THERMAL DYNAMICS®

A THERMADYNE® Company

# PAK MASTER® 100

## Air Plasma Cutting System

## With PCH-53P Torch

***The System Includes:***

- ***PAK MASTER® 100 Power Supply***
- ***PCH-53P Torch with Leads***
- ***Work Cable with Clamp***
- ***Input Gas Regulator Assembly***

# Service Manual

**April 11, 1997** **Manual No. 0-2465**

**WARNING** Read and understand this entire Servive Manual and your employer's safety practices before installing, operating, or servicing the equipment.

**WARNING** While the information contained in this Service Manual represents our best judgement, Thermal Dynamics Corporation assumes no liability for its use.

Pak Master® 100 Air Plasma Cutting System With PCH-53P Torch
Service Manual Number 0-2465

Published by:
Thermal Dynamics Corporation
Industrial Park No. 2
West Lebanon, New Hampshire, USA 03784
(603) 298-5711



Printed in the United States of America

April 11, 1997

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# SECTION 1: GENERAL INFORMATION

## 1.01 Notes, Cautions and Warnings

Throughout this manual, notes, cautions, and warnings are used to highlight important information. These highlights are categorized as follows:

***NOTE***

*An operation, procedure, or background information which requires additional emphasis or is helpful in efficient operation of the system.*

***CAUTION***

*A procedure which, if not properly followed, may cause damage to the equipment.*

***WARNING***

*A procedure which, if not properly followed, may cause injury to the operator or others in the operating area.*

## 1.02 Important Safety Precautions

***WARNING***

*OPERATION AND MAINTENANCE OF PLASMA ARC EQUIPMENT CAN BE DANGEROUS AND HAZARDOUS TO YOUR HEALTH.*

*To prevent possible injury, read, understand and follow all warnings, safety precautions and instructions before using the equipment. Call 1-603-298-5711 or your local distributor if you have any questions.*

GASES AND FUMES

Gases and fumes produced during the plasma cutting process can be dangerous and hazardous to your health.

- Keep all fumes and gases from the breathing area. Keep your head out of the welding fume plume.
- Use an air-supplied respirator if ventilation is not adequate to remove all fumes and gases.
- The kinds of fumes and gases from the plasma arc depend on the kind of metal being used, coatings on the metal, and the different processes. You must be very careful when cutting or welding any metals which may contain one or more of the following:

| | | |
|---|---|---|
| Antimony | Chromium | Mercury |
| Arsenic | Cobalt | Nickel |
| Barium | Copper | Selenium |
| Beryllium | Lead | Silver |
| Cadmium | Manganese | Vanadium |

- Always read the Material Safety Data Sheets (MSDS) that should be supplied with the material you are using. These MSDSs will give you the information regarding the kind and amount of fumes and gases that may be dangerous to your health.
- For information on how to test for fumes and gases in your workplace, refer to item 1 in Subsection 1.03, Publications in this manual.
- Use special equipment, such as water or down draft cutting tables, to capture fumes and gases.
- Do not use the plasma torch in an area where combustible or explosive gases or materials are located.
- Phosgene, a toxic gas, is generated from the vapors of chlorinated solvents and cleansers. Remove all sources of these vapors.

ELECTRIC SHOCK

Electric Shock can injure or kill. The plasma arc process uses and produces high voltage electrical energy. This electric energy can cause severe or fatal shock to the operator or others in the workplace.

- Never touch any parts that are electrically “live” or “hot.”
- Wear dry gloves and clothing. Insulate yourself from the work piece or other parts of the welding circuit.
- Repair or replace all worn or damaged parts.
- Extra care must be taken when the workplace is moist or damp.
- Install and maintain equipment according to NEC code, refer to item 4 in Subsection 1.03, Publications.
- Disconnect power source before performing any service or repairs.
- Read and follow all the instructions in the Operating Manual.

FIRE AND EXPLOSION

Fire and explosion can be caused by hot slag, sparks, or the plasma arc.

- Be sure there is no combustible or flammable material in the workplace. Any material that cannot be removed must be protected.
- Ventilate all flammable or explosive vapors from the workplace.
- Do not cut or weld on containers that may have held combustibles.
- Provide a fire watch when working in an area where fire hazards may exist.
- Hydrogen gas may be formed and trapped under aluminum workpieces when they are cut underwater or while using a water table. **DO NOT** cut aluminum alloys underwater or on a water table unless the hydrogen gas can be eliminated or dissipated. Trapped hydrogen gas that is ignited will cause an explosion.

NOISE

Noise can cause permanent hearing loss. Plasma arc processes can cause noise levels to exceed safe limits. You must protect your ears from loud noise to prevent permanent loss of hearing.

- To protect your hearing from loud noise, wear protective ear plugs and/or ear muffs. Protect others in the workplace.
- Noise levels should be measured to be sure the decibels (sound) do not exceed safe levels.
- For information on how to test for noise, see item 1 in Subsection 1.03, Publications, in this manual.

PLASMA ARC RAYS

Plasma Arc Rays can injure your eyes and burn your skin. The plasma arc process produces very bright ultra violet and infra red light. These arc rays will damage your eyes and burn your skin if you are not properly protected.

- To protect your eyes, always wear a welding helmet or shield. Also always wear safety glasses with side shields, goggles or other protective eye wear.
- Wear welding gloves and suitable clothing to protect your skin from the arc rays and sparks.
- Keep helmet and safety glasses in good condition. Replace lenses when cracked, chipped or dirty.
- Protect others in the work area from the arc rays. Use protective booths, screens or shields.
- Use the shade of lens as recommended in Subsection 1.03, item 4.

## 1.03 Publications

Refer to the following standards or their latest revisions for more information:

1. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
3. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018
6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES, obtainable from American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING AND ALLIED PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. NFPA Standard 70, NATIONAL ELECTRICAL CODE, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202

12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING, obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3
13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103
14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018

## 1.04 Note, Attention et Avertissement

Dans ce manuel, les mots “note,” “attention,” et “avertissement” sont utilisés pour mettre en relief des informations à caractère important. Ces mises en relief sont classifiées comme suit :

***NOTE***

*Toute opération, procédure ou renseignement général sur lequel il importe d’insister davantage ou qui contribue à l’efficacité de fonctionnement du système.*

***ATTENTION***

*Toute procédure pouvant résulter l’endommagement du matériel en cas de non-respect de la procédure en question.*

***AVERTISSEMENT***

*Toute procédure pouvant provoquer des blessures de l’opérateur ou des autres personnes se trouvant dans la zone de travail en cas de non-respect de la procédure en question.*

## 1.05 Precautions De Securite Importantes

***AVERTISSEMENT***

*L’OPÉRATION ET LA MAINTENANCE DU MATÉRIEL DE SOUDAGE À L’ARC AU JET DE PLASMA PEUVENT PRÉSENTER DES RISQUES ET DES DANGERS DE SANTÉ.*

*Il faut communiquer aux opérateurs et au personnel TOUS les dangers possibles. Afin d’éviter les blessures possibles, lisez, comprenez et suivez tous les avertissements, toutes les précautions de sécurité et toutes les consignes avant d’utiliser le matériel. Composez le + 603-298-5711 ou votre distributeur local si vous avez des questions.*

FUMÉE et GAZ

La fumée et les gaz produits par le procédé de jet de plasma peuvent présenter des risques et des dangers de santé.

- Eloignez toute fumée et gaz de votre zone de respiration. Gardez votre tête hors de la plume de fumée provenant du chalumeau.
- Utilisez un appareil respiratoire à alimentation en air si l’aération fournie ne permet pas d’éliminer la fumée et les gaz.
- Les sortes de gaz et de fumée provenant de l’arc de plasma dépendent du genre de métal utilisé, des revêtements se trouvant sur le métal et des différents procédés. Vous devez prendre soin lorsque vous coupez ou soudez tout métal pouvant contenir un ou plusieurs des éléments suivants:

| | | |
|---|---|---|
| antimoine | cadmium | mercure |
| argent | chrome | nickel |
| arsenic | cobalt | plomb |
| baryum | cuivre | sélénium |
| béryllium | manganèse | vanadium |

- Lisez toujours les fiches de données sur la sécurité des matières (sigle américain “MSDS”); celles-ci devraient être fournies avec le matériel que vous utilisez. Les MSDS contiennent des renseignements quant à la quantité et la nature de la fumée et des gaz pouvant poser des dangers de santé.
- Pour des informations sur la manière de tester la fumée et les gaz de votre lieu de travail, consultez l’article 1 et les documents cités à la page 5.

- Utilisez un équipement spécial tel que des tables de coupe à débit d'eau ou à courant descendant pour capter la fumée et les gaz.
- N'utilisez pas le chalumeau au jet de plasma dans une zone où se trouvent des matières ou des gaz combustibles ou explosifs.
- Le phosgène, un gaz toxique, est généré par la fumée provenant des solvants et des produits de nettoyage chlorés. Eliminez toute source de telle fumée.

## CHOC ELECTRIQUE

Les chocs électriques peuvent blesser ou même tuer . Le procédé au jet de plasma requiert et produit de l'énergie électrique haute tension. Cette énergie électrique peut produire des chocs graves, voire mortels, pour l'opérateur et les autres personnes sur le lieu de travail.

- Ne touchez jamais une pièce "sous tension" ou "vive"; portez des gants et des vêtements secs. Isolez-vous de la pièce de travail ou des autres parties du circuit de soudage.
- Réparez ou remplacez toute pièce usée ou endommagée.
- Prenez des soins particuliers lorsque la zone de travail est humide ou moite.
- Montez et maintenez le matériel conformément au Code électrique national des Etats-Unis. (Voir la page *5*, article 9.)
- Débranchez l'alimentation électrique avant tout travail d'entretien ou de réparation.
- Lisez et respectez toutes les consignes du Manuel de consignes.

## INCENDIE ET EXPLOSION

Les incendies et les explosions peuvent résulter des scories chaudes, des étincelles ou de l'arc de plasma. Le procédé à l'arc de plasma produit du métal, des étincelles, des scories chaudes pouvant mettre le feu aux matières combustibles ou provoquer l'explosion de fumées inflammables.

- Soyez certain qu'aucune matière combustible ou inflammable ne se trouve sur le lieu de travail. Protégez toute telle matière qu'il est impossible de retirer de la zone de travail.
- Procurez une bonne aération de toutes les fumées inflammables ou explosives.
- Ne coupez pas et ne soudez pas les conteneurs ayant pu renfermer des matières combustibles.
- Prévoyez une veille d'incendie lors de tout travail dans une zone présentant des dangers d'incendie.
- Le gas hydrogène peut se former ou s'accumuler sous les pièces de travail en aluminium lorsqu'elles sont coupées sous l'eau ou sur une table d'eau. NE PAS couper les alliages en aluminium sous l'eau ou sur une table d'eau à moins que le gas hydrogène peut s'échapper ou se dissiper . Le gas hydrogène accumulé explosera si enflammé.

## RAYONS D'ARC DE PLASMA

Les rayons provenant de l'arc de plasma peuvent blesser vos yeux et brûler votre peau. Le procédé à l'arc de plasma produit une lumière infra-rouge et des rayons ultra-violets très forts. Ces rayons d'arc nuiront à vos yeux et brûleront votre peau si vous ne vous protégez pas correctement.

- Pour protéger vos yeux, portez toujours un casque ou un écran de soudeur. Portez toujours des lunettes de sécurité munies de parois latérales ou des lunettes de protection ou une autre sorte de protection oculaire.
- Portez des gants de soudeur et un vêtement protecteur approprié pour protéger votre peau contre les étincelles et les rayons de l'arc.
- Maintenez votre casque et vos lunettes de protection en bon état. Remplacez toute lentille sale ou comportant fissure ou rognure.
- Protégez les autres personnes se trouvant sur la zone de travail contre les rayons de l'arc en fournissant des cabines ou des écrans de protection.
- Respectez le teint de lentille recommandé dans le article 4, page 5.

## BRUIT

Le bruit peut provoquer une perte permanente de l'ouïe. Les procédés de soudage à l'arc de plasma peuvent provoquer des niveaux sonores supérieurs aux limites normalement acceptables. V ous dú4ez vous protéger les oreilles contre les bruits forts afin d'éviter une perte permanente de l'ouïe.

- Pour protéger votre ouïe contre les bruits forts, portez des tampons protecteurs et/ou des protections auriculaires. Protégez également les autres personnes se trouvant sur le lieu de travail.
- Il faut mesurer les niveaux sonores afin d'assurer que les décibels (le bruit) ne dépassent pas les niveaux sûrs.

• Pour des renseignements sur la manière de tester le bruit, consultez l'article 1, page 5.

## 1.06 Documents De Reference

Consultez les normes suivantes ou les révisions les plus récentes ayant été faites à celles-ci pour de plus amples renseignements :

1. OSHA, NORMES DE SÉCURITÉ DU TRAVAILET DE PROTECTION DE LA SANTÉ, 29CFR 1910, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. Norme ANSI Z49.1, LA SÉCURITÉ DES OPÉRATIONS DE COUPE ET DE SOUDAGE, disponible auprès de la Société Américaine de Soudage (American Welding Society), 550 N.W. LeJeune Rd., Miami, FL 33126
3. NIOSH, LA SÉCURITÉ ET LA SANTÉ LORS DES OPÉRATIONS DE COUPE ET DE SOUDAGE À L'ARC ET AU GAZ, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. Norme ANSI Z87.1, PRATIQUES SURES POUR LA PROTECTION DES YEUX ET DU VISAGE AU TRAVAILET DANS LES ECOLES, disponible de l'InstitutAméricain des Normes Nationales (American National Standards Institute), 1430 Broadway, New York, NY10018
5. Norme ANSI Z41.1, NORMES POUR LES CHAUSSURES PROTECTRICES, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY10018
6. Norme ANSI Z49.2, PRÉVENTION DES INCENDIES LORS DE L'EMPLOI DE PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY10018
7. Norme A6.0 de l'Association Américaine du Soudage (AWS), LE SOUDAGE ET LACOUPE DE CONTENEURS AYANT RENFERMÉ DES PRODUITS COMBUSTIBLES, disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
8. Norme 51 de l'Association Américaine pour la Protection contre les Incendies (NFP A), LES SYSTEMES À GAZ AVEC ALIMENTATION EN OXYGENE POUR LE SOUDAGE, LA COUPE ET LES PROCÉDÉS ASSOCIÉS, disponible auprès de la National Fire ProtectionAssociation, Batterymarch Park, Quincy, MA02269
9. Norme 70 de la NFP A, CODE ELECTRIQUE NATIONAL, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. Norme 51B de la NFP A, LES PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA02269
11. Brochure GCA P-1, LA MANIPULATION SANS RISQUE DES GAZ COMPRIMÉS EN CYLINDRES, disponible auprès de l'Association des Gaz Comprimés (Compressed Gas Association), 1235 Jef ferson Davis Highway Suite 501, Arlington, VA 22202
12. Norme CSA W117.2, CODE DE SÉCURITÉ POUR LE SOUDAGE ET LA COUPE, disponible auprès de l'Association des Normes Canadiennes, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada, M9W 1R3
13. ivret NWSA, BIBLIOGRAPHIE SUR LASÉCURITÉ DU SOUDAGE, disponible auprès de l'Association Nationale de Fournitures de Soudage (National Welding Supply Association), 1900 Arch Street, Philadelphia, PA19103
14. Norme AWSF4.1 de l'Association Américaine de Soudage, RECOMMANDATIONS DE PRATIQUES SURES POUR LA PRÉP ARATION À LACOUPE ET AU SOUDAGE DE CONTENEURS ET TUYAUX AYANT RENFERMÉ DES PRODUITS DANGEREUX , disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
15. Norme ANSI Z88.2, PRATIQUES DE PROTECTION RESPIRATOIRE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY10018

## 1.07 Declaration of Conformity

Manufacturer: Thermal Dynamics Corporation
Address: Industrial Park #2
West Lebanon, New Hampshire 03784
USA

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 73/23/EU, as recently changed in Directive 93/63/EU) and to the National legislation for the enforcement of this Directive.

Serial numbers are unique with each individual piece of equipment and details description, parts used to manufacture a unit and date of manufacture.

**National Standard and Technical Specifications**

The product is designed and manufactured to a number of standards and technical requirements among them are:

* CSA (Canadian Standards Association) standard C22.2 number 60-M1990 for Arc welding equipment.

* UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.

* IEC 974-1 (BS 638-PT10) (EN 60 974-1) applicable to welding equipment and associated accessories.

* Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process, to ensure the product is safe and performs as specified. Rigorous testing is incorporated into the manufacturing process to ensure the manufactured product meets or exceeds all design specifications.

Thermal Dynamics has been manufacturing products that perform in a safe manner for more than 30 years and will continue to achieve excellence in our area of manufacture.

Manufacturers responsible representative: David Ashworth
Vice President & Managing Director
Thermadyne Europe
Chorley England.

## 1.08 Statement of Warranty

**LIMITED WARRANTY:** Thermal Dynamics Corporation (hereinafter "Thermal") warrants that its products will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within the time period applicable to the Thermal products as stated below, Thermal shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal's specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or accident, correct such defects by suitable repair or replacement, at Thermal's sole option, of any components or parts of the product determined by Thermal to be defective.

**THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

**LIMITATION OF LIABILITY:** Thermal shall not under any circumstances be liable for special or consequential damages, such as, but not limited to, damage or loss of purchased or replacement goods, or claims of customers of distributor (hereinafter "Purchaser") for service interruption. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liability is based.

**THIS WARRANTY BECOMES INVALID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL PRODUCT.**

**THIS WARRANTY IS INVALID IF THE PRODUCT IS SOLD BY NON-AUTHORIZED PERSONS.**

The limited warranty periods for Thermal products shall be as follows (with the exception of STAK PAK II): A maximum of three (3) years from date of sale to an authorized distributor and a maximum of two (2) years from date of sale by such distributor to the Purchaser, and with the following further limitations on such two (2) year period. The limited warranty period for STAK PAK II shall be as follows: A maximum of four (4) years from date of sale to an authorized distributor and a maximum of three (3) years from date of sale by such distributor to the Purchaser, and with the following further limitations on such three (3) year period:

| | | PARTS | |
|---|---|---|---|
| **PAK UNITS, POWER SUPPLIES** | **STAK PAK II** | **All OTHERS** | **LABOR** |
| MAIN POWER MAGNETICS | 3 YEARS | 2 YEARS | 1 YEAR |
| ORIGINAL MAIN POWER RECTIFIER | 3 YEARS | 2 YEARS | 1 YEAR |
| CONTROL PC BOARD | 3 YEARS | 2 YEARS | 1 YEAR |
| ALL OTHER CIRCUITS AND COMPONENTS INCLUDING, BUT NOT LIMITED TO, STARTING CIRCUIT, CONTACTORS, RELAYS, SOLENOIDS, PUMPS, POWER SWITCHING SEMI-CONDUCTORS | 1 YEAR | 1 YEAR | 1 YEAR |
| **CONSOLES, CONTROL EQUIPMENT, HEAT EXCHANGES, AND ACCESSORY EQUIPMENT** | 1 YEAR | 1 YEAR | 1 YEAR |
| **TORCH AND LEADS** | 180 DAYS | 180 DAYS | 180 DAYS |
| **REPAIR/REPLACEMENT PARTS** | 90 DAYS | 90 DAYS | NONE |

Warranty repairs or replacement claims under this limited warranty must be submitted by an authorized Thermal Arc® repair facility within thirty (30) days of the repair. No transportation costs of any kind will be paid under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the customer. All returned goods shall be at the customer's risk and expense. This warranty supersedes all previous Thermal warranties.

