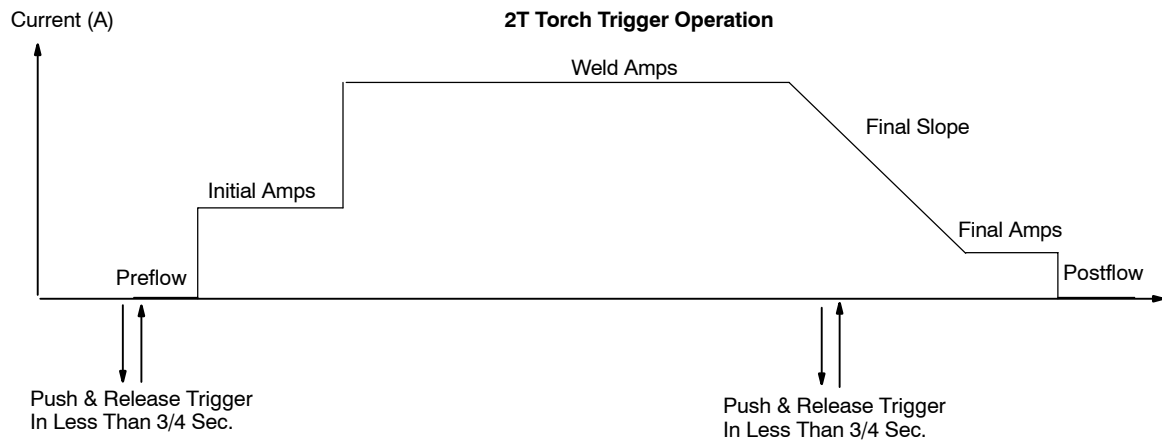
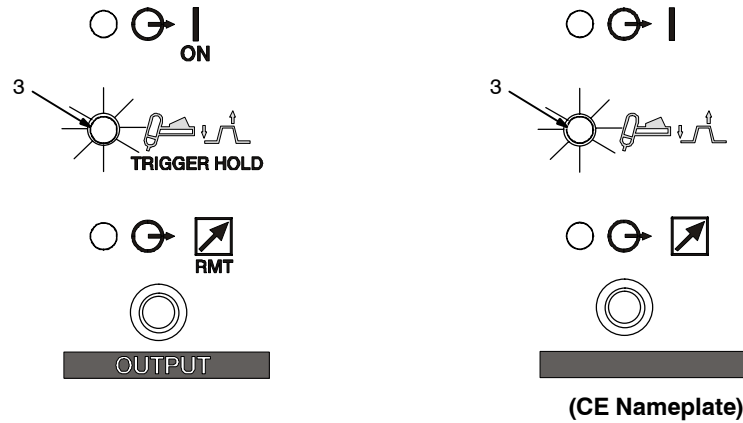
NOTE: If On/Off only type trigger is used, it must be a maintained switch. All functions become active.

Application: Use Remote Trigger when the operator desires to use a foot pedal or finger amperage control.

When Output Selector switch (see Section 4-2) position changes, Output control LED will always switch to Remote.

When Output On is selected, HF and gas control are disabled.

Trigger Hold (2T)



NOTE: If torch trigger is held more than 3 seconds, operation reverts to Remote Trigger (Standard) mode (see previous page). If arc is broken and trigger is depressed, HLP-10 will be displayed (see Section 6-2).



3 Trigger Hold

For trigger hold operation, press button to toggle LED to Trigger Hold position.

Torch trigger operation is as shown.

NOTE: When a foot or finger remote control is connected to the welding power source, only trigger input is functional.

NOTE: Amperage is controlled by the

welding power source.

Application: Use Trigger Hold (2T) when long extended welds are made. Trigger Hold (2T) can help to reduce operator fatigue.

4-6. 4T, 4T Momentary And Mini Logoic Trigger Operation (Requires Optional Sequence Controls)

4T Torch Trigger Operation

If unit is equipped with optional Sequence Controls (see Section 4-17), 4T trigger method is available.

4T torch trigger operation is as shown.

While in 4T mode, there is a feature available during the main weld sequence that al-

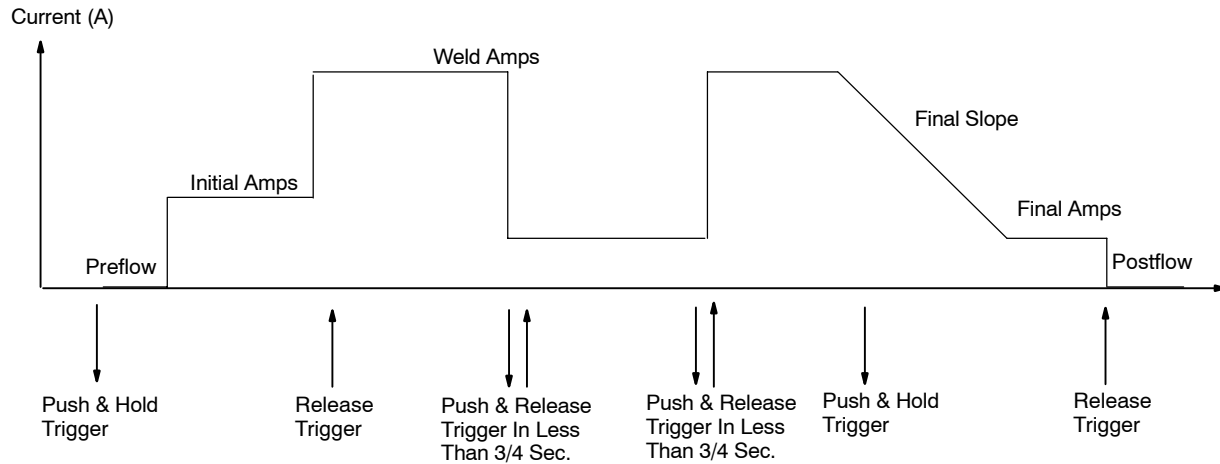
lows the operator to toggle between weld current and final current without breaking the arc.

NOTE: When a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by the welding power source.

Application:

Use 4T trigger method when the functions of a remote current control are desired, but only a remote on/off control is available.

Select 4T trigger method according to Section 4-7.



4T Momentary Torch Trigger Operation

If unit is equipped with optional Sequence Controls (see Section 4-17), 4T Momentary trigger method is available.

4T Momentary torch trigger operation is as shown.

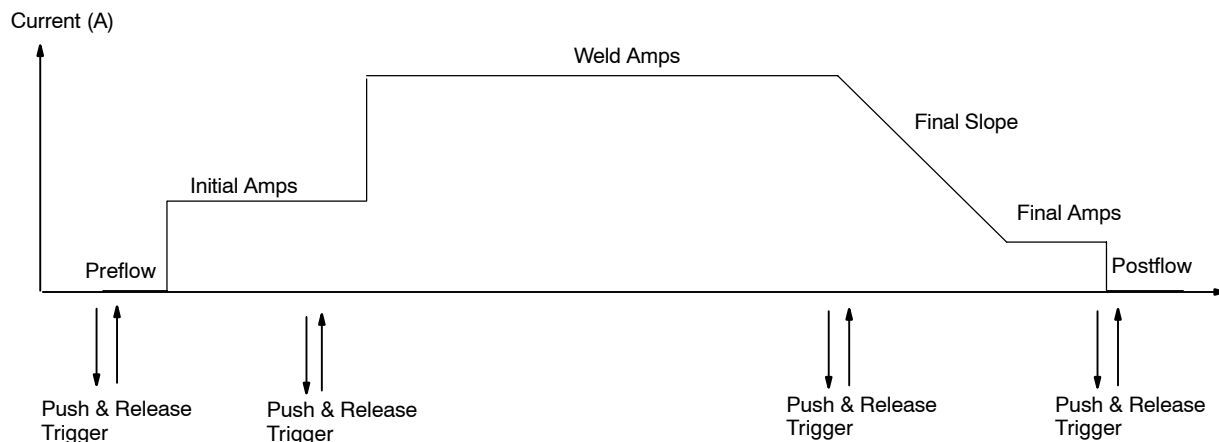
While in 4T Momentary mode, once the operator toggles out of weld current and begins final slope, toggling again will break the arc and go to postflow.

NOTE: When a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by the welding power source.

Application:

Use 4T Momentary trigger method when the functions of a remote current control are desired, but only a remote on/off control is available.

Select 4T Momentary trigger method according to Section 4-7.



Mini Logic Operation

If unit is equipped with optional Sequence Controls (see Section 4-17), Mini Logic operation is available.

Torch trigger operation is as shown.

During Mini Logic welding operation, the weld amperage can be manually changed

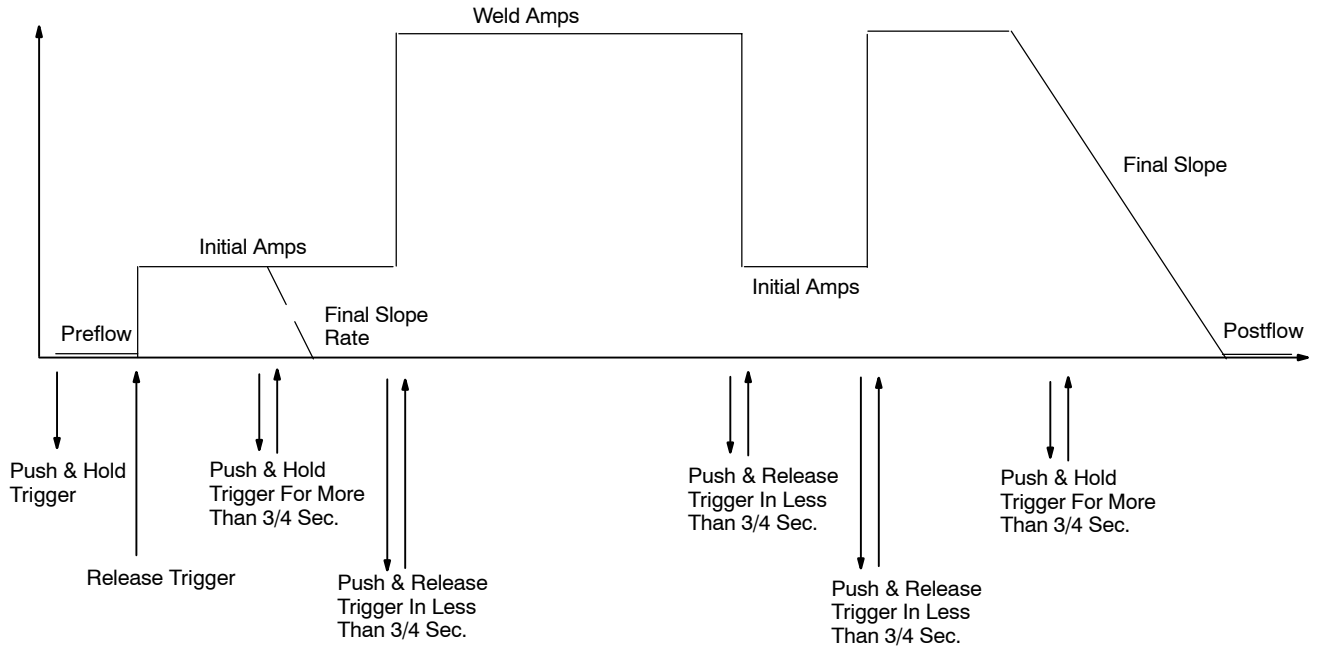
from the initial amps level to the main weld amps level by pressing and releasing the torch trigger in less than 3/4 seconds.

NOTE: When a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by

the welding power source.

Application: This ability to change amperage levels without either initial slope or final slope, gives the operator the opportunity to adjust filler metal without breaking the arc.

Select Mini Logic according to Section 4-7.



4-7. Reconfiguring Trigger Hold For 4T And Mini Logic Control

- 1 Output Control
- 2 Power Switch

To reconfigure Trigger Hold, turn Off power, push and hold Output control button and turn On power switch. Hold button for approximately 7 seconds (or until software version number `SEL` - clears, and meters display `[SEL] [H-2]`.

Press Output control button to change functions. Active function will be displayed on amperage (bottom) meter.

3 Meter Displays

Meter displays for the different functions will be as shown.

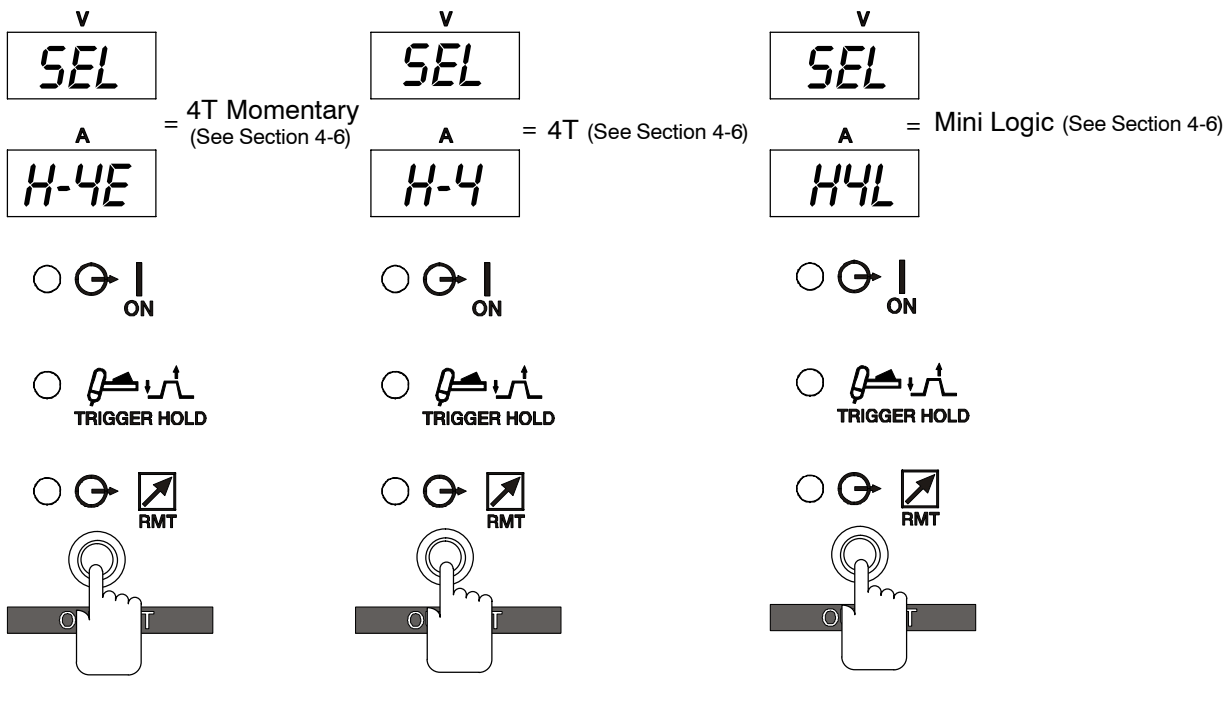
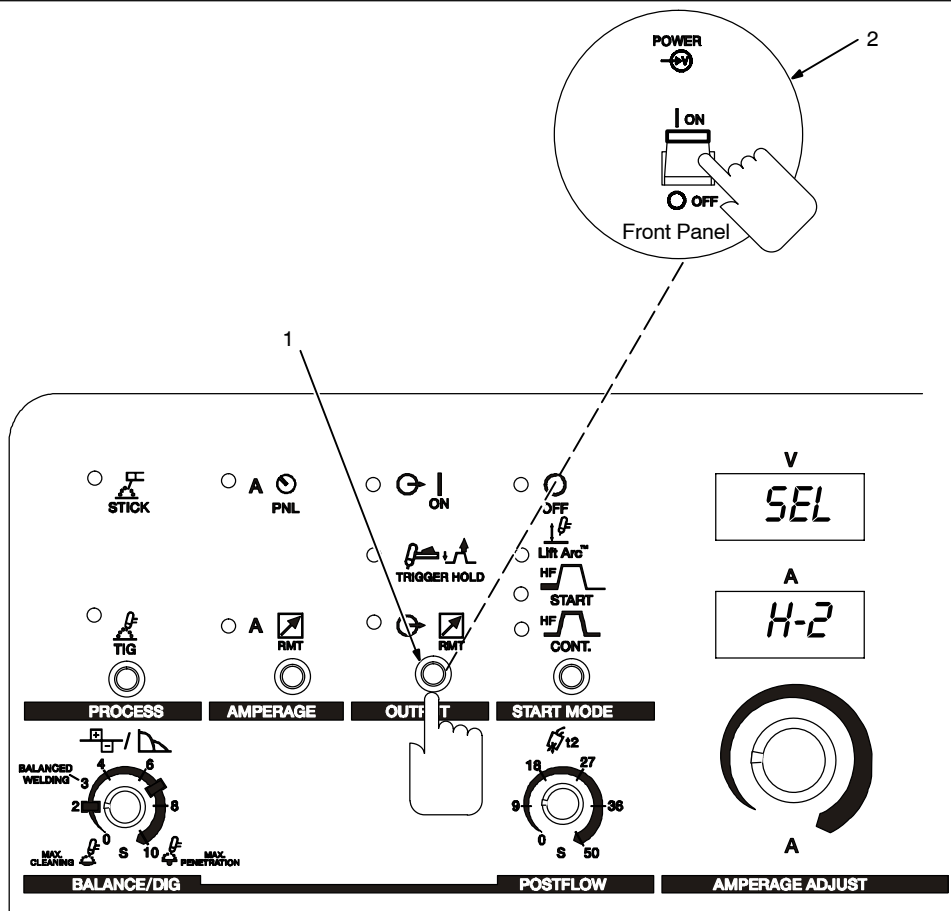
Press torch trigger or turn power Off to save setting.

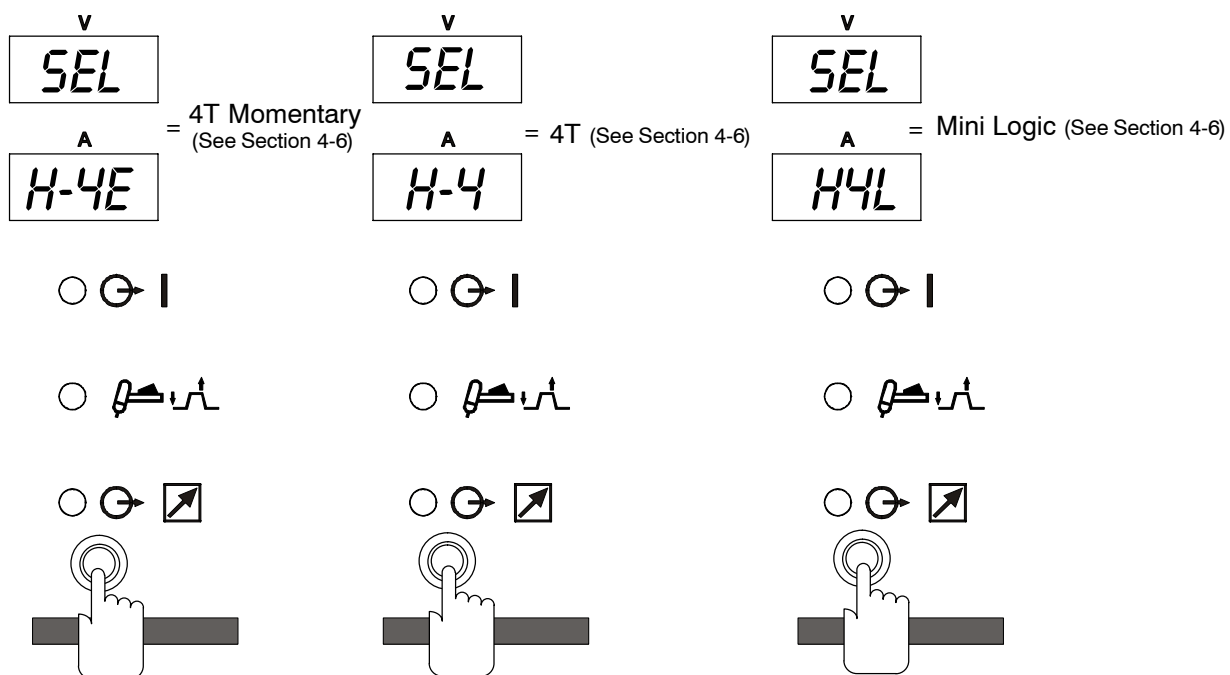
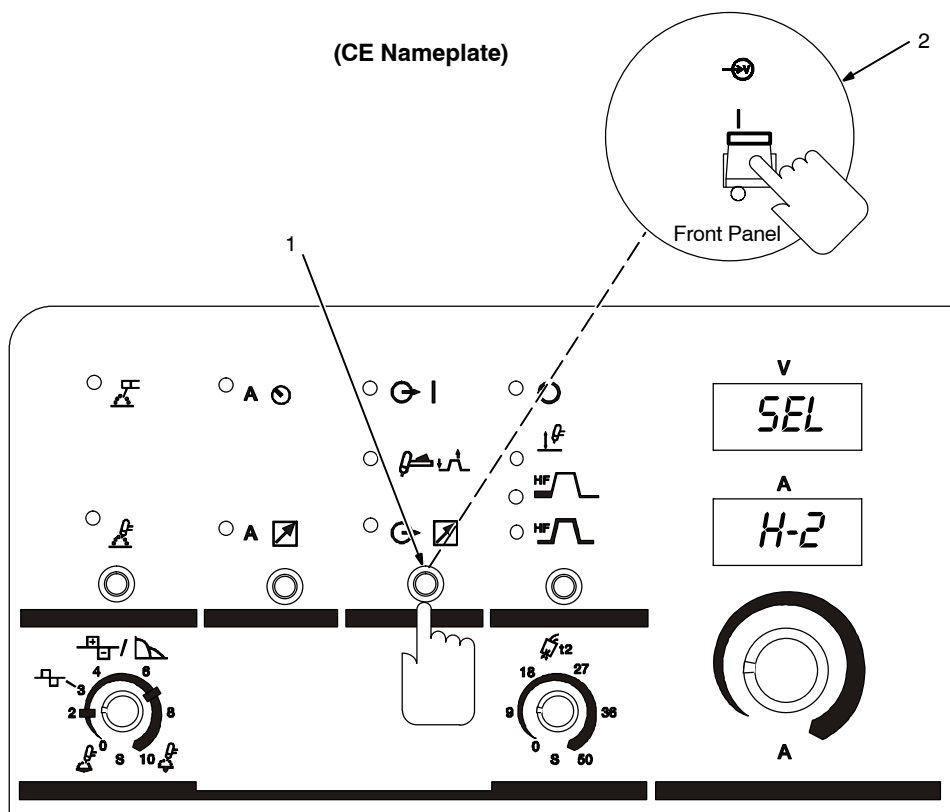
Proceed to Section 4-6 for 4T Operation.

Proceed to Section 4-6 for Mini Logic operation.

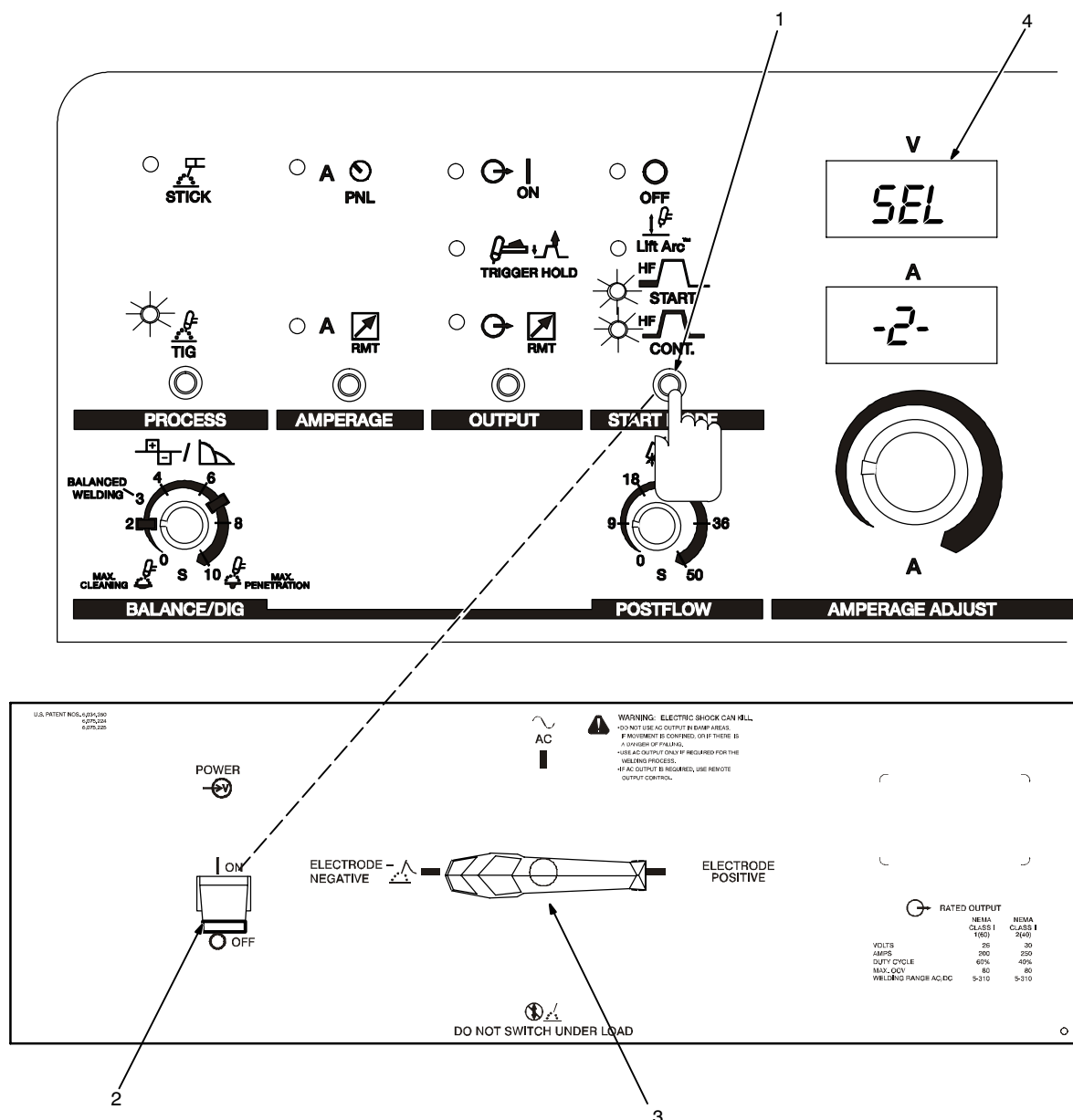
Proceed to Section 4-6 for 4T Momentary operation.

NOTE: These features are only available when optional Sequencer is installed.





4-8. Selecting TIG Starting Characteristics



Use this function to select desired TIG starting characteristics.

- 1 Start Mode
- 2 Power Switch
- 3 Output Selector Switch
- 4 Meters

To select or change TIG starting characteristics, proceed as follows: turn Off power. Place Output Selector switch in desired position (each position, DCEN, AC, or DCEP has three applicable start characteristics op-

tions). Push and hold Start Mode button and turn On power. Hold button for approximately 7 seconds (or until software version number _____ clears meters).

The TIG LED and all four Start LEDs will light, and the meters will display [SEL] [-2].

Press Start Mode button again to step through the three start characteristics choices. Amperage (bottom) meter displays active choice 1= light start, 2=medium/normal start, 3=high/hot start.

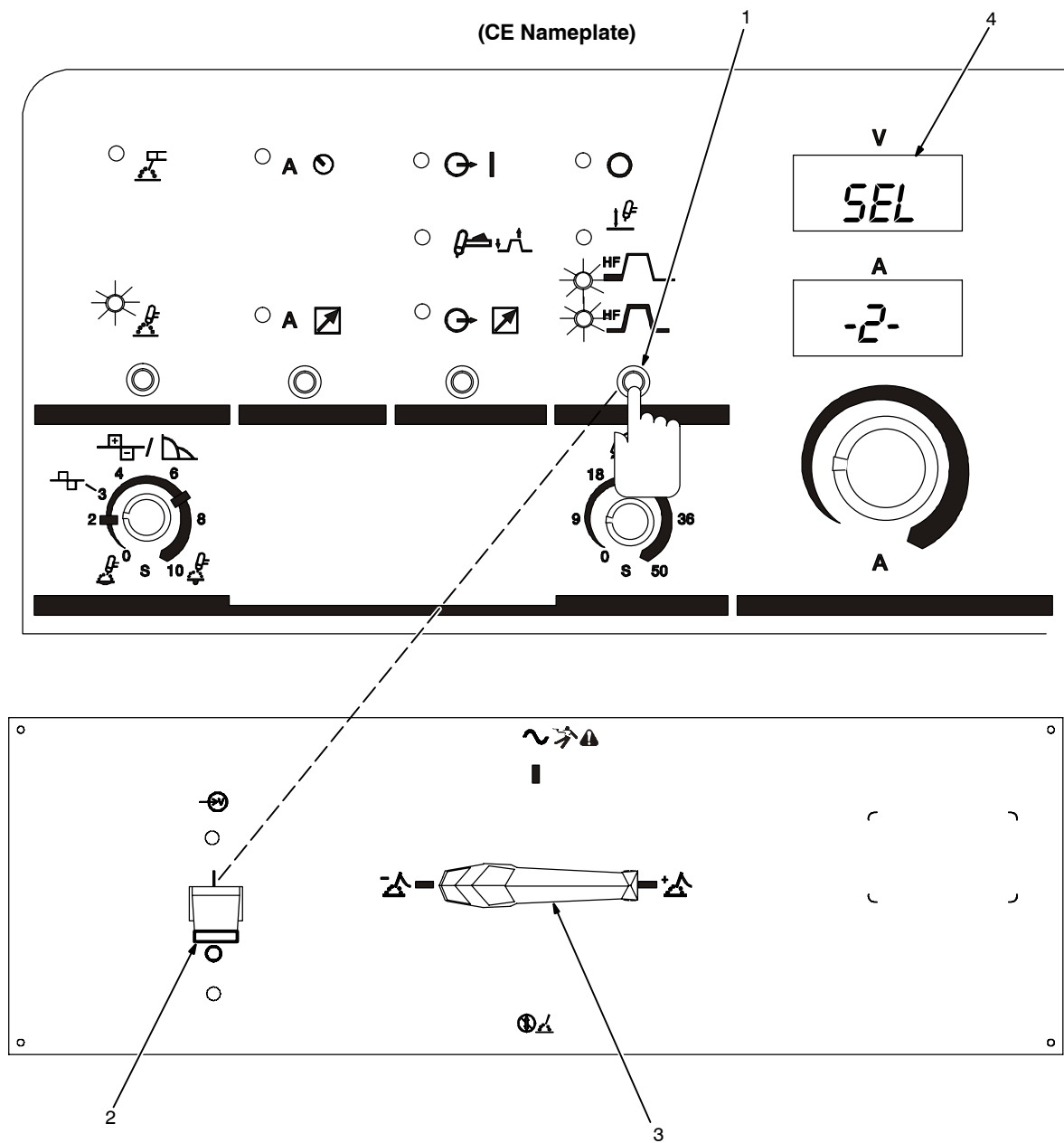
Press torch trigger or turn Off power to save setting.

Application:

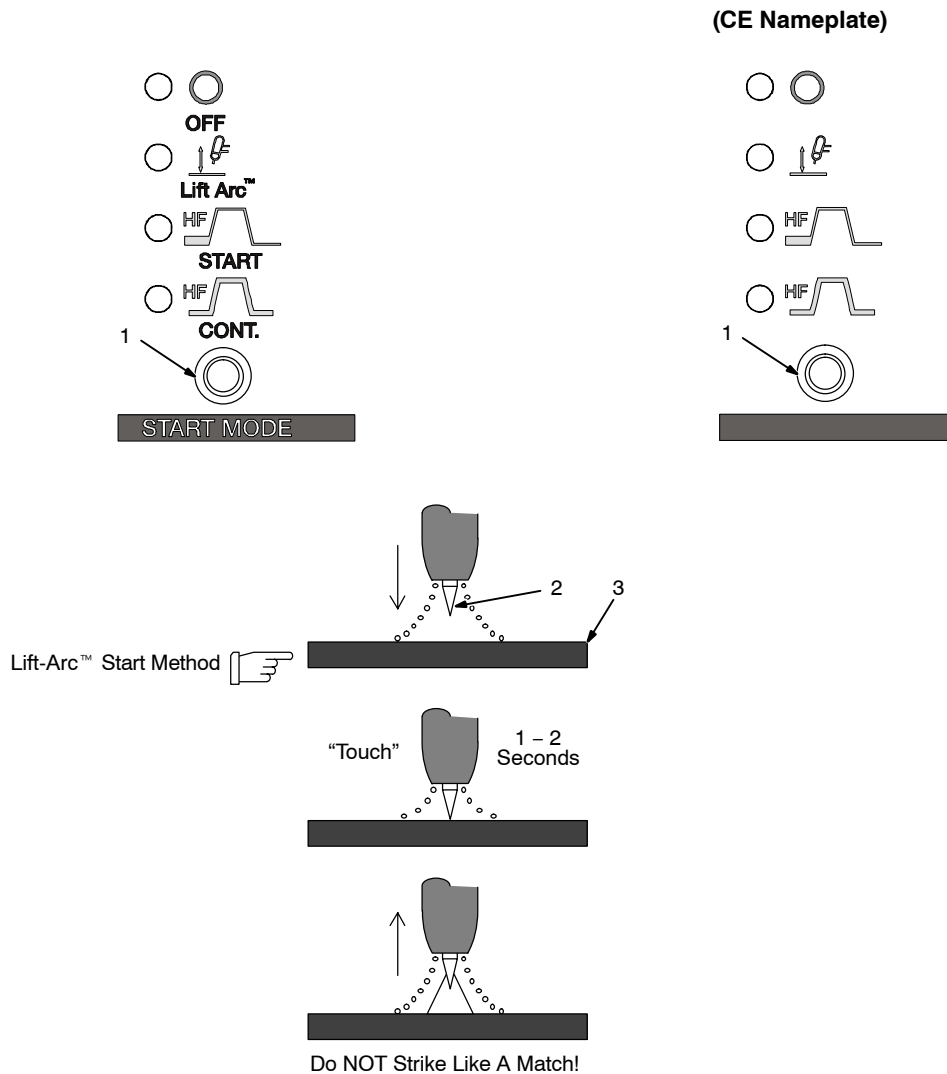
Select 1 (light/soft start) – when welding at low amperages on thin gauge material.

Select 2 (medium/normal start) – factory default setting used for most welding applications.

Select 3 (high/hot start) – when welding at high amperages on thick materials with a large diameter tungsten.



4-9. Start Mode



1 Start Mode

For SMAW welding, press button to toggle LED to Off position.

For GTAW welding, use control to select Off for no HF, Lift-Arc™, HF for arc starting only, or continuous HF. See Section 4-16 for adjusting high frequency intensity.

Application:

When Off is selected, use the scratch method to start an arc for both the SMAW and GTAW processes.

When Lift-Arc is selected, start arc as follows:

2 TIG Electrode

3 Workpiece

Touch tungsten electrode to workpiece at weld start point, enable output with torch trigger, foot control, or hand control. **Hold electrode to workpiece for 1-2 seconds,**

and slowly lift electrode. An arc will form when electrode is lifted.

Shielding gas begins to flow when electrode touches work piece only if remote is turned on or if output is turned on.

Normal open-circuit voltage is not present before tungsten electrode touches workpiece; only a low sensing voltage is present between electrode and workpiece. The solid state output contactor does not energize until after electrode is touching workpiece. This allows electrode to touch workpiece without overheating, sticking, or getting contaminated.

Application:

Lift-Arc is used for the DCEN GTAW process when HF Start method is not permitted, or to replace the scratch method.

When HF Start is selected, start arc as follows:

High frequency turns on to help start arc when output is enabled. High frequency

turns off when arc is started, and turns on whenever arc is broken to help restart arc.

Application:

HF Start is used when the DCEN GTAW process is required.

When HF Continuous is selected, start arc as follows:

High frequency turns on when output is energized and remains on for duration of weld.

Application:

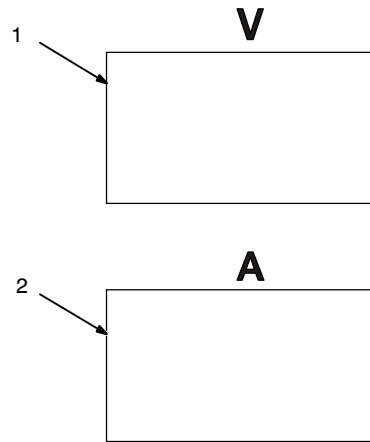
HF Continuous is used when the AC GTAW process is required.

NOTE: Lit LED indicates selected mode.

When Output Selector switch position changes, LED may change position, based upon last selection.

NOTE: Some start methods may not be available for all processes.

4-10. Meters

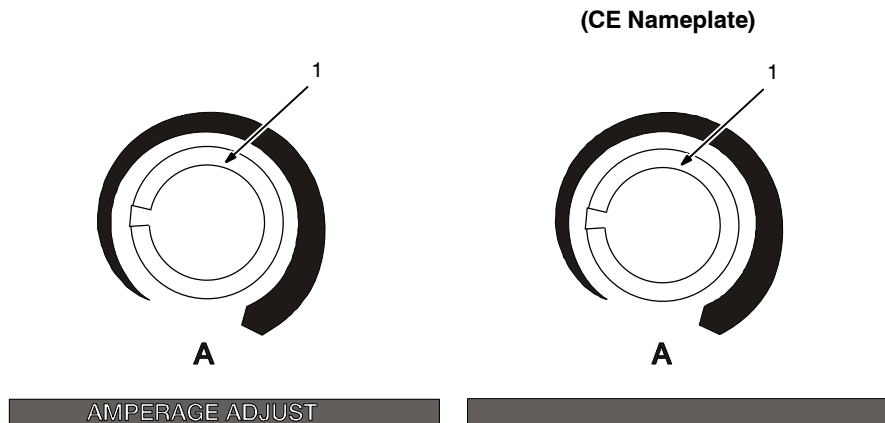


V 1 Voltmeter
Voltmeter displays average voltage (to the nearest 0.1 V) at the weld output terminals.

