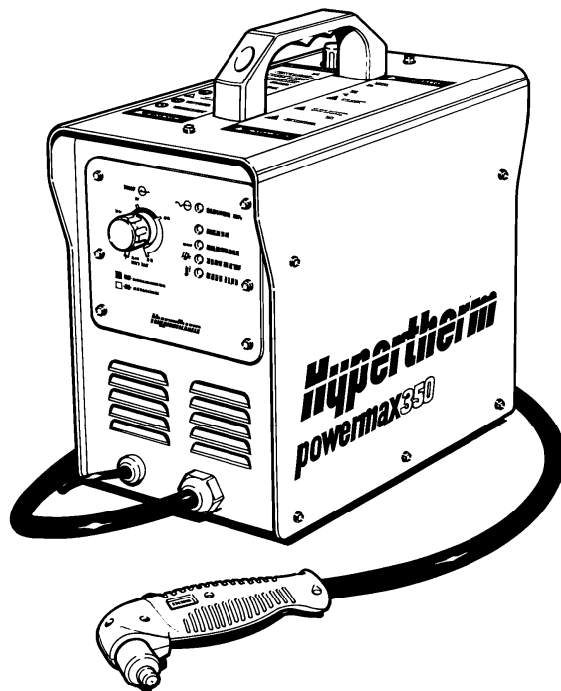


powermax350[®]

Plasma Arc Cutting System

***Service Manual
802920 Revision 1***



EN50199
EN50192

Hypertherm
*The world leader in
plasma cutting technology*

powermax350[®]

Plasma Arc Cutting System

Service Manual

IM-292

(P/N 802920)

Revision 1 July, 1998

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EMC INTRODUCTION

Hypertherm's CE-marked equipment is built in compliance with standard EN50199. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN50199 may not be adequate to completely eliminate interference when the affected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

This plasma equipment is designed for use only in an industrial environment.

INSTALLATION AND USE

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the cutting circuit, see *Earthing of Workpiece*. In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

ASSESSMENT OF AREA

Before installing the equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

- a. Other supply cables, control cables, signalling and telephone cables; above, below and adjacent to the cutting equipment.
- b. Radio and television transmitters and receivers.
- c. Computer and other control equipment.
- d. Safety critical equipment, for example guarding of industrial equipment.
- e. Health of the people around, for example the use of pacemakers and hearing aids.
- f. Equipment used for calibration or measurement.
- g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.
- h. Time of day that cutting or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

METHODS OF REDUCING EMISSIONS

Mains Supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure

Maintenance of Cutting Equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting Cables

The cutting cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential Bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered. However, metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of Workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, for example, ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitances selected according to national regulations.

Note. The cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is given in IEC TC26 (sec)94 and IEC TC26/108A/CD Arc Welding Equipment Installation and Use.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire plasma cutting installation may be considered for special applications

WARRANTY

WARNING

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty.

WARNING

You are responsible for the safe use of the Product. Hypertherm does not and cannot make any guarantee or warranty regarding the safe use of the Product in your environment.

GENERAL

Hypertherm, Inc. warrants that its Products shall be free from defects in materials and workmanship, if Hypertherm is notified of a defect (i) with respect to the power supply within a period of two (2) years from the date of its delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you. This warranty shall not apply to any Product which has been incorrectly installed, modified, or otherwise damaged. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight prepaid. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph or with Hypertherm's prior written consent.

The warranty above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty.

Distributors/OEMs may offer different or additional warranties, but Distributors/OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

PATENT INDEMNITY

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm's specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party. You shall notify Hypertherm promptly upon learning of any action or

threatened action in connection with any such alleged infringement, and Hypertherm's obligation to indemnify shall be conditioned upon Hypertherm's sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

LIMITATION OF LIABILITY

In no event shall Hypertherm be liable to any person or entity for any incidental, consequential, indirect, or punitive damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise and even if advised of the possibility of such damages.

LIABILITY CAP

In no event shall Hypertherm's liability, whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise, for any claim action suit or proceeding arising out of or relating to the use of the Products exceed in the aggregate the amount paid for the Products that gave rise to such claim.

INSURANCE

At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the Products.

NATIONAL AND LOCAL CODES

National and Local codes governing plumbing and electrical installation shall take precedent over any instructions contained in this manual. **In no event** shall Hypertherm be liable for injury to persons or property damage by reason of any code violation or poor work practices.

TRANSFER OF RIGHTS

You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty.

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Section 1

SAFETY

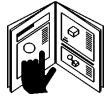
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RECOGNIZE SAFETY INFORMATION

The symbols shown in this section are used to identify potential hazards. When you see a safety symbol in this manual or on your machine, understand the potential for personal injury, and follow the related instructions to avoid the hazard.



FOLLOW SAFETY INSTRUCTIONS

Read carefully all safety messages in this manual and safety labels on your machine.

- Keep the safety labels on your machine in good condition. Replace missing or damaged labels immediately.
- Learn how to operate the machine and how to use the controls properly. Do not let anyone operate it without instruction.

- Keep your machine in proper working condition. Unauthorized modifications to the machine may affect safety and machine service life.

DANGER WARNING CAUTION

A signal word DANGER or WARNING is used with a safety symbol. DANGER identifies the most serious hazards.

- DANGER and WARNING safety labels are located on your machine near specific hazards.
- WARNING safety messages precede related instructions in this manual that may result in injury or death if not followed correctly.
- CAUTION safety messages precede related instructions in this manual that may result in damage to equipment if not followed correctly.



CUTTING CAN CAUSE FIRE OR EXPLOSION

Fire Prevention

- Be sure the area is safe before doing any cutting. Keep a fire extinguisher nearby.
- Remove all flammables within 35 feet (10 m) of the cutting area.
- Quench hot metal or allow it to cool before handling or before letting it touch combustible materials.
- Never cut containers with potentially flammable materials inside – they must be emptied and properly cleaned first.
- Ventilate potentially flammable atmospheres before cutting.
- When cutting with oxygen as the plasma gas, an exhaust ventilation system is required.

Explosion Prevention

- Do not use the plasma system if explosive dust or vapors may be present.
- Do not cut pressurized cylinders, pipes, or any closed container.
- Do not cut containers that have held combustible materials.



WARNING

Explosion Hazard
Argon-Hydrogen and Methane

Hydrogen and methane are flammable gases that present an explosion hazard. Keep flames away from cylinders and hoses that contain methane or hydrogen mixtures. Keep flames and sparks away from the torch when using methane or argon-hydrogen plasma.



WARNING

Hydrogen Detonation with Aluminum Cutting

- When cutting aluminum underwater, or with the water touching the underside of the aluminum, free hydrogen gas may collect under the workpiece and detonate during plasma cutting operations.
- Install an aeration manifold on the floor of the water table to eliminate the possibility of hydrogen detonation. Refer to the Appendix section of this manual for aeration manifold details.



ELECTRIC SHOCK CAN KILL

Touching live electrical parts can cause a fatal shock or severe burn.

- Operating the plasma system completes an electrical circuit between the torch and the workpiece. The workpiece and anything touching the workpiece are part of the electrical circuit.
- Never touch the torch body, workpiece or the water in a water table when the plasma system is operating.

Electric Shock Prevention

All Hypertherm plasma systems use high voltage in the cutting process (200 to 400 VDC are common). Take the following precautions when operating this system:

- Wear insulated gloves and boots, and keep your body and clothing dry.
 - Do not stand, sit or lie on – or touch – any wet surface when using the plasma system.
 - Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground. If you must work in or near a damp area, use extreme caution.
 - Provide a disconnect switch close to the power supply with properly sized fuses. This switch allows the operator to turn off the power supply quickly in an emergency situation.
 - When using a water table, be sure that it is correctly connected to earth ground.
- Install and ground this equipment according to the instruction manual and in accordance with national and local codes.
 - Inspect the input power cord frequently for damage or cracking of the cover. Replace a damaged power cord immediately. **Bare wiring can kill.**
 - Inspect and replace any worn or damaged torch leads.
 - Do not pick up the workpiece, including the waste cutoff, while you cut. Leave the workpiece in place or on the workbench with the work cable attached during the cutting process.
 - Before checking, cleaning or changing torch parts, disconnect the main power or unplug the power supply.
 - Never bypass or shortcut the safety interlocks.
 - Before removing any power supply or system enclosure cover, disconnect electrical input power. Wait 5 minutes after disconnecting the main power to allow capacitors to discharge.
 - Never operate the plasma system unless the power supply covers are in place. Exposed power supply connections present a severe electrical hazard.
 - When making input connections, attach proper grounding conductor first.
 - Each Hypertherm plasma system is designed to be used only with specific Hypertherm torches. Do not substitute other torches which could overheat and present a safety hazard.



CUTTING CAN PRODUCE TOXIC FUMES

Cutting can produce toxic fumes and gases that deplete oxygen and cause injury or death.

- Keep the cutting area well ventilated or use an approved air-supplied respirator.
- Do not cut in locations near degreasing, cleaning or spraying operations. The vapors from certain chlorinated solvents decompose to form phosgene gas when exposed to ultraviolet radiation.
- Do not cut metal coated or containing toxic materials, such as zinc (galvanized), lead, cadmium or beryllium, unless the area is well ventilated and the operator wears an air-supplied respirator. The coatings and any metals containing these elements can produce toxic fumes when cut.
- Never cut containers with potentially toxic materials inside – they must be emptied and properly cleaned first.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer.



A PLASMA ARC CAN CAUSE INJURY AND BURNS

Instant-On Torches

Plasma arc comes on immediately when the torch switch is activated.

The plasma arc will cut quickly through gloves and skin.

- Keep away from the torch tip.
- Do not hold metal near the cutting path.
- Never point the torch toward yourself or others.



ARC RAYS CAN BURN EYES AND SKIN

Eye Protection Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.

- Use eye protection in accordance with applicable national or local codes.
- Wear eye protection (safety glasses or goggles with side shields, or a welding helmet) with appropriate lens shading to protect your eyes from the arc's ultraviolet and infrared rays.

Skin Protection Wear protective clothing to protect against burns caused by ultraviolet light, sparks and hot metal.

- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.

Arc Current
 Up to 100 A
 100-200 A
 200-400 A
 Over 400 A



Lens Shade	
AWS (USA)	ISO 4850
No. 8	No. 11
No. 10	No. 11-12
No. 12	No. 13
No. 14	No. 14

Cutting Area Prepare the cutting area to reduce reflection and transmission of ultraviolet light:

- Paint walls and other surfaces with dark colors to reduce reflection.
- Use protective screens or barriers to protect others from flash and glare.
- Warn others not to watch the arc. Use placards or signs.



GROUNDING SAFETY

Work Cable Attach the work cable securely to the workpiece or the work table with good metal-to-metal contact. Do not connect it to the piece that will fall away when the cut is complete.

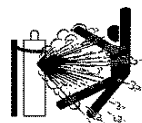
Work Table Connect the work table to an earth ground, in accordance with appropriate national or local electrical codes.

Input Power

- Be sure to connect the power cord ground wire to the ground in the disconnect box.
- If installation of the plasma system involves connecting the power cord to the power supply, be sure to connect the power cord ground wire properly.
- Place the power cord's ground wire on the stud first, then place any other ground wires on top of the power cord ground. Fasten the retaining nut tightly.
- Tighten all electrical connections to avoid excessive heating.

COMPRESSED GAS EQUIPMENT SAFETY

- Never lubricate cylinder valves or regulators with oil or grease.
- Use only correct gas cylinders, regulators, hoses and fittings designed for the specific application.
- Maintain all compressed gas equipment and associated parts in good condition.
- Label and color-code all gas hoses to identify the type of gas in each hose. Consult applicable national or local codes.

**GAS CYLINDERS CAN EXPLODE IF DAMAGED**

Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

- Handle and use compressed gas cylinders in accordance with applicable national or local codes.
- Never use a cylinder that is not upright and secured in place.
- Keep the protective cap in place over valve except when the cylinder is in use or connected for use.
- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use a hammer, wrench or other tool to open a stuck cylinder valve.

**NOISE CAN DAMAGE HEARING**

Prolonged exposure to noise from cutting or gouging can damage hearing.

- Use approved ear protection when using plasma system.
- Warn others nearby about the noise hazard.

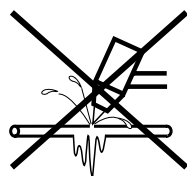
**PACEMAKER AND HEARING AID OPERATION**

Pacemaker and hearing aid operation can be affected by magnetic fields from high currents.

Pacemaker and hearing aid wearers should consult a doctor before going near any plasma arc cutting and gouging operations.

To reduce magnetic field hazards:

- Keep both the work cable and the torch lead to one side, away from your body.
- Route the torch leads as close as possible to the work cable.
- Do not wrap or drape the torch lead or work cable around your body.
- Keep as far away from the power supply as possible.

**A PLASMA ARC CAN DAMAGE FROZEN PIPES**

Frozen pipes may be damaged or can burst if you attempt to thaw them with a plasma torch.

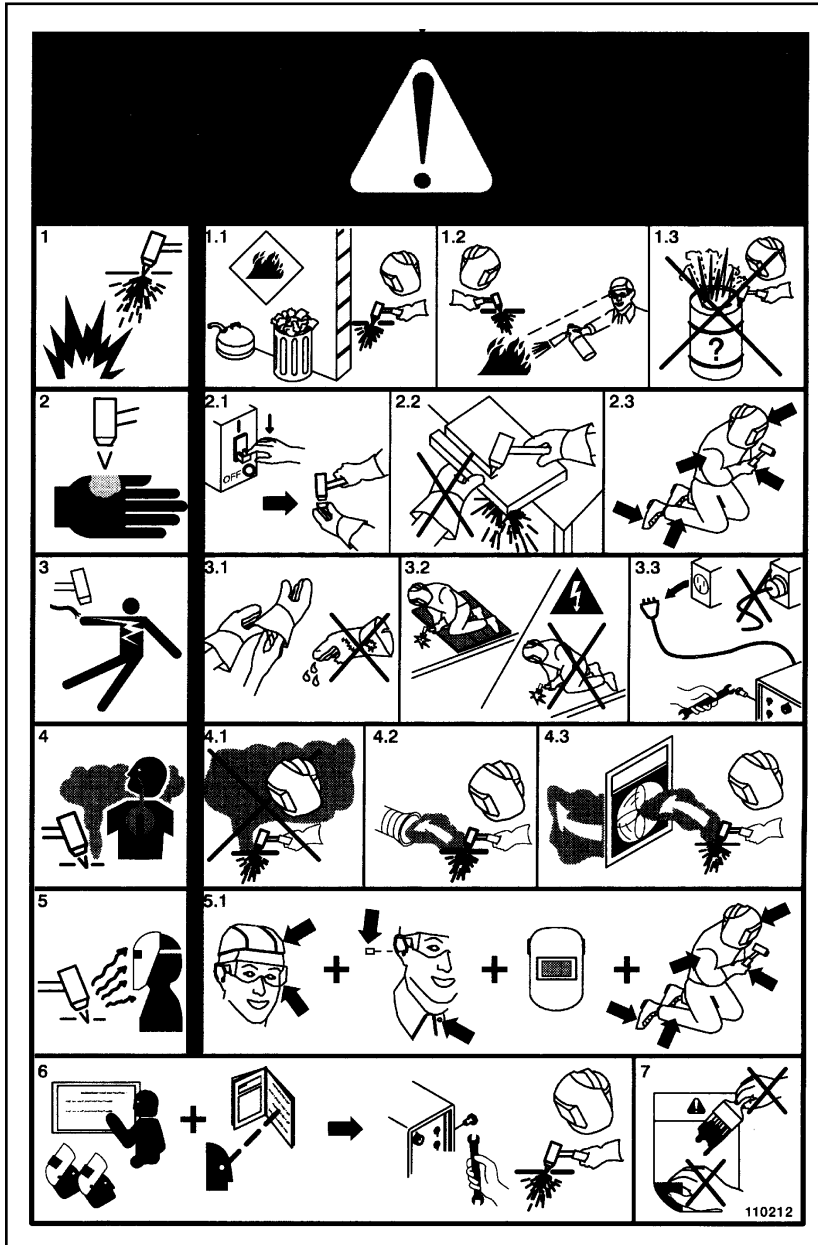
ADDITIONAL SAFETY INFORMATION

1. ANSI Standard Z49.1, *Safety in Welding and Cutting*, American Welding Society, 550 LeJeune Road, P.O. Box 351020, Miami, FL 33135
2. ANSI Standard Z49.2, *Fire Prevention in the Use of Cutting and Welding Processes*, American National Standards Institute, 1430 Broadway, New York, NY 10018
3. ANSI Standard Z87.1, *Safe Practices for Occupation and Educational Eye and Face Protection*, American National Standards Institute, 1430 Broadway, New York, NY 10018
4. AWS F4.1, *Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances*, American Welding Society, 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
5. AWS F5.2, *Recommended Safe Practices for Plasma Arc Cutting*, American Welding Society, 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
6. CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Cylinders*, Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202
7. CSA Standard W117.2, *Code for Safety in Welding and Cutting*, Canadian Standards Association Standard Sales, 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada
8. NFPA Standard 51B, *Cutting and Welding Processes*, National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210
9. NFPA Standard 70-1978, *National Electrical Code*, National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210
10. OSHA, *Safety and Health Standards*, 29FR 1910, U.S. Government Printing Office, Washington, D.C. 20402

SAFETY

WARNING LABEL

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described. The numbered text corresponds to the numbered boxes on the label.



