Red-D-Arc Welderentals

TM-229 409A 2006–12

Eff w/Serial Number LG250111A

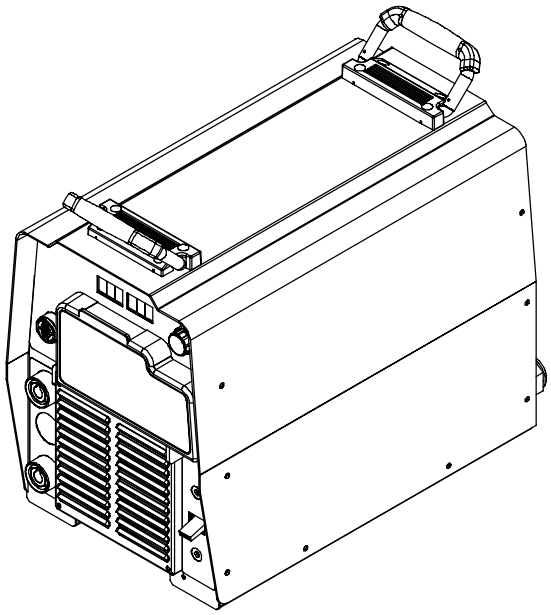
Processes

Multiprocess Welding

Description

Arc Welding Power Source

EXTREME 360 CC/CV Auto-Line



TECHNICAL MANUAL

File: MULTIPROCESS

TABLE OF CONTENTS

TABLE OF CONTENTS

SECTION 1 – SAFETY PRECAUTIONS FOR SERVICING

1-1. Symbol Usage

OM-229 409-B, 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.**

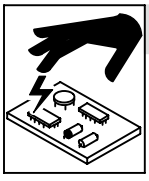
▲ **During servicing, keep everybody, especially children, away.**

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.

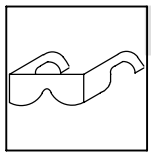


STATIC (ESD) can damage PC boards.

- 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.

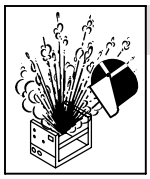


FLYING METAL can injure eyes.

- 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.

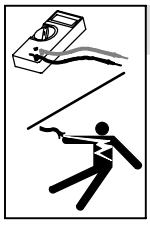
HOT PARTS can cause severe burns.

- 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.

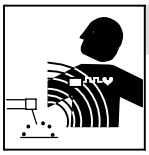
- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.

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.

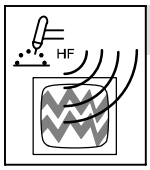


MAGNETIC FIELDS can affect pacemakers.

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

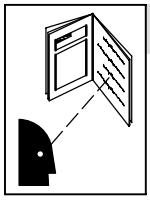
OVERUSE can cause OVERHEATING.

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

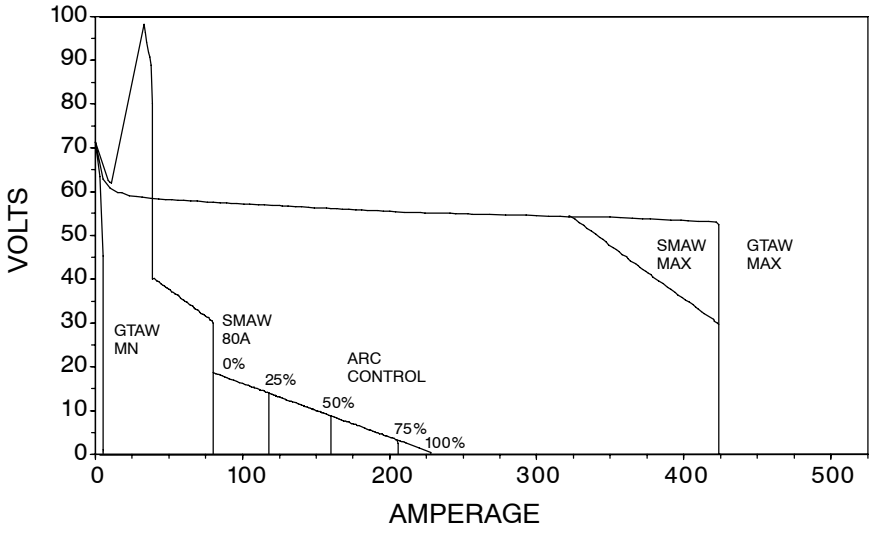
SECTION 2 – INTRODUCTION

2-1. Specifications

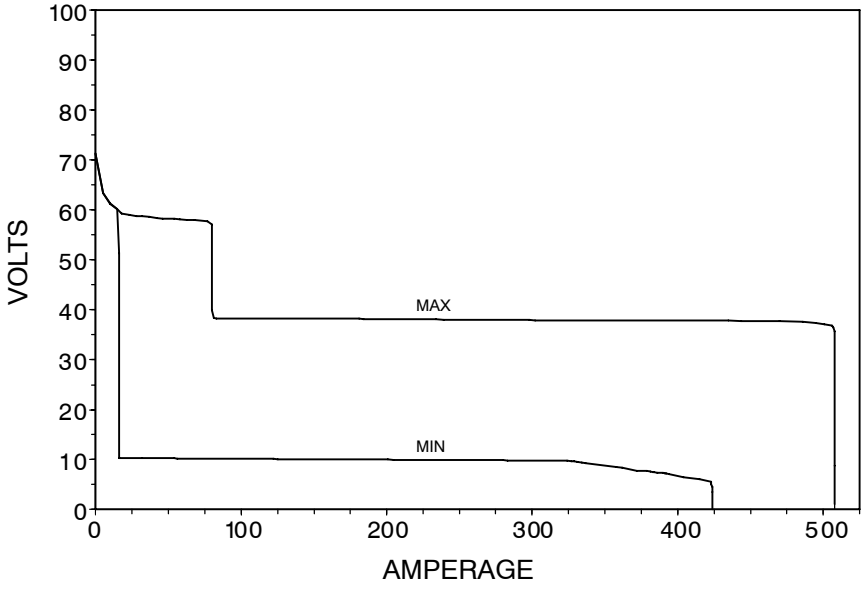
Input Power	Rated Output	Voltage Range in CV Mode	Amperage Range in CC Mode	Max. Open-Circuit Voltage	RMS Amps Input at Rated Load Output, 60 Hz 3-Phase at NEMA Load Voltages and Class I Rating					KVA	KW
					208 V	230 V	400 V	460 V	575 V		
3-Phase	350 A at 34 VDC, 60% Duty Cycle	10–38 V	5–425 A	75 VDC	40.4	36.1	20.6	17.8	14.1	14.2	13.6
1-Phase	300 A at 32 VDC, 60% Duty Cycle*				60.8	54.6	29.7	25.4	19.9	11.7	11.2
*See Section 2-3 for Duty Cycle Rating.											

2-2. Volt-Ampere Curves

A. CC Mode



B. CV Mode



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

217 836-A / 217 837-B

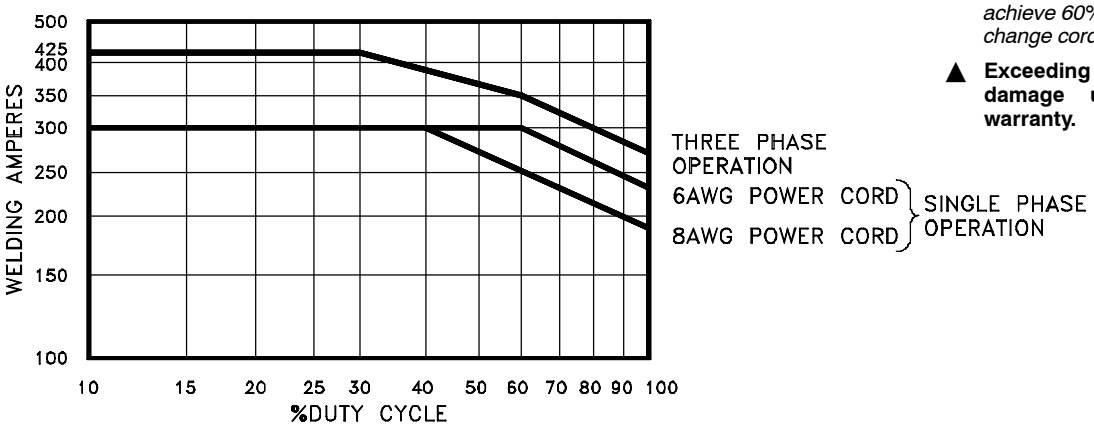
2-3. Duty Cycle And Overheating

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

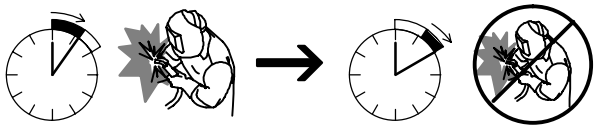
If unit overheats, output stops, a Help message is displayed and cooling fan runs. Wait fifteen minutes for unit to cool. Reduce amperage or voltage, or duty cycle before welding.

☞ *Single Phase Operation: The unit is supplied with a 8 AWG power cord. The rated output with 8 AWG is 300 amps, 32 volts at 40% duty cycle. To achieve 60% duty cycle change cord to 6 AWG.*

▲ **Exceeding duty cycle can damage unit and void warranty.**

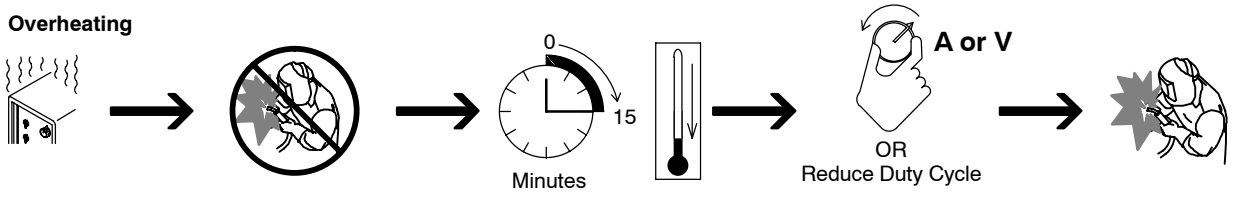


60% Duty Cycle



6 Minutes Welding — 4 Minutes Resting

Overheating



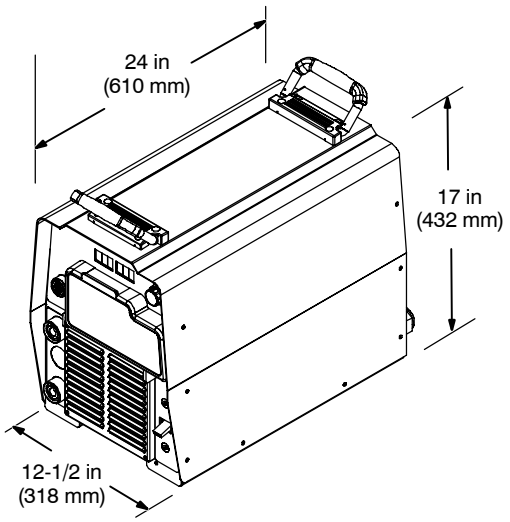
Ref. 216 568-A

Notes

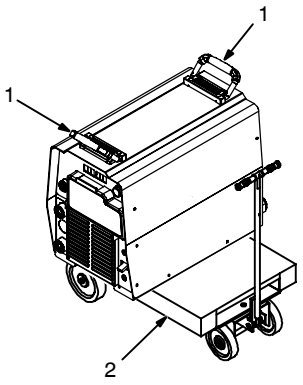
3-1. Selecting a Location

Dimensions And Weight

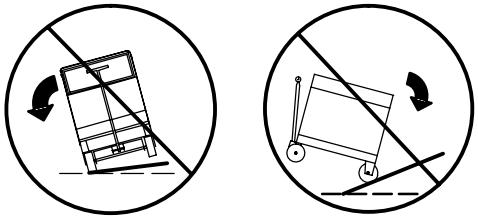
80 lb (36.3 kg)



Movement



▲ **Do not move or operate unit where it could tip.**



1 Lifting Handles

Use handles to lift unit.

2 Hand Cart

Use cart or similar device to move unit.

3 Rating Information

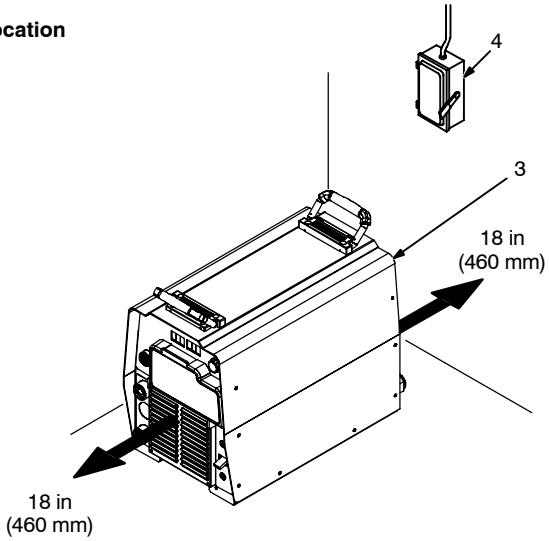
Use rating information on rear panel to determine input power needs.

4 Line Disconnect Device

Locate unit near correct input power supply.

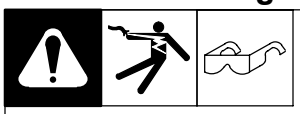
▲ **Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.**

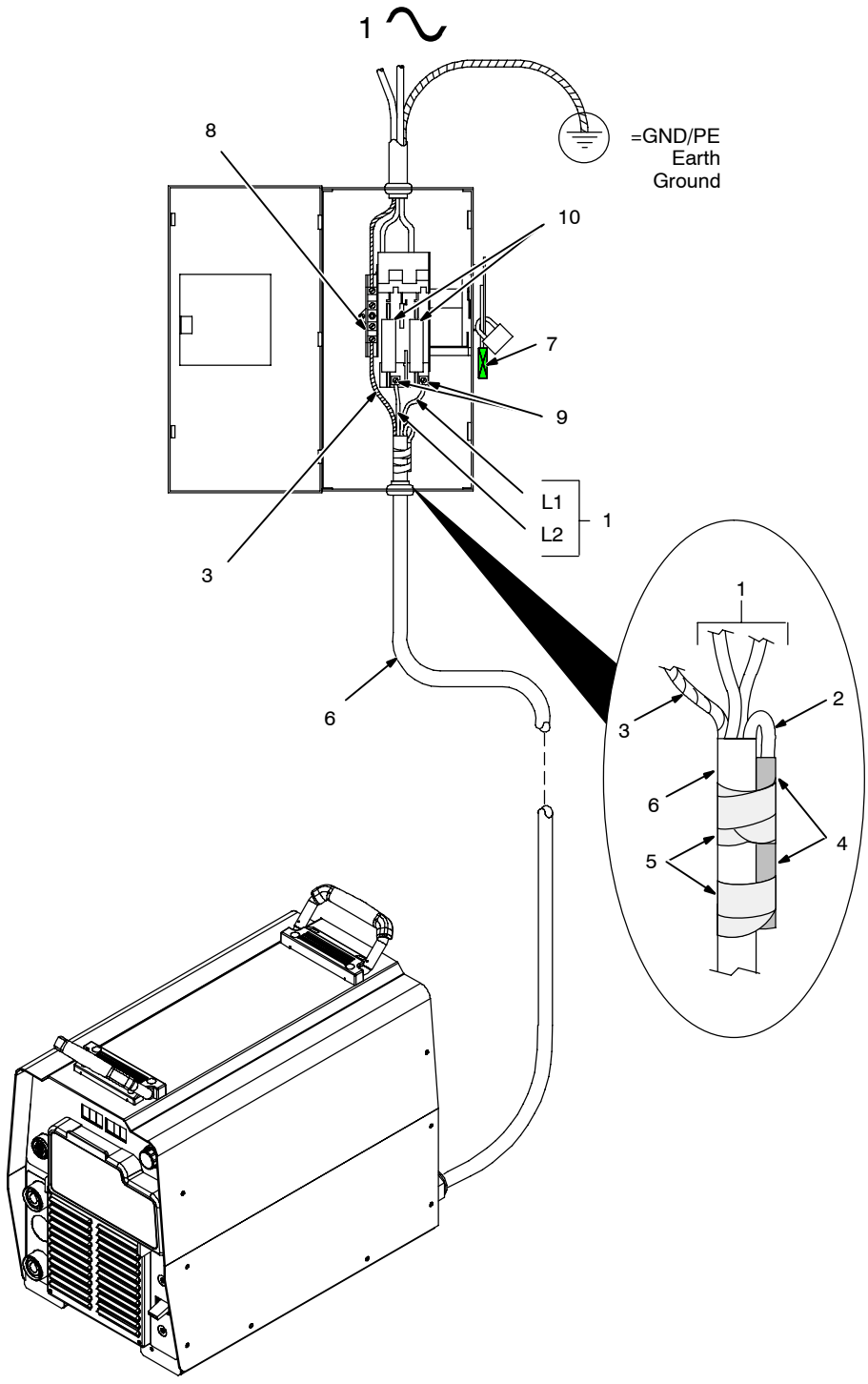
Location



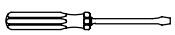
loc_2 3/96 - Ref. ST-151 556 / Ref. 803 691-C

3-2. Connecting 1-Phase Input Power





Tools Needed:



▲ **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.**

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

☞ *The Auto-Line circuitry in this unit automatically adapts the power source to the primary voltage being applied. Check input voltage available at site. This unit can be connected to any input power between 208 and 575 VAC without removing cover to relink the power source.*

1 Black And White Input Conductor (L1 And L2)

2 Red Input Conductor

3 Green Or Green/Yellow Grounding Conductor

4 Insulation Sleeving

5 Electrical Tape

Insulate and isolate red conductor as shown.

6 Input Power Cord.

7 Disconnect Device (switch shown in the OFF position)

8 Disconnect Device Grounding Terminal

9 Disconnect Device Line Terminals

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

Connect input conductors L1 and L2 to disconnect device line terminals.

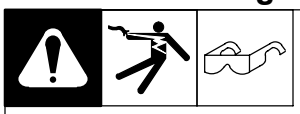
10 Overcurrent Protection

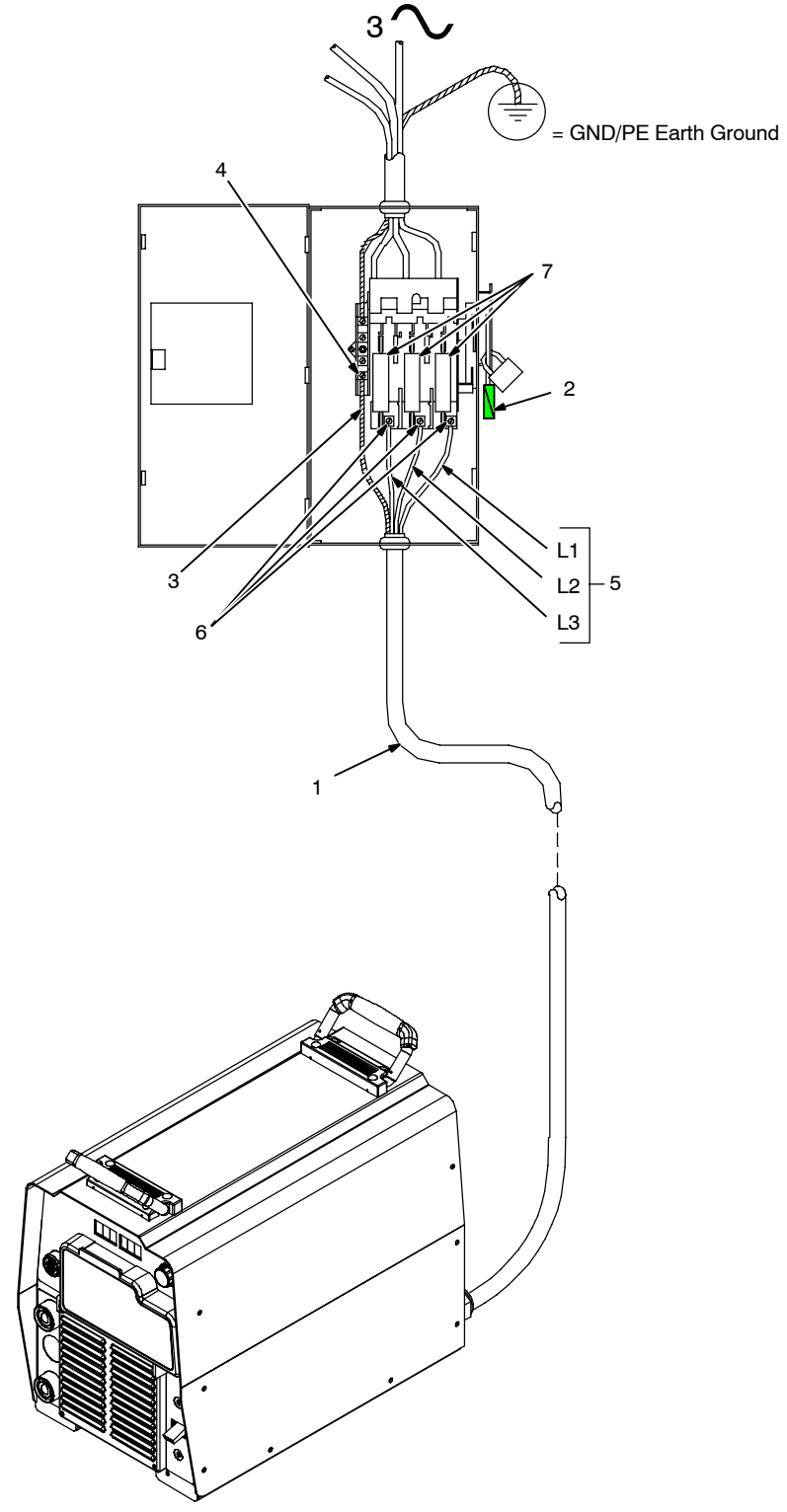
Select type and size of overcurrent protection using Section 3-4 (fused disconnect switch shown).

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

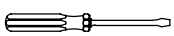
804 531-A

3-3. Connecting 3-Phase Input Power





Tools Needed:



▲ **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.**

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

☞ *The Auto-Line circuitry in this unit automatically adapts the power source to the primary voltage being applied. Check input voltage available at site. This unit can be connected to any input power between 208 and 575 VAC without removing cover to relink the power source.*

For Three-Phase Operation

1 Input Power Cord.

2 Disconnect Device (switch shown in the OFF position)

3 Green Or Green/Yellow Grounding Conductor

4 Disconnect Device Grounding Terminal

5 Input Conductors (L1, L2 And L3)

6 Disconnect Device Line Terminals

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

Connect input conductors L1, L2, and L3 to disconnect device line terminals.

7 Overcurrent Protection

Select type and size of overcurrent protection using Section 3-4 (fused disconnect switch shown).

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

804 531-A

3-4. Electrical Service Guide

▲ CAUTION: INCORRECT INPUT POWER can damage this welding power source. Phase to ground voltage shall not exceed +10% of rated input voltage.

NOTE ☞ *Actual input voltage should not be 10% less than minimum and/or 10% more than maximum input voltages listed in table. If actual input voltage is outside this range, output may not be available.*

	Single-Phase				
Input Voltage	208	230	400	460	575
Input Amperes At Rated Output	60.8	54.6	29.7	25.4	19.9
Max Recommended Standard Fuse Rating In Amperes [1]					
Time-Delay [2]	70	60	35	30	25
Normal Operating [3]	80	80	45	40	30
Min Input Conductor Size In AWG/Kcmil [4]	8	8	10	12	12
Max Recommended Input Conductor Length In Feet (Meters)	72 (22)	89 (27)	176 (54)	140 (43)	219 (67)
Min Grounding Conductor Size In AWG/Kcmil [4]	8	8	10	12	12

	Three-Phase				
Input Voltage	208	230	400	460	575
Input Amperes At Rated Output	40.4	36.1	20.6	17.8	14.1
Max Recommended Standard Fuse Rating In Amperes [1]					
Time-Delay [2]	45	40	25	20	15
Normal Operating [3]	60	50	30	25	20
Min Input Conductor Size In AWG/Kcmil [4]	8	10	12	14	14
Max Recommended Input Conductor Length In Feet (Meters)	119 (36)	96 (29)	175 (53)	150 (46)	234 (71)
Min Grounding Conductor Size In AWG/Kcmil [4]	10	10	12	14	14

Reference: 2005 National Electrical Code (NEC) (including article 630)

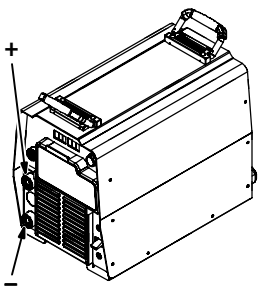
1 If a circuit breaker is used in place of af a fuse, choose a circuit breaker with time-current curves comparable to the recommended fuse.

2 “Time-Delay” fuses are UL class “RK5” .

3 “Normal Operating” (general purpose - no intentional delay) fuses are UL class “K5” (up to and including 60 amp), and UL class “H” (65 amp and above).