A 2 Ammeter
Use meter to preset amperage. Meter displays average weld amperage output of unit to nearest ampere when welding.

NOTE: Meters are self-calibrating. No adjustment available.

4-11. Amperage Adjustment Control



1 Amperage Adjustment Control
Use control to adjust amperage, and preset amperage on ammeter (see Section 4-10). This control may be adjusted while welding.

For remote amperage control, front panel control setting is the maximum amperage available. For example: If front panel control is set to 200 A, the range of the remote amperage control is 5 to 200 A.

For pulse welding, use Amperage Adjust control to select from 5–300 amps of peak amperage (see Section 4-15).

For spot welding, use Amperage Adjust control to select from 5–300 amps of peak amperage (see Section 4-20).

4-12. Balance/DIG Control

(CE Nameplate)



1 Balance/DIG Control

Balance Control (AC GTAW):

Control changes the AC output square wave. Rotating the control towards 10 provides deeper penetration. Rotating the control towards 0 provides more cleaning action of the workpiece.

When the control is in the Balanced position, the wave shape provides equal penetration and cleaning action.

Application:

When welding on oxide forming materials such as aluminum or magnesium, excess cleaning is not necessary. To produce a good weld, only a minimal amount, approximately a 0.10 in (2.5mm) of etched zone along the weld toes is required.

Set control to 7 and adjust as necessary. Joint configuration, set-up, process variables, and oxide thickness may affect setting.

NOTE: Arc rectification can occur when welding above 200 amps and/or while welding with helium gas. If this condition occurs, increasing the Balance control towards maximum penetration, may help to restabilize the arc.

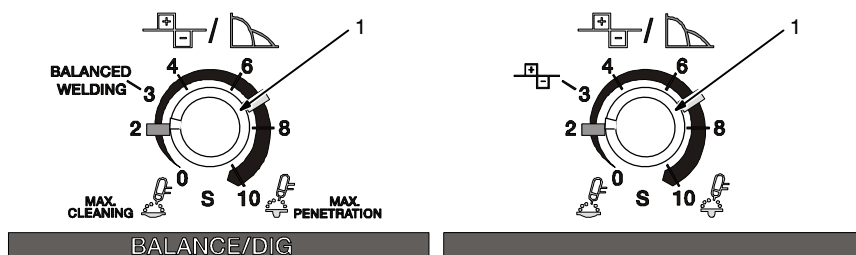
DIG Control (AC And DC SMAW):


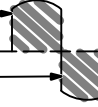
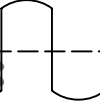
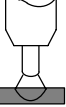

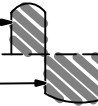
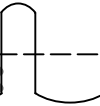
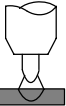

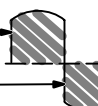
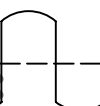

When set at 0, short-circuit amperage at low arc voltage is the same as normal welding amperage.

When setting is increased, short-circuit amperage at low arc voltage increases.

Application:

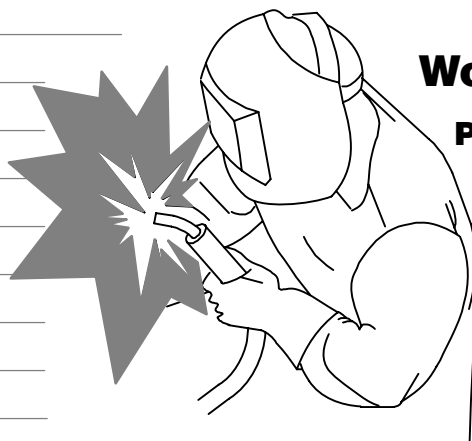
Control helps arc starting or making vertical or overhead welds by increasing amperage at low arc voltage, and reduces electrode sticking while welding.



Balance Control Examples		
Setting	Output Waveforms	Arc
Balanced 	50% Electrode Positive  50% Electrode Negative 	
More Penetration 	32% Electrode Positive  68% Electrode Negative 	
More Cleaning 	55% Electrode Positive  45% Electrode Negative 	

Ref. S-0795-A

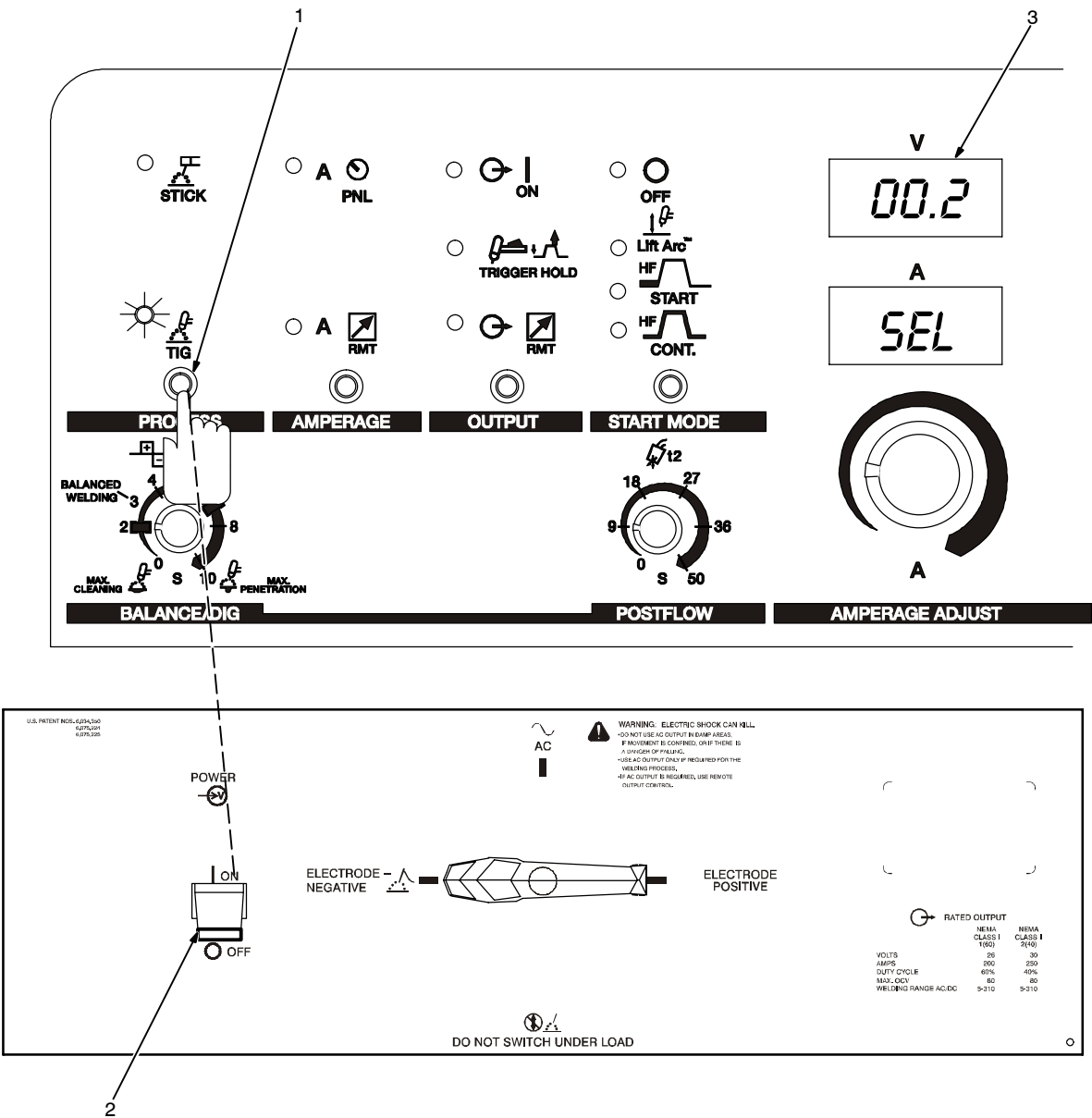
Notes



Work like a Pro!

Pros weld and cut safely. Read the safety rules at the beginning of this manual.

4-13. Preflow Time Control



Use control to set length of time (0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 or 5.0 seconds) gas flows before welding starts.

1 Process Control
2 Power Switch
3 Meters

To change preflow time, proceed as follows:

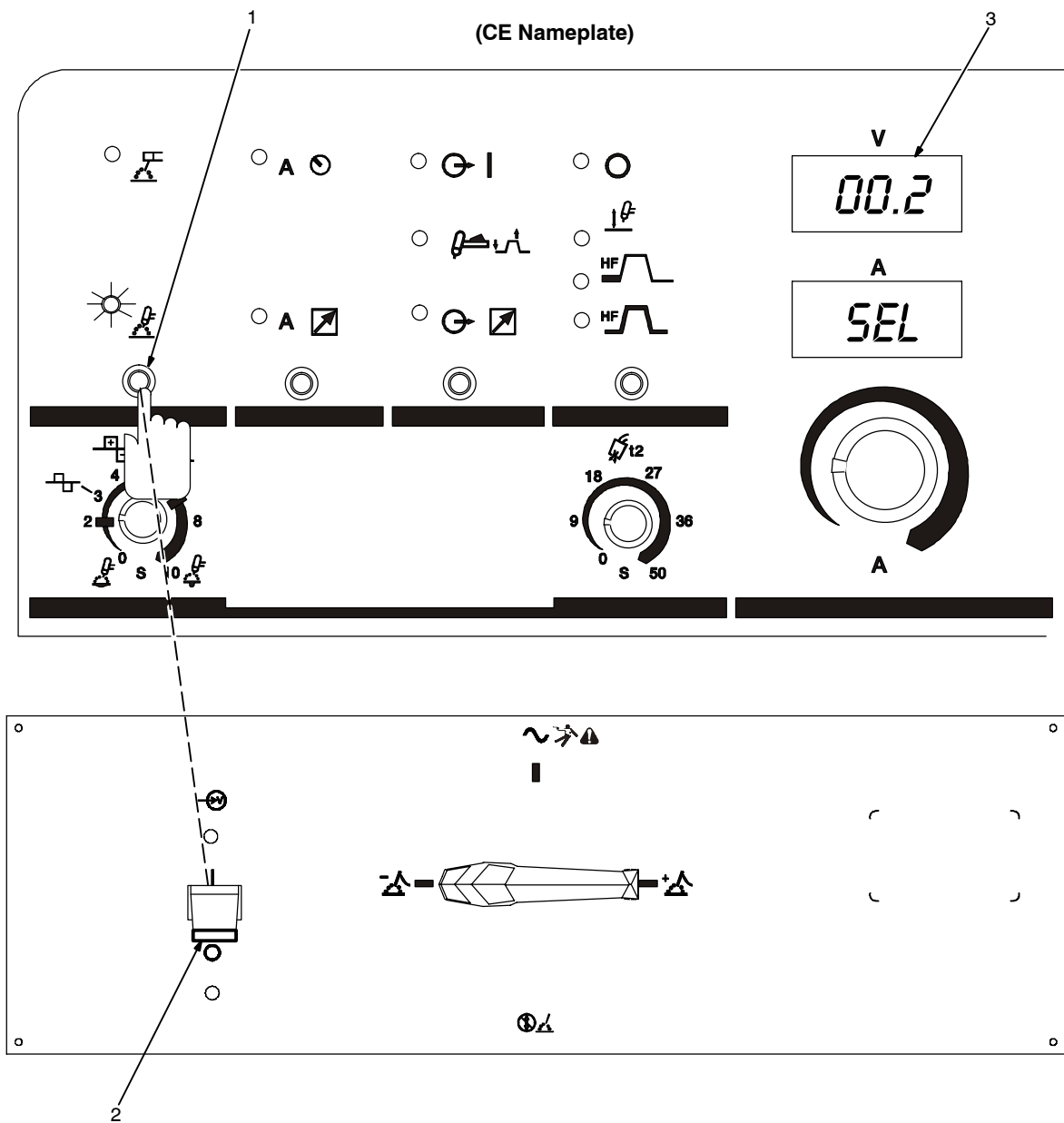
Turn power off. Push and hold Process Control button and turn On power. Hold button for approximately 7 seconds (or until software version number _____ clears meters).

The TIG LED will light and the meters will display [0.2] [SEL]. The factory preflow default setting is 0.2 seconds. To change preflow

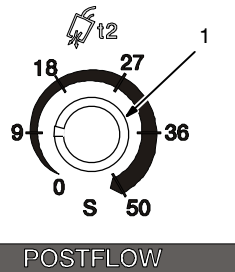
time, press and release Process Control button until desired time is displayed on meters.

Application:

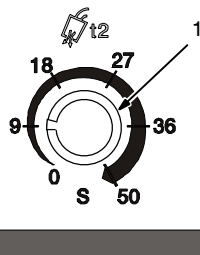
Preflow is used to purge the immediate weld area of atmosphere. Preflow also aids in consistent arc starting.



4-14. Postflow Time Control



(CE Nameplate)



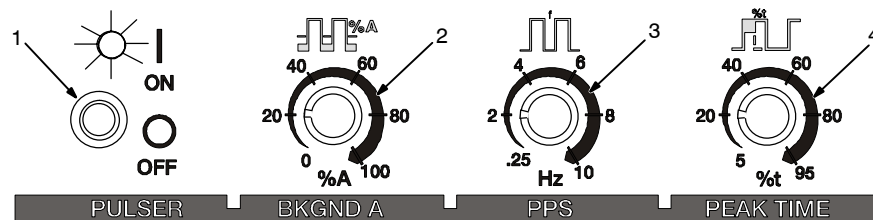
1 Postflow Time Control

Use control to set length of time (0–50 seconds) gas flows after welding stops. It is important to set enough time to allow gas to flow until after the tungsten and weld puddle has cooled down.

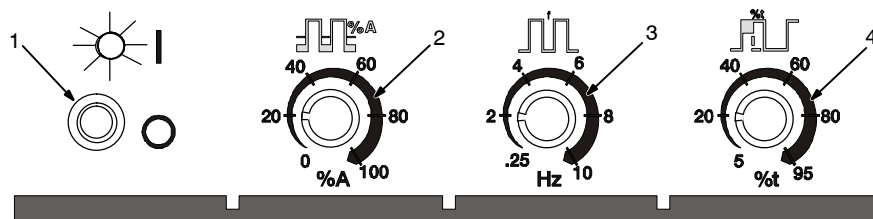
Application:

Postflow is required to cool tungsten and weld, and to prevent contamination of tungsten and weld. Increase postflow time if tungsten or weld are dark in appearance (approximately 1 second per 10 ampere of welding current).

4-15. Pulse Controls (Optional)



(CE Nameplate)



5

Percent (%) Peak Time Control Setting	Pulsed Output Waveforms
Balanced (50%) 	
More Time At Peak Amperage (80%) 	
More Time At Background Amperage (20%) 	

- 1 On/Off Control
Use control to turn pulse function On and Off.

- 2 Background Amps
Use Background Amps control to set the low pulse of the weld amperage, which cools the weld puddle and affects overall heat input. Background Amps is set as a percentage of peak amperage.

- 3 Pulse Frequency
Ranges from 0.25–10.0 pps (pulses per second). Control is used to determine appearance of weld bead.

- 4 Peak Time
A range of 5–95% of each pulse cycle can be spent at the peak amperage level.

Peak amperage (5–310 amps), is set with the Amperage Adjustment control (see Section 4-1). Peak amperage is the highest welding amperage allowed to occur in the pulse cycle. Weld penetration varies directly with peak amperage.

5 Pulsed Output Waveforms

Example shows affect changing the Peak Time control has on the pulsed output waveform.

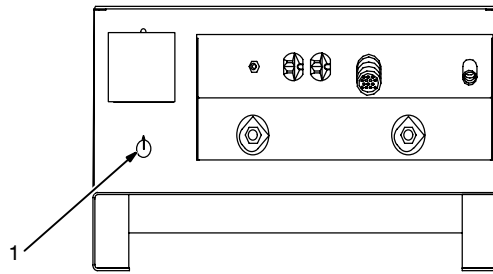
Application:

Pulsing refers to the alternating raising and lowering of the weld output at a specific rate. The raised portions of the weld output are controlled in width, height, and frequency, forming pulses of weld output. These pulses and the lower amperage level between them (called the background amperage) alternately heat and cool the molten weld puddle. The combined effect gives the operator better control of penetration, bead width, crowning, undercutting, and heat input. Controls can be adjusted while welding.

Pulsing can also be used for filler material addition technique training.

NOTE: Function is enabled, when LED is lit.

4-16. High Frequency Control (Prior To Serial No LC344556)



Ref. 801 972

▲ **Do not use high frequency while Shielded Metal Arc Welding (SMAW).**

1 High Frequency Control

For GTAW, use control to set HF intensity. Set as low as possible.

Application:

If HF is present at the tungsten, the control is set high enough.

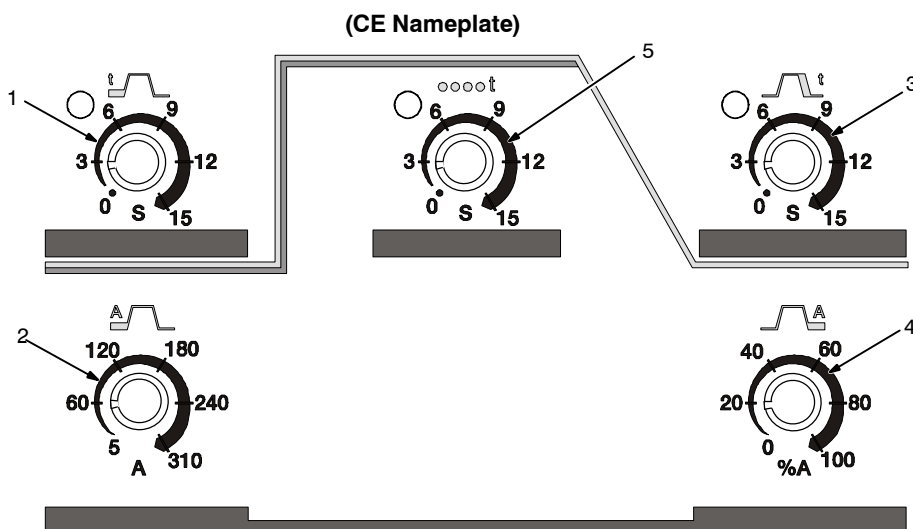
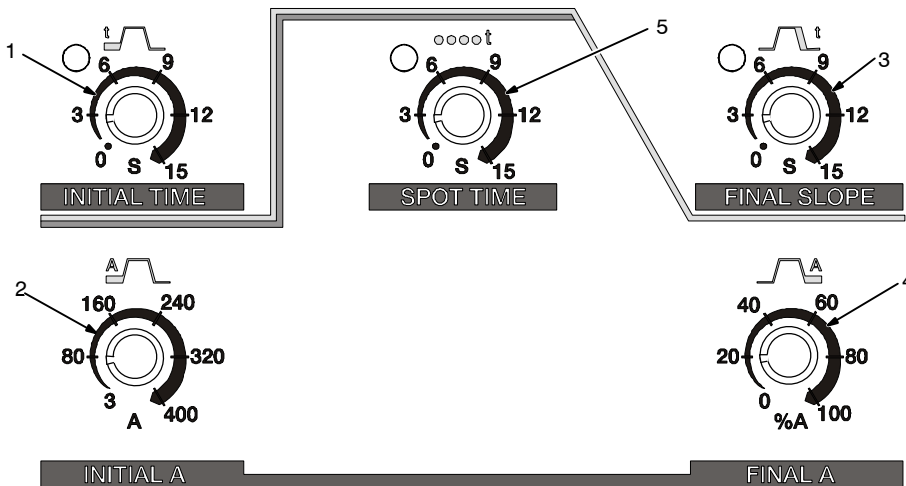
NOTE: Arc rectification can occur when welding above 200 amps and/or while welding with helium gas. If this condition occurs, increasing the HF Intensity control towards maximum, may help to re-stabilize the arc.

☞ *As high frequency intensity is increased, the possibility of interfering with local electronic devices, especially communication equipment, also increases. Set control as low as possible to avoid such interference.*

4-17. Sequence Controls (Optional)



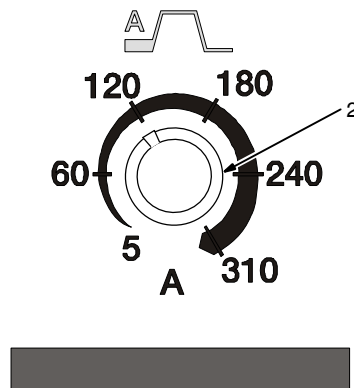
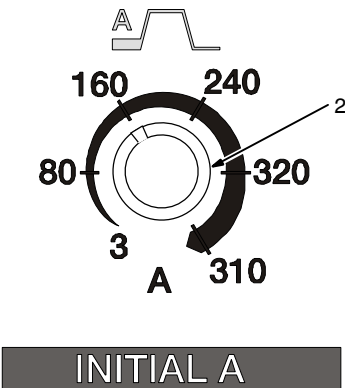
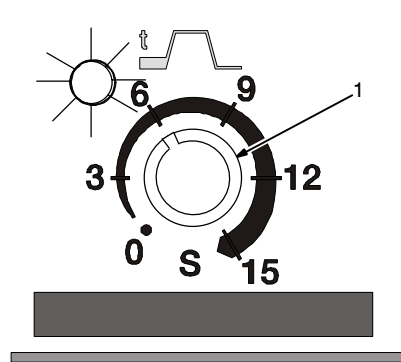
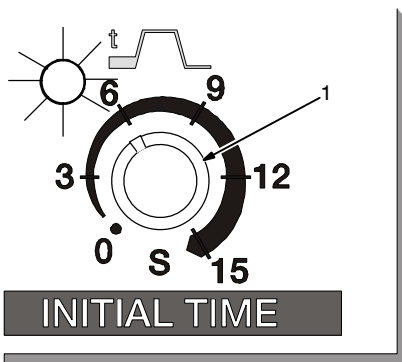
- 1 Initial Time Control
See Section 4-18.
- 2 Initial Amperage Control
See Section 4-18.
- 3 Final Slope Control
See Section 4-19.
- 4 Final Amperage Control
See Section 4-19.
- 5 Spot Time Control
See Section 4-20.



Ref. 196 616 / Ref. 196 764

4-18. Initial Time Control And Initial Amperage Control

(CE Nameplate)



1 Initial Time Control



Indicator light is on when Initial Time control function is active.

NOTE: Initial Sequence control function is inactive when Spot Time function is active.

Use control to select 0–15 seconds of start time.



2 Initial Amperage Control



Indicator Light is on when Initial Sequence control function is active.

NOTE: Initial Amperage control function is inactive when Spot Time function is active.

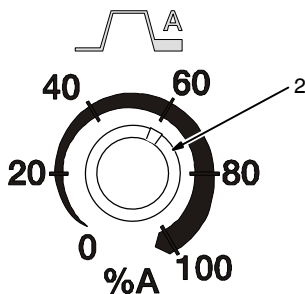
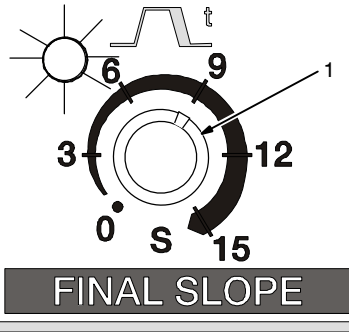
Use control to select a starting amperage (5–310 amps) that is different from the weld amperage. Note: Initial Amperage can be used with or without a remote control (Initial Amperage and Initial Time control settings will override a remote control device).

Application:

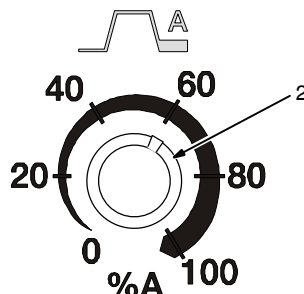
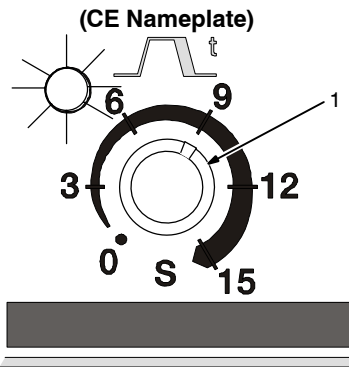
Initial Amperage can be used while GTAW welding to assist in preheating cold material prior to depositing filler material, or to ensure a soft start. Initial Amperage can also be used for SMAW to ensure a more consistent arc strike.

NOTE: Function is enabled, when LED is lit.

4-19. Final Slope Control And Final Amperage Control



FINAL A



1 Final Slope Control

Indicator light is on when Final Slope control function is active.

Note: Final Slope control function is inactive when Spot Time function is active.

Use control to reduce amperage over a set period of time (0–15 seconds) at the end of the weld cycle when NOT using a remote current control.



2 Final Amperage Control

Indicator light is on when Final Amperage control function is active.

Note: Final Amperage control function is inactive when Spot Time function is active (see Section 4-20).

Final amperage is the amperage to which weld amperage has sloped down to (0–100% of amperage set on Amperage Adjust control).

Application:

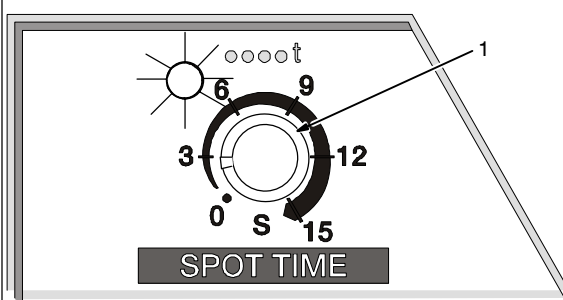
Final Slope should be used while GTAW welding materials that are crack sensitive, and/or the operator wants to eliminate the crater at the end of the weld.

Note: This applies if the operator is using an on/off only type control to start and stop the welding process.

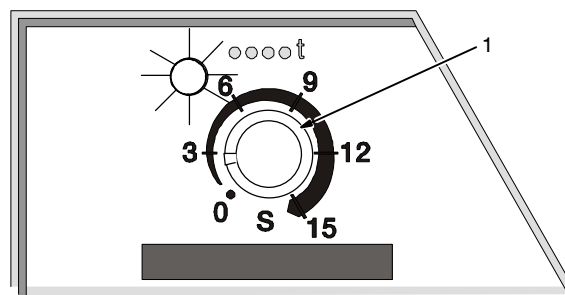
Note: Do not use this function with a foot or finger amperage control.

NOTE: Function is enabled, when LED is lit.

4-20. Spot Time Control



(CE Nameplate)



1 Spot Time Control

Indicator light is on when Spot Time function is active. When Spot Time function is active, Initial Time, Initial Amperage, Final Slope, and Final Amperage functions are inactive (see Section 4-17).

Used with the (GTAW) TIG Spot process, generally with a direct current electrode negative (DCEN) set-up.

Use control to select 0–15 seconds of spot time.

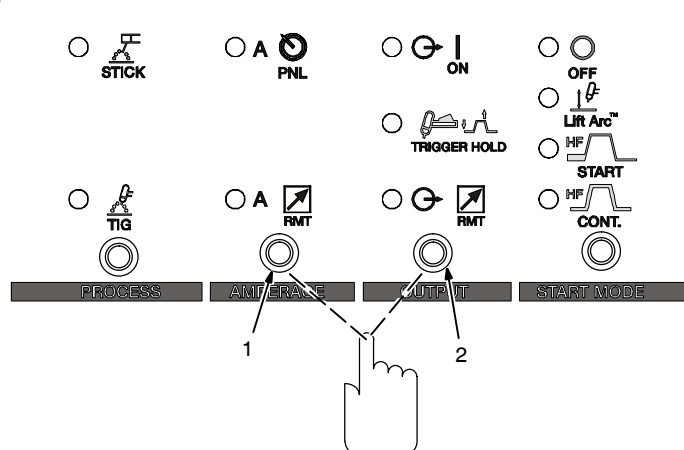
Use Amperage Adjust control (see Section 4-11) to set amperage.

Application:

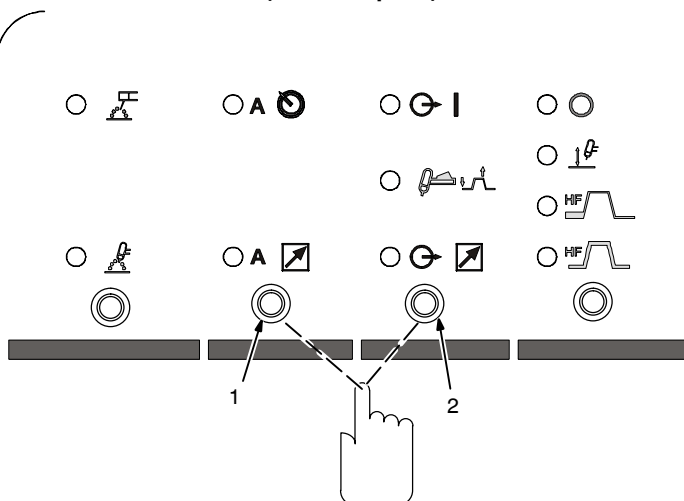
TIG spot welding is used for joining thinner materials that are in close contact with the fusion method. A good example would be joining coil ends.

NOTE: Function is enabled, when LED is lit.

4-21. Timer/Cycle Counter



(CE Nameplate)



- 1 Amperage Control
- 2 Output Control (Contactor)

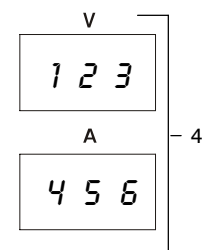
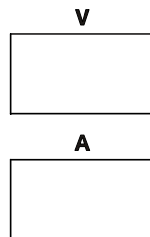
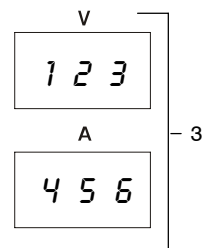
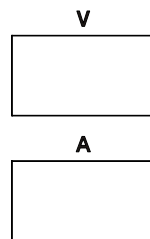
To read timer/cycle counter, hold Amperage and Output (contactor) buttons while turning on power.

- 3 Timer Display

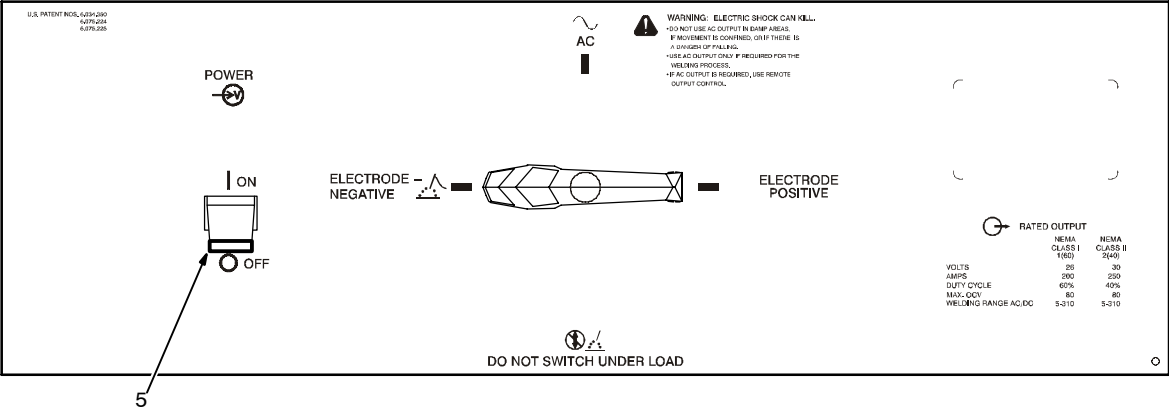
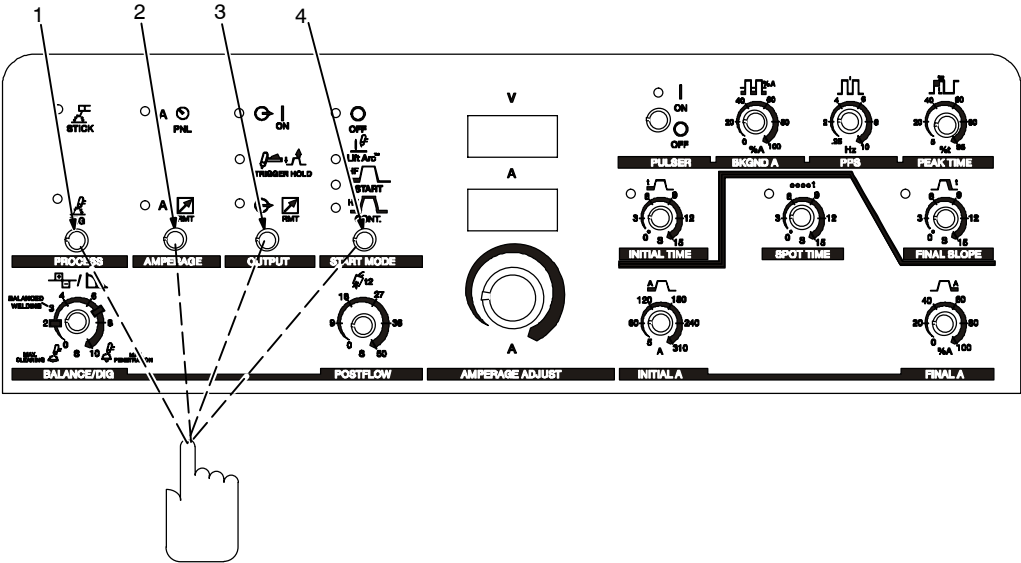
The hours and minutes are displayed on the volt and amp meters for the first five seconds, and are read as 1, 234 hours and 56 minutes.

- 4 Cycle Display

The cycles are displayed on the volt and amp meters for the next five seconds, and are read as 123, 456 cycles.



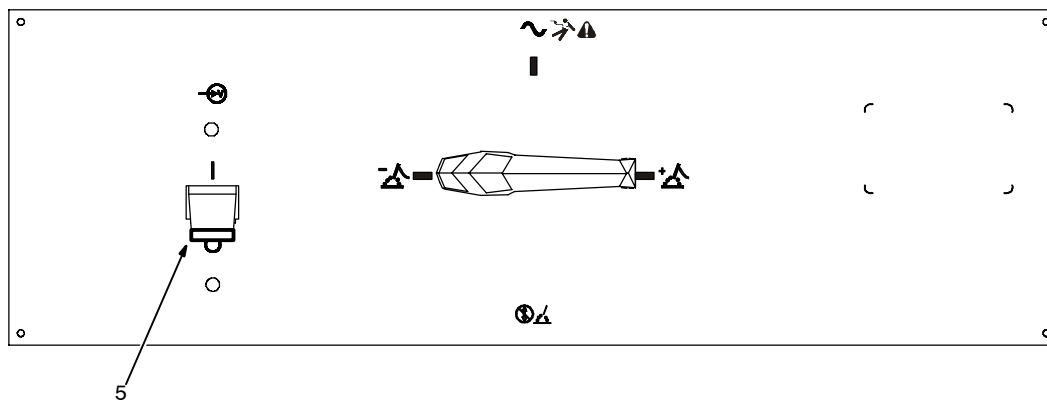
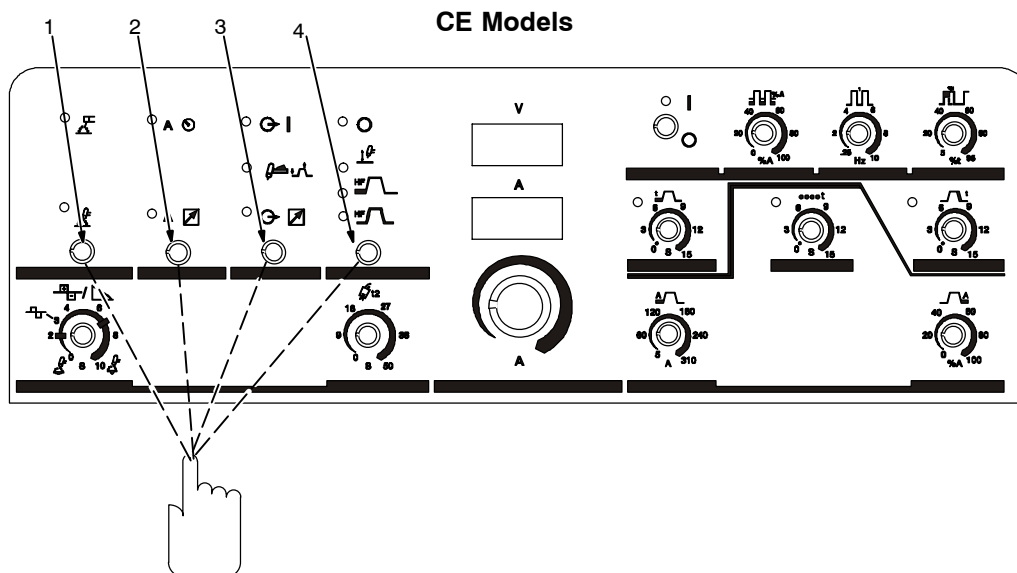
4-22. Resetting Unit To Factory Default Settings (All Models)



- 1 Process Control
- 2 Amperage Control
- 3 Output Control
- 4 Start Control

- 5 Power Switch
- To reset all welding power source functions to original factory settings, turn power off. Push and hold the Process, Amperage,

Output and Start controls and turn On power. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ clears meters).