1. Cutting sparks can cause explosion or fire.
 - 1.1 Keep flammables away from cutting.
 - 1.2 Keep a fire extinguisher nearby, and have a watchperson ready to use it.
 - 1.3 Do not cut on any closed containers.
2. The plasma arc can cause injury and burns.
 - 2.1 Turn off power before disassembling torch.
 - 2.2 Do not hold the material near cutting path.
 - 2.3 Wear complete body protection.
3. Electric shock from torch or wiring can kill. Protect yourself from electric shock.
 - 3.1 Wear insulating gloves. Do not wear wet or damaged gloves.
 - 3.2 Insulate yourself from work and ground.
 - 3.3 Disconnect input plug or power before working on machine.
4. Breathing cutting fumes can be hazardous to your health.
 - 4.1 Keep your head out of the fumes.
 - 4.2 Use forced ventilation or local exhaust to remove the fumes.
 - 4.3 Use ventilating fan to remove the fumes.
5. Arc rays can burn eyes and injure skin.
 - 5.1 Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.
6. Become trained and read the instructions before working on the machine or cutting.
7. Do not remove or paint over (cover) warning labels.

Section 1a

SÉCURITÉ

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IDENTIFIER LES CONSIGNES DE SÉCURITÉ

Les symboles indiqués dans cette section sont utilisés pour identifier les risques éventuels. Si vous trouvez un symbole de sécurité, que ce soit dans ce manuel ou sur l'équipement, soyez conscient des risques de blessures et suivez les instructions correspondantes afin d'éviter ces risques.



SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

Lire attentivement toutes les consignes de sécurité dans le présent manuel et sur les étiquettes de sécurité se trouvant sur la machine.

- Les étiquettes de sécurité doivent rester lisibles. Remplacer immédiatement les étiquettes manquantes ou abîmées.
- Apprendre à faire fonctionner la machine et à utiliser correctement les commandes. Ne laisser personne utiliser la machine sans connaître son fonctionnement.

- Garder la machine en bon état. Des modifications non autorisées sur la machine peuvent engendrer des problèmes de sécurité et raccourcir la durée d'utilisation de l'équipement.

DANGER AVERTISSEMENT PRÉCAUTION

Les signaux DANGER ou AVERTISSEMENT sont utilisés avec un symbole de sécurité, DANGER correspondant aux risques les plus sérieux.

- Les étiquettes de sécurité DANGER et AVERTISSEMENT sont situées sur la machine pour signaler certains dangers spécifiques.
- Les messages d'AVERTISSEMENT précèdent les instructions d'utilisation expliquées dans ce manuel et signalent les risques de blessures ou de mort au cas où ces instructions ne seraient pas suivies correctement.
- Les messages de PRÉCAUTION précèdent les instructions d'utilisation contenues dans ce manuel et signalent que le matériel risque d'être endommagé si les instructions ne sont pas suivies correctement.



LE COUPAGE PEUT PROVOQUER UN INCENDIE OU UNE EXPLOSION

Prévention des incendies

- Avant de commencer, s'assurer que la zone de coupage ne présente aucun danger. Conserver un extincteur à proximité.
- Éloigner toute matière inflammable à une distance d'au moins 10 m du poste de coupage.
- Tremper le métal chaud ou le laisser refroidir avant de le manipuler ou avant de le mettre en contact avec des matériaux combustibles.
- Ne jamais couper des récipients pouvant contenir des matières inflammables avant de les avoir vidés et nettoyés correctement.
- Aérer toute atmosphère potentiellement inflammable avant d'utiliser un système plasma.
- Lors de l'utilisation d'oxygène comme gaz plasma, un système de ventilation par aspiration est nécessaire.

Prévention des explosions

- Ne pas couper en présence de poussière ou de vapeurs.
- Ne pas couper de bouteilles, de tuyaux ou autres récipients fermés et pressurisés.
- Ne pas couper de récipients contenant des matières combustibles.



AVERTISSEMENT

Risque d'explosion
Argon-hydrogène et méthane

L'hydrogène et le méthane sont des gaz inflammables et potentiellement explosifs. Conserver à l'écart de toute flamme les bouteilles et tuyaux contenant des mélanges à base d'hydrogène ou de méthane. Maintenir toute flamme et étincelle à l'écart de la torche lors de l'utilisation d'un plasma d'argon-hydrogène ou de méthane.



AVERTISSEMENT

Détonation de l'hydrogène lors du coupage de l'aluminium

- Lors du coupage de l'aluminium sous l'eau, ou si l'eau touche la partie inférieure de la pièce d'aluminium, de l'hydrogène libre peut s'accumuler sous la pièce à couper et détonner lors du coupage plasma.
- Installer un collecteur d'aération au fond de la table à eau afin d'éliminer les risques de détonation de l'hydrogène. Se référer à l'annexe du manuel pour plus de renseignements sur les collecteurs d'aération.



LES CHOCS ÉLECTRIQUES PEUVENT ÊTRE FATALS

Toucher une pièce électrique sous tension peut provoquer un choc électrique fatal ou des brûlures graves.

- La mise en fonctionnement du système plasma ferme un circuit électrique entre la torche et la pièce à couper. La pièce à couper et tout autre élément en contact avec cette pièce font partie du circuit électrique.
- Ne jamais toucher le corps de la torche, la pièce à couper ou l'eau de la table à eau pendant le fonctionnement du système plasma.

Prévention des chocs électriques

Tous les systèmes plasma Hypertherm utilisent des hautes tensions pour le coupage (souvent de 200 à 400 V). On doit prendre les précautions suivantes quand on utilise le système plasma :

- Porter des bottes et des gants isolants et garder le corps et les vêtements au sec.
- Ne pas se tenir, s'asseoir ou se coucher sur une surface mouillée, ni la toucher quand on utilise le système plasma.
- S'isoler de la surface de travail et du sol en utilisant des tapis isolants secs ou des couvertures assez grandes pour éviter tout contact physique avec le travail ou le sol. S'il s'avère nécessaire de travailler dans ou près d'un endroit humide, procéder avec une extrême prudence.
- Installer un sectionneur avec fusibles appropriés, à proximité de la source de courant. Ce dispositif permet à l'opérateur d'arrêter rapidement la source de courant en cas d'urgence.
- En cas d'utilisation d'une table à eau, s'assurer que cette dernière est correctement mise à la terre.

- Installer et mettre à la terre l'équipement selon les instructions du présent manuel et conformément aux codes électriques locaux et nationaux.
- Inspecter fréquemment le cordon d'alimentation primaire pour s'assurer qu'il n'est ni endommagé, ni fendu. Remplacer immédiatement un cordon endommagé. **Un câble dénudé peut tuer.**
- Inspecter et remplacer les câbles de la torche qui sont usés ou endommagés.
- Ne pas saisir la pièce à couper ni les chutes lors du coupage. Laisser la pièce à couper en place ou sur la table de travail, le câble de retour connecté lors du coupage.
- Avant de vérifier, de nettoyer ou de remplacer les pièces de la torche, couper l'alimentation ou débrancher la prise de courant.
- Ne jamais contourner ou court-circuiter les verrouillages de sécurité.
- Avant d'enlever le capot du système ou de la source de courant, couper l'alimentation électrique. Attendre ensuite 5 minutes pour que les condensateurs se déchargent.
- Ne jamais faire fonctionner le système plasma sans que les capots de la source de courant ne soient en place. Les raccords exposés de la source de courant sont extrêmement dangereux.
- Lors de l'installation des connexions, attacher tout d'abord la prise de terre appropriée.
- Chaque système plasma Hypertherm est conçu pour être utilisé uniquement avec des torches Hypertherm spécifiques. Ne pas utiliser des torches inappropriées qui pourraient surchauffer et présenter des risques pour la sécurité.



LE COUPAGE PEUT PRODUIRE DES VAPEURS TOXIQUES

Le coupage peut produire des vapeurs et des gaz toxiques qui réduisent le niveau d'oxygène dans l'air et peuvent provoquer des blessures, voire la mort.

- Conserver le poste de coupage bien aéré ou utiliser un masque respiratoire homologué.
- Ne pas procéder au coupage près d'endroits où s'effectuent le dégraissage, le nettoyage ou la vaporisation. Certains solvants chlorés se décomposent sous l'effet des rayons ultraviolets et forment du phosgène.
- Ne pas couper des métaux peints ou contenant des matières toxiques comme le zinc (galvanisé), le plomb, le cadmium ou le béryllium, à moins que la zone de travail

soit très bien ventilée et que l'opérateur porte un masque respiratoire. Les revêtements et métaux contenant ces matières peuvent produire des vapeurs toxiques lors du coupage.

- Ne jamais couper de récipients pouvant contenir des matières inflammables avant de les avoir vidés et nettoyés correctement.
- Quand on utilise ce produit pour le soudage ou le coupage, il dégage des fumées et des gaz qui contiennent des produits chimiques qui, selon l'état de Californie, provoquent des anomalies congénitales et, dans certains cas, le cancer.



L'ARC PLASMA PEUT PROVOQUER DES BLESSURES OU DES BRÛLURES

Torches à allumage instantané

L'arc plasma s'allume immédiatement après que la torche soit mise en marche.

L'arc plasma coupe facilement les gants et la peau.

- Rester éloigné de l'extrémité de la torche.
- Ne pas tenir de métal près de la trajectoire de coupe.
- Ne jamais pointer la torche vers soi ou d'autres personnes.



LES RAYONS DE L'ARC PEUVENT BRÛLER LES YEUX ET LA PEAU

Protection des yeux Les rayons de l'arc plasma produisent de puissants rayons visibles ou invisibles (ultraviolets et infrarouges) qui peuvent brûler les yeux et la peau.

- Utiliser des lunettes de sécurité conformément aux codes locaux ou nationaux en vigueur.
- Porter des lunettes de protection (lunettes ou masque muni d'écrans latéraux ou encore masque de soudure) avec des verres teintés appropriés pour protéger les yeux des rayons ultraviolets et infrarouges de l'arc.

- Gants à crispin, chaussures et casque de sécurité.
- Vêtements ignifuges couvrant toutes les parties exposées du corps.
- Pantalon sans revers pour éviter que des étincelles ou des scories puissent s'y loger.
- Avant le coupage, retirer de ses poches tout objet combustible comme les briquets au butane ou les allumettes.

Zone de coupage Préparer la zone de coupage afin de réduire la réverbération et la transmission de la lumière ultraviolette :

- Peindre les murs et autres surfaces de couleur sombre pour réduire la réflexion de la lumière.
- Utiliser des écrans et autres dispositifs de protection afin de protéger les autres personnes de la lumière et de la réverbération.
- Prévenir les autres personnes de ne pas regarder l'arc. Utiliser des affiches ou des panneaux.

Courant de l'arc	Puissance des verres teintés	
	AWS (É.-U.)	ISO 4850
Jusqu'à 100 A	N° 8	N° 11
100-200 A	N° 10	N° 11-12
200-400 A	N° 12	N° 13
Plus de 400 A	N° 14	N° 14

Protection de la peau Porter des vêtements de sécurité pour se protéger contre les brûlures que peuvent causer les rayons ultraviolets, les étincelles et le métal brûlant :



MISE À LA MASSE ET À LA TERRE

Câble de retour Bien fixer le câble de retour (ou de masse) à la pièce à couper ou à la table de travail de façon à assurer un bon contact métal-métal. Ne pas fixer le câble de retour à la partie de la pièce qui doit se détacher.

Table de travail Raccorder la table de travail à la terre, conformément aux codes de sécurité locaux ou nationaux appropriés.

Alimentation

- S'assurer que le fil de terre du cordon d'alimentation est connecté à la terre dans le coffret du sectionneur.
- S'il est nécessaire de brancher le cordon d'alimentation à la source de courant lors de l'installation du système, s'assurer que le fil de terre est correctement branché.
- Placer tout d'abord le fil de terre du cordon d'alimentation sur le plot de mise à la terre puis placer les autres fils de terre par-dessus. Bien serrer l'écrou de retenue.
- S'assurer que toutes les connexions sont bien serrées pour éviter la surchauffe.

SÉCURITÉ DES BOUTEILLES DE GAZ COMPRIMÉ

- Ne jamais lubrifier les robinets des bouteilles ou les régulateurs avec de l'huile ou de la graisse.
- Utiliser uniquement les bouteilles, régulateurs, tuyaux et accessoires appropriés et conçus pour chaque application spécifique.
- Entretenir l'équipement et les pièces d'équipement à gaz comprimé afin de les garder en bon état.
- Étiqueter et coder avec des couleurs tous les tuyaux de gaz afin d'identifier le type de gaz contenu dans chaque tuyau. Se référer aux codes locaux ou nationaux en vigueur.



LES BOUTEILLES DE GAZ COMPRIMÉ PEUVENT EXPLOSER EN CAS DE DOMMAGES

Les bouteilles de gaz contiennent du gaz à haute pression. Si une bouteille est endommagée, elle peut exploser.

- Manipuler et utiliser les bouteilles de gaz comprimé conformément aux codes locaux ou nationaux.
- Ne jamais utiliser une bouteille qui n'est pas placée à la verticale et bien assujettie.
- Le capuchon de protection doit être placé sur le robinet sauf si la bouteille est en cours d'utilisation ou connectée pour utilisation.
- Éviter à tout prix le contact électrique entre l'arc plasma et une bouteille.
- Ne jamais exposer des bouteilles à une chaleur excessive, aux étincelles, aux scories ou aux flammes nues.
- Ne jamais utiliser des marteaux, des clés ou d'autres outils pour débloquer le robinet des bouteilles.



