THERMAL ARC®

A THERMADYNE® Company

# INVERTER ARC WELDER

MODEL 300GTS CC/TIG

- Stick
- TIG - High Frequency
  - Lift Start

## Service Manual

**First Edition**
**January 1995**

**Manual No. 0-2433**

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

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

Thermal Arc™ Model 300GTS Inverter Arc Welder Service Manual Number 0-2433

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## Updated Pages

The following pages have been updated to this manual since the last printing:

| Page Number(s) | Brief Description Of Change | Date |
|---|---|---|
| 37 & 39 | Replaced illustrations - Better parts location | 5/16/95 |

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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 arc welding equipment involves potential hazards. Operators and all others in the operating area should be alerted to possible hazards, and precautions should be taken to prevent possible injury.*

Read these safety precautions and the entire instruction manual before operating.

Do not use this power supply to thaw frozen water pipes.

This equipment must be installed, operated, and serviced by qualified personnel only.

**GASES AND FUMES**

Gases and fumes produced during arc welding can be dangerous and hazardous to your health.

Keep all fumes and gases from the breathing area.

Different arc welding processes, electrodes, and fluxes can produce different fumes, gases and radiation levels. Consult Material Safety Data Sheets (MSDS's) and manufacturer's instructions for specific technical data and precautionary measures for all fluxes, electrodes, and materials used.

Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Ventilation must be adequate to remove gases and fumes during operation as described in ANSI Standard Z49.1.

Use a downdraft table or water table to capture fumes and gases.

Use an air-supplied respirator if ventilation is not adequate to remove all fumes and gases.

When working in confined spaces provide adequate ventilation or wear an air-supplied respirator if necessary.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

When leaving confined space, shut off gas supply at source to prevent possible accumulation of gases if downstream valves are accidentally opened. Check that area is safe before re-entering.

Materials containing lead, cadmium, zinc, mercury, beryllium, and similar materials may produce harmful concentrations of toxic fumes when welded or cut. Adequate local exhaust ventilation must be used, or operators and others in the operating area must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from work surface and work area is well ventilated. Wear an air-supplied respirator if necessary.

Vapors from chlorinated solvents can be decomposed by the heat of the arc or flame to form phosgene, a highly toxic gas, and other lung and eye irritating products. The ultraviolet radiant energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. Do not weld or cut where solvent vapors may be drawn into the welding or cutting atmosphere or where radiant energy may penetrate to atmospheres containing even minute amounts of trichloroethylene or perchloroethylene. Solvents, degreasers, and potential sources of these vapors must be removed from the operating area.

Oil or grease in the presence of oxygen may ignite and burn violently. Keep cylinders, valves, couplings, regulators, hoses, and other apparatus clean and free from oil

and grease. Oxygen cylinders and apparatus should not be handled with oily hands or gloves. Do not allow an oxygen stream to contact oily or greasy surfaces.

Do not use oxygen as a substitute for compressed air.

NEVER ventilate with oxygen.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

**ARC RAYS**

Arc rays can injure eyes and burn skin.

Never look at an electric arc without protection. Protect eyes from exposure to arc. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause permanent damage to vision.

Use a welding helmet or shield with proper filter (see chart on page v). Place over face before striking arc.

Protect filter plate with a clear cover plate.

Do not use cracked or broken helmet or shield; radiation can pass through to cause burns.

Replace any cracked, broken or loose filter plates immediately. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields must be worn under helmet to protect eyes in case helmet is not in position before arc is struck.

Wear proper protective clothing. Arc rays can penetrate lightweight clothing,

Welding arc rays can reflect from light-colored surfaces.

Make sure others in the operating area are protected from arc rays.

For production welding, use separate room or enclosed bay. In open areas, surround operation with low reflective non-combustible screens or panels. Make sure that screen flaps or bay doors are closed before welding. Allow for free air circulation, particularly at floor level.

Provide face shields for all others viewing the weld.

Make sure others in the operating area are wearing flash goggles.

Recommended Eye Protection for Welding and Cutting (Based on AWS A6.2-73) is as follows:

| Welding or Cutting Operation | Electrode Size Metal Thickness or Welding Current | Filter Shade Number |
|---|---|---|
| Torch soldering | - | 2 |
| Torch brazing | - | 3 or 4 |
| Oxygen Cutting | | |
| Light | Under 1 in (25 mm) | 3 or 4 |
| Medium | 1-6 in (25-150 mm) | 4 or 5 |
| Heavy | Over 6 in (150 mm) | 5 or 6 |
| Gas welding | | |
| Light | Under 1/8 in (3 mm) | 4 or 5 |
| Medium | 1/8-1/2 in (3-12 mm) | 5 or 6 |
| Heavy | Over 1/2 in (12 mm) | 6 or 8 |
| Shielded metal arc welding (stick) electrodes | | |
| Light | Under 5/32 in (4 mm) | 10 |
| Medium | 5/32-1/4 in (4-6.4 mm) | 12 |
| Heavy | Over 1/4 in (6.4 mm) | 14 |
| Gas metal arc welding (MIG) | | |
| Non-ferrous base metal | All | 11 |
| Ferrous base metal | All | 12 |
| Gas tungsten arc welding (TIG) | All | 12 |
| Atomic hydrogen welding | All | 12 |
| Carbon arc welding | All | 12 |
| Plasma arc welding | All | 12 |
| Carbon arc air gouging | | |
| Light | - | 12 |
| Heavy | - | 14 |
| Plasma arc cutting | | |
| Light | Under 300 amps | 9 |
| Medium | 300-400 amps | 12 |
| Heavy | Over 400 amps | 14 |

**ELECTRIC SHOCK**

Electric shock can kill.