Thermal Arc® is a Registered Trademark of Thermal Dynamics.

Effective February 1, 1995

# SECTION 2: INTRODUCTION

## 2.01 Scope Of Manual

This Manual provides Service Instructions for Thermal Dynamics PAK Master® 100 Air Plasma Cutting System with PCH-53P Torch.

Refer to Operating Manual (0-2458) for individual operating procedures. Information in this edition is therefore particularly applicable to the Troubleshooting and Repair of the equipment, and is intended for use by properly-trained Service Technicians familiar with this equipment.

Read this Manual and the Operating Manual, 0-2458, thoroughly A complete understanding of the capabilities and functions of the equipment will assure obtaining the performance for which it was designed.

## 2.02 General Service Philosophy

Several key points are essential to properly support the application and operation of this equipment.

### A. Application

The equipment should satisfy the customer's requirements as supplied and as described in Section 3 of this manual. Be sure to confirm that the equipment is capable of the application desired.

### B. Modifications

No physical or electrical modifications other than selection of standard options and Accessories are to be made to this equipment.

### C. Customer/Operator Responsibilities

It is the customer / operators' responsibility to maintain the equipment and peripheral Accessories provided by Thermal Dynamics in good operating order in accordance with the procedures outlined in the Operating Manual, and to protect the equipment from accidental or malicious damage.

### D. Repair Restrictions

The electronics consists of Printed Circuit Board Assemblies which must be carefully handled, and must be replaced as units. No replacement of printed circuit solder-mounted components is allowed except as noted in this manual.

If to be returned, the replaced Printed Circuit Board Assemblies must be properly packaged in protective material and returned intact per normal procedures.

## 2.03 Service Responsibilities

The Service Technician should be familiar with the equipment and its capabilities. He should be prepared to recommend arrangements of components which will provide the most efficient layout, utilizing the equipment to its best possible advantage.

Maintenance work should be accomplished in a timely manner. If problems are encountered, or the equipment does not function as specified, contact Technical Services Department at West Lebanon for assistance.

# SECTION 3: DESCRIPTION

## 3.01 Scope of Manual

The information in this Section has two purposes: To fimilarize the Service Technician with the capabilities and limitations of the equipment, and to provide him with an overall understanding which will allow him, in turn, to properly train the customer's operating personnel.

## 3.02 System Description

The Pak Master 100 Air Plasma Cutting System Includes:

### A. Power Supply

The power supply provides 70 amp maximum output and includes all control circuitry, electrical and gas inputs and outputs, pilot circuitry, torch leads receptacle and a work cable with clamp. A ten foot primary input power cable is wired to the supply

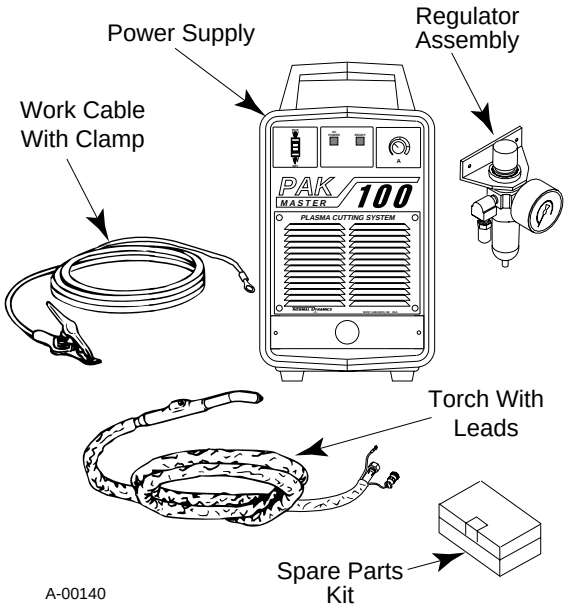



Figure 3-1 System Components

### B. Torch With Leads

The Torch, PCH-53P with Leads, provides a maximum 1 inch (25.4 mm) cut capacity and parts-in-place (PIP) circuit. Hand torches are available in 70° and 90° configurations. Torch leads are available in 25 ft (7.6 m), or 50 ft (15.2 m) lengths with fittings for simple installation. The torch includes a spare parts kit which provides an assortment of replacement torch parts.

## 3.03 Specifications/Design Features

### A. Power Supply Technical Specifications

The following specifications apply to the Power Supply only:

**1. Front Panel Controls:**

RUN / SET Switch and Output Current Control

**2. Front Panel LED Indicators:**

AC POWER and READY

**3. Rear Panel Controls:**

ON / OFF Switch, input power cable and gas connection

**4. Input Power**

Available for the following input power:

208 / 230 VAC (±10%), 50 / 60 Hz, Single-Phase

380 / 415 VAC (±10%), 50 / 60 Hz, Three-Phase

460 V AC (±10%), 50 / 60 Hz, Three-Phase

**5. Load/No Load Input Current**

| Unit | At No Load | | | At Rated Load | | |
|---|---|---|---|---|---|---|
| | Amps | KVA | KW | Amps | KVA | KW |
| 208 VAC 1-Phase | 2.4 | 0.5 | 0.3 | 75 | 15.6 | 9.9 |
| 230 VAC 1-Phase | 2.2 | 0.5 | 0.3 | 68 | 15.6 | 9.9 |
| 230 VAC 3-Phase | 1.3 | 0.5 | 0.3 | 32 | 12.7 | 9.9 |
| 380 VAC 3-Phase | 0.8 | 0.5 | 0.3 | 19 | 12.7 | 9.9 |
| 415 VAC 3-Phase | 0.7 | 0.5 | 0.3 | 18 | 12.7 | 9.9 |
| 460 VAC 3-Phase | 0.6 | 0.5 | 0.3 | 16 | 12.7 | 9.9 |

**6. Output Power**

Continuously variable from 16 to 70 Amps maximum 40% Duty Cycle

**7. Cut Capacity**

1 in (25.4 mm)

**8. Pilot Circuitry**

High Frequency (HF), Pulsed DC

**9. Weight**

95 lbs (43 kg)

**10. Dimensions**

20" (510 mm) High x 12" (305 mm) W ide x 18.5" (470 mm) Long

## B. Torch Specifications

The following specifications apply to theTorch Assembly only:

**1. Configurations**

70° or 90° Hand Torch

**2. Current Rating**

70 amps Maximum, DC Straight Polarity

**3. Duty Cycle**

100% @ 70 amps

**4. Cutting Range**

Most metals up to 1 inch (25.4 mm)

**5. Pierce Rating**

1/2 in (12.7 mm)

**6. Transfer Distance**

Approximately 3/8 in (9.5 mm)

**7. Torch Parts**

Electrode, Tip, Shield Cup

**8. Parts-In-Place (PIP)**

Contacts made when shield cup is installed

**9. Gases**

Compressed Air, Nitrogen (N2)

**10. Pressure Requirements**

70 psi (4.8 BAR)

**11. Flow Requirements:**

Cutting - 300 scfh (141.5 lpm)

**12. Available Leads Lengths**

25 ft (7.6 m), or 50 ft (15.2 m)

## C. Regulator/Filter Assembly Specifications

The following specifications apply to the Regulator/Filter Assembly only:

**1. Regulator maximum gauge pressure**

160 psi (1 1 BAR)

**2. Filter**

Coalescent type filter

# SECTION 4: SERVICE TROUBLESHOOTING DIAGNOSTICS

## 4.01 Introduction

This Section provides service diagnostics for the P AK Master 100 Air Plasma Cutting System with PCH-53P Torch,, allowing theTechnician to islolate any faulty Subassemblies. Refer to Section 5, Repairs & Replacement Procedures, for parts replacement instructions.

Under no circumstances are field repairs to be attempted on Printed Circuit Boards or other Subassemblies of this unit. Evidence of unauthorized repairs will void the factory warranty

## 4.02 Periodic Inspection & Procedures

This subsection describes inspection procedures which should be performed at periodic intervals as required.

### A. General Power Supply Maintenance

***WARNING***

*Disconnect primary power to the system before disassembling the torch, leads, or power supply.*

The only routine maintenance required for the power supply is a thorough cleaning and inspection, with the frequency depending on the usage and the operating environment.

***CAUTION***

*Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.*

To clean the unit, open the enclosure (refer to Section 5.03-A, Opening Enclosure) and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean. If necessary , solvents that are recommended for cleaning electrical apparatus may be used.

### B. General Torch Maintenance

Even if precautions are taken to use only clean air with a torch, eventually the inside of the torch becomes coated with residue. This buildup can affect the pilot arc initiation and the overall cut quality of the torch.

***WARNINGS***

*Disconnect primary power to the system before disassembling the torch, leads, or power supply.*

*DO NOT touch any internal torch parts while the AC indicator light on the front panel of the power supply is ON.*

The inside of the torch should be cleaned with electrical contact cleaner using a cotton swab or soft wet rag. In severe cases, the torch can be removed from the leads and cleaned more thoroughly by pouring electrical contact cleaner into the torch and blowing it through with compressed air.

***CAUTION***

*Dry the torch thoroughly before reinstalling.*

## 4.03 Common Operating Problems

***WARNINGS***

*Disconnect primary power at the source before disassembling the power supply, torch, or torch leads.*

*Frequently review the Important Safety Precautions (page 1). Be sure the operator is equipped with proper gloves, clothing, eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece while the torch is activated.*

***CAUTION***

*Sparks from the cutting process can cause damage to coated, painted, and other surfaces such as glass, plastic and metal.*

***NOTE***

*Handle torch leads with care and protect them from damage.*

### A. Piloting

Piloting is harder on parts life than actual cutting because the pilot arc is directed from the electrode to the tip rather than to a workpiece. Whenever possible, avoid excessive pilot arc time to improve parts life.

### B. Torch Standoff

Improper standoff (the distance between the torch tip and workpiece) can adversely affect tip life as well as shield cup life. Standoff may also significantly affect the bevel angle. Reducing standoff generally results in a more square cut. A specially designed shield cup attachment is available for drag cutting, which allows the operator to keep the torch in contact with the workpiece during operation.

### C. Edge Starting

For edge starts, hold the torch perpendicular to the workpiece with the front of the torch tip at the edge of the workpiece, not touching, at the point where the cut is to start. When starting at the edge of the plate, do not pause at the edge and force the arc to "reach" for the edge of the metal. Establish the cutting arc as quickly as possible.

### D. Direction of Cut

The plasma gas stream swirls as it leaves the torch. The purpose of the swirl is to maintain a smooth column of gas. The swirl effect results in one side of a cut being more square than the other. Viewed along the direction of travel, the left side of the cut is more square than the right.

### E. Dross

On carbon steel, top spatter (dross on top of the plate) is normally caused by a slow torch travel speed or a high torch standoff. This slow speed dross is usually easy to remove. Dross along the cut line on the bottom of the plate is more difficult to remove and is often caused by high torch travel speeds.

### F. Common Cutting Faults

**1. Insufficient Penetration**

*a. Cutting speed too fast*

*b. Torch tilted too much*

*c. Metal too thick*

*d. Worn torch parts*

*e. Cutting current too low*

**2. Main Arc Extinguishes**

*a. Cutting speed too slow*

*b. Torch standoff too high from workpiece*

*c. Cutting current too high*

*d. Work cable disconnected*

*e. Worn torch parts*

**3. Excessive Dross Formation**

*a. Cutting speed too slow*

*b. Torch standoff too high from workpiece*

*c. Worn torch parts*

*d. Improper cutting current*

**4. Short Torch Parts Life**

*a. Oil or moisture in air source*

*b. Exceeding system capability (material too thick)*

*c. Excessive pilot arc time*

*d. Air flow too low (incorrect pressure)*

*e. Improperly assembled torch*

*f. Incorect torch parts for the operation*

*g. Non-Genuine Thermal Dynamics parts used*

## 4.04 Troubleshooting Guide

### A. Troubleshooting and Repair

Troubleshooting and repairing the this unit is a process which should be undertaken only by those familiar with high voltage high power electronic equipment.

***WARNING***

*There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have had training in power electronics measurement and troubleshooting techniques.*

### B. Advanced Troubleshooting

***NOTE***

*For basic troubleshooting and parts replacement procedures refer to Pak Master® 100 Air Plasma Cutting System With PCH/M-53 Torch Operating Manual 0-2427.*

The advanced troubleshooting covered in this Service Manual requires power supply disassembly and live measurements. It is helpful for solving many of the common problems that can arise with the PAK Master® 100 Air Plasma Cutting System with PCH-53P Torch.

If major complex subassemblies are faulty, the unit must be returned to an authorized service center for repair.

Specific test procedures are referenced by the troubleshooting guide.

The guide has two sections as follows:

**Section 4.05 - Troubleshooting Specific Problems**

**Section 4.06 - Test Procedures**

### C. How to use this Guide

The following information is a guide to help the Service Technician determine the most likely causes for various symptoms.

This guide is set up in the following manner:

**A. Symptom (Bold Type)**

Any Special Instructions (Text Type)

*1. Cause (Italic Type)*

a. Check / Remedy (Text Type)

Locate your **symptom**, check the *causes* (easiest listed first) then remedies. Repair as needed being sure to verify that unit is fully operational after any repairs.

***NOTE***

*Many signals are transfered between various assemblies on interconnecting cables. If these cables become faulty they can then cause various problems. **Do not** forget about these cables when troubleshooting.*

## 4.05 Troubleshooting Specific Problems

**A. Molded circuit breaker MCB (primary power switch) trips**

*1. Faulty input rectifier (D1)*

a. Check device per Section 4.06-D. Replace faulty device per Section 5.03-E.

*2. Faulty IGBT module (Q1)*

a. Check device per Section 4.06-E. Replace faulty device per Section 5.03-D.

*3. Faulty capacitor (C7) - 208/230 VAC Units Only*

a. Check device per Section 4.06-G. Replace faulty device if necessary .

*4. Faulty capacitors (C5 and C6) - 308/415 and 460 VAC Units Only*

a. Check device per Section 4.06-H. Replace faulty device(s) if necessary .

**B. AC POWER indicator not ON**

***NOTE***

*Wait for 10 seconds after applying power for the power smart logic to check input power.*

*1. Switch at customer's main power panel in OFF position.*

a. Close main power panel switch

*2. Input power not properly connected to customer's main power panel*

a. Check that input power is present and unit is properly connected (refer to Section 3.05, Input Power Connections, in Operating Manual 0-2458).

*3. Actual input voltage does not correspond to voltage rating of unit*

a. Check actual line voltage vs. voltage rating on primary power switch (rear of unit).

*4. Customer's main power line fuse(s) blown*

a. Check main power panel fuse(s) and replace as required.

*5. Unit internal fuse (F1) blown or loose*

a. If blown, doublecheck input voltage vs. voltage rating on primary power switch (rear of unit) and replace fuse per Section 5.03-B. If fuse blows again, check circuit.

*6. Faulty molded circuit breaker MCB (primary power switch)*

a. Check MCB circuit and replace faulty MCB if necessary .

*7. Faulty AC POWER indicator.*

a. Check indicator circuit and replace faulty device if necessary .

**C. AC POWER indicator ON; READY indicator OFF; Fan not operating**

*1. Airflow obstructed*

a. Check for obstructed air flow and correct condition.

2. *Faulty fan assembly*

   a. Check fan circuit for 200 V AC between wires 13 and 15. If voltage is present replace Fan Assembly. If voltage is not present check transformer (T2) and replace if necessary .

3. *Unit is overheated*

   a. Allow unit to cool down for about 5 minutes. Make sure the unit has not been operated beyond 40% duty cycle limit of the power supply.

4. *Input line voltage is below 75% of rated level*

   a. Check and connect to proper input power line

5. *Faulty thermal switch THS1 or THS2*

   a. Check for proper connection of CN12 at Main PC Board (PCB1).

   b. Check THS1 and THS2 for continuity after unit cools. If open, replace defective thermal switch.

6. *Input voltage of 460 VAC applied to 208/230 VAC or 380/415 VAC Models*

   a. Check input line voltage and correct as required.

7. *Faulty output diode (D2)*

   a. Check device per Section 4.06-F . Replace faulty device if necessary .

**D. AC POWER indicator ON; READY indicator ON. READY indicator goes out when torch switch is pressed. READY indicator will come back ON only after turning main power switch (MCB) OFF then ON.**

1. *Faulty output diode (D2)*

   a. Check device per Section 4.06-F . Replace faulty device if necessary .

**E. Torch will not pilot when torch switch is activated**

1. *RUN/SET switch in SET position*

   a. Move switch to RUN position.

2. *Torch switch activated during 20 second pre-flow*

   a. Release switch and wait at least 20 seconds before activating switch again

3. *Parts-In-Place (PIP) pins not installed.*

   a. Check pins

4. *Faulty torch parts*

   a. Inspect torch parts and replace if necessary . Refer to Section 5.05, Replacing Consumable Torch Parts

5. *Gas pressure too high*

   a. Set pressure to 50 psi.

6. *Faulty torch switch or control cable*

   a. Check between pins 3 and 4 at the torch control connector for continuity when the torch switch is pressed. Replace as necessary

7. *Faulty high frequency trigger circuit*

   a. Check High Frequency PCB Assembly (PCB2) and replace if necessary .

8. *Faulty pilot circuit*

   a. Check R12 and MC (magnetic contactor) and replace if necessary .

9. *Pilot current flow longer than 3 seconds*

   a. Release and press torch switch again.

10. *Faulty gas regulator*

    a. Check and replace if necessary

**F. AC Power indicator ON; READY indicator ON; Fan operating; No cutting output**

1. *Torch not properly connected to power supply*

   a. Check that torch leads are properly attached to power supply

2. *Shield cup not properly installed on torch*

   a. Check that shield cup is fully seated against torch head (do not overtighten)

3. *Faulty work cable*

   a. Check that work cable is properly connected.

   b. Check work cable for continuity and replace if necessary .

4. *Parts-In-Place (PIP) pins not installed.*

   a. Check pins

5. *Faulty input rectifier (D1)*

   a. Check device per Section 4.06-D. Replace faulty device per Section 5.03-E.

6. *Faulty IGBT module (Q1)*

   a. Check device per Section 4.06-E. Replace faulty device per Section 5.03-D.

   b. Check wiring from CN2-CN3 on Main PC Board (PCB1) to CN1-CN2 on IGBT gate printed circuit board (PCB3).

7. *Faulty secondary diode (D2)*

   a. Check device per Section 4.06-F . Replace faulty device if necessary .

8. *Faulty Main PC Board (PCB1)*

   a. Check for loose connections to Main PC Board (PCB1).

   b. Check Main PC Board (PCB1) per Section 4.06-I. Replace faulty assembly per Section 5.03-C.