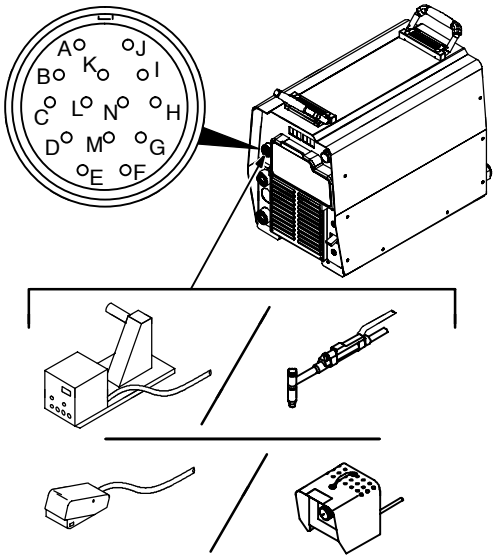
4 Conductor data in this section specifies conductor size (excluding flexible cord or cable) between the panelboard and the equipment per NEC Table 310.16. If a flexible cord or cable is used, minimum conductor size may increase. See NEC Table 400.5(A) for flexible cord and cable requirements.

3-5. Weld Output Receptacles And Selecting Cable Sizes

Weld Output Terminals	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					
 Output Receptacles	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
	600	3/0	4/0	2-2/0	2-3/0	2-4/0	3-3/0	3-4/0	3-4/0

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. S-0007-D

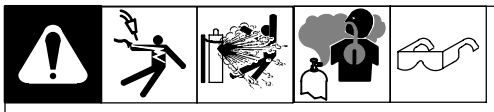
3-6. Remote 14 Receptacle Information

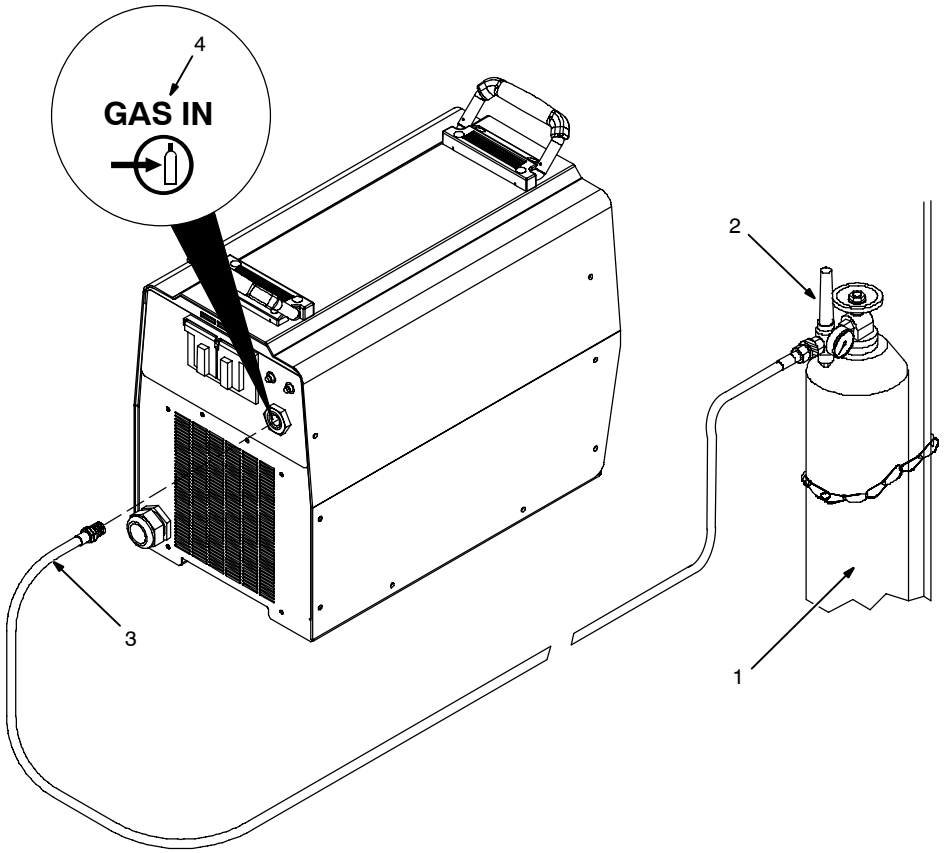


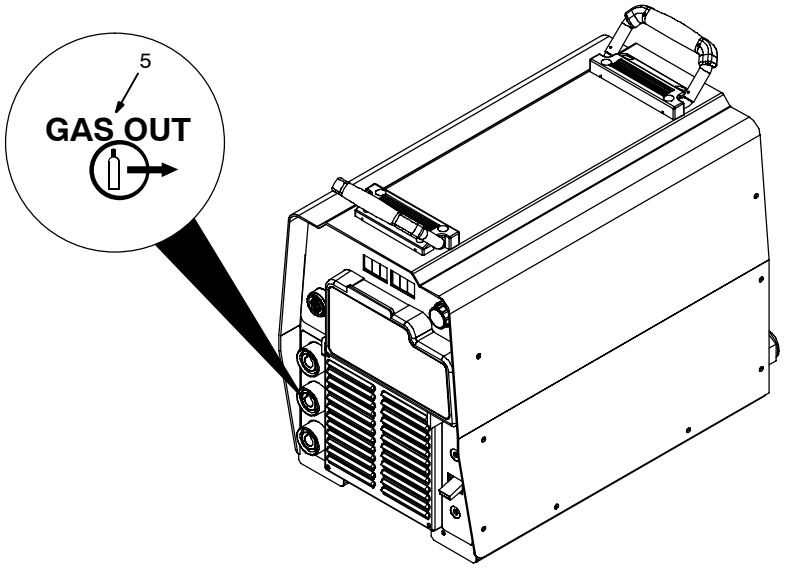
REMOTE 14	Socket*	Socket Information
24 VOLTS AC OUTPUT (CONTACTOR)	A	24 volts ac. Protected by circuit breaker CB2.
	B	Contact closure to A completes 24 volts ac contactor control circuit.
115 VOLTS AC OUTPUT (CONTACTOR)	I	115 volts ac. Protected by circuit breaker CB1.
	J	Contact closure to I completes 115 volts ac contactor control circuit.
REMOTE OUTPUT CONTROL	C	Output to remote control; 0 to +10 volts dc, +10 volts dc in MIG mode.
	D	Remote control circuit common.
	E	0 to +10 volts dc input command signal from remote control.
	M	CC/CV select
A/V AMPERAGE VOLTAGE	F	Current feedback; +1 volt dc per 100 amperes.
	H	Voltage feedback; +1 volt dc per 10 output receptacle volts.
GND	G	Circuit common for 24 and 115 volts ac circuits.
	K	Chassis common.

*The remaining sockets are not used.

3-7. Optional Gas Valve Operation And Shielding Gas Connection







Obtain gas cylinder and chain to running gear, wall, or other stationary support so cylinder cannot fall and break off valve.

1 Cylinder

2 Regulator/Flowmeter

Install so face is vertical.

3 Gas Hose Connection

Fitting has 5/8-18 right-hand threads. Obtain and install gas hose.

4 Gas In Fitting

5 Gas Out Fitting

The Gas In and Gas Out fittings have 5/8-18 right-hand threads. Obtain proper size, type, and length hose and make connections as follows:

Connect hose from shielding gas supply regulator/flowmeter to Gas In fitting.

Connect hose coupler to torch. Connect one end of gas hose to hose coupler. Connect remaining end of gas hose to Gas Out fitting.

Operation

The gas solenoid controls gas flow during the TIG process as follows:

Remote TIG

Gas flow starts with remote contactor on.

Gas flow stops at end of post–flow if current was detected, or with remote contactor off if no current was detected.

Lift–Arc TIG

Gas flow starts when tungsten touches work (touch sensed).

Gas flow stops at end of post–flow.

Scratch Start TIG

Gas flow starts when current is detected.

Gas flow stops at end of post–flow.

Post–flow time is factory set to 5 seconds per 100 amps of weld current. The minimum post–flow time is 5 seconds. The maximum post–flow is 20 seconds (post flow settings are not adjustable by the end user).

Ref. 803 705-A / Ref. 803 691-C

4-1. Front Panel Controls

1 Power Switch

☞ *The fan motor is thermostatically controlled and only runs when cooling is needed.*

2 Voltmeter

3 Ammeter

4 V/A (Voltage/Amperage) Adjustment Control

5 Mode Switch

The Mode switch setting determines both the process and output On/Off control (see Section 4-3). Source of control (panel or remote) for the amount of output is selected on the V/A Control switch.

For Air Carbon Arc (CAC-A) cutting and gouging, place switch in Stick position. For best results, place Arc Control in the maximum position.

6 Remote 14 Receptacle

For remote control, make connections to Remote 14 receptacle. In TIG modes and the REMOTE STICK mode, remote control is a percent of V/A Adjust control setting (value selected on V/A Adjust is maximum available on remote). In ELECTRODE HOT STICK mode the remote control is not used. In the MIG mode, remote control provides full range of unit output regardless of V/A Adjust control setting.

7 Arc Control

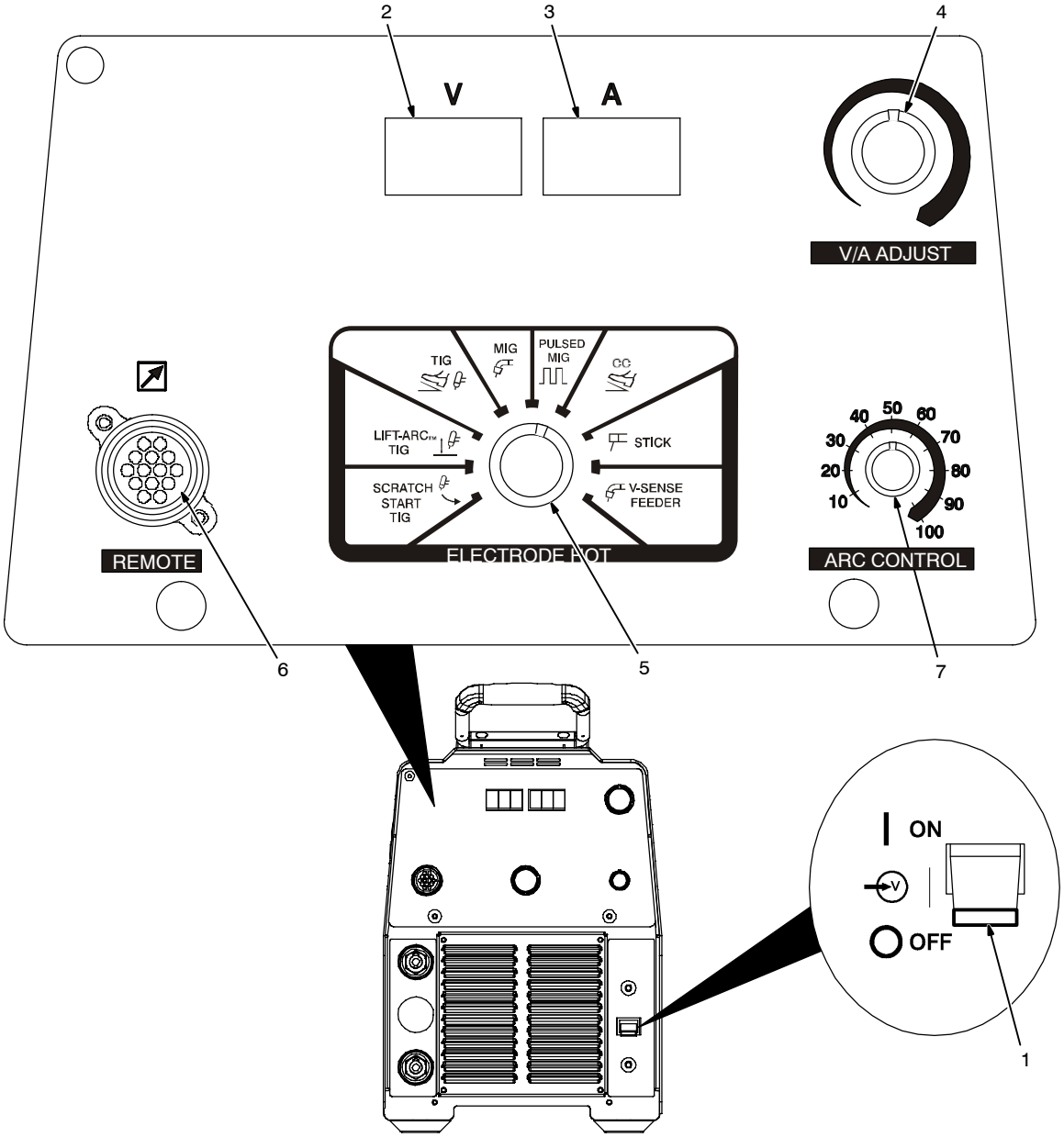
Control adjusts Dig when Stick or CC mode is selected on mode switch. When set towards minimum, short-circuit amperage at low arc voltage is the same as normal welding amperage.

When set towards maximum, short-circuit amperage is increased at low arc voltage to assist with arc starts as well as reduce sticking while welding.

Select setting best suited for application.

Control adjusts inductance when MIG or V-Sense Feeder position is selected on the mode switch. Inductance determines the “wetness” of the weld puddle. When set towards maximum, “wetness” (puddle fluidity) increases.

When Pulsed MIG or one of the TIG modes is selected, this control is not functional.



Ref. 803 692-B / Ref. 212 064

4-2. Meter Functions

NOTE ☞ *The meters display the actual weld output values for approximately three seconds after the arc is broken.*

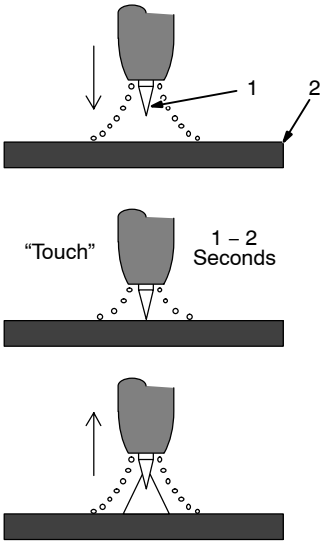
Mode	Meter Reading At Idle		Meter Reading While Welding	
Scratch Start TIG	V **71.7** Actual Volts (OCV)	A **85** Preset Amps	V **10.3** Actual Volts	A **85** Actual Amps
Lift-Arc TIG	V **14.1** Actual Volts	A **85** Preset Amps	V **10.3** Actual Volts	A **85** Actual Amps
TIG	V Blank	A **85** Preset Amps	V **10.3** Actual Volts	A **85** Actual Amps
MIG	V **24.5** Preset Volts	A Blank	V **24.5** Actual Volts	A **250** Actual Amps
Pulsed MIG	V **PPP** Pulse Display	A **PPP** Pulse Display	V **24.5** Actual Volts	A **250** Actual Amps
CC	V Blank	A **85** Preset Amps	V **24.5** Actual Volts	A **85** Actual Amps
Stick	V **71.7** Actual Volts (OCV)	A **85** Preset Amps	V **24.5** Actual Volts	A **85** Actual Amps
V-Sense Feeder	V **71.7** Flashes OCV And Preset	A Blank	V **24.5** Actual Volts	A **250** Actual Amps

4-3. Mode Switch Settings

NOTE ☞ *The Stick and CC modes provide the* Adaptive Hot Start™ *feature, which automatically increases the output amperage at the start of a weld should the start require it. This eliminates electrode sticking at arc start.*

Mode Switch Setting	Process	Output On/Off Control
Scratch Start TIG	GTAW	Electrode Hot
Lift-Arc TIG	GTAW – See Section 4-4	Electrode Hot
TIG	GTAW With HF Unit, Pulsing Device, Or Remote Control	At Remote 14
MIG	GMAW	At Remote 14
Pulsed MIG	GMAW-P (Requires an external pulsing device.)	At Remote 14
CC	Stick (SMAW) With Remote On/Off	At Remote 14
Stick	SMAW	Electrode Hot
V-Sense Feeder	MIG (GMAW) With Voltage Sensing Wire Feeder	Electrode Hot

4-4. Lift-Arc TIG Procedure



Do NOT Strike Like A Match!

With Process Switch in the Lift-Arc TIG position, start an arc as follows:

1 TIG Electrode

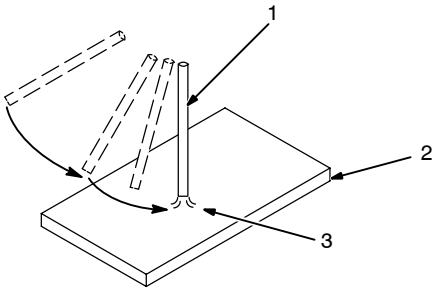
2 Workpiece

Touch tungsten electrode to workpiece at weld start point, **hold electrode to workpiece for 1-2 seconds**, and slowly lift electrode. An arc will form when electrode is lifted.

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.

Ref. S-156 279

4-5. Stick Start Procedure



With Stick selected, start arc as follows:

1 Electrode

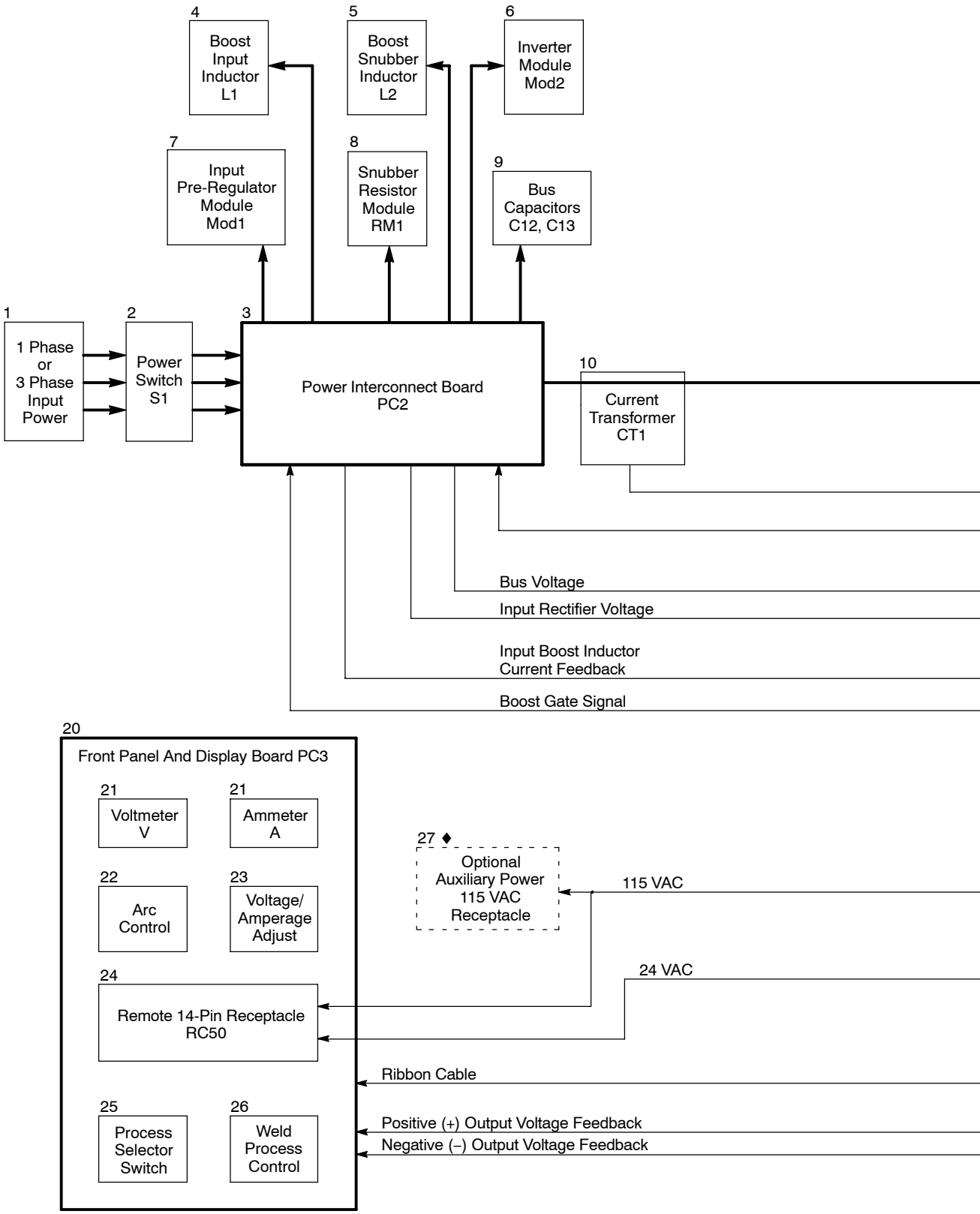
2 Workpiece

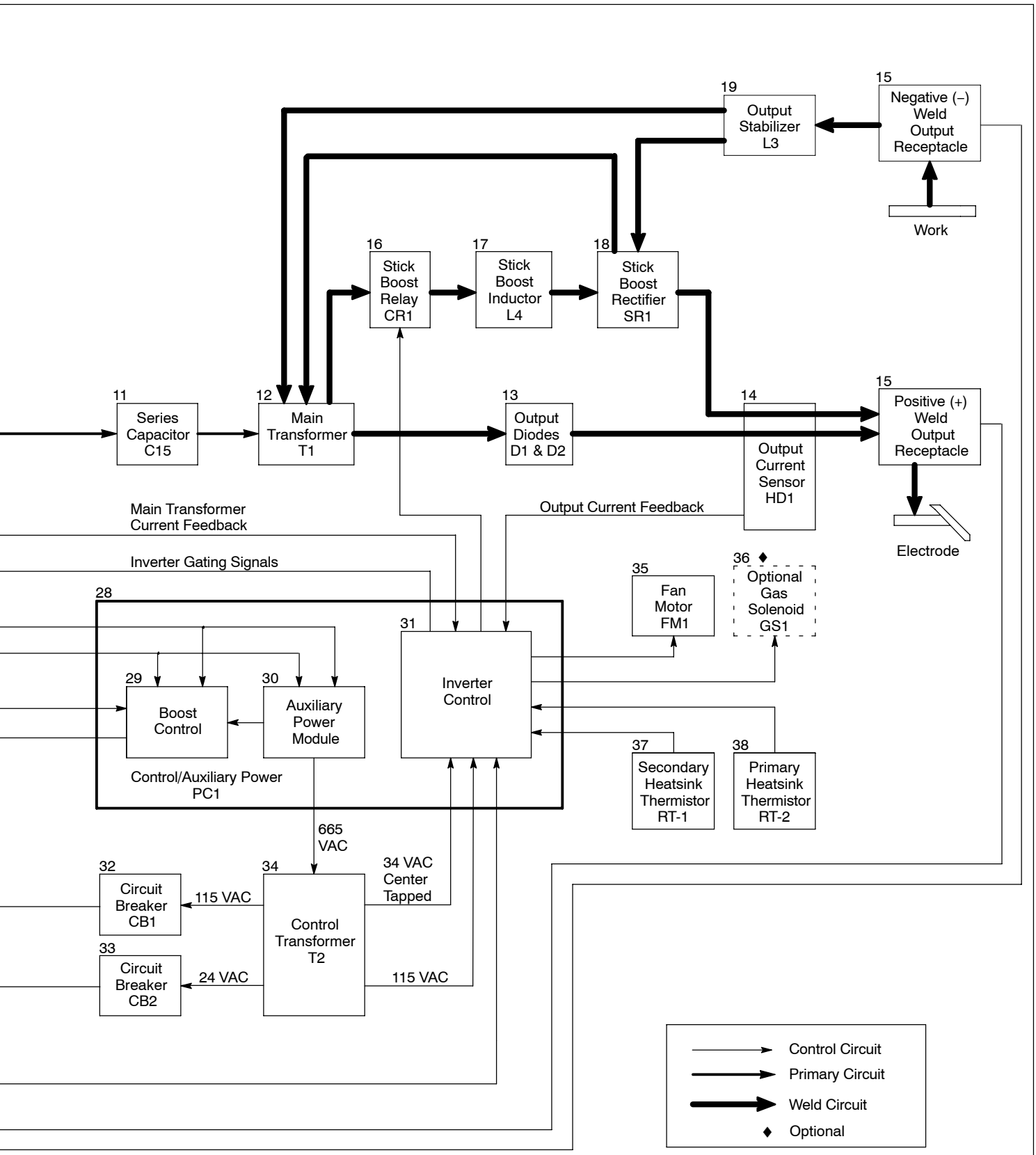
3 Arc

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

Low OCV Stick

The unit can be optionally configured for low open circuit voltage (OCV) operation. When the unit is configured for low OCV operation only a low sensing voltage (approximately 15 VDC) is present between the electrode and the workpiece prior to the electrode touching the workpiece. Consult a Factory Authorized Service Agent for information regarding how to configure the unit for low OCV stick welding operation.


4
Boost Input Inductor L1
5
Boost Snubber Inductor L2
6
Inverter Module Mod2
7
Input Pre-Regulator Module Mod1
8
Snubber Resistor Module RM1
9
Bus Capacitors C12, C13
1
1 Phase or 3 Phase Input Power
2
Power Switch S1
3
Power Interconnect Board PC2
10
Current Transformer CT1
Bus Voltage
Input Rectifier Voltage
Input Boost Inductor Current Feedback
Boost Gate Signal
20
Front Panel And Display Board PC3
21
Voltmeter V
21
Ammeter A
22
Arc Control
23
Voltage/ Amperage Adjust
24
Remote 14-Pin Receptacle RC50
25
Process Selector Switch
26
Weld Process Control
27 ♦
Optional Auxiliary Power 115 VAC Receptacle
115 VAC
24 VAC
Ribbon Cable
Positive (+) Output Voltage Feedback
Negative (–) Output Voltage Feedback


19
Output Stabilizer L3
15
Negative (–) Weld Output Receptacle
Work
16
Stick Boost Relay CR1
17
Stick Boost Inductor L4
18
Stick Boost Rectifier SR1
11
Series Capacitor C15
12
Main Transformer T1
13
Output Diodes D1 & D2
14
Output Current Sensor HD1
15
Positive (+) Weld Output Receptacle
Electrode
Main Transformer Current Feedback
Output Current Feedback
Inverter Gating Signals
28
31
Inverter Control
35
Fan Motor FM1
36 ♦
Optional Gas Solenoid GS1
29
Boost Control
30
Auxiliary Power Module
Control/Auxiliary Power PC1
37
Secondary Heatsink Thermistor RT-1
38
Primary Heatsink Thermistor RT-2
665 VAC
32
Circuit Breaker CB1
115 VAC
34
Control Transformer T2
34 VAC Center Tapped
33
Circuit Breaker CB2
24 VAC
115 VAC
Control Circuit
Primary Circuit
Weld Circuit
♦ Optional

Theory Of Operation Components

1 Primary Input Power

Single or Three-Phase AC primary power supply.