Do not contact electrically live parts.

Install equipment according to safety precautions, instruction manual, and all applicable codes.

Keep all panels, covers, and guards in place.

Disconnect all primary power before installing or servicing this equipment.

Insulate operator and others from work and ground.

Replace any cracked or damaged insulating parts.

Shut down welding power source before touching electrode, wire drive assembly, welding wire, wire reel, or any metal parts in contact with the welding wire.

Exposed hot conductors or other bare metal in the welding circuit or in ungrounded, electrically hot equipment can cause potentially fatal electric shock. Do not contact a wet surface when welding without suitable protection.

Wear dry insulating gloves and body protection. Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat cannot be avoided. Sweat, sea water, or moisture between body and an electrically hot part or grounded metal reduces electrical resistance and could cause potentially fatal electric shock.

A voltage will exist between the electrode and any conducting object in the work circuit. Examples of conducting objects include, but are not limited to, buildings, electrical tools, work benches, welding power source cases, workpieces, etc. Never touch electrode to any metal object unless the welding power source is off.

Arc welding equipment must be grounded according to the National Electrical Code, and the work must be grounded according to ANSI Z49.1 “Safety in Welding and Cutting.”

When installing, connect the frames of each unit such as welding power source, control, work table and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made electrically hot by stray current may cause potentially fatal electric shock. Do not ground to electrical conduit or to pipe carrying any gas or flammable liquid such as oil or fuel.

Check phase requirements before installing. If only three-phase power is available, connect single-phase equipment to only two wires of the three-phase line. Do not connect the equipment ground lead to the third (live) wire, or the equipment will become electrically hot - a dangerous condition that may cause potentially fatal electric shock.

Before welding, check ground for continuity. Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken off ground plug.

Fully insulated electrode holders should be used. Do not use holders with protruding screws.

Fully insulated lock-type connectors should be used to join welding cable lengths.

Frequently inspect cables for wear, cracks and damage. Replace those with excessively worn or damaged insulation to avoid potentially fatal electric shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable.

Keep cables dry, free of oil and grease, and protected from hot metal and sparks.

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

**Electrode**

For equipment with output ON / OFF control (contactor): Welding power sources for use with gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and similar processes normally are equipped with devices that permit ON-OFF control of the welding power output. When so equipped the electrode wire becomes electrically hot when the power source switch is ON and welding gun switch is closed. Never touch electrode wire or any conducting object in contact with electrode circuit unless the welding power source is OFF.

For equipment without output ON / OFF control (no contactor): Welding power sources used with shielded metal arc welding (SMAW) and similar processes may not be equipped with welding power output ON-OFF control devices. With such equipment the electrode is electrically hot when the power switch is turned ON. Never touch the electrode unless the welding power source is off.

Safety devices such as interlocks and circuit breakers should never be disconnected or shunted out.

Before installing, inspecting, or servicing equipment, disconnect primary power and remove line fuses (or lock or red-tag switches) to prevent accidental electric shock. Disconnect all cables from welding power source and pull all 115V line-cord plugs.

Do not open power circuit or change polarity while welding. If it must be disconnected in an emergency, guard against shock burns and flash from switch arcing.

Always shut off and disconnect all primary power when leaving equipment unattended.

Primary power disconnect switch must be available near the welding power source.

## FIRE AND EXPLOSION

Fire and explosion can be caused by hot slag, spatter, sparks, extreme heat, misuse of compressed gases and cylinders, and electrical short circuits.

Remove all combustibles from working area or provide a fire watch. Avoid paint spray rooms, dip tanks, storage areas, ventilators. Move work to an area free of combustibles if possible. If work cannot be moved, move combustibles at least 35 ft (10.7 m) away from sparks and heat or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls having combustibles on opposite sides should not be welded on or cut. Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

A fire watch with suitable fire extinguishing equipment must be provided during and after welding or cutting if combustibles (including building construction) are within 35 ft (10.7 m), if combustibles are further than 35 ft but may be ignited by flying sparks, or if openings (concealed or visible) in floors or walls within 35 ft may expose combustibles to sparks.

Combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

A hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

Do not weld or cut an empty container that has held combustibles, or that can produce flammable or toxic vapors when heated, unless container has first been cleaned as described in AWS Standard A6.0. This includes a thorough steam or caustic cleaning (or a solvent or water washing, depending on the combustible's solubility) followed by purging and inerting with nitrogen or carbon dioxide, and using protective equipment as recommended in A6.0. Waterfilling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see preceding paragraph). Do not depend on smell or sight to determine if it is safe to weld or cut.

Hollow castings or containers must be vented before welding or cutting to prevent explosion.

Never weld or cut in potentially explosive atmospheres containing flammable dust, gas, or liquid vapor (such as gasoline).

Do not mount this equipment over combustible surfaces.

Flying sparks or falling slag can fly up to 35 ft (10.7 m) and pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the operator.

Keep equipment clean and operable, free of oil, grease, and metallic particles that can cause short circuits in electrical parts.

Overloading arc welding equipment beyond rated capacity may overheat cables and cause fire.

Loose cable connections may overheat or flash and cause fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to rupture under rough handling.

After work is done, check that area is free of sparks, glowing embers, and flames.

Burn Prevention - Wear protective clothing including gauntlet welding gloves, hat, and high safety toe shoes. Button shirt collar to protect chest and neck, button pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag. Wear dark colored, substantial long-sleeve clothing (particularly for gas-shielded arc). As necessary, use additional protective clothing such as leather jacket or sleeves, flame-proof apron, and fire-resistant leggings. Avoid outer garments of untreated cotton.