**G. Low cutting output with no control**

1. *Faulty AMPERAGE control (VR1) on front panel*

   a. Check VR1 for proper connections.

   b. VR1 wiper DC voltage is adjustable from 0 to 15 VDC after current flow. Check for proper level and replace if necessary .

2. *Faulty Main PC Board (PCB1)*

   a. Check for loose connections to Main PC Board (PCB1).

   b. Check Main PC Board (PCB1) per Section 4.06-I. Replace faulty assembly per Section 5.03-C.

**H. Limited output with no control**

1. *Poor input or output connections*

   a. Check all input and output connections.

2. *Faulty AMPERAGE control (VR1) on front panel*

   a. Check VR1 for proper connections.

   b. VR1 wiper DC voltage is adjustable from 0 to 15 VDC after current flow. Check for proper level and replace if necessary .

3. *Faulty Main PC Board (PCB1)*

   a. Check for loose connections to Main PC Board (PCB1).

   b. Check Main PC Board (PCB1) per Section 4.06-I. Replace faulty assembly per Section 5.03-C.

**I. Erractic or improper cutting output**

1. *Poor input or output connections*

   a. Check all input and output connections.

2. *Incorrect type and size cable on input or output*

   a. Use proper type and size cables.

3. *Use of non-genuine TDC replacement parts*

   a. Use only TDC replacement parts.

4. *Worn torch consumables*

   a. Check and replace with genuine TDC parts.

5. *Improper gas pressure*

   a. Set pressure to proper level.

**J. AC Power indicator ON; READY indicator OFF; cutting output available; Fan not operating,**

1. *Fan blades blocked*

   a. Check and clear blades.

2. *Faulty fan assembly*

   a. Check fan circuit for 200 V AC between wires 13 and 15. If voltage is present replace Fan Assembly. If voltage is not present check transformer (T2) and replace if necessary .

**K. AC POWER indicator ON; READY indicator ON; Fan operates; No gas flow**

1. *Gas not connected or pressure too low*

   a. Check source for at least 70 psi (4.8 BAR).

2. *Faulty Main PC Board (PCB1)*

   a. Check for loose connections to Main PC Board (PCB1).

   b. Check Main PC Board (PCB1) per Section 4.06-I. Replace faulty assembly per Section 5.03-C.

3. *Faulty solenoid valve (SOL)*

   a. Check for proper or loose connections to SOL at CN10 on Main PC Board (PCB1).

   b. Check SOL and replace if needed.

**L. Torch cuts but not adequately**

1. *Current set too low*

   a. Increase current setting

2. *Torch is being moved too fast across workpiece*

   a. Reduce cutting speed (refer to Operating Manual 0-2458, Appendix 1, Cutting Speed Charts)

3. *Excessive oil or moisture in torch*

   a. Hold torch 1/8 inch (3 mm) from clean surface while purging (SET position), and observe oil or moisture buildup (**Do Not Activate Torch**)

4. *Use of non-genuine TDC replacement parts*

   a. Use only TDC replacement parts.

5. *Worn torch consumables*

   a. Check and replace with genuine TDC parts.

## 4.06 Test Procedures

***WARNING***

***ELECTRIC SHOCK*** *can kill;* ***SIGNIFICANT DC VOLTAGE*** *exists after removal of input power.*

### A. Safety Precautions

1. Significant DC Voltage exists after removal of input power. Allow 2 minutes for discharge time. Voltage measured on input capacitors must be zero before performing service on the power supply
2. Do Not touch electrical components with any part of the human body when power is applied.
3. Keep away for any moving parts.
4. Hot surfaces can cause severe burns. Allow equipment to cool before servicing.
5. Electrostatic discharge can damage printed circuit board assemblies. Transport printed circuit boards in proper anti-static shielded packages. Use proper grounding techniques with wrist strap before handling printed circuit boards.
6. Misaligned plugs can cause printed circuit board damage. Be sure plugs are properly aligned and completely seated.
7. Excessive pressure can damage printed circuit board. Use only minimal pressure and gentle movement when disconnecting or connecting printed circuit board plugs.

### B. Opening Enclosure

1. Turn off MCB of power source and open wall disconnect switch or circuit breaker.
2. Wait at least two minutes to allow discharge time of input capacitors.
3. To open the enclosure requires the removal of several phillips head screws. Carefully remove all the screws before attempting to seperate the two halves of the enclosure. The screws should be removed in the following order:
   a. Two small screws on the bottom front and rear.
   b. Two on each side at bottom.
   c. Two long screws and nuts in the handles.
   d. Two on the center molding between the two handles.
   e. Two on each side at top.

   By removing the screws in this order it will help hold the two halves inplace until all the screws have been removed.
4. Remove the plastic enclosure.
5. Close the enclosure by reversing the above steps.

### C. Diode Testing Basics

Testing of diode modules requires a digital volt/ohm meter that has a diode test scale. Remember that even if the diode module checks good, it may still be bad. If in doubt, replace the diode module.

1. Locate the diode module to be tested.
2. Remove cables from mounting studs on diodes to isolate the module.
3. Set digital volt/ohm meter to diode test scale.
4. Using the Figures for each test, check each diode in the module. Each diode must be checked in forward bias (plus to negative) and reverse bias (negative to plus) direction.
5. Connect the volt/ohm meter positive lead to the anode (+) of the diode and the negative lead to the cathode (-) of the diode for forward bias testing (refer to Figure 4-1). A properly functioning diode will conduct in the forward bias direction and indicate between 0.3 to 0.9 volts.

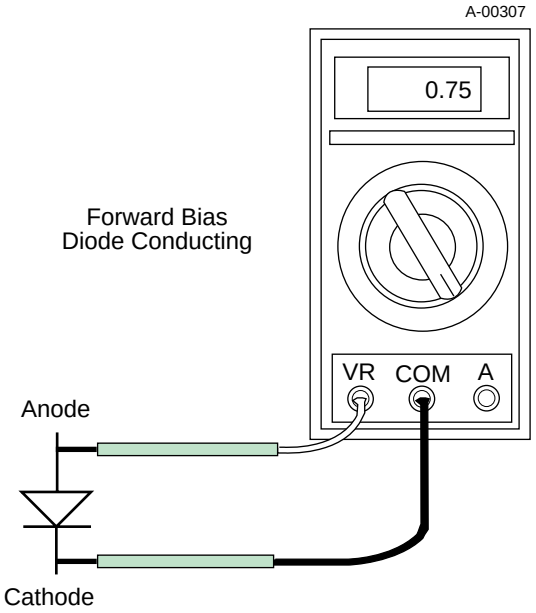



Figure 4-1 Testing Diode Forward Bias

6. Reverse the meter leads across the diode for reverse bias testing (refer to Figure 4-2). A properly functioning diode will block in the reverse bias direction and depending on the meter function will indicate an open or "OL".

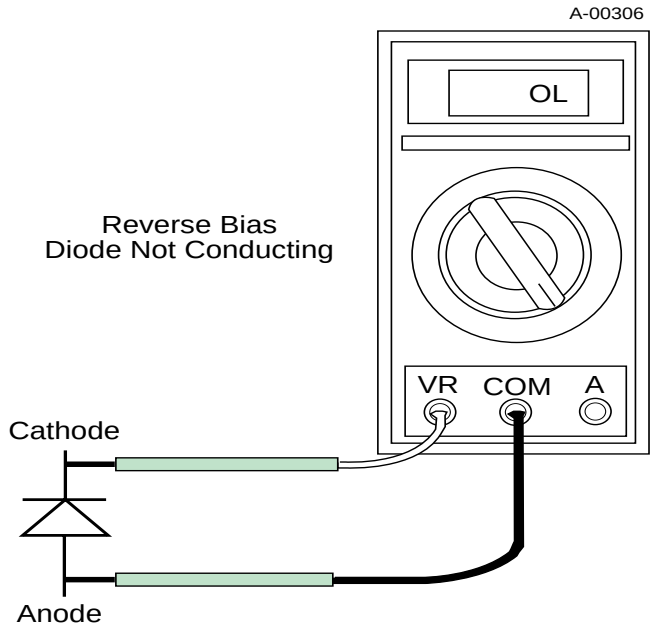



Figure 4-2 Testing Diode Reverse Bias

5. If a diode checks bad, replace the diode module.

6. Reconnect all cables to proper terminals.

## D. Input Diode (D1) Test Procedure

***NOTE***

*This test requires a digital volt meter with a diode test scale.*

Perform a visual inspection of input diode (D1) assembly. Most failures are identified by a fracture in the plastic case of the device. If there are no signs of physical damage or failure then proceed with the following test procedure:

1. Disconnect lead #22 from the negative terminal of input diode (D1) assembly.

2. Set meter on diode test scale.

3. The input diode (D1) assembly contains six standard diodes and a SCR used for the inrush circuit. The diodes are connected to form a three phase full wave circuit with three diodes connected to the negative terminal and three connected to the the R2 terminal. Test each diode in the forward (R2 to R, S, T) and reverse (- to R, S, T) direction as shown in Figure 4-3. A properly functioning diode conducts in the forward direction (plus to negative) and blocks in the reverse direction (negative to plus).

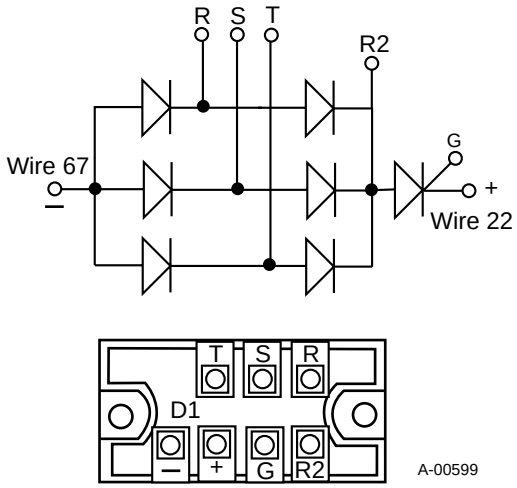



Figure 4-3 Testing Input Diode (D1) Assembly

4. If any diode section does not check properly, replace the input diode (D1) assembly per Section 5.03-D.

5. To check the SCR in the input diode (D1) assembly use the following procedure:

   a. Remove the leads from terminals R2, G, and positive (+)

   b. Check for the SCR diode in the forward direction - R2 to (+) terminal.

   c. Check the SCR diode in the reverse direction - (+) terminal to R2.

   d. Check the gate between 'G' and (+) terminals for resistance of approximately 50 ohms.

   If the SCR does not check properly, replace the input diode (D1) assembly per Section 5.03-E.

   If the SCR checks are correct, reconnect the leads removed in Step "a" above.

6. If the input diode (D1) assembly checks are correct, reconnect the lead removed in Step 1 above.

## E. Power IGBT (Q1) Module Test Procedure

***NOTE***

*This procedure requires a digital volt ohm meter that has a diode test scale. A more conclusive test requires specialized equipment. Therefore, even if the IGBTpower module checks out good, it may still be bad. If in doubt, replace the IGBT module.*

Perform a careful inspection of each IGBT module (Q1). Most failures are identified by a fracture in the plastic case of the device. If there are no signs of physical damage or failure then proceed with the following test procedure:

1. Disconnect all leads and bus bars from the IGBT module to be tested noting the location of each.

2. Select the diode test scale on the digital meter .

3. The IGBT module contains two diode sections. One diode is across C2E1 (anode) to C1 (cathode) and one is across E2 (anode) to C2E1 (cathode). Test each diode section in the forward (anode to cathode) and reverse (cathode to anode) direction (refer to Figure 4-4). A properly functioning diode conducts in the forward direction (meter indicates 0.3 to 0.9 volts) and blocks in the reverse direction (meter indicates an open).

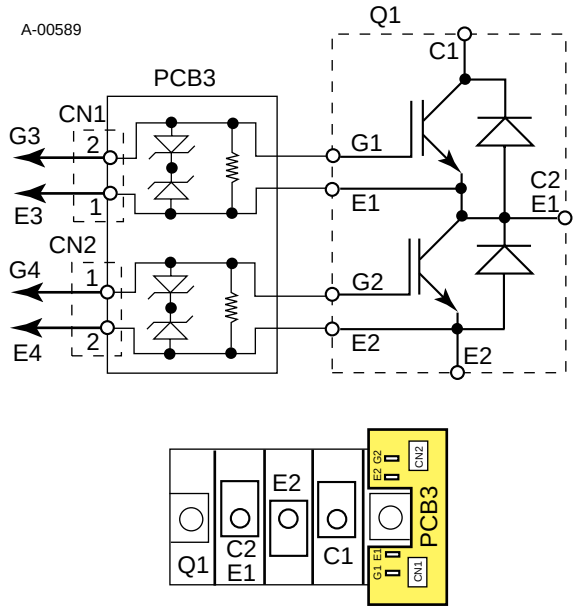



Figure 4-4 Testing IGBT Module (Q1) Assembly

5. If any diode section does not check properly, replace the IGBT module.

6. Select the ohms scale on the digital meter and check the gates of the IGBT module using the following procedure:

   a.. Check the resistance between the gate and emitter circuit place the meter leads on CN1 connector pins 1 & 2 of the Gate PC Board (PCB3) soldered to the IGBT module. A properly functioning IGBT module should read 1k ohms.

   b. Do the same for CN2 connector on the PC board.

   c. If the IGBT module does not check properly, replace the IGBT module per Section 5.03-E.

7. If IGBT checks are correct, reinstall the IGBT module using the following procedure:

   a. Clean the old heatsink residue from the heatsink surface.

   b. Apply a thin layer of Dow Corning # 340 or equivalent heatsink compound to the IGBT module.

   c. Torque the IGBT module mounting screws to 27 inch-lbs.

## F. Output Diode (D2) Test Procedure

This procedure requires a digital volt / ohm meter that has a diode test scale. A more conclusive test requires specialized equipment. Therefore, even if the output diodes check out good, it may still be bad. If in doubt, replace the diode module.

1. Locate output diode (D2) in power supply

2. Remove cables from mounting studs on the diode.

3. Set meter on diode test scale.

4. The output diode (D2) assembly contains four standard diodes. The diodes are connected to form a full wave circuit with two diodes connected to the negative (-) terminal and two connected to the the plus (+) terminal. Test each diode in the forward and reverse direction as shown in Figure 4-5. A properly functioning diode conducts in the forward direction (plus to negative) and blocks in the reverse direction (negative to plus).

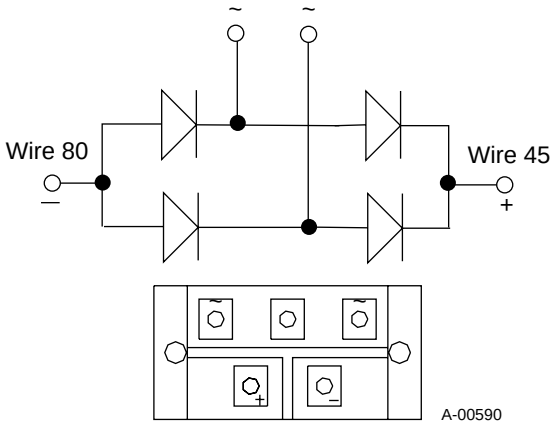



Figure 4-5 Testing Output Diode

5. If diode checks bad, replace diode module. Clean surface of heat sink where diode was mounted. Apply a thin layer of heat sink compound (dow corning no. 340 or equivalent) to mounting surface on new diode. Install new diode onto heat sink and torque to 27 in-lbs.

6. Connect all cables to proper terminals.

## G. 208/230V Model Input Capacitor (C7) Test Procedure

1. Check C7 for case damage (bulge and / or split). Check with ohm meter for shorts or open circuit. Replace if necessary .

2. Remove wire #22 from C7 capacitor .

3. Check resistor network R2, R3, and R4 for 10K ohms. See parts list and parts view for location. Replace if necessary .

4. Reconnect all connection.

## H. 380/415 and 460V Model Input Capacitor (C5 & C6) Test Procedure

1. Check C5 and C6 for case damage (bulge and / or split). Check with ohm meter for shorts or open circuit. Replace if necessary .

2. Remove wire #67 from C6 capacitor .

3. Check resistor network R3 for 100K ohms. See parts list and parts view for location. Replace if necessary.

4. Remove wire #22 from C5 capacitor .

5. Check resistor network R2 for 100K ohms. See parts list and parts view for location. Replace if necessary.

6. Reconnect all connections.

## I. Main PC Board (PCB1) Test Procedure

The Main PC Board (PCB1) is divided into twelve tests. Each test helps in determining if the Main PC Board is faulty. Perform each test in the order given.

***NOTE***

*All oscilloscope setting are for x1 probe.*

For all test points on Main PC Board (PCB1), use TP0 for logic common. Some of the test points require a oscilloscope with probe. Resistance checks are measured with power supply turned OFF Signal tests are measured with power supply turned ON.

***WARNING***

*Before disconnecting or connecting any connectors or wiring* ***turn the power supply OFF.***

**1. Power Supply Circuit**

a. Turn power supply OFF and disconnect wire #22 from D1.

b. Remove CN7 plug from High Frequency PC Board (PCB2).

c. With power supply turned ON, checkAC input voltage of power supply on Main PC Board (PCB1) at connector CN1 for the following:

| CN1 | Reading |
|---|---|
| Pin 1 to 3 | 18 VAC |
| Pin 2 to 3 | 18 VAC |
| Pin 3 is common | |

If AC voltage is not present check control winding of transformer T1.

d. Check output DC voltage of power supply on Main PC Board (PCB1) for the following:

| Main PC Board | Reading |
|---|---|
| TP2 to TP0 | Regulated +15 VDC |
| TP3 to TP0 | Regulated -15 VDC |
| TP1 to TP0 | Unregulated +24 VDC |
| TP0 is circuit common | |

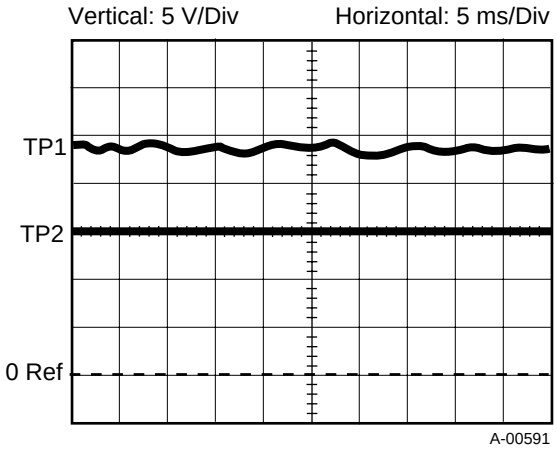



Figure 4-6 TP2 and TP1 Waveforms

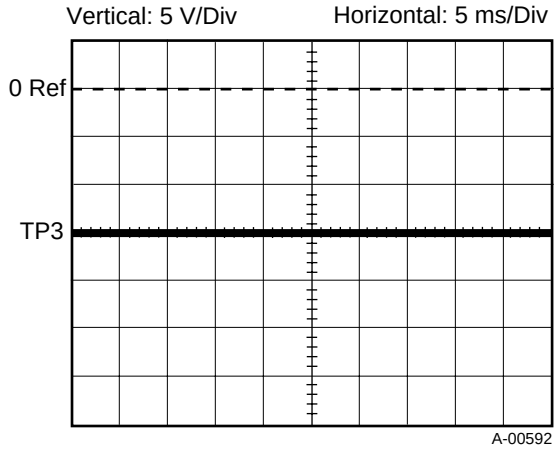



Figure 4-7 TP3 Waveform

e. If DC voltage is not present, turn power supply OFF and replace Main PC Board (PCB1).