SECTION 5 – THEORY OF OPERATION

5-1. Theory Of Operation Prior To LB141715

1 Input Terminal Board TE1

Provides means for operation on different input voltages.

2 Power Switch S1

Provides on/off control of welding power source.

3 Main Transformer T1

Supplies power to weld output circuit, various control circuits, main control board PC1, and fan motors FM1 and FM2.

4 Main Rectifier

Changes the ac output from T1 to full-wave rectified dc and controls output current level.

5 Fan Motors FM1, FM2

Provides cooling of internal components.

6 Control Relay CR1

Controls operation of fan motors.

7 115 VAC Duplex Receptacle RC2

Provides connection point for auxiliary equipment.

8 Circuit Breaker CB1

Protects 115 volts AC winding.

9 Control Board PC1

Controls weld output by changing the SCR gate pulses (conduction times) after comparing current feedback to selected amperage signal. Also provides user interface.

10 Thermistor TH1

Provides temperature feedback about the rectifier back to control board PC1.

11 Thermistor TH2

Provides temperature feedback to the control board PC1 about main transformer T1.

12 Remote 14 Receptacle RC1

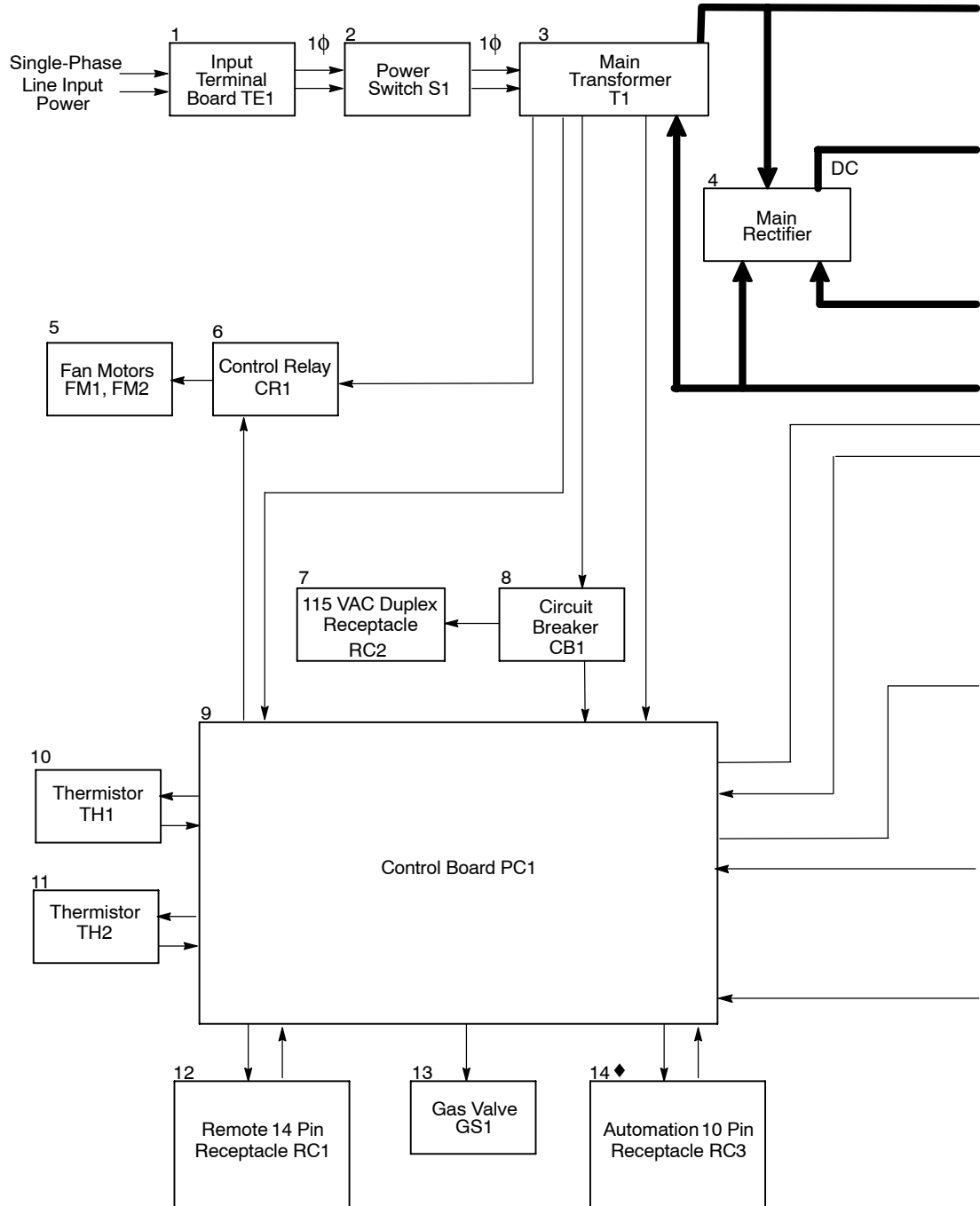
Provides connect point for remote amperage and contactor devices.

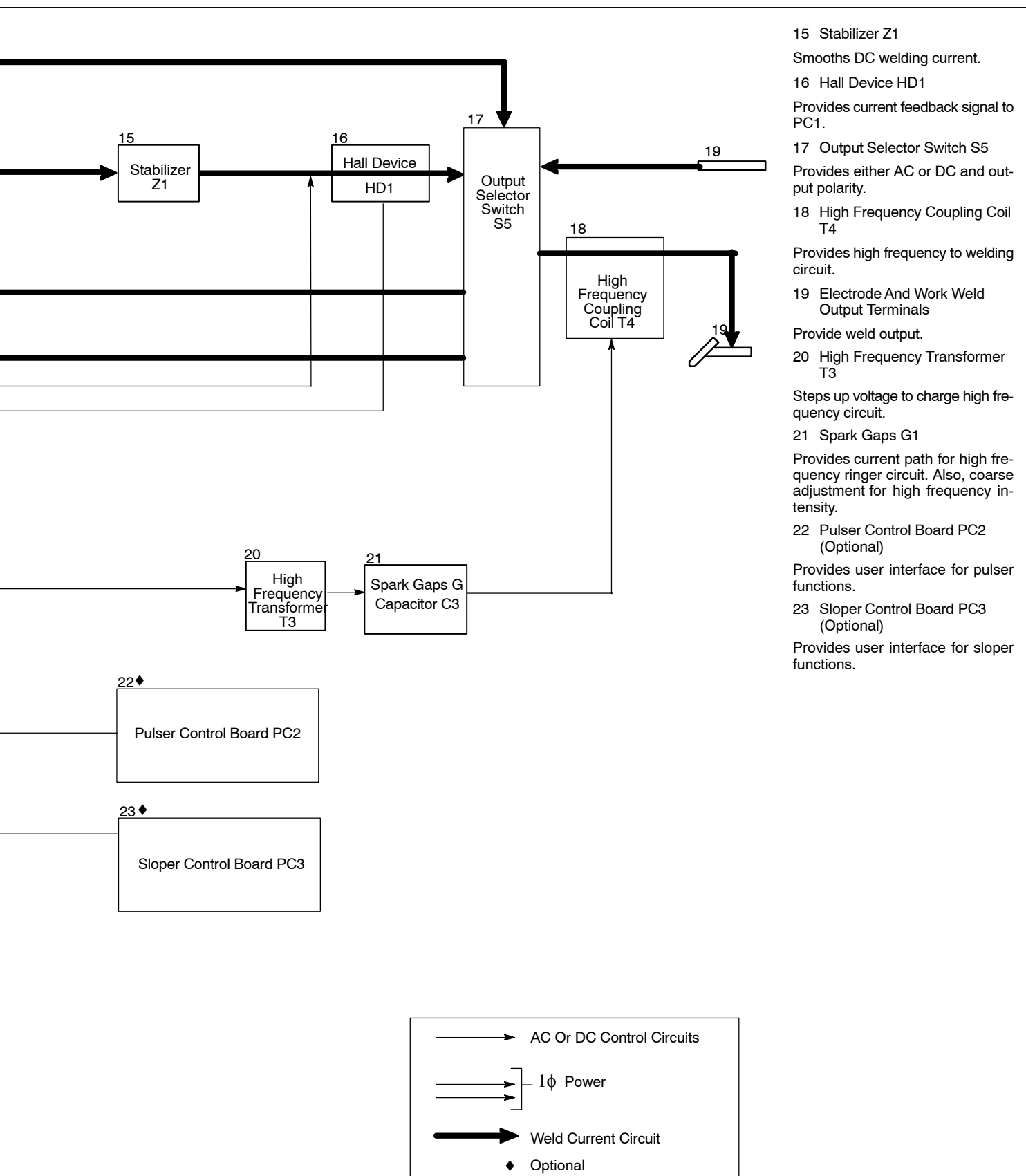
13 Gas Valve GS1

Provides control of shielding gas.

14 Automation 10-Pin Receptacle RC3

Provides a connection point for optional Automation 10-pin.





5-2. Theory Of Operation Effective With LB141715

1 Input Terminal Board TE1

Provides means for operation on different input voltages.

2 Power Switch S1

Provides on/off control of welding power source.

3 Main Transformer T1

Supplies power to weld output circuit, various control circuits, main control board PC1, and fan motors FM1 and FM2.

4 Main Rectifier

Changes the ac output from T1 to full-wave rectified dc and controls output current level.

5 Fan Motors FM1, FM2

Provides cooling of internal components.

6 115 VAC Duplex Receptacle RC2

Provides connection point for auxiliary equipment.

7 Circuit Breaker CB1

Protects 115 volts AC winding.

8 Control Board PC1

Controls weld output by changing the SCR gate pulses (conduction times) after comparing current feedback to selected amperage signal. Also provides user interface.

9 Thermistor TH1

Provides temperature feedback about the rectifier back to control board PC1.

10 Thermistor TH2

Provides temperature feedback to the control board PC1 about main transformer T1.

11 Remote 14 Receptacle RC1

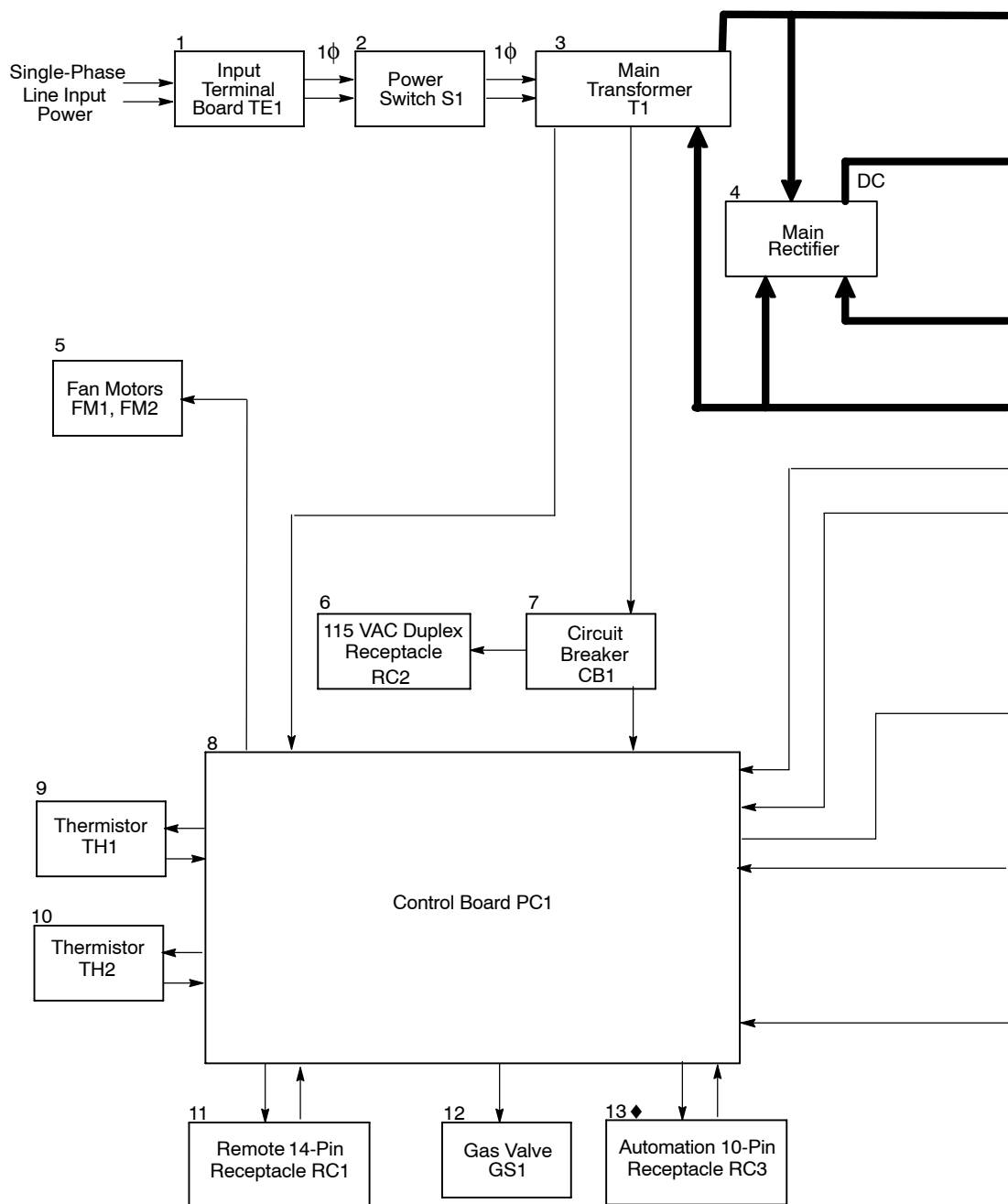
Provides connect point for remote amperage and contactor devices.

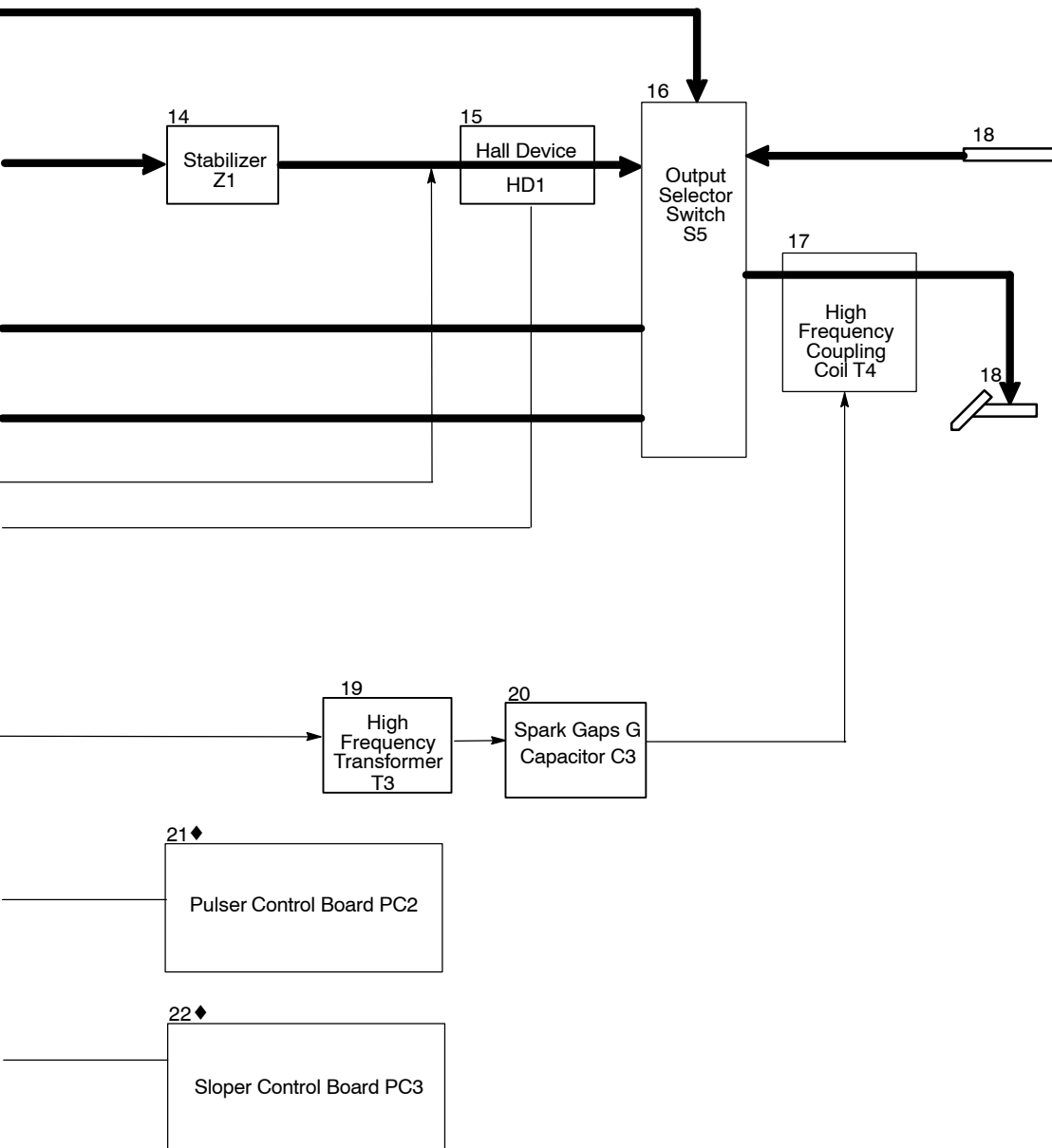
12 Gas Valve GS1

Provides control of shielding gas.

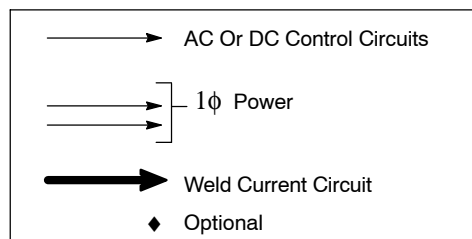
13 Automation 10-Pin Receptacle RC3

Provides a connection point for optional Automation 10-pin.



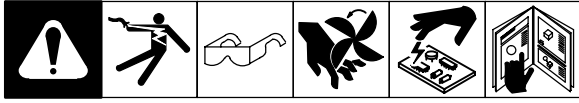


- 14 Stabilizer Z1
Smooths DC welding current.
- 15 Hall Device HD1
Provides current feedback signal to PC1.
- 16 Output Selector Switch S5
Provides either AC or DC and output polarity.
- 17 High Frequency Coupling Coil T4
Provides high frequency to welding circuit.
- 18 Electrode And Work Weld Output Terminals
Provide weld output.
- 19 High Frequency Transformer T3
Steps up voltage to charge high frequency circuit.
- 20 Spark Gaps G1
Provides current path for high frequency ringer circuit. Also, coarse adjustment for high frequency intensity.
- 21 Pulser Control Board PC2 (Optional)
Provides user interface for pulser functions.
- 22 Sloper Control Board PC3 (Optional)
Provides user interface for sloper functions.



SECTION 6 – TROUBLESHOOTING

6-1. Troubleshooting Table



☞ See Section 6-3 or 6-4 for test points and values and Parts List for parts location.

☞ Use MILLER Testing Booklet (Part No. 150 853) when servicing this unit.

☞ See Section 6-2. Diagnostic help (HLP) messages shown on Voltmeter/Ammeter for help during troubleshooting.

▲ Disable high frequency by placing Mode switch in Off position before testing unit.


Trouble	Remedy
No weld output; unit completely inoperative; meters not lit up.	Turn on power switch (see Section 4-1).
	Place line disconnect switch in the On position (see Section 3-18).
	Check line fuse(s), and replace if necessary (see Section 3-18). If line fuse blown, check the next four entries.
	Check for proper input power connections (see Section 3-18).
	Check for proper jumper link position (see Section 3-17).
	Check modules Mod1 and Mod2 in main rectifier, and replace if necessary. If any modules are replaced, check capacitors C7 through C10 for a short or open, and check for proper connections. Replace C7 through C10 if necessary (see Section 6-3).
	Check diode D1 in main rectifier SR1, and replace if necessary (see Section 6-3).
	If unit has power factor correction, check capacitors C20 through C23 for a short or open, and check for proper connections. Replace C20 through C23 if necessary (see Section 6-3).
	Check power switch S1, and replace if necessary (see Section 6-3 or 6-4).
	Check coil voltage and connections of contactor W. Check continuity of coil and condition of contacts. Replace W if necessary (see Section 6-3).
	Check hall device HD1; pin 1 is +15 volts dc, pin 2 is -15 volts dc, pin 3 is +2 volt per 100 amps feedback, and pin 4 is ground (GND) (see Section 6-3). Replace if necessary.
No weld output; meters lit, fans on. NOTE: Units have Fan-On-Demand™, and fans run only when necessary.	Place Output switch in On position, or place switch in Remote 14 position and connect remote contactor control to Remote 14 receptacle RC1 (see Sections 4-1 and 3-7).
	Remote Output control is activated. Release Remote Output control, help (HLP) message 10 displayed on voltmeter/ammeter (see Section 6-2).
	Unit overheated. Allow unit to cool with fan on, help (HLP) message 3 or 5 displayed on voltmeter/ammeter (see Section 6-2).
	Malfunction in the thermal protection circuitry, help (HLP) message 0, 2, 4, or 9 displayed on voltmeter/ammeter (see Section 6-2).
	Check, repair, or replace remote control device.
	Output selector switch is not in correct position, help (HLP) message 11 displayed on voltmeter/ammeter (see Section 6-2).. Place output selector switch in proper position.
	Check modules Mod1 and Mod2 in main rectifier, and replace if necessary. If any modules are replaced, check capacitors C7 through C10 for a short or open, and check for proper connections. Replace C7 through C10 if necessary (see Section 6-3).
	Check hall device HD1; pin 1 is +15 volts dc, pin 2 is -15 volts dc, pin 3 is +2 volt per 100 amps feedback, and pin 4 is ground (GND) (see Section 6-3). Replace if necessary.
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).

Trouble	Remedy
Unit provides only maximum or minimum weld output.	Be sure Amperage switch is in proper position (see Section 4-1).
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
	Be sure remote control is operating properly.
	Check hall device HD1; pin 1 is +15 volts dc, pin 2 is -15 volts dc, pin 3 is +2 volt per 100 amps feedback, and pin 4 is ground (GND) (see Section 6-3). Replace if necessary.
Erratic or improper weld output.	Use proper size and type of weld cable (see Section 3-6).
	Use proper size and type tungsten.
	Clean and tighten all weld connections (see Section 3-6).
	Be sure Output Selector switch is in proper position for welding process (see Section 4-1).
	If using a remote control, check position of Amperage Adjustment control R2 (see Section 4-1).
	Check hall device HD1; pin 1 is +15 volts dc, pin 2 is -15 volts dc, pin 3 is +2 volt per 100 amps feedback, and pin 4 is ground (GND) (see Section 6-3). Replace if necessary.
	Check capacitors C1 and C11 for a short or open, and check for proper connections. Replace C1 and C11 if necessary (see Section 6-3).
	Check resistance and connections of resistor R1; R1 is 50 ohms $\pm 10\%$. Replace R1 if necessary (see Section 6-3).
	Check resistance and connections of resistor R2; R2 is 10 ohms $\pm 10\%$. Replace R2 if necessary (see Section 6-3).
	Check modules Mod1 and Mod2 in main rectifier, and replace if necessary. If any modules are replaced, check capacitors C7 through C10 for a short or open, and check for proper connections. Replace C7 through C10 if necessary (see Section 6-3).
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
	Check pulser board PC2 and connections, and replace if necessary (see Section 6-8).
No arc/balance control.	Be sure Arc/Balance control R3 is in proper position (see Section 4-1).
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
No control of weld output.	Place Output switch in On position, or place switch in Remote 14 position and connect remote contactor control to Remote 14 receptacle RC1 (see Sections 4-1 and 3-7).
	Be sure Amperage control switch is in proper position (see Section 4-1).
	Check modules Mod1 and Mod2 in main rectifier, and replace if necessary. If any modules are replaced, check capacitors C7 through C10 for a short or open, and check for proper connections. Replace C7 through C10 if necessary (see Section 6-3).
	Check hall device HD1; pin 1 is +15 volts dc, pin 2 is -15 volts dc, pin 3 is +2 volt per 100 amps feedback, and pin 4 is ground (GND) (see Section 6-3). Replace if necessary.
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
	Check pulser board PC2 and connections, and replace if necessary (see Section 6-8).
	Check optional timer board PC3 and connections, and replace if necessary (see Section 6-10).
No power output from duplex receptacle RC2.	Check circuit breaker CB1, and reset if necessary (see Section 7-2).
	Check wiring of duplex receptacle RC2. Repair or replace if necessary (see Section 6-3).
	Check main transformer T1 for signs of winding failure. Check continuity across windings, and check for proper connections. Check secondary voltages. Replace T1 if necessary (see Section 6-3).

Trouble	Remedy
Gas control not working properly.	Check coil voltage and connections of gas valve GS, and replace if necessary (see Section 6-3).
	Check status of diagnostic LED26 on main control board PC1. Replace PC1 if necessary (see Section 6-6).
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
	Check incoming gas pressure at gas valve GS to make sure it does not exceed 90 psi.
Pulser not working properly in GTAW mode.	Check pulser board PC2 and connections, and replace if necessary (see Section 6-8).
Final Slope option not working properly in GTAW mode.	Check optional timer board PC3 and connections, and replace if necessary (see Section 6-10).
Start control option not working properly in GTAW mode.	Check optional timer board PC3 and connections, and replace if necessary (see Section 6-10).
Spot time option not working properly in GTAW mode.	Check optional timer board PC3 and connections, and replace if necessary (see Section 6-10).
Preflow not working properly in GTAW mode.	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
Remote 14 receptacle RC1 not working properly.	Be sure Amperage control switch and Output switch are in the Remote 14 position (see Section 4-1).
	Check remote control for pin A shorted to ground.
	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
No high frequency; difficulty in establishing GTAW arc.	Check circuit breaker CB1, and reset if necessary (see Section 7-2).
	Select proper size tungsten.
	Check High Frequency intensity control R5 setting (prior to LC344556).
	Be sure that torch cable is not close to any grounded metal, and disconnect any unused cables.
	Check cables and torch for cracked insulation or bad connections. Repair or replace necessary parts.
	Check spark gaps G1, and adjust if necessary (see Section 7-3).
	Check capacitor C3 for a short or open, and check for proper connections. Replace C3 if necessary (see Section 6-3).
	Check high frequency transformer T3 for signs of winding failure. Check continuity across windings, and check for proper connections. Check primary voltages. Replace T3 if necessary (see Section 6-3).
Wandering arc – poor control of direction of arc.	Check main transformer T1 for signs of winding failure. Check continuity across windings, and check for proper connections. Check secondary voltages. Replace T1 if necessary (see Section 6-3).
	Reduce gas flow rate (see Section 3-9).
	Select proper size tungsten.
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Properly prepare tungsten.
	Shield weld zone from drafts.
	Increase postflow time (see Section 4-1).
	Check and tighten all gas fittings (see Section 3-9).
	Properly prepare tungsten.
	Replace torch parts if water has leaked into torch.

Trouble	Remedy
One or both fan motors FM1 and FM2 do not run. NOTE: Units have Fan-On-Demand™, and fans run only when necessary.	Check and clear blocked fan blade(s).
	Check coil voltage and connections of fan motors FM1 and FM2, and replace if necessary (see Section 6-3).
Voltage and/or amperage meters not working properly.	Check main control board PC1 and connections, and replace if necessary (see Section 6-6).
Electronic equipment in welding area not working properly.	HF interference problem. Check for proper installation, and correct problem (see Section 8).

6-2. Voltmeter/Ammeter Help Displays

 All directions are in reference to the front of the unit. All circuitry referred to is located inside the unit.

0 Help 0 Display

Indicates a short in the thermal protection circuitry located on the transformer of the unit.

1 Help 1 Display

An SCR overcurrent condition has occurred. Turn power off and back on to correct condition. If problem continues, check hall device HD1 (see Section 6-3 or 6-4).

2 Help 2 Display

Indicates an open in the thermal protection circuitry located on the transformer of the unit.

3 Help 3 Display

Indicates the transformer of the unit has overheated. The unit has shut down to allow the fan to cool it (see Section 3-4). Operation

will continue when the unit has cooled.

4 Help 4 Display

Indicates an open in the thermal protection circuitry located on the rectifier assembly of the unit.

5 Help 5 Display

Indicates the rectifier assembly of the unit has overheated. The unit has shut down to allow the fan to cool it (see Section 3-4). Operation will continue when the unit has cooled.

6 Help 6 Display

Not used.

7 Help 7 Display

Not used.

8 Help 8 Display

Not used.

9 Help 9 Display

Indicates a short in the thermal protection circuitry located on the rectifier assembly of the unit.

10 Help 10 Display

Indicates Remote Output control is activated. Release Remote Output control to clear help message.

11 Help 11 Display

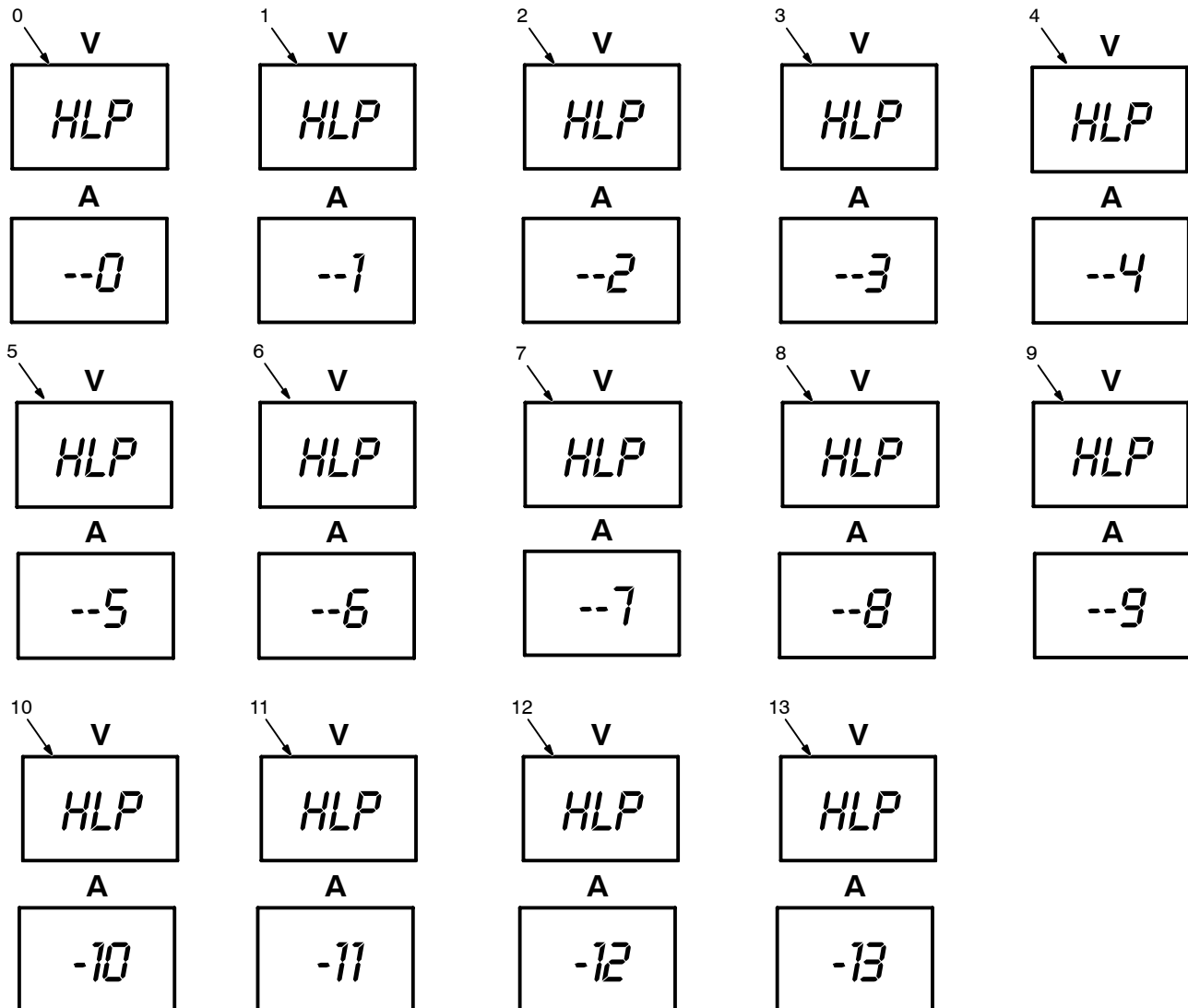
Indicates Output Selector switch is not in correct position (see Section 4-2).

12 Help 12 Display

Indicates a non-allowable set-up on the front panel.

13 Help 13 Display

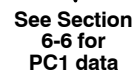
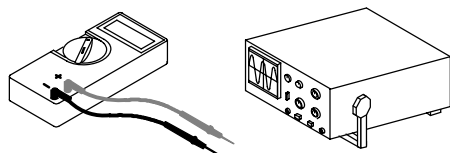
AIC option output enable signal broken causing weld output to stop, but gas continues to flow. Check to see if pins C and D of 10-pin connector are shorted together.

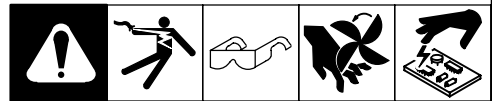


This image shows a full page of blank, lined paper. It features approximately 28 horizontal grey lines spaced evenly across the page, typical of notebook paper. The lines are thin and light grey, set against a plain white background. There are no margins, text, or other markings on the page.