Wear helmet with safety goggles and glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass) for welding or cutting (and chipping) to protect the eyes from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered.

Avoid oily or greasy clothing which may be ignited by sparks.

Do not handle hot metal such as electrode stubs and workpieces without gloves.

Medical first aid and eye treatment facilities and personnel should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Flammable hair preparations should not be used by persons intending to weld or cut.

Allow work and equipment to cool before handling.

## NOISE

Noise can cause permanent hearing loss.

Wear proper protective ear muffs or plugs.

Make sure others in the operating area are protected from noise.

**HIGH PRESSURE GAS CYLINDERS**

Comply with the precautions in this manual and those detailed in CGA Standard P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS.

Pressure Regulators:

Regulator relief valve is designed to protect only the regulator from overpressure and not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve) if gas leaks externally, if delivery pressure continues to rise with downstream valve closed, or if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Do not attempt to repair faulty regulators. Send to manufacturer's authorized repair center where special techniques and tools are used by trained personnel.

Cylinders must be handled carefully to prevent leaks and damage to walls, valves, or safety devices.

Contact with electrical circuits including third rails, electrical wires, or welding circuits can product short circuit arcs that may lead to a serious accident.

ICC or DOT markings must be on each cylinder as an assurance of safety when the cylinder is properly handled.

Use only cylinders with name of gas clearly marked on them; do not rely on color to identify gas content. Notify supplier if unmarked. Never deface or alter name, number or other markings on a cylinder.

Keep valves closed on empty cylinders, replace caps securely, mark MT, keep separate from full cylinders and return promptly.

Never use a cylinder or contents for other than intended use. Never use as a support or roller.

Locate or secure cylinders so they cannot be knocked over.

Keep cylinders clear of passageways and work areas where they may be struck.

To transport cylinders with a crane, use a secure support such as a platform or cradle. Do not lift cylinders by valves or caps, or by chains, slings, or magnets.

Do not expose cylinders to excessive heat, sparks, slag, or flame which may cause rupture. Do not allow contents to exceed 1300°F. Cool with water spray where such exposure exists.

Protect cylinders and valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Do not use hammer or wrench to open a cylinder lock valve which cannot be opened by hand. Notify supplier.

Never mix gases in a cylinder.

Never refill any cylinder.

Do not modify or exchange cylinder fittings.

**Hose**

Never use hose unless appropriate for specified gas. General hose identification is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for hose (not ordinary wire or other substitute) as a binding to connect hoses to fittings.

Do not use copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Coil excess hose to prevent kinks and tangles. Suspend hose off ground to protect from damage. Protect hose from damage by sharp edges, sparks, slag, excessive heat, and open flame.

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in soapy water; bubbles indicate leaks.

Repair leaky or worn hose by cutting area out and splicing. Do not tape.

**Proper Connections**

Keep cylinder valve outlet free of impurities which may clog orifices and damage seats before connecting regulator. Except for hydrogen, crack valve momentarily and point outlet away from people and sources of ignition. Wipe clean with a lintless cloth.

Match regulator to cylinder. Before connecting, check that regulator label and cylinder marking area match and that regulator inlet and cylinder outlet match. Never connect a regulator designed for one type of gas to a cylinder containing another gas.

When assembling threaded connections, clean and smooth seats where necessary before tightening. If connection leaks, disassemble, clean, and retighten using properly fitting wrench.

Use a CGA adapter (available from supplier) between cylinder and regulator, if required. Use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

**Pressurizing Steps**

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw clockwise. Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.

Do not stand in front of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure increases slowly. When gauge is pressurized (gauge reaches regulator maximum) open cylinder valve fully to seal stem against possible leak when using oxygen and inert gases. For fuel gas, open less than one turn to permit quick emergency shutoff.

Use pressure charts (available from supplier) for safe and efficient, recommended pressure settings on regulators.

Check for leaks on first pressurization and regularly thereafter. Brush with soapy solution (one capful of liquid detergent per gallon of water); bubbles indicate leak Clean off soapy water after test; dried soap is combustible.

Remove leaky or defective equipment immediately for repair.

Close gas supply at source and drain gas when leaving equipment unattended.

Do not use rope staging support for welding or cutting operation; rope may burn.

**Electronic Life Support Devices (Pacemakers)**

Magnetic fields from high currents can affect pacemaker operation. Persons wearing electronic life support equipment (pacemakers) should consult with doctor before going near arc welding, gouging, or spot welding operations.

## 1.03 Publications

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

1. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

2. 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

3. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, 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 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: 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:

| **PAK UNITS, POWER SUPPLIES** | **PARTS** | **LABOR** |
|---|---|---|
| MAIN POWER MAGNETICS | 2 YEARS | 1 YEAR |
| ORIGINAL MAIN POWER RECTIFIER | 2 YEARS | 1 YEAR |
| CONTROL PC BOARD | 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 |
| **CONSOLES, CONTROL EQUIPMENT, HEAT EXCHANGES, AND ACCESSORY EQUIPMENT** | 1 YEAR | 1 YEAR |
| **TORCH AND LEADS** | 180 DAYS | 180 DAYS |
| **REPAIR/REPLACEMENT PARTS** | 90 DAYS | 90 DAYS |

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. Authorized Thermal Arc® repair facilities are authorized distributors and authorized Thermal Arc® Service Centers. 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 January 18, 1991

# SECTION 2: INTRODUCTION

## 2.01 Scope Of Manual

This Manual provides Service Instructions for Thermal Dynamics Model 300GTS Inverter Arc Welder.

Refer to Operating Manual (0-2425) 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, 0-2425, 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.