**2. Inverter Balance Circuit (CT1)**

a. With power supply turned OFF, disconnect connector CN4 plug.

b. Check for the following resistances:

| Main PC Board | Reading |
|---|---|
| CN4 receptacle, pins 1 to 2 | 4K ohms |
| CN4 plug, pins 1 to 2 | 3 ohms |

If check at CN4 receptacle is not correct, replace Main PC Board (PCB1).

If check at CN4 plug is not correct, replace Main PC Board (PCB1).

**3. Precharge Circuit Test**

a. Turn power supply OFF.

b. Turn power supply ON and check the precharge circuit on Main PC Board (PCB1) at CR13 to TP0 (Normally 0 VDC; +15 VDC during initial charge).

The indication at CR13 should start at 0 VDC, goto +15 VDC for approximately 5 seconds, then return to 0 VDC.

If levels are not correct, turn power supply OFF and replace Main PC Board (PCB1).

**4. Close Loop Current Feedback (CT2) Test**

a. With power supply turned OFF, disconnect connector CN7 plug from the High Frequency PC Board (PCB3).

b. Turn power supply ON.

c. Check the close loop current feedback circuit on Main PC Board (PCB1) from TP5 to TP0. The indication should be 0 to 4 VDC; 1 VDC per 10 Amps of output current.

If voltage values are not correct, turn power supply OFF and replace Main PC Board (PCB1).

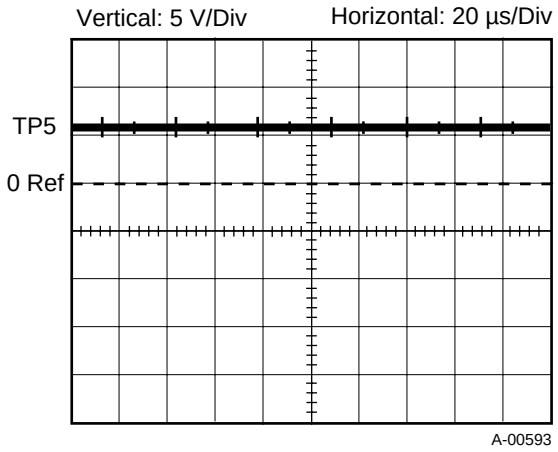



Figure 4-8 TP5 Waveform

e. Turn power supply OFF and reconnect connector CN7 plug.

**5. IC5 & Gate Drive Test**

a. Turn power supply OFF and disconnect wire #22 from D1.

b. Disconnect connector CN7 on the High Frequency PC Board (PCB3).

c. Turn power supply ON.

d. Check the inverter ON/OFF signal on Main PC Board (PCB1) for the following:

| Main PC Board | Reading |
|---|---|
| IC5 Pin 15 | 0 VDC (Inverter Stopped) |
| | +14 VDC (Inverter Running) |

If voltage values are not correct, turn power supply OFF and replace Main PC Board (PCB1).

e. Check to verify output of IC5 pulse waveform per the following:

| Main PC Board | Reading |
|---|---|
| TP7 to TP0 | 15 V Square Wave |
| TP8 to TP0 | 15 V Square Wave |
| TP0 is circuit common | |

If signals are not correct, turn power supply OFF and replace Main PC Board (PCB1).

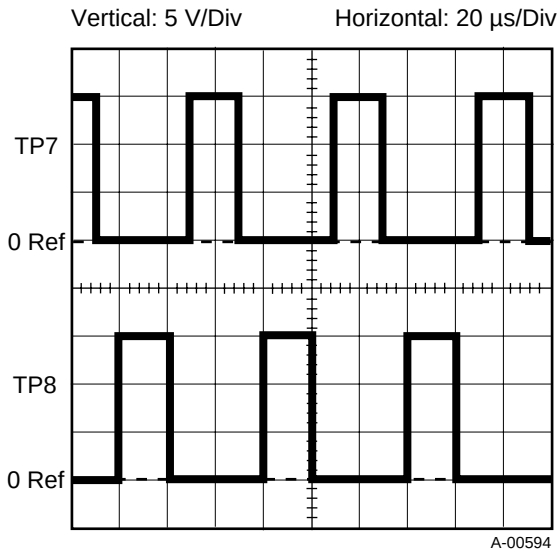



Figure 4-9 TP7 and TP8 Waveforms

f. Turn power supply OFF and reconnect wire #22 to D1.

g. Disconnect CN2 and CN13 from the Main PC Board (PCB1).

h. Turn power supply ON.

i. Check pulse transformer drive per the following (refer to Figures 4-10):

| Main PC Board | Reading |
|---|---|
| TP11 to TP12 | 20 V (Approx.) Square Wave |
| TP21 to TP22 | 20 V (Approx.) Square Wave |

If signals are not correct, turn power supply OFF and replace Main PC Board (PCB1).

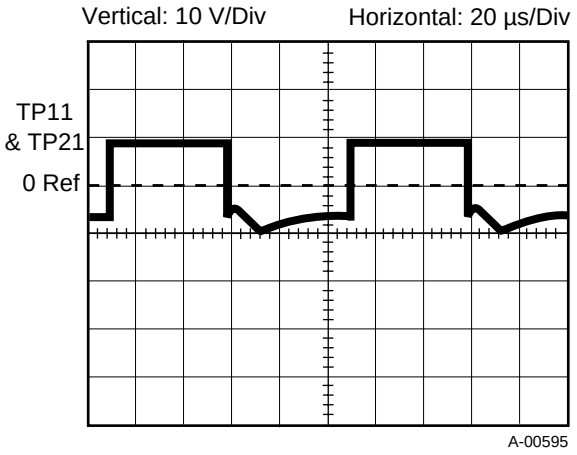



Figure 4-10 TP11 and TP21 Waveforms No Load Condition

j. Turn power supply OFF and reconnect all connectors.

## 4.07 Main PC Board (PCB1) Adjustments

The Main PC Board (PCB1) has various adjustments on it. These adjustments must be properly set for the power supply to operate properly

***WARNING***

*These adjustments require that the unit be powered on. High voltages and currents will be present. Use extreme caution when making adjustments.*

To properly make the adjustments described in this Subsection requires the use of an oscilloscope and probes. Do not attempt to make the adjustments with only a meter.

***NOTE***

*All oscilloscope setting are for x1 probe.*

### A. Versions

These adjustments apply only to the following versions or later of the Main PC Board (PCB1):

| Model (Type) | PCB1 Number |
|---|---|
| 208/230 VAC | WK-3272 |
| 460 VAC | WK-3272 S01 |
| 380-415 VAC | WK-3272 S01 |

### B. Adjustment References

The function of each adjustment and it's reference designation are as follows:

| Reference | Description |
|---|---|
| VR1 | Low Input Voltage |
| VR2 | Hall CT Offset |
| VR3 | Output Current Maximum |

### C. Adjustments

1. Initial Setup

The unit must be set to the following conditions before making any adjustments:

a. Disconnect CN7 from the High Frequency PC Board (PCB3).

b. Apply gas pressure more than 50 psi or connect a jumper between CN12 pins 5 and 6 on the Main PC Board (PCB1).

**2. Basic Oscillation (No Adjustment)**

a. Connect the channel of the oscilloscope to TP13 and the common to TP0.

b. Turn ON power to the unit.

c. The sawtooth waveform should be approximately 3.2 volts at 50 µs (refer to Figure 4-11).

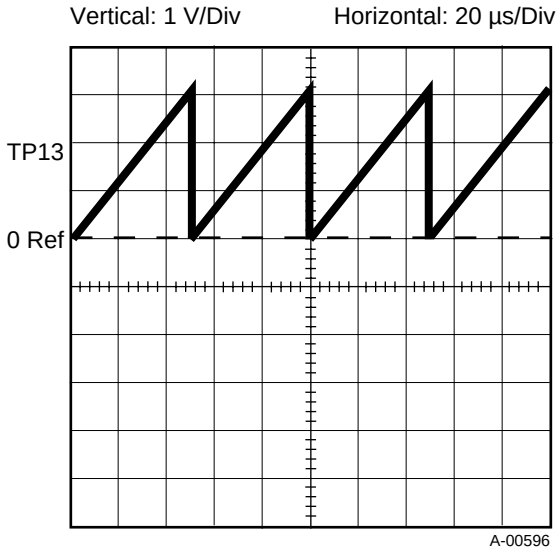



Figure 4-11 Basic Oscillation Waveform at TP13

d. If the waveform is not correct, replace Main PC Board (PCB1).

**3. Dead Time (No Adjustment)**

a. Connect the one channel of the oscilloscope to TP7, one channel to TP8 and the common to TP0.

b. The dead time is the time between the trailing edge of the waveform at TP7 and the leading edge of the waveform at TP8 (refer to Figure 4-12). This time should be approximately 4µs.

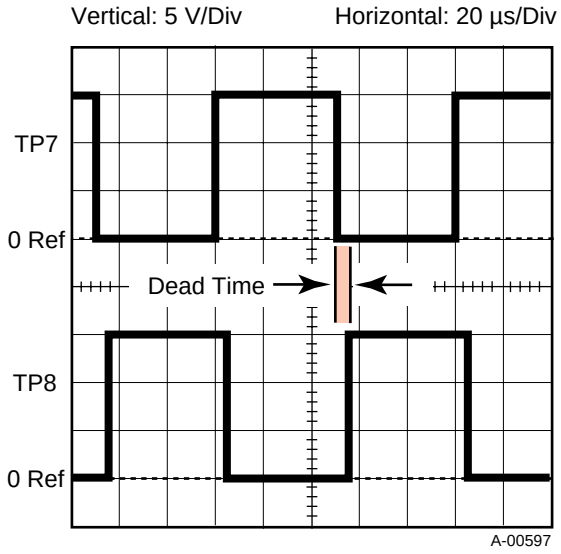



Figure 4-12 Dead Time Between TP7 and TP8

c. If the waveform is not correct, replace Main PC Board (PCB1).

**4. Hall CT Offset (VR2)**

a. Connect the channel of the oscilloscope to TP5 and the common to TP0.

b. Turn power supply ON.

c. Voltage indication should be zero volts.

e. If the voltage is not correct, adjust VR2 until the voltage is zero (refer to Figure 4-13)

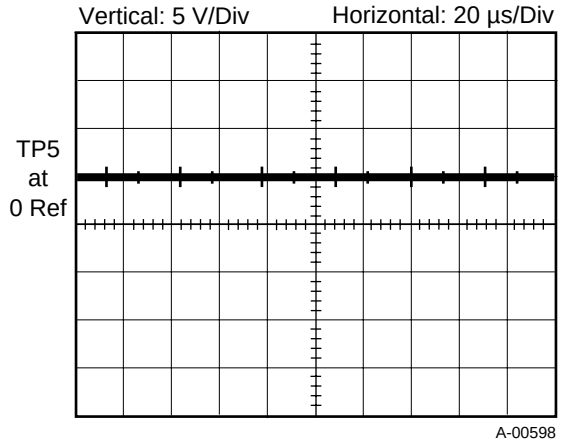



Figure 4-13 Hall CT Offset at TP5

**5. Minimum Output Current (No Adjustment)**

a. Set the RUN/SET switch to the RUN position.

b. Set the CURRENT control on the front panel to the minimum position (fully counterclockwise).

c. Press the torch switch.

d. Measure the output current of the power supply The current should be approximately 16 amperes (±10%)

e. If the current indication is not correct, check IC4, R15, R16, R17, CURRENT adjustment control, or connection at CN19 pin 1.

**6. Maximum Output Current (VR3)**

a. Set the RUN/SET switch to the RUN position.

b. Set the CURRENT control on the front panel to the maximum position (fully clockwise).

c. Press the torch switch.

d. Measure the output current of the power supply The current should be approximately 70 amperes (±5)

e. Turn amperage/voltage (A/V) control fully clockwise.

g. If the current indication is not correct, adjust VR3 until the meter indicates the proper value.

## 4.08 Smart Logic Circuit Description

The 208/230 VAC and 380/415 VAC models incorporate a "Smart Logic" circuit, which automatically senses the input voltage levels and adjusts it to allow for operation of unit within input rating on data tag. It is not necessary to manually switch (terminals or links) if unit is moved to a new location and a different input power is selected.

***NOTE***

*The 460 VAC model does not use the "Smart Logic" circuit.*

Smart Logic incorporates a Inrush circuit and input voltage sensing circuit. When MCB is turned on the Inrush circuit provides a precharging of the input capacitors. CR1 will close after the input capacitors have charged to full operating voltage. Aprox. 5 seconds to charge the input capacitors. During precharge the Main PC Board is sensing the input voltage and configuring the input power circuit and control transformer to match the input voltage. The Power Supply is configured to the highest input voltage when MCB is in the OFF position.

The following describes each model and their SMART LOGIC operation:

**208/230 volt model:**

When MCB is turned on, the Main PC Board samples the incoming primary voltage between L1 & L2. With 230 volt single or three phase input voltage applied, the Main PC board will send a signal to CR1 to close. A time delay of 3 to 4 seconds will be noticed before CR1 energizes. When CR1 closes the input power devices and control transformer will change from a series configuration to a parallel configuration. When 460 volt input voltage is applied, CR1 is not energized. The power devices and control transformer stay in a series configuration preventing the unit from powering up.

**380-415 volt model:**

CR1 contactor is not required to parallel or series the input power circuitry as in the 230/280 volt model. When MCB is turned on the Main PC board only requires the inrush circuitry to operate.

**460 volt model:**

The SMART LOGIC circuit is not used in this model.

## 4.09 Torch and Leads Troubleshooting

### A. Checking the Center Insulator

The center insulator separates the negative and positive charged sections of the torch. If the center insulator does not provide adequate resistance, current which is intended for the pilot arc may be dissipated into the torch head, resulting in torch failure.

***WARNINGS***

*Disconnect primary power to the system before disassembling the torch, leads, or power supply.*

*DO NOT touch any internal torch parts while the AC indicator light on the front panel of the power supply is on.*

1. Remove the shield cup, tip and electrode from the torch.

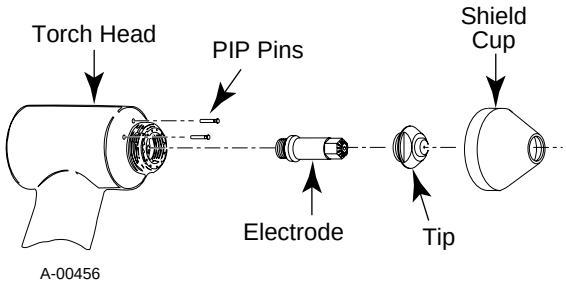



Figure 4-14 Torch Head Parts Removal

2. Disconnect the torch leads from the power supply to isolate the torch from power supply circuits.

3. Using an ohmmeter (set to 10K or higher), check for continuity between the positive and negative torch fittings. Infinite resistance (no continuity) should be found. If there is continuity between the two torch fittings, remove the torch head from the leads (Refer to Section 5.04-A, Hand Torch or 5.04-B, Machine Torch).

## B. Checking Torch Head Connections

Visually check that the torch switch wires, pilot lead connection, and negative / plasma lead connections are properly connected and in good condition (no shorts or arcing). If problems are evident, repair or replace as required.

## C. Checking Torch Head

With the torch head disconnected from the leads, measure the resistance between negative cathode body of the torch head (where the electrode seats) and the positive anode body of the torch head (the outer threads where the shield cup seats). Infinite resistance (no continuity) should be measured between negative and positive sections of the torch head. If any current can flow through the center insulator, the torch head is faulty and must be replaced. If the torch head is okay, the problem is in the leads assembly .

## D. Checking Torch Leads

If the torch assembly is okay, check the torch leads by measuring the resistance between the positive pilot lead connector and the negative / plasma lead fitting. If continuity is found, replace the torch leads. If no continuity is found, the torch leads are probably good. The torch leads should be tested further for insulation breakdown if no other fault can be found. To test the torch leads for insulation breakdown use the following procedure:

1. Remove the tip and electrode from the torch head assembly if not already done.

2. Connect a Hi-Pot Tester capable of producing 2500V AC between the positive pilot lead and the plasma (negative) lead fittings.

3. Increase the output of the Hi-Pot Tester to a maximum of 2500VAC.

If the voltage drops to 0VAC then the insulation between the torch leads is breaking down and the leads must be replaced.

## E. Checking Pilot and Switch Control Wires

Check the pilot and switch control wires for opens from one end of the torch leads to the other . If open replace torch leads. Check for shorts to other components in the torch leads. If shorted then replace torch leads.

## F. Reassembling Torch and Leads

Recheck the torch head, leads, and connections to confirm proper measurements. If each component is found to be okay, there is an assembly problem. Carefully reassemble the torch and leads then return to paragraph 'A' - Step 2 above.

# SECTION 5: REPAIRS & REPLACEMENT PROCEDURES

## 5.01 Introduction

This Section describes parts replacement procedures and all cable repairs which may be performed on the PAK Master 100 Air Plasma Cutting System with PCH-53P Torch.

Under no circumstances are field repairs to be attemped on Printed Circuit Board or other Subassemblies of this unit. Evidence of unauthorized repairs may void the factory warranty

## 5.02 Anti-Static Handling Procedures

### A. General

***CAUTION***

*PC boards can be irreparably damaged by improper handling due to electrostatic discharge (ESD).*

Replacement PC boards are shipped in a protective enclosure to prevent damage from electrostatic discharge (ESD) during shipping. Included with each replacement board is a ground strap to prevent static damage during installation.

***WARNINGS***

*Read and understand these instructions and the instructions on the grounding wrist strap package before opening the power supply enclosure or removing the replacement PC board from its protective enclosure.*

*Disconnect primary power to the system before disassembling the torch, torch leads, or power supply enclosure.*

*Do not operate the power supply or test equipment under power while wearing the grounding wrist strap.*

### B. Procedure

1. Open the wrist strap and unwrap the first two folds of the band. Wrap the adhesive side firmly around your wrist.
2. Unroll the rest of the band and peel the liner from the copper foil at the opposite end.
3. Attach the copper foil to a convenient and exposed electrical ground.
4. Connect the power supply primary cable ground to the same electrical ground as the wrist strap.
5. Open the power supply enclosure (see instruction manual for the power supply) and remove the failed PC board.
6. Carefully open the ESD protective bag and remove the replacement PC board.
7. Install the replacement PC board in the power supply and make all necessary connections.
8. Place the failed PC board in the ESD protective bag and seal for return shipping.
9. Reassemble the power supply enclosure (see instruction manual for the power supply).
10. Remove the grounding wrist strap from your wrist and from the electrical ground connection before reconnecting primary power to the power supply

## 5.03 Power Supply Disassembly & Parts Replacement

***WARNING***

*Disconnect primary power at the source before assembling or disassembling power supply, torch parts, or torch and leads assemblies.*

### A. Opening Enclosure

1. Turn OFF power to the power supply both at the rear panel MCB and at the main power disconnect.
2. Wait at least two minutes to allow the input capacitors to discharge.
3. To open the enclosure requires the removal of several phillips head screws. Carefully remove all the screws before attempting to seperate the two halves of the enclosure. The screws should be removed in the following order:
   a. Two small screws on the bottom front and rear.
   b. Two on each side at bottom.
   c. Two long screws and nuts in the handles.

d. Two on the center molding between the two handles.

e. Two on each side at top.