LE BRUIT PEUT PROVOQUER DES PROBLÈMES AUDITIFS

Une exposition prolongée au bruit du coupage ou du gougeage peut provoquer des problèmes auditifs.

- Utiliser un casque de protection homologué lors de l'utilisation du système plasma.
- Prévenir les personnes aux alentours des risques encourus en cas d'exposition au bruit.



PACEMAKERS ET PROTHÈSES AUDITIVES

Les champs magnétiques produits par les courants à haute tension peuvent affecter le fonctionnement des prothèses auditives et des pacemakers. Les personnes portant ce type d'appareil doivent consulter un médecin avant de s'approcher d'un lieu où s'effectue le coupage ou le gougeage plasma.

Pour réduire les risques associés aux champs magnétiques :

- Garder loin de soi et du même côté du corps le câble de retour et le faisceau de la torche.
- Faire passer le faisceau de la torche le plus près possible du câble de retour.
- Ne pas s'enrouler le faisceau de la torche ou le câble de retour autour du corps.
- Se tenir le plus loin possible de la source de courant.

Étiquette de sécurité

Cette étiquette est apposée sur certaines sources de courant. Il est important que l'utilisateur et le technicien de maintenance comprennent la signification des symboles de sécurité. Les numéros de la liste correspondent aux numéros des images.



1. Les étincelles produites par le coupage peuvent provoquer une explosion ou un incendie.
 - 1.1 Pendant le coupage, éloigner toute matière inflammable.
 - 1.2 Conserver un extincteur à proximité et s'assurer qu'une personne soit prête à l'utiliser.
 - 1.3 Ne jamais couper de récipients fermés.
2. L'arc plasma peut provoquer des blessures et des brûlures.
 - 2.1 Couper l'alimentation avant de démonter la torche.
 - 2.2 Ne pas tenir la surface à couper près de la trajectoire de coupe.
 - 2.3 Porter des vêtements de protection couvrant tout le corps.
3. Un choc électrique causé par la torche ou les câbles peut être fatal. Se protéger contre les risques de chocs électriques.
 - 3.1 Porter des gants isolants. Ne pas porter de gants mouillés ou abîmés.
 - 3.2 S'isoler de la surface de travail et du sol.
 - 3.3 Débrancher la prise ou la source de courant avant de manipuler l'équipement.
4. L'inhalation des vapeurs produites par le coupage peut être dangereuse pour la santé.
 - 4.1 Garder le visage à l'écart des vapeurs.
 - 4.2 Utiliser un système de ventilation par aspiration ou d'échappement localisé pour dissiper les vapeurs.
 - 4.3 Utiliser un ventilateur pour dissiper les vapeurs.
5. Les rayons de l'arc peuvent brûler les yeux et provoquer des lésions de la peau.
 - 5.1 Porter un casque et des lunettes de sécurité. Se protéger les oreilles et porter une chemise dont le col peut être déboutonné. Porter un casque de soudure dont la protection filtrante est suffisante. Porter des vêtements protecteurs couvrant la totalité du corps.
6. Se former à la technique du coupage et lire les instructions avant de manipuler l'équipement ou de procéder au coupage.
7. Ne pas retirer ou peindre (recouvrir) les étiquettes de sécurité.

Section 2 SPECIFICATIONS

In this section:

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Specifications	2-2
Power Supply	2-2
PAC110 Torch	2-3
S Mark	2-4
IEC Symbols Used	2-4

SPECIFICATIONS

INTRODUCTION

The Powermax350 plasma cutting system uses a chopper power supply to cut mild steel, stainless steel, aluminum and other metals. Cylinder air or shop air is used as the plasma gas. Air used for plasma cutting must be clean, dry and oil-free.

This service manual provides information for a **qualified service technician** to maintain and troubleshoot the power supply and torch. This manual also provides a detailed list of safety practices so that the system can be safely operated and maintained. **READ THE SAFETY SECTION (Section 1) FIRST!**

The Powermax350 operator manual provides the setup and daily operating instructions.

SPECIFICATIONS

Power Supply

Rated Open Circuit Voltage (OCV) (U_0)	255 VDC
Rated Output Current (I_2)	17–27 amps
Full Rated Output	27 amps at 91 VDC at 104° F (40° C)
Duty Cycle (X) at 40° C, at rated output voltage (U_2), and at rated output current (I_2)	35% ($I_2=27A$, $U_2=91V$) 60% ($I_2=21A$, $U_2=88V$) 100% ($I_2=17A$, $U_2=87V$) See power supply data tag for more information on duty cycle.
Ambient Temperature and Duty Cycle	Power supplies will operate between +14° and 104° F (-10° and +40° C). Power supplies operated in an ambient temperature above 86° F (30° C) may show some decrease in duty cycle.
Apparent Input Power (S_1)	3.8 kVA (U_1 , I_1)
Input Voltage (U_1)/Input Current (I_1) at 2.25 kw Output	115/230V/33.3/17.8A 1-Phase, 60 Hz (Non CE) 115/230V/33.3/17.8A 1-Phase, 50 Hz (CE) 200V/18.5A 1-Phase, 50/60 Hz (Non CE)
Dimensions and Weight:	
Depth	15.75 inches (400 mm)
Width	8.5 inches (216 mm)
Height	12 inches (305 mm)
Weight	44 pounds (20 kg) 47 pounds (21.4 kg) with torch
Gas Requirements:	
Gas Type	Air - clean, dry, oil-free
Supplied Air Pressure and Flowrate	70 –120 psi (4.8 –8.3 bar) @ 270 scfh/4.5 scfm (127 l/min) supplied to power supply pressure regulator.
Power Supply Pressure Regulator Setting	60 psi (4.1 bar) flowing

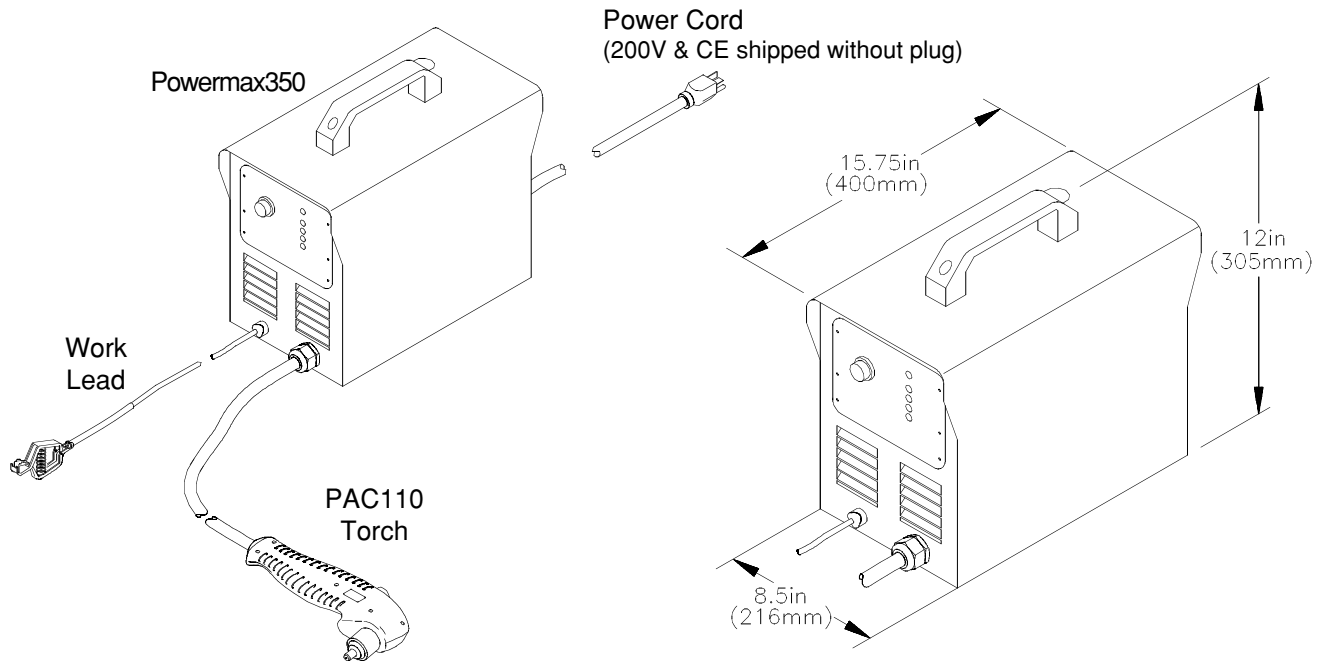


Figure 2-1 Powermax350 Plasma Cutting System

PAC110 Torch

Recommended Cutting Capacity	1/4 inch (6 mm) @ 25A (35% duty cycle)
Maximum Cutting Capacity	3/8 inch (10 mm) @ 25A (35% duty cycle)
Severance Cutting Capacity	1/2 inch (12 mm) @ 25A (35% duty cycle)
Gas Flow	270 scfh/4.5 scfm at 60 psi (127 l/min at 4.1 bar)
Weight	3 pounds (1.4 kg)

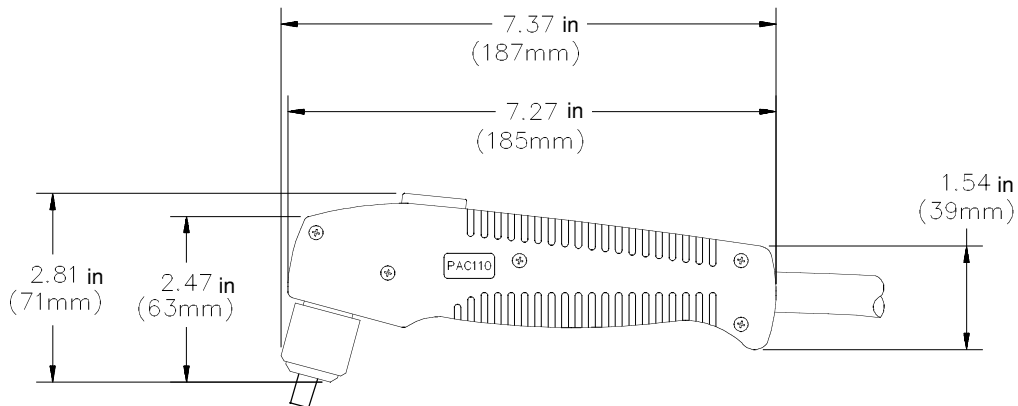







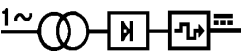







Figure 2-2 PAC110 Torch with Dimensions

SPECIFICATIONS

S MARK

The Powermax350 conforms to **CE** standard EN50192. The **S** mark indicates that the power supply and torch are suitable for use in environments with increased hazard of electrical shock.

IEC SYMBOLS USED

	Direct Current (DC).
	Alternating current (AC).
	Plasma cutting torch.
	AC input power connection.
	The terminal for the external protective (earthed) conductor.
	A chopper-based power source.
	Anode (+) work clamp.
	Temperature switch.
	Pressure switch.
	Plasma torch in the TEST position (cooling and cutting gas exiting nozzle).
	The power is on.
	The power is off.
	Volt/amp curve.

Section 3 MAINTENANCE

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PAC110 Torch Repair	3-20
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ROUTINE MAINTENANCE



WARNING



SHOCK HAZARD: Always turn off the power and unplug the cord before changing consumable parts. Do not rely on the cap-on sensor switch to remove power. It is provided strictly for safety backup. In the U.S., use a "lock-out / tag-out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.

Under severe conditions, routine maintenance should be performed more frequently.

Before Each Use

- Check the air pressure.
- Check the torch and consumables.

Every Week

- Check the torch cap-on sensor system by listening for the micro-switch to "click" when the retaining cap is loosened. Check the *Torch Cap Shutdown System* as follows:

Turn power On (I) and loosen the torch retaining cap.

If shutdown system works properly, READY LED extinguishes and TORCH CAP LED illuminates.

If the shutdown system does not work properly, turn power Off (O) and check for proper air pressure, blocked or leaking hose, or loose torch retaining cap. Check the system by retightening the retaining cap and resetting the power as described above.

3 Months

- Replace damaged or unreadable labels.
- Service the filter and pressure regulator.
- Check the air supply hose.
- Replace any cracked parts.
- Check the torch body and torch lead.
- Replace the torch lead if the insulation is broken.

6 Months

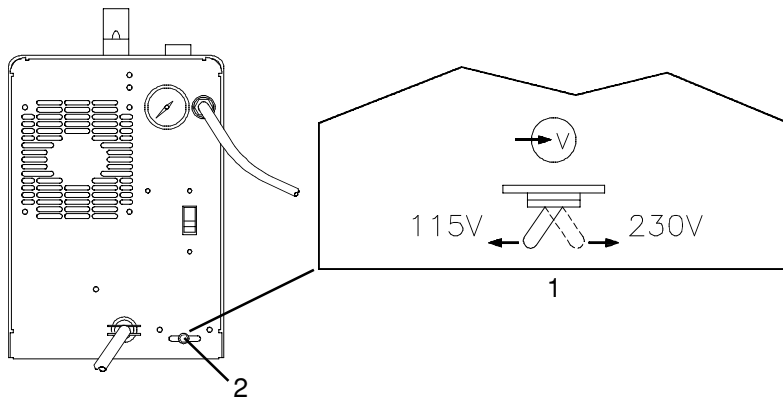
- Blow out or vacuum the inside of the power supply.

THEORY OF OPERATION

General

115/230 Volt Unit

The 115/230 volt power supplies are shipped to operate at 115 volts. To operate at 230 volts, the input voltage selector switch must be set to the 230V position (Figure 3-1) and a 230V plug must be installed on the power cord.



- 1 Input Voltage Selector Switch
- 2 Retaining screw
 - Remove screw and position switch to select required voltage.
 - Reinstall retaining screw and tighten to secure switch in place.

To use rated output (see specifications in section 2), an individual branch circuit capable of carrying 33A, 115V at 35% duty cycle; or 18A, 230V at 35% duty cycle and protected by fuses or circuit breakers is required.

Figure 3-1 Repositioning Input Voltage Selector Switch

200 Volt Unit

The 200 volt power supplies operate at 200 volts only and do not include an input voltage selector switch.

Functional Description

Refer to the functional block diagram, Figure 3-2 and the system wiring diagram Figure 3-4. Refer to Section 4, *Parts List*, to locate and identify the system components described.

MAINTENANCE

1 Input Filter FL1 (CE units only)

Provides input power noise filtering.

2 Power Switch S1

Provides on/off control of power to main transformer T1.

3 Input Voltage Selector Switch S2

Connects primary of main transformer T1 for 115 or 230 VAC operation.

4 Fan Motor FM

Provides cooling of internal components.

5 Main Transformer T1

Supplies power to output circuit, power control board PC1, safety control board PC2, and fan motor FM.

6 Integrated Rectifier SR1

Changes AC output from T1 to full-wave rectified DC.

7 Power Control Board PC1

Supplies and regulates cutting current to torch. Also provides some timing and control functions.

8 Safety Control Board PC2

Provides timing and control functions, monitors safety interlocks and provides isolation from power circuitry. Also contains power, ready and trouble LEDs.

9 Output Control R6

Selects cutting output level.

10 Thermostat TP1

If unit overheats, TP1 opens stopping cutting output. TP1 is located inside T1.