2 Power Switch S1

Provides on/off control of primary input power to welding power source.

3 Power Interconnect Board PC2

Provides electrical connections for L1, L2, MOD1, MOD2, RM1, C12 & C13. Precharge and bleeder resistors and snubber capacitors are mounted on PC2.

4 Boost Input Inductor L1

Required to boost input rectifier voltage to bus voltage.

5 Boost Snubber Inductor L2

Required to ensure soft–switching of the boost IGBT located in MOD1.

6 Inverter Module MOD2

Contains the main inverter IGBTs, snubber IGBTs, main boost diode, and two boost snubber diodes.

7 Input Pre–Regulator Module MOD1

Contains the input rectifier diodes, boost IGBT, and one boost snubber diode.

8 Snubber Resistor Module RM1

Contains one boost snubber resistor and one inverter snubber resistor.

9 Bus Capacitors C12 & C13

Stores energy and filters the DC bus voltage for input boost and inverter.

10 Current Transformer CT1

Provides T1 current feedback to PC1. Used to protect inverter IGBTs in case of T1 primary overcurrent.

11 Series Capacitor C15

Provides protection against T1 saturation. Saturation occurs when the voltage across the transformer is not balanced. The unbalanced voltage appears as a DC offset voltage across the transformer and can cause a primary overcurrent. The capacitor protects against this condition by blocking the DC offset.

12 Main Transformer T1

Switching action of IGBTs in MOD2 creates the AC voltage source for T1 primary. T1 secondary outputs supply power to the weld circuit.

13 Output Diodes D1, D2

Rectifies the main secondary output of T1.

14 Output Current Sensor HD1

Provides weld output current feedback to PC1.

15 Positive (+) and Negative (–) Weld Output Receptacles

Provide weld output and allow changing of output polarity.

16 Stick Boost Relay CR1

Provides on/off control of Stick boost output circuit.

17 Stick Boost Inductor L4

Limits current in the Stick boost output circuit.

18 Stick Boost Rectifier SR1

Rectifies the Stick boost secondary output of T1.

19 Output Stabilizer L3

Filters or smooths the DC weld output current.

20 User Interface Board PC3

Consists of Voltmeter V, Ammeter A, Arc Control, Voltage/Amperage Adjust, Remote 14–pin receptacle, Process Selector Switch, and Weld Process Control.

21 Voltmeter V, Ammeter A

See Sections 4-1, Front Panel Controls and 4-2, Meter Functions.

22 Arc Control

Controls Dig in Stick process or Inductance in MIG process. See Section 4-1, Front Panel Controls.

23 Voltage/Amperage Adjust

Selects weld output voltage or amperage level. See Section 4-1, Front Panel Controls.

24 Remote 14-Pin Receptacle RC50

Provides connection to auxiliary equipment. See Sections 4-1, Front Panel Controls, and 3-6, Remote 14 Receptacle Information.

25 Process Selector Switch

Selects weld process. See Section 4-1, Front Panel Controls.

26 Weld Process Control

Controls weld output by automatically adjusting output current command signal to Inverter Control.

27 Optional Auxiliary Power 115 VAC Receptacle

Provides connection for auxiliary equipment to welding power source.

28 Control/Auxiliary Power Board PC2

Contains the boost control, auxiliary power module, and inverter control.

29 Boost Control

Controls switching of boost IGBT in MOD1 to regulate L1 current and the DC bus voltage.

30 Auxiliary Power Module

Contains power supply for boost control power, and inverter IGBTs to create AC voltage source for T2 primary.

31 Inverter Control

Controls the main inverter and snubber IGBTs within MOD2. Regulates the weld output current to the value received from weld process controller. Provides power to PC3. Drives fan motor and gas valve. Provides interface between primary and secondary thermistors and PC3.

32 Circuit Breaker CB1

Provides overload protection for remote 14-pin 115 VAC power, and optional 115 VAC receptacle.

33 Circuit Breaker CB2

Provides overload protection for remote 14-pin 24 VAC power.

34 Control Transformer T2

Provides power to inverter control on PC1, remote 14-pin receptacle, and optional 115 VAC receptacle.

35 Fan Motor FM1

Provides cooling of heatsinks and components mounted inside wind tunnel. The fan motor is thermostatically controlled and only runs when cooling is needed. Once unit is cooled to proper temperature, fan will continue to run for ten minutes.

36 Optional Gas Solenoid GS1

Provides on/off flow of shielding gas to the arc while TIG welding.

37 Secondary Heatsink Thermistor RT-1

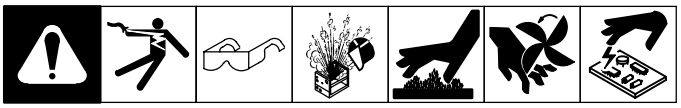
Monitors temperature of secondary heatsink for fan motor control and overtemperature shutdown.

38 Primary Heatsink Thermistor RT-2

Monitors temperature of primary heatsink for fan motor control and overtemperature shutdown.

SECTION 6 – TROUBLESHOOTING

6-1. Checking Unit Before Applying Power



☞ *See Section 6-24 for test points and values and Section 9 for parts location.*

▲ **Discharge input capacitors according to Section 6-3 and be sure voltage is near zero before touching any parts.**

▲ **Before applying power to unit, complete the pre-power flowchart in Section 6-2 to avoid causing further damage.**

▲ **Although control/auxiliary power board PC1 and power interconnect board PC2 are briefly checked in the pre-power flowchart, more complete tests may be needed later for these parts. This procedure is simply to get a basic okay to power up unit.**

NOTE ☞

The pre-power flowchart should be followed if any of the following conditions exist:

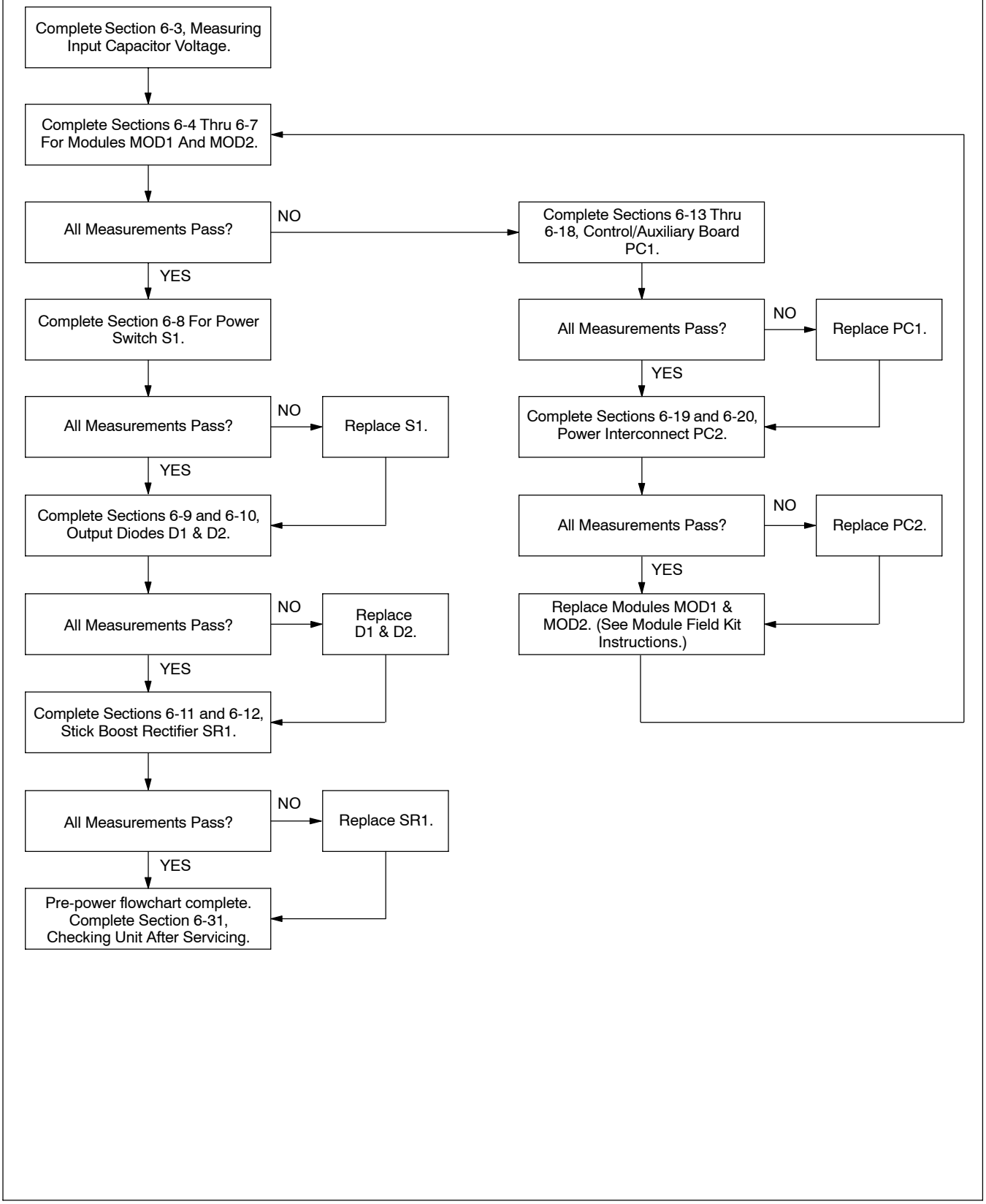
the symptoms are unknown;

the unit is completely inoperative;

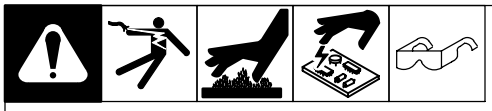
visual damage is found on any of the following components: capacitors C12 and C13, control board PC1, IGBT power modules MOD1 and MOD2, interconnecting board PC2, or input rectifier SR1;

there is no output or limited output.

6-2. Pre-Power Flowchart



6-3. Measuring Input Capacitor Voltage



▲ **Turn Off welding power source, and disconnect input power.**

Remove cover

1 Power Interconnect Board PC2

2 Voltmeter

3 Capacitor C12

Measure the dc voltage across C12 (+) Positive Terminal and C12 (–) Negative Terminal on PC2 as shown until voltage drops to near 0 (zero) volts.

4 Capacitor C13

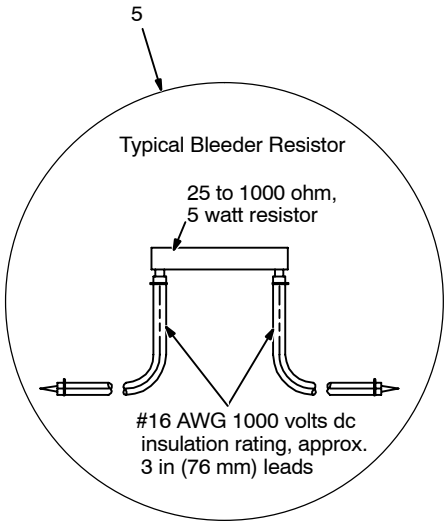
Measure the dc voltage across C13 (+) Positive Terminal and C13 (–) Negative Terminal on PC2 as shown until voltage drops to near 0 (zero) volts.

☞ *If the capacitor voltage does not drop to near zero after several minutes, use a bleeder resistor of between 25 and 1000 ohms, at least 5 watts, #16 AWG 1000 volts dc insulating rating wire to discharge the capacitor(s) .*

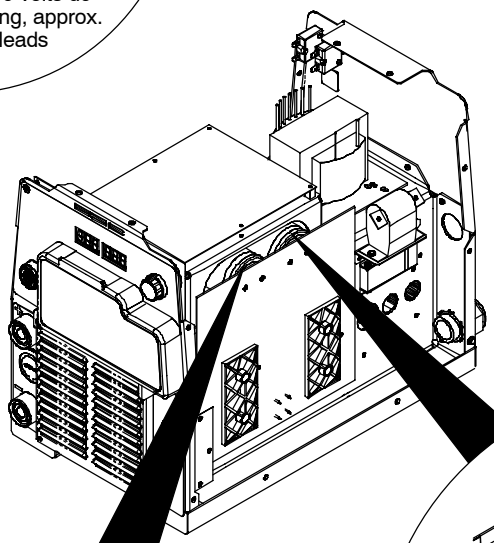
5 Typical Bleeder Resistor

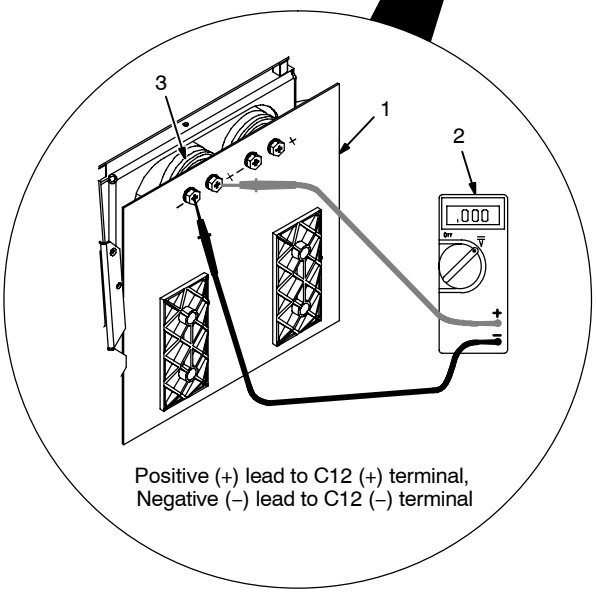
An example of a typical bleeder resistor is shown on this page.

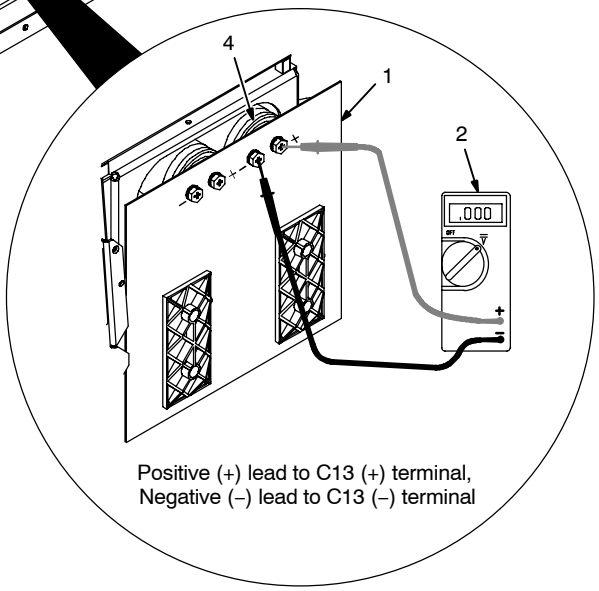
Proceed with pre-power flowchart.



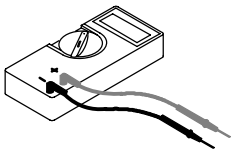
▲ **Significant DC voltage can remain on capacitors after unit is Off. Always check the voltage as shown to be sure the input capacitors have discharged before working on unit.**





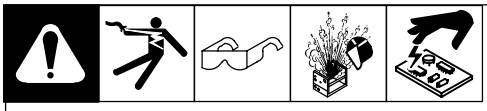


Test Equipment Needed:

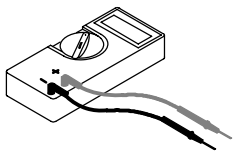


Ref. 803 721-B / 907 161

6-4. Input Pre-Regulator Module (MOD1)



Test Equipment Needed:



▲ **Read and follow safety information in Section 6-1 before proceeding.**

▲ **Wear an earth grounded wrist strap when performing pre-power checks. Remove wrist strap before performing any checks or procedures with power applied to the machine.**

☞ *Board layout may differ from that shown.*

1 MOD1

Visually inspect MOD1 for damage.

2 –BUS

3 D12 Cathode

4 AC1

5 AC2

6 AC3

7 L1

8 L1-L2

9 TP1

10 +BUS

Check all measurements for Input Pre–Regulator Module (MOD1) (see Section 6-5).

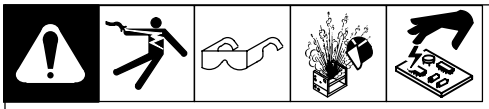
If all measurements passed, MOD1 is OK. Continue to the end of the pre–power flowchart (see Section 6-2).

Ref. 907 161 / 225 065-A

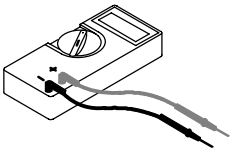
6-5. Input Pre-Regulator Module (MOD1) Test Point Values

Input Pre-Regulator Module MOD1	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
Boost IGBT	–BUS	L1-L2	0.20 - 0.90	N/A
Boost IGBT **(w/Plug Removed From RC3)**	D12 Cathode	–BUS	N/A	100k
Boost Snubber Diode	L1-L2	TP1 (C6 and C7)	0.20 - 0.90	N/A
Input SCR	AC1	L1	0.20 - 0.90	N/A
Input SCR	AC2	L1	0.20 - 0.90	N/A
Input SCR	AC3	L1	0.20 - 0.90	N/A
Input Diode	–BUS	AC1	0.20 - 0.90	N/A
Input Diode	–BUS	AC2	0.20 - 0.90	N/A
Input Diode	–BUS	AC3	0.20 - 0.90	N/A

6-6. Inverter Module (MOD2)



Test Equipment Needed:



▲ **Read and follow safety information in Section 6-1 before proceeding.**

▲ **Wear an earth grounded wrist strap when performing pre-power checks. Remove wrist strap before performing any checks or procedures with power applied to the machine.**

☞ *Board layout may differ from that shown.*

1 MOD2

Visually inspect MOD2 for damage.

2 –BUS
3 TP2
4 TP1
5 L2
6 TP4
7 HF-XFMR
8 D4
9 D2
10 TP3
11 D8
12 D10
13 D11
14 +BUS

Check all measurements for Inverter Module (MOD2) (see Section 6-7).

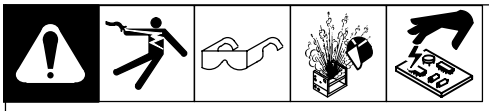
If all measurements passed, MOD2 is OK. Continue to the end of the pre–power flowchart (see Section 6-2).

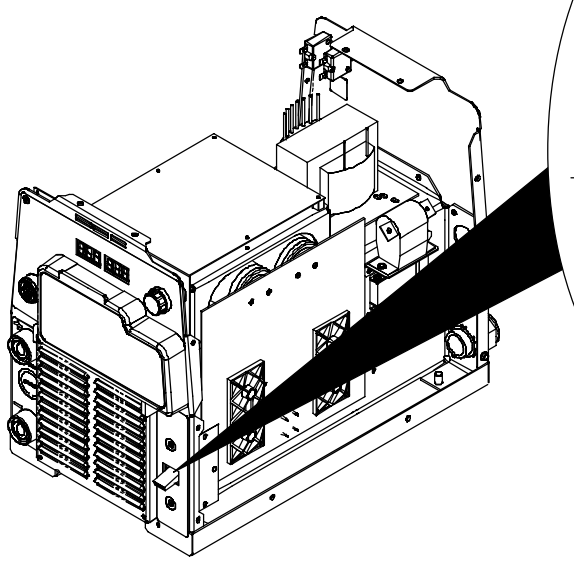
Ref. 907 161 / 225 065-A

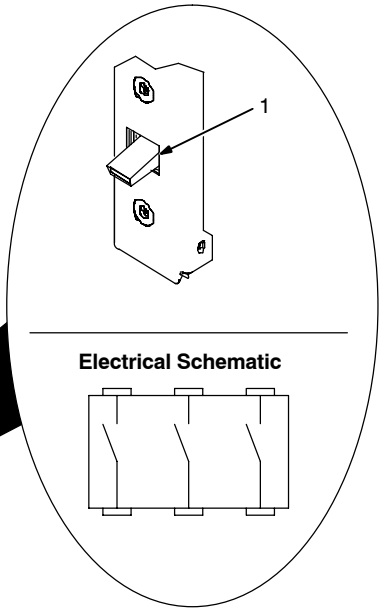
6-7. Inverter Module (MOD2) Test Point Values

Inverter Module MOD2	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
Boost Snubber Diode	TP1 (C6 and C7)	TP4 (C1)	0.20 - 0.90	N/A
Boost Snubber Diode	L2	TP4 (C1)	0.20 - 0.90	N/A
Main Boost Diode	TP4 (C1)	+BUS	0.20 - 0.90	N/A
Inverter IGBT	HF-XFMR	+BUS	0.20 - 0.90	N/A
Inverter IGBT	–BUS	HF-XFMR	0.20 - 0.90	N/A
Snubber IGBT	TP2 (D11 Cathode)	HF-XFMR	0.20 - 0.90	N/A
Snubber IGBT	TP2 (D11 Cathode)	TP3 (C2)	0.20 - 0.90	N/A
Inverter IGBT Gate	D2 Cathode	HF-XFMR	N/A	100k
Inverter IGBT Gate	D4 Cathode	–BUS	N/A	100k
Snubber IGBT Gate **(w/Plug Removed From RC1)**	D10 Cathode	TP2 (D11 Cathode)	N/A	100k
Snubber IGBT Gate **(w/Plug Removed From RC1)**	D8 Cathode	TP2 (D11 Cathode)	N/A	100k

6-8. Power Switch (S1)







▲ **Read and follow safety information in Section 6-1 before proceeding.**

1 Power Switch S1

Visually inspect S1 for damage.

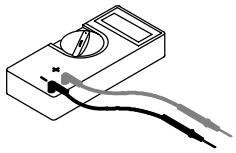
Check switch mechanical operation by turning switch On and Off several times. Switch should snap sharply between the On and Off positions.

Check switch electrical operation by checking continuity across S1 contacts with switch in the On position. With switch in the Off position, ohmmeter should read open.

Replace switch if necessary.

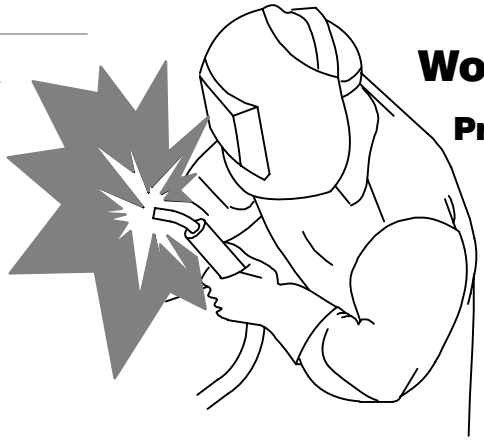
Continue to the end of the pre–power flowchart (see Section 6-2).

Test Equipment Needed:



Ref. 907 161 / Ref. 183 484

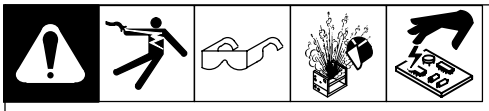
Notes

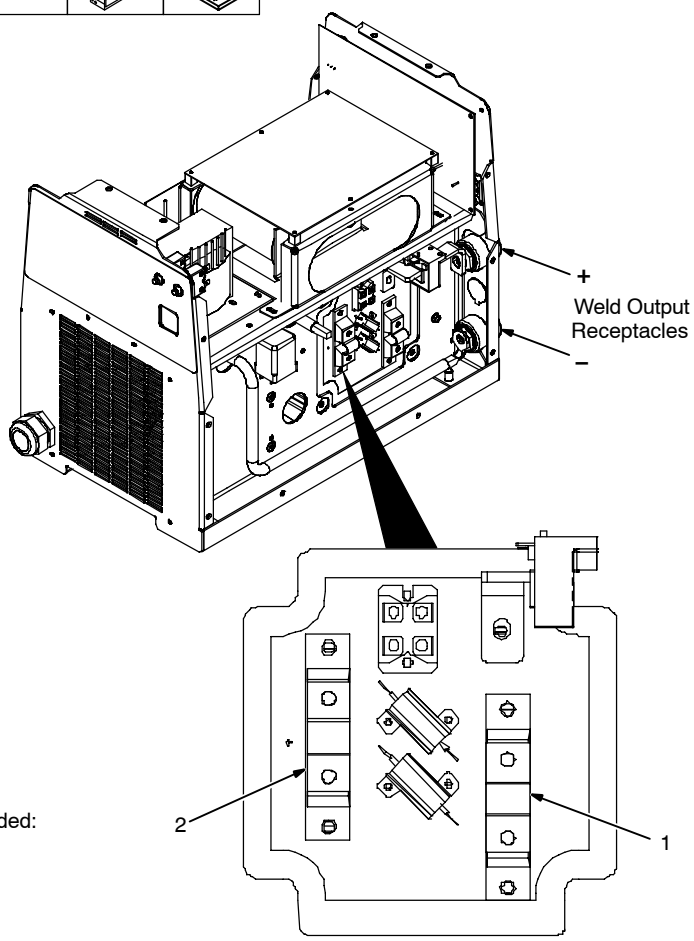


Work like a Pro!