By removing the screws in this order it will help hold the two halves inplace until all the screws have been removed.

4. Reverse the above sequence to reassemble the enclosure.

## B. Fuse Replacement

1. Open the enclosure per paragraph "A" above.
2. Remove the plastic cover protecting the top of the unit inside.
3. Locate the internal fuse (F1) at the top rear of the unit.
4. Replace the fuse (5 amp 600V).
5. Reinstall the plastic cover removed in Step 2.
6. Close the enclosure per paragraph "A" above.

## C. Main PC Board (PCB1) Assembly Replacement

1. Open the Power Supply as described in paragraph "A" above.
2. Carefully remove all cable connections to the PCB Assembly noting the location of each.
3. Set the switches on the replacement PCB the same as the one removed.

***NOTE***

*Be sure that the switches on the replacement PCB are set the same as the old PCB.*

4. Reinstall the replacement Main PC Board Assembly by reversing the above procedure and noting the following:

| Connector | Description of Cable |
|---|---|
| CN1 | AC Supply for Main PC Board |
| CN2 | G1/E1 of IGBT Module (Q1) |
| CN4 | Over-Current Detect of IGBT |
| CN6 | High Voltage Filter |
| CN8 | Torch Control Switch |
| CN9 | CURRENT control potentiometer |
| CN10 | Solenoid and RUN/SET Switch |
| CN11 | High Frequency Control |
| CN12 | Temperature Sensors, Pressure Sensors, AC POWER Indicator and READY Indicator |
| CN13 | G2/E2 of IGBT Module (Q1) |
| CN15 | Smart Logic Relay |
| CN16 | Inrush SCR Gate |

***CAUTION***

*Make sure that all cables are inserted into the proper connectors.*

## D. IGBT Module (Q1) Replacement

1. Open the Power Supply as described in paragraph "A" above.
2. Mark and disconnect all leads to the IGBT Module (Q1) assembly.
3. Remove the screws securing the IGBT Module assembly to the heatsink.
4. Using a 30 watt soldering iron carefully remove the IGBT Gate PC Board (PCB3) from the IGBT Module.
5. Carefully solder the Gate PC Board (PCB3) onto the replacement IGBT Module.

***NOTE***

*Be careful to not over heat the gate and emitter terminals when soldering as damage to the module may occur.*

6. Clean the residue of old heatsink compound from the surface where the IGBT Module was installed.
7. Apply a thin coat of Dow Corning #340 or equivalent heatsink compound to the mounting surface of the replacement IGBT Module.

8. Install the replacement IGBT Module (Q1) assembly onto the heatsink and secure with the two screws removed in Step 3 above.

9. Torque the screws to 20 inch-lbs.

10. Reconnect all leads and bus bars removed in Step 2 above to the proper terminals.

### E. Input Diode (D1) Replacement

1. Open the Power Supply as described in paragraph "A" above.

2. Mark and disconnect all leads to the Input Diode (D1) assembly.

3. Remove the screws securing the Input Diode assembly to the heatsink.

4. Carefully remove the old Input Diode assembly

5. Clean the residue of old heatsink compound from the surface where the Input Diode (D1) was installed.

6. Apply a thin coat of Dow Corning #340 or equivalent heatsink compound to the mounting surface of the replacement Input Diode assembly.

7. Install the replacement Input Diode (D1) assembly onto the heatsink and secure with the two screws removed in Step 3 above.

9. Torque the screws to 20 inch-lbs.

10. Reconnect all leads and bus bars removed in Step 2 above to the proper terminals.

## 5.04 Torch Component Parts Replacement

***WARNING***

*Disconnect primary power to the system before disassembling the torch, leads, or power supply.*

### A. Torch Head Replacement

1. Roll the torch switch sheath back over the handle to expose the torch switch connectors.

2. Disconnect the torch switch leads. One lead goes to one side of the parts-in-place (PIP) circuit. The second lead goes to the control cable.

***NOTE***

*The torch switch connectors are made to fit into its matching connector.*

3. With a twisting motion, pull the torch from the handle.

4. Disconnect the negative lead and pilot lead from the torch head.

5. Remove the defective torch head assembly .

6. Connect the negative lead and pilot leads to the replacement torch head assembly.

7. Feed the torch switch leads through the handle and install the torch head on the handle.

8. Connect the two torch switch leads to the mating connectors in the leads assembly. Position the torch switch leads so the connectors do not extend beyond the edge of the handle and the leads do not extend out from under the sheath. Allow sufficient slack in the leads to avoid pulling the leads tightly around the edge of the handle.

9. Roll the torch switch sheath back over the handle.

### B. Torch Leads Replacement

1. Remove the torch head as described in paragraph "A" above.

2. Remove the torch handle from the defective leads assembly.

3. Remove the lower front panel cover from the front of the power supply

4. Disconnect the torch gas connection, pilot control wire and torch control cable from the lower front panel of the power supply

5. Pull the defective leads from the lower front panel cover.

6. Feed the replacement leads assembly through the hole in the lower front panel.

7. Connect the torch gas connection, pilot control wire and torch control cable to the lower front panel of the power supply

8. Reinstall the lower front panel cover.

9. Slide the torch handle onto the leads.

10. Install the torch head assembly onto the leads.

### C. Torch Switch Replacement

1. Roll the torch switch sheath back over the handle to expose the torch switch connectors.

2. Disconnect the torch switch leads. One lead goes to one side of the parts-in-place (PIP) circuit. The second lead goes to the control cable.

***NOTE***

*The torch switch connectors are made to fit into its matching connector.*

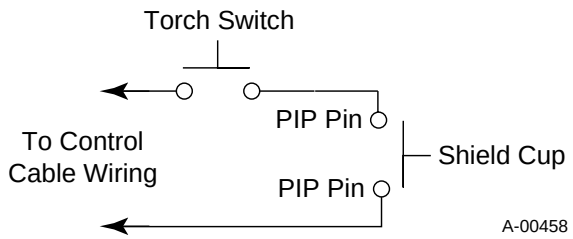



Figure 5-1 Torch Switch and PIP Schematic

3. Remove the defective torch switch from the sheath.
4. Position the replacement torch switch in the sheath.
5. Connect the two torch switch leads to the mating connectors in the leads assembly. Position the torch switch leads so the connectors do not extend beyond the edge of the handle and the leads do not extend out from under the sheath. Allow sufficient slack in the leads to avoid pulling the leads tightly around the edge of the handle.
6. Roll the torch switch sheath back over the handle.

# SECTION 6: PARTS LISTS

## 6.01 Introduction

### A. Parts List Breakdown

The parts list provide a breakdown of all replaceable components. The parts lists are arranged as follows:

**Section 6.03:** Replacement - Complete Systems

**Section 6.04:** Replacement Torch And Lead Assemblies

**Section 6.05:** Replacement Hand Torch Parts

**Section 6.06:** Replacement Power Supply Parts (208/230V Units)

**Section 6.07:** Replacement Power Supply Parts (380/415V Units)

**Section 6.08:** Options and Accessories

**Section 6.09:** Spare Parts Kits

***NOTE***

*Parts listed without item numbers are not shown, but may be ordered by the catalog number shown.*

### B. Returns

If a Thermal Dynamics product must be returned for service, contact your Thermal Arc distributor. Materials returned to Thermal Dynamics without proper authorization will not be accepted.

## 6.02 Ordering Information

Order replacement parts by catalog number and complete description of the part or assembly, as listed in the parts list for each type item. Also include the model and serial number of the torch. Address all inquiries to your authorized Thermal Dynamics distributor.

## 6.03 Replacement - Complete Systems

Complete systems include: Power supply with primary power cable, work cable, PCH-53Ptorch with leads, pressure regulator / air filter, air hose and fittings, torch spare parts kit, and operating manual.

| Description | Qty | Catalog # |
|---|---|---|
| **PAKMASTER 100 with PCH-53P 70° Torch** | | |
| 208 / 230V Single Phase with 25' Leads | 1 | 1-7200-2 |
| 380 / 415V Three Phase with 25' Leads | 1 | 1-7204-2 |
| 460V Three Phase with 25' Leads | 1 | 1-7208-2 |
| 208 / 230V Single Phase with 50' Leads | 1 | 1-7202-2 |
| 380 / 415V Three Phase with 50' Leads | 1 | 1-7206-2 |
| 460V Three Phase with 50' Leads | 1 | 1-7210-2 |
| **PAKMASTER 100 with PCH-53P 90° Torch** | | |
| 208 / 230V Single Phase with 25' Leads | 1 | 1-7200-1 |
| 380 / 415V Three Phase with 25' Leads | 1 | 1-7204-1 |
| 460V Three Phase with 25' Leads | 1 | 1-7208-1 |
| 208 / 230V Single Phase with 50' Leads | 1 | 1-7202-1 |
| 380 / 415V Three Phase with 50' Leads | 1 | 1-7206-1 |
| 460V Three Phase with 50' Leads | 1 | 1-7210-1 |
| **PAKMASTER 100 Power Supply Only** | | |
| 208 / 230V Single Phase | 1 | 3-7100 |
| 380 / 415V Three Phase | 1 | 3-7101 |
| 460V Three Phase | 1 | 3-7102 |

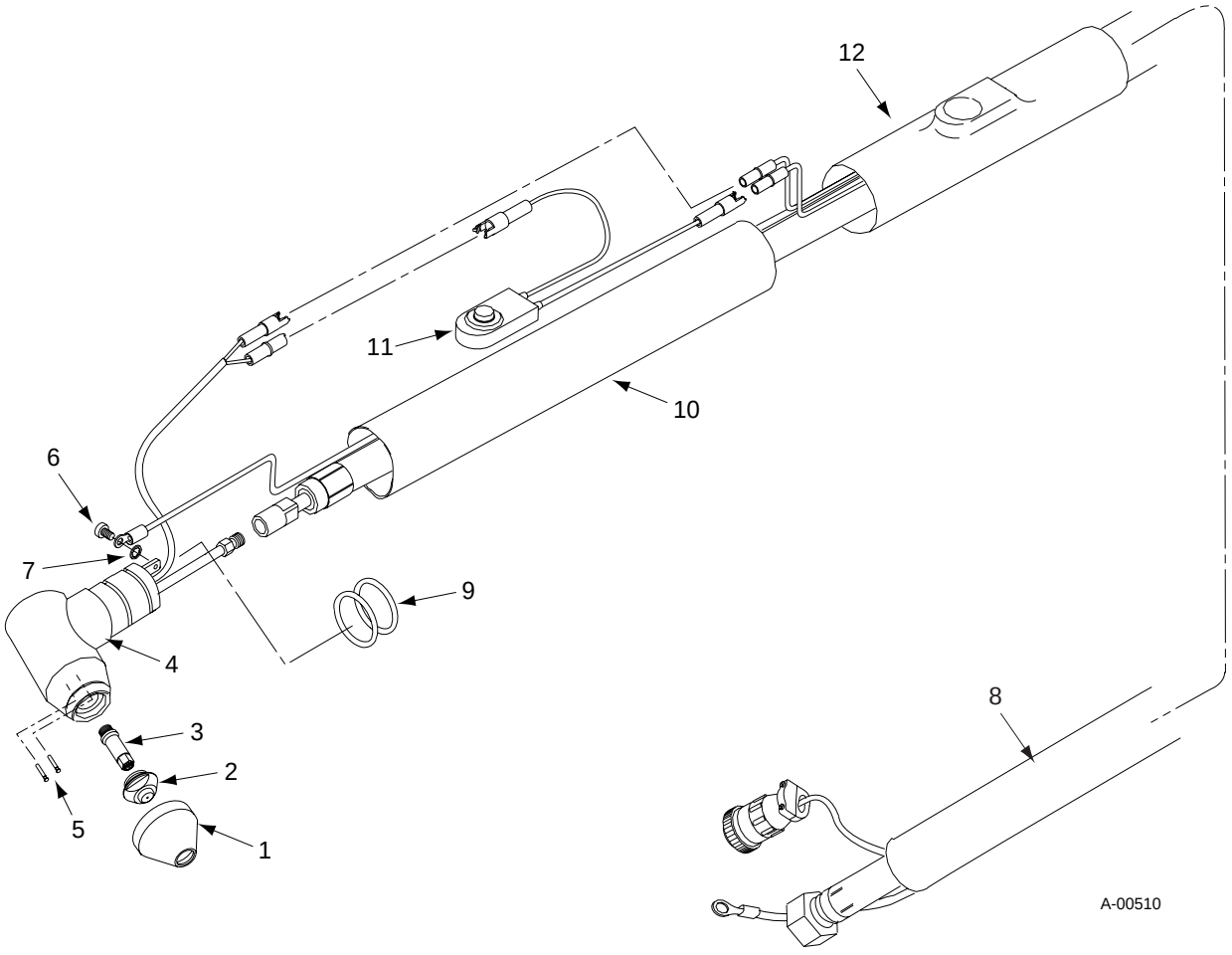
## 6.04 Replacement Torch And Lead Assemblies

| Description | Qty | Catalog # |
|---|---|---|
| Replacement Torch With Leads Only: | | |
| PCH-53P 70° Hand Torch with 25 ft (7.6 m) Leads | 1 | 2-7104 |
| PCH-53P 70° Hand Torch with 50 ft (15.2 m) Leads | 1 | 2-7114 |
| PCH-53P 90° Hand Torch with 25 ft (7.6 m) Leads | 1 | 2-7103 |
| PCH-53P 90° Hand Torch with 50 ft (15.2 m) Leads | 1 | 2-7113 |
| Replacement Torch Assemblies include: Work cable, PCH-53P torch with leads, pressure regulator / air filter, air hose and fittings, torch spare parts kit, and operating manual. | | |
| PCH-53P 70° Hand Torch with 25 ft (7.6 m) Leads | 1 | 7-1708 |
| PCH-53P 70° Hand Torch with 50 ft (15.2 m) Leads | 1 | 7-1710 |
| PCH-53P 90° Hand Torch with 25 ft (7.6 m) Leads | 1 | 7-1707 |
| PCH-53P 90° Hand Torch with 50 ft (15.2 m) Leads | 1 | 7-1709 |

## 6.05 Replacement Hand Torch Parts

| Item # | Qty | Description | Catalog # |
|---|---|---|---|
| 1 | 1 | Shield Cup, Standard | 9-6355 |
| 2 | 1 | Tip, Cutting,Air, 0.049" Orifice, 70 Amps | 9-5897 |
| 3 | 1 | Electrode, Air, Cutting or Gouging | 9-5898 |
| 4 | 1 | Assembly, Torch Head, PCH-53 70 ° (Includes items #5 - 7) | 9-6370 |
| | 1 | Assembly, Torch Head, PCH-53 90 ° (Includes items #5 - 7) | 9-6390 |
| 5 | 2 | PIP Spring Probes (Pins) | 9-5723 |
| 6 | 1 | #6-32X1 / 4 Phillips Pan Head Screw | See Note |
| 7 | 1 | #6 Internal Star Washer | See Note |
| 8 | 1 | Lead Assembly, Cable (Includes item # 12) | |
| | | 25 ft (7.6m) Length | 4-6048 |
| | | 50 ft (15.2m) Length | 4-6050 |
| 9 | 2 | O-Ring | 8-0536 |
| 10 | 1 | Handle | 9-5644 |
| 11 | 1 | Assembly, Torch Switch | 9-1246 |
| 12 | 1 | Sheath, Handle | 8-4216 |

NOTE: Item can be purchased locally.


12
11
10
6
7
9
4
3
2
5
1
8
A-00510

## 6.06 Replacement Power Supply Parts (208/230V Units)

| Item # | Qty | Description | Catalog # |
|---|---|---|---|
| F1 | 1 | Fuse 5A 600V | 9-1107 |
| TSH1 | 1 | Thermal Switch | 10-2273 |
| TSH2 | 1 | Thermal Switch | 9-1074 |
| MC | 1 | Magnetic Contactor | 9-1097 |
| MCB | 1 | Circuit Breaker | 9-1075 |
| VR1 | 1 | Variable Resistor | 10-2124 |
| SOL | 1 | Solenoid Valve | 9-1077 |
| R1 | 1 | Resistor | 10-2207 |
| R9 | 1 | Resistor (See Note 1) | 9-1078 |
| R9 | 1 | Resistor (See Note 2) | 9-1093 |
| C5 & C6 | 1 | Capacitor | 9-1091 |
| C7 | 1 | Capacitor | 9-1079 |
| Q1 | 1 | IGBT | 9-1080 |
| Q3 | 1 | IGBT | 9-1081 |
| D1 | 1 | Input Diode | 10-2653 |
| D2 | 1 | Output Diode | 9-1082 |
| CR1 | 1 | Relay | 9-1083 |
| FAN | 1 | Cooling Fan | 9-1084 |
| PRS | 1 | Pressure Switch | 9-1099 |
| S2 | 1 | RUN / SET Switch | 9-1096 |
| T2 | 1 | Transformer (See Note 1) | 9-1085 |
| T2 | 1 | Transformer (See Note 2) | 9-1094 |
| PCB1 | 1 | Main PC Board (See Note 1) | 9-1086 |
| PCB1 | 1 | Main PC Board (See Note 2) | 9-1095 |
| PCB2 | 1 | High Frequrency PC Board | 9-1087 |
| PCB3 | 1 | IGBT Gate PC Board | 10-2147 |
| PCB4 | 1 | Pilot Timer PC Board (See Note 1) | 9-1088 |