11 Power-Up Delay Relay CR6, Input Resistor R2

During power-up (2-3 seconds), R2 limits inrush current to T1. CR6 shorts out R2 after power up delay and keeps R2 shorted out while the unit is operating.

12 Contactor Control Relay CR7

Connects main transformer T1 secondary output power to integrated rectifier SR1.

13 Air Filter/Regulator

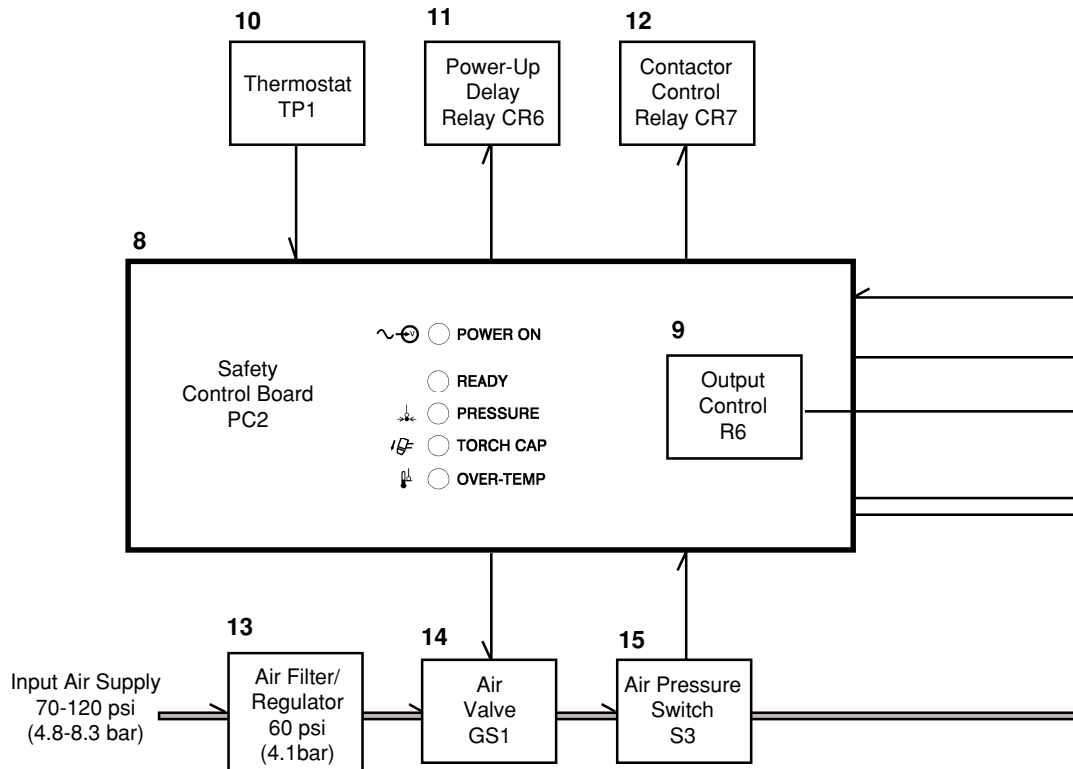
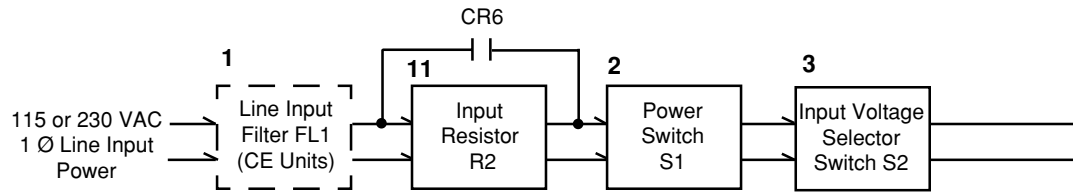
Filters and regulates pressure of input air supply.

14 Air Valve GS1

Allows airflow for pilot arc, cutting and postflow.

15 Air Pressure Switch S3

Provides signal to PC2 to shut down unit if air pressure is to low.



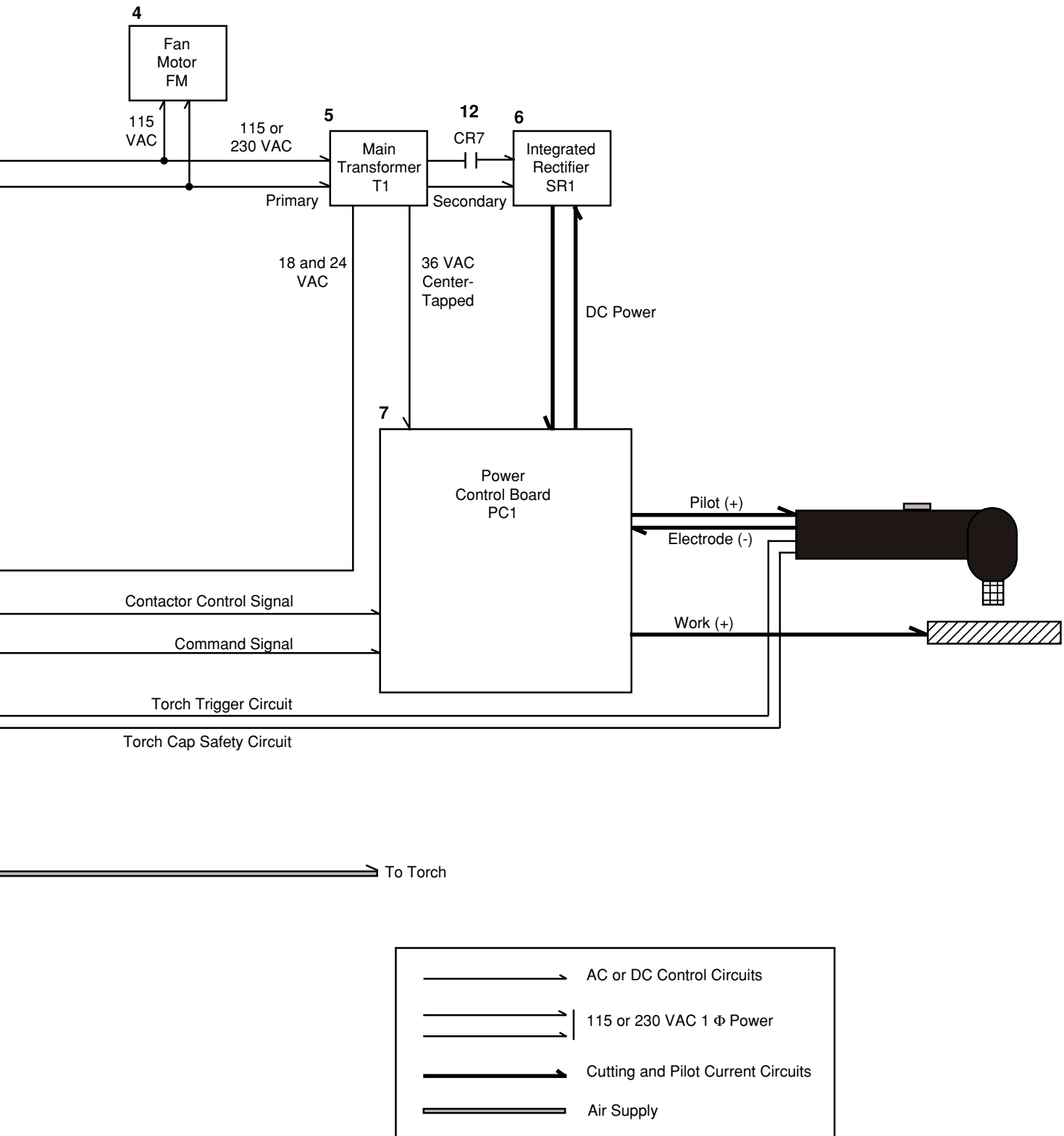


Figure 3-2.1 Functional Block Diagram, 115/230 Volt

1 Power Switch S1

Provides on/off control of power to main transformer T1.

2 Main Transformer T1

Supplies power to output circuit, power control board PC1, safety control board PC2, and fan motor FM.

3 Fan Motor FM

Provides cooling of internal components.

4 Integrated Rectifier SR1

Changes AC output from T1 to full-wave rectified DC.

5 Power Control Board PC1

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Connects main transformer T1 secondary output power to integrated rectifier SR1.

11 Air Filter/Regulator

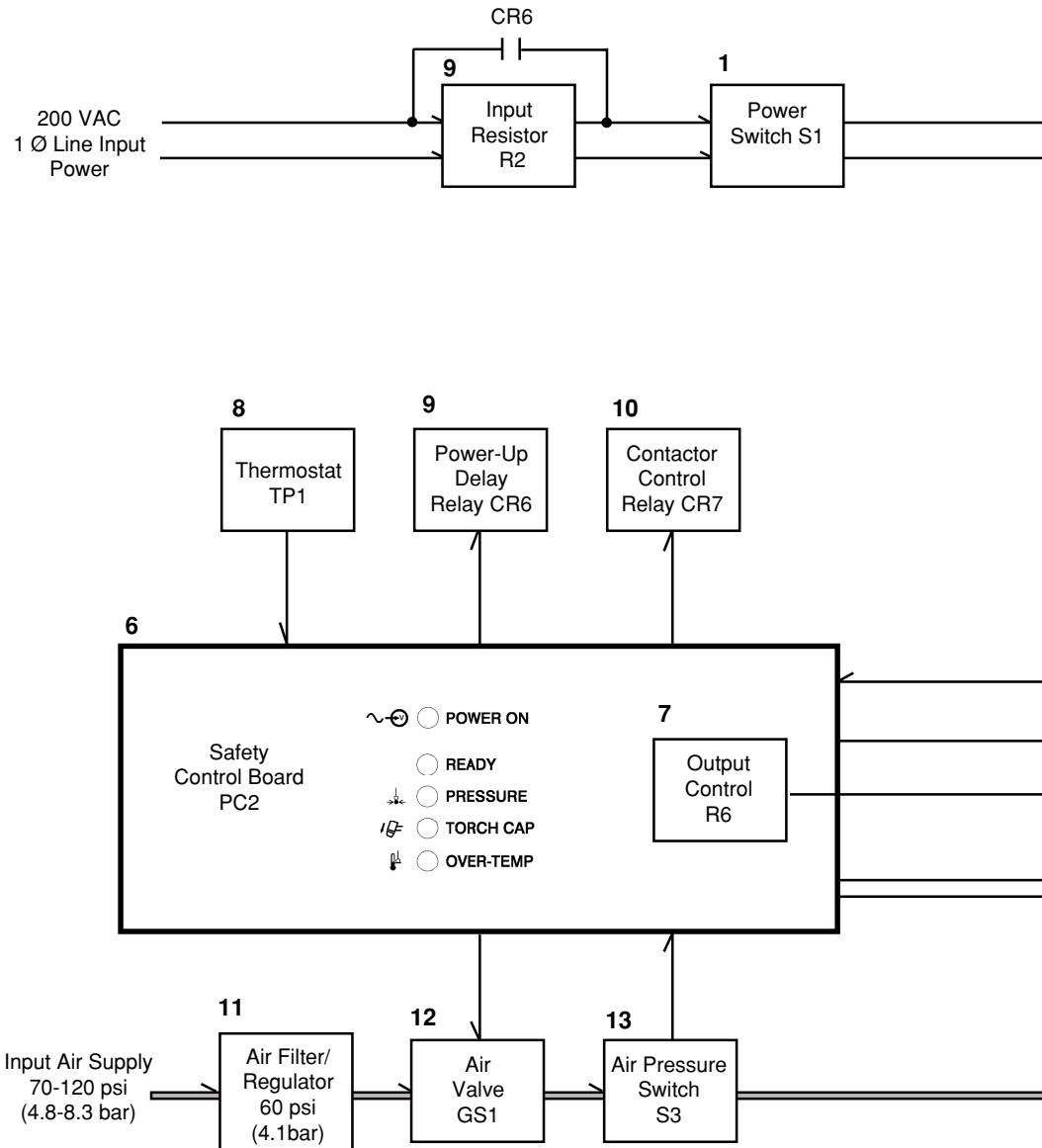
Filters and regulates pressure of input air supply.

12 Air Valve GS1

Allows airflow for pilot arc, cutting and postflow.

13 Air Pressure Switch S3

Provides signal to PC2 to shut down unit if air pressure is too low.



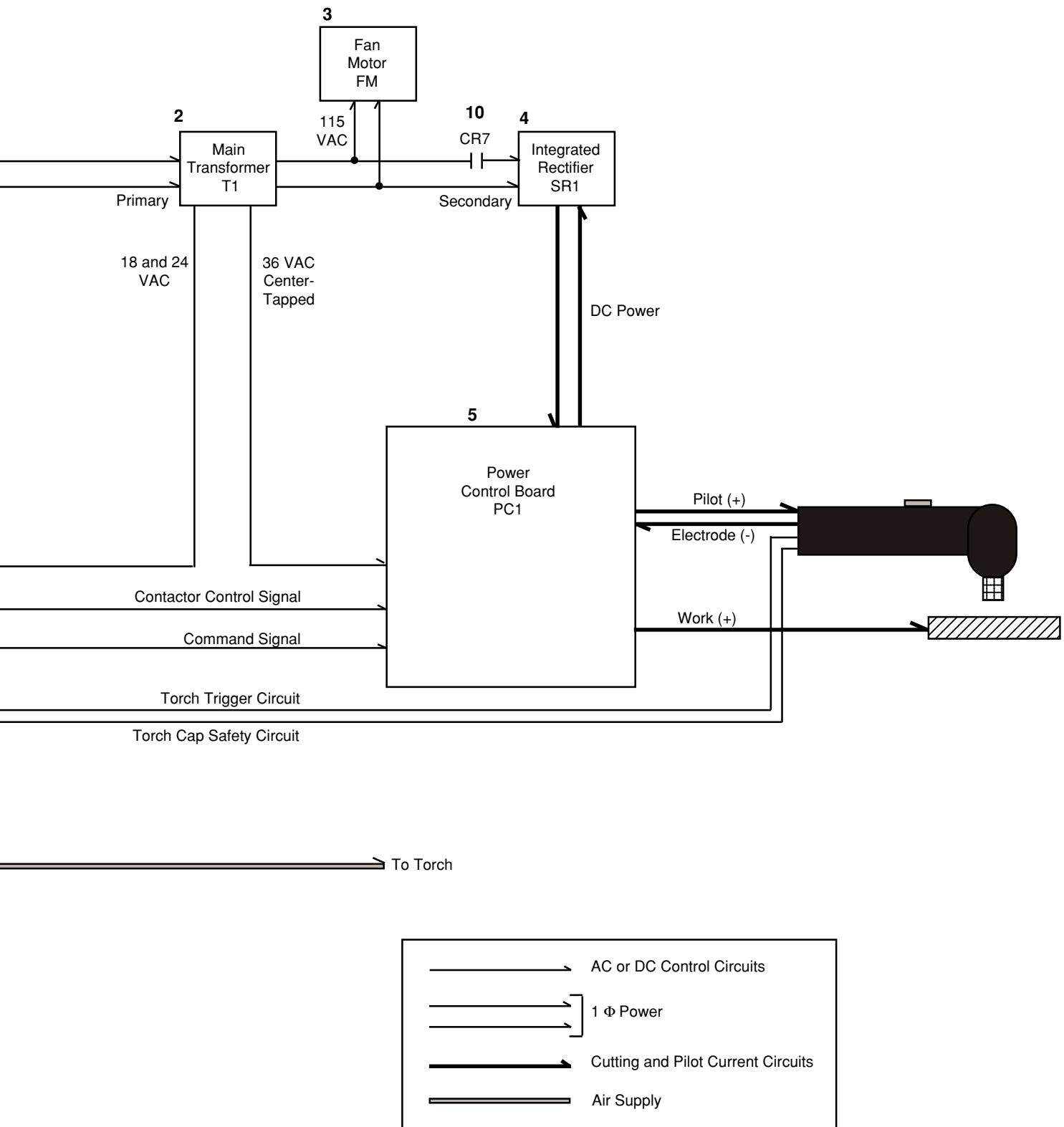


Figure 3-2.2 Functional Block Diagram, 200 Volt

TROUBLE LED INDICATORS

If certain problems occur, the READY LED extinguishes, a trouble LED illuminates and the torch stops firing.