▲ **Disable high frequency by placing Mode switch in Off position before testing unit.**

Test Equipment Needed:

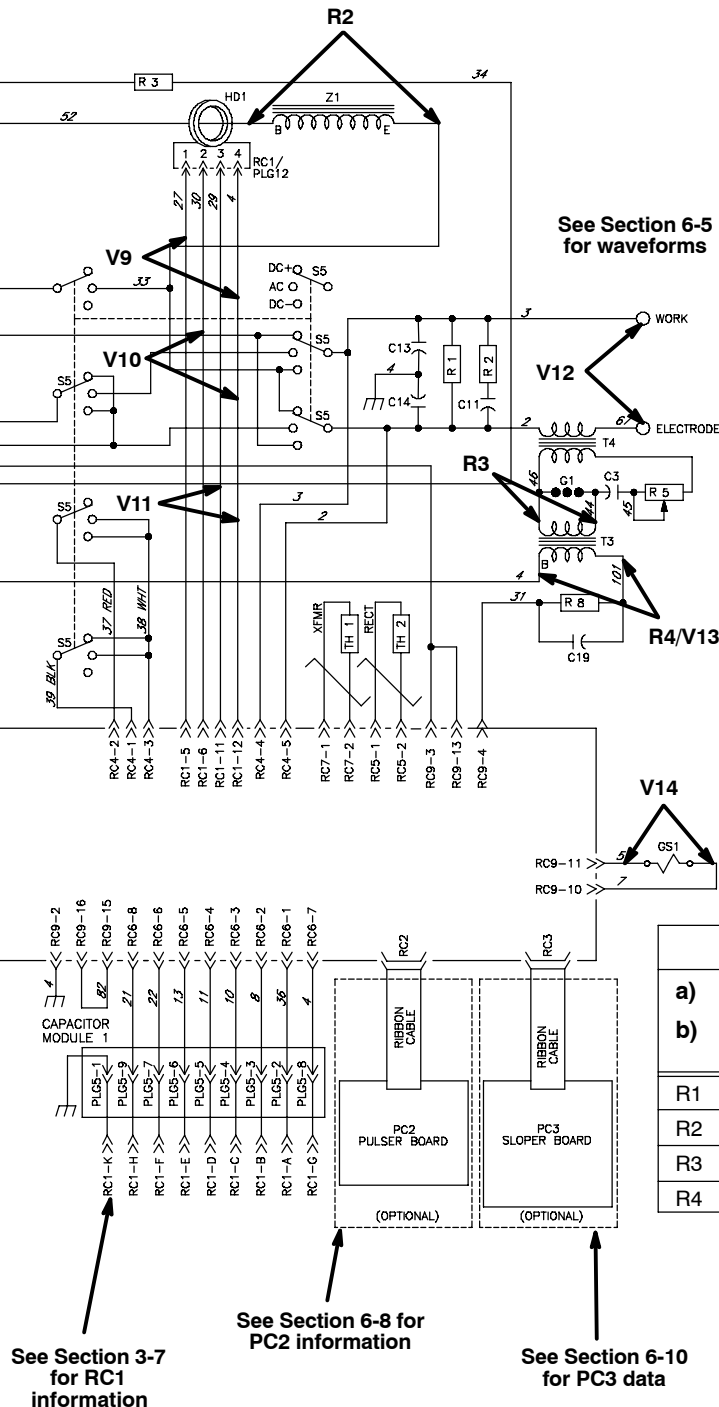




Voltage Readings

- a) Tolerance - $\pm 10\%$ unless specified
- b) Reference - to circuit common (lead 4) unless noted
- c) Reference - single arrow: reference to circuit common (lead 42); double arrow: reference to points indicated
- d) Wiring Diagram - see Section 9

V1	84 volts AC
V2	230 volts AC
V3	230 volts AC
V4	115 volts AC
V5	115 volts AC
V6	104 volts AC
V7	19 volts AC
V8	19 volts AC
V9	+15 volts dc
V10	-15 volts dc
V11	+2.0 volts DC per 100 amperes of weld output
V12	75 volts AC open-circuit voltage 75 volts DC open-circuit voltage
V13	115 volts AC with high frequency on
V14	+24 volts DC with contactor on and in GTAW mode

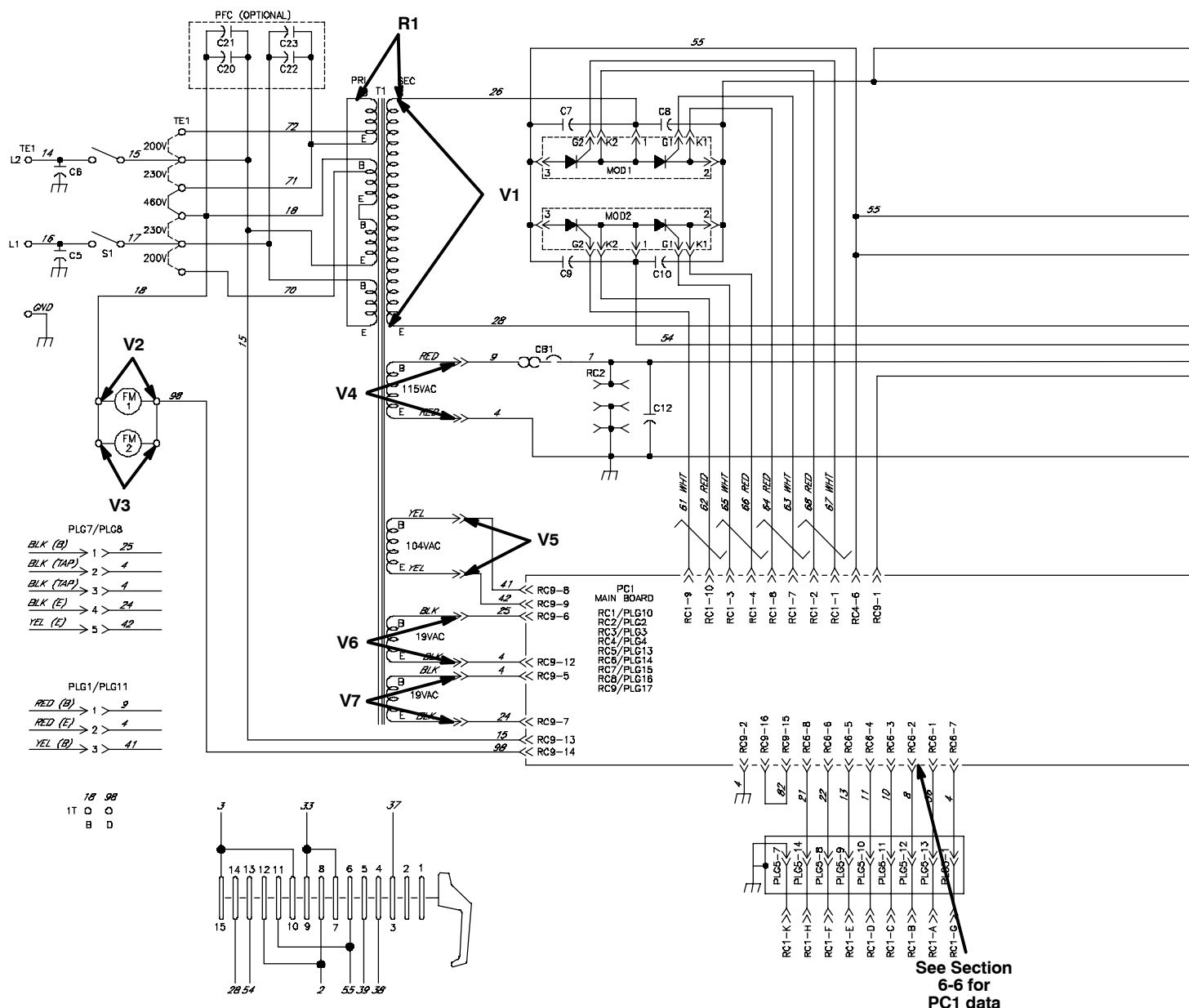
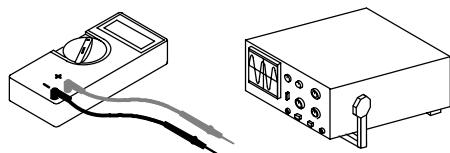


Resistance Values

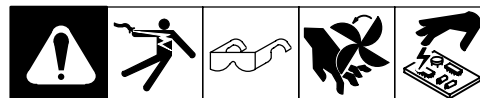
a) Tolerance – ±10% unless specified	
b) Turn Off unit and disconnect input power before checking resistance	
R1	All values for T1 are less than 1 ohm
R2	Less than 1 ohm
R3	6.1 k ohms
R4	5.1 ohms

▲ **Disable high frequency by placing Mode switch in Off position before testing unit.**

Test Equipment Needed:



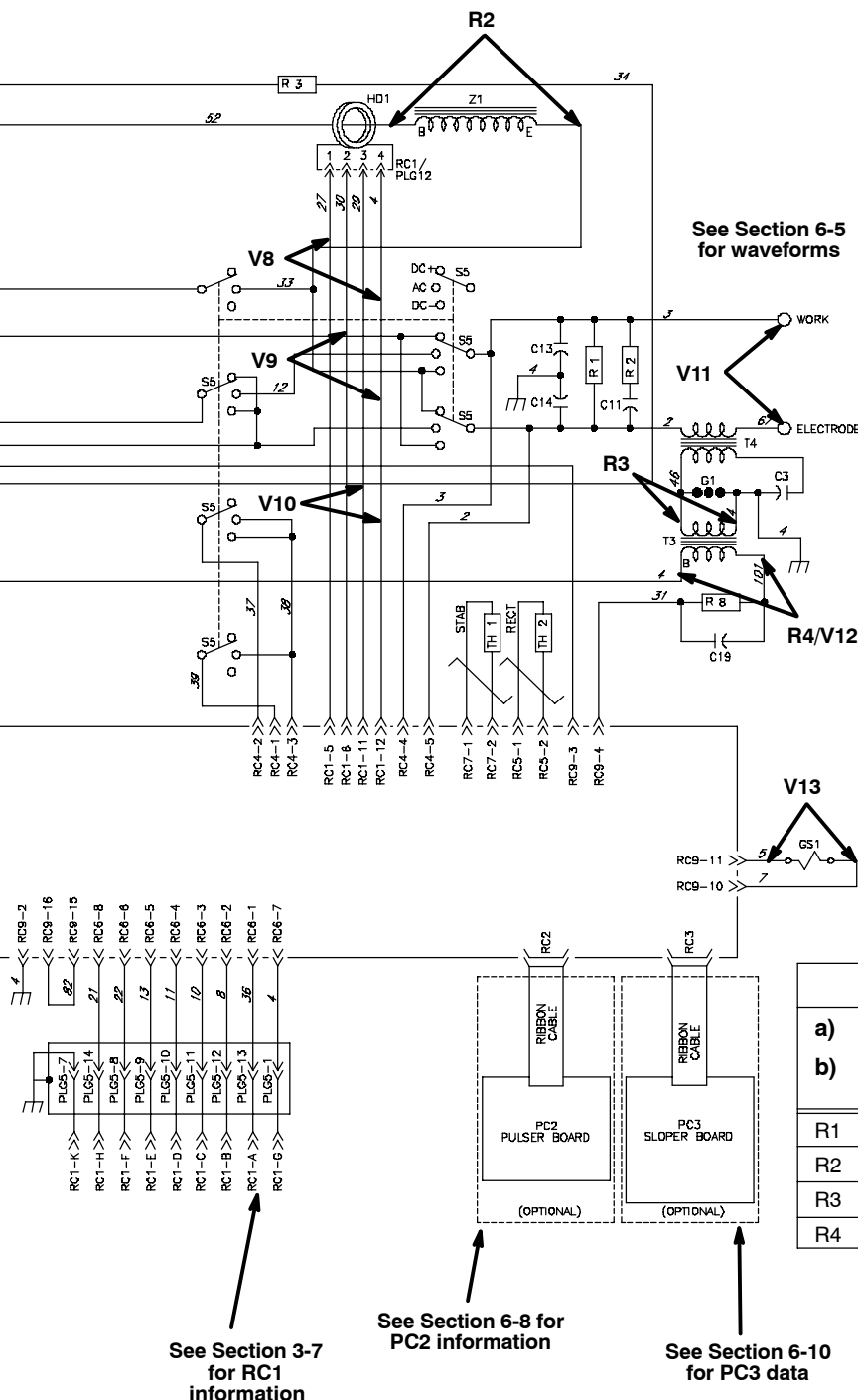
See Section
6-6 for
PC1 data



Voltage Readings

- a) Tolerance - $\pm 10\%$ unless specified
- b) Reference - to circuit common (lead 4) unless noted
- c) Reference - single arrow: reference to circuit common (lead 42); double arrow: reference to points indicated
- c) Wiring Diagram - see Section 9


V1	84 volts AC
V2	230 volts AC
V3	230 volts AC
V4	115 volts AC
V5	104 volts AC
V6	19 volts AC
V7	19 volts AC
V8	+15 volts dc
V9	-15 volts dc
V10	+2.0 volts DC per 100 amperes of weld output
V11	75 volts AC open-circuit voltage 75 volts DC open-circuit voltage
V12	115 volts AC with high frequency on
V13	+24 volts DC with contactor on and in GTAW mode

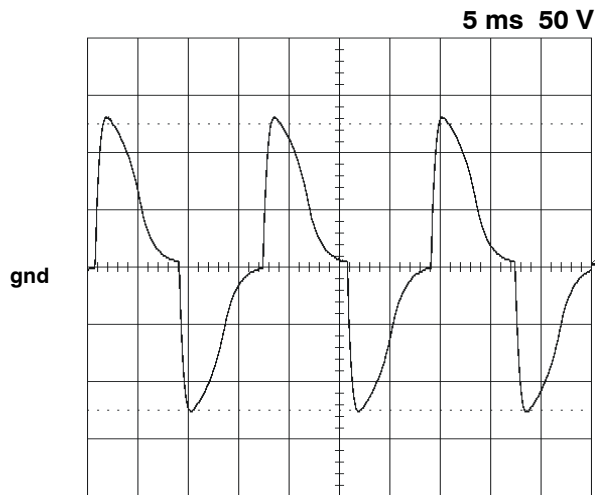


Resistance Values

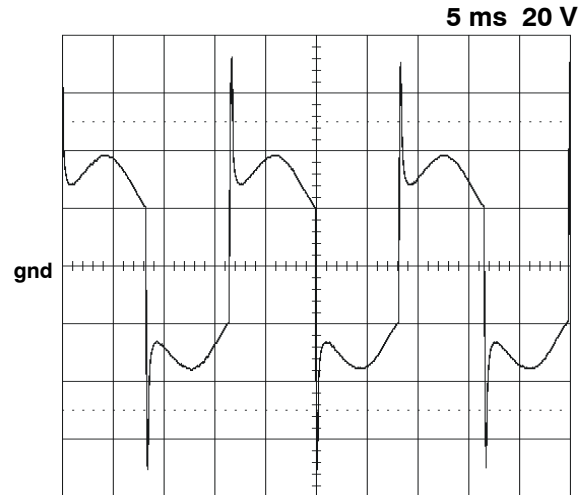
a)	Tolerance - $\pm 10\%$ unless specified
b)	Turn Off unit and disconnect input power before checking resistance
R1	All values for T1 are less than 1 ohm
R2	Less than 1 ohm
R3	6.1 k ohms
R4	5.1 ohms

6-5. Waveforms for Sections 6-3

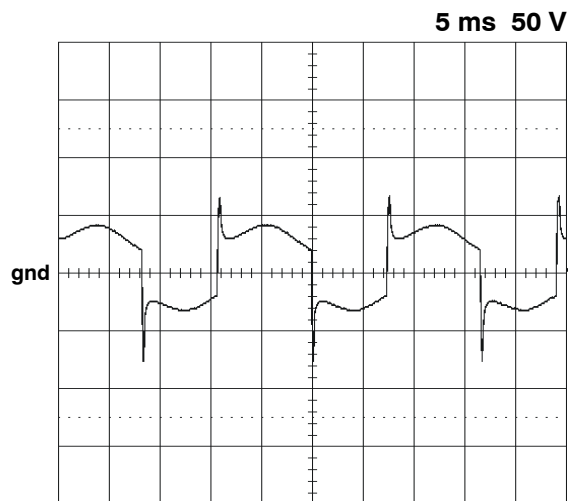
 The waveforms represent the output of the welding power source. When operating properly, the power source waveforms should match those shown.



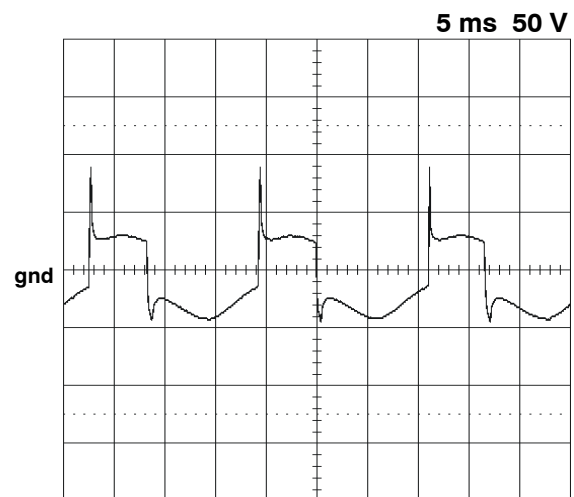
A. AC Open-Circuit Voltage, Amperage Adjustment Control At Max, Arc/Balance Control At Balanced Position



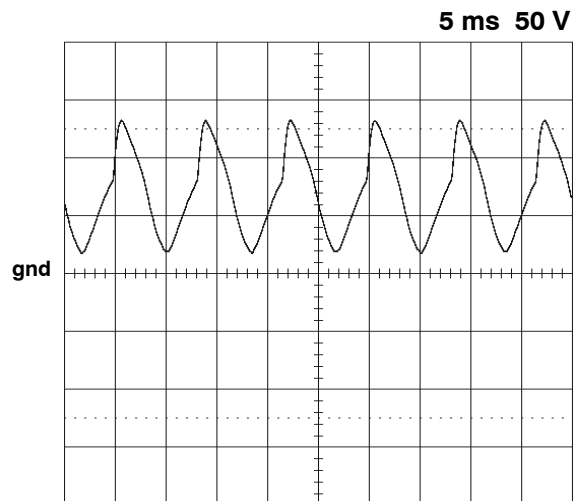
B. 30 Volts AC, 250 Amperes, Arc/Balance Control At Balanced Position (Resistive Load)



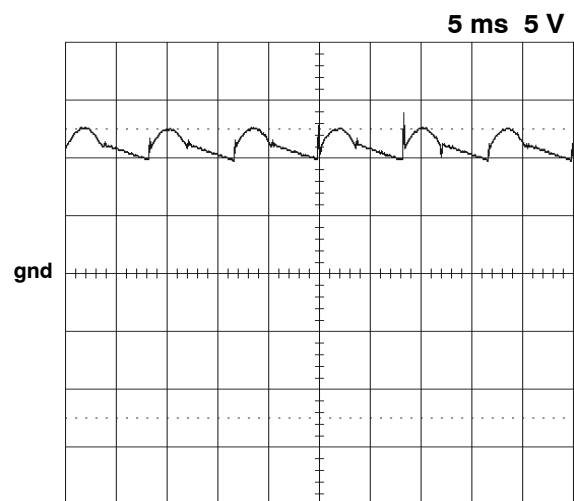
C. 30 Volts AC, 250 Amperes, Arc/Balance Control At Max Cleaning Position (Resistive Load)



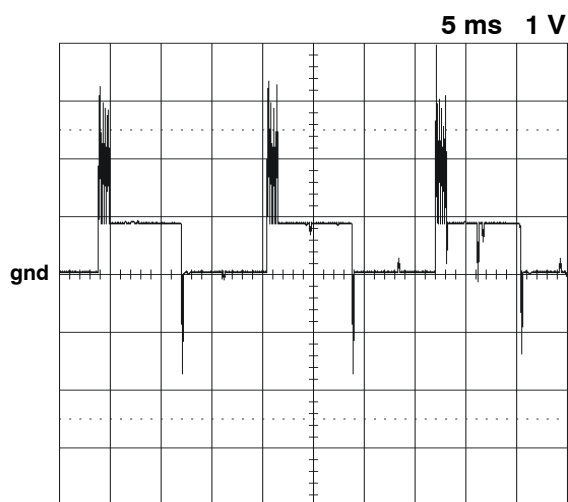
D. 30 Volts AC, 250 Amperes, Arc/Balance Control At Max Penetration Position (Resistive Load)



E. DC Open-Circuit Voltage, Amperage Adjustment Control At Max, Arc/Balance Control At Balanced Position, Waveform May Not Be Stable



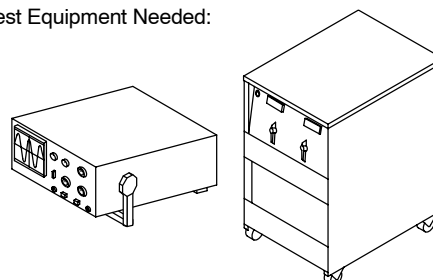
F. 10 Volts DC, 150 Amperes, Arc/Balance Control At Balanced Position (Resistive Load)



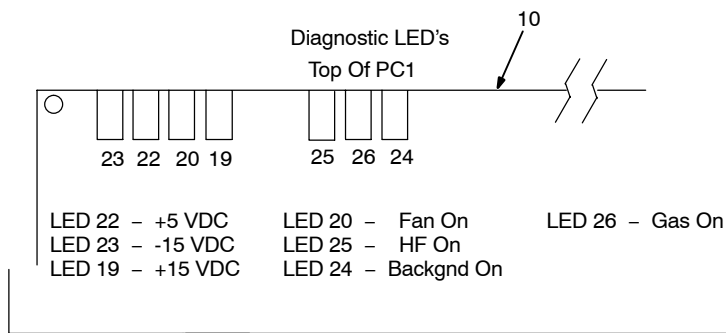
G. SCR Gate Pulses With Respect To Cathode At 10 Volts AC, 150 Amperes (Resistive Load)



Test Equipment Needed:



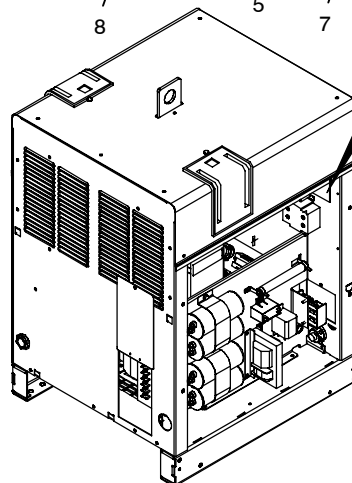
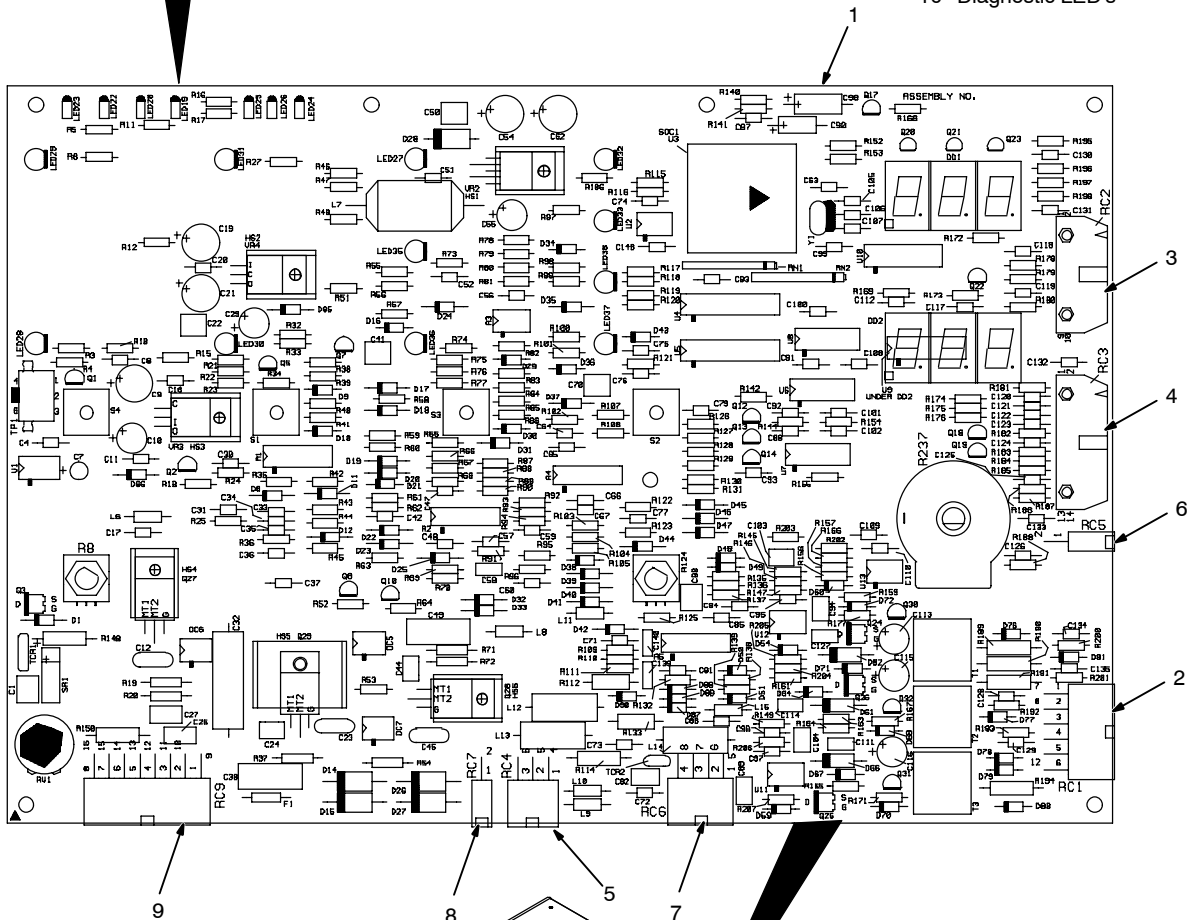
6-6. Main (Interface) Board PC1 Testing Information (Use with Section 6-7)



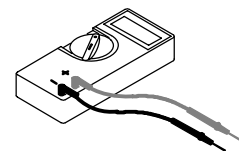
▲ Disable high frequency by placing Mode switch in Off position before testing unit.

Be sure plugs are secure before testing. See Section 6-7 for specific values during testing.

- 1 Control Board PC1
- 2 Receptacle RC1
- 3 Receptacle RC2
- 4 Receptacle RC3
- 5 Receptacle RC4
- 6 Receptacle RC5
- 7 Receptacle RC6
- 8 Receptacle RC7
- 9 Receptacle RC9
- 10 Diagnostic LED's



Test Equipment Needed:



6-7. Main (Interface) Board PC1 Test Point Values



PC1 Voltage Readings

- a) Tolerance – $\pm 10\%$ unless specified
b) Reference – to circuit common (lead 4) unless noted

Receptacle	Pin	Value
RC1	1	Gate pulse for module 1, SCR 2
	2	Reference for pin 1
	3	Gate pulse for module 2, SCR 1
	4	Reference for pin 3
	5	+15 volts DC for hall device HD1
	6	–15 volts DC for hall device HD1
	7	Gate pulse for module 1, SCR 1
	8	Reference for pin 7
	9	Gate pulse for module 2, SCR 2
	10	Reference for pin 9
	11	Hall device HD1 current feedback signal, 2 volts per 100 amperes
	12	Ground reference signal for hall device HD1
RC2	1	Ground reference signal for potentiometers pulser board PC2
	2	Ground reference signal for pulser board PC2
	3	Pulse Peak Time reference, 0 to +5 volts DC variable
	4	Not used
	5	Pulse Background Amperage reference, 0 to +5 volts DC variable
	6	Pulser board PC2 preset, 0 volts DC while connected and +5 volts DC while not connected
	7	Pulse Frequency reference, 0 to +5 volts DC variable
	8	Pulser LED, +3.6 volts DC while on, 0 volts DC while off
	9	Pulser On/Off, 0 volts DC while on; +5 volts DC while off
	10	+5 volts dc
RC3	1	Final Amperage reference, 0 to +5 volts DC variable
	2	Initial Time reference, 0 to +5 volts DC variable
	3	Final Time reference, 0 to +5 volts DC variable
	4	Ground reference for Sequencer board PC3
	5	Initial Amperage reference, 0 to +5 volts DC variable
	6	Ground reference for potentiometers on Sequencer board PC3
	7	Spot Time, 0 to +5 volts DC variable
	8	+5 volts dc
	9	Not used
	10	Initial Time LED, +3.6 volts DC while on, 0 volts DC while off
	11	Final Time LED, +3.6 volts DC while on, 0 volts DC while off
	12	Spot Time LED, +3.6 volts DC while on, 0 volts DC while off
	13	Sequencer board PC3 preset, 0 volts DC while connected and +5 volts DC while not connected

Receptacle	Pin	Value
	14	Not used
RC4	1	Output Selector switch S5 position sense signal, 0 volts DC while in AC or DCEN positions, +5 volts DC while in DCEP position
	2	Output Selector switch S5 position sense signal, 0 volts DC while in AC or DCEP positions, +5 volts DC while in DCEN position
	3	Output Selector switch S5 position sense ground reference
	4	Voltage feedback sense lead–work
	5	Voltage feedback sense lead–electrode
	6	Background voltage negative, -98 volts dc
RC5	1	Thermistor input from rectifier, +5 volts dc
	2	+5 volts DC from thermistor
RC6	1	+24 volts DC output
	2	Contactora, +24 volts DC with external output control closed
	3	Remote Amperage control reference +10 volts dc
	4	Ground reference for Remote Amperage control
	5	Remote Amperage control input 0 to +10 volts dc
	6	Output current feedback, +1 volt dc per 100 amperes
	7	Ground reference for +24 volts dc
	8	Output voltage feedback, +1 volt dc per 10 volts output
RC7	1	Thermistor input from stabilizer, +5 to 0 volts dc
	2	+5 volts DC for stabilizer thermistor
RC8 (Prior to LC451816)	1	Pulse lockout – collector, see output below
	2	Final slope – emitter, 0 to +30 volts DC depending on collector voltage
	3	Final slope – collector, see output below
	4	Valid arc – emitter, 0 to +30 volts DC depending on collector voltage
	5	Valid arc – collector, see output below
	6	Pulse lockout – emitter, 0 to +30 volts DC depending on collector voltage
	7	Start/stop, 0 volts DC while on, +5 volts DC while off
	8	Gas valve, 0 volts DC while on
	9	Output enable, 0 volts DC while on, +5 volts DC while off
	10	Ground reference for chassis
<p style="text-align: center;">OUTPUTS</p> <p style="text-align: center;">User supplied signal, 0 to +30 volts DC and 6 to 100 mA</p>		
RC9	1	Background voltage positive, +98 volts dc
	2	Ground reference for chassis
	3	115 volts AC for high frequency
	4	High frequency control, 115 volts AC when on, 0 volts AC when off
	5	Ground reference for 19 volts AC winding
	6	19 volts AC input from transformer T1
	7	19 volts AC input from transformer T1

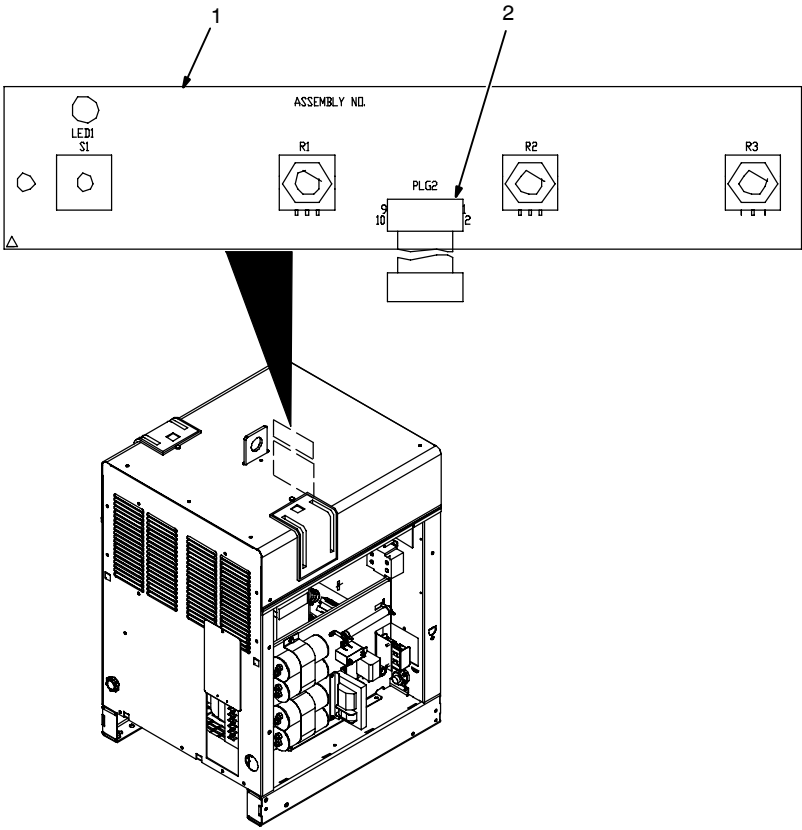
Receptacle	Pin	Value
	8	104 volts AC input from transformer T1, background voltage
	9	104 volts AC input from transformer T1, background voltage
	10	Ground reference for gas valve
	11	+24 volts DC signal to gas valve
	12	Ground reference for 19 volts AC winding
	13	115 volts AC for fans prior to LB141715; 230 volts AC effective with LB141715
	14	Fan-On-Demand control, 115 volts AC while on, 0 volts AC while off prior to LB141715; 230 volts AC effective with LB141715
	15	Machine select, 0 volts dc
	16	Ground reference for machine select

6-8. Pulser Board PC2 Testing Information (Use with Section 6-9)

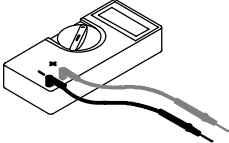
▲ **Disable high frequency by placing Mode switch in Off position before testing unit.**

Be sure plugs are secure before testing. See Section 6-9 for specific values during testing.

1 Pulser Board PC2
2 Plug PLG2







Test Equipment Needed:



802 839-C / 190 735

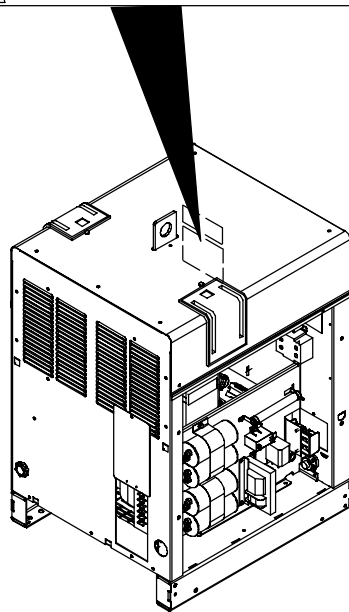
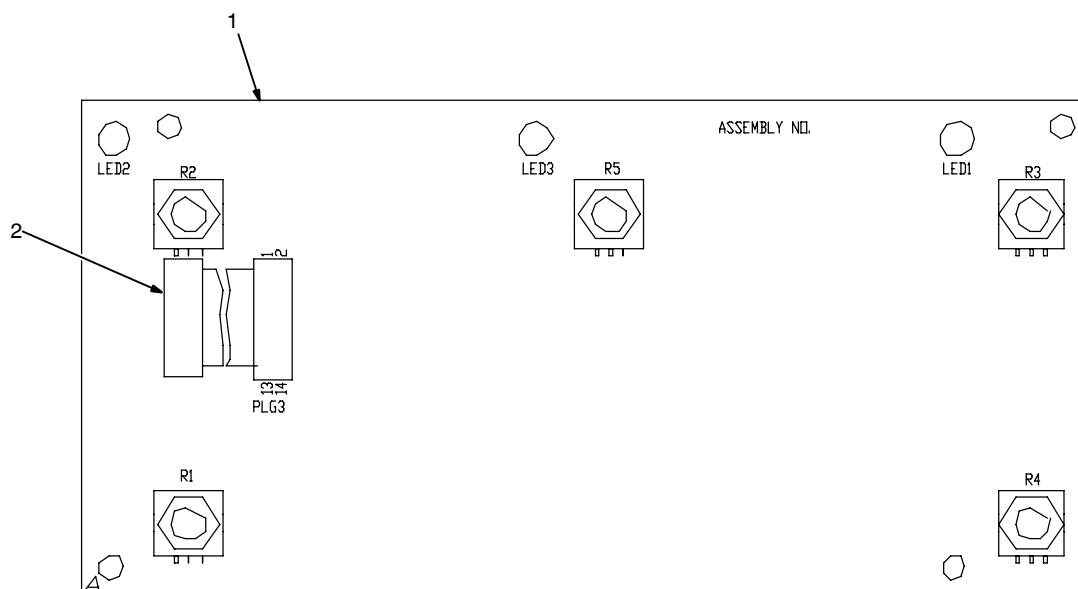
6-9. Pulser Board PC2 Test Point Values

   			PC2 Voltage Readings	<p>a) Tolerance – $\pm 10\%$ unless specified</p> <p>b) Reference – to circuit common (lead 4) unless noted</p>
Receptacle	Pin	Value		
PLG2	1	Ground reference for pulser board		
	2	Ground reference for potentiometers on pulser board		
	3	Pulse Peak Time reference, 0 to +5 volts DC variable		
	4	Not used		
	5	Pulse Background Amperage reference, 0 to +5 volts DC variable		
	6	Pulser board present, 0 volts DC while connected and +5 volts DC while not connected		
	7	Pulse Frequency reference, 0 to +5 volts DC variable		
	8	Pulser LED, +3.6 volts DC while on, 0 volts DC while off		
	9	Pulser On/Off, 0 volts DC while on; +5 volts DC while off		
	10	+5 volts DC		

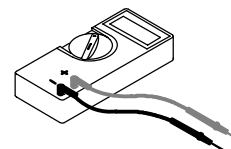
6-10. Sloper (Sequencer) Board PC3 Testing Information (Use with Section 6-11)

▲ Disable high frequency by placing Mode switch in Off position before testing unit.

- 1 Sloper Board PC3
- 2 Plug PLG3

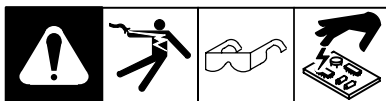


Test Equipment Needed:



802 839-B / 190 739

6-11. Sloper (Sequencer) Board PC3 Test Point Values

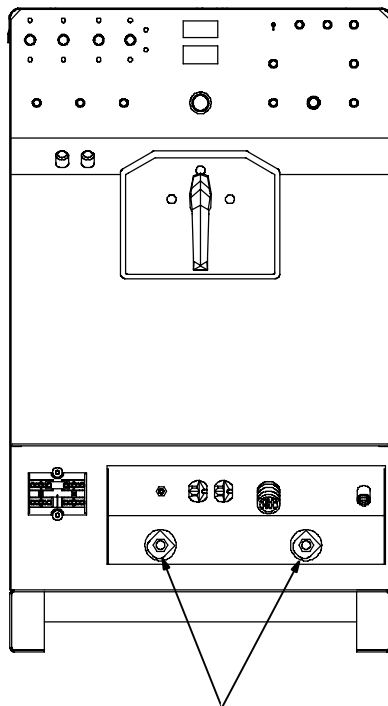


PC3 Voltage Readings

- a) Tolerance – $\pm 10\%$ unless specified
- b) Reference – to circuit common (lead 4) unless noted

Receptacle	Pin	Value
PLG3	1	Final Amperage reference, 0 to +5 volts DC variable
	2	Initial Time reference, 0 to +5 volts DC variable
	3	Final Time reference, 0 to +5 volts DC variable
	4	Ground reference for sloper (sequencer) board
	5	Start Amperage reference, 0 to +5 volts DC variable
	6	Ground reference for potentiometers on sloper (sequencer) board
	7	Spot Time, 0 to +5 volts DC
	8	+5 volts DC
	9	Not used
	10	Initial LED, +3.6 volts DC while on, 0 volts DC while off
	11	Final LED, +3.6 volts DC while on, 0 volts DC while off
	12	Spot LED, +3.6 volts DC while on, 0 volts DC while off
	13	Sloper (sequencer) board present, 0 volts DC while connected and +5 volts DC while not connected
	14	Not used

6-12. Check Unit Output After Servicing



1 Weld Output Terminals

Check open-circuit voltage between terminals according to Section 6-3 (voltage V20)

Use output waveforms to check unit output after servicing (see Section 6-5. Check each module as necessary.

If correct voltage is not present, repeat troubleshooting procedures.

If removed, reinstall cover and side panels.

801 972-C

SECTION 7 – MAINTENANCE

7-1. Routine Maintenance

▲ Disconnect power before maintaining.