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

6-9. Output Diodes D1, D2





Diodes D1, D2

▲ **Read and follow safety information in Section 6-1 before proceeding.**

1 Diode D1

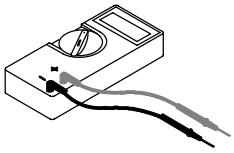
2 Diode D2

Visually inspect D1 and D2 for damage.

Check all measurements for output diodes D1 and D2 (see Section 6-10).

If all measurements passed, the output diodes D1 and D2 are OK. Continue to the end of the pre–power flowchart (see Section 6-2).

Test Equipment Needed:

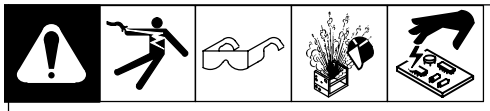


Ref. 907 161

6-10. Output Diodes D1, D2 Test Point Values

Output Diodes D1 And D2	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
D1	Terminal Anode	Secondary Heatsink	0.10 - 0.90	N/A
D2	Terminal Anode	Secondary Heatsink	0.10 - 0.90	N/A

6-11. Stick Boost Rectifier (SR1)



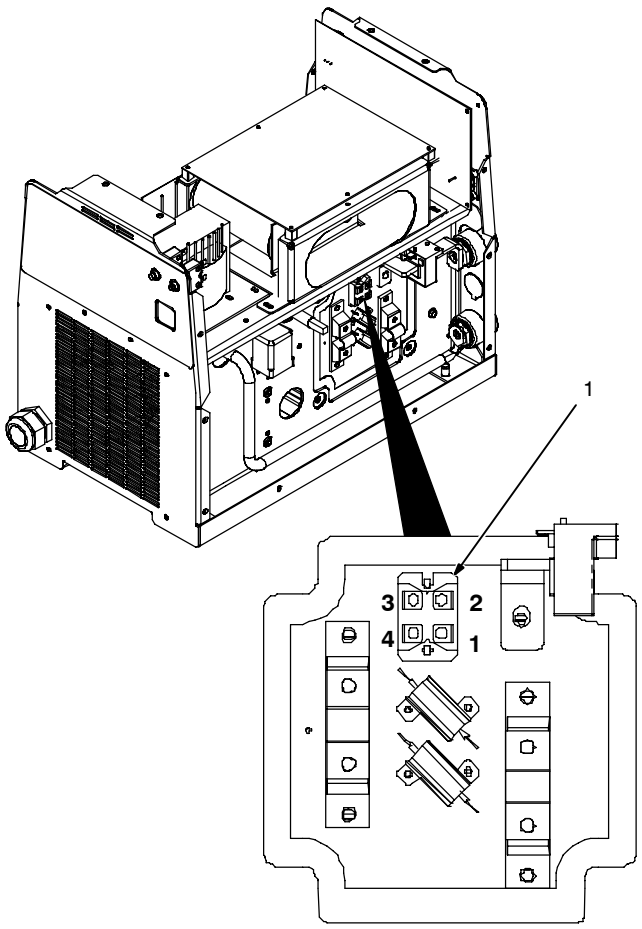
▲ **Read and follow safety information in Section 6-1 before proceeding.**

1 Stick Boost Rectifier SR1

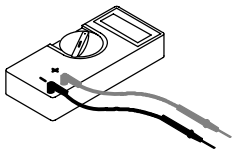
Visually inspect SR1 for damage.

Check all measurements for stick boost rectifier SR1 (see Section 6-12).

If all measurements passed, SR1 is OK. Continue to the end of the pre–power flowchart (see Section 6-2).



Test Equipment Needed:



Ref. 907 161

6-12. Stick Boost Rectifier (SR1) Test Point Values

Stick Boost Rectifier SR1	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
SR1	Terminal 2	Terminal 1	0.20 - 0.90	N/A
SR1	Terminal 4	Terminal 1	0.20 - 0.90	N/A
SR1	Terminal 3	Terminal 2	0.20 - 0.90	N/A
SR1	Terminal 3	Terminal 4	0.20 - 0.90	N/A

Notes

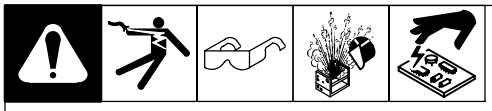
OHM'S LAW

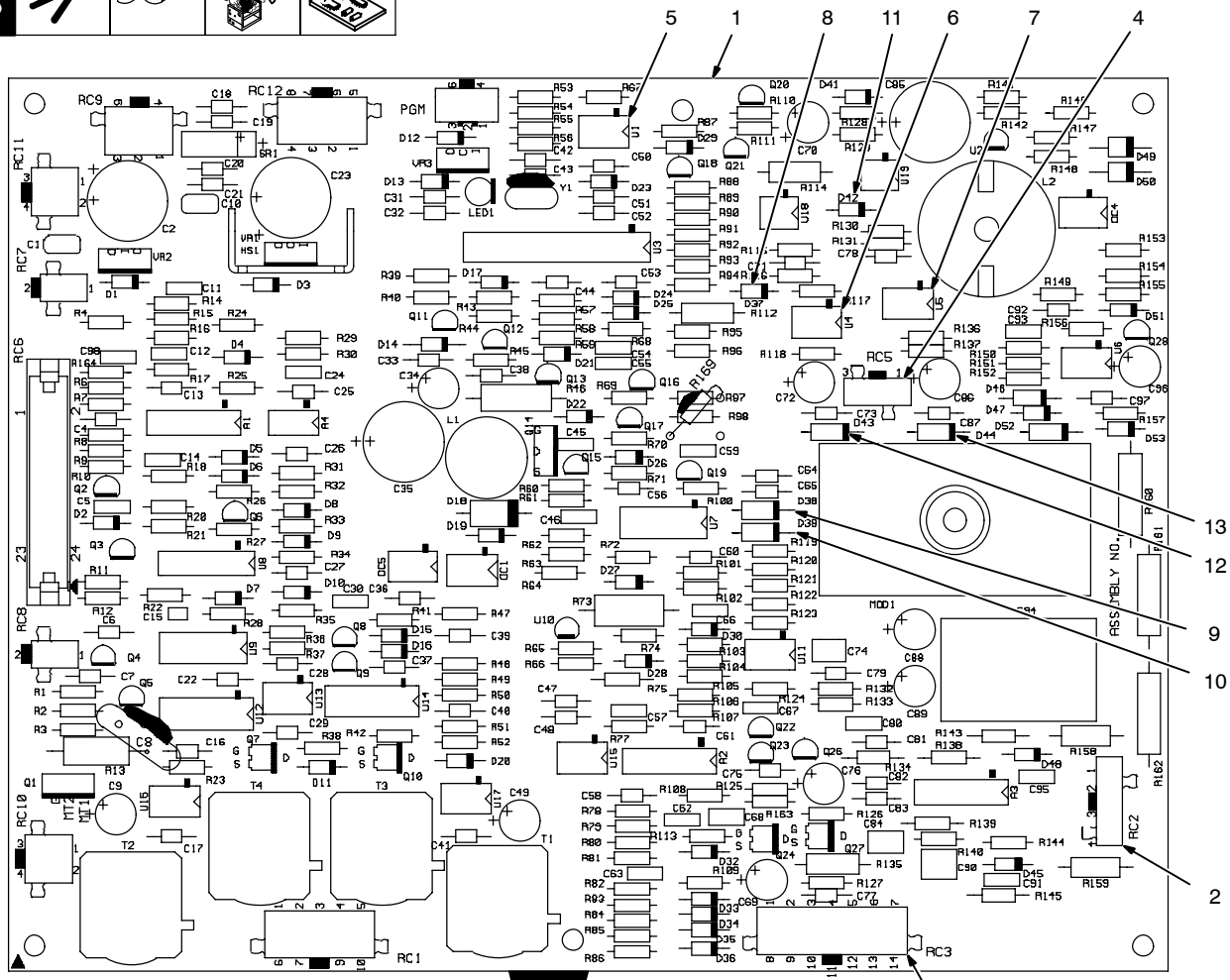
VOLTAGE = CURRENT X RESISTANCE

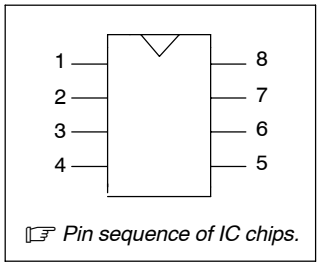
$$CURRENT = \frac{VOLTAGE}{RESISTANCE}$$

$$RESISTANCE = \frac{VOLTAGE}{CURRENT}$$

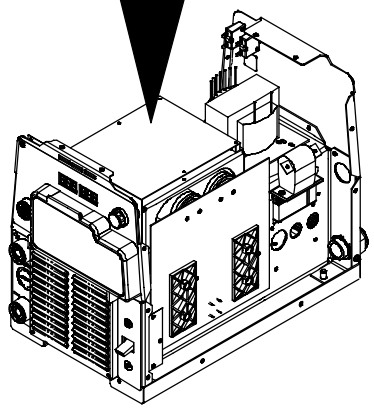
6-13. Control/Auxiliary Power Board PC1 – Auxiliary Power Circuit



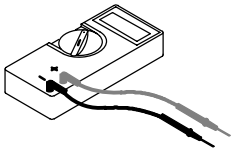




☞ *Pin sequence of IC chips.*



Test Equipment Needed:



Ref. 217 184-F / 907 161

▲ **Read and follow safety information in Section 6-1 before proceeding.**

▲ **Wear an earth grounded wrist strap when performing pre-power checks. Remove wrist strap before performing any checks or procedures with power applied to the machine.**

☞ *Remove all plugs from PC1 before testing.*

1 Control Board PC1
2 Receptacle RC2
3 Receptacle RC3
4 Receptacle RC5
5 IGBT Gate Drive IC U1
6 IGBT Gate Drive IC U4
7 IGBT Gate Drive IC U5
8 Diode D37
9 Diode D38
10 Diode D39
11 Diode D42
12 Diode D43
13 Diode D44

Unplug all connections to PC1.

Visually inspect PC1 for damage.

Check all measurements for PC1 Auxiliary Power, Pre-Regulator and Inverter Control (see Sections 6-14 thru 6-18).

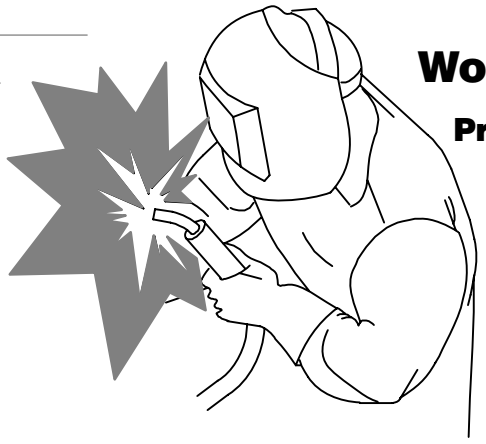
If all measurements passed, continue to the end of the pre-power flowchart (see Section 6-2).

☞ *If any measurements failed, replace PC1.*

6-14. Control/Auxiliary Power Board PC1 – Auxiliary Power Circuit Test Point Values

60Hz Auxiliary Power Bridge	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
Auxiliary Bridge IGBT	RC5 Pin 3	RC2 Pin 1	0.20 - 0.90	N/A
Auxiliary Bridge IGBT	RC5 Pin 1	RC2 Pin 1	0.20 - 0.90	N/A
Auxiliary Bridge IGBT	RC3 Pin 6 (PRECOM)	RC5 Pin 3	0.20 - 0.90	N/A
Auxiliary Bridge IGBT	RC3 Pin 6 (PRECOM)	RC5 Pin 1	0.20 - 0.90	N/A
Auxiliary Bridge IGBT Gate Drive IC U1	RC3 Pin 6 (PRECOM)	U1 Pin 5	0.20 - 0.90	N/A
Auxiliary Bridge IGBT Gate Drive IC U1	U1 Pin 5	U1 Pin 6	0.20 - 0.90	N/A
Auxiliary Bridge IGBT Gate Drive IC U1	RC3 Pin 6 (PRECOM)	U1 Pin 7	0.20 - 0.90	N/A
Auxiliary Bridge IGBT Gate Drive IC U1	U1 Pin 7	U1 Pin 6	0.20 - 0.90	N/A
Auxiliary Bridge IGBT Gate Drive IC U4	RC5 Pin 1	U5 Pin 7	0.20 - 0.90	N/A
Auxiliary Bridge IGBT Gate Drive IC U5	RC5 Pin 3	U4 Pin 7	0.20 - 0.90	N/A
D37	D37 Anode	D37 Cathode	0.20 - 0.90	N/A
D38	D38 Anode	D38 Cathode	0.20 - 0.90	N/A
D39	D39 Anode	D39 Cathode	0.20 - 0.90	N/A
D42	D42 Anode	D42 Cathode	0.20 - 0.90	N/A
D43	D43 Anode	D43 Cathode	0.20 - 0.90	N/A
D44	D44 Anode	D44 Cathode	0.20 - 0.90	N/A

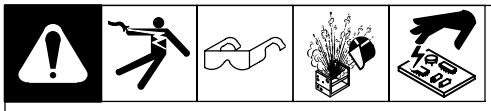
Notes

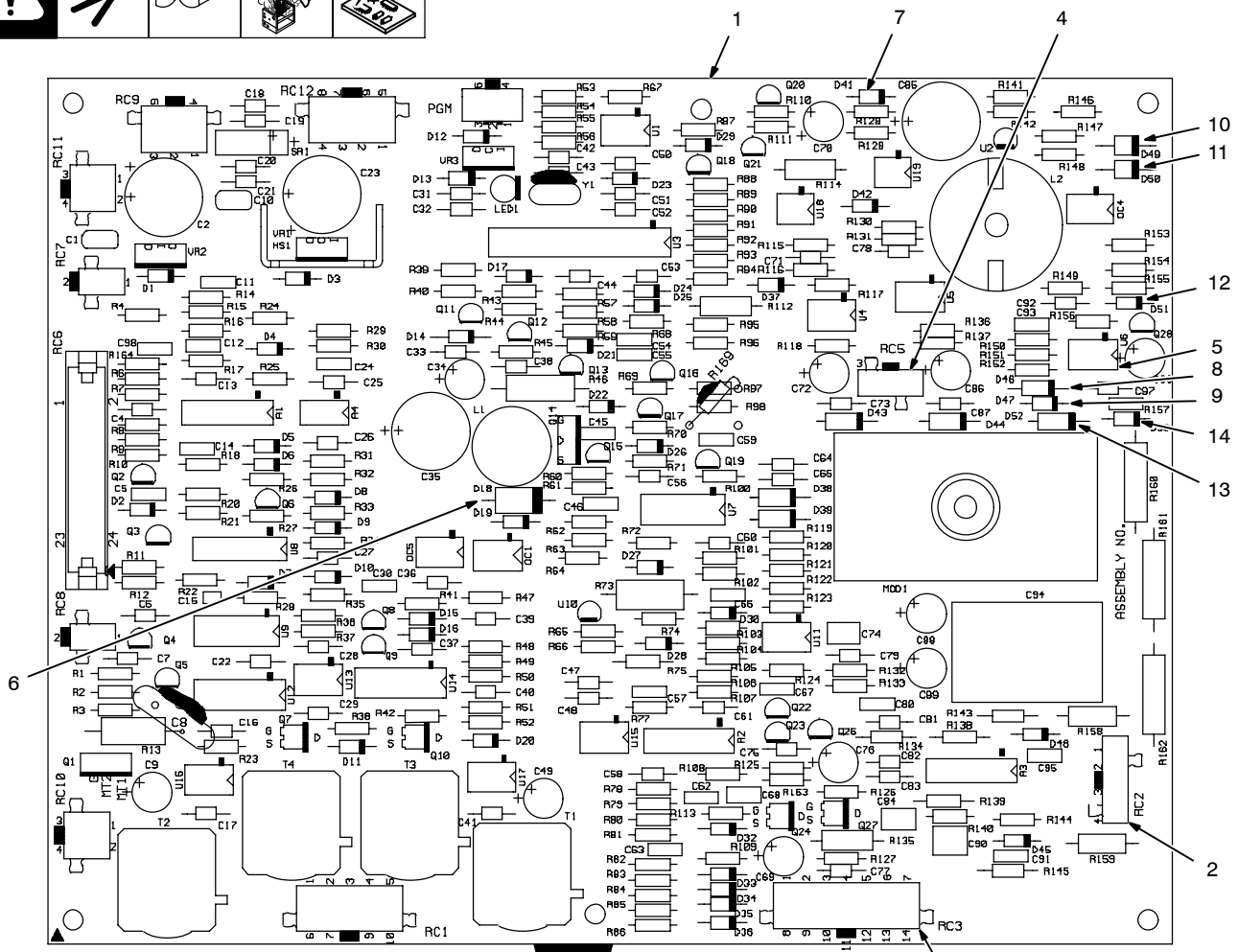


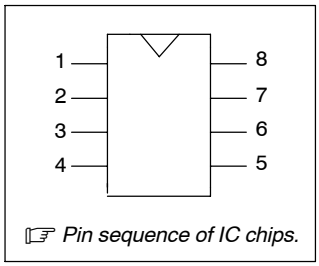
Work like a Pro!

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

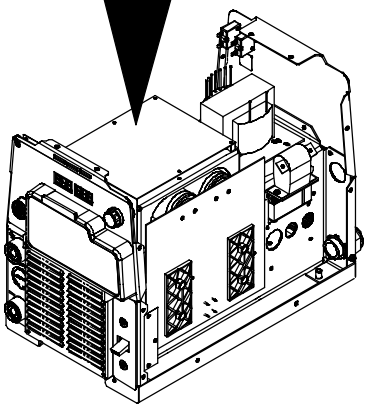
6-15. Control/Auxiliary Power Board PC1 – Pre-Regulator Control Circuit



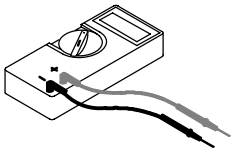




☞ *Pin sequence of IC chips.*



Test Equipment Needed:



Ref. 217 184-F / 907 161

▲ **Read and follow safety information in Section 6-1 before proceeding.**

▲ **Wear an earth grounded wrist strap when performing pre-power checks. Remove wrist strap before performing any checks or procedures with power applied to the machine.**

☞ *Remove all plugs from PC1 before testing.*

1 Control Board PC1
2 Receptacle RC2
3 Receptacle RC3
4 Receptacle RC5
5 IGBT Gate Drive IC U6
6 Diode D18
7 Diode D41
8 Diode D46
9 Diode D47
10 Diode D49
11 Diode D50
12 Diode D51
13 Diode D52
14 Diode D53

Unplug all connections to PC1.

Visually inspect PC1 for damage.

Check all measurements for PC1 Auxiliary Power, Pre-Regulator and Inverter Control (see Sections 6-14 thru 6-18).

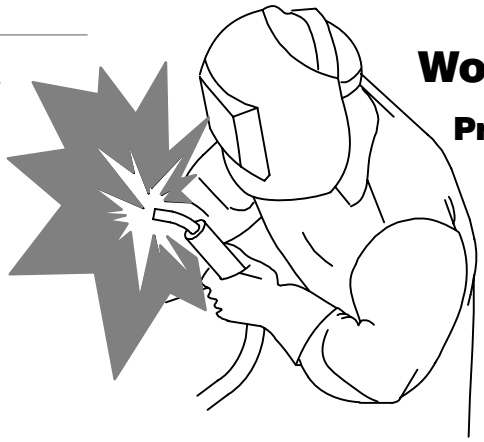
If all measurements passed, continue to the end of the pre-power flowchart (see Section 6-2).

☞ *If any measurements failed, replace PC1.*

6-16. Control/Auxiliary Power Board PC1 – Pre-Regulator Control Circuit Test Point Values

Pre-Regulator Control	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
Buck IGBT	U6 Pin 3	RC2 Pin 1	0.20 - 0.90	N/A
Buck Diode	RC3 Pin 6 (PRECOM)	U6 Pin 5 (BUCK-COM)	0.20 - 0.90	N/A
Buck IGBT Gate Drive IC U6	U6 Pin 6	U6 Pin 7 (BUCK+15V)	0.20 - 0.90	N/A
D18	D18 Anode	D18 Cathode	0.20 - 0.90	N/A
D41	D41 Anode	D41 Cathode	0.20 - 0.90	N/A
D46	D46 Anode	D46 Cathode	0.10 - 0.30	N/A
D47	D47 Anode	D47 Cathode	0.10 - 0.30	N/A
D49	D49 Anode	D49 Cathode	0.20 - 0.90	N/A
D50	D50 Anode	D50 Cathode	0.20 - 0.90	N/A
D51	D51 Anode	D51 Cathode	0.20 - 0.90	N/A
D52	D52 Anode	D52 Cathode	0.20 - 0.90	N/A
D53	D53 Anode	D53 Cathode	0.20 - 0.90	N/A
Boost IGBT Gate Drive	RC3 Pin 4 (BOOST–G)	RC3 Pin 2 (PRE+15V)	0.20 - 0.90	N/A
Boost IGBT Gate Drive	RC3 Pin 4 (BOOST–G)	RC3 Pin 3 (PRE–12V)	N/A	1.9k - 2.1k
Boost IGBT Gate Drive	RC3 Pin 3 (PRE–12V)	RC3 Pin 4 (BOOST–G)	0.20 - 0.90	N/A

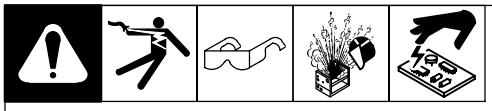
Notes

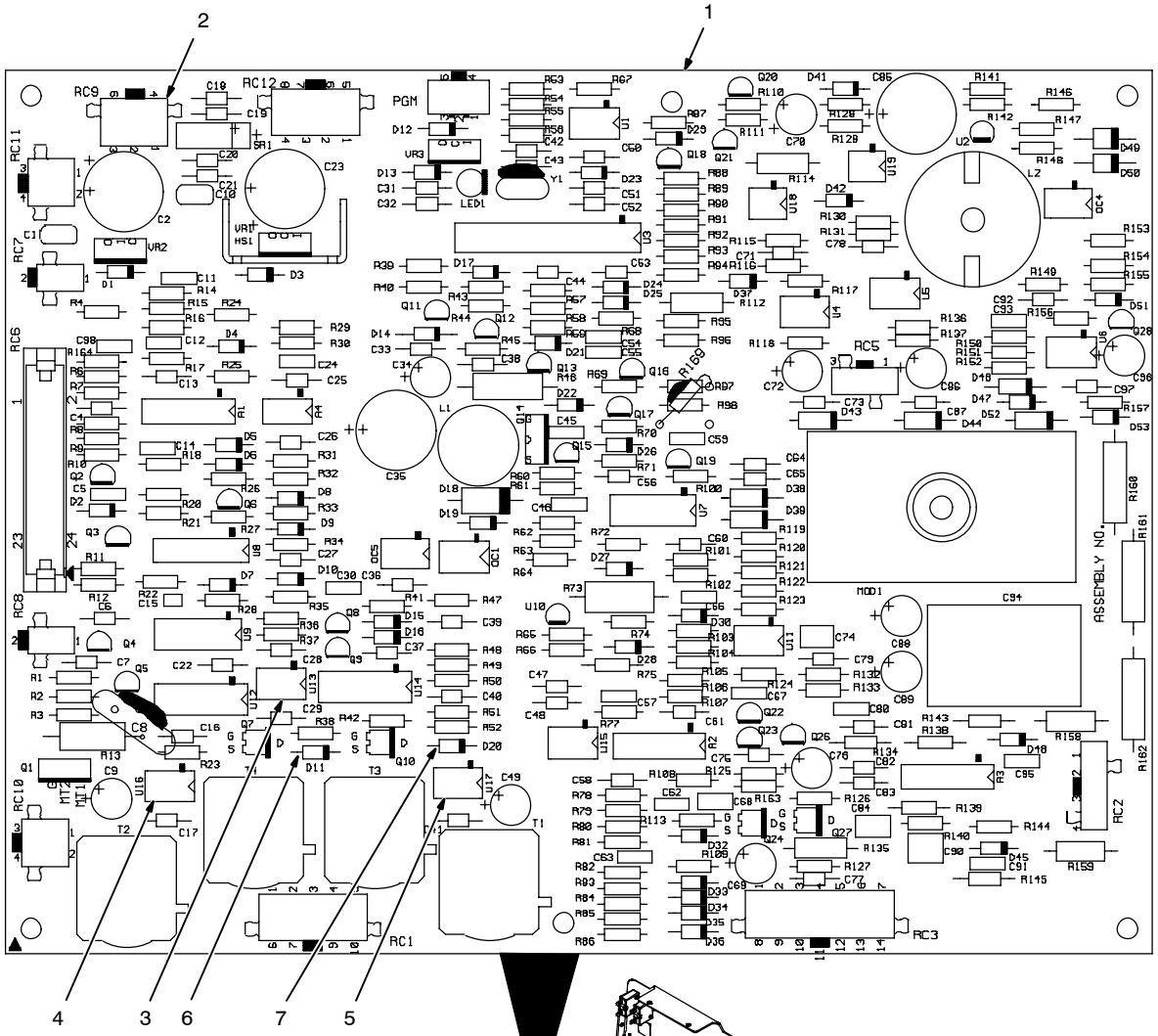


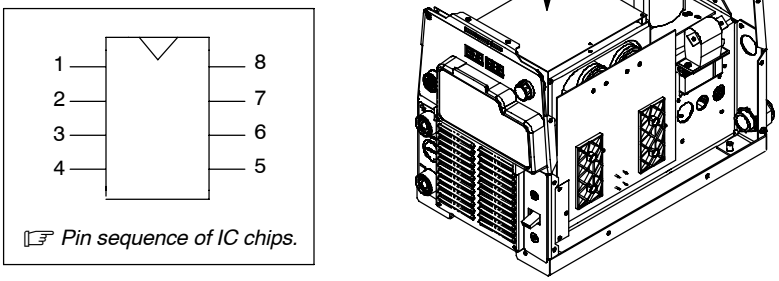
Work like a Pro!