- **PRESSURE** LED - Illuminates if air pressure is below 40 psi (2.8 bar).

Turn power Off (O) and check for proper air pressure.

- **TORCH CAP** LED - Illuminates if the retaining cap is loose.

Turn power Off (O) and check that the retaining cap is tight. **Whenever the retaining cap shutdown system has been activated, the power must turned Off (O) and then back On (I) to reset the system.**

If problems persist, complete weekly checks listed under Routine Maintenance before performing troubleshooting.

- **OVER-TEMP** LED - Illuminates if power supply overheats. See Duty Cycle and Overheating in the Operation section.

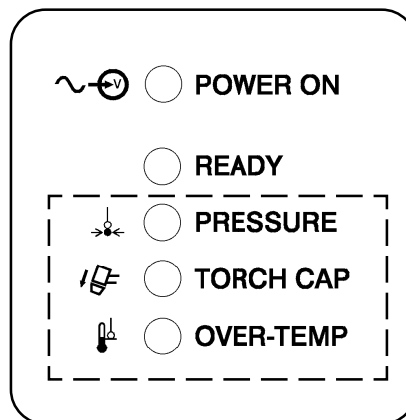


Figure 3-3 Trouble LED Indicators

TROUBLESHOOTING

Refer to Figure 3-4 and 3-5 to assist in the troubleshooting process.

**WARNING**

SHOCK HAZARD: Always turn off the power and unplug the cord or set the line disconnect switch to Off before servicing the unit or changing consumable parts. In the U.S., use a "lock-out / tag-out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.

Problem	Cause/Solution
1. No pilot arc; difficulty in establishing an arc.	1.1 Clean or replace worn consumables as necessary. 1.2 Check for proper installation of swirl ring. 1.3 Check for damaged torch or torch lead. 1.4 Check air system for leaks. 1.5 Check coil voltage and connections of control relay CR6. Check continuity of coil and condition of contacts. Replace if necessary. 1.6 Check coil voltage and connections of gas valve GS1. Check continuity of coil. Replace if necessary. 1.7 Check integrated rectifier SR1. Replace if necessary. 1.8 Check power control board PC1 and connections. Replace if necessary. 1.9 Check safety control board PC2 and connections. Replace if necessary.
2. No cutting output; POWER ON, READY, PRESSURE, TORCH CAP and OVER-TEMP LEDs extinguished; fan not operating.	2.1 Place the Power switch to On (I). 2.2 Plug in the power cord or set line disconnect switch to On. 2.3 Check line disconnect fuses and replace if needed or reset circuit breakers. 2.4 115/230 Volt units: Check position of input voltage selector switch S2.

Problem	Cause/Solution
	2.5 Check resistance and connections of input resistor R2 which is rated at 10 ohms \pm 10 %. Replace if necessary.
	2.6 Check coil voltage and connections of control relay CR6. Check continuity of coil and condition of contacts. Replace if necessary.
	2.7 Check transformer T1 for signs of winding failure. Check continuity across windings and check connections. Check secondary voltages. Replace if necessary.
3. No cutting output; POWER ON and READY LEDs illuminated; PRESSURE, TORCH CAP and OVER-TEMP LEDs extinguished; fan operating.	3.1 Check that the work clamp is connected.
	3.2 Clean or replace worn consumables as necessary.
	3.3 Check resistance and connections of input resistor R2 which is rated at 10 ohms \pm 10 %. Replace if necessary.
	3.4 Check coil voltage and connections of contactor control relay CR7. Check continuity of coil and condition of contacts. Replace if necessary.
	3.5 Check coil voltage and connections of control relay CR6. Check continuity of coil and condition of contacts. Replace if necessary.
	3.6 Check coil voltage and connections of gas valve GS1. Check continuity of coil. Replace if necessary.
	3.7 Check power control board PC1 and connections. Replace if necessary.
	3.8 Check safety control board PC2 and connections. Replace if necessary.
4. No cutting output; POWER ON LED illuminated; READY, PRESSURE, TORCH CAP and OVER-TEMP LEDs extinguished; fan operating.	4.1 Reset power switch S1.
	4.2 Check safety control board PC2 and connections. Replace if necessary.
5. No control of cutting output.	5.1 115/230 Volt units: Check position of input voltage selector switch S2.
	5.2 Check power control board PC1 and connections. Replace if necessary.
	5.3 Check safety control board PC2 and connections. Replace if necessary.

Problem	Cause/Solution
6. No air flow; POWER ON and READY LEDs illuminated; PRESSURE, TORCH CAP and OVER-TEMP LEDs extinguished; fan operating.	6.1 Check air system for leaks. 6.2 Check for proper torch lead connections. 6.3 Check coil voltage and connections of gas valve GS1. Check continuity of coil. Replace if necessary. 6.4 Check safety control board PC2 and connections. Replace if necessary.
7. PRESSURE LED illuminated; READY LED extinguished.	7.1 Check for correct air pressure. 7.2 Check for sufficient air supply pressure. 7.3 Check air system for leaks. 7.4 Check for dirty air filter/regulator and clean, if needed.
8. TORCH CAP LED illuminated; READY LED extinguished.	8.1 Check torch retaining cap to ensure it is tight. 8.2 Check for proper torch lead connections. 8.3 Check safety control board PC2 and connections. Replace if necessary.
9. OVER-TEMP LED illuminated; READY LED extinguished.	9.1 Thermostat TP1 is open (overheating). Allow the fan to operate; the thermostat closes when the unit has cooled. 9.2 Check transformer T1 for signs of winding failure. Check continuity across windings and check connections. Check secondary voltages. Replace if necessary. 9.3 Check safety control board PC2 and connections. Replace if necessary.
10. Fan not operating; POWER ON and READY LEDs illuminated.	10.1 Check coil voltage and connections of fan motor FM. Check continuity of coil. Replace if necessary.
11. PRESSURE, TORCH CAP and OVER-TEMP LEDs not working.	11.1 Check safety control board PC2 and connections. Replace if necessary.

Resistance Values	
a)	Tolerance $\pm 10\%$ unless specified
b)	Turn Off (O) and remove input power plug from receptacle before checking resistance.
R1	All values for T1 are less than 1 ohm

Voltage Readings	
a)	Tolerance $\pm 10\%$ unless specified
b)	Reference - to circuit common, lead 43 unless noted
V1, V2, V3	115 VAC
V4	170 VAC
V5, V6, V7	18 VAC
V8	24 VAC
V9	255 VDC open-circuit voltage
V10	22.5 VDC during pilot arc
V11	12 VDC
V12, V13	24 VDC
V14	255 VDC open-circuit voltage

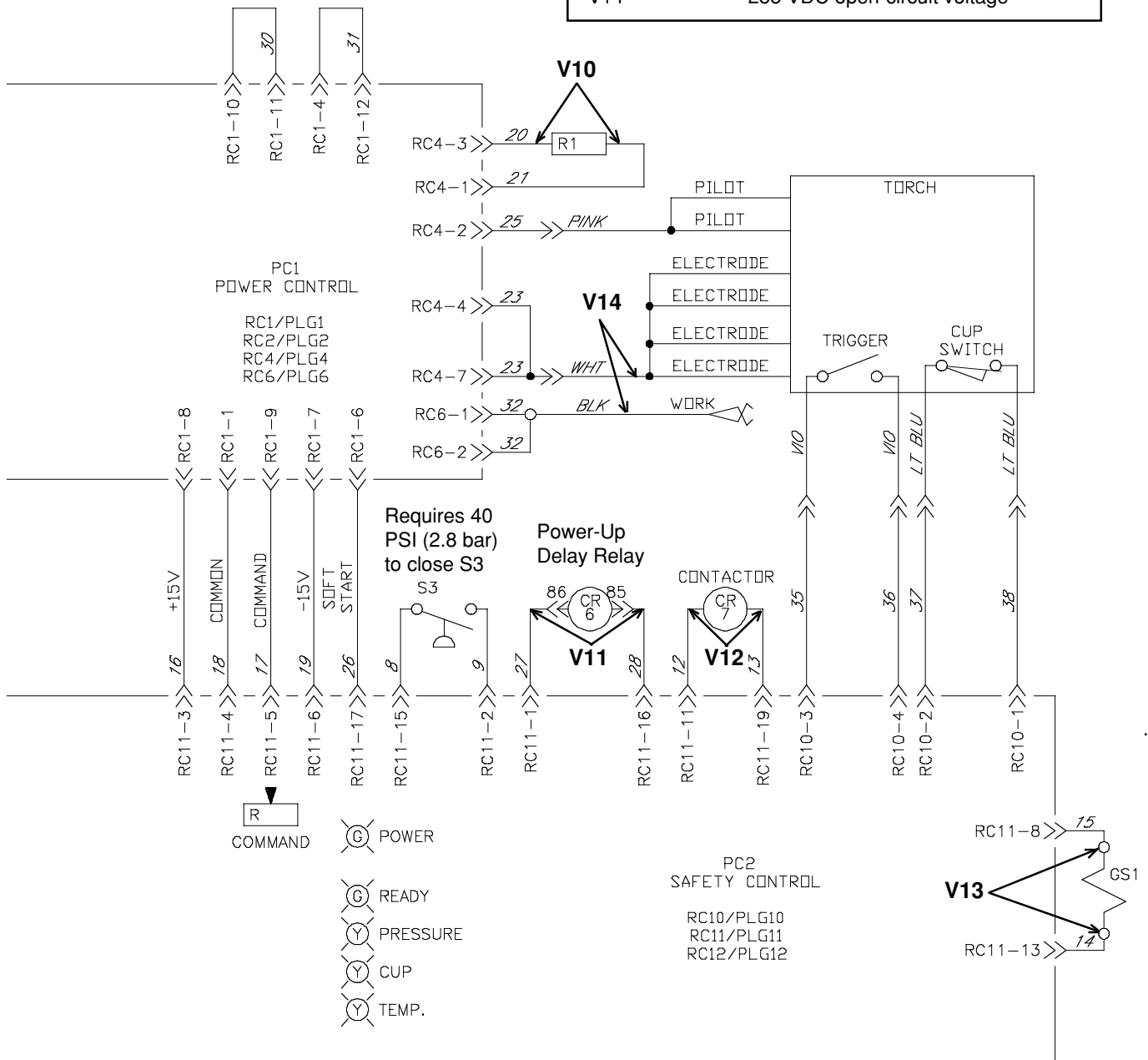
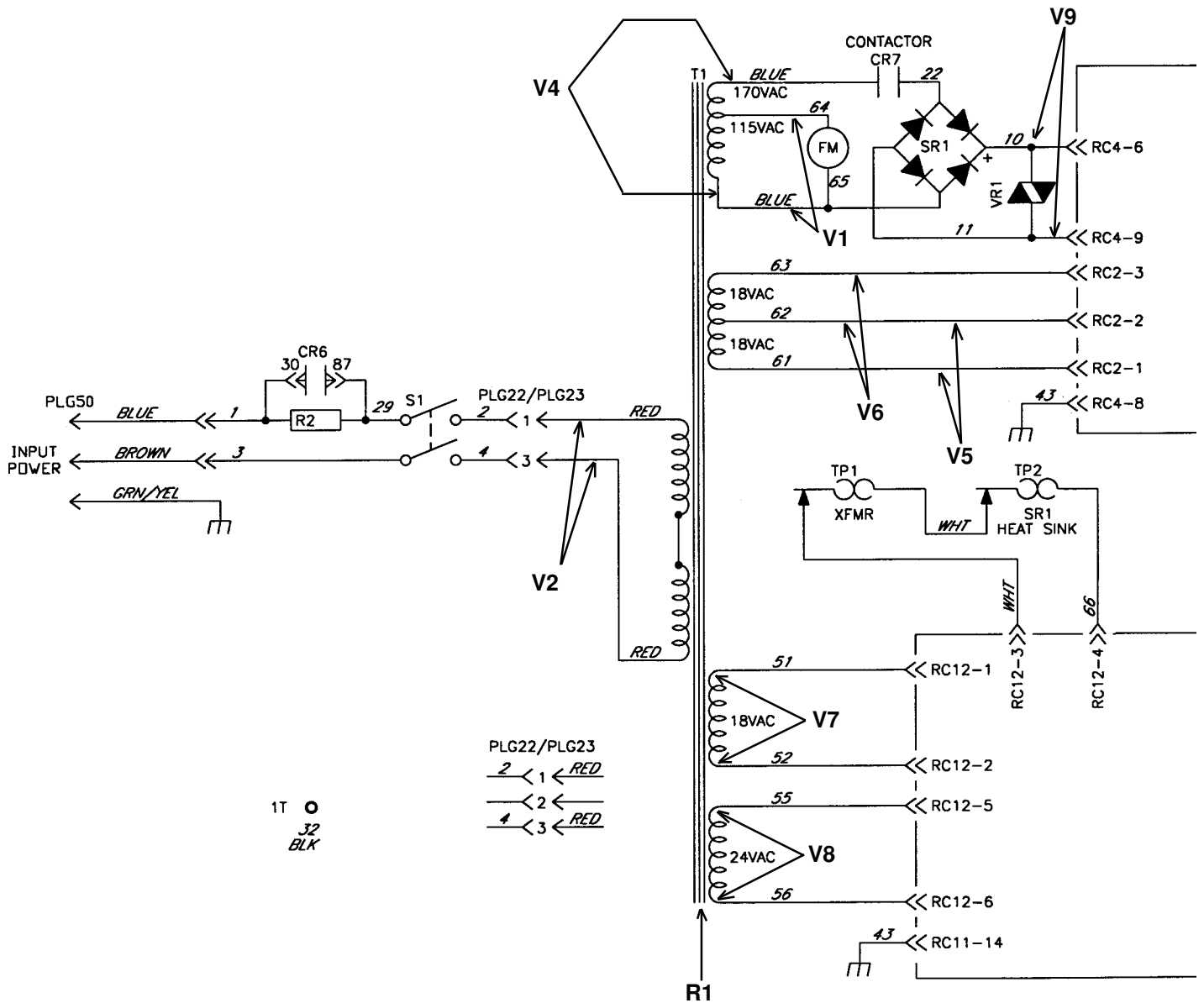