3 Months			
	<p>Replace Unreadable Labels</p>		<p>Repair Or Replace Cracked Weld Cables</p>
	<p>Clean And Tighten Weld Terminals</p>		<p>Adjust Spark Gaps</p>
	<p>14-Pin Cord</p>		<p>Gas Hose</p>
	<p>Torch Cable</p>		<p>Replace Cracked Parts</p>
6 Months			
<p>Blow Out Or Vacuum Inside, During Heavy Service, Clean Monthly</p>			

7-2. Circuit Breaker CB1

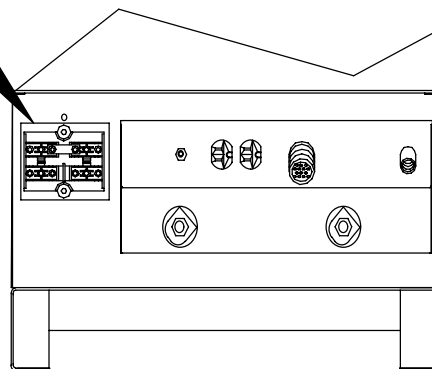
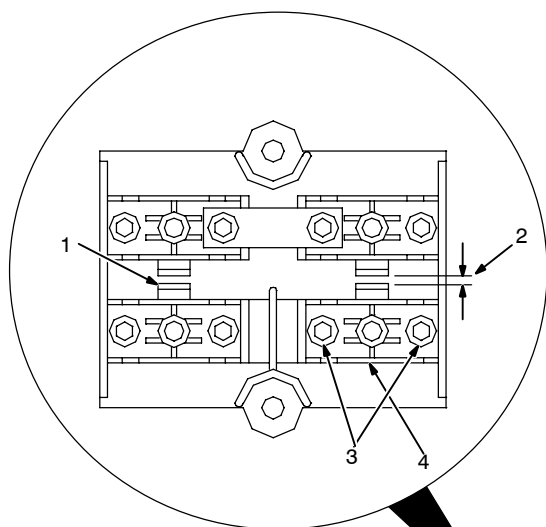
▲ Turn off power before resetting breaker.

1 Circuit Breaker CB1

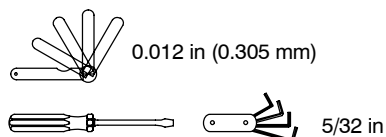
If CB1 opens, high frequency and output to the 115 volts ac duplex receptacle stop. Press button to reset breaker.

Ref. 801 972-C

7-3. Adjusting Spark Gaps



Tools Needed:



▲ **Turn Off welding power source and disconnect and lockout/tagout input power before adjusting spark gaps.**

Open access door.

1 Tungsten End Of Point

Replace point if tungsten end disappears; do not clean or dress tungsten.

2 Spark Gap

Normal spark gap is 0.012 in (0.305 mm).

If adjustment is needed, proceed as follows:

3 Adjustment Screws

Loosen screws. Place gauge of proper thickness in spark gap.

4 Pressure Point

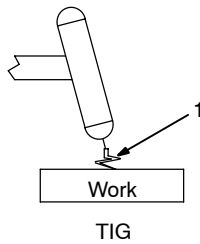
Apply slight pressure at point until gauge is held firmly in gap. Tighten screws. Adjust other gap.

Reinstall access door.

Ref. 801 972-C / Ref. S-0043

SECTION 8 – HIGH FREQUENCY

8-1. Welding Processes Requiring High Frequency

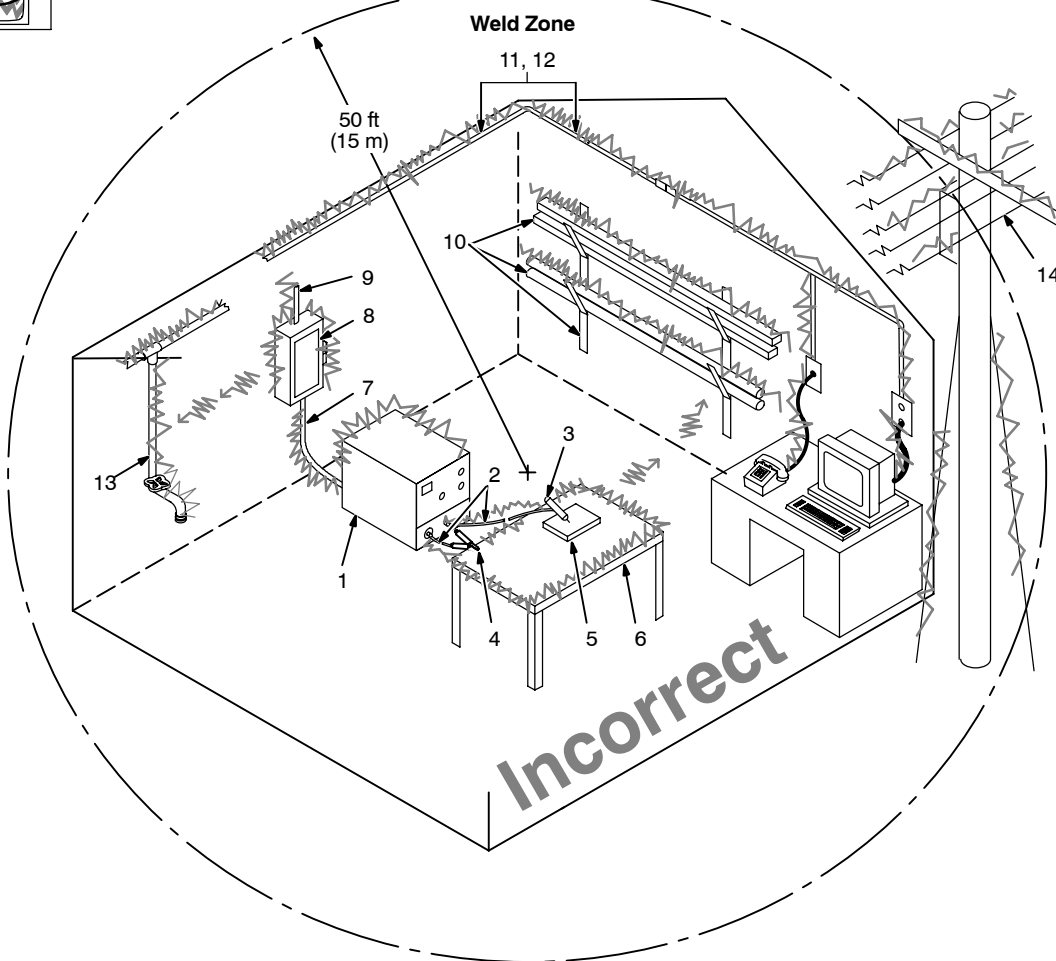


1 High-Frequency Voltage

TIG – helps arc jump air gap between torch and workpiece and/or stabilize the arc.

high_freq 12/96 – S-0693

8-2. Incorrect Installation



Sources of Direct High-Frequency Radiation

- 1 High-Frequency Source (welding power source with built-in HF or separate HF unit)
- 2 Weld Cables
- 3 Torch
- 4 Work Clamp
- 5 Workpiece
- 6 Work Table

Sources of Conduction of High Frequency

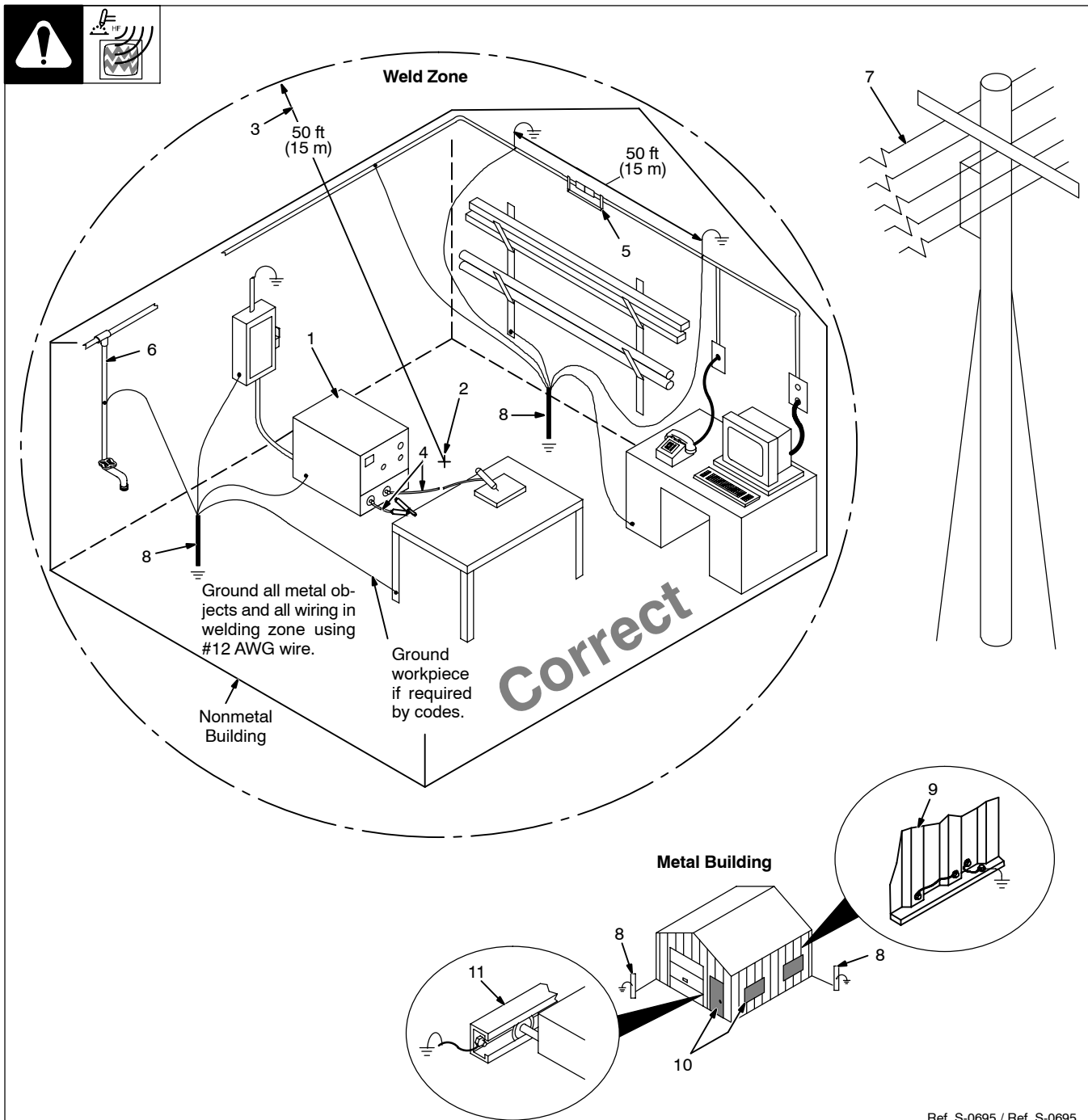
- 7 Input Power Cable
- 8 Line Disconnect Device
- 9 Input Supply Wiring

Sources of Reradiation of High Frequency

- 10 Ungrounded Metal Objects
- 11 Lighting
- 12 Wiring
- 13 Water Pipes and Fixtures
- 14 External Phone and Power Lines

S-0694

8-3. Correct Installation



Ref. S-0695 / Ref. S-0695

- 1 High-Frequency Source (welding power source with built-in HF or separate HF unit)

Ground metal machine case, work output terminal, line disconnect device, input supply, and worktable.

- 2 Center Point of Welding Zone

Midpoint between high-frequency source and welding torch.

- 3 Welding Zone

A circle 50 ft (15 m) from center point in all directions.

- 4 Weld Output Cables

Keep cables short and close together.

- 5 Conduit Joint Bonding and Grounding

Electrically join (bond) all conduit sections using copper straps or braided wire. Ground conduit every 50 ft (15 m).

- 6 Water Pipes and Fixtures

Ground water pipes every 50 ft (15 m).

- 7 External Power or Telephone Lines

Locate high-frequency source at least 50 ft (15 m) away from power and phone lines.

- 8 Grounding Rod

Consult the National Electrical Code for specifications.

Metal Building Requirements

- 9 Metal Building Panel Bonding Methods

Bolt or weld building panels together, install copper straps or braided wire across seams, and ground frame.


- 10 Windows and Doorways

Cover all windows and doorways with grounded copper screen of not more than 1/4 in (6.4 mm) mesh.

- 11 Overhead Door Track

Ground the track.

SECTION 9 – ELECTRICAL DIAGRAMS

 The circuits in this manual can be used for troubleshooting, but there might be minor circuit differences from your machine. Use circuit inside machine case or contact distributor for more information.

The following is a list of all diagrams for models covered by this manual.

Model	Serial Or Style Number	Circuit Diagram	Wiring Diagram
Non-CE Syncrowave 250 DX	LA349426 Thru LB141714	202 484-A	194 382-B♦♦
	LB141715 and following	194 381-K	194 382-G
CE Syncrowave 250 DX	LA349426 and following	194 381-K	194 382-H
Interface Circuit Board PC1	LA349426 thru LB141714	192 807♦♦	
	LB141715 and following	203 901-B	
Interface Circuit Board PC1 For Units With Optional Automation 10-Pin Connection	LB141715 and Following	203 923-A	
Pulser Circuit Board PC2♦	LA349426 and following	190 736	
Circuit Board PC3♦	LA349426 and following	190 740	
♦ Optional			
♦♦ Not included in this manual			

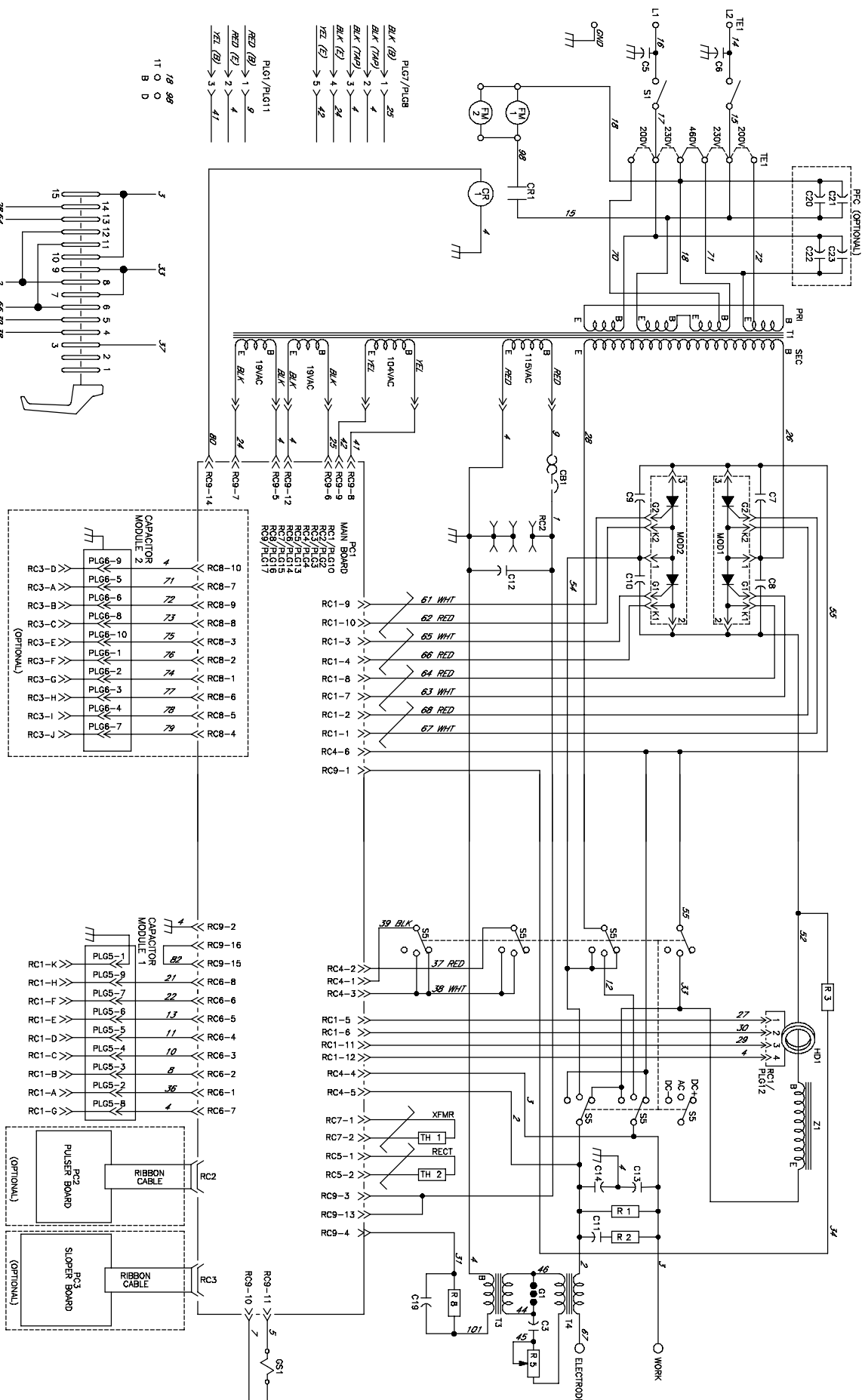



Figure 9-1. Circuit Diagram For Non-CE Syncrowave 250 DX Models Effective With Serial No. LA349426 Thru LB141714

202 484-A



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⚠ WARNING

ELECTRIC SHOCK HAZARD

- Do not touch live electrical parts.
- Disconnect input power or stop engine before servicing.
- Do not operate with covers removed.
- Have only qualified persons install, use, or service this unit.

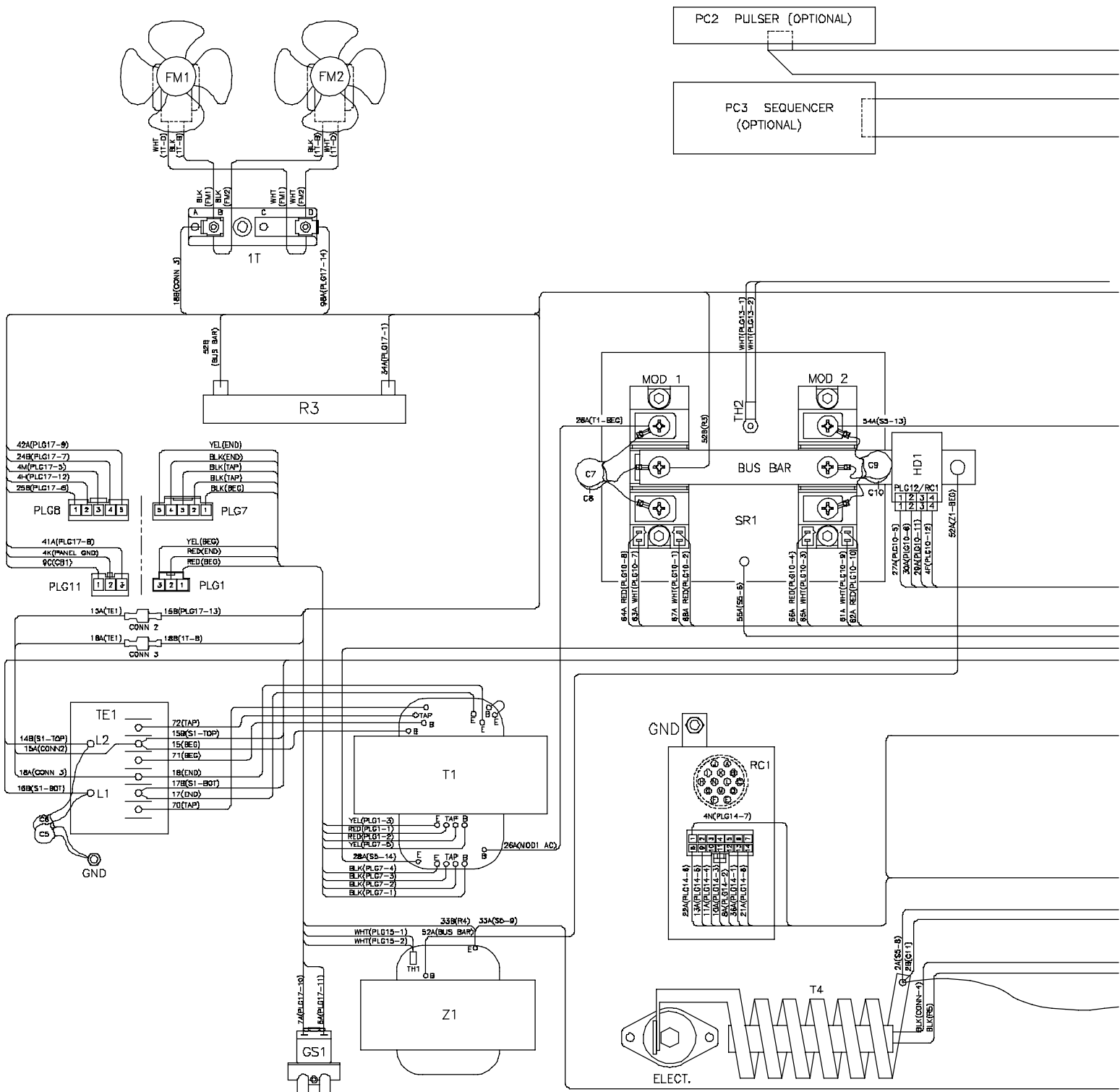


Figure 9-3. Wiring Diagram For Syncrowave 250 DX Effective With Serial No. LA349426 And Following

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Syncrowave 250 DX

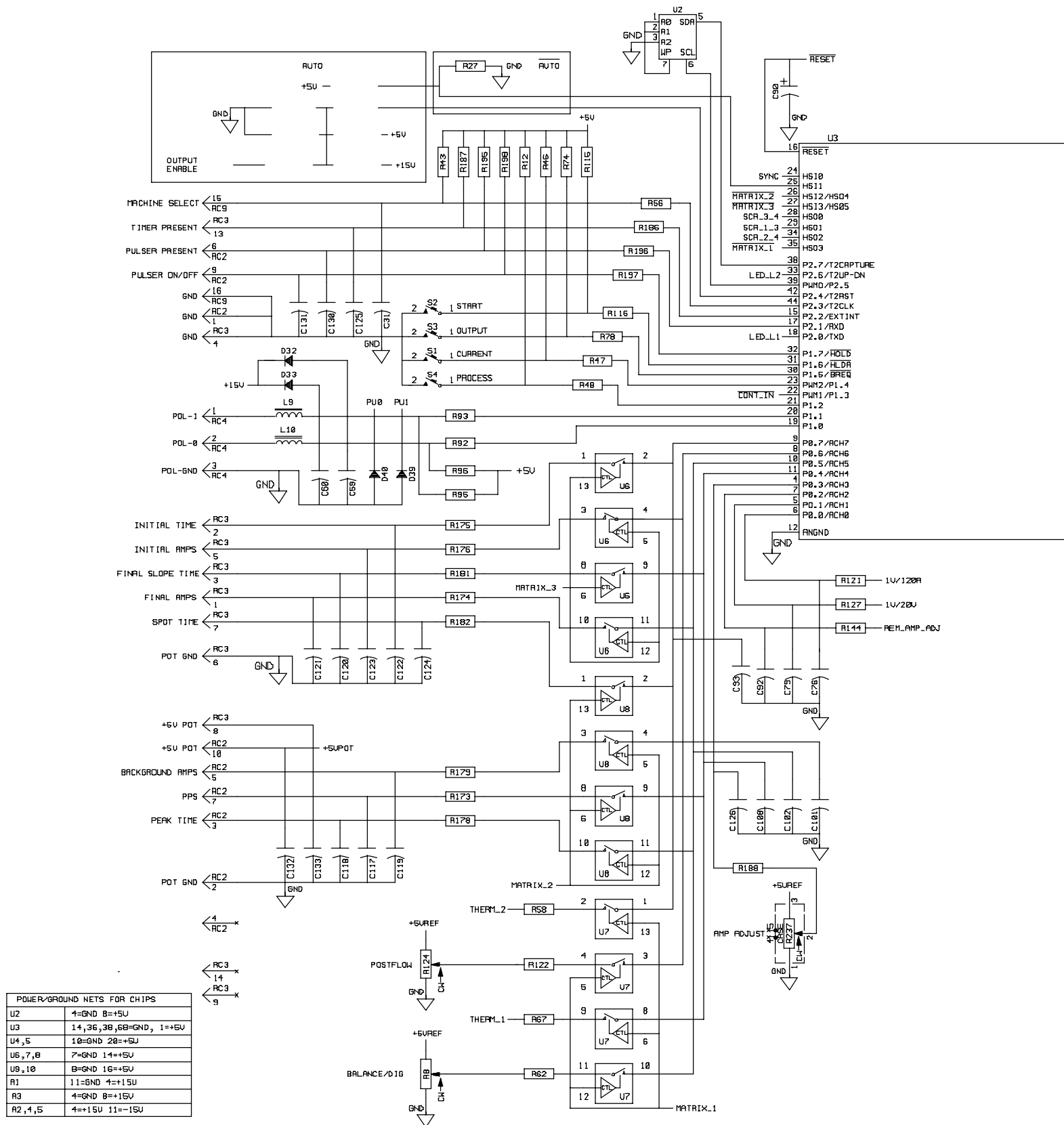
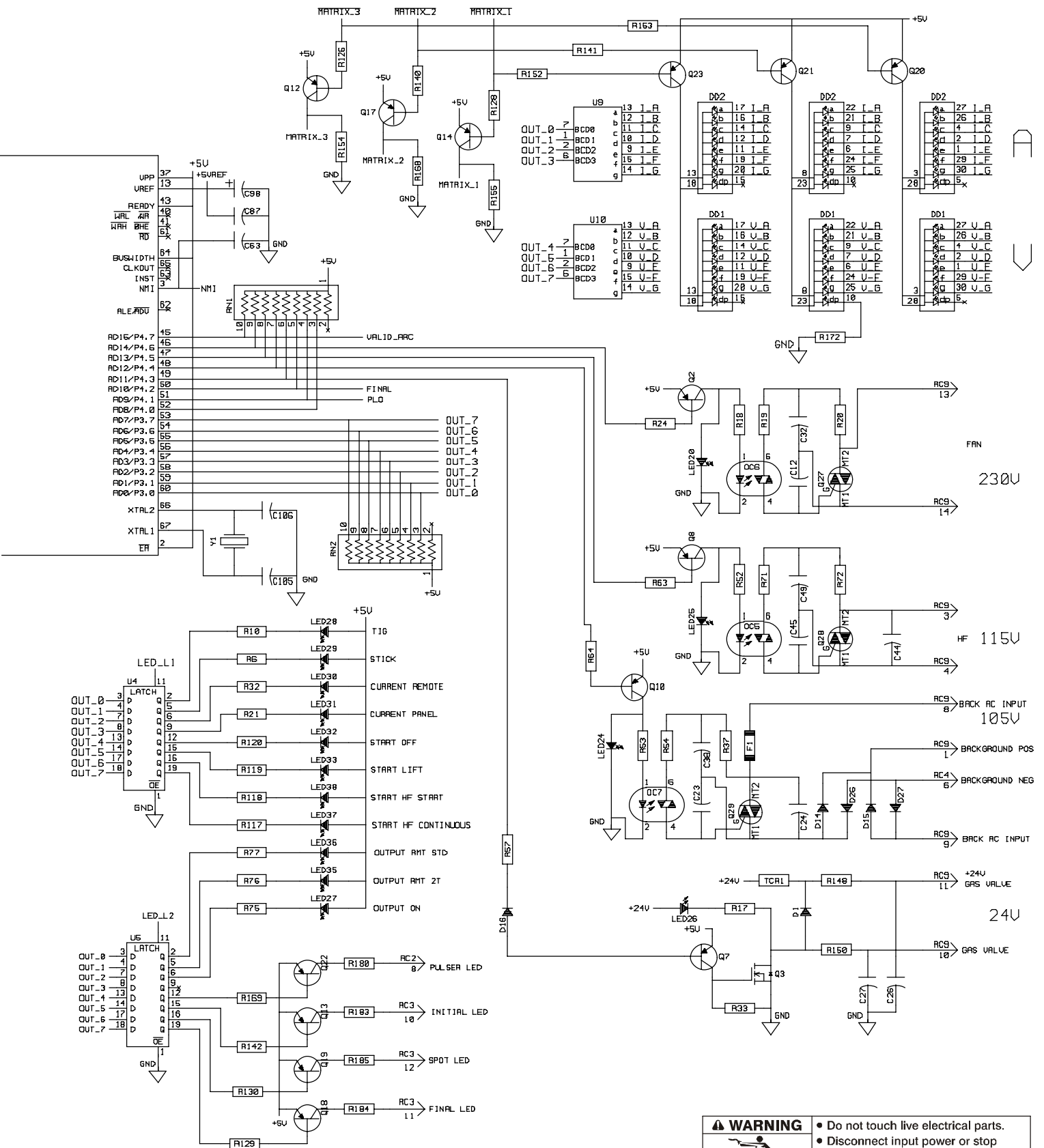


Figure 9-4. Circuit Diagram For Main Control Board PC1 Effective With Serial No. LB141715 And Following (Part 1 Of 3)



⚠ WARNING

- Do not touch live electrical parts.
- Disconnect input power or stop engine before servicing.
- Do not operate with covers removed.
- Have only qualified persons install, use, or service this unit.

ELECTRIC SHOCK HAZARD

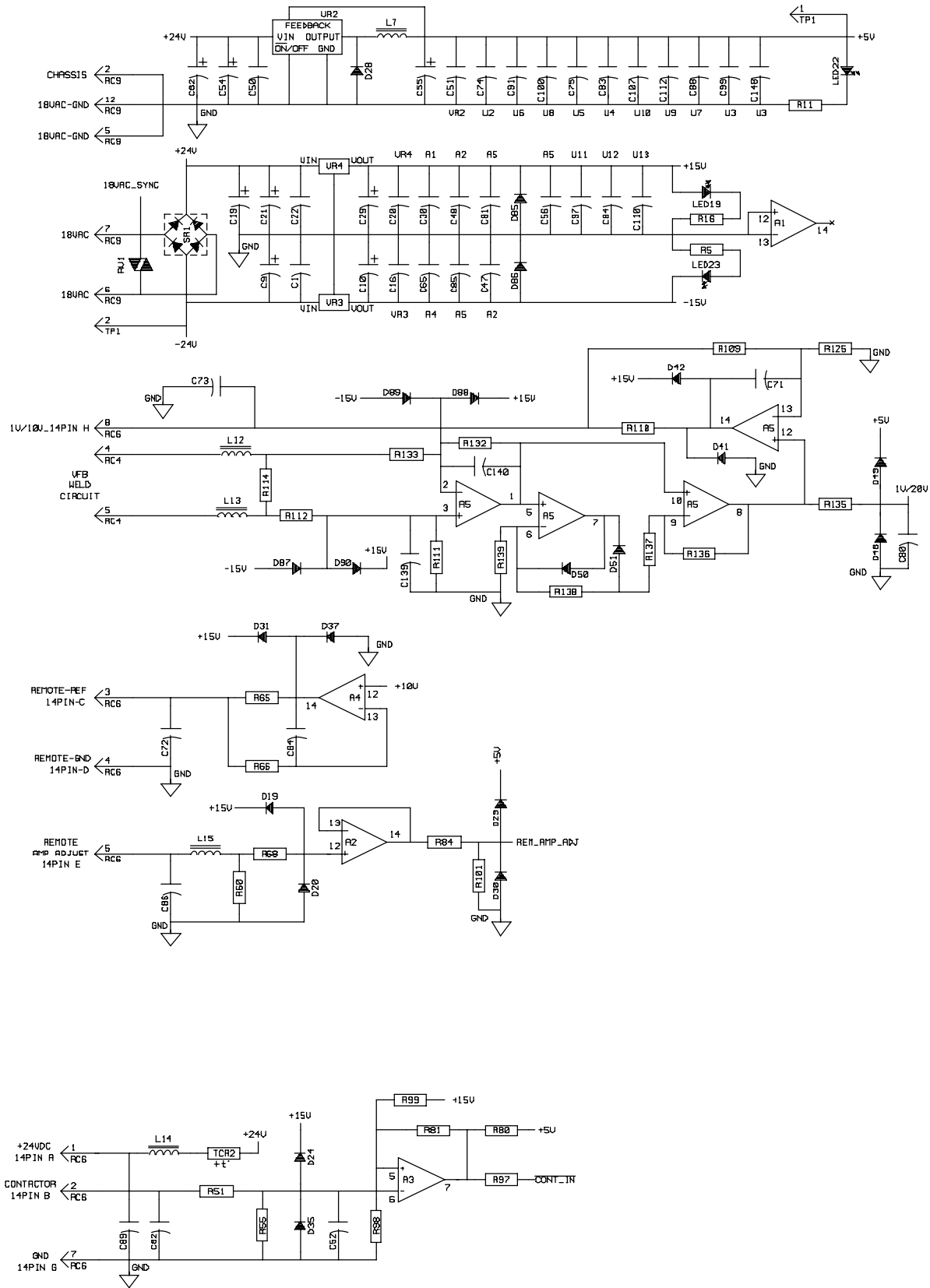
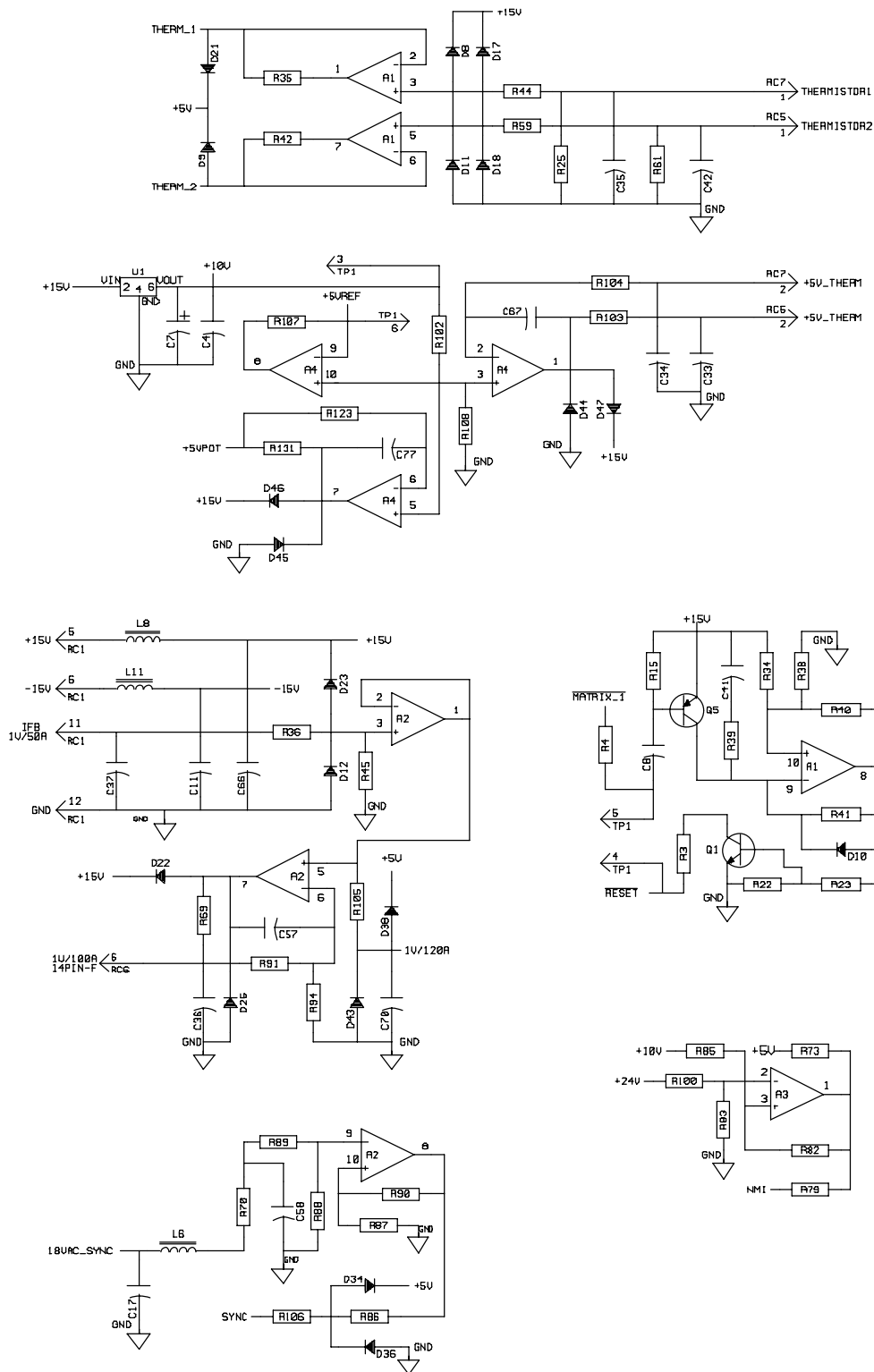