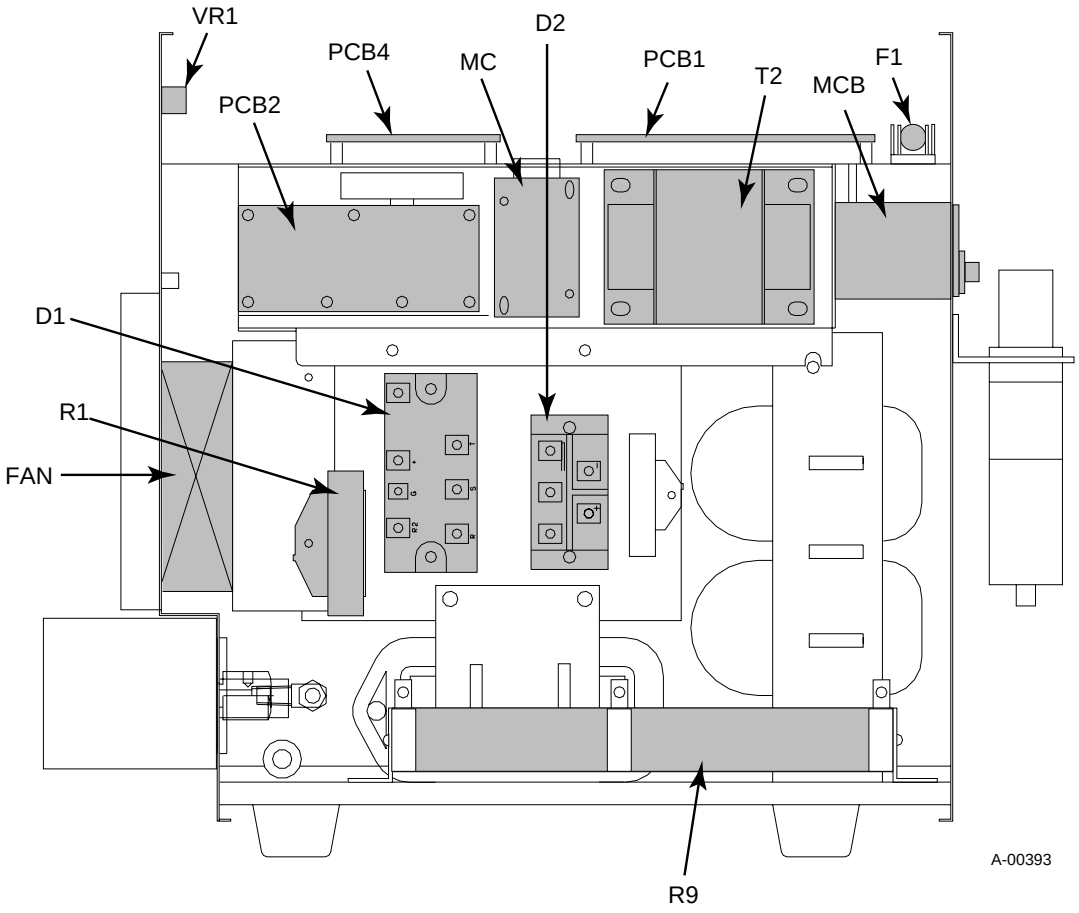
The following items are not shown:

| | | | |
|---|---|---|---|
| CON1 | 1 | Torch Control Receptacle | 9-1098 |
| +P | 1 | Pilot Stud and Knob Assembly | 9-1108 |
| | 1 | Front Panel | 9-1100 |
| | 1 | Rear Panel | 9-1103 |
| | 1 Set | Left and Right Case Halves | 9-1106 |

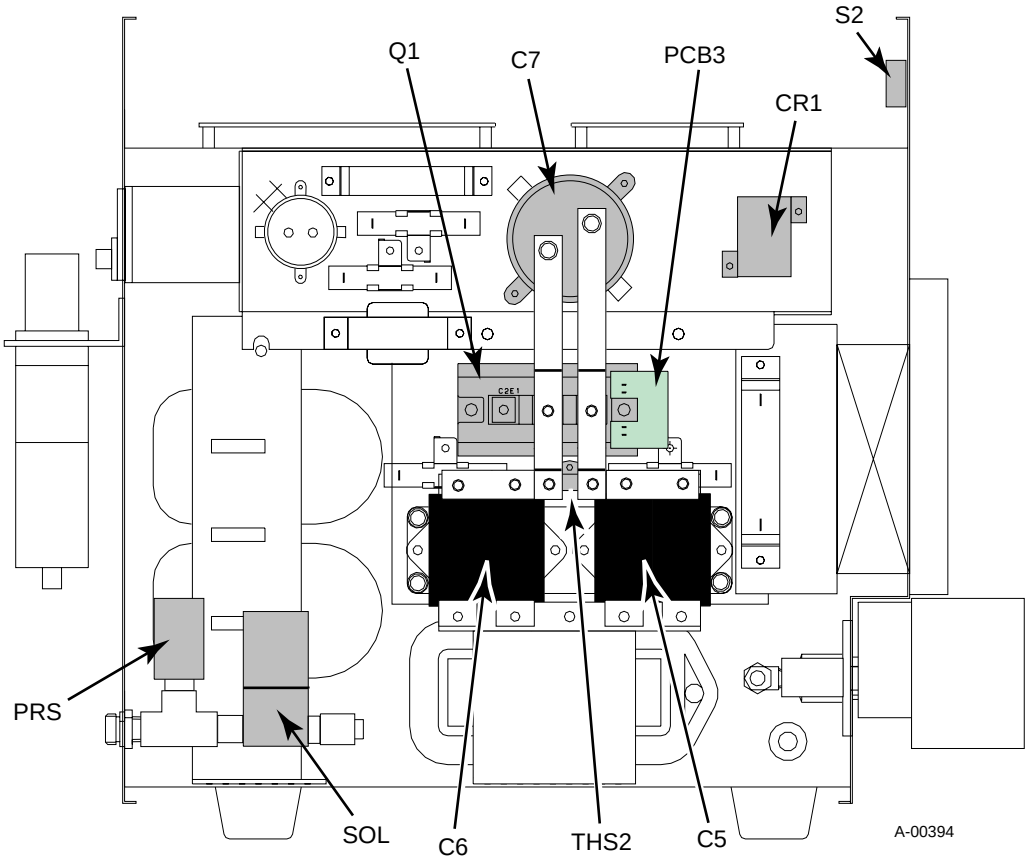
NOTES:

1. Used on 208 / 230V units without any letter after the serial number
2. Used on 208 / 230V units with the letter 'A' or higher after the serial number

Right Side




Left Side



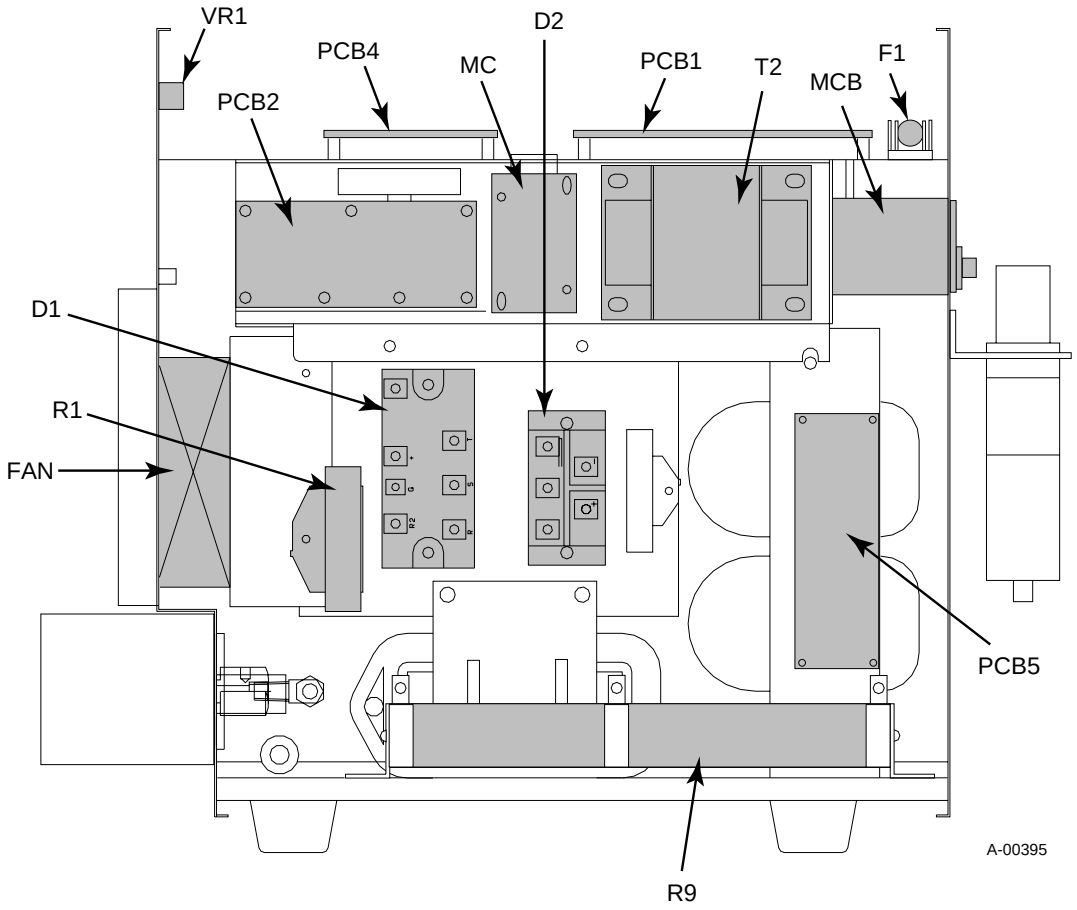
## 6.07 Replacement Power Supply Parts (380/415V & 460V Units)

| Item # | Qty | Description | Catalog # |
|---|---|---|---|
| F1 | 1 | Fuse 5A 600V | 9-1107 |
| TSH1 | 1 | Thermal Switch | 10-2273 |
| TSH2 | 1 | Thermal Switch | 9-1074 |
| MC | 1 | Magnetic Contactor | 9-1097 |
| MCB | 1 | Circuit Breaker | 9-1076 |
| VR1 | 1 | Variable Resistor | 10-2124 |
| SOL | 1 | Solenoid Valve | 9-1077 |
| R1 | 1 | Resistor | 10-2207 |
| R9 | 1 | Resistor | 9-1078 |
| C5 & C6 | 1 | Capacitor | 10-2120 |
| C7 | 1 | Capacitor | 9-1092 |
| Q1 | 1 | IGBT | 9-1080 |
| Q3 | 1 | IGBT | 9-1081 |
| D1 | 1 | Input Diode | 10-2640 |
| D2 | 1 | Output Diode | 9-1082 |
| FAN | 1 | Cooling Fan | 9-1084 |
| PRS | 1 | Pressure Switch | 9-1099 |
| S2 | 1 | RUN/SET Switch | 9-1096 |
| T2 | | Transformer | |
| | 1 | Transformer - 380/415V Unit | 9-1089 |
| | 1 | Transformer - 460V Unit | 9-1085 |
| PCB1 | 1 | Main PC Board | 9-1086 |
| PCB2 | 1 | High Frequency PC Board | 9-1087 |
| PCB3 | 1 | IGBT Gate PC Board | 10-2147 |
| PCB4 | 1 | Pilot Timer PC Board | 9-1090 |
| PCB5 | | Surge Absorber | |
| | 1 | 380/415V Unit | 10-2145 |
| | 1 | 460V Unit | 10-2164 |

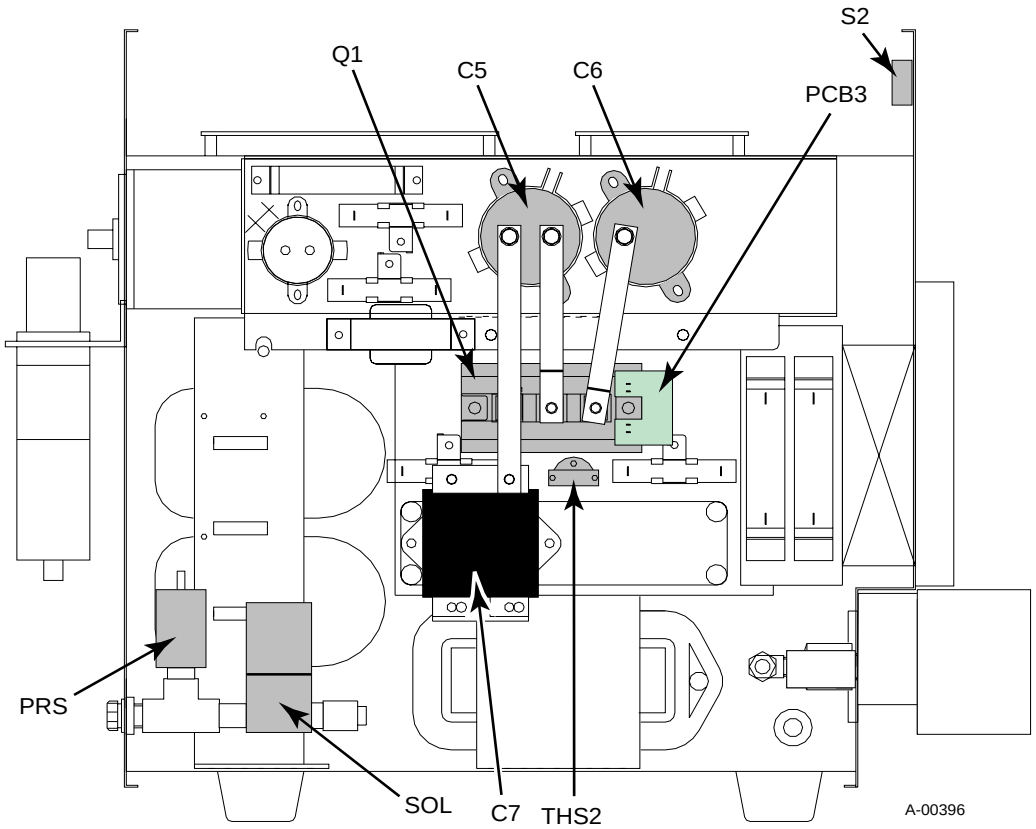
The following items are not shown:

| | | | |
|---|---|---|---|
| CON1 | 1 | Torch Control Receptacle | 9-1098 |
| +P | 1 | Pilot Stud and Knob Assembly | 9-1108 |
| | | Front Panel | |
| | 1 | 380/415V Unit | 9-1101 |
| | 1 | 460V Unit | 9-1102 |
| | | Rear Panel | |
| | 1 | 380/415V Unit | 9-1104 |
| | 1 | 460V Unit | 9-1105 |
| | 1 Set | Left and Right Case Halves | 9-1106 |

Right Side




Left Side



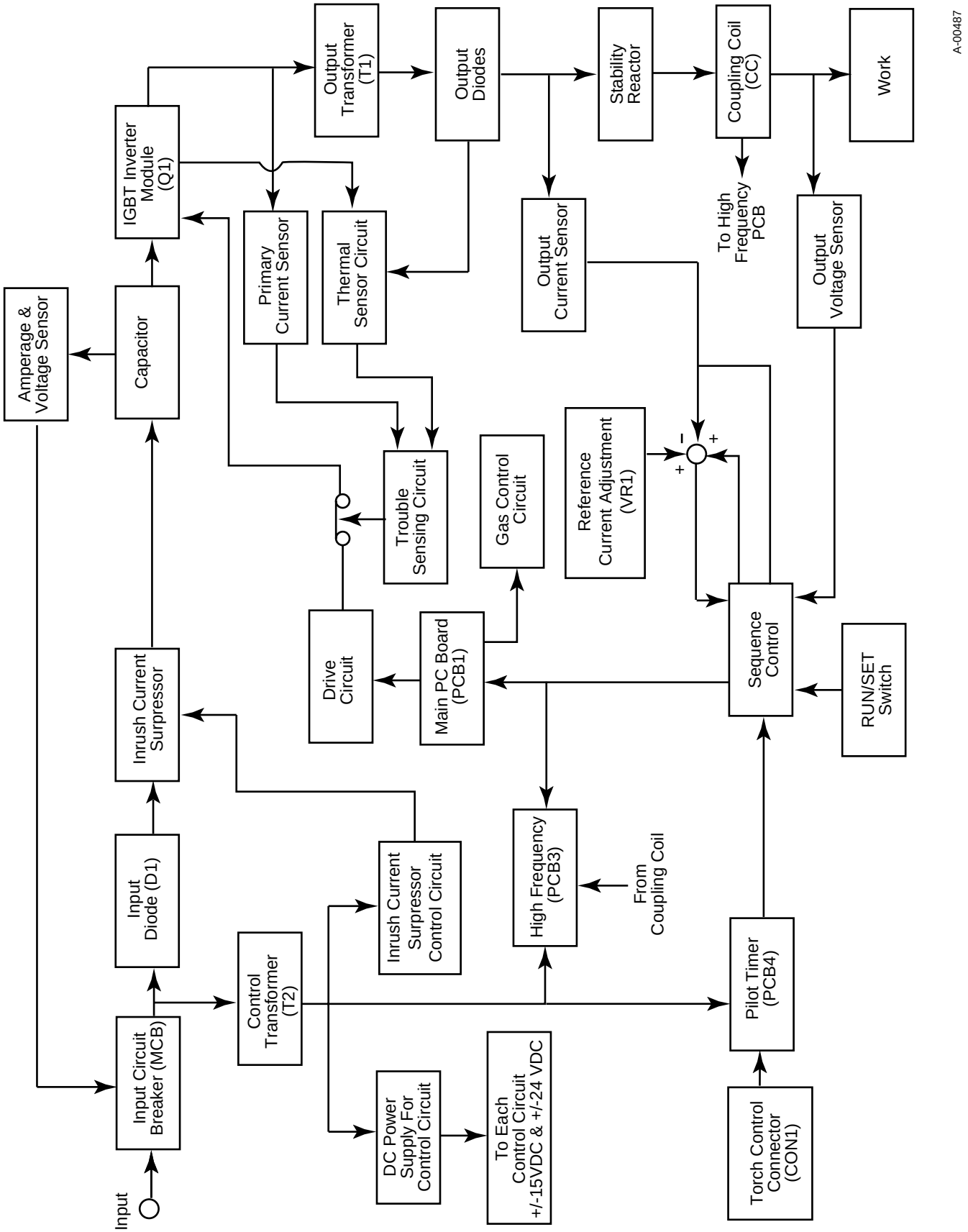
## 6.08 Options and Accessories

| Qty | Description | Catalog # |
|---|---|---|
| 1 | Two Stage Air Filter Kit | 7-0100 |
| | Replacement Element | |
| 1 | First Stage | 9-1021 |
| 1 | Second Stage | 9-1022 |
| 1 | Smart Cart - Wicked Wheels | 7-7777 |

## 6.09 Spare Parts Kits

| Qty | Description | Catalog # |
|---|---|---|
| 1 | Cutting, Air, Parts Kit Includes: | 5-0102 |
| 1 | Lubricant | 8-4025 |
| 1 | Box, Utility | 8-3141 |
| 1 | Nut Driver, 1/4" | 9-5620 |
| 5 | Electrode, Air, Plated | 9-5898 |
| 5 | Cutting Tip, Air, 0.049 Orifice | 9-5897 |
| 1 | Shield Cup, Standard With Shield | 9-6355 |
| 1 | Wrench, Open End, 1/2" | 8-4007 |