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

6-17. Control/Auxiliary Power Board PC1 – Inverter Control Circuit

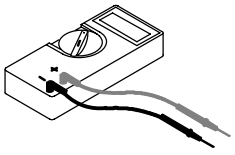






☞ *Pin sequence of IC chips.*

Test Equipment Needed:



Ref. 217 184-F / 907 161

▲ **Read and follow safety information in Section 6-1 before proceeding.**

▲ **Wear an earth grounded wrist strap when performing pre-power checks. Remove wrist strap before performing any checks or procedures with power applied to the machine.**

☞ *Remove all plugs from PC1 before testing.*

1 Control Board PC1
2 Receptacle RC9
3 IGBT Gate Drive IC U13
4 IGBT Gate Drive IC U16
5 IGBT Gate Drive IC U17
6 Diode D11
7 Diode D20

Unplug all connections to PC1.

Visually inspect PC1 for damage.

Check all measurements for PC1 Auxiliary Power, Pre-Regulator and Inverter Control (see Sections 6-14 thru 6-18).

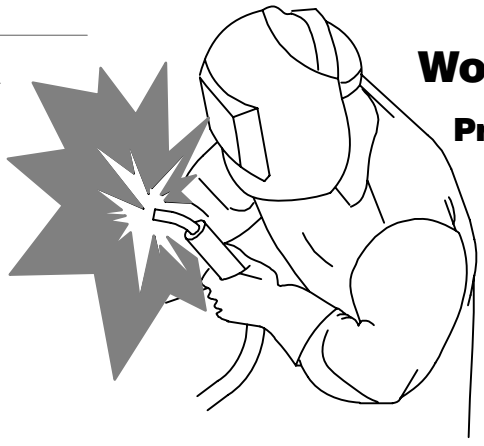
If all measurements passed, continue to the end of the pre-power flowchart (see Section 6-2).

☞ *If any measurements failed, replace PC1.*

6-18. Control/Auxiliary Power Board PC1 – Inverter Control Circuit Test Point Values

Inverter Control	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
Inverter IGBT Gate Drive IC U16	U16 Pin 5	RC9 Pin 4 (+15V)	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U16	U16 Pin 7	RC9 Pin 4 (+15V)	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U16	RC9 Pin 6 (GND)	U16 Pin 5	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U16	RC9 Pin 6 (GND)	U16 Pin 7	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U17	U17 Pin 5	RC9 Pin 4 (+15V)	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U17	U17 Pin 7	RC9 Pin 4 (+15V)	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U17	RC9 Pin 6 (GND)	U17 Pin 5	0.20 - 0.90	N/A
Inverter IGBT Gate Drive IC U17	RC9 Pin 6 (GND)	U17 Pin 7	0.20 - 0.90	N/A
Snubber IGBT Gate Drive IC U13	U13 Pin 5	RC9 Pin 4 (+15V)	0.20 - 0.90	N/A
Snubber IGBT Gate Drive IC U13	U13 Pin 7	RC9 Pin 4 (+15V)	0.20 - 0.90	N/A
Snubber IGBT Gate Drive IC U13	RC9 Pin 6 (GND)	U13 Pin 5	0.20 - 0.90	N/A
Snubber IGBT Gate Drive IC U13	RC9 Pin 6 (GND)	U13 Pin 7	0.20 - 0.90	N/A
D11	D11 Anode	D11 Cathode	0.20 - 0.90	N/A
D20	D20 Anode	D20 Cathode	0.20 - 0.90	N/A

Notes

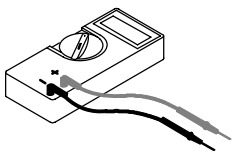


Work like a Pro!

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

6-19. Power Interconnect Board (PC2)

Test Equipment Needed:



Ref. 907 161 / 225 065-A

▲ **Read and follow safety information in Section 6-1 before proceeding.**

▲ **Wear an earth grounded wrist strap when performing pre-power checks. Remove wrist strap before performing any checks or procedures with power applied to the machine.**

1 Power Interconnect Board PC2
2 Resistor R10
3 Resistor R11
4 Resistor R12
5 Resistor R14
6 AC1
7 AC2
8 AC3
9 Q1
10 Q2
11 Diode D1
12 Diode D2
13 Diode D3
14 Diode D4
15 Diode D8
16 Diode D9
17 Diode D10
18 Diode D11
19 Diode D12
20 Diode D13
21 Center Bus
22 –BUS
23 +BUS

☞ *Remove all plugs from PC2 before testing.*

Visually inspect PC2 for damage.

Check all measurements for PC2.

If all measurements passed, continue to the end of the pre-power flowchart (see Section 6-2).

☞ *If any measurements failed, replace PC2.*

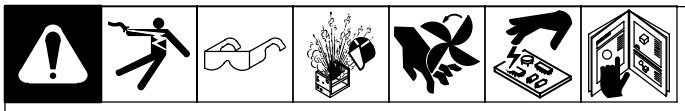
▲ **Pre-power checks are now complete. Remove earth grounded wrist strap before performing any checks or procedures with power applied to the machine.**

6-20. Power Interconnect Board (PC2) Test Point Values

Power Interconnect Board PC2	DVM Positive Lead	DVM Negative Lead	DVM Diode	DVM Ohms
Pre-Charge Resistor R14	R14 Bottom	R14 Top	N/A	200
SCR Gate Resistor R10	R10 Left	R10 Right	N/A	10 - 16.5
SCR Gate Resistor R11	R11 Left	R11 Right	N/A	10 - 16.5
SCR Gate Resistor R12	R12 Left	R12 Right	N/A	10 - 16.5
Pre-Charge Diode D5	AC3	R14 Top	0.20 - 0.90	N/A
Pre-Charge Diode D6	AC2	R14 Top	0.20 - 0.90	N/A
Pre-Charge Diode D7	AC1	R14 Top	0.20 - 0.90	N/A
Boost Gate Protection Diode D12	D12 Anode	D12 Cathode	0.20 - 0.90	N/A
Boost Gate Protection Diode D13	D13 Anode	D13 Cathode	0.20 - 0.90	N/A
Inverter Gate MOSFET Q1	Q1-S (Source)	Q1-D (Drain)	0.20 - 0.90	N/A
Inverter Gate MOSFET Q2	Q2-S (Source)	Q2-D (Drain)	0.20 - 0.90	N/A
Inverter Gate Protection Diode D1	D1 Anode	D1 Cathode	0.20 - 0.90	N/A
Inverter Gate Protection Diode D2	D2 Anode	D2 Cathode	0.20 - 0.90	N/A
Inverter Gate Protection Diode D3	D3 Anode	D3 Cathode	0.20 - 0.90	N/A
Inverter Gate Protection Diode D4	D4 Anode	D4 Cathode	0.20 - 0.90	N/A
Snubber Gate Protection Diode D8	D8 Anode	D8 Cathode	0.20 - 0.90	N/A
Snubber Gate Protection Diode D9	D9 Anode	D9 Cathode	0.20 - 0.90	N/A
Snubber Gate Protection Diode D10	D10 Anode	D10 Cathode	0.20 - 0.90	N/A
Snubber Gate Protection Diode D11	D11 Anode	D11 Cathode	0.20 - 0.90	N/A
Bleeder Resistor R1 (Prior to LF278160) ☞ *Bleeder resistor measurements may require several minutes to complete.*	Center Bus	–BUS	N/A	28k - 32k
Bleeder Resistor R1 (Eff W/LF278161)	Center Bus	–BUS	N/A	37k - 41k
Bleeder Resistor R8 (Prior to LF278160)	+BUS	Center Bus	N/A	28k - 32k
Bleeder Resistor R8 (Eff W/LF278161)	+BUS	Center Bus	N/A	37k - 41k

Notes

6-21. Troubleshooting Table



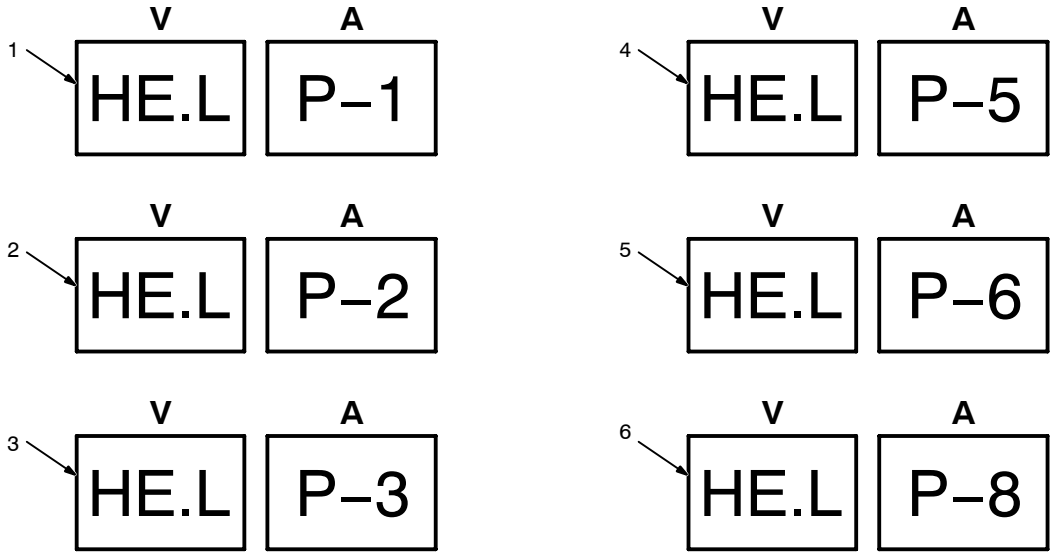
☞ *See Section 6-24 for test points and values and Section 9 for parts location.*

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

Trouble	Remedy
No weld output; unit completely inoperative.	Follow Pre-Power Flowchart, and replace any failed components (see Section 6-2).
	Place line disconnect switch in On position (see Section 3-2 or 3-3).
	Check and replace line fuse(s), if necessary, or reset circuit breaker (see Sections 3-2 and 3-3).
	Check for proper input power connections and check condition of power cord (see Section 3-2 or 3-3).
	Check continuity of Power switch S1 and replace if necessary (see Section 6-8).
	Check control transformer T2 for signs of winding failure. Check continuity across windings, and check for proper connections. Check secondary voltages. Replace T2 if necessary.
	Check control/auxiliary power board PC1 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-25).
	Check power interconnect board PC2 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-27).
	Check front panel/display board PC3 and connections, and replace if necessary (see Section 6-29).
No weld output; meter display On.	Follow Pre-Power Flowchart and replace any failed components (see Section 6-2).
	Unit overheated and HELP 3 or HELP 5 screen is displayed. Allow unit to cool with fan On (see Section 6-22).
	If a remote accessory is connected to remote 14 receptacle RC50: Check accessory contact closure (continuity), and replace accessory if necessary. Check accessory amperage control potentiometer resistance and connections, and replace accessory if necessary.
	Check input and output voltages of hall device HD1 (see Section 6-24). Replace HD1 if necessary.
	Check control/auxiliary power board PC1 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-25).
	Check front panel/display board PC3 and connections, and replace if necessary (see Section 6-29).
Low weld output with no control.	Check input and output voltages of hall device HD1 (see Section 6-24). Replace HD1 if necessary.
	Check control/auxiliary power board PC1 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-25).
	Check front panel/display board PC3 and connections, and replace if necessary (see Section 6-29).
Maximum weld output with no control.	Check input and output voltages of hall device HD1 (see Section 6-24). Replace HD1 if necessary.
	Check control/auxiliary power board PC1 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-25).
	Check front panel/display board PC3 and connections, and replace if necessary (see Section 6-29).
Limited output and low open circuit voltage (OCV).	Check for proper input and output connections
	If a remote accessory is connected to remote 14 receptacle RC50: Check accessory contact closure (continuity), and replace accessory if necessary. Check accessory amperage control potentiometer resistance and connections, and replace accessory if necessary.
	Check input and output voltages of hall device HD1 (see Section 6-24). Replace HD1 if necessary.
	Check control/auxiliary power board PC1 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-25).
	Check front panel/display board PC3 and connections, and replace if necessary (see Section 6-29).
	Check if Low Open Circuit Voltage Stick Mode is enabled (see Section 6-23).

Trouble	Remedy
Erratic or improper weld output.	Use proper size and type of weld cable (see Section 3-4).
	Clean and tighten all weld connections.
	Check for proper input and output connections.
	Replace electrode.
	If a remote accessory is connected to remote 14 receptacle RC50: Check all remote accessory connections (proper pin/socket alignment). Check accessory amperage control potentiometer resistance and connections, and replace if necessary.
	Check input and output voltages of hall device HD1 (see Section 6-24). Replace HD1 if necessary.
	Check control/auxiliary power board PC1 and connections, and replace if necessary (see Pre-Power Checks in Sections 6-13 thru 6-18, and also see Section 6-25).
	Check front panel/display board PC3 and connections, and replace if necessary (see Section 6-29).
Fan motor does not run after approximately four minutes of operation at rated load.	Check and clear blocked fan blade
	Check receptacle wiring and connections. Check thermistors RT-1 and RT-2 (see Section 6-24). ☞ *Fan motor FM1 starts and meters display HELP-2 when RT-1 or RT-2 is disconnected from PC1. When RT-1 or RT-2 is reconnected, the meter displays change but the fan continues to run (see Section 6-22).*
	Check fan motor FM (see Section 6-24) and replace fan motor if necessary.
Wandering arc; poor control of arc direction.	Use proper size tungsten.
	Use properly prepared tungsten.
	Reduce gas flow rate.
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Shield weld zone from drafts.
	Increase postflow time.
	Check and tighten all gas fittings.
	Water in torch. Refer to torch manual.

6-22. Voltmeter/Ammeter Diagnostics



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

1 Help 1 Display

Indicates a malfunction in the primary power circuit caused by an overcurrent condition in the primary IGBT switching circuit. If this display is shown, complete the Pre-Power Flowchart in Section 6-2.

2 Help 2 Display

Indicates a malfunction in the thermal protection circuit. The unit has detected a shorted or open thermistor. If this display is shown, verify thermistors RT-1 and RT-2 are plugged into circuit board PC1 and check thermistor input values on circuit board PC3 (see Section 6-29).

3 Help 3 Display

Indicates the left side of the unit has overheated. The unit has shut down to allow the fan to cool it (see Section 2-3). Operation will continue when the unit has cooled.

4 Help 5 Display

Indicates the right side of the unit has overheated. The unit has shut down to allow the fan to cool it (see Section 2-3). Operation will continue when the unit has cooled.

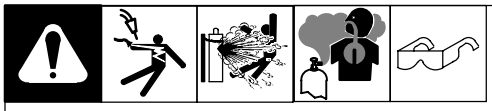
5 Help 6 Display

Indicates operation at maximum input current. The unit has a maximum allowable input current limit. As the line voltage decreases, the required input current increases. If the line voltage is too low, the output power is limited by the input current. When this limit is reached, the unit automatically reduces output power to continue operation. If this display is shown, have a qualified electrician check the input voltage.

6 Help 8 Display

Indicates a malfunction in the secondary power circuit of the unit. The unit has detected a high open circuit voltage condition. If this display is shown, complete the Pre-Power Flowchart in Section 6-2, Check for proper connection of bypass capacitors C6 and C7 (see Figure 8-2). Check operation of control relay CR1 (see Section 6-24).

6-23. Enabling Low Open Circuit Voltage Stick Mode (Optional)



▲ **Disconnect and lockout/tag-out input power before removing cover.**

Follow this procedure to modify the unit for low open circuit voltage (OCV) when Stick welding. OCV is reduced to about 15 volts dc.

1 Front Panel And Display Board PC3

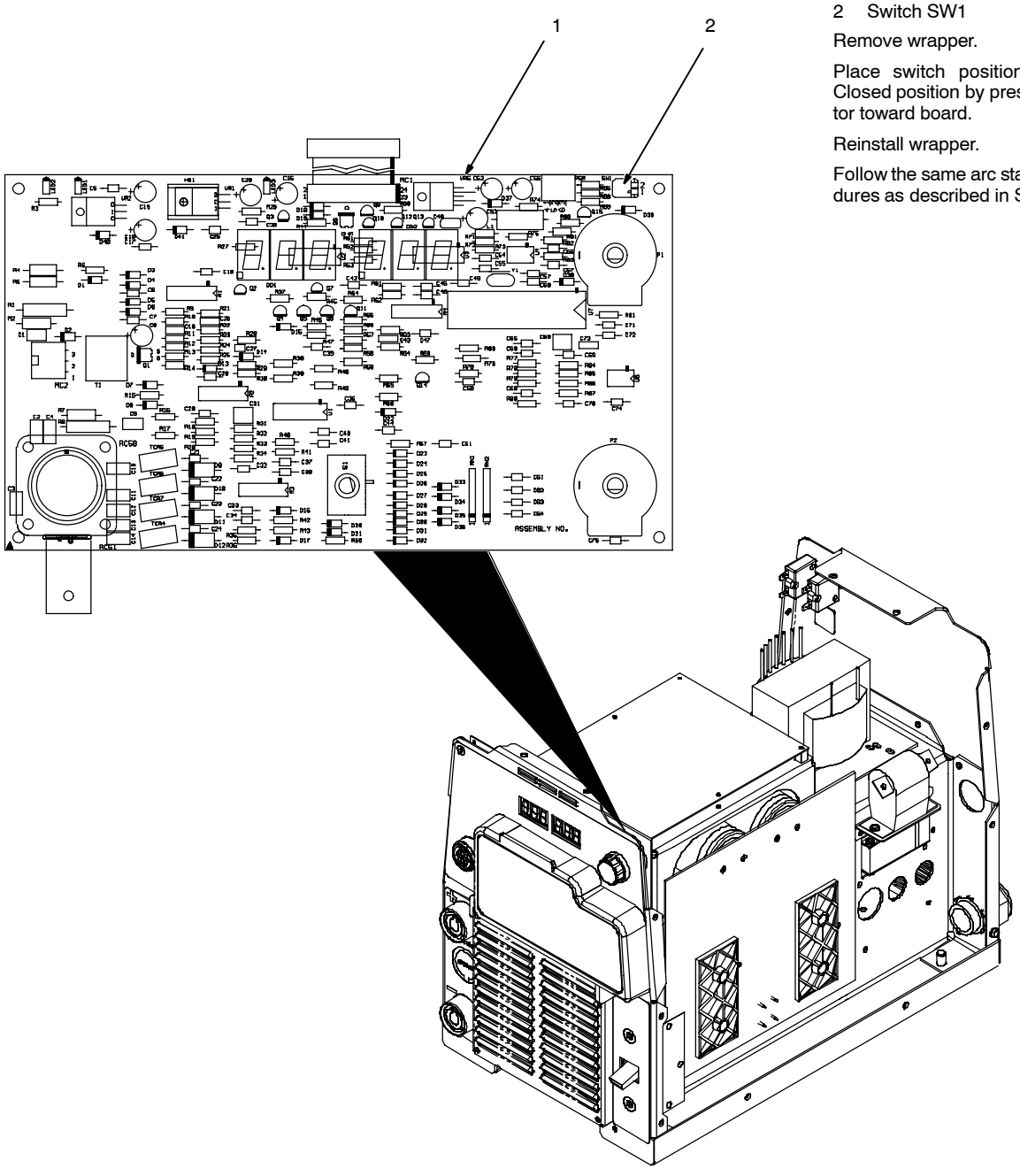
2 Switch SW1

Remove wrapper.

Place switch position 1 in the Closed position by pressing actuator toward board.

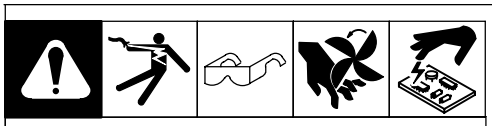
Reinstall wrapper.

Follow the same arc starting procedures as described in Section 4-5.



907 161 / 217 181

6-24. Troubleshooting Circuit Diagram

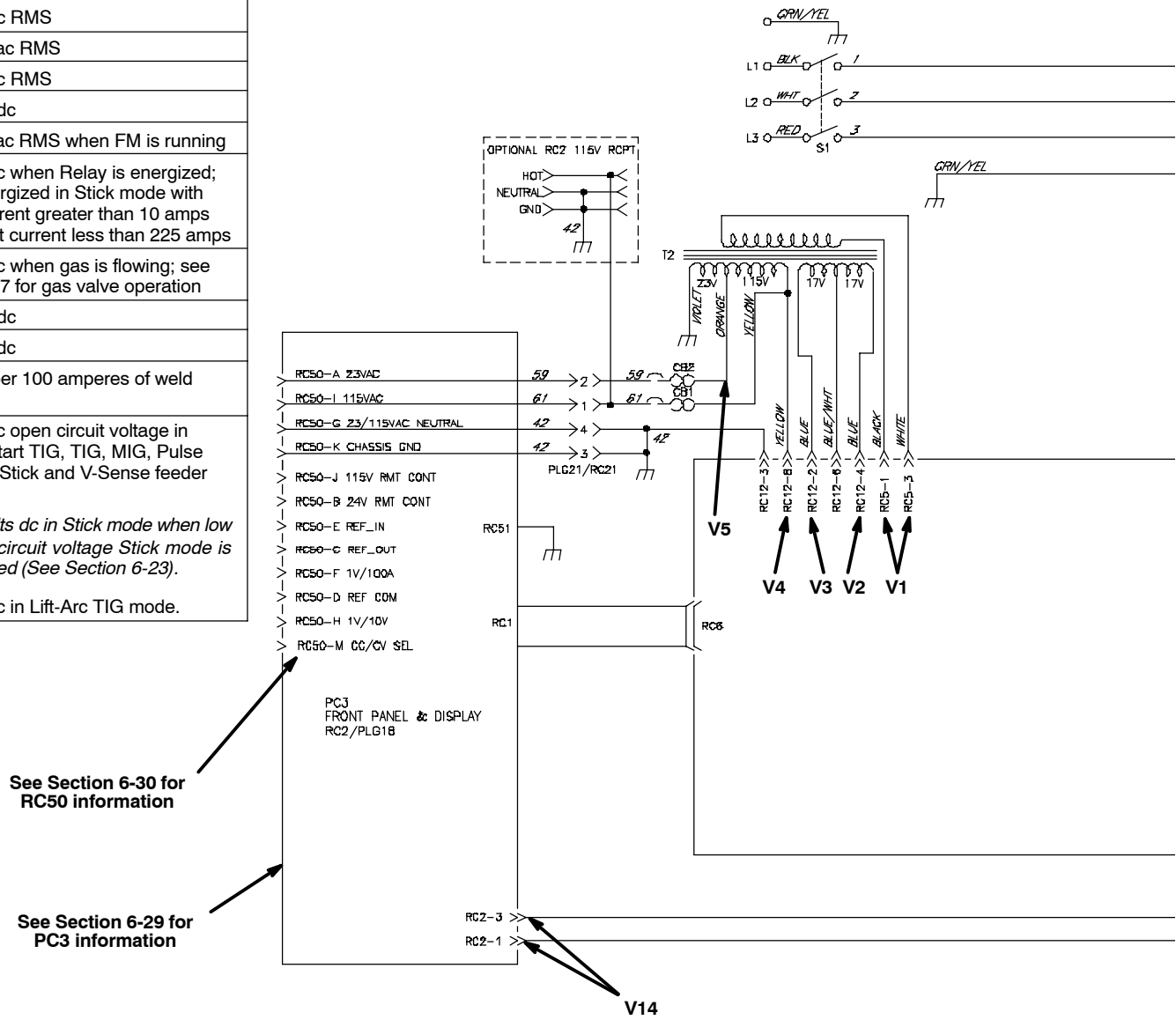


Voltage Readings	
a) Tolerance – ±10% unless specified	
b) Reference – single arrow: reference to circuit common (lead 42); double arrow: reference to points indicated	
c) Wiring Diagram – see Section 8	
V1	665 volts ac RMS
V2, V3	17 volts ac RMS
V4	115 volts ac RMS
V5	24 volts ac RMS
V6, V7	470 volts dc
V8	115 volts ac RMS when FM is running
V9	24 volts dc when Relay is energized; Relay energized in Stick mode with output current greater than 10 amps and preset current less than 225 amps
V10	24 volts dc when gas is flowing; see Section 3-7 for gas valve operation
V11	+15 volts dc
V12	–15 volts dc
V13	1 volt dc per 100 amperes of weld output
V14	72 volts dc open circuit voltage in Scratch Start TIG, TIG, MIG, Pulse MIG, CC, Stick and V-Sense feeder modes. ☞ *14 volts dc in Stick mode when low open circuit voltage Stick mode is enabled (See Section 6-23).* 14 volts dc in Lift-Arc TIG mode.