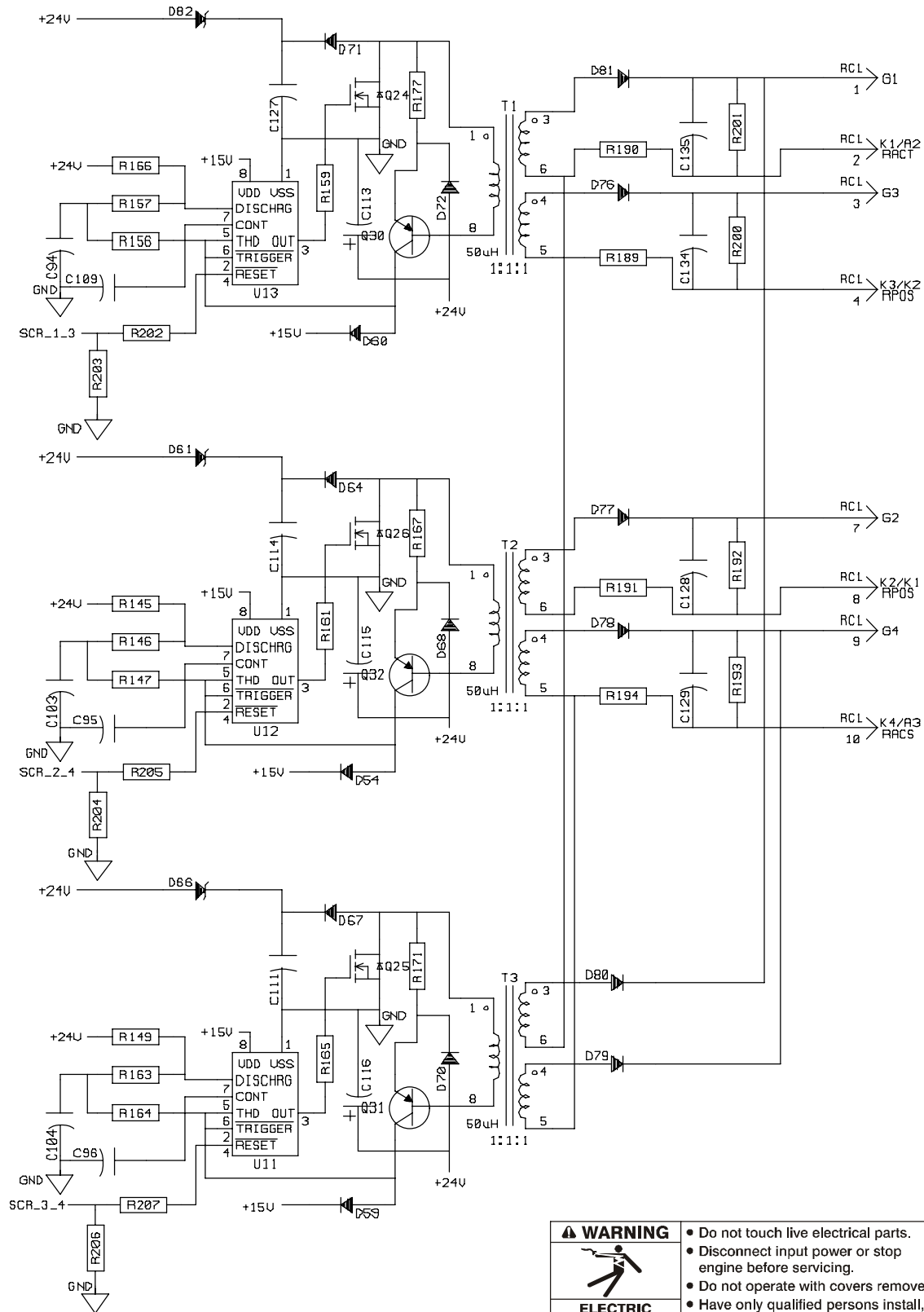


Figure 9-5. Circuit Diagram For Main Control Board PC1 Effective With Serial No. LB141715 And Following (Part 2 Of 3)

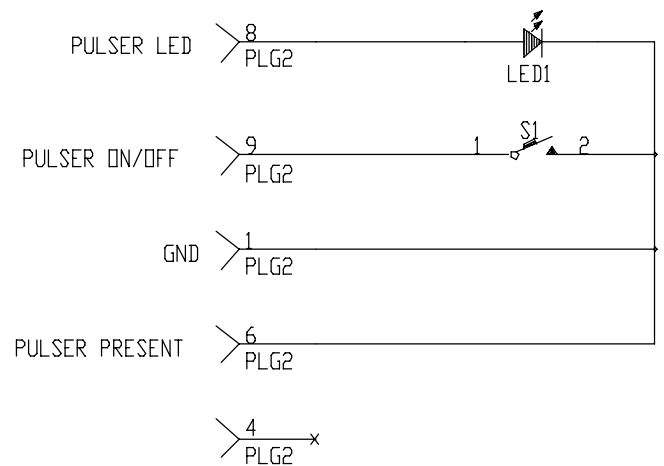
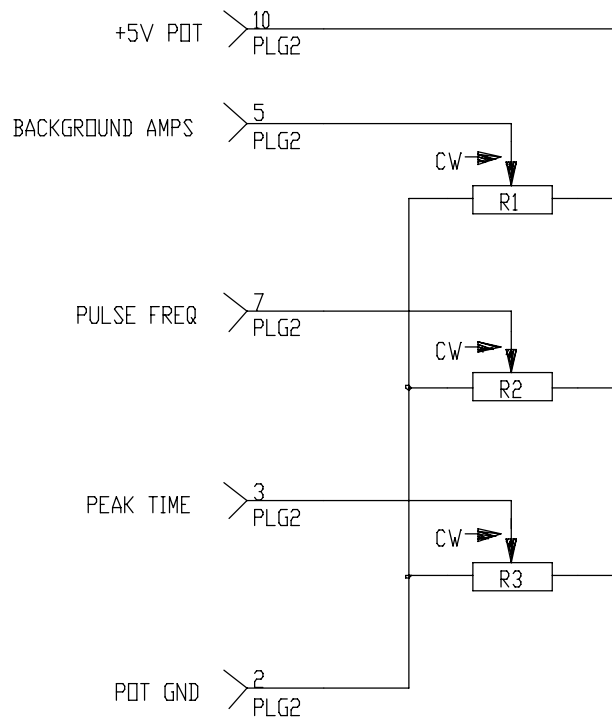


<p>⚠ WARNING</p>  <p>ELECTRIC SHOCK HAZARD</p>	<ul style="list-style-type: none"> • Do not touch live electrical parts. • Disconnect input power or stop engine before servicing. • Do not operate with covers removed. • Have only qualified persons install, use, or service this unit.
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203 901-B (3 of 3)

Figure 9-6. Circuit Diagram For Main Control Board PC1 Effective With Serial No. LB141715 And Following (Part 3 Of 3)





⚠ WARNING	<ul style="list-style-type: none"> • Do not touch live electrical parts. • Disconnect input power or stop engine before servicing. • Do not operate with covers removed. • Have only qualified persons install, use, or service this unit.
 ELECTRIC SHOCK HAZARD	

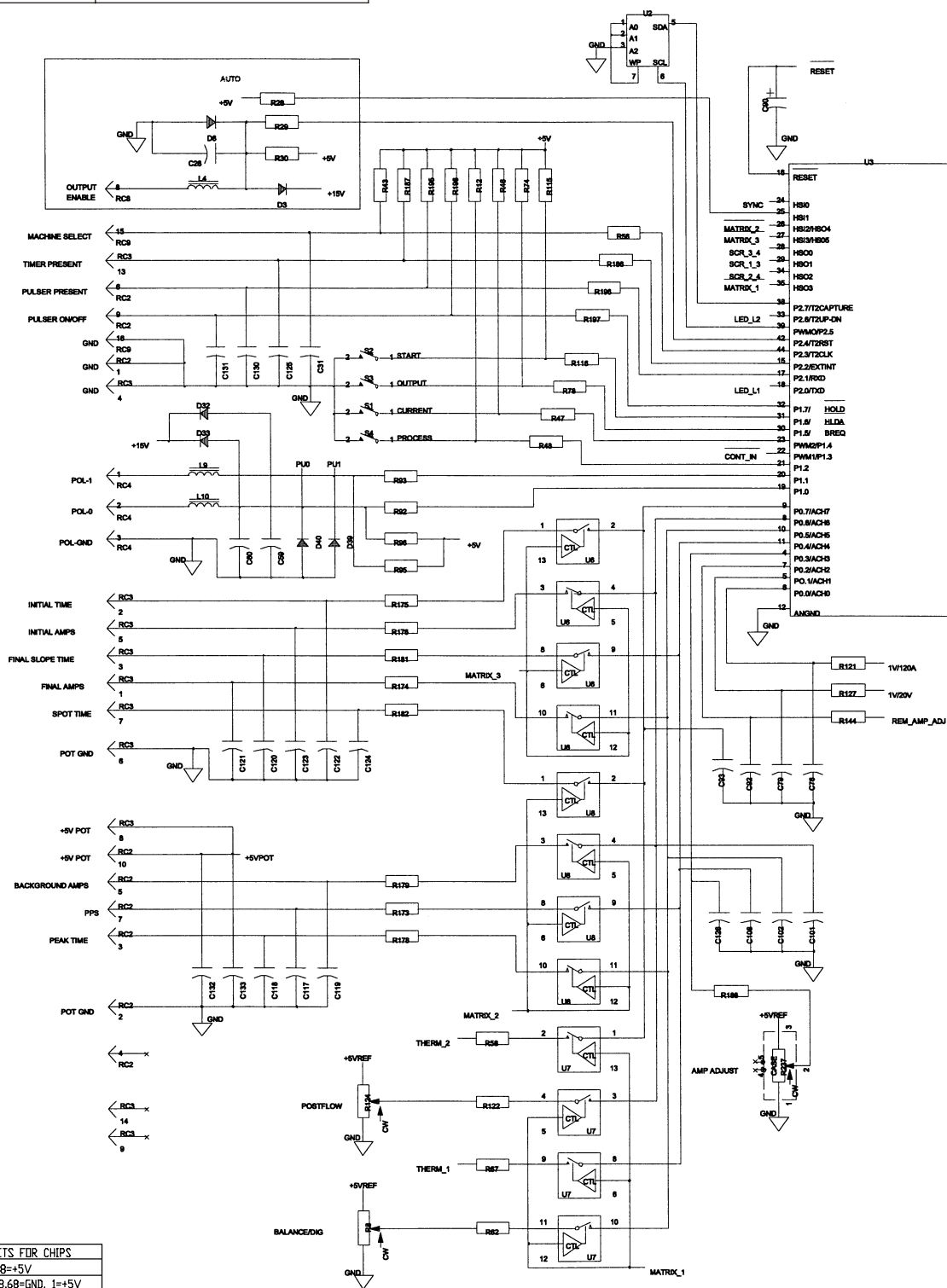
Figure 9-7. Circuit Diagram For Optional Pulser Board PC2 Effective With Serial No. LA349426 And Following

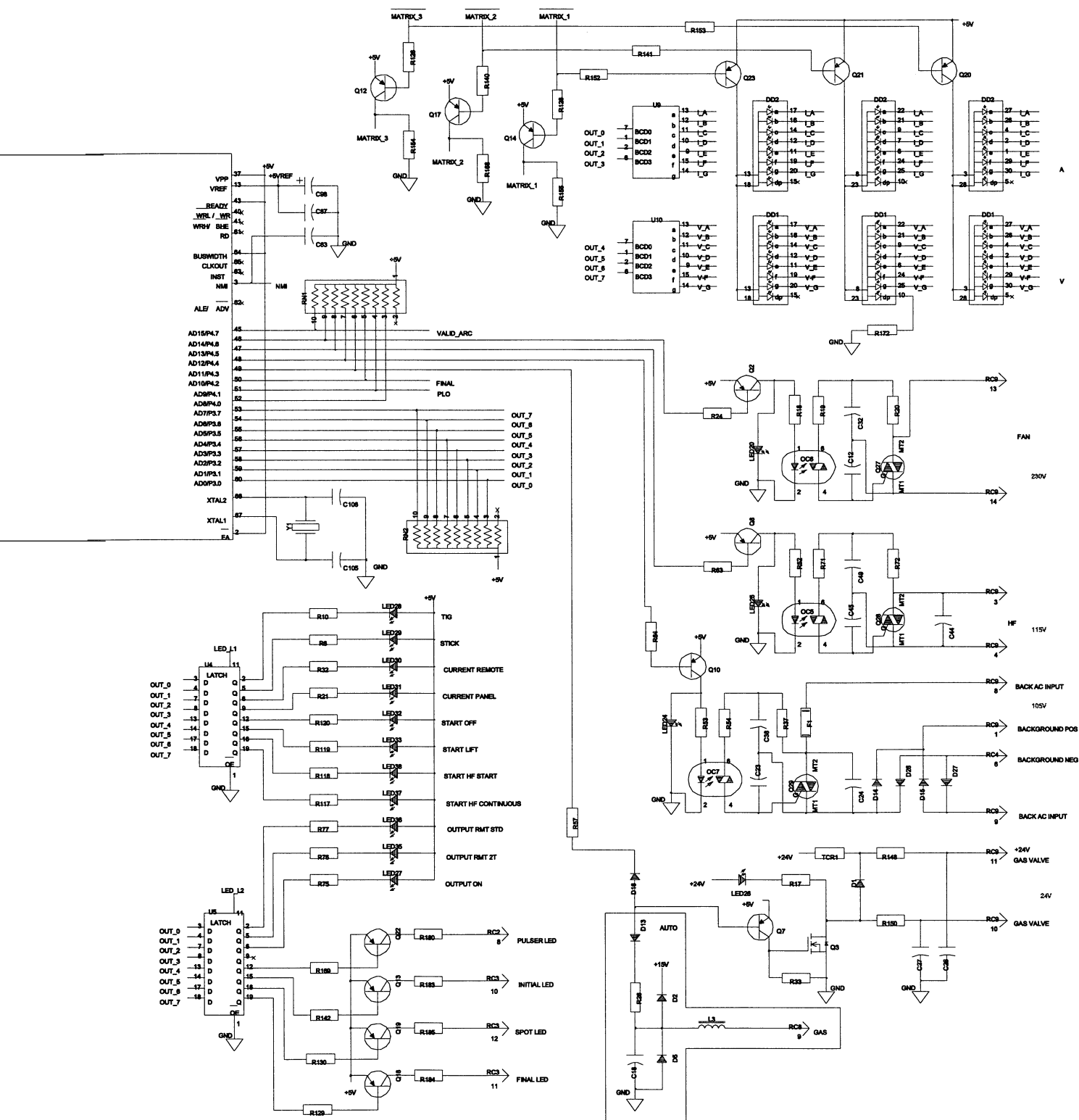
⚠ WARNING



ELECTRIC SHOCK HAZARD

- Do not touch live electrical parts.
- Disconnect input power or stop engine before servicing.
- Do not operate with covers removed.
- Have only qualified persons install, use, or service this unit.







- Do not touch live electrical parts.
- Disconnect input power or stop engine before servicing.
- Do not operate with covers removed.
- Have only qualified persons install, use, or service this unit.

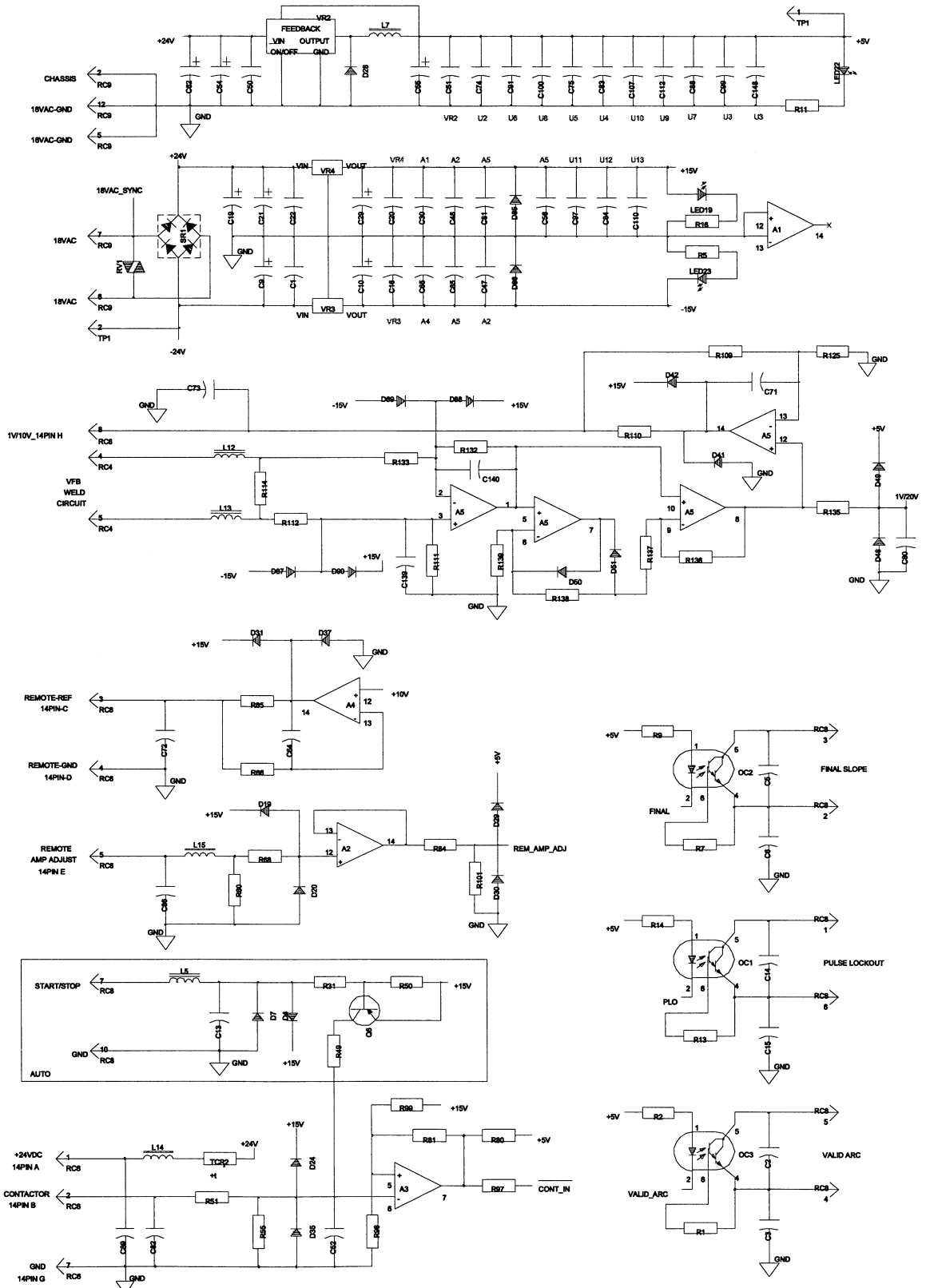
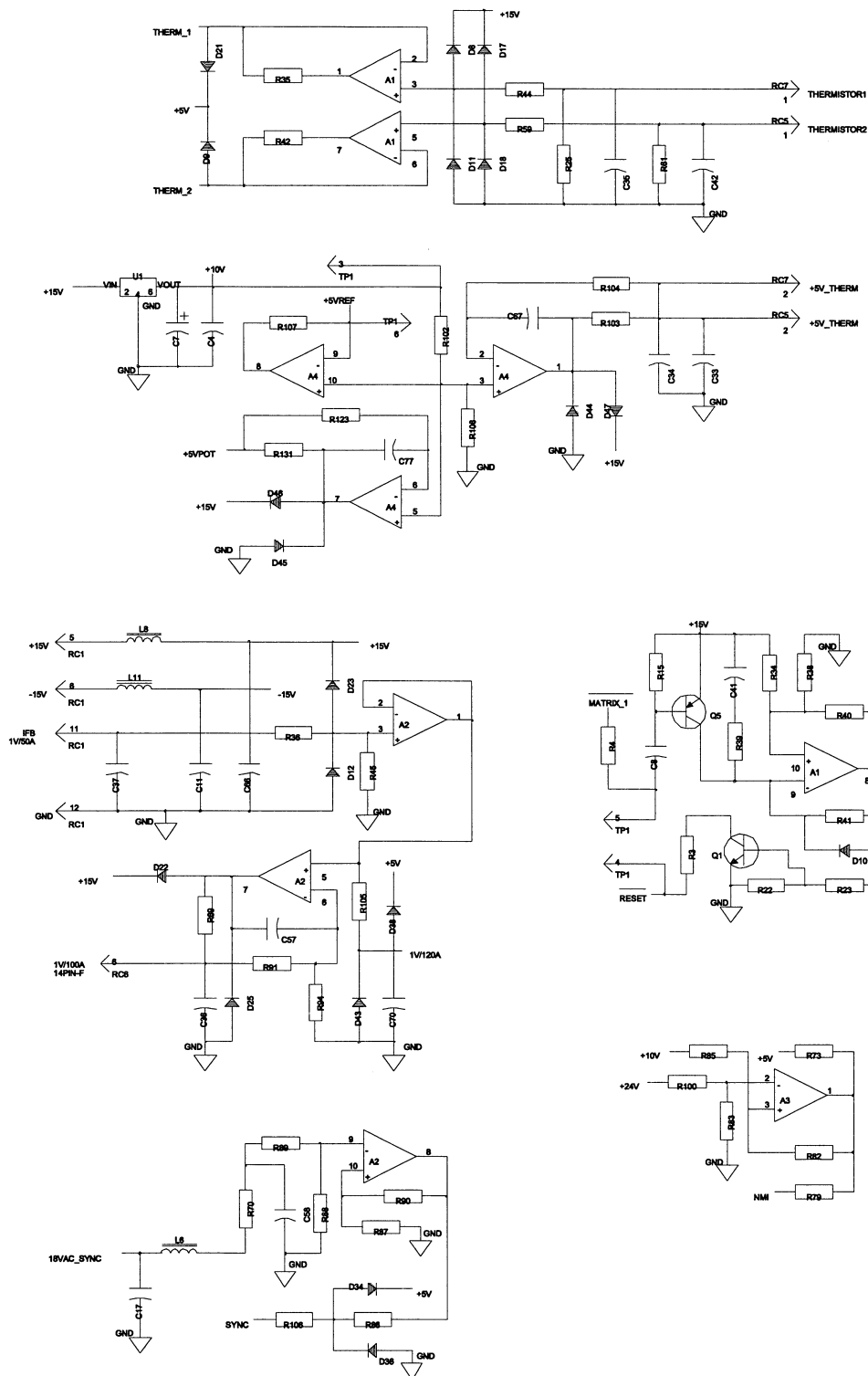
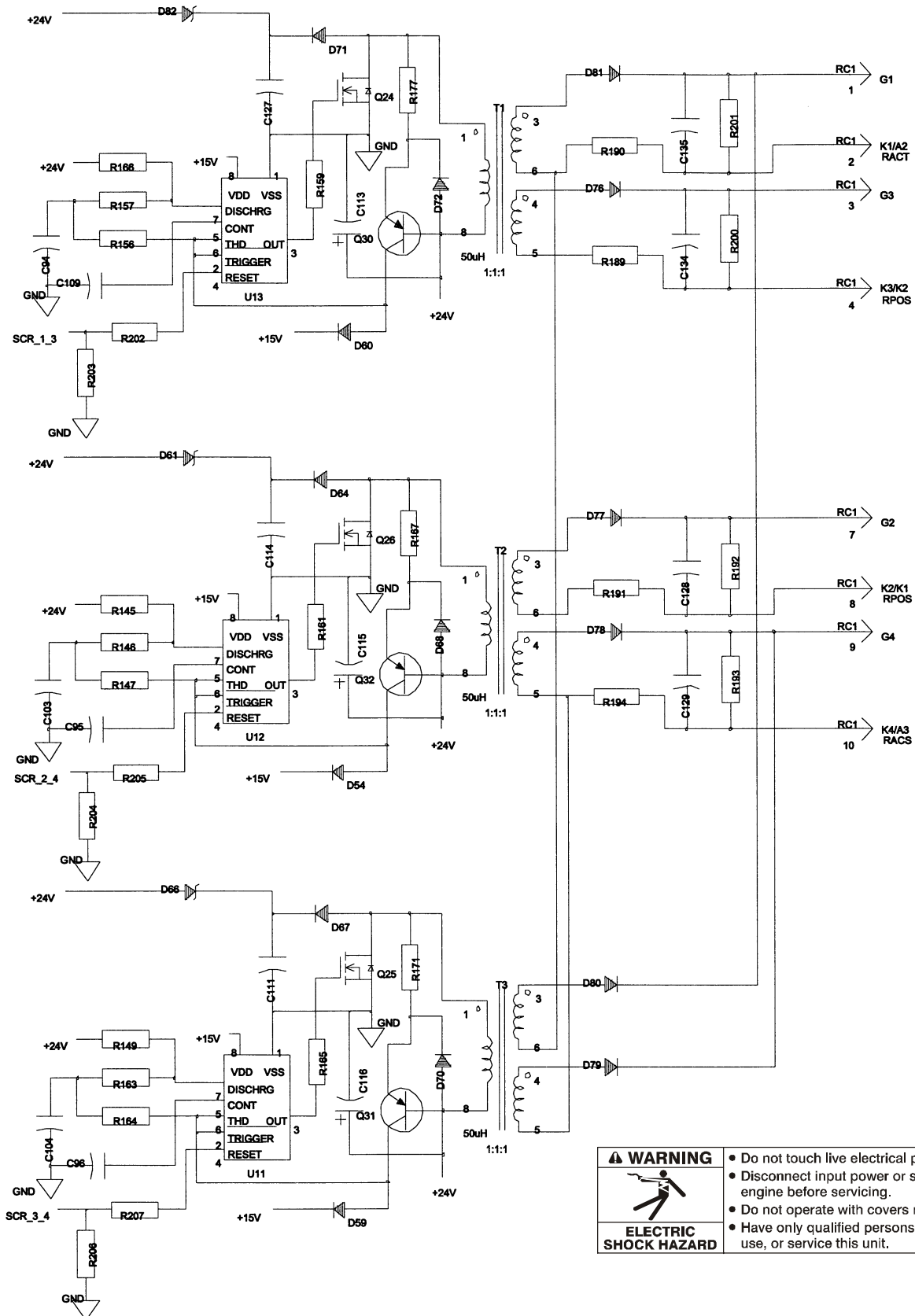


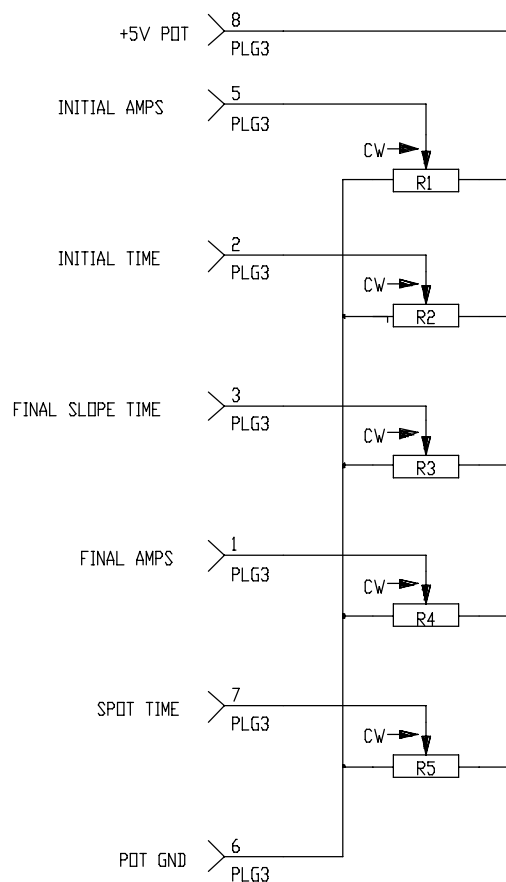
Figure 9-9. Circuit Diagram For Main Control Board PC1 With Optional Automation 10-Pin Connection Effective With Serial No. LB141715 And Following (Part 2 Of 3)



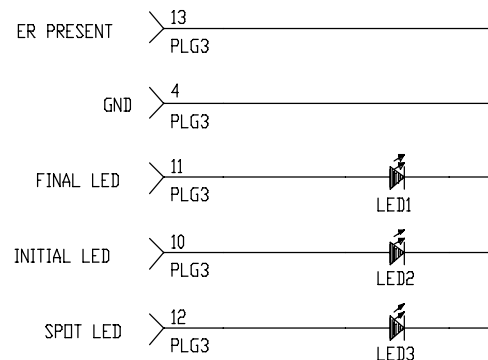


203 923-A

Figure 9-10. Circuit Diagram For Main Control Board PC1 With Optional Automation 10-Pin Connection Effective With Serial No. LB141715 And Following (Part 3 Of 3)



TIM




⚠ WARNING	<ul style="list-style-type: none"> Do not touch live electrical parts. Disconnect input power or stop engine before servicing. Do not operate with covers removed. Have only qualified persons install, use, or service this unit.
 ELECTRIC SHOCK HAZARD	

Figure 9-11. Circuit Diagram For Optional Sloper Board PC3 Effective With Serial No. LA349426 And Following

SECTION 10 – SELECTING AND PREPARING TUNGSTEN ELECTRODE FOR DC OR AC WELDING

ac/dc_gtaw 2/2000



▲ Whenever possible and practical, use DC weld output instead of AC weld output.

10-1. Selecting Tungsten Electrode (Wear Clean gloves To Prevent Contamination Of Tungsten)

Electrode Diameter	Amperage Range - Gas Type♦ - Polarity			
	DC – Argon – Electrode Negative/Straight Polarity	DC – Argon – Electrode Positive/Reverse Polarity	AC – Argon	AC – Argon – Balanced Wave
2% Ceria (Orange Band), 1.5% Lanthanum (Gray Band), Or 2% Thorium (Red Band) Alloy Tungstens				
.010"	Up to 25	*	Up to 20	Up to 15
.020"	15-40	*	15-35	5-20
.040"	25-85	*	20-80	20-60
1/16"	50-160	10-20	50-150	60-120
3/32"	135-235	15-30	130-250	100-180
1/8"	250-400	25-40	225-360	160-250
5/32"	400-500	40-55	300-450	200-320
3/16"	500-750	55-80	400-500	290-390
1/4"	750-1000	80-125	600-800	340-525
Pure Tungsten (Green Band)				
.010"	Up to 15	*	Up to 15	Up to 10
.020"	5-20	*	5-20	10-20
.040"	15-80	*	10-60	20-30
1/16"	70-150	10-20	50-100	30-80
3/32"	125-225	15-30	100-160	60-130
1/8"	225-360	25-40	150-210	100-180
5/32"	360-450	40-55	200-275	160-240
3/16"	450-720	55-80	250-350	190-300
1/4"	720-950	80-125	325-450	250-400
Zirconium Alloyed Tungsten (Brown Band)				
.010"	*	*	Up to 20	Up to 15
.020"	*	*	15-35	5-20
.040"	*	*	20-80	20-60
1/16"	*	*	50-150	60-120
3/32"	*	*	130-250	100-180
1/8"	*	*	225-360	160-250
5/32"	*	*	300-450	200-320
3/16"	*	*	400-550	290-390
1/4"	*	*	600-800	340-525

♦ Typical argon shielding gas flow rates are 15 to 35 cfh (cubic feet per hour).

*Not Recommended.

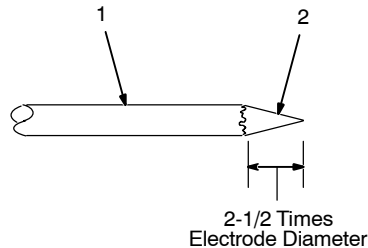
Figures listed are a guide and are a composite of recommendations from American Welding Society (AWS) and electrode manufacturers.

10-2. Preparing Tungsten Electrode For Welding



▲ Grinding the tungsten electrode produces dust and flying sparks which can cause injury and start fires. Use local exhaust (forced ventilation) at the grinder or wear an approved respirator. Read MSDS for safety information. Consider using tungsten containing ceria, lanthana, or yttria instead of thorium. Grinding dust from thoriated electrodes contains low-level radioactive material. Properly dispose of grinder dust in an environmentally safe way. Wear proper face, hand, and body protection. Keep flammables away.

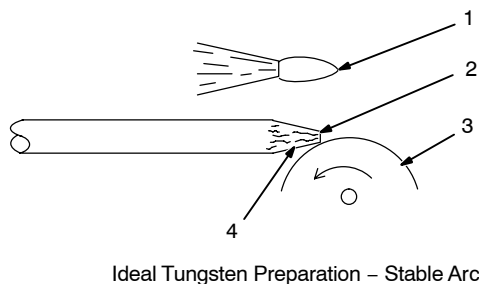
A. Preparing Tungsten For DC Electrode Negative (DCEN) Welding Or AC Welding With Inverter Machines



1 Tungsten Electrode

2 Tapered End

Grind end of tungsten on fine grit, hard abrasive wheel before welding. Do not use wheel for other jobs or tungsten can become contaminated causing lower weld quality.



1 Stable Arc

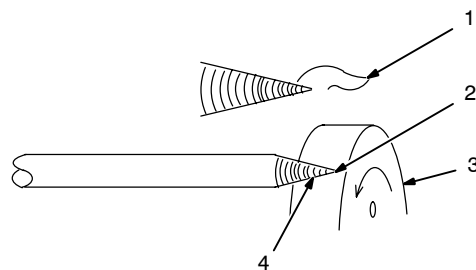
2 Flat

Diameter of this flat determines amperage capacity.

3 Grinding Wheel

Grinding wheel should be dedicated to grinding tungsten only.

4 Straight Ground



1 Arc Wander

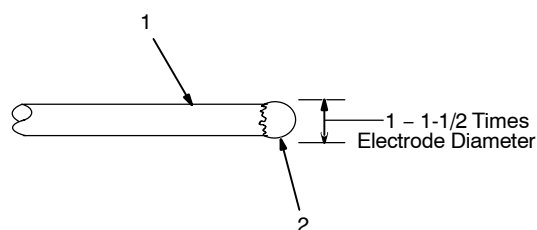
2 Point

3 Grinding Wheel

Grinding wheel should be dedicated to grinding tungsten only.

4 Radial Ground

B. Preparing Tungsten For Conventional AC Welding



1 Tungsten Electrode

2 Balled End

▲ Understand and follow safety symbols at start of Section 11-1 before preparing tungsten.

Ball end of tungsten by applying AC amperage recommended for a given electrode diameter (see Section 10-1). Let ball on end of the tungsten take its own shape.

SECTION 11 – GUIDELINES FOR TIG WELDING (GTAW)

11-1. Positioning The Torch



▲ Weld current can damage electronic parts in vehicles. Disconnect both battery cables before welding on a vehicle. Place work clamp as close to the weld as possible.

☞ For additional information, see your distributor for a handbook on the Gas Tungsten Arc Welding (GTAW) process.

1 Workpiece

Make sure workpiece is clean before welding.

2 Work Clamp

Place as close to the weld as possible.

3 Torch

4 Filler Rod (If Applicable)

5 Gas Cup

6 Tungsten Electrode

Select and prepare tungsten according to Sections 10-1 and 10-2.

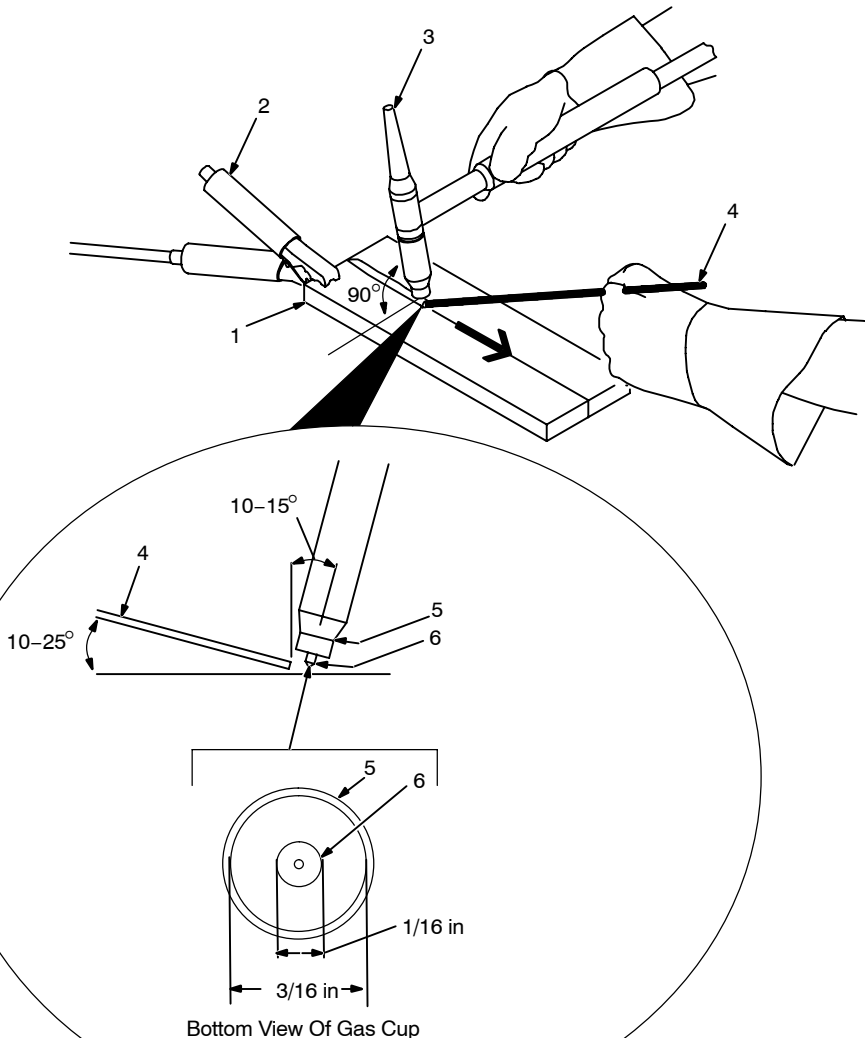
Guidelines:

The inside diameter of the gas cup should be at least three times the tungsten diameter to provide adequate shielding gas coverage. (For example, if tungsten is 1/16 in diameter, gas cup should be a minimum of 3/16 in diameter.

Tungsten extension is the distance the tungsten extends out gas cup of torch.

The tungsten extension should be no greater than the inside diameter of the gas cup.

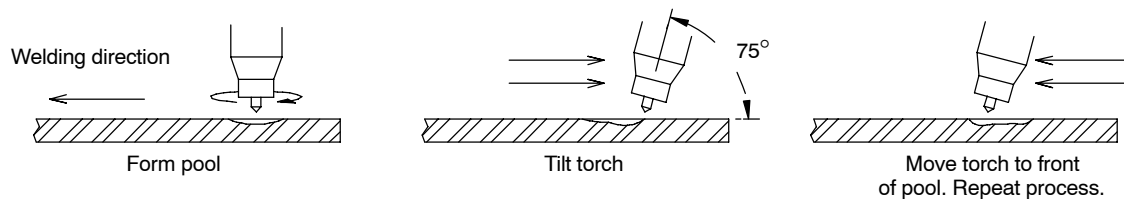
Arc length is the distance from the tungsten to the workpiece.