Printed Circuit Board Assemblies to be returned 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 Introduction

The information in this Section has two purposes: To familiarize 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 General Description

The Thermal Arc™ 300GTS is a three-phase or single-phase (if derated) DC arc welding power source with Constant Current (CC) output characteristics. The unit is equipped with a gas control valve, lift arc starter, and high-frequency arc starter for use with Gas Tungsten Arc Welding (GTAW). This unit is designed for use with Shielded Metal Arc Welding (SMAW), Gas Tungsten Arc Welding - Lift Start (GTAW) and Gas Tungsten Arc Welding - Pulsed (GTAW-P) processes. A digital amperage/voltage meter is optional.

## 3.03 Specifications/Design Features

### A. Front Panel Controls/Indicators

**1. AC POWER Indicator**

The AC POWER indicator on the front panel comes on when the PRIMARY POWER switch is in ON position, indicating that the unit is energized.

**2. WARNING Indicator**

The WARNING indicator located on the front panel will turn ON if the unit detects one of the following conditions:

- Input voltage too low
- Thermal overload

**3. AMPERAGE Control**

***NOTE***

*The AMPERAGE control may be adjusted while welding.*

The AMPERAGE control selects the desired amperage within the entire range of the welding power source. Rotating the control clockwise increases the amperage output. The scale surrounding the AMPERAGE control represents the approximate amperage (A) value.

**4. ARC Control**

***NOTE***

*The ARC control may be adjusted while welding.*

The ARC control provides a variable selection of short circuit amperage to suit individual welding situations when operating in the STICK (SMAW) mode. Rotating the control clockwise causes amperage to increase as a short circuit condition is approached.

When the control is set at 100, short circuit amperage is considerably higher than normal welding amperage. This provides extra amperage for arc starting in out-of-position welds as well as momentary over amperage necessary for certain electrode types.

When the control is set at 0 (zero), short circuit amperage above normal welding amperage is minimal.

When the control is set at 50, short circuit amperage is approximately half that of the 100 position, but still higher than normal welding amperage. The 50 position provides a moderate amperage increase for arc starting necessary for certain type of electrodes and applications.

Select a setting best suited for the application and electrode type.

**5. Process Selector Switch**

The process selector toggle switch allows the operator to select the type of process to be used. There are three settings for the switch. When to the left it selects the STICK welding (SMAW) process; center selects the LIFT TIG welding (GTAW) process; to the right selects the HF TIG welding (GTAW) process.

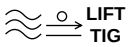
**a. STICK Welding (SMAW)** 


The unit provides weld output characteristics specifically designed for the Shielded Metal Arc Welding (SMAW) process. The ARC control is active.

**b. HF TIG (GTAW with High Frequency Start)** 


In this position, the unit provides weld output for the gas tungsten arc welding (GTAW) process. High frequency will be present from the time the contactor is closed until a welding arc is established. Once an arc is established, high frequency is no longer present. High frequency is present any time the arc is broken to aid in restarting the arc as long as the contactor is energized. When the process selector switch is in this position, the POST FLOW control will function and the ARC control will not function.

**c. LIFT TIG (GTAW without High Frequency)**




The unit provides weld output for the gas tungsten arc welding (GTAW) process. High frequency will not be present. POST FLOW control will function. The ARC and HOT START controls will not function. The unit will provide a low open circuit voltage and approximately 15 amps (for 1.0 ms) to the tungsten electrode when touched to the work and lifted away from surface. After the welding arc becomes established, the output current will be regulated at determined current level.

**6. AMPERAGE Switch**

This switch determines whether the amperage / voltage is adjusted by the front panel AMPERAGE control or by a remote control device.

a. PANEL Position 


If remote control function is not desired, place this switch in PANEL position.

**b. REMOTE 14 Position** 


For remote amperage control, place the AMPERAGE switch in REMOTE 14 position.

Remote control is a percentage of the value set by the front panel AMPERAGE control. For example, if the AMPERAGE control is set at half maximum output, the maximum output available from the remote control will be half the welding power source maximum output.

**7. OUTPUT CONTACTOR Switch**

***NOTE***

*Although the term CONTACTOR is used the output is not switched on or off by a physical contactor; rather, the unit uses solid-state output control.*

The switch has two functions:

**a. REMOTE 14 Position** 


Contactor connections are made to the REMOTE 14 receptacle. Open circuit voltage will be present at the weld output receptacles whenever the torch switch or remote device is closed.

**b. ON Position** 


Remote contactor control not used. Open circuit voltage will be available whenever the PRIMARY POWER switch is in ON position.

**8. POST FLOW Control**

The POST FLOW control sets the length of time gas flows after the arc is extinguished. Post flow time begins when the arc is broken and the contactor opens. When post flow time ends, the gas valve closes, shutting off shielding gas flow to the torch.

POST FLOW time can be adjusted from 1-50 seconds. Rotating the control clockwise increases post flow time.

***NOTE***

*The POST FLOW control and gas valve only work if the process selector switch is in one of the gas tungsten arc welding positions, the OUTPUT CONTACTOR switch is in REMOTE position, and a remote control is connected to the REMOTE 14 receptacle.*

**9. PRE FLOW Control**

The PRE FLOW control only works if the process selector switch is in HF TIG position, the OUTPUT CONTACTOR switch is in REMOTE position and a remote control is connected to the REMOTE 14 receptacle.

The PRE FLOW time can be adjusted from 0.5 to 15 seconds. The welding arc and high frequency will not become established until the PRE FLOW control completes timing. Rotating the control clockwise increases the PRE FLOW time.

The HOT START control only works if the process selector switch is in HF TIG position, the OUTPUT CONTACTOR switch is in REMOTE position and a remote control is connected to the REMOTE 14 receptacle.