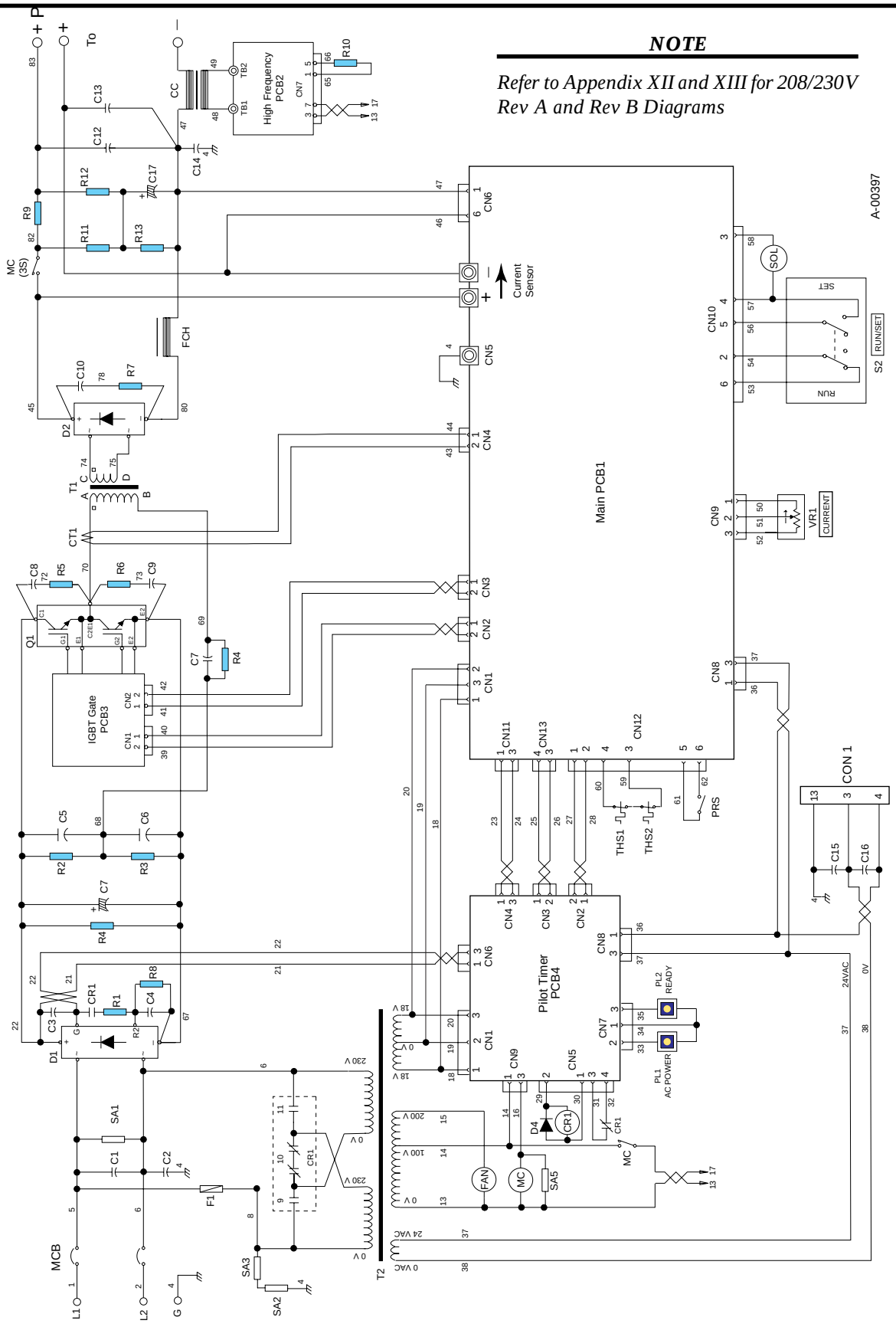
# APPENDIX I: SYSTEM BLOCK DIAGRAM



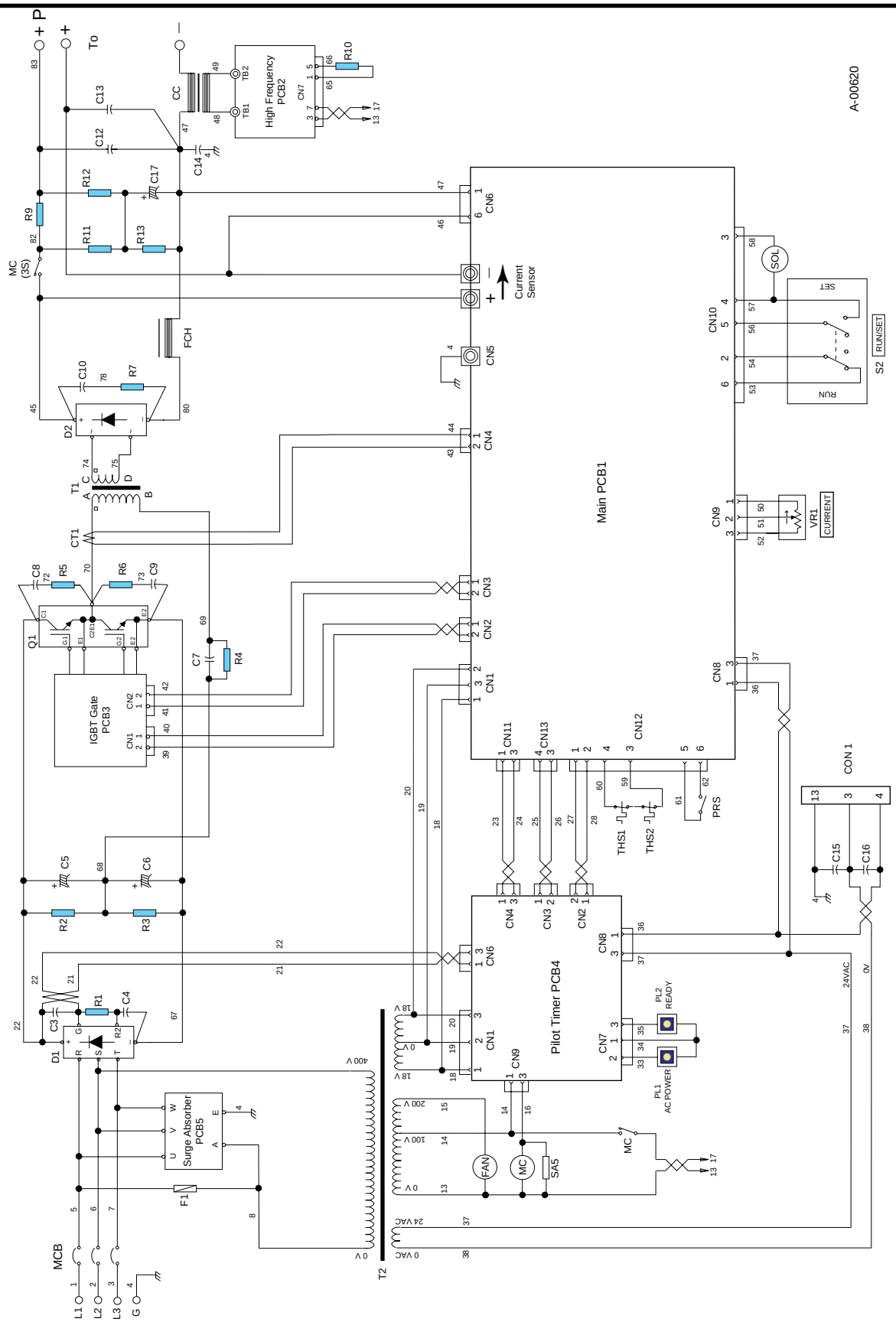
# APPENDIX II: INTERCONNECTION DIAGRAM 208/230V UNITS

***NOTE***

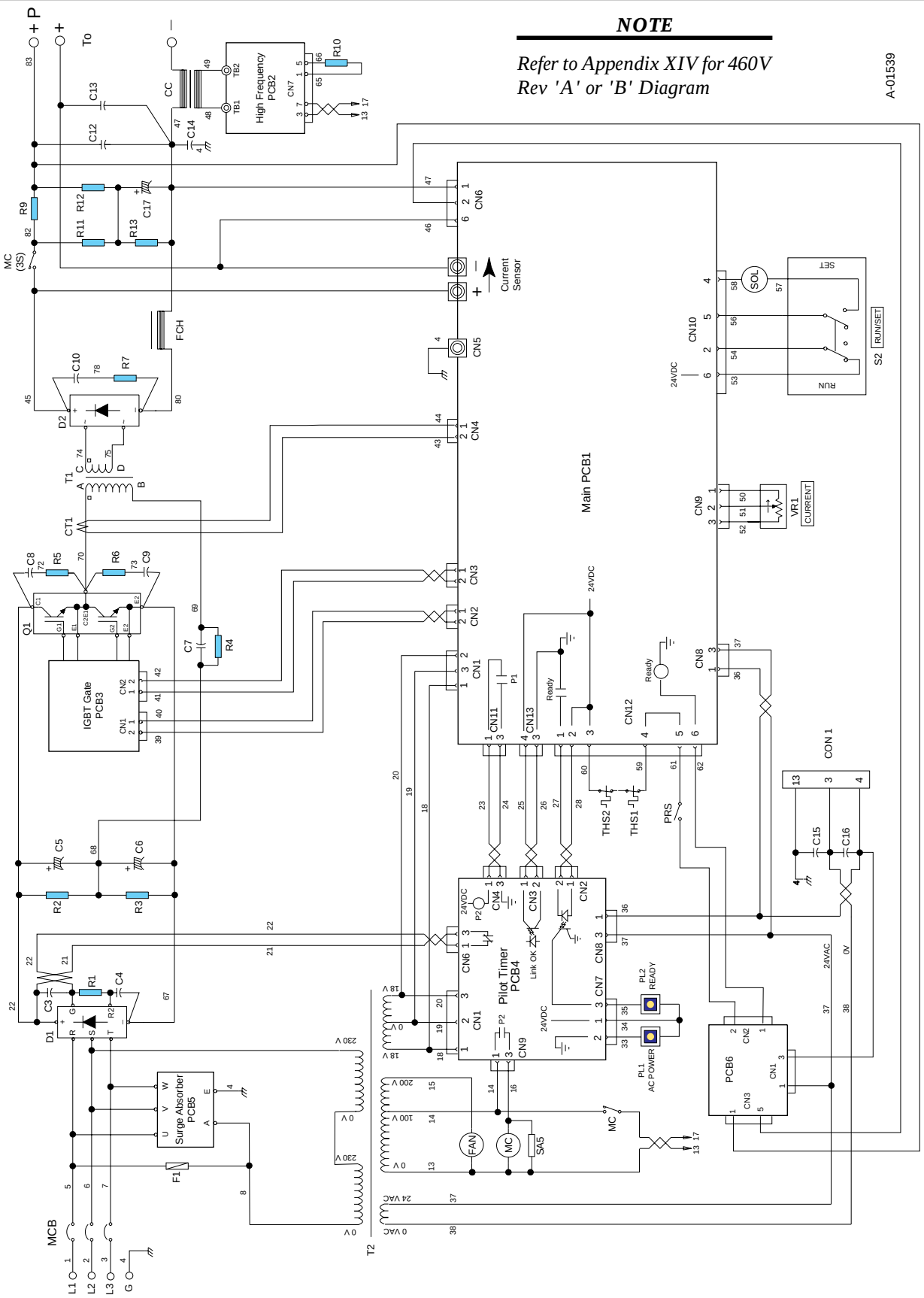
*Refer to Appendix XII and XIII for 208/230V Rev A and Rev B Diagrams*



# APPENDIX III: INTERCONNECTION DIAGRAM
# 380/415V UNITS



# APPENDIX IV: INTERCONNECTION DIAGRAM
# 460V UNITS



# APPENDIX V: PILOT TIMER PC BOARD (PCB4) CONNECTOR REFERENCE

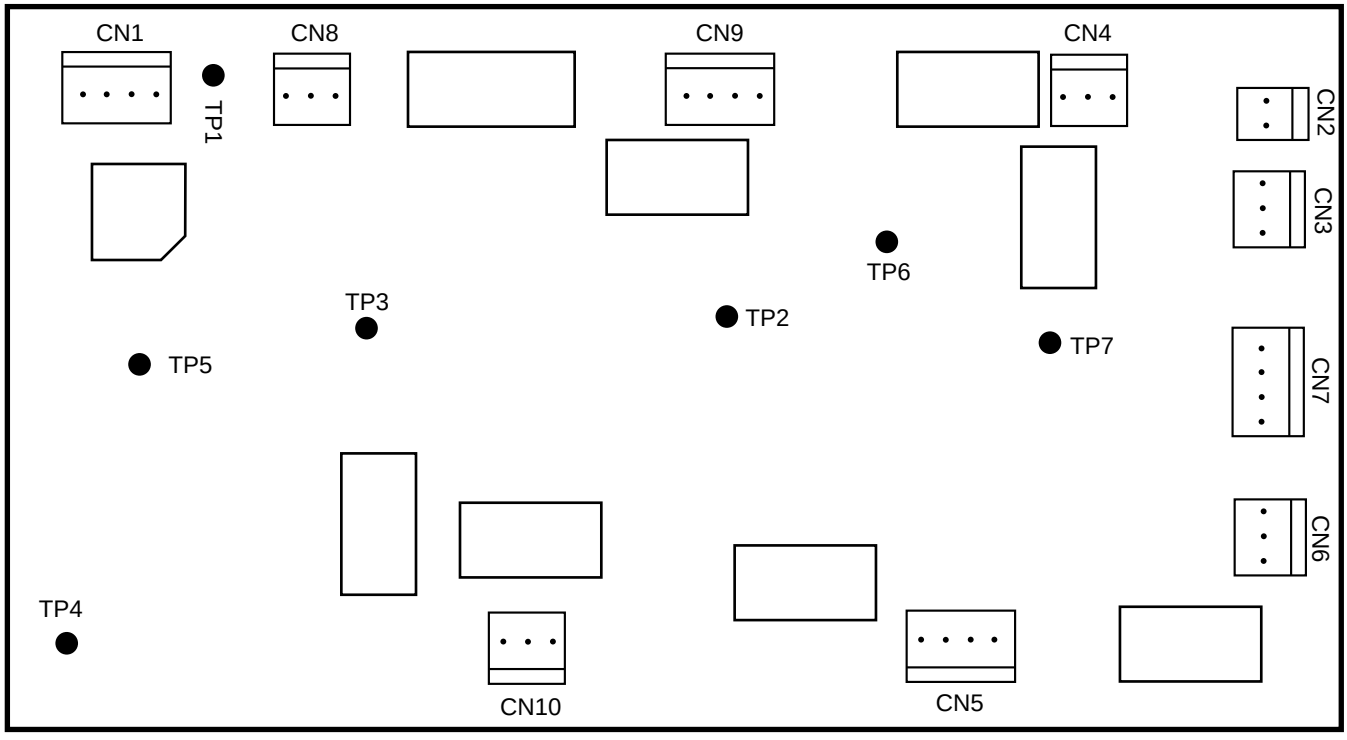
| Connector | Reference | Description |
|---|---|---|
| CN1 | T2 | 18 VAC supply |
| CN2 | PCB1 | Warning signal |
| CN3 | PCB1 | Inverter ON/OFF control |
| CN4 | PCB1 | High Frequency (HF) control relay circuit |
| CN5 | CR1 | SMART-LOGIC control circuit |
| CN6 | D1 | Pre-charging contactor |
| CN7 | PL1/2 | AC & READY enable circuit |
| CN8 | CON1 | Torch Switch Control |

# APPENDIX VI: PILOT TIMER PC BOARD (PCB4) CONNECTOR SIGNALS

| Connector | Pin | Value | Description |
|---|---|---|---|
| CN1 | 1 | 18 VAC | AC power from T2 |
| | 2 | 0 VAC | Circuit Common |
| | 3 | 18 VAC | AC Power from T2 |
| CN2 | 1 - 2 | | Normally 0V; Abnormal 1V |
| CN3 | 1 - 2 | | Normally 0V; Abnormal +24V |
| | 3 | | Not Used |
| CN4 | 1 | +24 VDC | Normally unregulated +24 VDC if HF relay de-energized |
| | 2 | | Not used |
| | 3 | 0 V | PCB common |
| CN5 | 1 - 2 | 24 VDC | Smart Logic (Not Used on 460 V Units) |
| | 3 - 4 | | Smart Logic OFF state 0V; ON state 24 VDC (Not Used on 460V Units) |
| CN6 | 1 | | "G" output of Input Diode D1 |
| | 2 | | Not used |
| | 3 | | "+" output of Input Diode D1 |
| CN7 | 1 | +24 VDC | Unregulated +24 VDC to AC POWER and READY indicators |
| | 2 | | Low side of AC POWER indicator (PL1) |
| | 3 | | Low side of READY indicator (PL2) |
| | 4 | | Not used |
| CN8 | 1 | 24 VAC | 24 VAC to CON1 |
| | 2 | | Not used |
| | 3 | 24 VAC | 24 VAC from T@ |
| CN9 | 1 | 100 VAC | AC Power from T2 |
| | 2 | | Not Used |
| | 3 | 100 VAC | To Magentic Contactor (MC) through CR5 Relay Contact |
| | 4 | | Not Used |
| CN10 | 1 - 3 | | Not used |
| NOTE - All values with respect to test point TP1 on Pilot PC Board (PCB4). | | | |

# APPENDIX VII: PILOT TIMER PC BOARD (PCB4) TEST POINT SIGNALS

| Connector | Value | Description |
|---|---|---|
| TP1 | | PC Common |
| TP2 | +15 VDC | Regulated voltage of control circuit |
| TP3 | -48 VDC | Unregulated |
| TP4 | -24 VDC | Unregulated |
| TP5 | +24 VDC | Unregulated |
| TP6 | | Pilot Timer ON 0V; Pilot Timer OFF 24 VDC |
| TP7 | | 24 VDC at READY state; 0 V Abnormal State |
| NOTE - All values with respect to test point TP1 on Pilot Timer PC Board (PCB4). | | |




A-00600

# APPENDIX VIII: MAIN PC BOARD (PCB1) CONNECTOR REFERENCE

| Connector | Reference | Description |
|---|---|---|
| CN1 | T2 | AC supply for Main PC Board |
| CN2 | PCB3 | G1/E1 of IGBT Module (Q1) |
| CN3 | PCB3 | G2/E2 of IGBT Module (Q1) |
| CN4 | CT1 | Over-Current Detect of IGBT |
| CN5 | Ground | Case Ground |
| CN6 | + Output | High Voltage Filter |
| CN8 | T2/CON1 | Torch Switch Control |
| CN9 | VR1 | CURRENT Potentiometer connections |
| CN10 | S2 & SOL | RUN/SET and SOL connections |
| CN11 | PCB4 | High Frequency (HF) control relay circuit |
| CN12 | THS1/THS2 & PRS | Temperature sensors, pressure switch, and AC POWER/READY indicators |
| CN13 | PCB4 | G2/E2 of IGBT Module (Q1) |