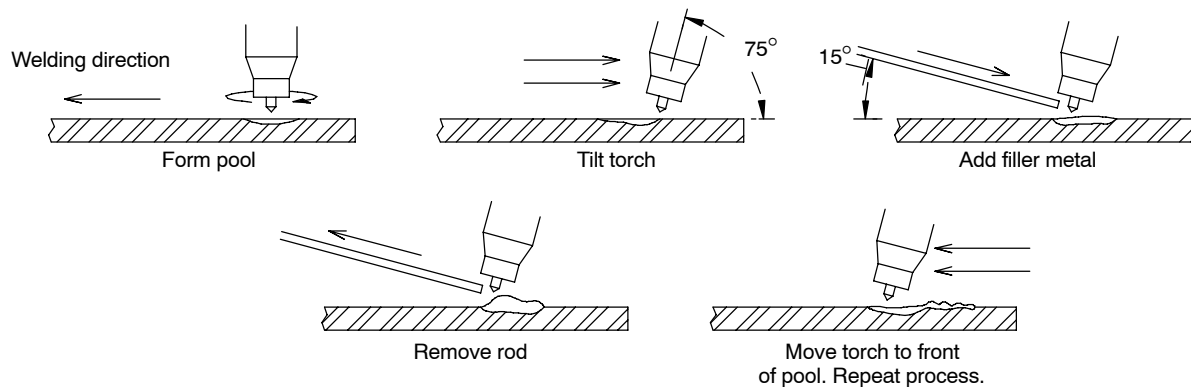
Bottom View Of Gas Cup

11-2. Torch Movement During Welding

Tungsten Without Filler Rod



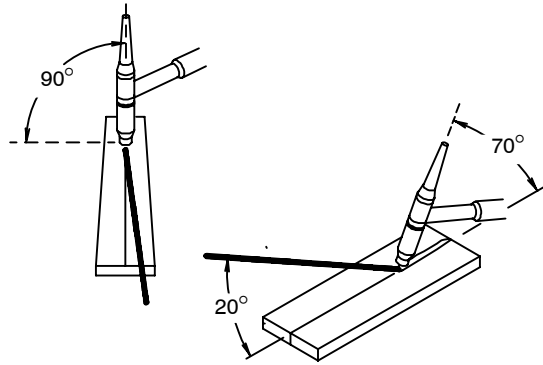
Tungsten With Filler Rod



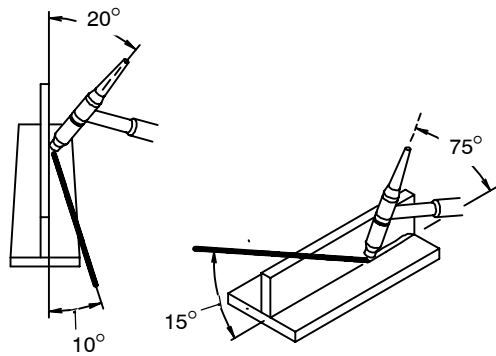
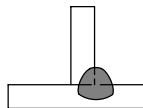
ST-162 002-B

11-3. Positioning Torch Tungsten For Various Weld Joints

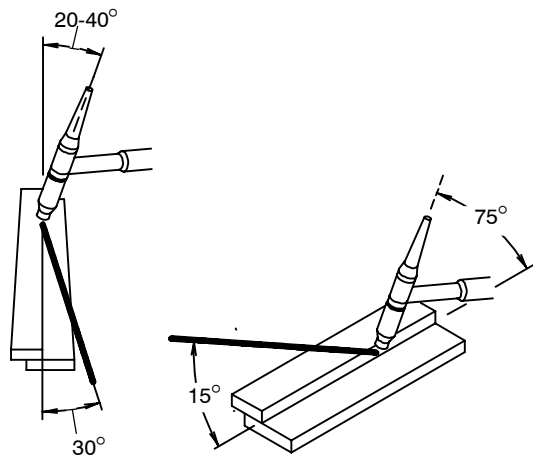
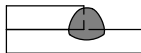
Butt Weld And Stringer Bead



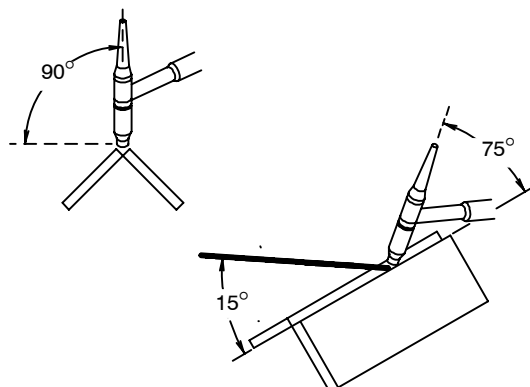
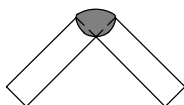
"T" Joint



Lap Joint



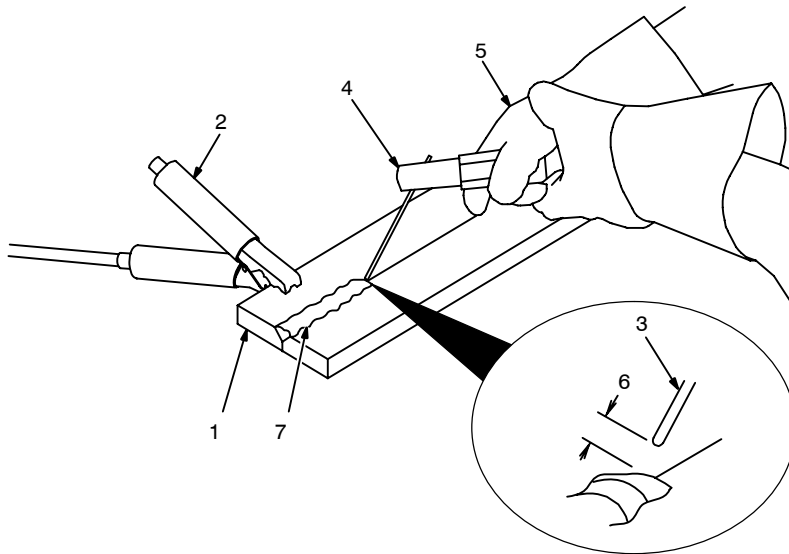
Corner Joint



SECTION 12 – STICK WELDING (SMAW) GUIDELINES



12-1. Stick Welding Procedure



▲ Weld current starts when electrode touches workpiece.

▲ Weld current can damage electronic parts in vehicles. Disconnect both battery cables before welding on a vehicle. Place work clamp as close to the weld as possible.

1 Workpiece

Make sure workpiece is clean before welding.

2 Work Clamp

3 Electrode

A small diameter electrode requires less current than a large one. Follow electrode manufacturer's instructions when setting weld amperage (see Section 12-2).

4 Insulated Electrode Holder

5 Electrode Holder Position

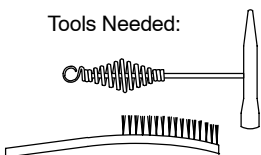
6 Arc Length

Arc length is the distance from the electrode to the workpiece. A short arc with correct amperage will give a sharp, crackling sound.

7 Slag

Use a chipping hammer and wire brush to remove slag. Remove slag and check weld bead before making another weld pass.

Tools Needed:



stick 12/96 – ST-151 593

12-2. Electrode and Amperage Selection Chart

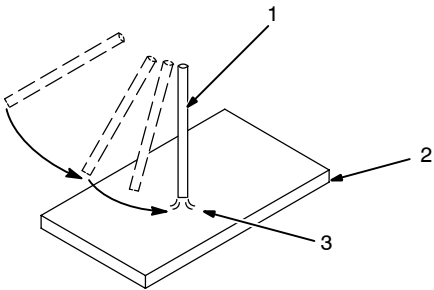
ELECTRODE	DIAMETER	AMPERAGE RANGE								
		50	100	150	200	250	300	350	400	450
6010 & 6011	3/32									
	1/8									
	5/32									
	3/16									
	7/32									
6013	1/4									
	1/16									
	5/64									
	3/32									
	1/8									
	5/32									
	3/16									
	7/32									
7014	1/4									
	3/32									
	1/8									
	5/32									
	3/16									
7018	7/32									
	1/4									
	3/32									
	1/8									
	5/32									
7024	3/16									
	7/32									
	1/4									
	3/32									
	1/8									
Ni-CI	5/32									
	3/16									
	3/32									
	1/8									
308L	5/32									
	3/16									

ELECTRODE	DC*	AC	POSITION	PENETRATION	USAGE
6010	EP		ALL	DEEP	MIN. PREP, ROUGH
6011	EP	✓	ALL	DEEP	HIGH SPATTER
6013	EP,EN	✓	ALL	LOW	GENERAL
7014	EP,EN	✓	ALL	MED	SMOOTH, EASY, FAST
7018	EP	✓	ALL	LOW	LOW HYDROGEN, STRONG
7024	EP,EN	✓	FLAT HORIZ FILLET	LOW	SMOOTH, EASY, FASTER
NI-CL	EP	✓	ALL	LOW	CAST IRON
308L	EP	✓	ALL	LOW	STAINLESS

*EP = ELECTRODE POSITIVE (REVERSE POLARITY)
EN = ELECTRODE NEGATIVE (STRAIGHT POLARITY)

Ref. S-087 985-A

12-3. Striking an Arc – Scratch Start Technique

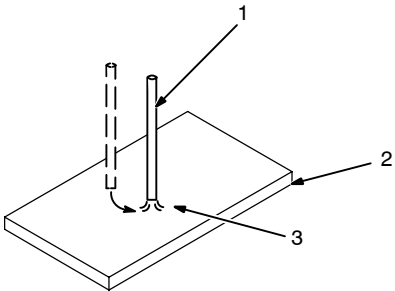


- 1 Electrode
- 2 Workpiece
- 3 Arc

Drag electrode across workpiece like striking a match; lift electrode slightly after touching work. If arc goes out electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

S-0049

12-4. Striking an Arc – Tapping Technique

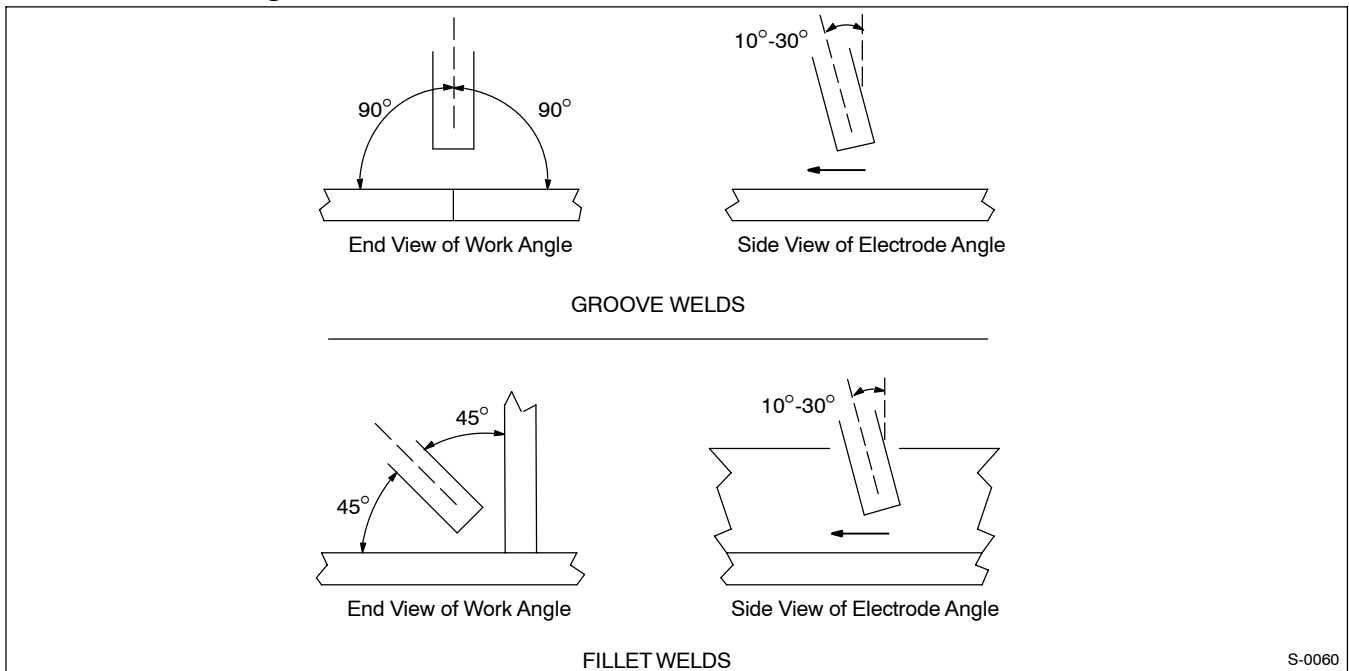


- 1 Electrode
- 2 Workpiece
- 3 Arc

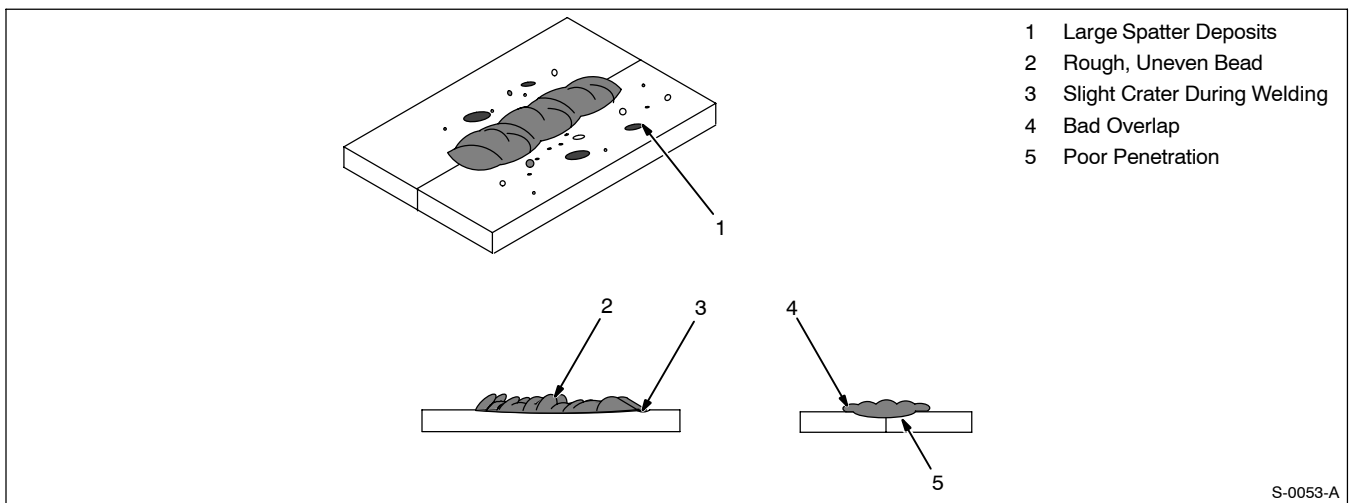
Bring electrode straight down to workpiece; then lift slightly to start arc. If arc goes out, electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

S-0050

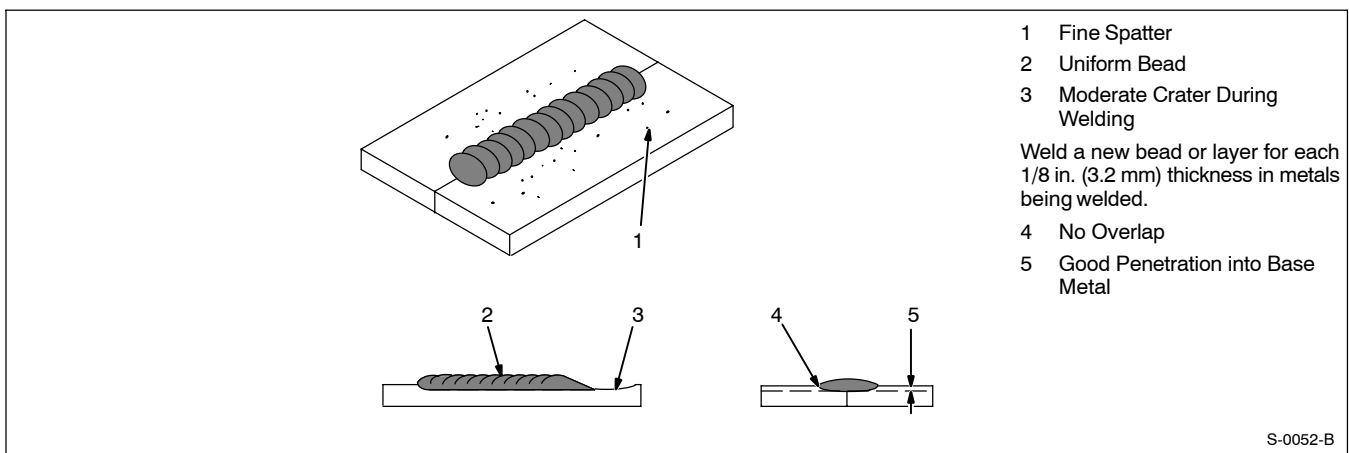
12-5. Positioning Electrode Holder



12-6. Poor Weld Bead Characteristics



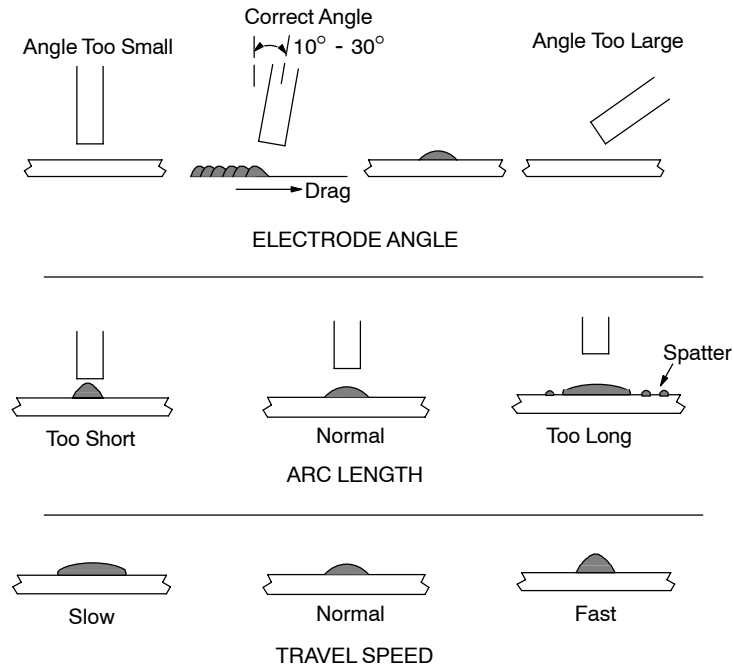
12-7. Good Weld Bead Characteristics



12-8. Conditions That Affect Weld Bead Shape

NOTE

Weld bead shape is affected by electrode angle, arc length, travel speed, and thickness of base metal.

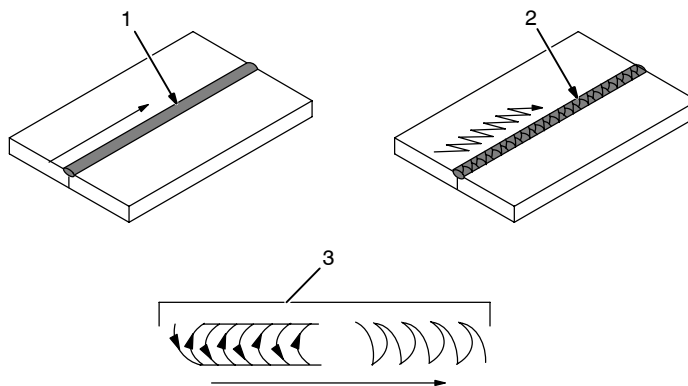


S-0061

12-9. Electrode Movement During Welding

NOTE

Normally, a single stringer bead is satisfactory for most narrow groove weld joints; however, for wide groove weld joints or bridging across gaps, a weave bead or multiple stringer beads work better.

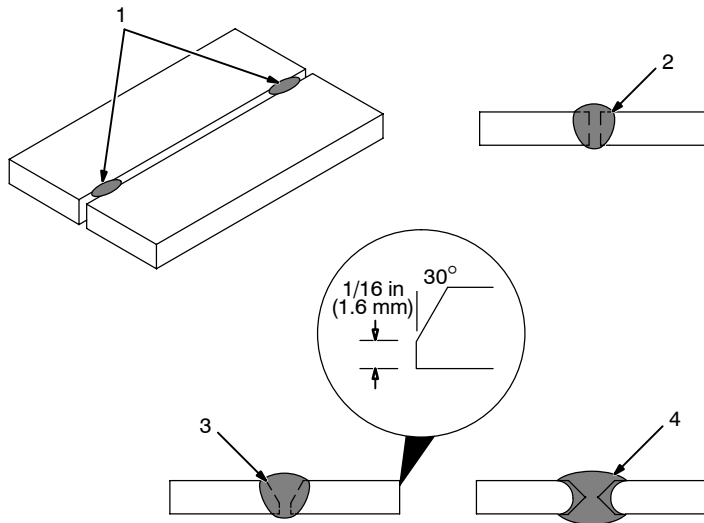


- 1 Stringer Bead – Steady Movement Along Seam
- 2 Weave Bead – Side to Side Movement Along Seam
- 3 Weave Patterns

Use weave patterns to cover a wide area in one pass of the electrode. Do not let weave width exceed 2-1/2 times diameter of electrode.

S-0054-A

12-10. Butt Joints



1 Tack Welds

Prevent edges of joint from drawing together ahead of electrode by tack welding the materials in position before final weld.

2 Square Groove Weld

Good for materials up to 3/16 in (5 mm) thick.

3 Single V-Groove Weld

Good for materials 3/16 – 3/4 in (5-19 mm) thick. Cut bevel with oxy-acetylene or plasma cutting equipment. Remove scale from material after cutting. A grinder can also be used to prepare bevels.

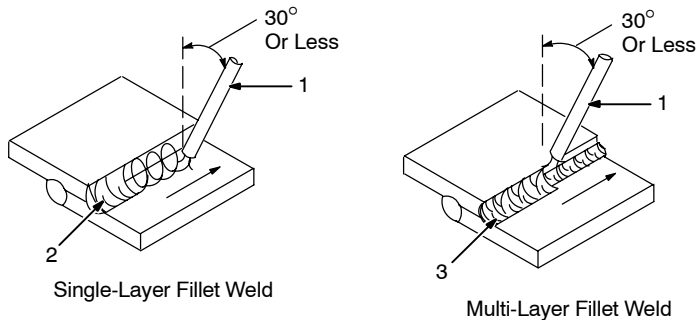
Create 30 degree angle of bevel on materials in V-groove welding.

4 Double V-Groove Weld

Good for materials thicker than 3/16 in (5 mm).

S-0662

12-11. Lap Joint



1 Electrode

2 Single-Layer Fillet Weld

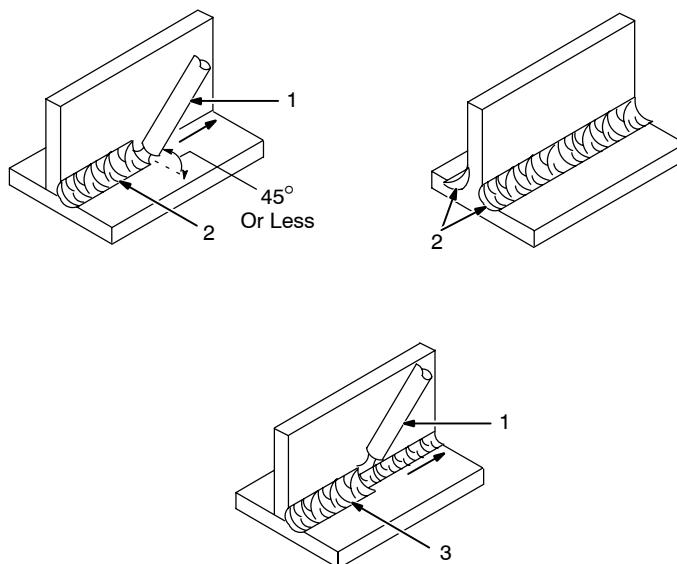
Move electrode in circular motion.

3 Multi-Layer Fillet Weld

Weld a second layer when a heavier fillet is needed. Remove slag before making another weld pass. Weld both sides of joint for maximum strength.

S-0063 / S-0064

12-12. Tee Joint



1 Electrode

2 Fillet Weld

Keep arc short and move at definite rate of speed. Hold electrode as shown to provide fusion into the corner. Square edge of the weld surface.

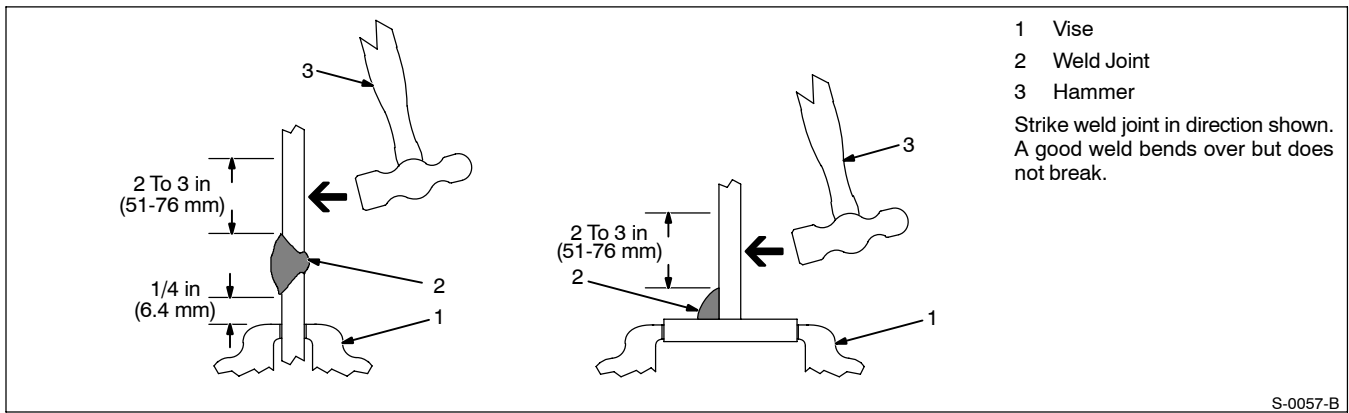
For maximum strength weld both sides of upright section.

3 Multi-Layer Deposits

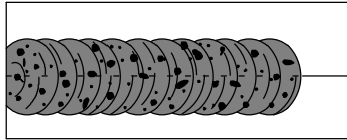
Weld a second layer when a heavier fillet is needed. Use any of the weaving patterns shown in Section 12-9. Remove slag before making another weld pass.

S-0060 / S-0058-A / S-0061

12-13. Weld Test



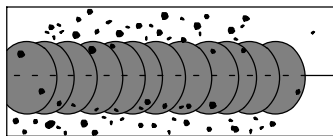
12-14. Troubleshooting – Porosity



Porosity – small cavities or holes resulting from gas pockets in weld metal.

Possible Causes	Corrective Actions
Arc length too long.	Reduce arc length.
Damp electrode.	Use dry electrode.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, slag, and dirt from work surface before welding.

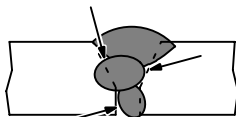
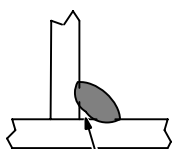
12-15. Troubleshooting – Excessive Spatter



Excessive Spatter – scattering of molten metal particles that cool to solid form near weld bead.

Possible Causes	Corrective Actions
Amperage too high for electrode.	Decrease amperage or select larger electrode.
Arc length too long or voltage too high.	Reduce arc length or voltage.

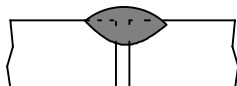
12-16. Troubleshooting – Incomplete Fusion



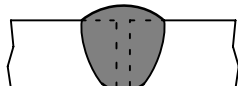
Incomplete Fusion – failure of weld metal to fuse completely with base metal or a preceding weld bead.

Possible Causes	Corrective Actions
Insufficient heat input.	Increase amperage. Select larger electrode and increase amperage.
Improper welding technique.	Place stringer bead in proper location(s) at joint during welding.
	Adjust work angle or widen groove to access bottom during welding.
	Momentarily hold arc on groove side walls when using weaving technique.
	Keep arc on leading edge of weld puddle.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, slag, and dirt from work surface before welding.

12-17. Troubleshooting – Lack Of Penetration



Lack of Penetration

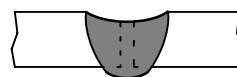


Good Penetration

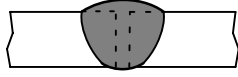
Lack Of Penetration – shallow fusion between weld metal and base metal.

Possible Causes	Corrective Actions
Improper joint preparation.	Material too thick. Joint preparation and design must provide access to bottom of groove.
Improper weld technique.	Keep arc on leading edge of weld puddle.
Insufficient heat input.	Increase amperage. Select larger electrode and increase amperage.
	Reduce travel speed.

12-18. Troubleshooting – Excessive Penetration



Excessive Penetration

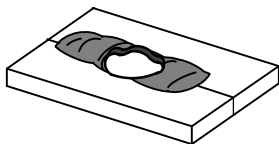


Good Penetration

Excessive Penetration – weld metal melting through base metal and hanging underneath weld.

Possible Causes	Corrective Actions
Excessive heat input.	Select lower amperage. Use smaller electrode.
	Increase and/or maintain steady travel speed.

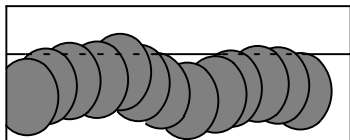
12-19. Troubleshooting – Burn-Through



Burn-Through – weld metal melting completely through base metal resulting in holes where no metal remains.

Possible Causes	Corrective Actions
Excessive heat input.	Select lower amperage. Use smaller electrode.
	Increase and/or maintain steady travel speed.

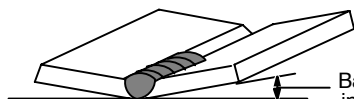
12-20. Troubleshooting – Waviness Of Bead



Waviness Of Bead – weld metal that is not parallel and does not cover joint formed by base metal.

Possible Causes	Corrective Actions
Unsteady hand.	Use two hands. Practice technique.

12-21. Troubleshooting – Distortion



Base metal moves in the direction of the weld bead.

Distortion – contraction of weld metal during welding that forces base metal to move.

Possible Causes	Corrective Actions
Excessive heat input.	Use restraint (clamp) to hold base metal in position.
	Make tack welds along joint before starting welding operation.
	Select lower amperage for electrode.
	Increase travel speed.
	Weld in small segments and allow cooling between welds.



TM-359G

2006-01

Eff. w/Serial Number LA349426

Processes



TIG (GTAW) Welding



Stick (SMAW) Welding

Description

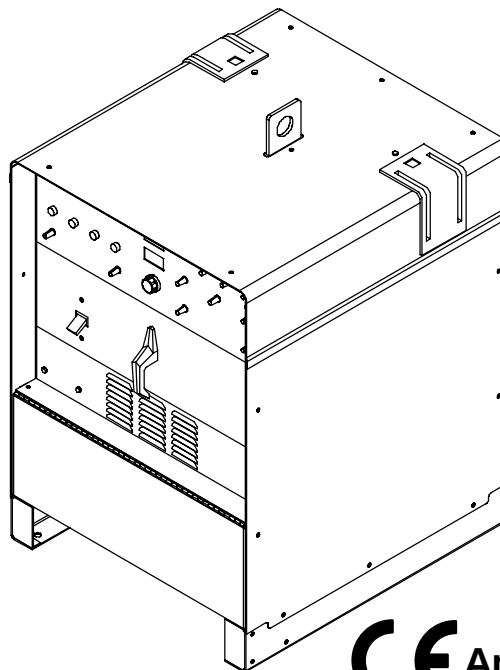


Arc Welding Power Source

Syncrowave[®] 250 DX

PARTS LIST

Eff w/ LA349426 Through LC066672




CE And Non-Ce Models



Visit our website at
www.MillerWelds.com

SECTION 13 – PARTS LIST LA349426 Thru LC066672

 Hardware is common and not available unless listed.