**10. HOT START Control**

The HOT START time is approximately 0.1 seconds and the HOT START current value is adjusted from 0 to 100% over the determined weld current set at AMPERAGE control. Rotating the control clockwise increases HOT START current.

*Example: Weld current set at AMPERAGE control is 100 amps and HOT START is set at 50%. The arc will initiate at 150 amps for 0.1 seconds and then resume at 100 amps.*

The process selector switch allows the operator to select the STICK welding (SMAW) process, the LIFT TIG (GTAW) process without high frequency, or the HF TIG (GTAW) process with high frequency start.

**11. Optional Digital AMPERAGE/VOLTAGE Meter and Switch**

The LED AMPERAGE / VOLTAGE meter displays either an amperage (A) or voltage (V) value. The selected (preview) amperage value is displayed when welding is not taking place.

The meter is not intended for exact amperage or voltage measurements. The amperage display indicates amperage output of the welding power source and is driven by circuitry on control board PC1. The voltage sensing circuitry is internally connected to the welding power source output terminals. The voltage display indicates the voltage at the weld output terminals, but does not necessarily indicate the actual voltage at the welding arc (due to cable resistance, poor connections, etc.).

## C. PRIMARY POWER Switch (Rear Panel)

The PRIMARY POWER switch (circuit breaker) energizes the welding power source when placed in the ON position. Placing the PRIMARY POWER switch in OFF position shuts down the welding power source and turns off the AC POWER indicator.

## D. Input Power

**1. Input power SMART-LINK**

Unit incorporates a Inrush circuit and input voltage sensing circuit. When MCB1 is turned on the Inrush circuit provides a precharging of the input capacitors. MC-1 will close after the input capacitors have charged to full operating voltage (approximately 5 seconds). During precharge the control / logic 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 MCB1 is in the OFF position.

**2. Input Power**

Available for the following input power:

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

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

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

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

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

460 VAC (±10%), 50 / 60 Hz, Single or Three-Phase

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

**3. Rated Load Output**

**The following data is at 60% duty cycle:**

**Single-Phase:**

| | |
|---|---|
| Amperes | 210 |
| Volts | 28 |
| Duty Cycle | 60% |
| Range (Min-Max) | |
| Amperes | 5-260 |
| Volts | 10-30 |
| Maximum OCV | 70 |

**Three-Phase:**

| | |
|---|---|
| Amperes | 300 |
| Volts | 32 |
| Duty Cycle | 60% |
| Range (Min-Max) | |
| Amperes | 5-375 |
| Volts | 10-36 |
| Maximum OCV | 70 |

**4. Load/No Load Outputs**

| | Output At Rated Load | | | No Load Output | | |
|---|---|---|---|---|---|---|
| | Amps | KVA | KW | Amps | KVA | KW |
| 208 VAC 1-Phase | 48 | 10 | 7 | 2.5 | 0.5 | 0.3 |
| 208 VAC 3-Phase | 39 | 14 | 11 | 1.5 | 0.5 | 0.3 |
| 230 VAC 1-Phase | 43 | 10 | 7 | 2 | 0.5 | 0.3 |
| 230 VAC 3-Phase | 35 | 14 | 11 | 1 | 0.5 | 0.3 |
| 380 VAC 3-Phase | 21 | 14 | 11 | 1 | 0.5 | 0.3 |
| 400 VAC 3-Phase | 18 | 14 | 11 | 1 | 0.5 | 0.3 |
| 415 VAC 3-Phase | 19 | 14 | 11 | 0.5 | 0.5 | 0.3 |
| 460 VAC 1-Phase | 21 | 10 | 7 | 1 | 0.5 | 0.3 |
| 460 VAC 3-Phase | 18 | 14 | 11 | 0.5 | 0.5 | 0.3 |
| 575 VAC 3-Phase | 14 | 14 | 11 | 0.5 | 0.5 | 0.3 |

### 5. Duty Cycle

The duty cycle of a welding power source is the percentage of a ten minute period that a welding power source can be operated at a given output without causing overheating and damaging of the unit. This unit is rated at 60 percent duty cycle when operated at 300 amperes from three-phase input power, or when operated at 210 amperes from single-phase input power. If the unit is operated from three-phase input power, the unit can be operated at 300 amperes for six consecutive minutes, but it must operate at no load for the remaining four minutes to allow proper cooling. When the welding power source is operated from single-phase input power, the unit can be operated at 210 amperes for six consecutive minutes, but it must operate at no load for the remaining four minutes to allow proper cooling. If the welding amperes decrease, the duty cycle increases. If the welding amperes are increased beyond rated output, the duty cycle will decrease.

***CAUTIONS***

***EXCEEDING DUTY CYCLE RATINGS*** *will cause the thermal overload protection circuit to become energized and shut down output until the unit cools to normal operating temperature.*

***CONTINUAL EXCEEDING OF DUTY CYCLE RATINGS*** *can cause damage to the welding power source.*

*Do not exceed indicated duty cycles.*

## E. Voltage/Amperage Curve

***NOTE***

*Voltage/Amperage curve shows the voltage and amperage output capabilities of the welding power source. Curves of other settings will fall between the curve shown.*