Figure 3-4.1 Wiring Diagram, 115/230 Volt

WARNING

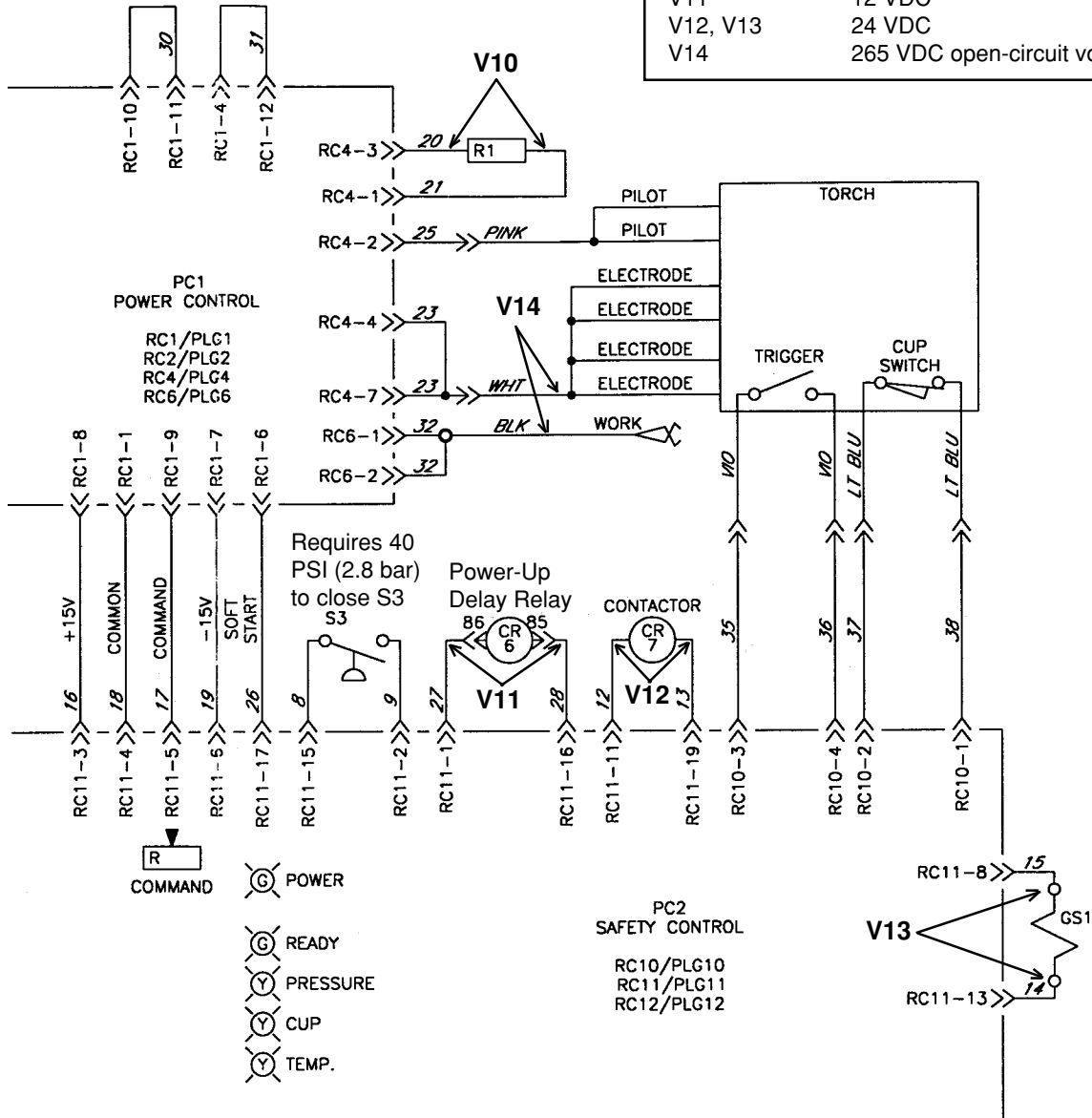
SHOCK HAZARD: Always turn off the power and unplug the cord or set the line disconnect switch to Off before servicing the unit or changing consumable parts. In the U.S., use a "lock-out / tag-out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.



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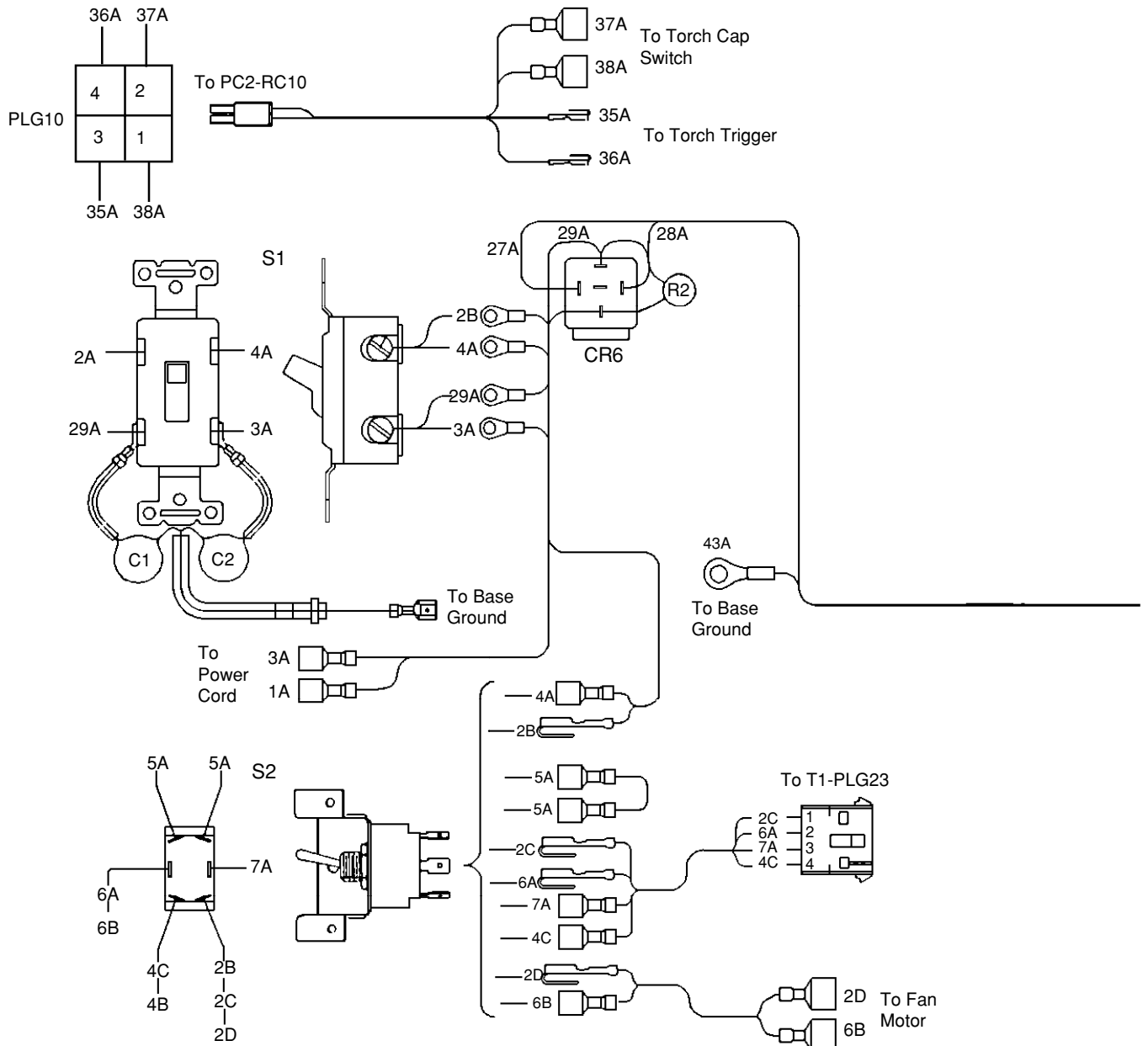
Resistance Values	
a)	Tolerance $\pm 10\%$ unless specified
b)	Turn Off (O) and remove input power plug from receptacle before checking resistance.
R1	All values for T1 are less than 1 ohm

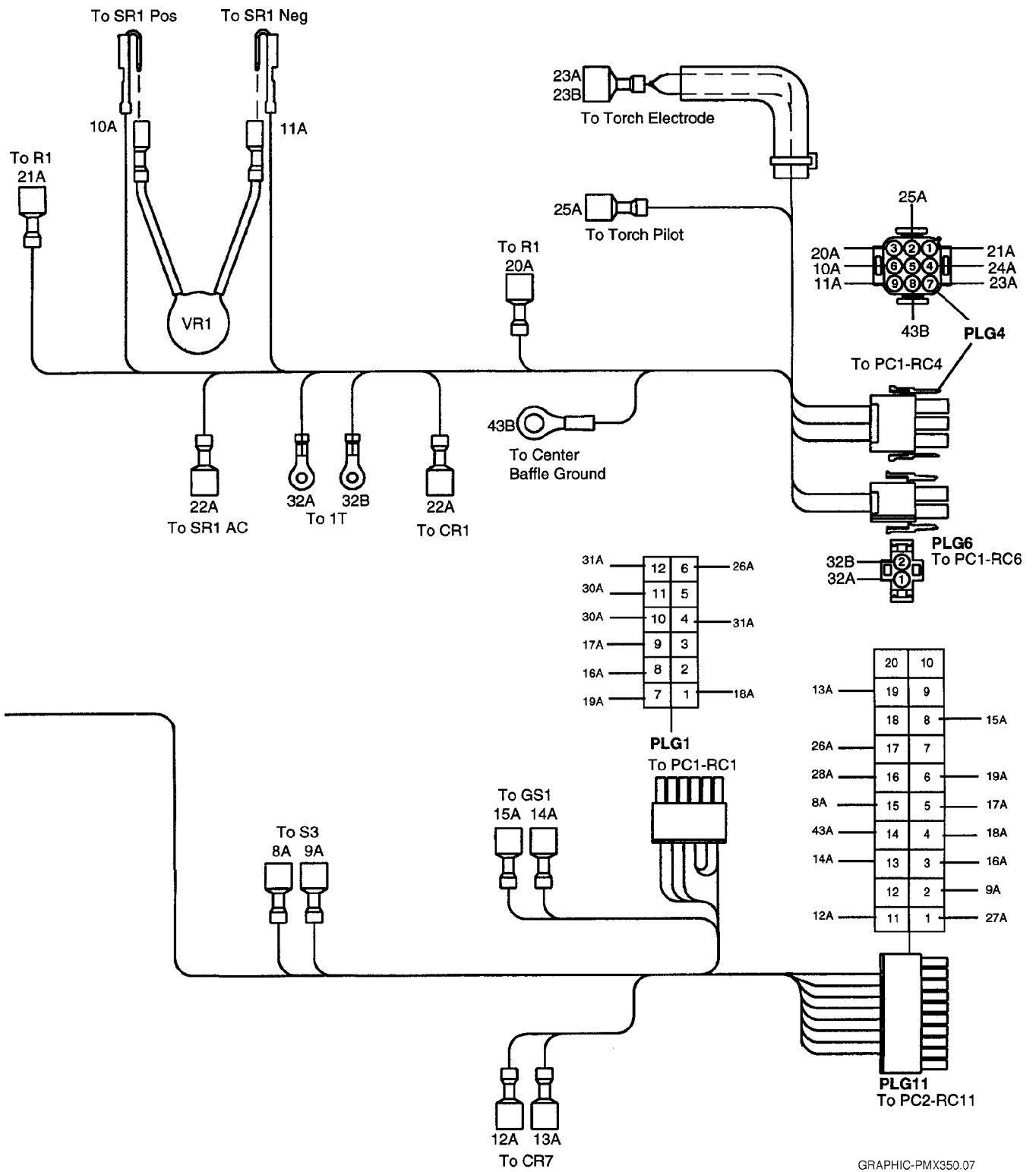
Voltage Readings	
a)	Tolerance $\pm 10\%$ unless specified
b)	Reference - to circuit common, lead 43 unless noted
V1	115 VAC
V2	200 VAC
V4	170 VAC
V5, V6, V7	18 VAC
V8	24 VAC
V9	265 VDC open-circuit voltage
V10	22.5 VDC during pilot arc
V11	12 VDC
V12, V13	24 VDC
V14	265 VDC open-circuit voltage



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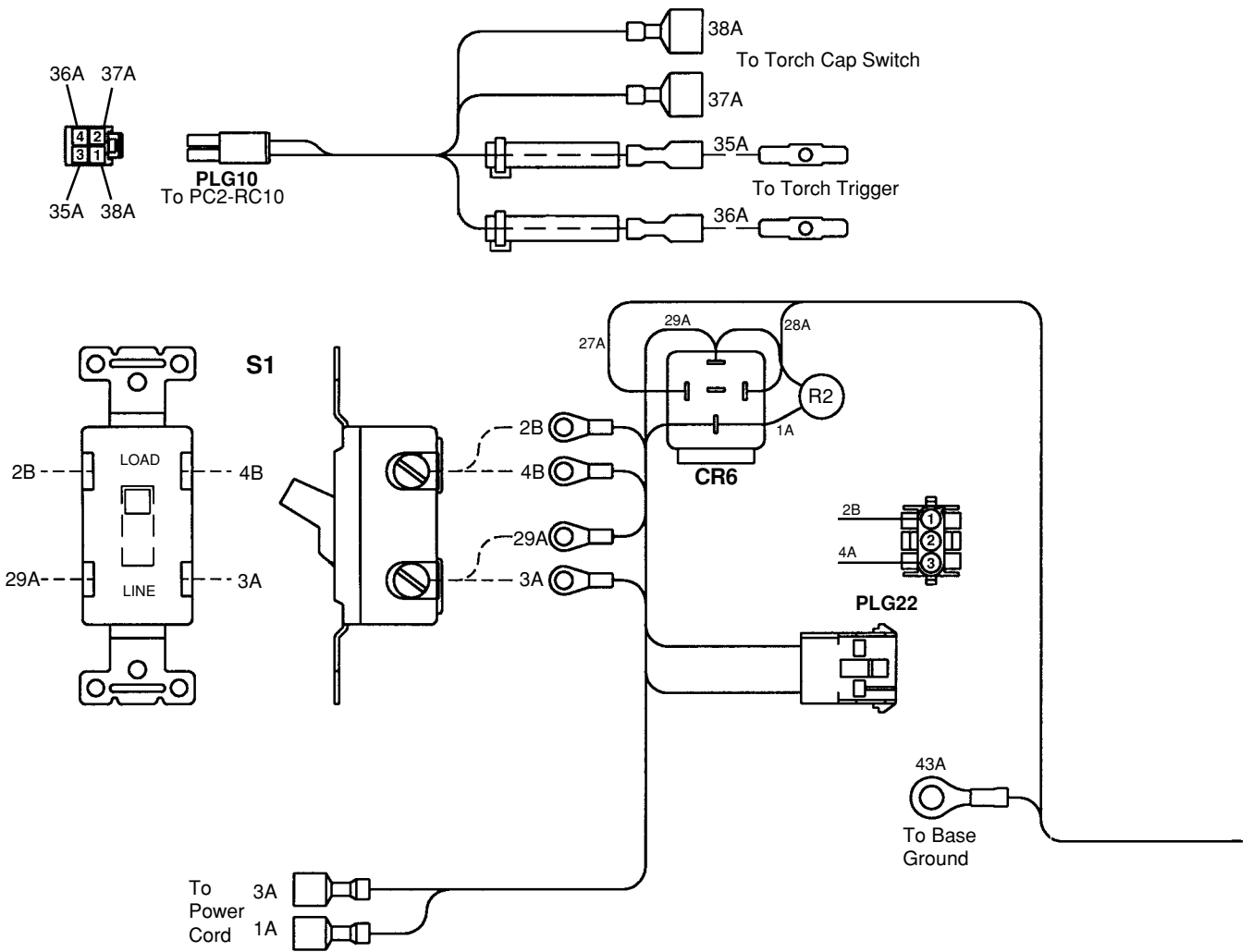
Figure 3-4.2 Wiring Diagram, 200 Volt