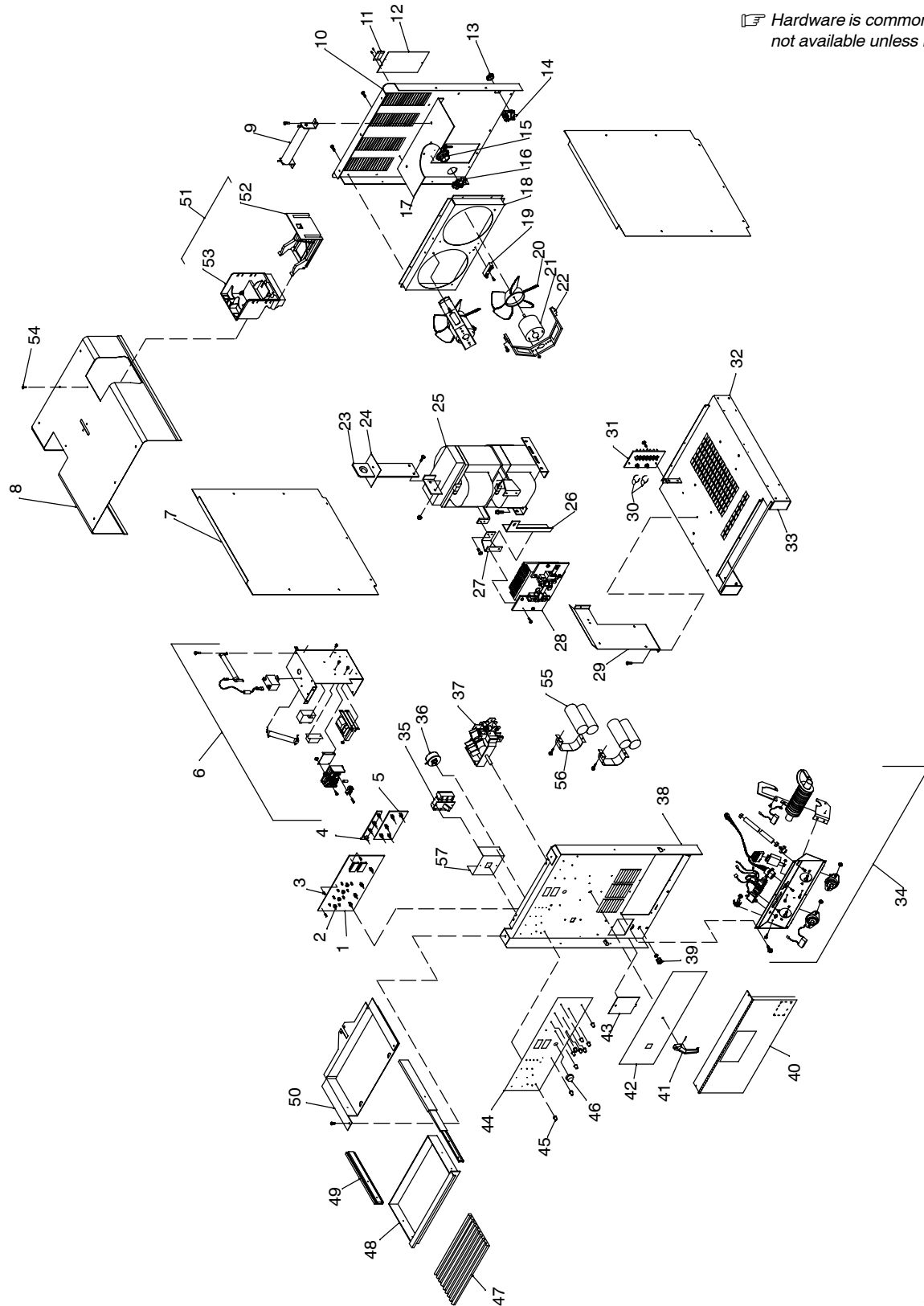


Figure 13-1. Main Assembly

802 609-E

Eff w/LA349426 Thru LC066672

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure 13-1. Main Assembly				
1	PC1	203 899	Circuit Card Assy, Interface (includes)	1
		186 914	Display, LED Numeric 7 Segment 3 Digit (LED's 18 - 23) (prior to LB141715)	6
	PLG13, 15	131 054	Connector W/Sockets	2
	PLG10	130 203	Connector W/Sockets	1
	PLG14	115 092	Connector W/Sockets	1
	PLG4	115 093	Connector W/Sockets	1
	PLG17	131 052	Connector W/Sockets	1
	PLG16	115 091	Connector W/Sockets	1
2		195 778	Actuator Push Button Assy	4
3		190 512	Stand-off, No 6-32 X .6406 Lg	4
4	PC2	♦190 734	Circuit Card, Pulser	1
5	PC3	♦190 738	Circuit Card, Sequencer	1
6		Figure 13-2	Hf Control Box Assy	1
7		192 863	Panel, Side (Prior to LB118755)	2
7		204 289	Panel, Side (Eff w/LB118755 thru LB145946)	2
7		204 658	Panel, Side (Eff w/LB145947)	2
		194 590	Label, Miller 12.563 X 5.376 Horizontal Syncrowav	2
8		184 048	Top, Cover (Prior to LB118755)	1
8		204 312	Top, Cover (Eff w/LB118755 thru LB145946)	1
8		204 657	Top, Cover (Eff w/LB145947 thru LB212096)	1
8		205 726	Top, Cover (Eff w/LB212097)	1
9	R3	201 133	Resistor, WW Fxd 400 W 35 Ohm W/Mtg Bkt	1
10		+192 861	Panel, Rear (Prior to LB118755)	1
10		+204 291	Panel, Rear (Eff w/LB118755)	1
		127 363	Label, Warning Electric Shock Can Kill	1
		168 384	Label, Warning Electric Shock And Incorrect Input P	1
11		168 343	Hinge, Cont Polyolefin Copolymer 2.000 L W/.125h	1
12		184 057	Door, Primary Board	1
		189 491	Spacer, Hinge	1
13		605 227	Nut, 750-14 Knurled 1.68dia .41h Nyl (prior to LE109322)	1
14	GS1	218 494	Kit, Valve, 24vdc 2way Custom Port 1/8 Orf W/Frict	1
		602 969	Plug, Protective No 6 Plastic	2
15		010 146	Clamp, Nyl .625 Clamp Dia X.500 Wide .203 Mtg Hole	1
16		176 272	Conn, Clamp Cable	1
17		202 485	Baffle, Rear Panel	1
	CR1	186 162	Relay	1
18		184 058	Fan, Plenum	1
19	1T	199 312	Block, Terminal Fast-on	1
20		150 783	Blade, Fan 9.000 5wg 39deg .312 Bore Cw Plstc	2
21	FM1, FM2	188 706	Motor, Fan 230v 50/60hz 1550 Rpm .312 Dia Shaft	2
22		187 807	Bracket, Mtg Motor Fan	2
23		192 864	Support, Lift Eye (Prior to LB118755)	1
23		204 293	Support, Lift Eye (Eff w/LB118755)	1
24		026 627	Gasket, Lifting Eye Cover	1
25	T1, Z1	194 379	Xfmr/Stabilizer Assy, 200/230/460	1
25	T1, Z1	196 715	Xfmr/Stabilizer Assy, 230/460/575	1
25	T1, Z1	196 711	Xfmr/Stabilizer Assy, 220/400/440/520	1
	TH1	201 443	Thermistor, NTC 10k ohm @ 25 deg C 27.5 in lead	1
	PLG1	202 119	Connector W/Sockets	1
	PLG7	202 116	Connector W/Sockets	1
	PLG8	202 117	Connector W/Sockets	1
	PLG11	202 118	Connector W/Sockets	1
26		200 647	Bracket, Support Switch	1
27		192 862	Bracket, Mtg Rectifier	2
28	SR1	Figure 13-4	Rectifier Assy	1
		605 603	Tubing, Gl Acryl 1.000-1.036 ldxspool Nat Fa1	0.875
29		184 052	Baffle, Cap Power Factor	1
30	C5, C6	111 634	Capacitor Assy	1

Eff w/LA349426 Thru LC066672

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure 13-1. Main Assembly (continued)				
... 31	TE1	034 587	Term Assy, Pri 1ph 3v (includes) (Prior to LB027094)	1
... 31	TE1	202 790	Term Assy, Pri 1ph 3v (includes) (Eff w/LB027094)	1
		083 426	Terminal Board, pri	1
		038 618	Link, jumper term bd pri	2
		601 835	Nut, brs hex 10-32reg	12
		601 836	Nut, brs hex .250-20 jam hvy	4
		038 888	Stud, pri board brs .250-20 x 1.500	2
		038 887	Stud, pri board brs 10-32 x 1.375	6
		010 913	Washer, flat brs .187 ID	6
		010 915	Washer, flat brs .250 ID x .625 OD x .031thk	4
		602 207	Washer, lock .255 ID x .489 OD	2
		175 479	Link, jumper	1
		190 161	Lug, Univ W/Screw 1/O-14 Wire .266std (Prior to LB027094)	3
		190 161	Lug, Univ W/Screw 1/O-14 Wire .266std (Eff w/LB027094)	1
... 32		+196 584	Base	1
		155 436	Label, Ground/Protectiv	1
... 33		189 224	End Cap	4
... 34		Figure 13-3	HF Panel Assy, Lower	1
... 35	S1	128 757	Switch, Tgl Dpst 60a 600vac Scr Term Wide Tgl	1
... 36	R5	198 547	Rheostat, Ww 25. W 1.5 Ohm Fric Term	1
... 37	S5	201 121	Switch Assy, Polarity With Leads And Hardware (Dx)	1
... 38		192 860	Panel, Front (Prior to LB118755)	1
... 38		204 305	Panel, Front (Eff w/LB118755)	1
		143 397	Blank, Snap-in Nyl .312 Mtg Hole Black	8
		117 860	Blank, Snap-in Nyl .187 Mtg Hole Black	1
		107 983	Blank, Snap-in Nyl .500 Mtg Hole Black	1
... 39		097 922	Knob, Pointer .875 Dia X .250 Id W/Set Screwsplstc	1
		174 041	Label, Indicator Intensity Control	1
... 40		+196 492	Door, Access Front	1
		134 327	Label, Warning General Precautionary Static&wire Fe	1
		127 363	Label, Warning Electric Shock Can Kill	1
... 41		175 952	Plastic, Handle Switch	1
... 42		194 388	Nameplate, Miller Syncrowave 250DX	1
... 42		196 766	Nameplate, Miller Syncrowave 250DX (Wordless)	1
... 43		184 066	Door Spark Gap Access	1
... 44		196 616	Plate, Indicator Syncrowave 250DX	1
... 44		196 764	Plate, Indicator Syncrowave 250DX (Wordless)	1
... 45		183 332	Knob, Pointer .570 Dia X .125 Id W/Spring Clip	3
... 46		174 991	Knob, Pointer 1.250 Dia X .250 Id W/Spring Clip-.21	1
... 47		204 416	Drawer, Mat (Eff w/LB118755)	1
... 48		204 313	Drawer, Tray (Eff w/LB118755)	1
... 49		204 307	Slide, Drawer (Eff w/LB118755)	2
... 50		204 314	Drawer (Eff w/LB118755)	1
... 51		204 389	HOLDER, Torch/Cable (includes) (Eff w/LB118755)	2
... 52		200 920	Door, Torch/Cable Holder	2
... 53		200 922	Housing, Torch/Cable Holder	2
... 54		494 907	SCREW, k50 x 20 pan hd - trx pld pt thread forming (Eff w/LB118755)	2
... 55	C20-C23	♦203 517	CAPACITOR, polyp film 150uf 250 VAC can 10%	4
... 56		♦129 201	BRACKET, mtg capacitor	2
... 57		205 669	INSULATOR, switch power (Eff w/LB212097)	1

♦ OPTIONAL


+When ordering a component originally displaying a precautionary label, the label should also be ordered.

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

Eff w/LA349426 Thru LC066672

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
196 762 Figure 13-2. HF Control Box Assembly (Figure 13-1 Item 6)				
... 1	G1	206 502	Spark Gap Assy, Service Kit (includes)	1
		199 855	Base	1
		199 856	Holder, Points	4
		196 455	Points, Spark Gap	4
... 2		184 068	Bracket, Spark Gap	1
... 3	C3	201 197	Capacitor, Polyp Met Film .002uf 10000vdc/4400vac pnl mtg	1
... 4	R8	188 067	Resistor, ww fxd 100 w 200 ohm w/clips	1
... 5	C11, C19	195 552	Capacitor, Polyp Met Film 20. Uf 250 Vac 10%	2
... 6	R2	189 132	Resistor Assy,	1
... 7	R1	186 468	Resistor, Ww Fxd 100 W 50 Ohm W/Clips	1
... 8		010 493	Bushing, Snap-in Nyl .625 Id X .875 Mtg Hole	1
... 9		196 576	Hf, Control Box	1
... 10	T3	074 398	Xfmr, High Voltage 115v Pri 3600v Sec 30 Ma	1

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

 Hardware is common and not available unless listed.

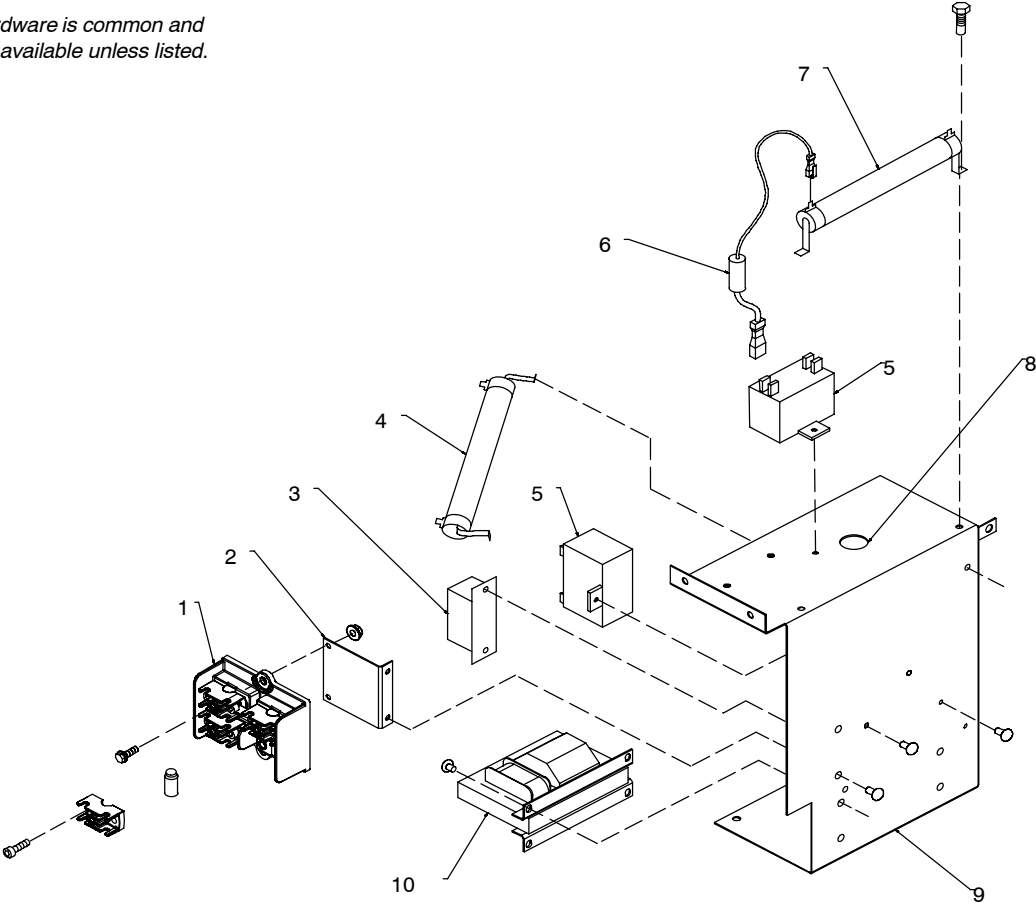


Figure 13-2. HF Control Box Assembly

802 756-A

Eff w/LA349426 Thru LC066672

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
197 026 Figure 13-3. HF Panel Assembly, Lower (Figure 13-1 Item 34)				
1		197 022	Panel, Lower Hf	1
2		208 294	Connector, Faston Male 4-Prong	1
3	RC2/CB1/C12	201 153	Receptacle, W/Leads And Circuit Breaker	1
		156 734	Nut, 010-32 .31hex .13h Stl Pld Sem Cone Wshr.38d	1
4	RC1	201 127	Harness, Assy 14 Pin Recpt	1
	PLG5	143 976	Connector W/Sockets	1
5	CM1	197 220	Module, Filter .1mf 500vdc 8 Ckt	1
6		089 120	Clamp, Hose .375 - .450 Clp Dia Slftng Green	2
7		155 527	Hose, Nprn Brd No 1 X .250 Id X 28.000	1
8		120 854	Ftg, Gas	1
9	C13, C14	196 499	Capacitor Assy,	2
10		157 317	Holder, Hf Coil	1
11	T4	199 487	Coil, Hf Coupling	1
		203 474	Service Kit, DX Coupling Coil	1
12		157 318	Holder, Hf Coil	1
13		039 047	Terminal, Pwr Output Red	2

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

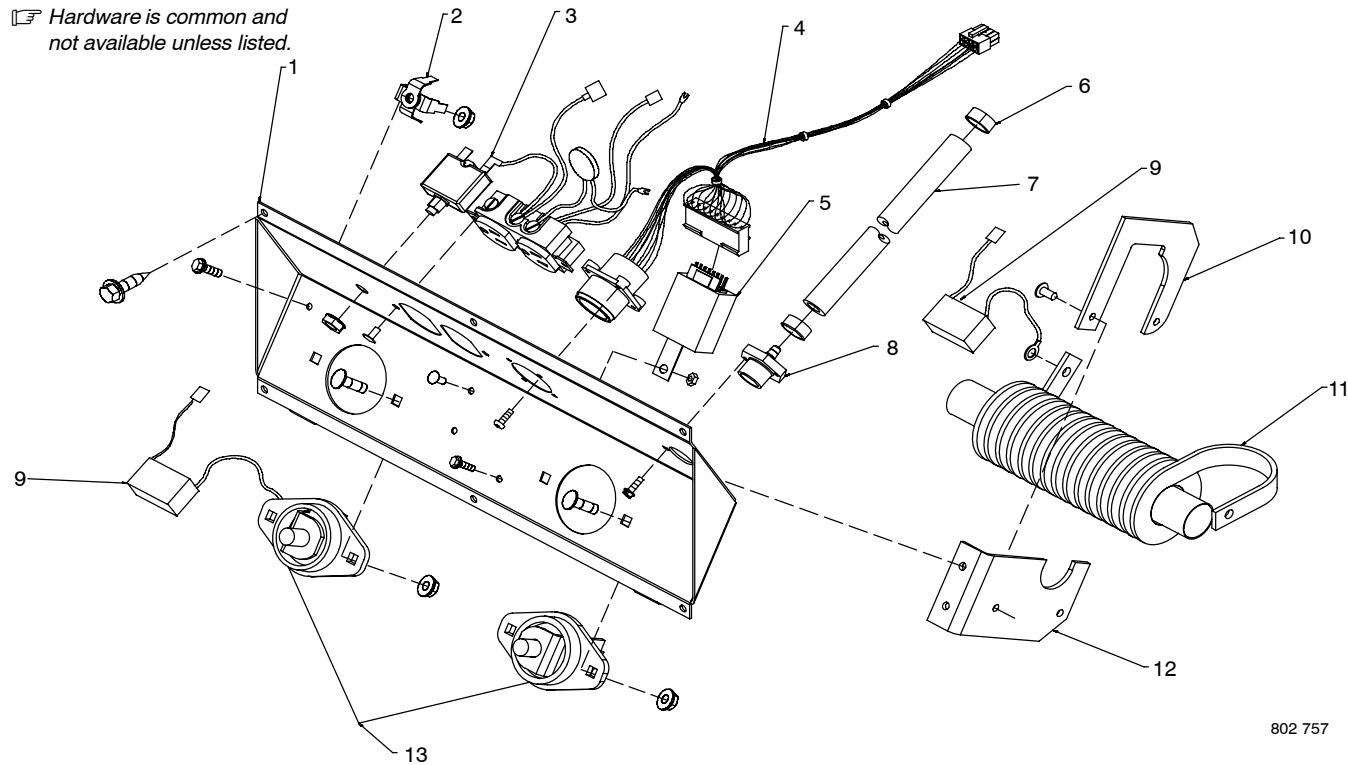


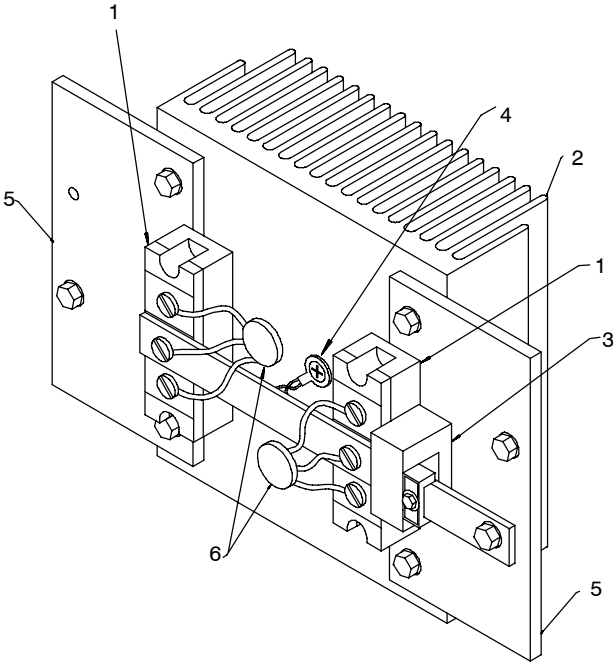
Figure 13-3. HF Panel Assembly, Lower

Eff w/LA349426 Thru LC066672

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
196 485 Figure 13-4. HF Rectifier Assembly (Figure 13-1 Item 28)				
... 1 ...	Mod 1, 2 ...	196 760 ...	Thyristor, SCR Module	2
... 2		196 191 ...	Heat Sink, Rectifier	1
... 3	HD1	191 941 ...	Transducer, Current Hall	1
... 4	TH2	188 431 ...	Thermister, NTC	1
... 5		196 171 ...	Insulator, Rectifier	2
... 6 ..	C7, 8, 9, 10 ..	190 460 ...	Capacitor Assy	2

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☞ Hardware is common and not available unless listed.



Ref. 802 609-A

Figure 13-4. Rectifier Assembly



TM-359G

2006-01

Eff. w/Serial Number LA349426

Processes



TIG (GTAW) Welding



Stick (SMAW) Welding

Description

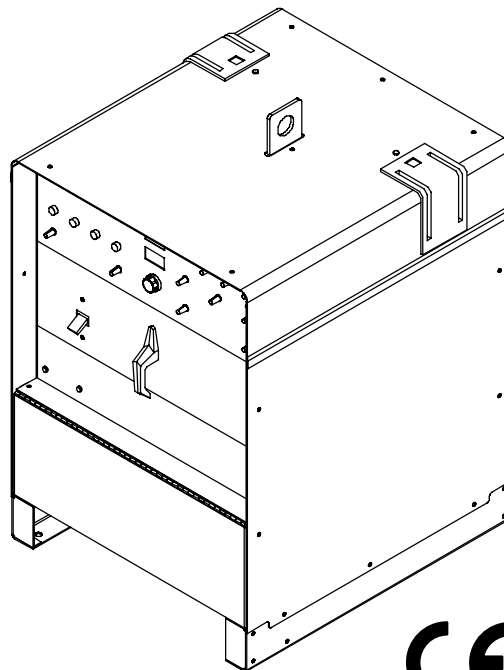


Arc Welding Power Source

Syncrowave[®] 250 DX

PARTS LIST

Eff w/ LC066673 And Following



 And Non-Ce Models



Visit our website at
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SECTION 14 – PARTS LIST FOR LC066672 AND FOLLOWING

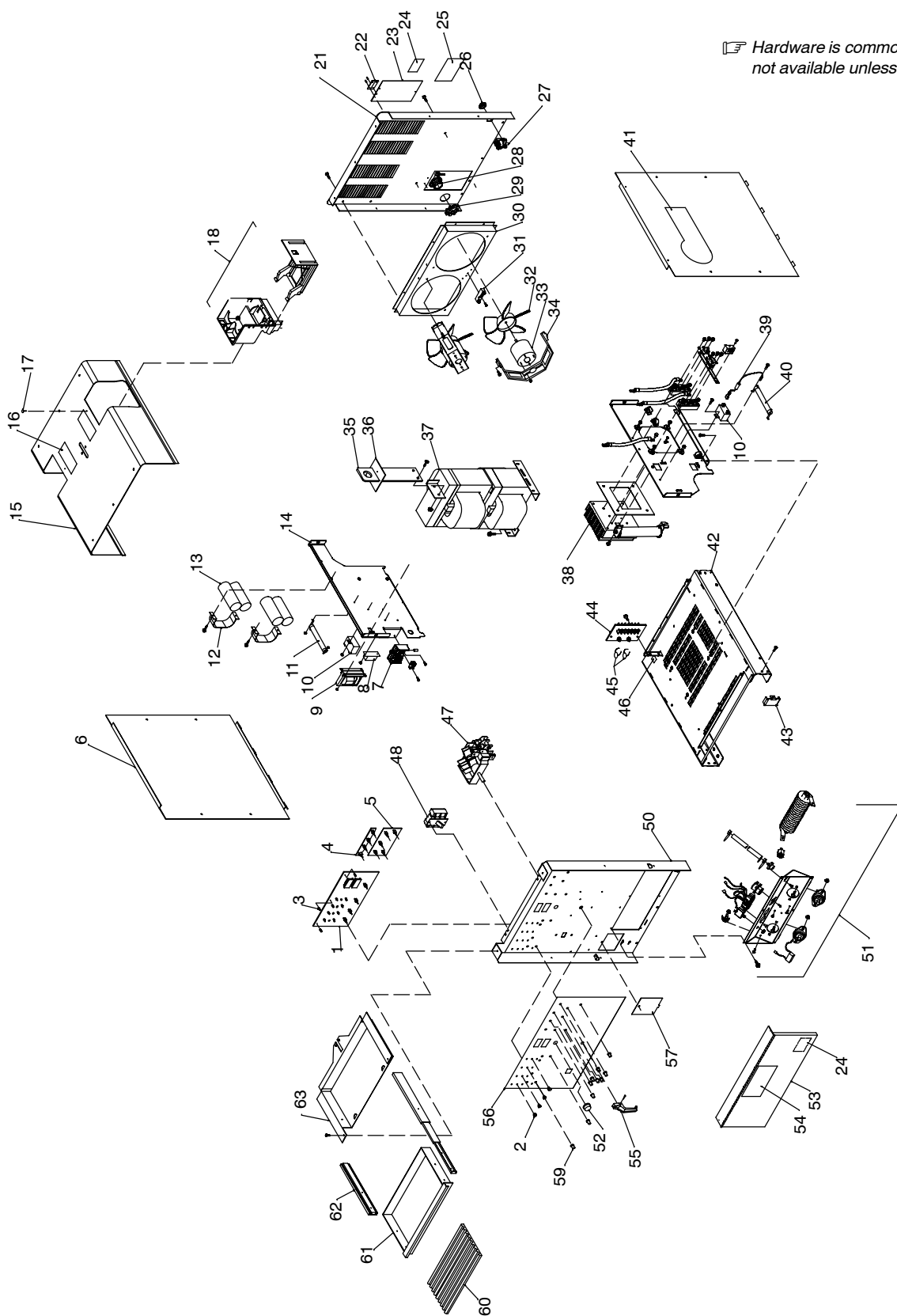


Figure 14-1. Main Assembly

802 609-L

Eff w/LC066672 And Following

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure 14-1. Main Assembly				
1	PC1	203 899	Circuit Card Assy, Interface (includes)	1
		186 914	Display, LED Numeric 7 Segment 3 Digit (LED's 18 - 23)	6
			(prior to LB141715)	2
	PLG13, 15	131 054	Connector W/Sockets	1
	PLG10	130 203	Connector W/Sockets	1
	PLG14	115 092	Connector W/Sockets	1
	PLG4	115 093	Connector W/Sockets	1
	PLG17	131 052	Connector W/Sockets	1
	PLG16	115 091	Connector W/Sockets	1
2		195 778	Actuator Push Button Assy	4
3		190 512	Stand-off, No 6-32 X .6406 Lg	4
4	PC2	♦190 734	Circuit Card, Pulser	1
5	PC3	♦190 738	Circuit Card, Sequencer	1
6		207 562	Panel, Side	2
7	G1	206 502	Spark Gap Assy, Service Kit (includes)	1
		199 855	Base	1
		199 856	Holder, Points	4
		196 455	Points, Spark Gap	4
8	C3	210 237	Capacitor, Mica .002 UF 10,000 V Panel Mtg (Service Kit)	1
9	T3	208 045	Xfmr, High Voltage 115v Pri 3600v Sec 30 Ma w/Term	1
10	C11, C19	195 552	Capacitor, Polyp Met Film 20. Uf 250 Vac 10%	2
11	R8	188 067	Resistor, ww fxd 100 w 200 ohm w/clips	1
12		♦129 201	Bracket, mtg capacitor	2
13	C20-23	♦203 517	Capacitor, polyp film 150 uf 250 VAC can 10%	4
14		207 574	Panel, Left Wind Tunnel	1
15		205 726	Top, Cover	1
16		201 019	Label, Warning electric shock excess weight	2
17		494 907	Screw, k50 x 20 pan hd - trx pld pt thread forming	2
18		204 389	Holder, Torch/Cable	2
21		+207 563	Panel, Rear	1
22		168 343	Hinge, Cont Polyolefin Copolymer 2.000 L W/.125h	1
23		184 057	Door, Primary Board	1
		189 491	Spacer, Hinge	1
24		127 363	Label, Warning Electric Shock Can Kill	1
25		168 384	Label, Warning Electric Shock And Incorrect Input P	1
26		605 227	Nut, 750-14 Knurled1.68dia .41h Nyl (prior to LE109322)	1
27	GS1	218 494	KIT, valve 24VDC 2way custom port 1/8 orf w/frict	1
		602 969	Plug, Protective No 6 Plastic	2
28		010 146	Clamp, Nyl .625 Clamp Dia X.500 Wide .203 Mtg Hole	1
29		176 272	Conn, Clamp Cable	1
30		184 058	Fan, Plenum	1
31	1T	199 312	Block, Terminal Fast-on	1
32		150 783	Blade, Fan 9.000 5wg 39deg .312 Bore Cw Plstc	2
33	FM1, FM2	188 706	Motor, Fan 230v 50/60hz 1550 Rpm .312 Dia Shaft	2
34		187 807	Bracket, Mtg Motor Fan	2
35		204 293	Support, Lift Eye	1
36		026 627	Gasket, Lifting Eye Cover	1
37	T1, Z1	207 607	Xfmr/Stabilizer Assy, 200/230/460	1
37	T1, Z1	207 710	Xfmr/Stabilizer Assy, 230/460/575	1
37	T1, Z1	207 711	Xfmr/Stabilizer Assy, 220/400/440/520	1
	TH1	201 443	Thermistor, NTC 10k ohm @ 25 deg C 27.5 in lead	1
	PLG1	202 119	Connector W/Sockets	1
	PLG7	202 116	Connector W/Sockets	1
	PLG8	202 117	Connector W/Sockets	1
	PLG11	202 118	Connector W/Sockets	1
38	SR1	207 611	Rectifier Assy, (Figure 14-3)	1
39	R2	189 132	Resistor Assy,	1
40	R1	186 468	Resistor, Ww Fxd 100 W 50 Ohm W/Clips	1
41		194 590	Label, Miller 12.563 X 5.376 Horizontal Syncrowav	2
42		+207 559	Base	1

Eff w/LC066672 And Following

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure 14-1. Main Assembly (continued)				
43		207 571	End Cap	4
44	TE1	202 790	Term Assy, Pri 1ph 3v (includes)	1
		083 426	Terminal Board, pri	1
		038 618	Link, jumper term bd pri	2
		601 835	Nut, brs hex 10-32reg	12
		601 836	Nut, brs hex .250-20 jam hvy	4
		038 888	Stud, pri board brs .250-20 x 1.500	2
		038 887	Stud, pri board brs 10-32 x 1.375	6
		010 913	Washer, flat brs .187 ID	6
		010 915	Washer, flat brs .250 ID x .625 OD x .031thk	4
		602 207	Washer, lock .255 ID x .489 OD	2
		175 479	Link, jumper	1
		213 248	Lug, Univ W/Screw 2/O-14 Wire .266std	1
45	C5, C6	111 634	Capacitor Assy	1
46		155 436	Label, Ground/Protectiv	1
47	S5	207 236	Switch, Polarity/Changeover (DX)	1
48	S1	128 757	Switch, Tgl Dpst 60a 600vac Scr Term Wide Tgl	1
49	R5	198 547	Rheostat, Ww 25. W 1.5 Ohm Fric Term	1
50		207 570	Panel, Front (prior to LC344556)	1
50		212 245	Panel, Front (eff w/LC344556)	1
		143 397	Blank, Snap-in Nyl .312 Mtg Hole Black	8
		117 860	Blank, Snap-in Nyl .187 Mtg Hole Black	1
		107 983	Blank, Snap-in Nyl .500 Mtg Hole Black	1
		174 041	Label, Indicator Intensity Control	1
51		207 612	HF Panel Assy, Lower (Figure 14-2)	1
52		174 991	Knob, Pointer 1.250 Dia X .250 Id W/Spring Clip-.21	1
53		+196 492	Door, Access Front	1
54		203 990	Label, Warning General Precautionary Static&wire Fe	1
55		175 952	Plastic, Handle Switch	1
56		204 776	Nameplate, Miller Syncrowave 250DX	1
56		208 242	Nameplate, Miller Syncrowave 250DX (Wordless)	1
57		207 572	Door Spark Gap Access	1
59		183 332	Knob, Pointer .570 Dia X .125 Id W/Spring Clip	3
60		204 416	Drawer, Mat	1
61		204 314	Drawer	1
62		204 307	Slide, Drawer (prior to LC728110)	2
62		216 593	Slide, Drawer (eff w/LC728110)	2
63		204 313	Drawer, tray	1

♦ OPTIONAL


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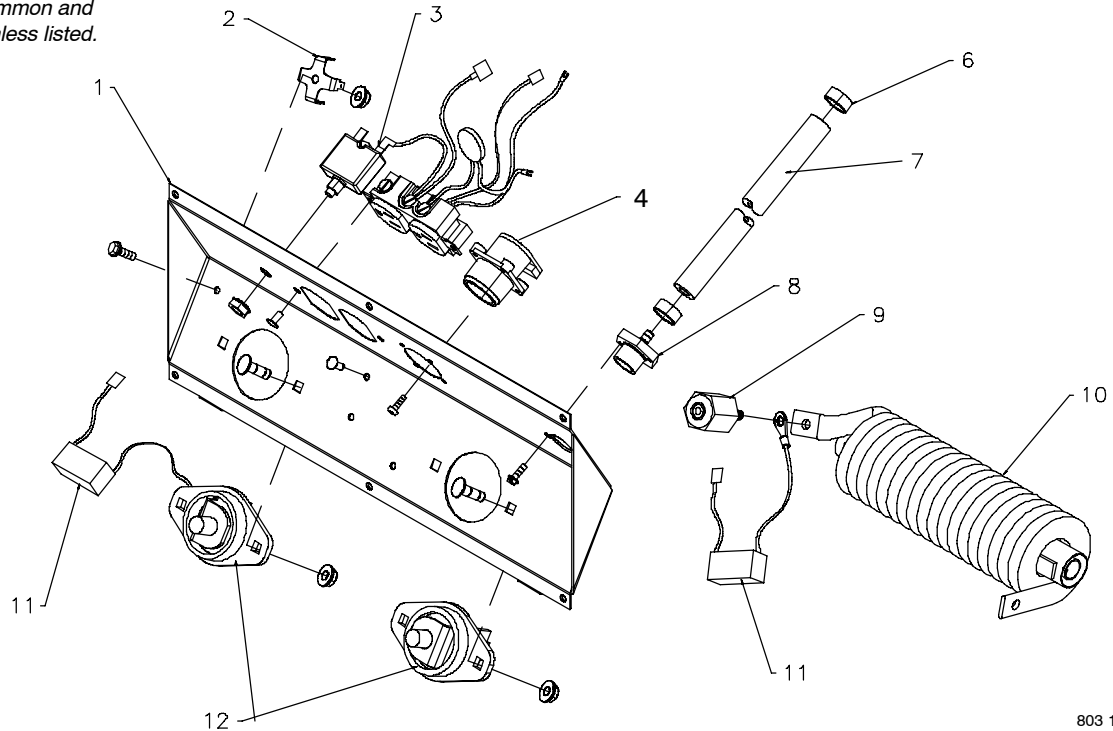
To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

Eff w/LC066672 And Following

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
207 612 Figure 14-2. HF Panel Assembly, Lower (Figure 14-1 Item 51)				
... 1		207 569	Panel, Lower Hf (prior to LC451816)	1
... 1		213 217	Panel, Lower Hf (eff w/LC451816)	1
... 2		208 294	Connector, Faston Male 4-Prong	1
... 3	RC2/CB1/C12	207 617	Receptacle, W/Leads And Circuit Breaker	1
...		156 734	Nut, 010-32 .31hex .13h Stl Pld Sem Cone Wshr.38d	1
... 4	RC1	201 127	Harness, Assy 14 Pin Recpt (prior to LC451816)	1
... 4	RC1	211 911	Conn, cir ms/cpc 14 skt size 20 rcpt w/fitting (eff w/LC451816)	1
...	PLG5	143 976	Connector W/Sockets	1
...	CM1	197 220	Module, Filter .1mf 500vdc 8 Ckt (prior to LC451816)	1
... 6		089 120	Clamp, Hose .375 - .450 Clp Dia Slftng Green	2
... 7		155 527	Hose, Nprn Brd No 1 X .250 Id X 28.000	1
... 8		208 408	Ftg, Gas	1
... 9		207 560	Insulator, Standoff W/Stud	1
... 10	T4	199 487	Coil, Hf Coupling	1
...		203 474	Service Kit, DX Coupling Coil	1
... 11	C13, C14	206 878	Capacitor Assy,	2
... 12		039 047	Terminal, Pwr Output Red	2

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 Hardware is common and not available unless listed.



803 165-B

Figure 14-2. HF Panel Assembly, Lower

Eff w/LC066672 And Following

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
207 611 Figure 14-3. HF Rectifier Assembly (Figure 14-1 Item 38)				
... 1	...	206 984	Heat Sink, Rectifier	1
... 2	...	207 558	Insulator, Rectifier	1
... 3	...	196 355	Insulator, Screw	4
... 4	...	200 260	Clip, Snap In (prior to LC373373)	3
... 4	...	211 441	Clip, Snap In (eff w/LC373373)	3
... 5	...	207 575	Panel, Right Windtunnel	1
... 6	...	199 962	Bus Bar	1
... 7	C7, 8, 9, 10	190 460	Capacitor Assy	2
... 8	HD1	191 941	Transducer, Current Hall	1
... 9	Mod 1, 2	196 760	Thyristor, SCR Module	2
... 10	TH2	206 327	Thermister, NTC 30K Ohm @ 25 deg C	1
... 11	R3	207 615	Resistor, WW Fxd 400 W 35 Ohm W/Mtg Bkt (prior to LC373373)	1
... 11	R3	211 440	Resistor, WW Fxd 400 W 35 Ohm W/Mtg Bkt (eff w/LC373373)	1

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

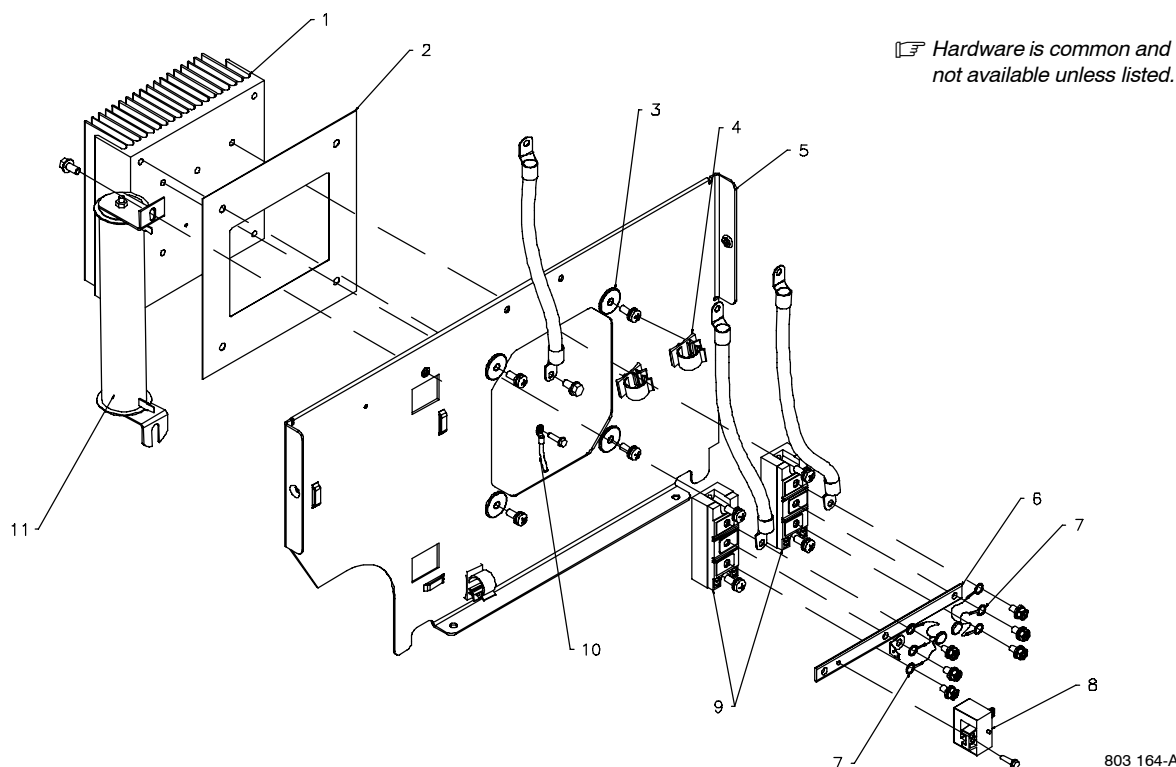


Figure 14-3. Rectifier Assembly

Notes

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