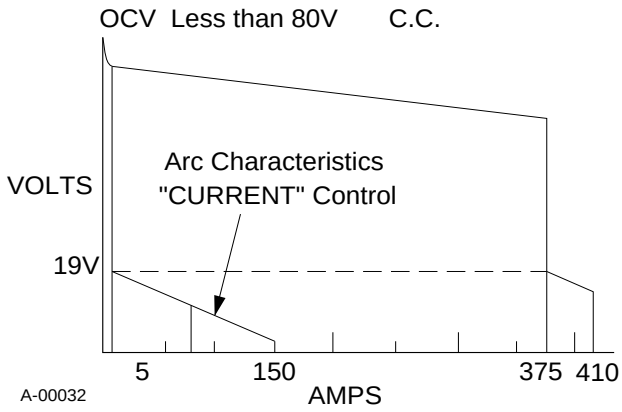



**Figure 3-A** Voltage / Amperage Curve

## F. Physical Characteristics

### 1. Weight with Cable

Model 230 / 46083.8 lb (38.1 kg)
Model 380 / 41576.6 lb (34.8 kg)
Model 460 / 57579.0 lb (35.9 kg)

### 2. Dimensions All Units

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

# SECTION 4: SERVICE TROUBLESHOOTING DIAGNOSTICS

## 4.01 Introduction

This Section provides service diagnostics for the Model 300GTS Inverter Arc Welding System, allowing the Technician 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.

***WARNINGS***

*Disconnect primary power at the source before disassembling the power supply.*

*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 unit is activated.*

## 4.02 Periodic Inspection & Procedures

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

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.

To clean the unit, open the enclosure (refer to Section 4.07-B, 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.

***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.*

## 4.03 Common Welding Operating Faults

The following are some common operating faults during the welding operation:

### A. Power

Main power not connected

Main power not turned on

Main ON / OFF switch to OFF

### B. Poor Weld

Wrong electrode used

Electrode not properly prepared

Incorrect welding amperage setting

Speed to fast or slow

Incorrect switch settings for operation

Poor weld output connection(s)

### C. Remote Operation

Incorrect switch settings

Remote not connected

## 4.04 Circuit Fault Isolation

***NOTE***

*Before beginning troubleshooting visually inspect the internal components for signs of over heating, fractures and damage.*

***CAUTION***

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

This section is to help isolate the defect circuit before troubleshooting, identify symptoms, and test the unit for proper operation. Follow the instructions as given to identify the possible symptom(s) and the defective circuit. After repairs are complete then run the following tests again to verify that the unit is fully operational.

## A. Initial Setup Conditions

Set the front panel controls per the following:

1. Set Process Selector switch to STICK mode
2. Set OUTPUT CONTACTOR selector to REMOTE 14 position
3. Set AMPERAGE selector to PANEL position
4. Amperage (A) control fully counterclockwise (minimum)
5. ARC control fully counterclockwise (minimum)
6. No connections to the remote receptacle(s)

## B. SMART-LINK Test

1. Place METER selector on optional Digital Meter to the 'V' position to indicate volts. If the optional Digital Meter is not installed then connect a digital voltmeter between the positive (+) and negative (-) output terminals of the unit. Set the digital voltmeter to indicate VDC.
2. Connect the unit to 460 volt, 3 phase input voltage. Connect the wires as follows:
   a. Red to Line 1
   b. White to Line 2
   c. Black to Line 3
   d. Green to earth ground.
3. Turn on primary power at the source.
4. Place the power supply ON / OFF circuit breaker (MCB) on back of unit to the ON position. Five seconds later MC1 will close.

***NOTE***

*Newer units have solid state inrush circuit where MC1 is part of the Input Diode Module (D1).*

5. Place OUTPUT CONTACTOR selector to ON position. The meter will indicate approximately 60vdc open circuit.
6. Place OUTPUT CONTACTOR selector to Remote 14 position.
7. Turn off the power supply ON / OFF circuit breaker (MCB).
8. Turn off primary power at the source.
9. Reconnect the unit to 230 volt ,3 phase input voltage.
10. Turn on primary power at the source.
11. Place the power supply ON / OFF circuit breaker (MCB) on back of unit to the ON position and note the following:
    a. MC2 will close three seconds after turning on MCB.
    b. MCB1 will close five seconds after turning on MCB.

***NOTE***

*Newer units have solid state inrush circuit where MC1 is part of the Input Diode Module (D1).*

12. Place OUTPUT CONTACTOR selector to ON position. The meter will indicate approximately 60vdc open circuit.
13. Place OUTPUT CONTACTOR selector to Remote14 position.
14. Turn off the power supply ON / OFF circuit breaker (MCB).

This completes the SMART-LINK test. If any step does not function as noted then the SMART-LINK Circuit is defective. Note the symptom and proceed to Section 4.05, Troubleshooting Guide.

## C. Output Load Test

1. Place OUTPUT CONTACTOR selector to Remote14 position.
   a. Connect the output negative and positive posts in a dead short condition.
   b. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit.
2. Place OUTPUT CONTACTOR selector to ON position. The meter will indicate approximately 5 amperes.
3. Slowly turn the Amperage (A) control clockwise to maximim The meter should increase slowly to a maximum of approximately 375 amperes and then decrease back to 5 amperes as the Amperage (A) control is turned counterclockwise.
4. Place OUTPUT CONTACTOR selector to Remote 14 position.
5. Remove short circuit condition.

This completes the Output Load Test. If any step does not function as noted then the Output Circuit is defective. Note the symptom and proceed to Section 4.05, Troubleshooting Guide.

### D. Arc Control Test

1. Place OUTPUT CONTACTOR selector to Remote14 position.
   a. Connect the output negative and positive posts in a dead short condition.
   b. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit.
2. Place OUTPUT CONTACTOR selector to ON position.
3. Adjust Amperage (A) control until meter indicates 100 amperes.
4. Turn ARC control clockwise to maximum setting. Meter will indicate approximately 245 amperess.
5. Turn ARC control back to minimum.
6. Place OUTPUT CONTACTOR selector to Remote14 position..
7. Remove short circuit condition.