Resistance Values	
a) Tolerance – ±10% unless specified	
b) Turn Off unit and disconnect input power before checking resistance	
R1 thru R6, R9	Less than 1 ohm
R7 and R8	190 – 210 ohms

▲ **Discharge input capacitors according to Section 6-3, and be sure voltage is near zero before touching any parts.**

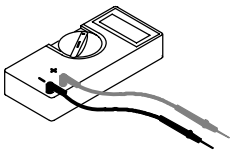
☞ *No calibration available for voltmeter V or ammeter A.*



See Section 6-30 for RC50 information

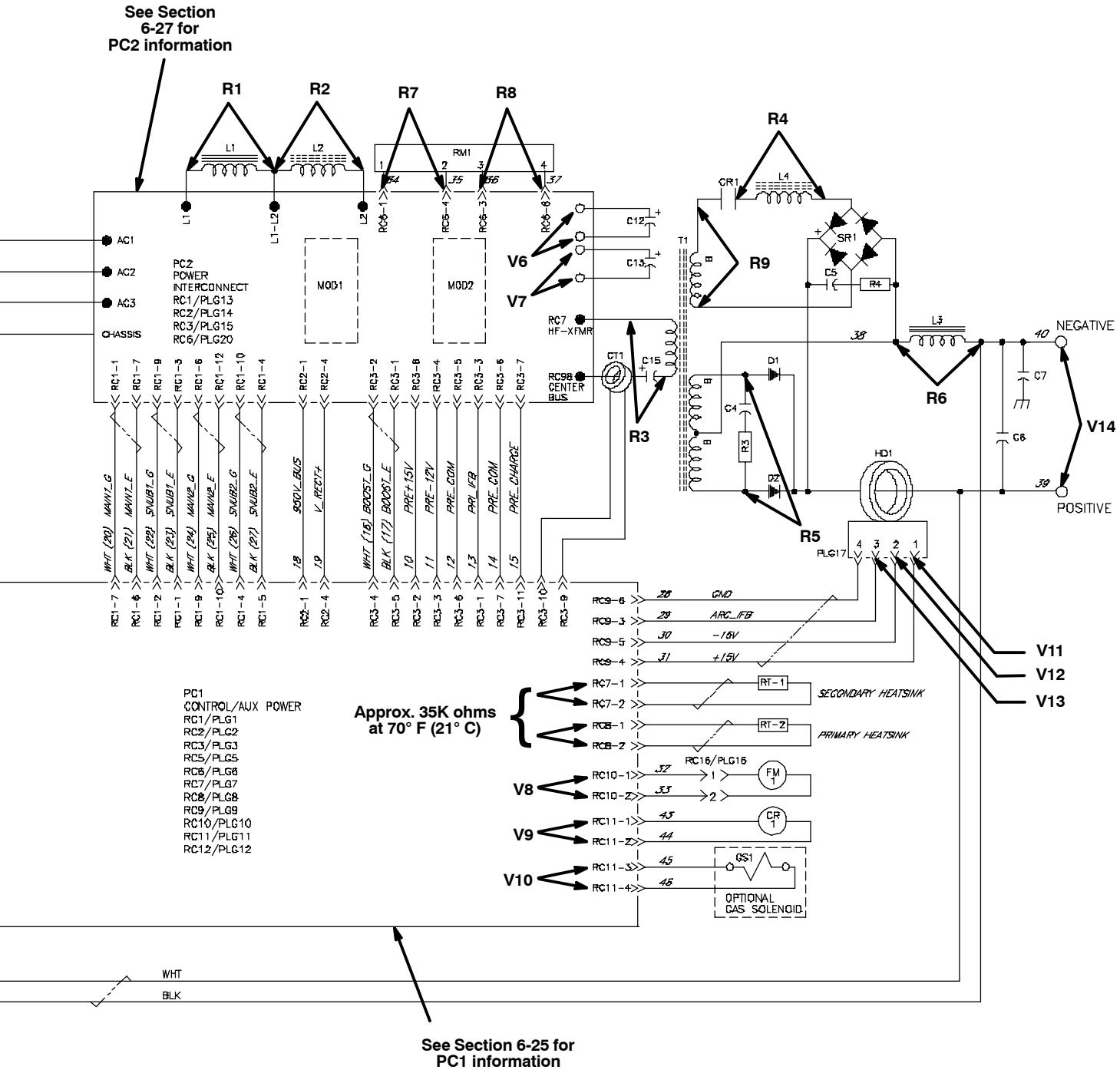
See Section 6-29 for PC3 information

Test Equipment Needed:



▲ **HIGH VOLTAGE: Do not measure without proper instrumentation.**

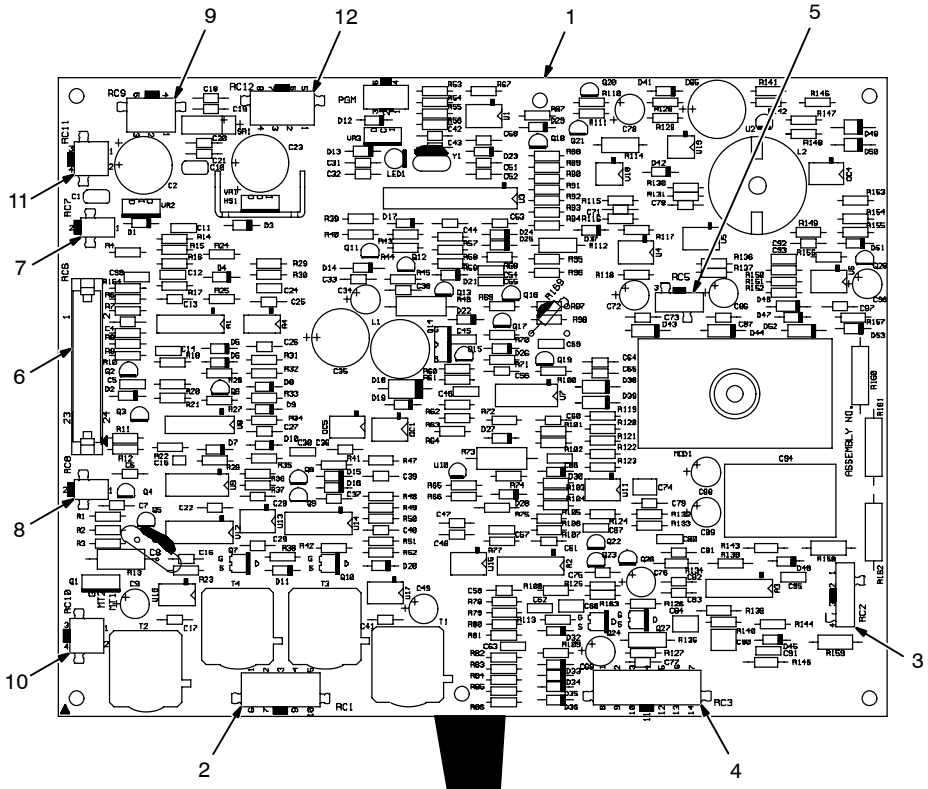
☞ *V1 thru V5 and V8 – use only true RMS meter to obtain correct voltage reading.*

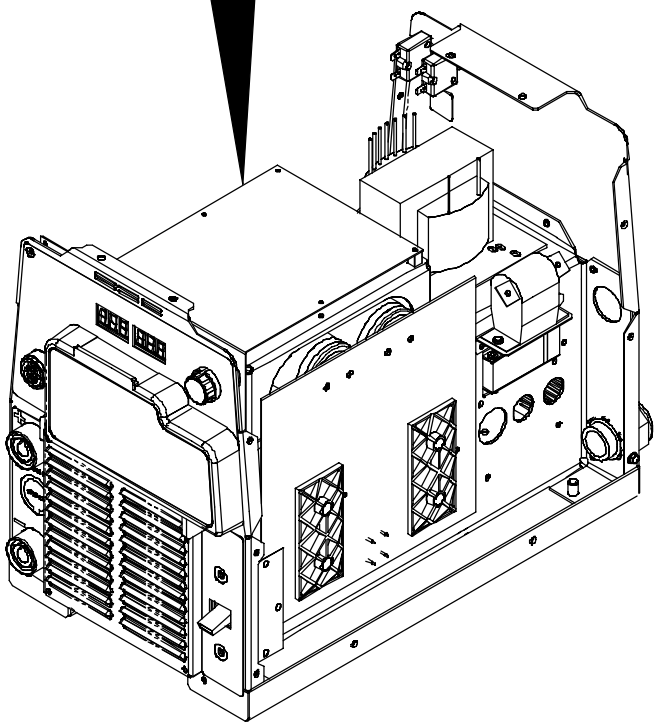


⚠ WARNING	• Do not touch live electrical parts. • Disconnect input power or stop engine before servicing. • Do not operate with covers removed. • Have only qualified persons install, use, or service this unit.
ELECTRIC SHOCK HAZARD	

211 328-E

6-25. Control/Auxiliary Power Board PC1 Testing Information (Use with Section 6-26)



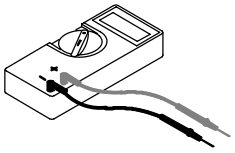


▲ Warning this procedure requires the machine to be electrically live. Significant DC voltage can remain on capacitors after unit is Off.

Be sure plugs are secure before applying power. See Section 6-26 for specific values during testing.

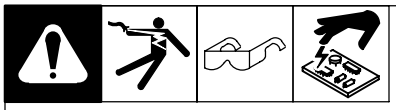
1 Inverter Control Board PC1
2 Receptacle RC1
3 Receptacle RC2
4 Receptacle RC3
5 Receptacle RC5
6 Receptacle RC6
7 Receptacle RC7
8 Receptacle RC8
9 Receptacle RC9
10 Receptacle RC10
11 Receptacle RC11
12 Receptacle RC12

Test Equipment Needed:



Ref. 217 184-F / 907 161

6-26. Control/Auxiliary Power Board PC1 Test Point Values



PC1 Voltage Readings

a) Tolerance – ±10% unless specified

b) Reference – to circuit common (lead 42) unless noted

Receptacle	Pin	Type	Value
RC1	▲ **Do not measure – high voltage present.**		
RC2	▲ **High voltage present. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
	NOTE: All pins on this receptacle are referenced to the primary – Bus		
	1	Input	Primary (+) bus; regulated to 940 volts dc with respect to primary (–) bus.
	2		Not used
	3		Not used
	4	Input	Primary (+) rectifier; rectified primary line volts.
RC3	▲ **High voltage present. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
	NOTE: All pins on this receptacle are referenced to the primary – Bus		
	1	Input	Do not measure – Boost inductor current feedback; 1 volt dc per 16 amps of boost inductor current
	2	Output	+15 volts dc; regulated with respect to primary (–) bus
	3	Output	–12 volts dc; regulated with respect to primary (–) bus
	4	Output	Do not measure – Boost IGBT gate drive signal
	5		Do not measure – Boost IGBT gate drive signal return
	6	Precom	Circuit common referenced to primary (–) bus
	7	Precom	Circuit common referenced to primary (–) bus
	8	Precom	Circuit common referenced to primary (–) bus
	9	Input	Do not measure – HF transformer current sense CT; senses overcurrent in HF transformer primary
	10		Do not measure – HF transformer current sense CT return
	11	Output	Precharge relay coil return; 0 volts dc = relay contacts open, –12 volts dc = relay contacts closed
	12		Not used
	13	Input	Do not measure – Test point, used to test board only
	14	Input	Do not measure – Test point, used to test board only
RC5	▲ **High voltage present. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
	NOTE: All pins on this receptacle are referenced to the primary – Bus		
	1	Output	Control transformer primary; 665 volts ac rms with respect to RC5 pin 3
	2		Not Used
	3	Output	Control transformer primary; 665 volts ac rms with respect to RC5 pin 1

Section 6-26. Control/Auxiliary Power Board PC1 Test Point Values (Continued)

Receptacle	Pin	Type	Value
RC6	1	Input	Output reference; 1 volt dc per 425 amperes of weld output when machine is under load
	2	Input	Voltage feedback; 1 volt dc per 10 volts dc of weld output
	3	Output	Current feedback; 1 volt dc per 100 amperes of weld output
	4		Not Used
	5	Input	Output enable; 0 volts dc = ON, +15 volts dc = OFF
	6		Not Used
	7		Boost relay coil return; +24 volts dc = relay contacts open, 0 volts dc = relay contacts closed
	8		Gas valve coil return; +24 volts dc = valve closed (no gas flow), 0 volts dc = valve open
	9	Input	Fan enable; +5 volts dc = fan on, −15 volts dc = fan off
	10		Not Used
	11	Output	HF transformer over current detect; 0 volts dc = OK, +5 volts dc = OVERCURRENT
	12		Not Used
	13	Input	+5 volts dc reference voltage for thermistors
	14	GND	Circuit common referenced to chassis
	15	Output	Secondary side thermistor return; +2 volts dc at 25°C thermistor temperature
	16	GND	Circuit common referenced to chassis
	17	Output	Primary side thermistor return; +2 volts dc at 25°C thermistor temperature
	18	GND	Circuit common referenced to chassis
	19	Output	Foldback; decreases weld output if input bus voltage drops, 0 volts = OK, +15 volts dc 15Khz pwm squarewave = foldback
	20	GND	Circuit common referenced to chassis
	21	Output	+24 volts dc, unregulated dc voltage with respect to GND
	22	Output	+24 volts dc, unregulated dc voltage with respect to GND
	23	Output	−24 volts dc, unregulated dc voltage with respect to GND
	24	Output	−24 volts dc, unregulated dc voltage with respect to GND
RC7	1	Output	+5 volts dc reference voltage for secondary side thermistor
	2	Input	Secondary side thermistor return; +2 volts dc at 25°C thermistor temperature
RC8	1	Output	+5 volts dc reference voltage for primary side thermistor
	2	Input	Primary side thermistor return; +2 volts dc at 25°C thermistor temperature

Section 6-26. Control/Auxiliary Power Board PC1 Test Point Values (Continued)

RC9	1	Output	Do not measure – Test point, used to test board only
	2	Output	Do not measure – Test point, used to test board only
	3	Input	Do not measure – Weld output current sensor signal
	4	Output	+15 volts dc power to current sensor
	5	Output	–15 volts dc power to current sensor
	6	GND	Weld output current sensor signal common
RC10	1	Output	115 volts ac rms with respect to GND; power feed to fan
	2	Output	Fan power return; measure with respect to RC10–1, 115 volts ac rms = fan on, 0 volts ac rms = fan off
	3	Output	Do not measure – Test point, used to test board only
	4	Output	Do not measure – Test point, used to test board only
RC11	1	Output	+24 volts output to boost relay coil
	2		Boost relay coil return; +24 volts dc = relay contacts open, 0 volts dc = relay contacts closed
	3	Output	+24 volts output to gas valve coil
	4		Gas valve coil return; +24 volts dc = valve closed (no gas flow), 0 volts dc = valve open
RC12	1		Not Used
	2	Input	34 volts ac rms; measure with respect to RC12 pin 4, power supply used to create +24/–24 volts dc
	3	Chassis	Power source chassis; circuit common (GND) on this pin bonded to chassis thru wire
	4	Input	34 volts ac rms; measure with respect to RC12 pin 2, power supply used to create +24/–24 volts dc
	5		Not Used
	6	Input	Center tap of 34 volt ac connected to circuit common (GND) on board
	7		Not Used
	8	Input	115 volts ac rms

Notes

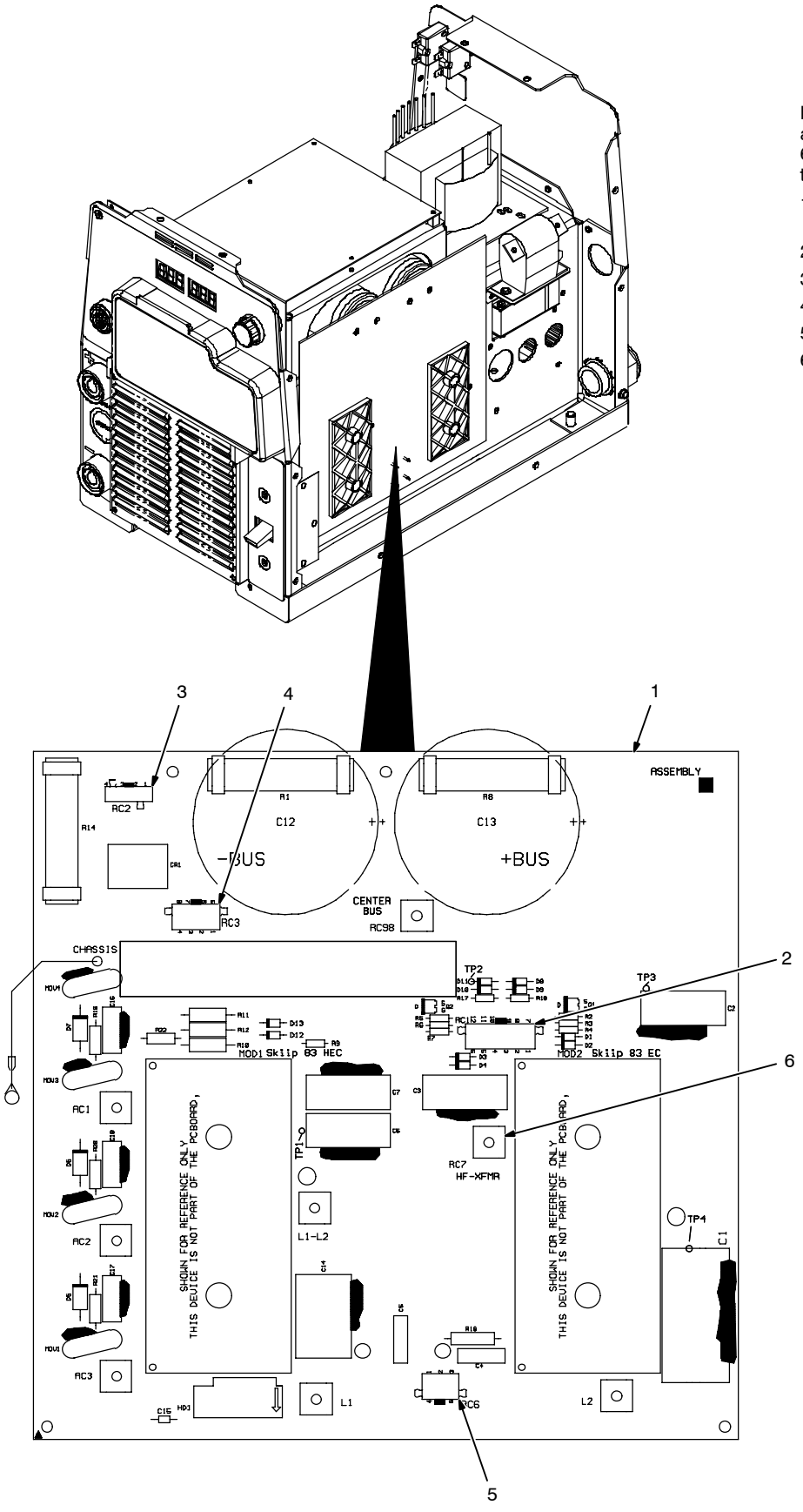
OHM'S LAW

VOLTAGE = CURRENT X RESISTANCE

$$CURRENT = \frac{VOLTAGE}{RESISTANCE}$$

$$RESISTANCE = \frac{VOLTAGE}{CURRENT}$$

6-27. Power Interconnect Board PC2 Testing Information (Use with Section 6-28)

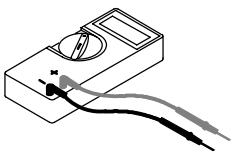


▲ **Warning this procedure requires the machine to be electrically live. Significant DC voltage can remain on capacitors after unit is Off.**

Be sure plugs are secure before applying power. See Section 6-28 for specific values during testing.

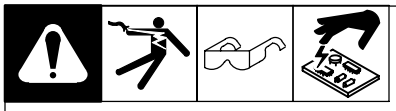
1 Power Interconnect Board PC2
2 Receptacle RC1
3 Receptacle RC2
4 Receptacle RC3
5 Receptacle RC6
6 Receptacle RC7

Test Equipment Needed:



Ref. 225 065-A / 907 161

6-28. Power Interconnect Board PC2 Test Point Values



PC2 Voltage Readings

a) Tolerance – ±10% unless specified

b) Reference – to circuit common (lead 42) unless noted

Receptacle	Pin	Type	Value
RC1	▲ **Do not measure – high voltage present.**		
RC2	▲ **High voltage present. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
	NOTE: All pins on this receptacle are referenced to the primary – Bus		
	1	Output	Primary (+) bus; regulated to 940 volts dc with respect to primary (–) bus
	2		Not Used
	3		Not Used
	4	Output	Primary (+) rectifier; rectified primary line volts
RC3	▲ **High voltage present. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
	NOTE: All pins on this receptacle are referenced to the primary – Bus		
	1		Do not measure – Boost IGBT gate drive signal return
	2	Input	Do not measure – Boost IGBT gate drive signal
	3	Output	Do not measure – Boost inductor current feedback
	4	Input	–12 volts dc; regulated with respect to primary (–) bus, –12 volts dc power to boost inductor current sensor
	5	Precom	Circuit common referenced to primary (–) bus
	6	Precom	Circuit common referenced to primary (–) bus
	7	Input	Precharge relay coil return; 0 volts dc = relay contacts open, –12 volts dc = relay contacts closed
	8	Input	+15 volts dc; regulated with respect to primary (–) bus, +15 volts dc power to boost inductor current sensor
RC6	▲ **High voltage present. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
	NOTE: All pins on this receptacle are referenced to the primary – Bus		
	1		Snubber resistor1; input boost snubber, located in resistor module mounted to primary heat sink
	2		Not Used
	3		Snubber resistor2; inverter snubber, located in resistor module mounted to primary heat sink
	4		Snubber resistor1; input boost snubber, located in resistor module mounted to primary heat sink
	5		Not Used
	6		Snubber resistor2; inverter snubber, located in resistor module mounted to primary heat sink

Section 6-28. Power Interconnect Board PC2 Test Point Values (Continued)

	▲ **High voltage present. The following terminals are used to interconnect the main power circuit with the primary supply, and with power circuit components not soldered in the pcb. Voltages on this receptacle can exceed 900 volts DC from chassis (GND).**		
Receptacle	**Pin**	**Type**	**Value**
AC1		Power	Primary AC mains phase 1; line voltage, measure with respect to AC2 or AC3
AC2		Power	Primary AC mains phase 2; line voltage, measure with respect to AC1 or AC3
AC3		Power	Primary AC mains phase 3; line voltage, measure with respect to AC1 or AC2
L1		Power	Input boost inductor; rectified line voltage, measure with respect to (–) bus
L1-L2		Power	Common point between input boost inductor and boost IGBT snubber inductor
L2		Power	Boost IGBT snubber inductor
HF-XFMR		Power	High frequency weld power transformer primary
C13 (+)		Power	(+) Bus; regulated to 940 volts dc with respect to (–) bus
C12 (–)		Power	(–) Bus; power circuit common
Center Bus		Power	Bus capacitors center point; regulated to 470 volts dc with respect to (–) bus

Notes

MATERIAL THICKNESS REFERENCE CHART

24 Gauge (.025 in)

22 Gauge (.031 in)

20 Gauge (.037 in)

18 Gauge (.050 in)

16 Gauge (.063 in)

14 Gauge (.078 in)

1/8 in (.125 in)

3/16 in (.188 in)

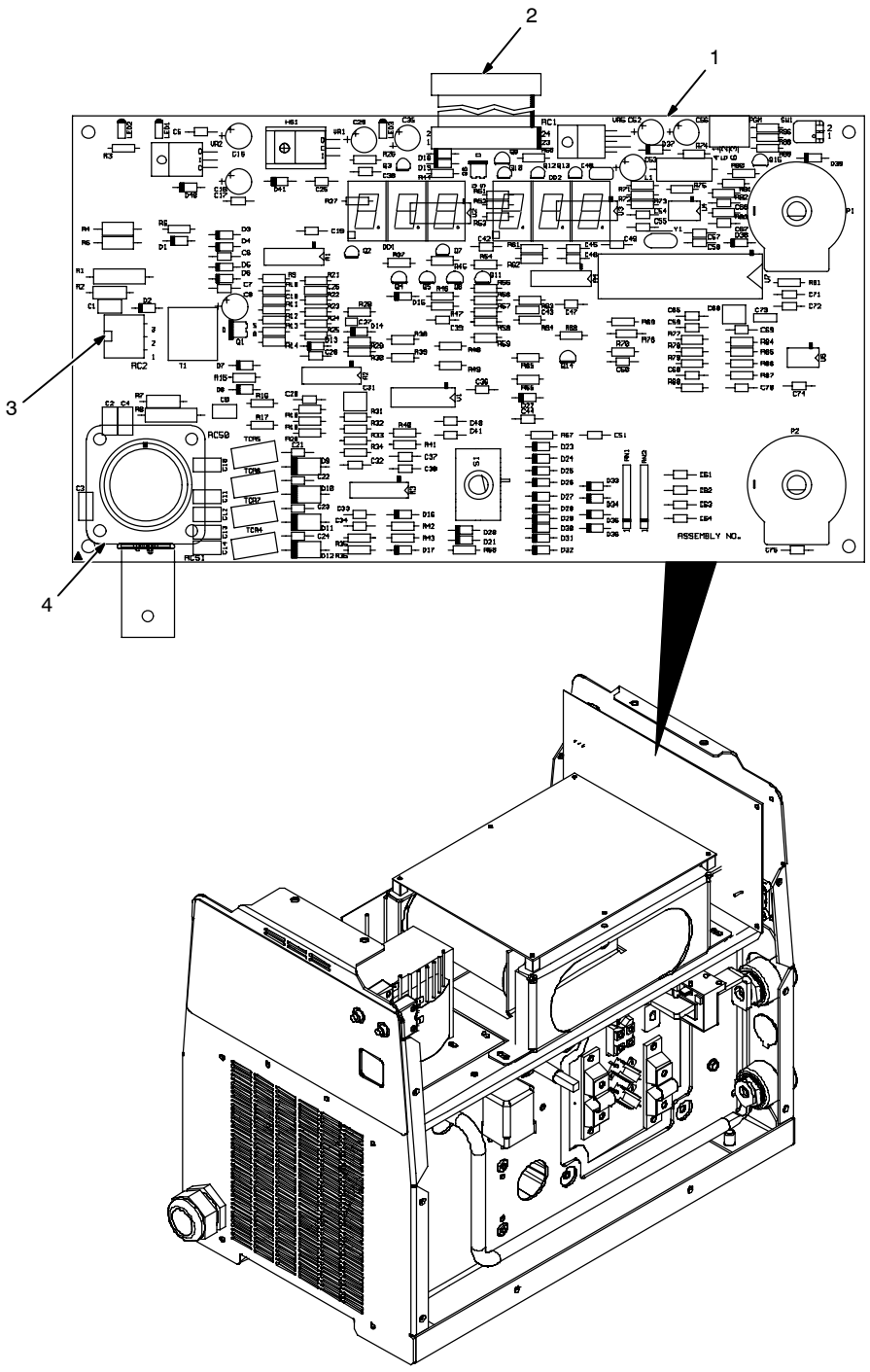
1/4 in (.25 in)

5/16 in (.313 in)

3/8 in (.375 in)

1/2 in (.5 in)

6-29. Front Panel/Display Board PC3 Testing Information (Use with Section 6-30)

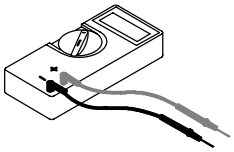


▲ **Warning this procedure requires the machine to be electrically live. Significant DC voltage can remain on capacitors after unit is Off.**

Be sure plugs are secure before applying power. See Section 6-30 for specific values during testing.