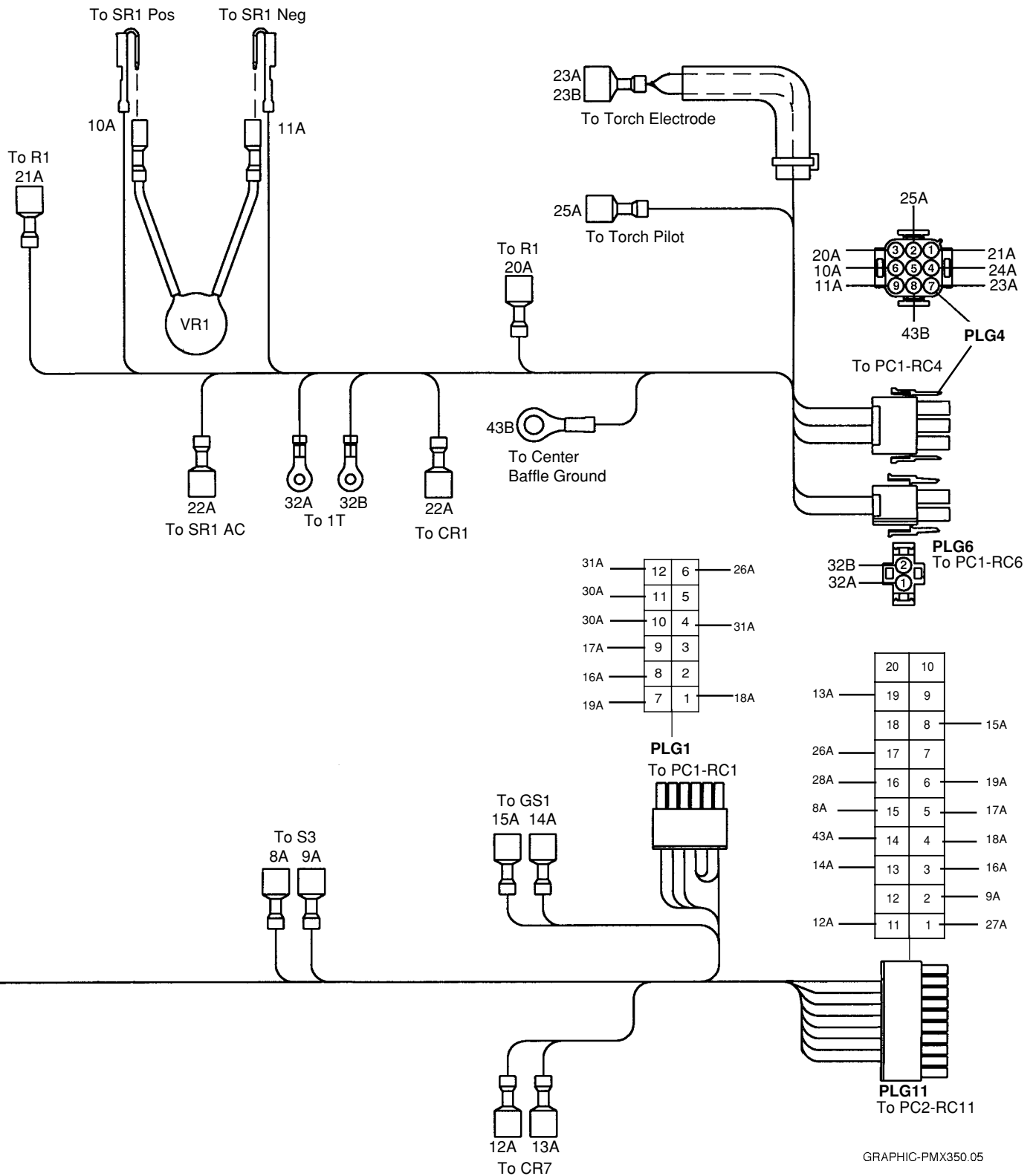


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Figure 3-5.1 Wiring Harness Diagram, 115/230 Volt



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GRAPHIC-PMX350.05

Figure 3-5.2 Wiring Harness Diagram, 200 Volt

PAC110 TORCH REPAIR

Parts and Required Tools

The PAC110 torch can be repaired in the field by removing the torch main body from the torch assembly and installing a new torch main body and a plastic cinch strap (Tyrap). To perform the repair, the following customer-supplied tools are required:

- #1 Phillips-head screwdriver
- 7/16 inch (11 mm) open-end wrench
- Wire cutters
- Crimping tool



WARNING



SHOCK HAZARD: Always turn off the power and unplug the cord or set the line disconnect switch to Off before servicing the unit or changing consumable parts. In the U.S., use a "lock-out / tag-out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.

Torch Main Body Removal and Replacement

To disassemble and repair the torch, refer to Figure 3-6 and perform the following procedure:

1. Remove the 5 screws which secure the handle halves together.
2. Remove the torch main body and torch switch from the handle halves.
3. Cut and remove the cinch strap (Tyrap).
4. Cut the 4 white wires connecting the torch lead to the plunger. Cut the wires at the butt splice.
5. Cut the 2 blue wires connecting the torch lead to the microswitch. Cut the wires at the butt splices.
6. Cut the 2 red wire connecting the torch lead to the pilot arc lead. Cut the wire at the butt splice.
7. Disconnect the torch main body and torch lead gas fitting using the 7/16 inch open-end wrench.

To install the new torch, reverse the removal procedure:

1. While holding the torch main body to keep the wires from twisting, connect the body assembly and the torch lead gas fitting using the 7/16 inch open-end wrench.
2. Connect the 2 red wire from the torch lead to the butt splice connecting the red wire to the pilot arc fitting using the crimping tool.
3. Connect the 2 blue wires from the torch lead to the butt splices connecting the white wires to the microswitch using the crimping tool.
4. Connect the 4 white wires from the torch lead to the butt splice connecting the black plunger wire to the torch main body using the crimping tool.

5. Install the new cinch strap (Tyrap) as shown.
6. Install the torch main body assembly and torch switch into one of the handle halves. While positioning the handle halves together, be careful not to pinch any wires, especially around the torch switch retainers.
7. Replace the 5 screws to secure the handle halves together. If the seams do not fit together tightly, remove the screws and check for pinched wires.

Torch Switch Removal and Replacement

To disassemble and repair the torch, refer to Figure 3-6 and perform the following procedure.

1. Remove the 5 screws that secure the handle halves together.
2. Remove the torch switch from the handle.
3. Remove the torch switch by cutting the 2 splices at the torch lead (violet wires).
4. Replace the torch switch by crimping the switch wires and the violet wires from the torch lead together with the splices.
5. Install the torch switch back into the handle. While positioning the handle halves together, be careful not to pinch any wires, especially around the torch switch retainers.
6. Replace the 5 screws to secure the handle halves together.

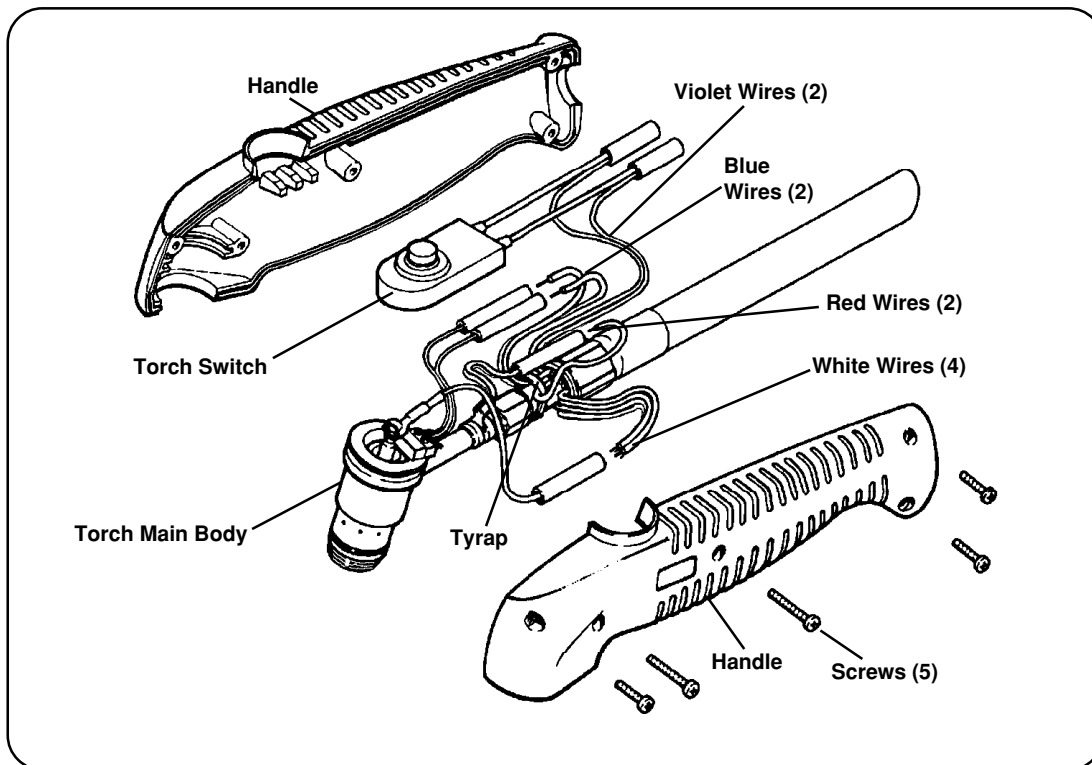


Figure 3-6 PAC110 Torch Repair

TECHNICAL QUESTIONS

If you are unable to fix the problem with your Powermax350 by following this basic troubleshooting guide or if you need further assistance:

1. Call your distributor, who will be able to help you, or refer you to an authorized Hypertherm repair facility.
2. Call Hypertherm Technical Service or the nearest Hypertherm office listed in the front of this manual.

Section 4 PARTS LIST

In this section:

115/230 Volt Power Supply	4-2
200 Volt Power Supply	4-4
PAC110 Torch Assembly and Leads	4-6
Consumable Parts	4-7

PARTS LIST

115/230 VOLT POWER SUPPLY

Index No.	Part No.	Description	Ref. Desig.	Quantity
1	060074	Varistor	VR1	1
2	060044	Rectifier, integ 40A 800V	SR1	1
3	060052	Heat Sink	-	1
4	060042	Insulator, end	-	2
5	060043	Bracket, resistor	-	1
6	060049	Resistor, wire wound, fixed 338W 1.5 ohm	R1	1
7	060015	Stand-Off Support PC card	-	4
8	060065	Switch, Pressure 40 psi fixed	S3	1
9	060055	Fitting, plastic qdisc elbow 1/4 NPT x 1/4 OD tubing	-	2
10	060063	Fitting, pipe brass tee 1/8 NPT	-	1
11	060064	Fitting, pipe brass nipple 1/8 NPT	-	1
12	060062	Fitting, pipe brass elbow ST 1/4 NPT	-	1
13	060066	Fitting, pipe brass nipple L 1/4 NPT x 2.5	-	1
14	060067	Fitting, pipe brass coupling 1/4 NPT	-	1
15	060033	Fitting, pipe stainless qdisc M 1/4 NPT (in consum. box)	-	1
	060059	Fitting, pipe brass plug schnd 1/4 NPT	-	1
16	015540	Gasket, neoprene	-	1
17	060057	Bracket, mounting air filter/regulator	-	1
18	060058	Gauge, pressure 0-160 psi 1/8 NPT	-	1
19	060056	Regulator/Filter, 250 psig in 100 psig max out	-	1
20	060060	Fitting, pipe brass barbed female 3/16 tbg 1/8 NPT	-	1
21	060001	Baffle, center	-	1
		Insulator, edge trim	-	1
		Bushing, snap in	-	1
22	060019	Stand-off, 6-32 x .437 long	-	3
23	060040	Assembly, circuit card, power control	PC1	1
24	060003	Handle, lifting	-	1
25	060002	Cover	-	1
26	060028	Box, consumable storage	-	1
	060027	Shelf, consumable box storage	-	1
	060029	Door, consumable box storage	-	1
	060030	Catch, consumable storage	-	1
	060031	Hinge, consumable storage	-	1
27	060075	Switch, toggle, DPST, 40A 600V	S1	1
	060034	Gasket, switch	-	1
28	060076	Relay, enclosed, 12 VDC SPST	CR6	1
29	060000	Case Section, base/back/front	-	1
30	060014	Connector, cable clamp .750	-	1
31	060012	Cable, power 10 ft. 14 gauge 3/C	PLG50	1
	060013	Cable, power 10 ft. 14 gauge 3/C (CE)	PLG50	1
32	060006	Fan, motor 115V 50/60 Hz 3100 RPM	FM	1
33	060007	Transformer, power main 115/230V	T1	1
	060008	Transformer, power main 115/230V (CE)	T1	1
34	060004	Mount, neoprene	-	6
35	060011	Bushing, strain relief .455/.629 ID x 1.115 mtg	-	1
36	060009	Cable, work 15 ft. 12 gauge with clamp	-	1
37	060010	Bushing, strain relief .500 ID x .455 mtg hole	-	1
38	060016	Knob, pointer PowerMax	-	1
39	060041	Assembly, circuit card, safety control	PC2	1
40	060018	Stand-Off Support PC card	-	4
41	060080	Bracket, switch	-	1
42	060079	Switch, toggle DPDT 15A 125 VAC	S2	1
43	060078	Thermistor, PTC 8A 250V	R2	1
44	060070	Assembly, capacitor	C1, C2	1
45	060053	Valve, 24 VAC 3-way 1/8 NPT 5/32 orifice 100 psi	GS1	1
	060024	Tubing, pneumatic .250 OD x .170 ID x 13.5 inches	-	1
46	060054	Fitting, pipe brass adapter 1/8 NPT	-	1
47	060005	Contact, def prp 25A 1P 24V	CR7	1