This completes the Arc Control Test. If any step does not function as noted then the Arc Control Circuit is defective. Note the symptom and proceed to Section 4.05, Troubleshooting Guide.

### E. LIFT TIG Circuit Test

1. Set Process Selector switch to LIFT TIG mode.
2. Place OUTPUT CONTACTOR selector to REMOTE 14 position.
3. Place METER selector on optional Digital Meter to the 'V' position to indicate volts. If the optional Digital Meter is not installed then connect a digital voltmeter between the positive (+) and negative (-) output terminals of the unit. Set the digital voltmeter to indicate VDC.
4. Place OUTPUT CONTACTOR selector to ON position. Meter will indicate approximately 12 to 14 volts
5. Place OUTPUT CONTACTOR selector to REMOTE 14 position.
6. Connect the output negative and positive posts in a dead short condition.
7. Place OUTPUT CONTACTOR selector to ON position. Meter will indicate approximately 1 volt.
8. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit. Meter will indicate approximately 17 to 28 amperes.
9. Place OUTPUT CONTACTOR selector to REMOTE 14 position.
10. Remove short circuit condition.

This completes the LIFT TIG Test. If any step does not function as noted then the LIFT TIG Circuit is defective. Note the symptom and proceed to Section 4.05, Troubleshooting Guide.

### F. HF (High Frequency) TIG Circuit Test

1. Set Process Selector switch to HF TIG mode.
2. Place OUTPUT CONTACTOR selector to REMOTE 14 position.
3. Close remote switch. After PRE-FLOW time HF circuit will turn ON (arc at points).
4. Open remote switch. HF circuit turns OFF.
5. Connect the output negative and positive posts in a dead short condition.
6. Close remote switch. HF circuit should not turn ON.
7. Open remote switch.
8. Remove short circuit condition.

This completes the HF TIG Test. If any step does not function as noted then the HF TIG Circuit is defective. Note the symptom and proceed to Section 4.05, Troubleshooting Guide.

## 4.05 Troubleshooting Guide

### A. Troubleshooting and Repair

Troubleshooting and repairing 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 Model 300GTS Inverter Arc Welder Operating Manual 0-2425.*

The advanced troubleshooting covered in this Service Manual requires disassembly of the unit and live measurements. It is helpful for solving many of the common problems that can arise with the Model 300GTS Inverter Arc Welding System.

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

Specific test procedures and reference tables have been grouped together, and are referenced by the troubleshooting guide. Use the tables, diagrams, and test procedures in conjunction with the troubleshooting guide to perform the tests and repairs.

Before beginning make sure primary power is turned off and disconnected from the wall outlet. Wait two minutes before opening the enclosure to allow the primary capacitors to discharge.

Before beginning troubleshooting visually inspect the internal components for signs of over heating, fractures and damage.

The guide has two sections as follows:

**Section 4.06 - Troubleshooting Specific Problems**

**Section 4.07 - Test Procedures**

## C. How to use 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:

**X. 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.

# 4.06 Troubleshooting Specific Problems

**Troubleshooting Preparation**

1. Set PROCESS selector switch to the STICK mode.
2. Set Contactor selector switch to REMOTE 14 position.
3. Set AMPERAGE selector switch to PANEL position.
4. Disconnect all remote devices.
5. Connect to input voltage (check data tag on back of power supply for proper input voltage required).

***NOTE***

*Operate power supply on ALL input voltages as noted on nameplate when testing power supply.*

6. Close wall disconnect switch or circuit breaker.
7. Turn power supply ON / OFF circuit breaker (MCB) to ON.

**A. Power supply ON/OFF circuit breaker (MCB) trips when turned ON; OUTPUT CONTACTOR selector in REMOTE 14 position**

1. *Input voltage over rated limit*
    a. Connect to proper line voltage.
2. *Shorted or burned MC2 contactor*
    a. Check MC2 contacts for shorts and replace if necessary.
    b. Check MC2 actuator assembly and replace if necessary.
3. *Shorted primary inverter components*
    a. Check surge absorber board (PCB10), inverter components,input diode (D1), IGBT modules (Q1 and Q2) capacitors C4 and C5 per Section 4.07-A through F and H.
4. *Faulty control/logic board (PCB1)*
    a. Check control / logic board (PCB1), capacitor inbalance circuit per Section 4.07-I-2.

**B. Green AC POWER indicator OFF; Fan not operating**

1. *Input line disconnect switch in OFF position*
    a. Place input line disconnect switch to ON position.

2. *Input line fuses open*

   a. Check and replace fuses if necessary.

3. *Fuse (F1) open or loose contact*

   a. Check fuse (F1) and replace if necessary.

4. *Power supply ON/OFF circuit breaker (MCB) in OFF position*

   a. Place ON / OFF circuit breaker (MCB) to ON position.

5. *Power supply ON/OFF circuit breaker (MCB) faulty*

   a. Check connections and contacts through the circuit breaker (MCB) contacts and replace if necessary.

6. *Faulty control transformer (T2)*

   a. Check control transformer (T2) primary and secondary windings for shorts or open circuits and replace if necessary.

**C. Red WARNING indicator ON; No weld output**

1. *Line voltage below rated limit*

   a. Connect to proper line voltage

2. *Thermostat THS1 or THS2 open (thermal shutdown)*

   a. Allow unit to cool 5 minutes before turning ON power supply. If problem still occurs check THS1 and THS2 for continuity across CN27 pins 1 to 2 and replace if necessary.

**D. Power supply ON/OFF circuit breaker (MCB) trips when remote contactor points are closed or AMPERAGE/VOLTAGE selector in PANEL position**

1. *Faulty IGBT modules (Q1 or Q2)*

   a. Check IGBT modules for shorted gate circuit or defective diodes per Section 4.07-F and replace if necessary.