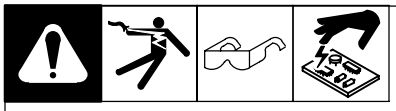
1 Process Control Board PC3
2 Receptacle RC1
3 Receptacle RC2
4 Receptacle RC51

Test Equipment Needed:



Ref. 217 181-B / 907 161

6-30. Front Panel/Display Board PC3 Test Point Values



PC3 Voltage Readings

a) Tolerance – ±10% unless specified

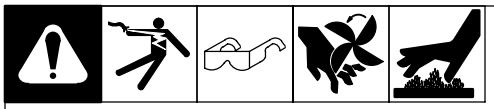
b) Reference – to circuit common (lead 42) unless noted

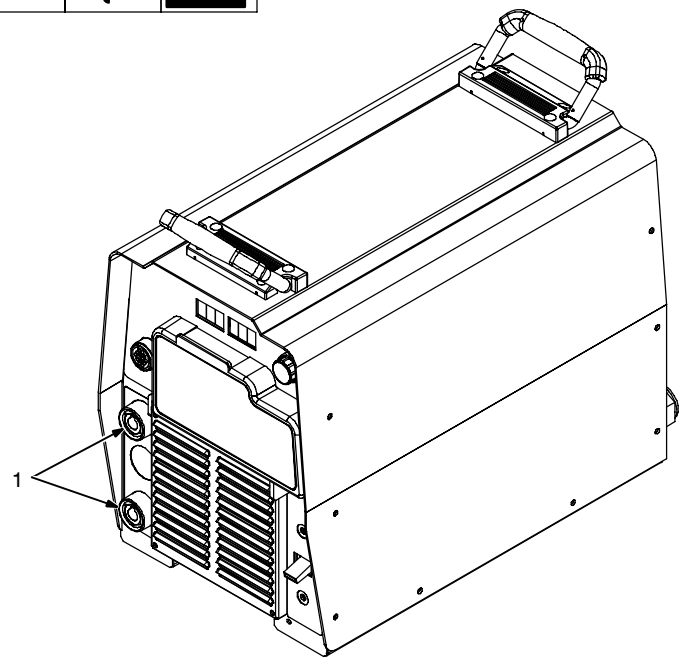
Receptacle	Pin	Type	Value
RC1	1	Output	Output reference; 1 volt dc per 425 amperes of weld output when machine is under load
	2	Output	Voltage feedback; 1 volt dc per 10 volts dc of weld output
	3	Input	Current feedback; 1 volt dc per 100 amperes of weld output
	4		Not Used
	5	Output	Output enable; 0 volts dc = ON, +15 volts dc = OFF
	6		Not Used
	7		Boost relay coil return; +24 volts dc = relay contacts open, 0 volts dc = relay contacts closed
	8		Gas valve coil return; +24 volts dc = valve closed (no gas flow), 0 volts dc = valve open
	9	Output	Fan enable; +5 volts dc = fan on, −15 volts dc = fan off
	10		Not Used
	11	Input	HF transformer over current detect; 0 volts dc = OK, +5 volts dc = OVERCURRENT
	12		Not Used
	13	Output	+5 volts dc reference voltage for thermistors
	14	GND	Circuit common referenced to chassis
	15	Input	Secondary side thermistor return; +2 volts dc at 25°C thermistor temperature
	16	GND	Circuit common referenced to chassis
	17	Input	Primary side thermistor return; +2 volts dc at 25°C thermistor temperature
	18	GND	Circuit common referenced to chassis
	19	Input	Foldback; decreases weld output if input bus voltage drops, 0 volts = OK, +15 volts dc 15Khz pwm squarewave = foldback
	20	GND	Circuit common referenced to chassis
	21	Input	+24 volts dc, unregulated dc voltage with respect to GND, power feed to front panel pcb
	22	Input	+24 volts dc, unregulated dc voltage with respect to GND, power feed to front panel pcb
	23	Input	−24 volts dc, unregulated dc voltage with respect to GND, power feed to front panel pcb
	24	Input	−24 volts dc, unregulated dc voltage with respect to GND, power feed to front panel pcb
RC2	1	Input	Negative weld output terminal; used for output voltage feedback
	2		Not Used
	3	Input	Positive weld output terminal; used for output voltage feedback
RC50	A	Output	23 volts ac RMS at 10 amps; 14−pin remote accessory power
	B	Input	Remote output enable; 0 volts ac = weld output off, 23 volts ac RMS = weld output on
	C	Output	Output signal to remote command reference; 0 to 10 volts dc
	D	GND	Remote command reference signal common
	E	Input	Input signal from remote command; 0 to 10 volts dc
	F	Output	Current feedback; 1 volt dc per 100 amperes of weld output

Section 6-30. Front Panel/Display Board PC3 Test Point Values (Continued)

Receptacle	Pin	Type	Value
RC50	G	GND	14−pin remote accessory power return
	H	Output	Voltage feedback; 1 volt dc per 10 volts dc of weld output
	I	Output	115 volts ac at 2 amps; 14−pin remote accessory power
	J	Input	Remote output enable; 0 volts ac = weld output off, 115 volts ac = weld output on
	K	Chassis	Power source chassis
	L		Not used
	M	Input	Remote process select; 0 volts dc = CC, 15 volts dc = CV
	N		Not used

6-31. Checking Unit Output After Servicing





1 Weld Output Terminals

Check open-circuit voltage between terminals according to Section 6-24 (voltage V-14)

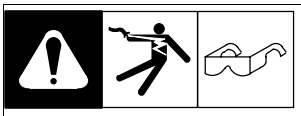
If correct voltage is not present, repeat troubleshooting procedures.

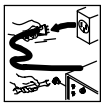
Reinstall cover and side panels if removed.

803 691-C

SECTION 7 – MAINTENANCE

7-1. Routine Maintenance



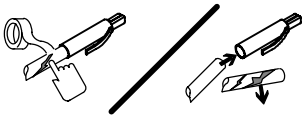


▲ **Disconnect power before maintaining.**

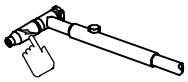
☞ *Maintain more often during severe conditions.*

3 Months

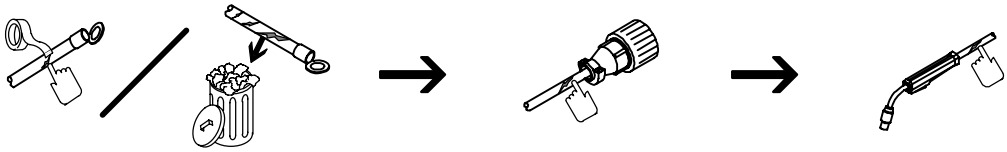
Replace Damaged Or Unreadable Labels



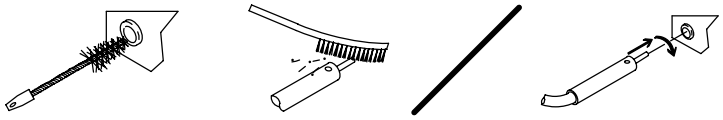
Repair Or Replace Cracked Cables



Replace Cracked Torch Body

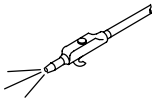


Repair Or Replace Cracked Cables And Cords



Clean And Tighten Weld Connections

6 Months

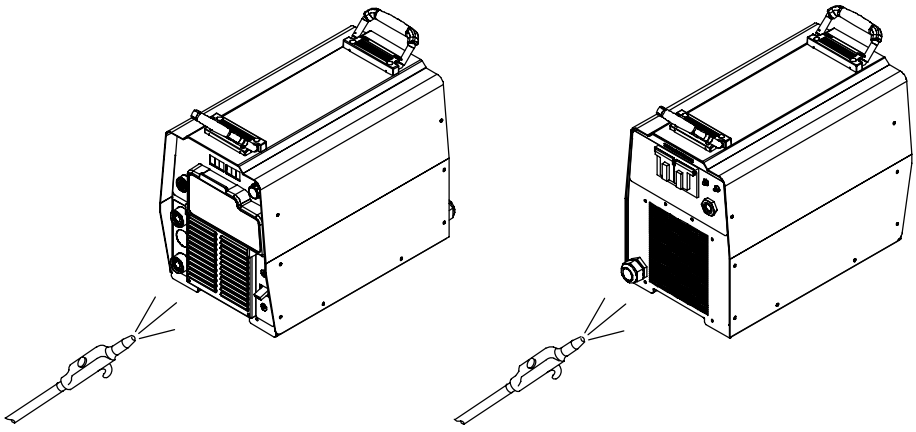


Blow Out Inside

7-2. Blowing Out Inside Of Unit

▲ **Do not remove case when blowing out inside of unit.**

To blow out unit, direct airflow through front and back louvers as shown.



Ref. 803 691-C / 803 692-C

SECTION 8 – 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
EXTREME 360 (208 – 575 Volt Models)	LG250111A and following	211 328-E	220 922-B
Circuit Board PC1 (Control/Auxiliary Power)	LG250111A and following	217 185-F♦♦	
Circuit Board PC2 (Power Interconnect)	LG250111A and following	225 066-A♦♦	
Circuit Board PC3 (Front Panel/Display)	LG250111A and following	217 182-B♦♦	

♦♦ Not included in this manual

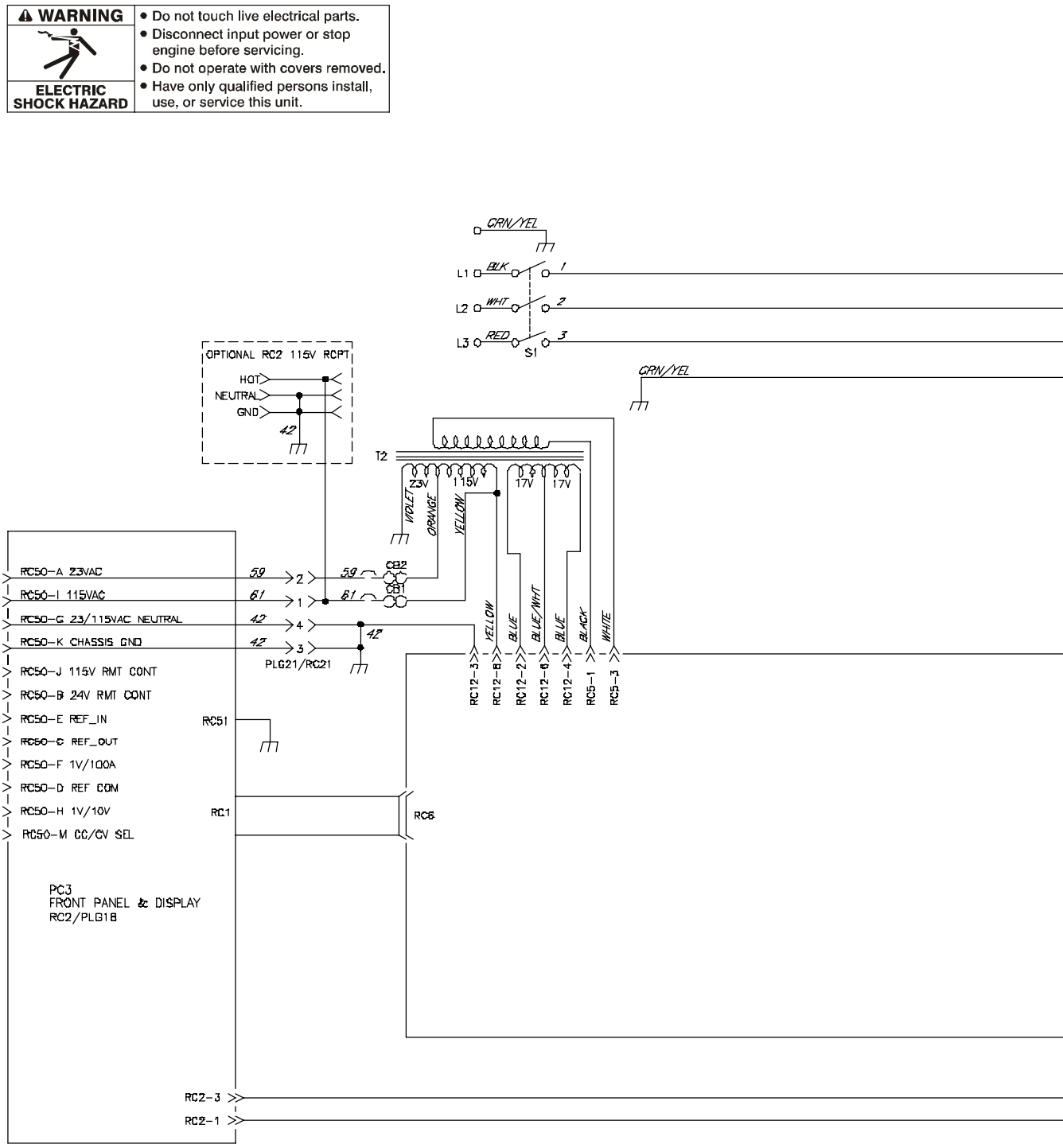
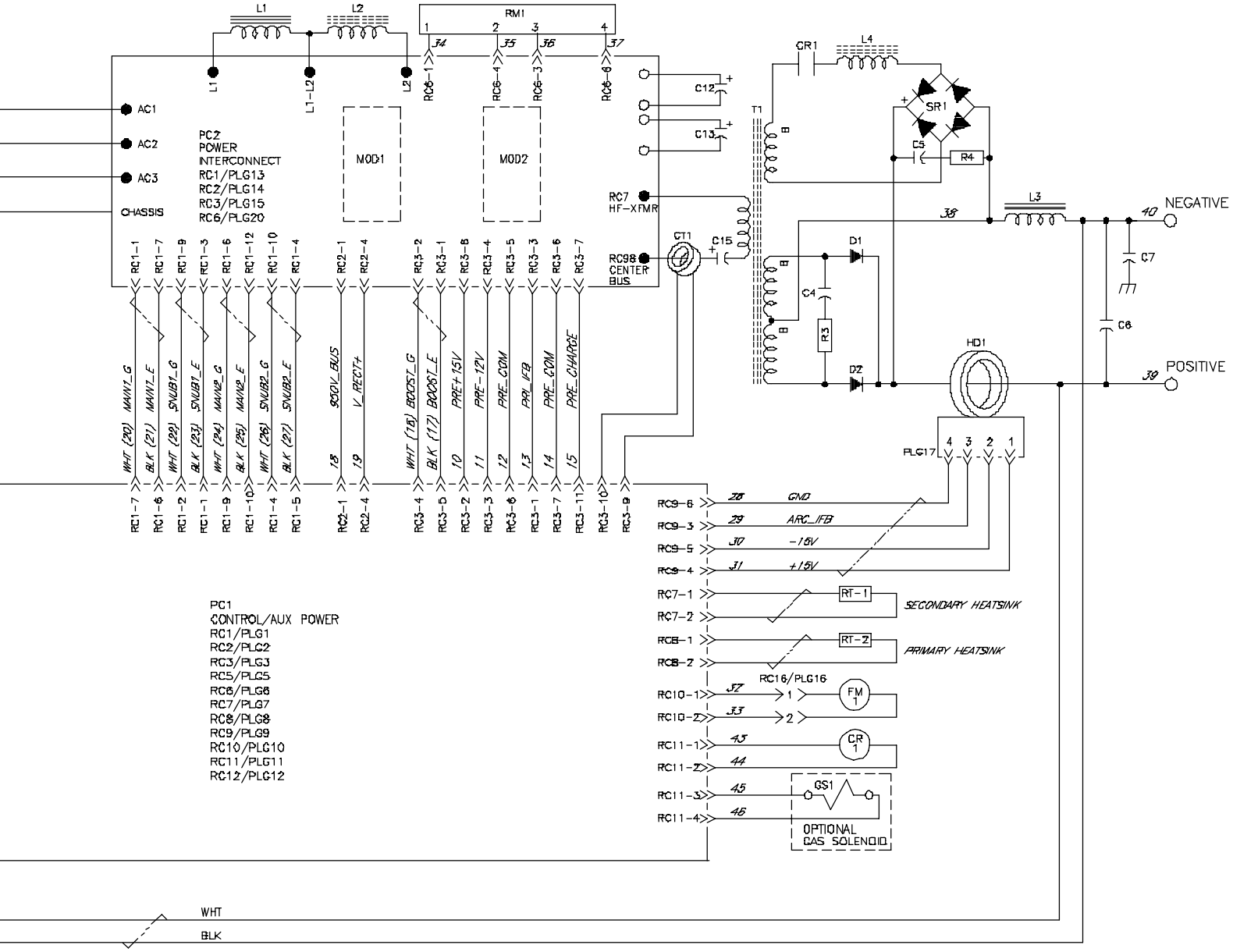


Figure 8-1. Circuit for EXTREME 360 (208 – 575 Volt) Eff. w/LG250111A And Following


L1
L2
RM1
AC1
AC2
AC3
CHASSIS
PC2
POWER
INTERCONNECT
RC1/PLG13
RC2/PLG14
RC3/PLG15
RC6/PLG20
MOD1
MOD2
RC7
HF-XFMR
RC98
CENTER
BUS
CT1
C12
C13
C15
CR1
SR1
C5
R4
T1
D1
D2
C4
R3
L3
C7
C8
NEGATIVE
POSITIVE
HD1
PLG17
PC1
CONTROL/AUX POWER
RC1/PLG1
RC2/PLG2
RC3/PLG3
RC5/PLG5
RC6/PLG6
RC7/PLG7
RC8/PLG8
RC9/PLG9
RC10/PLG10
RC11/PLG11
RC12/PLG12
GND
ARC_IFB
-15V
+15V
RT-1
SECONDARY HEATSINK
RT-2
PRIMARY HEATSINK
RC16/PLG16
FM 1
CR 1
GS1
OPTIONAL
GAS SOLENOID
WHT
BLK

211 328-E

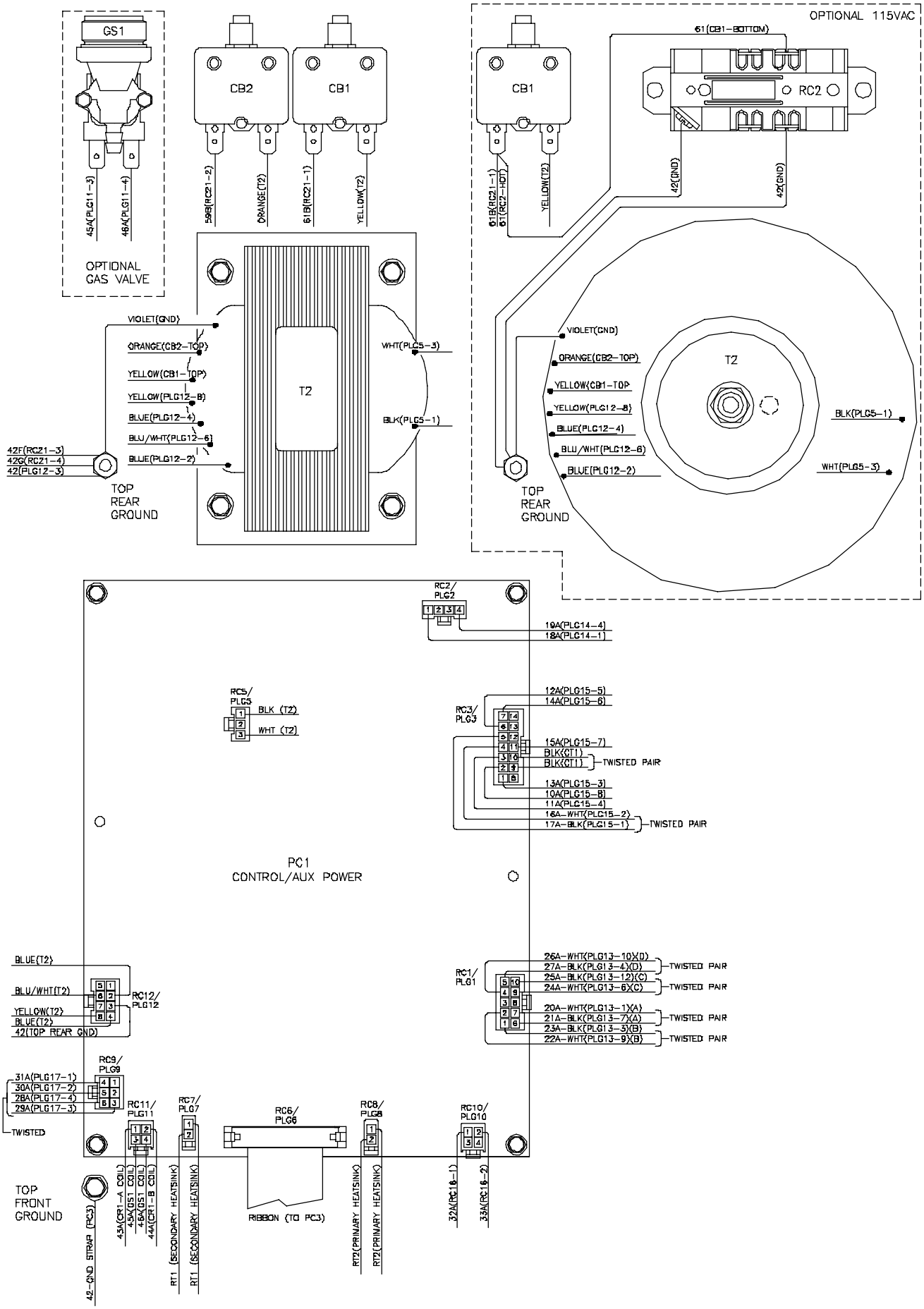
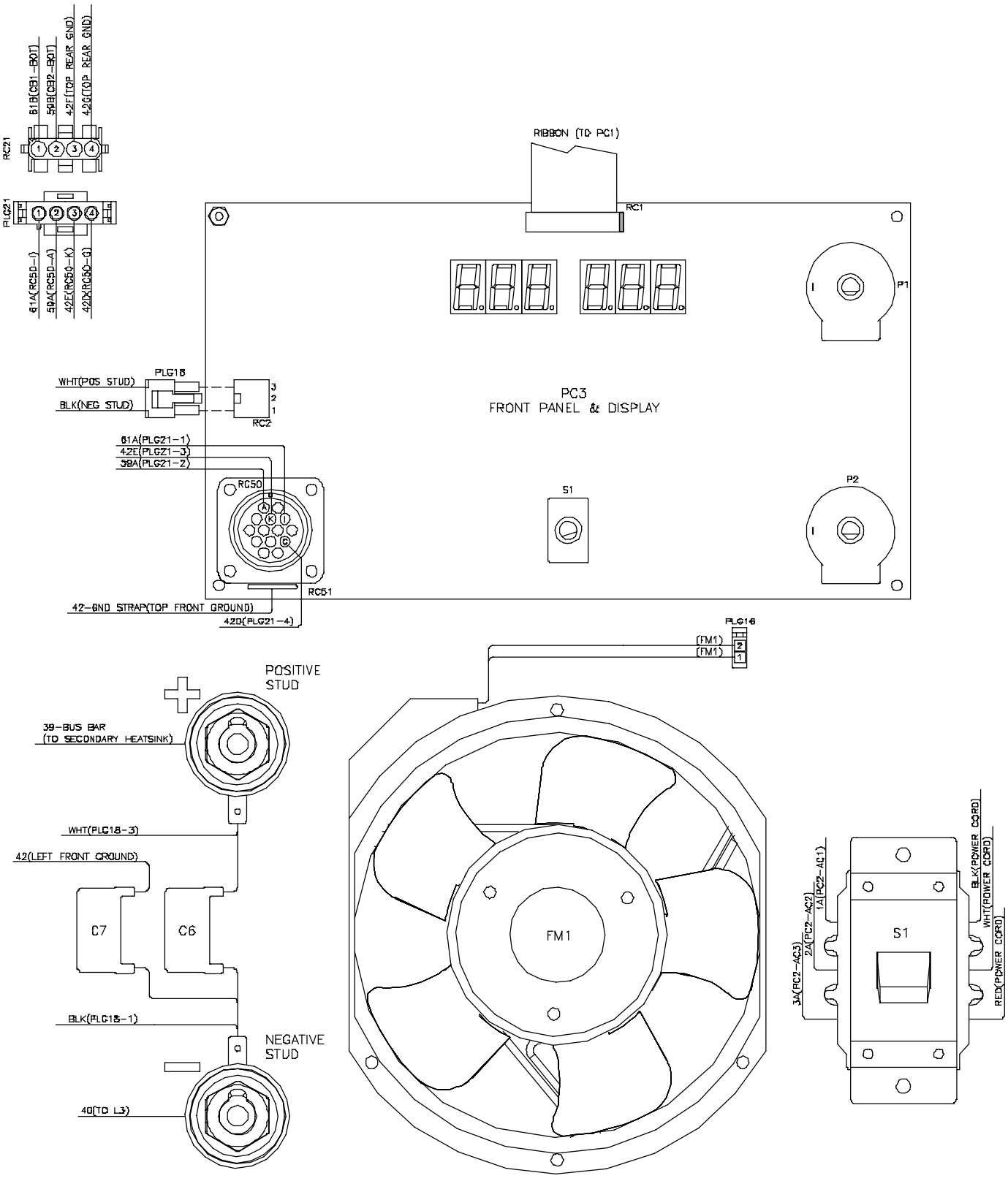