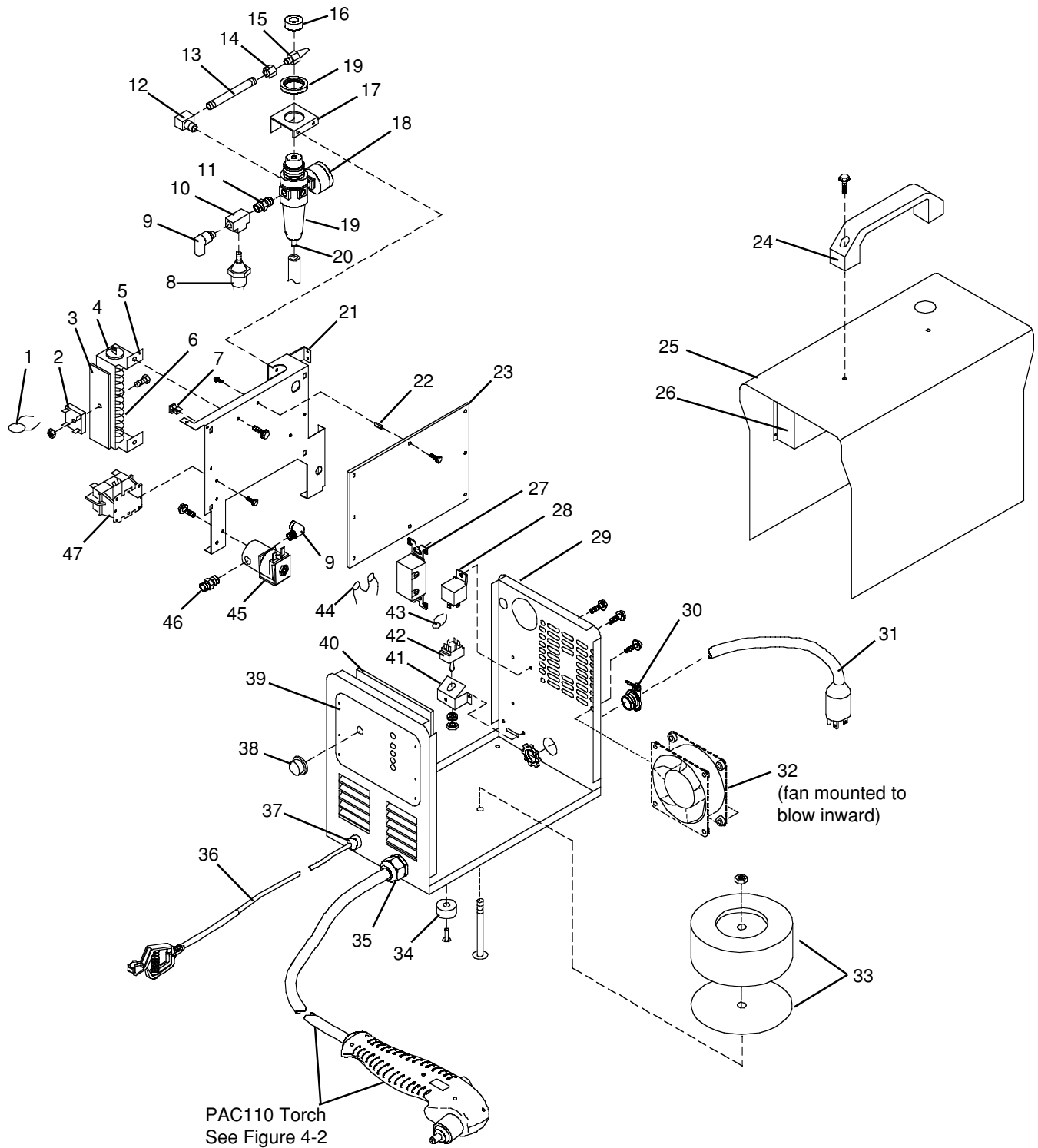
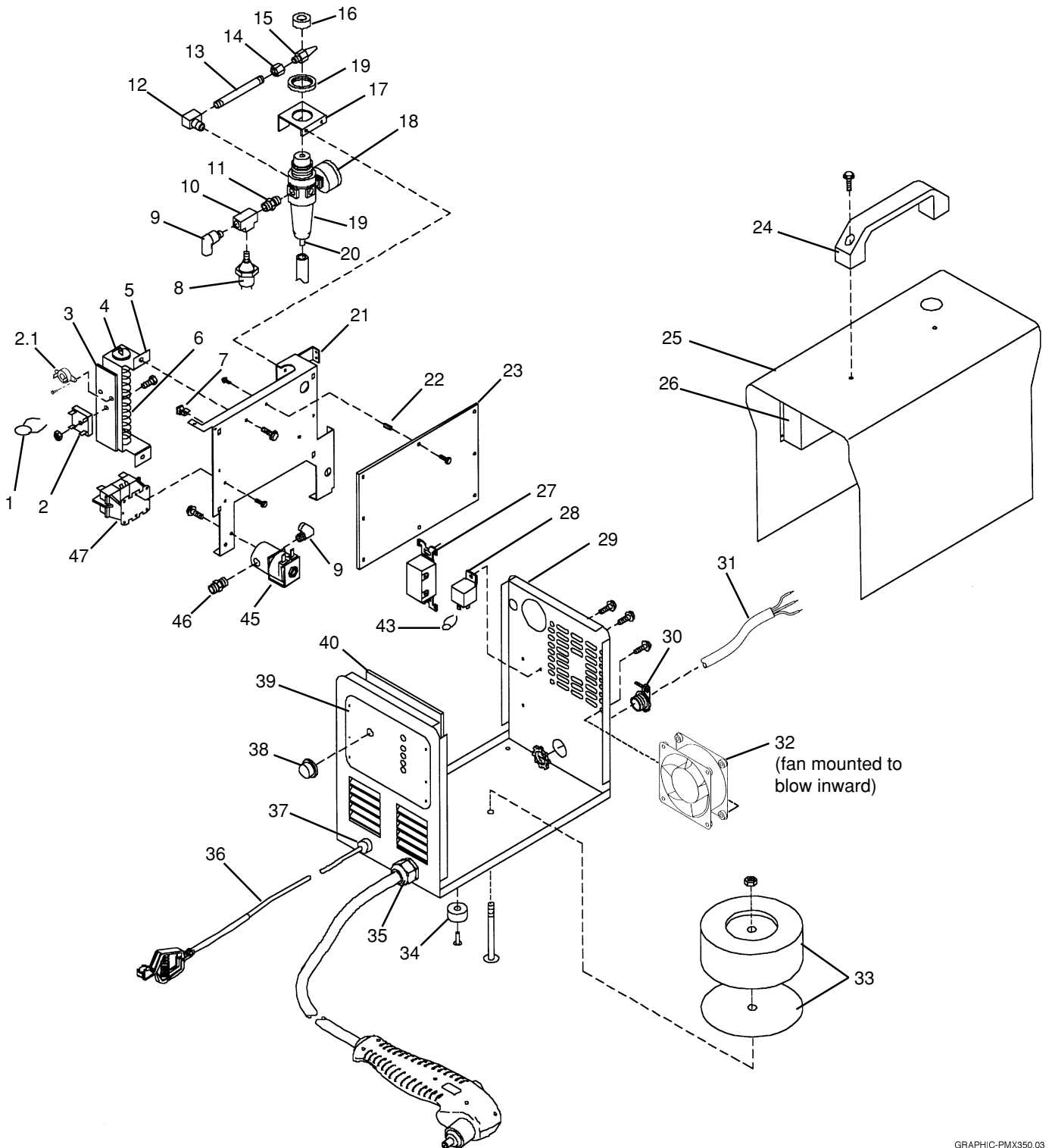


Figure 4-1.1 115/230 Volt Powermax350 Power Supply

PARTS LIST

200 VOLT POWER SUPPLY

Index No.	Part No.	Description	Ref. Desig.	Quantity
1	060074	Varistor	VR1	1
2	060044	Rectifier, integ 40A 800V	SR1	1
2.1	060129	Thermostat, NC open 70C	-	1
3	060052	Heat Sink	-	1
4	060042	Insulator, end	-	2
5	060043	Bracket, resistor	-	1
6	060049	Resistor, wire wound, fixed 338W 1.5 ohm	R1	1
7	060015	Stand-Off Support PC card	-	4
8	060065	Switch, Pressure 40 psi fixed	S3	1
9	060055	Fitting, plastic qdisc elbow 1/4 NPT x 1/4 OD tubing	-	2
10	060063	Fitting, pipe brass tee 1/8 NPT	-	1
11	060064	Fitting, pipe brass nipple 1/8 NPT	-	1
12	060062	Fitting, pipe brass elbow ST 1/4 NPT	-	1
13	060066	Fitting, pipe brass nipple L 1/4 NPT x 2.5	-	1
14	060067	Fitting, pipe brass coupling 1/4 NPT	-	1
15	060033	Fitting, pipe stainless qdisc M 1/4 NPT (in consum. box)	-	1
	060059	Fitting, pipe brass plug schnd 1/4 NPT	-	1
16	015540	Gasket, neoprene	-	1
17	060057	Bracket, mounting air filter/regulator	-	1
18	060058	Gauge, pressure 0-160 psi 1/8 NPT	-	1
19	060056	Regulator/Filter, 250 psig in 100 psig max out	-	1
20	060060	Fitting, pipe brass barbed female 3/16 tbg 1/8 NPT	-	1
21	060001	Baffle, center	-	1
		Insulator, edge trim	-	1
		Bushing, snap in	-	1
22	060019	Stand-off, 6-32 x .437 long	-	3
23	060040	Assembly, circuit card, power control	PC1	1
24	060003	Handle, lifting	-	1
25	060002	Cover	-	1
26	060028	Box, consumable storage	-	1
	060027	Shelf, consumable box storage	-	1
	060029	Door, consumable box storage	-	1
	060030	Catch, consumable storage	-	1
	060031	Hinge, consumable storage	-	1
27	060075	Switch, toggle, DPST, 40A 600V	S1	1
	060034	Gasket, switch	-	1
28	060076	Relay, enclosed, 12 VDC SPST	CR6	1
29	060000	Case Section, base/back/front	-	1
30	060014	Connector, cable clamp .750	-	1
31	060013	Cable, power 10 ft. 14 gauge 3/C	PLG50	1
32	060006	Fan, motor 115V 50/60 Hz 3100 RPM	FM	1
33	060125	Transformer, power main 200V	T1	1
34	060004	Mount, neoprene	-	6
35	060011	Bushing, strain relief .455/.629 ID x 1.115 mtg	-	1
36	060009	Cable, work 15 ft. 12 gauge with clamp	-	1
37	060010	Bushing, strain relief .500 ID x .455 mtg hole	-	1
38	060016	Knob, pointer PowerMax	-	1
39	060041	Assembly, circuit card, safety control	PC2	1
40	060018	Stand-Off Support PC card	-	4
41	-	-	-	-
42	-	-	-	-
43	060078	Thermistor, PTC 8A 250V	R2	1
44	-	-	-	-
45	060053	Valve, 24 VAC 3-way 1/8 NPT 5/32 orifice 100 psi	GS1	1
	060024	Tubing, pneumatic .250 OD x .170 ID x 13.5 inches	-	1
46	060054	Fitting, pipe brass adapter 1/8 NPT	-	1
47	060005	Contact, def prp 25A 1P 24V	CR7	1



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Figure 4-1.2 200 Volt Powermax350 Power Supply

PARTS LIST

PAC110 Torch Assembly

Index No.	Part No.	Description	Quantity
	070057	Torch Assembly with 15 ft (4.5 m) Lead	
	070058	Torch Assembly with 25 ft (7.6 m) Lead	
1	001192	Handle, PAC110	1
2	075339	Screws, P/S, # 4 X 1/2, PH, RND, S/B	3
3	075341	Screws, P/S, # 4 X 3/4, PH, RND, S/B	2
4	005094	Switch, Torch Pushbutton	1
5	020588	Torch Main Body with Micro-Switch, PAC110	1
6	044016	O-Ring: BUNA 90 Duro .614X.070	1
7	029241	Torch Lead, 15 ft (4.5 m)	1
7	029257	Torch Lead, 25 ft (7.6 m)	1

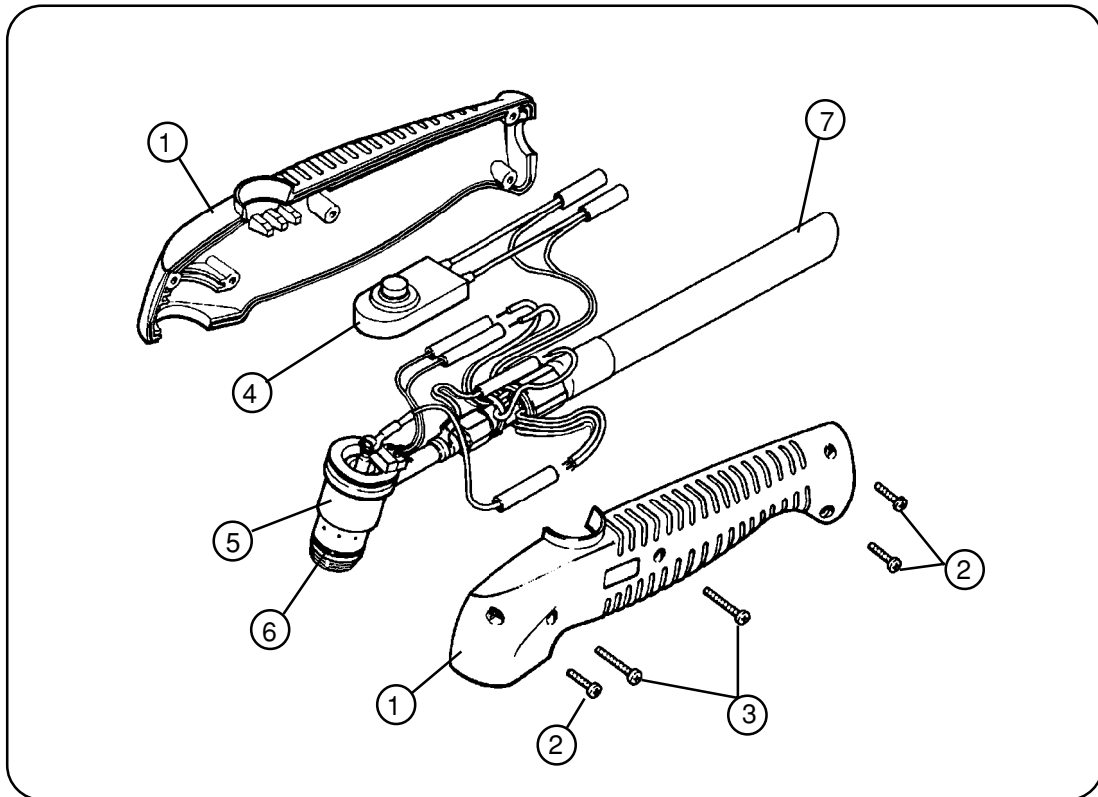


Figure 4-2 PAC110 Torch Assembly and Torch Leads

CONSUMABLE PARTS

Index No.	Part No.	Description	Quantity
1	020239	Ring, Swirl	1
2	020382	Electrode, Extended	1
3	120504	Nozzle, Extended, 25A	1
4	020218	Cap, Retaining	1

The consumable parts are found in a box, located in the left side of the power supply cover.

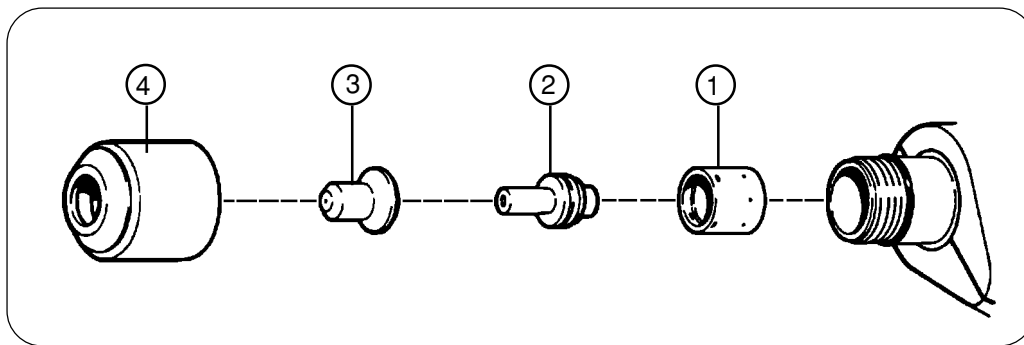


Figure 4-3 Consumable Parts