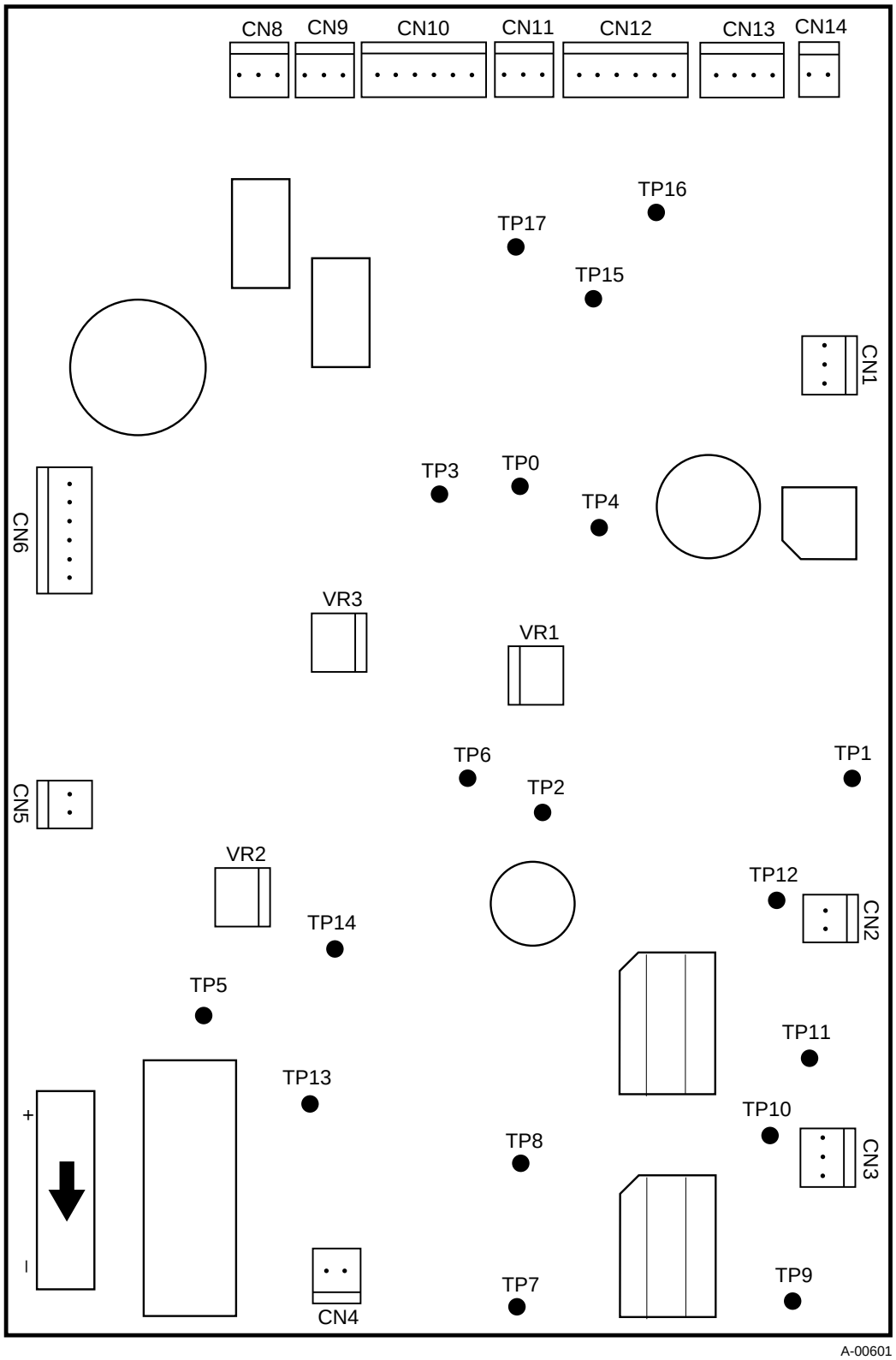
# APPENDIX IX: MAIN PC BOARD (PCB1) CONNECTOR SIGNALS

| Connector | Pin | Value | Description |
|---|---|---|---|
| CN1 | 1 | 18 VAC | AC power from T2 |
| | 2 | 18 VAC | AC power from T2 |
| | 3 | 0 VAC | Circuit common |
| CN2 | 1 | | IGBT Drive Signal |
| | 2 | | IGBT Drive Signal |
| CN3 | 1 | | IGBT Drive Signal |
| | 2 | | IGBT Drive Signal |
| CN4 | 1 | | Over Current Detector (CT1) |
| | 2 | | Over Current Detector (CT1) |
| CN5 | 1 | | PC Common |
| | 2 | | Not used |
| CN6 | 1 | | (-) Output |
| | 2 | | Not used |
| | 3 | | Not used |
| | 4 | | Not used |
| | 5 | | Not used |
| | 6 | | (+) Output |
| CN8 | 1 | | 0 VAC from Transformer (T2) when Torch Switch is pushed |
| | 2 | | Not used |
| | 3 | 24 VAC | AC voltage from T2 |
| CN9 | 1 | 0 V | PCB common for CURRENT adjustment potentiometer (VR1) |
| | 2 | 0 to +15 VDC | Center wiper of CURRENT adjustment potentiometer (VR1) |
| | 3 | +15 VDC | Regulated +15 VDC for Current adjustment potentiometer (VR1) through CR1 relay contacts |
| CN10 | 1 | | Not used |
| | 2 | +24 VDC | Unregulated +24 VDC when RUN/SET switch in RUN position |
| | 3 | 0 - 24 VDC | Unregulated +24 VDC in SET; 0 VDC in RUN |
| | 4 | +24 VDC | Unregulated +24 VDC to Gas Solenoid (SOL) |
| | 5 | 0 V | PCB common to RUN/SET Switch |
| | 6 | +24 VDC | Unregulated +24 VDC to RUN/SET Switch |
| CN11 | 1 | +24 VDC | Normally unregulated +24 VDC if HF relay de-energized |
| | 2 | | Not used |
| | 3 | 0 VDC | PC Commom |
| CN12 | 1 - 2 | | Abnormal Current Flows from Pin 2 to Pin 1 |
| | 3 - 4 | | Normally 0V; Abnormal 24 VDC |
| | 5 - 6 | | Normally 0V; Abnormal 24 VDC (Gas Pressure) |
| CN13 | 1 | | Not used |
| | 2 | | Not used |
| | 3 - 4 | | Normally 0V; Abnormal 24 VDC (Ready Circuit) |

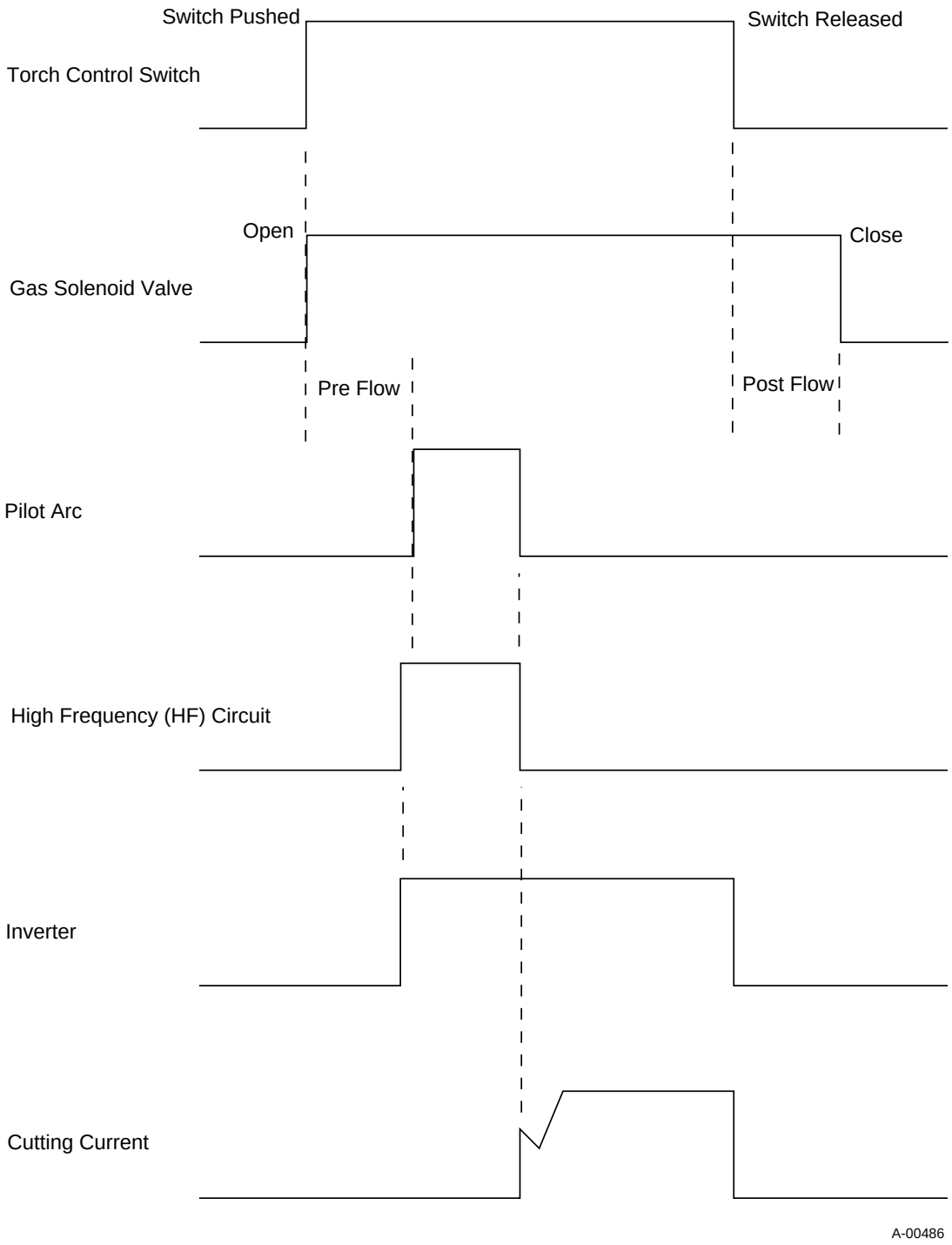
NOTE - All values with respect to test point TP0 on Main PC Board (PCB1).

# APPENDIX X: MAIN PC BOARD (PCB1) TEST POINT SIGNALS

| Connector | Value | Description |
|---|---|---|
| TP0 | Common | Circuit common |
| TP1 | +24 VDC | Unregulated - Used for relays drive and detect point of over voltage. |
| TP2 | +15 VDC | Regulated voltage of control circuit |
| TP3 | -15 VDC | Regulated voltage of control circuit |
| TP4 | | Normally 0V; Abnormal +15V |
| TP5 | 0 V | Hall CT Offset - Adjusted by CURRENT potentiometer |
| TP6 | | Reference Signal Approximately 5.2V @ 70A |
| TP7 | | )VDC @ Standby; +15VPWM Ouptput When Torch Switch Closes |
| TP8 | | )VDC @ Standby; +15VPWM Ouptput When Torch Switch Closes After Delay |
| TP9 | | IGBT Drive Signal |
| TP10 | | IGBT Drive Signal |
| TP11 | | IGBT Drive Signal |
| TP12 | | IGBT Drive Signal |
| TP13 | 20 KHz | Sawtooth waveform of 20 KHz (50 us +/- 2) |
| TP14 | | Normally +15 VDC; Abnormal 0V (Over Current) |
| TP15 | | Normally +15 VDC; Abnormal 0V (TEMP/GAS Pressure) |
| TP16 | | Normally +15 VDC; Abnormal 0V (TEMP/GAS Pressure) |
| TP17 | | Inverter ON Signal Approximately 0V @ ON; 0.6V @ OFF |
| NOTE - All values with respect to test point TP0 on Main PC Board (PCB1). | | |


CN8
CN9
CN10
CN11
CN12
CN13
CN14
TP16
TP17
TP15
CN1
TP3
TP0
TP4
CN6
VR3
VR1
TP6
TP1
TP2
CN5
VR2
TP12
CN2
TP14
TP5
TP11
TP13
TP10
CN3
TP8
+
–
TP7
TP9
CN4
A-00601

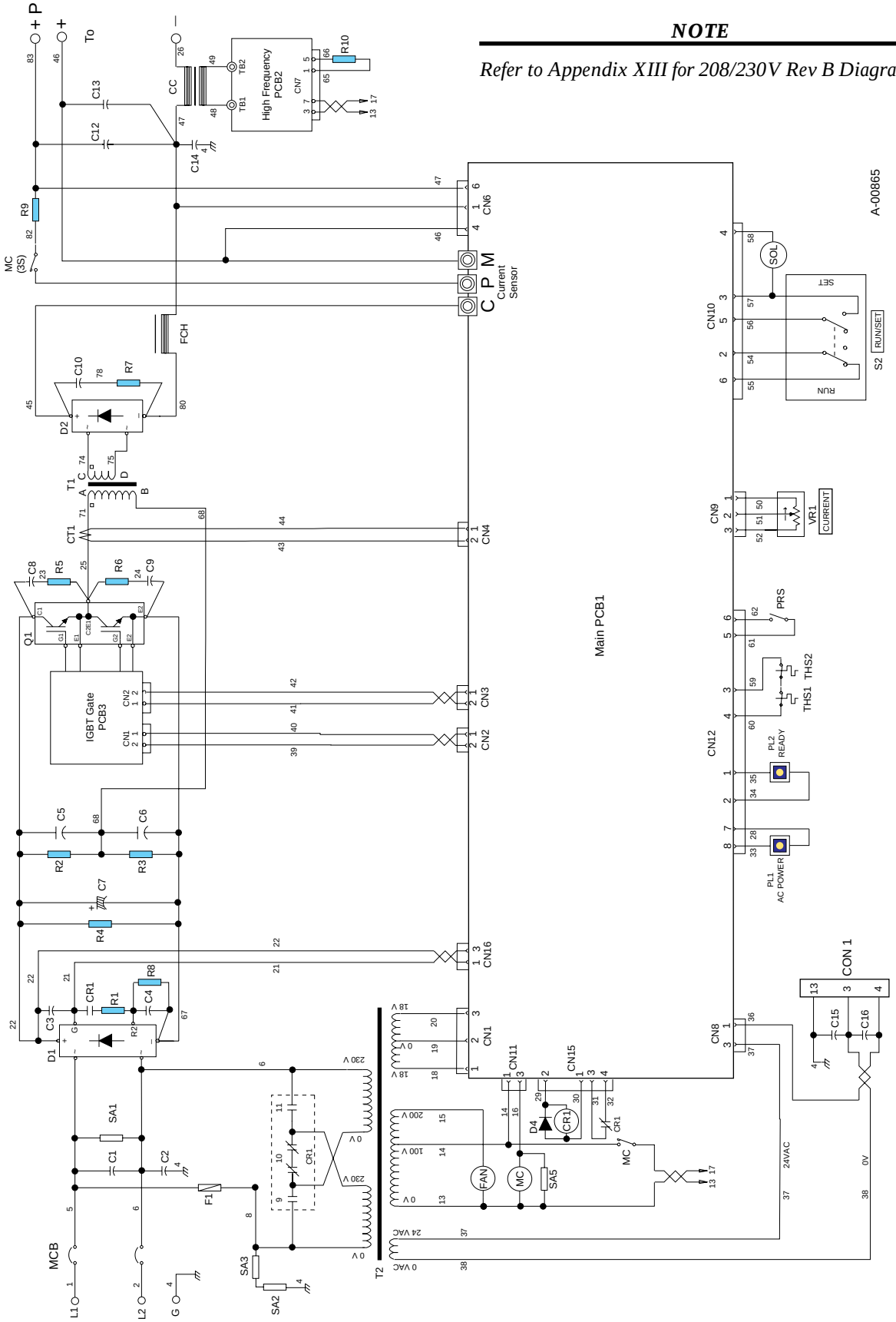
# APPENDIX XI: SEQUENCE TIMING DIAGRAMS



# APPENDIX XII: INTERCONNECTION DIAGRAM
# 208/230V - REV 'A' UNITS

***NOTE***

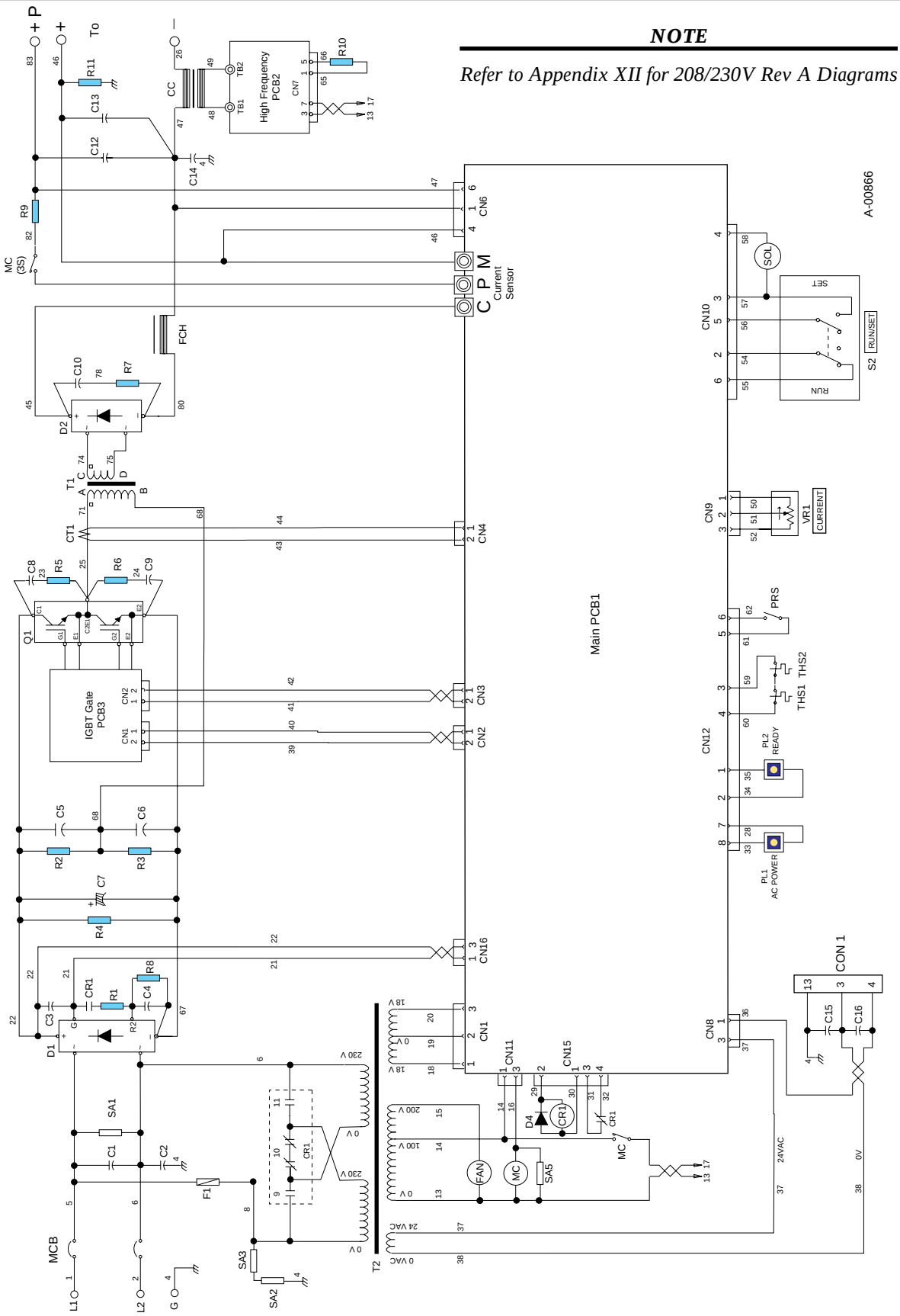
*Refer to Appendix XIII for 208/230V Rev B Diagrams*



# APPENDIX XIII: INTERCONNECTION DIAGRAM
# 208/230V - REV 'B' UNITS

***NOTE***

*Refer to Appendix XII for 208/230V Rev A Diagrams*



# APPENDIX XIV: INTERCONNECTION DIAGRAM
# 460V - REV 'A' or 'B' UNITS