Figure 8-2. Wiring Diagram for EXTREME 360 (208 – 575 Volt) Eff. w/LG250111A And Following (1 of 2)



⚠ 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	

220 922-B

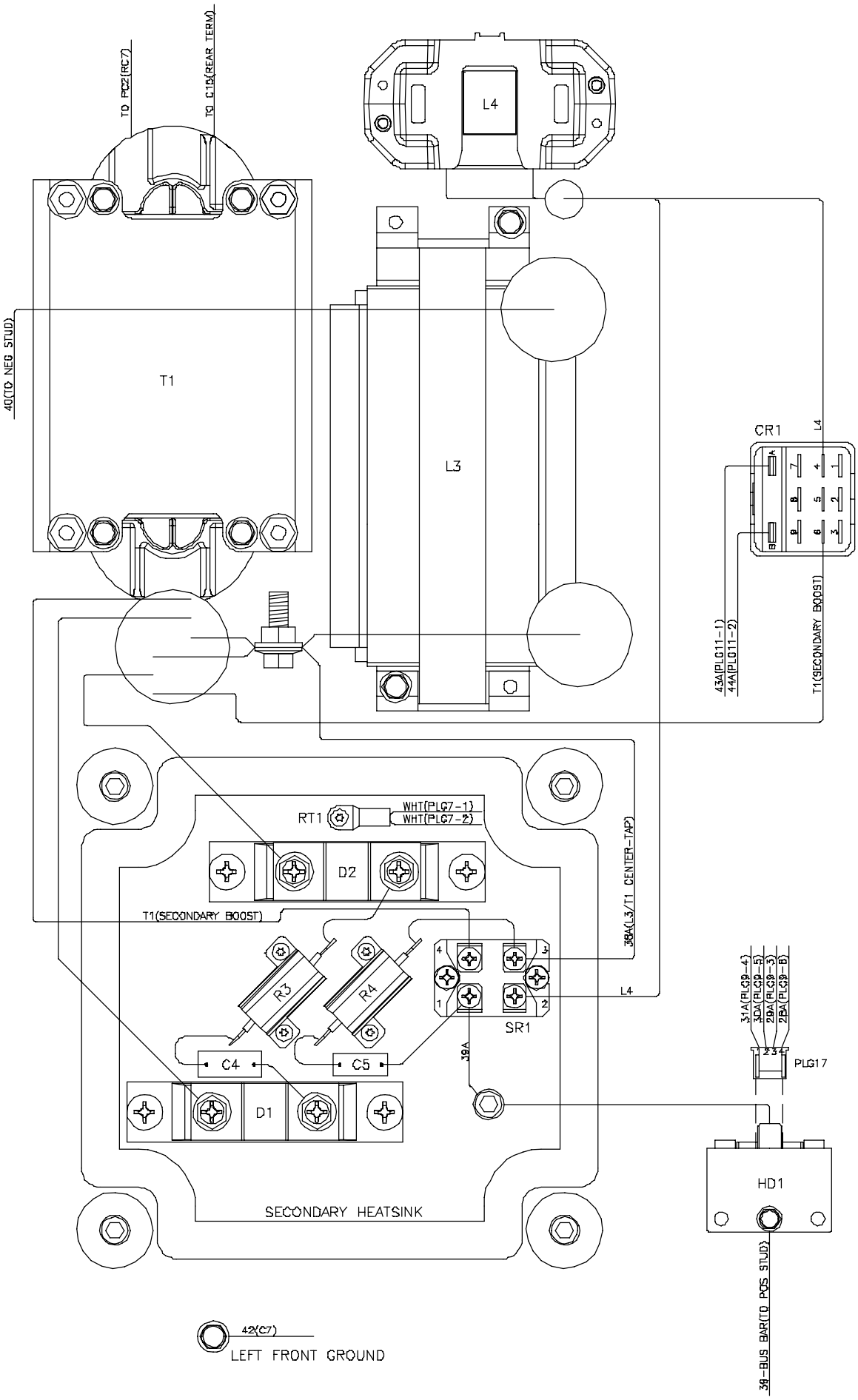
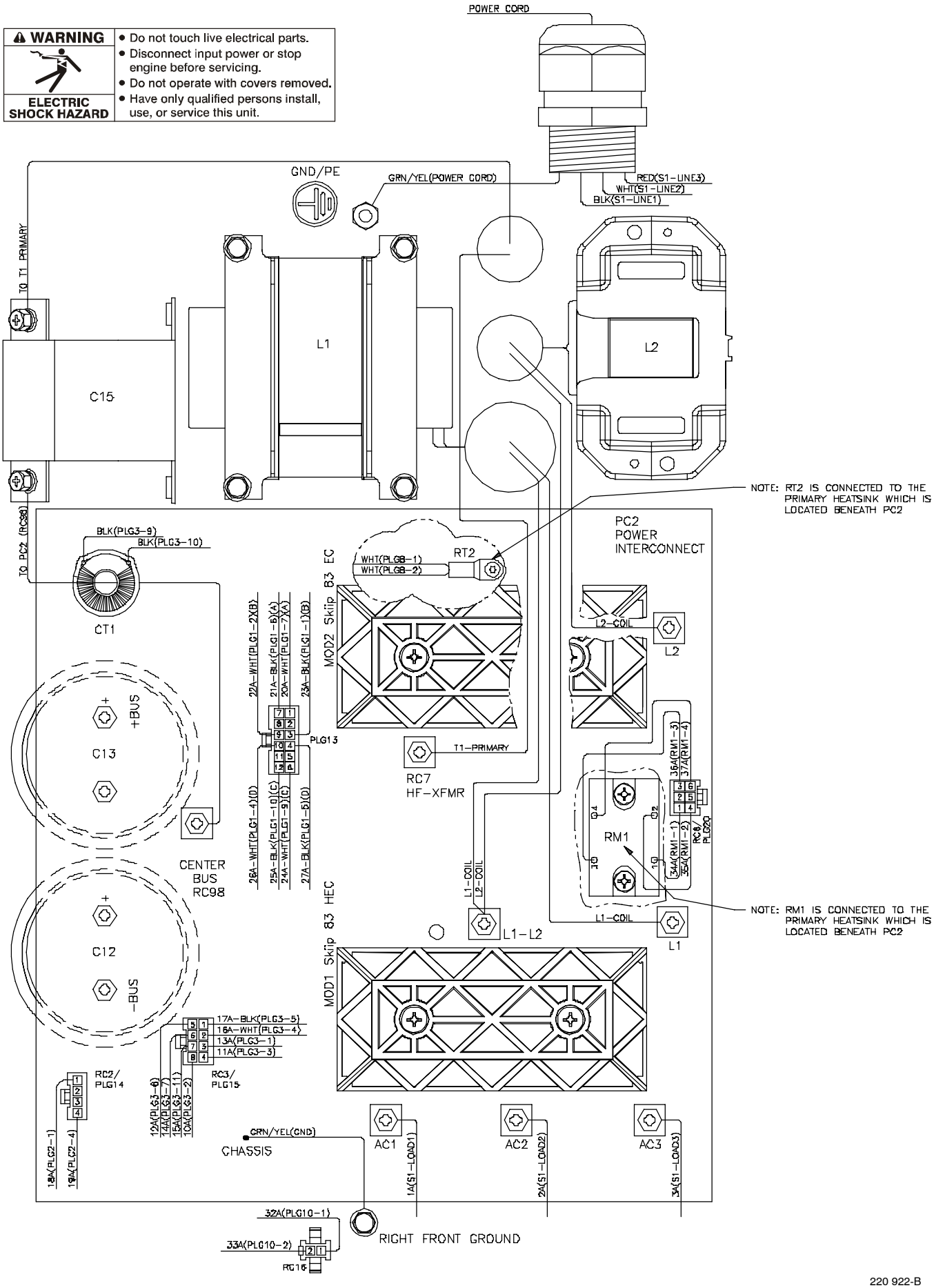


Figure 8-3. Wiring Diagram for EXTREME 360 (208 – 575 Volt) Eff. w/LG250111A And Following (2 of 2)


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.
POWER CORD
GND/PE
GRN/YEL(POWER CORD)
RED(S1-LINE3)
WHT(S1-LINE2)
BLK(S1-LINE1)
TO T1 PRIMARY
L1
L2
C15
TO PC2 (RC98)
BLK(PLG3-9)
BLK(PLG3-10)
CT1
WHT(PLG8-1)
WHT(PLG8-2)
RT2
PC2
POWER
INTERCONNECT
NOTE: RT2 IS CONNECTED TO THE PRIMARY HEATSINK WHICH IS LOCATED BENEATH PC2
MOD2 Skiip 83 EC
L2-COIL
L2
22A-WHT(PLG1-2)(B)
21A-BLK(PLG1-6)(A)
20A-WHT(PLG1-7)(A)
23A-BLK(PLG1-1)(B)
PLG13
T1-PRIMARY
RC7
HF-XFMR
+BUS
C13
CENTER
BUS
RC98
C12
-BUS
28A-WHT(PLG1-4)(D)
25A-BLK(PLG1-10)(C)
24A-WHT(PLG1-9)(C)
27A-BLK(PLG1-5)(D)
36A(RM1-3)
37A(RM1-4)
RM1
34A(RM1-1)
35A(RM1-2)
RC8/
PLG20
L1-COIL
L2-COIL
L1-L2
L1-COIL
L1
NOTE: RM1 IS CONNECTED TO THE PRIMARY HEATSINK WHICH IS LOCATED BENEATH PC2
MOD1 Skiip 83 HEC
17A-BLK(PLG3-5)
16A-WHT(PLG3-4)
13A(PLG3-1)
11A(PLG3-3)
RC2/
PLG14
RC3/
PLG15
12A(PLG3-6)
14A(PLG3-7)
15A(PLG3-11)
10A(PLG3-2)
18A(PLG2-1)
19A(PLG2-4)
GRN/YEL(GND)
CHASSIS
AC1
AC2
AC3
1A(S1-LOAD1)
2A(S1-LOAD2)
3A(S1-LOAD3)
32A(PLG10-1)
33A(PLG10-2)
RC16
RIGHT FRONT GROUND
220 922-B

Notes

Red-D-Arc Welderentals

TM-229 409 2006–12

Eff w/Serial Number LG250111A

Processes

Multiprocess Welding

Description

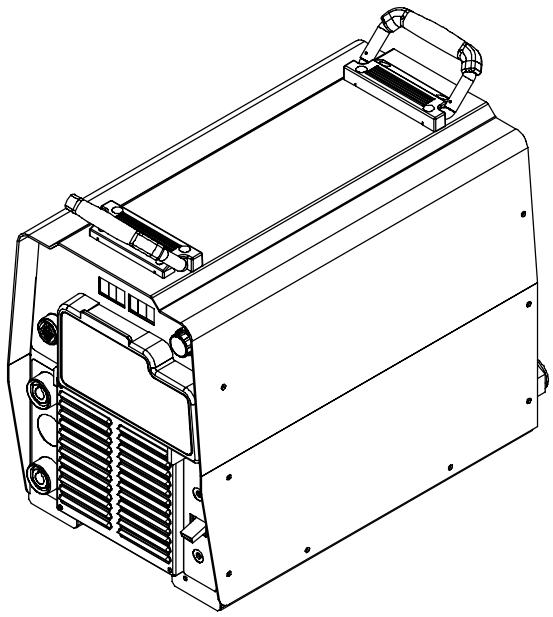
Arc Welding Power Source

EXTREME 360 CC/CV Auto-Line

PARTS LIST

Eff w/LG250111A And Following

For OM-229 409 Revisions A Thru B



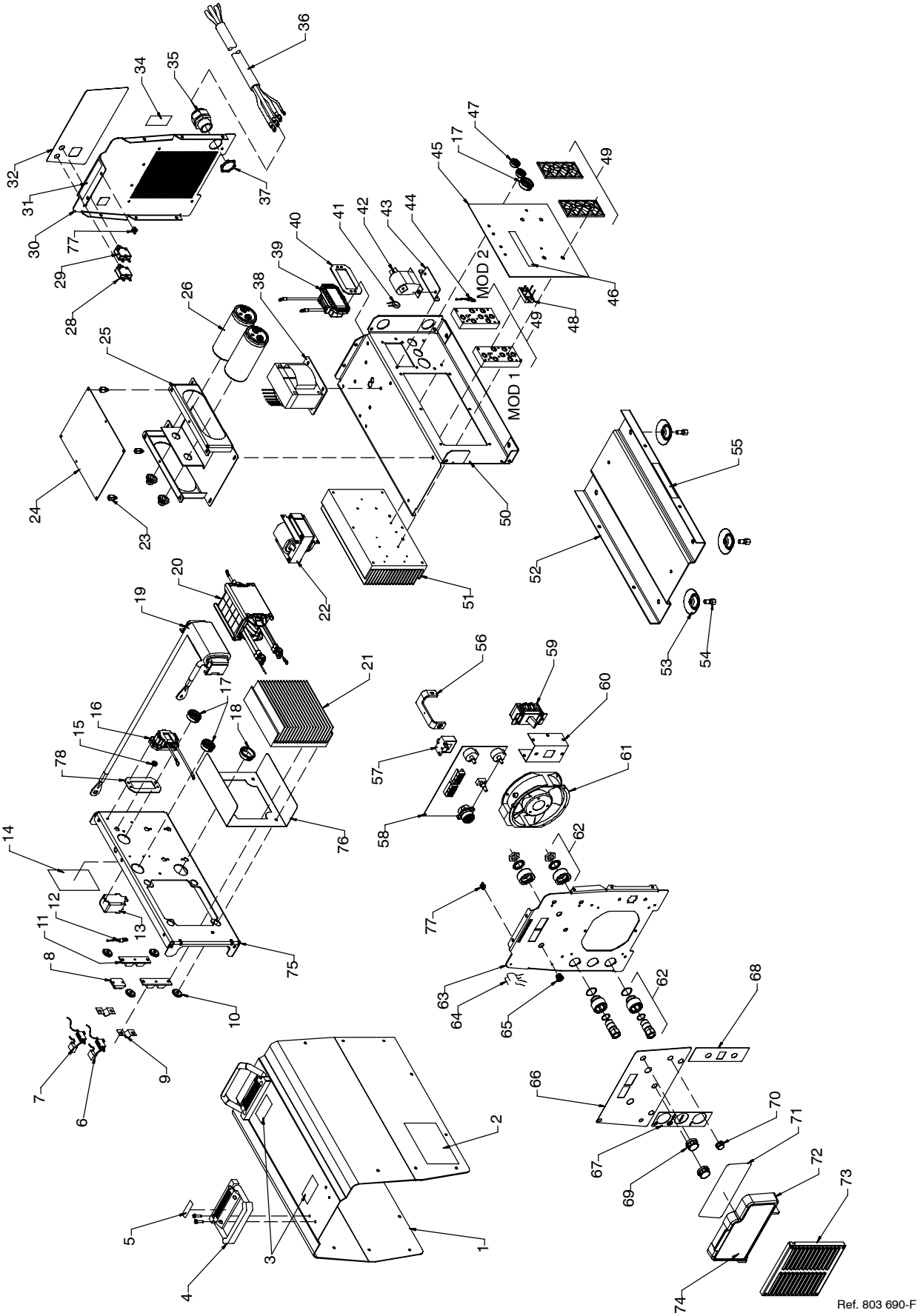


Figure 9-1. Parts Assembly

Eff w/LG250111A And Following

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

Figure 9-1. Parts Assembly

1		229 541	Wrapper (Includes Insulators and Safety Labels)	1
		175 256	Insulator, Side Rh (Not Shown)	1
		178 551	Insulator, Side (Not Shown)	1
2		134 327	Label, Warning General Precautionary Static & Wire Feed	1
3		138 442	Label, Caution Falling Equip Can Cause Injury	2
4		195 585	Handle, Rubberized Carrying	2
5		135 483	Label, Important Remove These Two Handle Screws	2
6	R3/C4	196 518	Resistor/Capacitor	1
7	R4/C5	196 510	Resistor/Capacitor	1
8	SR1	201 530	Kit, Diode Fast Recovery Bridge	1
9		199 840	Bus Bar, Diode	2
10		196 355	Insulator, Screw	4
11		201 531	Kit, Diode Power Module	2
12	RT1	199 798	Thermistor, NTC 30K Ohm @ 25 Deg C 18In Lead	1
13	CR1	198 549	Relay, Encl 24VDC Spst 35a/300VAC 4pin Flange Mtg	1
14		227 127	Label, Warning Electric Shock/Exploding Parts	1
15		010 546	Bushing, Snap-In Nyl .375 Id X .500 Mtg Hole	1
16	L4	218 020	Inductor, Boost	1
17		179 276	Bushing, Snap-In Nyl 1.000 Id X 1.375 Mtg Hole Cent	3
18		170 647	Bushing, Snap-In Nyl 1.312 Id X 1.500 Mtg Hole	1
19	L3	212 150	Inductor, Output	1
20	T1	212 132	XFMR, HF Litz/Litz W/Boost	1
21		212 197	Heat Sink, Lh Rect	1
22	L1	212 091	Inductor, Input	1
23		083 147	Grommet, Scr No 8/10 Panel Hole .312 Sq .500 High	4
24	PC1	218 007	Circuit Card Assy, Control/Aux Power W/Program	1
		216 113	Stand-Off Support, PC Card .187 Dia W/P&I .375	2
	PLG1	115 091	Housing Plug+Pins (Service Kit) RC1	1
	PLG2	201 665	Housing Plug+Pins (Service Kit) RC2	1
	PLG3	131 056	Housing Plug+Pins (Service Kit) RC3	1
	PLG5	131 204	Housing Plug+Pins (Service Kit) RC5	1
	PLG7	131 054	Housing Plug+Pins (Service Kit) RC7	1
	PLG8	131 054	Housing Plug+Pins (Service Kit) RC8	1
	PLG9	115 093	Housing Plug+Pins (Service Kit) RC9	1
	PLG10	115 094	Housing Plug+Pins (Service Kit) RC10	1
	PLG11	115 094	Housing Plug+Pins (Service Kit) RC11	1
	PLG12	115 092	Housing Plug+Pins (Service Kit) RC12	1
25		212 072	Bracket, Mtg Capacitor/Pc Board	1
26	C12,13	219 930	Kit, Capacitor Elctlt Replacement (Includes)	1
		193 738	. Capacitor, Elctlt 1800 Uf 500 VDC Can 2.52 Dia	2
		217 040	. Nut, Nylon M12 Thread Capacitor Mounting	2
28	CB2	083 432	Circuit Breaker, Man Reset 1P 10A 250VAC Frict	1
29	CB1	089 807	Circuit Breaker, Man Reset 1P 2.5A 250VAC Frict	1
30		+212 071	Panel, Rear Standard	1
31		126 026	Label, Warning Electric Shock Can Kill Significant	1
32			Nameplate, Rear (Order by Model and Serial Number)	1
34		217 480	Label, Warning Incorrect Connections	1
35		215 980	Bushing, Strain Relief .709/.984 Id X1.375 Mtg Hole	1
36		219 487	Cable, Power 12 Ft 8Ga 4C (Non-Stripped End)	1
37		182 445	Nut, Conduit 1.000 Npt Pld 1.730 Od X .200 Thk	1
38	T2	211 109	XFMR, Control 665V 336Va Syn Aux Pwr	1
39	L2	218 018	Inductor, Pre-Regulator	1
40		218 566	Gasket, Inductor Mounting	1
41	CT1	196 231	XMFR, Current Sensing 200/1	1
42	C15	196 143	Capacitor, Polyp Met Film 16. Uf 400 VAC 10%	1
43		216 117	Bracket, Mtg Capacitor Series	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 9-1. Parts Assembly (Continued)	
44	RT2	199 798	Thermistor, Ntc 30K Ohm @ 25 Deg C 18in Lead	1
45	PC2	225 442	Circuit Card Assy, Interconnect W/Label & Clips (Includes)	1
46		126 026	Label, Warning Electric Shock Can Kill Significant	1
		223 343	Clip, Wire Stdf .40–.50 Bndl .156Hole .031–.078Thk	2
	PLG13	130 203	Housing Plug+Pins (Service Kit) RC1	1
	PLG14	201 665	Housing Plug+Pins (Service Kit) RC2	1
	PLG15	115 092	Housing Plug+Pins (Service Kit) RC3	1
	PLG20	115 093	Housing Plug+Pins (Service Kit) RC6	1
47		153 403	Bushing, Snap-In Nyl .750 Id X 1.000 Mtg Hole Cent	2
48	RM1	205 751	Module, Power Resistor W/Plug	1
49		217 625	Kit, Input/Pre-Regulator And Inverter Module (Includes)	1
			MOD 1, SKiip 83 HEC	1
			MOD 2, SKiip 83 EC	1
50		212 206	Windtunnel, Rh	1
51		196 330	Heat Sink, Power Module	1
52		+175 132	Base	1
53		173 693	Foot, Mtg Unit	4
54		176 736	Screw, Mtg Foot	4
55		153 178	Label, Warning Exploding Parts Can Serious Injury	1
56		212 074	Bus Bar, Output	1
57	HD1	182 918	Transducer, Current 400A Module Supply V +/– 15V	1
58	PC3	218 008	Circuit Card Assy, Front Panel & Display W/Program	1
	PLG18	131 204	Housing Plug+Pins (Service Kit) RC2	1
	RC50	210 233	Rcpt, W/Pins	1
	PLG21	212 088	Plug, W/Leads	1
	RC21	167 640	Housing Plug+Pins (Service Kit)	1
59	S1	128 756	Switch, Tgl 3Pst 40A 600VAC Scr Term Wide Tgl	1
60		176 226	Insulator, Switch Power	1
61	FM1	196 313	Fan, Muffin 115V 50/60Hz 3000 Rpm 6.378 Mtg Holes	1
	PLG16	131 054	Housing Plug+Pins (Service Kit)	1
	RC16	135 635	Housing Plug+Pins (Service Kit)	1
62		218 183	Rcpt Assy, Tw Lk Insul Fem (Tweco Type) (Fac-op) (Includes)	2
		209 473	Receptacle, Twist Lock Tweco Style (Female) Power	1
		185 712	Insulator, Bulkhead Front	1
		185 713	Insulator, Bulkhead Rear	1
		185 714	Washer, Tooth 22Mmid X 31.5Mmod 1.310-1Mmt Intern	1
		185 717	Nut, M20-1.5 1.00Hex .19H Brs Locking	1
		185 718	O-Ring, 0.989 Id X 0.070 H	1
		186 228	O-Ring, 0.739 Id X 0.070 H	1
63		212 070	Panel, Front Standard	1
64	C6,7	214 749	Capacitor Assy	1
65		216 112	Fastener, Panel Receptacle Quick Access	2
66			Nameplate (Order by Model and Serial Number)	1
67			Nameplate, Connection (Order by Model and Serial Number)	1
68			Nameplate, Power (Order by Model and Serial Number)	1
69		174 991	Knob, Pointer 1.250 Dia X .250 Id W/Spring Clip–.21	2
70		174 992	Knob, Pointer .840 Dia X .250 Id W/Spring Clip–.21	1
71		212 949	Label, Process	1
72		218 041	Door, W/Quick Access Ball Fasteners	1
73		175 138	Box, Louver	1
74			Label, (Order by Model and Serial Number)	1
75		+212 207	Windtunnel, Lh	1
76		211 503	Insulator, Heat Sink	1
77		207 152	Nut, 010–32 U-Nut Multi-Thread	4
78		227 746	Gasket, Inductor Mounting	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Notes

MATERIAL THICKNESS REFERENCE CHART

24 Gauge (.025 in)

22 Gauge (.031 in)

20 Gauge (.037 in)

18 Gauge (.050 in)

16 Gauge (.063 in)

14 Gauge (.078 in)

1/8 in (.125 in)

3/16 in (.188 in)

1/4 in (.25 in)

5/16 in (.313 in)

3/8 in (.375 in)

1/2 in (.5 in)

Owner's Record

Please complete and retain with your personal records.

Model Name Serial/Style Number

Purchase Date (Date which equipment was delivered to original customer.)

Distributor

Address

City

State Zip

Red-D-Arc Welderentals®

www.red-d-arc.com

Contact the Delivering Carrier to:

File a claim for loss or damage during shipment.

For assistance in filing or settling claims, contact your distributor and/or equipment manufacturer's Transportation Department.

PRINTED IN USA 2006–01