2. *Faulty control/logic board (PCB1)*

   a. Check control / logic board (PCB1) per Section 4.07-I Steps 4 and 11. Replace if necessary.

3. *Faulty output diodes*

   a. Check output diodes per Section 4.07-G and replace if necessary.

**E. No weld or output; Fan operating; WARNING indicator off**

1. *OUTPUT CONTACTOR selector (S2) in REMOTE 14 position with no remote contactor connected*

   a. Place OUTPUT CONTACTOR selector (S2) to ON position or connect remote contactor control to remote receptacle.

2. *Faulty remote control device*

   a Set OUTPUT CONTACTOR selector (S2) to ON position and AMPERAGE selector (S3) to PANEL position. If amperage and voltage can be adjusted repair or replace remote control device.

3. *Faulty OUTPUT CONTACTOR selector (S2)*

   a. Check for continuity on control / logic board (PCB1) at connector CN3 pins 2 and 3 when OUTPUT CONTACTOR selector (S2) is in ON position. Replace if necessary.

4. *Faulty inrush circuit (MC1 and R1)*

   a. Check MC1 for burned contact points, open or shorted actuator coil. Repalce if necessary.

   b. Check R1 resistance for 200 ohms. Replace if necessary.

5. *Faulty control/logic board (PCB1)*

   a. Check all connections on control / logic board (PCB1).

   b. Check CR3 relay on control / logic board (PCB1). Check for 100 VAC at connector CN14 pins 1 and 3 on the control / logic board (PCB1). Approximately 5 seconds after turning the power supply ON, CR3 will close and the voltage will be 0 VAC. Replace control / logic board (PCB1) if necessary.

**F. Low or maximim weld output with no control**

1. *OUTPUT CONTACTOR selector (S2) in REMOTE 14 position with no remote contactor connected*

   a. Place OUTPUT CONTACTOR selector (S2) to ON position or connect remote contactor control to remote receptacle.

2. *Faulty remote control device*

   a. Set OUTPUT CONTACTOR selector (S2) to ON position and AMPERAGE selector (S3) to PANEL position. If amperage and voltage can be adjusted repair or replace remote control device.

3. *Faulty AMPERAGE selector switch (S3)*

   a. Check AMPERAGE selector switch (S3) for open circuit condition and replace if necessary.

4. *Faulty Amperage(A) control potentiometer (VR1)*

   a. Check VR1 for open circuit condition.

5. *Faulty control/logic board (PCB1)*

   a. Check amperage / voltage signal per Section 4.07-I Step 10 and replace control / logic board (PCB1) if necessary.

**G. Limited weld output**

1. *Poor primary input voltage*

   a. Check primary input voltage.

2. *Faulty Amperage (A) control potentiometer (VR1)*

   a. Check VR1 for open circuit condition.

3. *Faulty current feedback device (CT2)*

   a. Check continuity and signals to current feedback device (CT2) per Section 4.07-I Step 7 and replace if necessary.

4. *Faulty control/logic board (PCB1)*

   a. Check amperage / voltage signal per Section 4.07-I Step 7 and replace control / logic board (PCB1) if necessary.

**H. Erratic or improper weld output**

1. *Loose welding cable connection*

   a. Tighten all welding cable connections

2. *Improper setup*

   a. Check for proper connection of input power (refer to Operating Manual 0-2425, Section 2.6).

3. *Faulty remote devices*

   a. Check all remote devices and repair or replace if necessary.

4. *Faulty Amperage (A) control potentiometer (VR1)*

   a. Check VR1 for open circuit condition.

5. *Faulty current feedback device (CT2)*

   a. Check continuity and signals to current feedback device (CT2) per Section 4.07-I Step 7 and replace if necessary.

6. *Faulty control/logic board (PCB1)*

   a. Check amperage / voltage signal per Section 4.07-I Step 10 and replace control / logic board (PCB1) if necessary.

7. *Faulty ARC control potentiometer (VR2)*

   a. Check VR2 per Section 4.07-I Step 9 and replace if necessary.

## 4.07 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 handleing 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 MCB1 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. Remove the two screws on the bottom of the unit securing the plastic enclosure to the metal framing of the unit.
4. Remove the ten bolts securing the rest of the plastic enclosure to the metal framing.
5. To remove the plastic enclosure pull it open, away from the top of the frame, and slide it up from the bottom.
6. 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-A). A properly functioning diode will conduct in the forward bias direction and indicate between 0.3 to 0.9 volts.

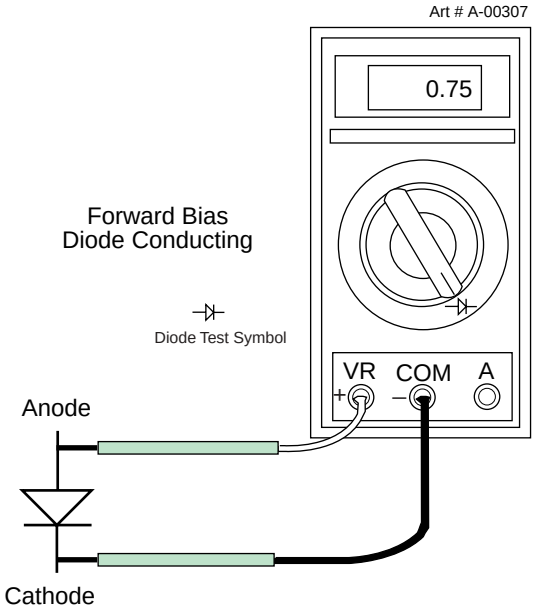



Figure 4-A Testing Diode Forward Bias

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

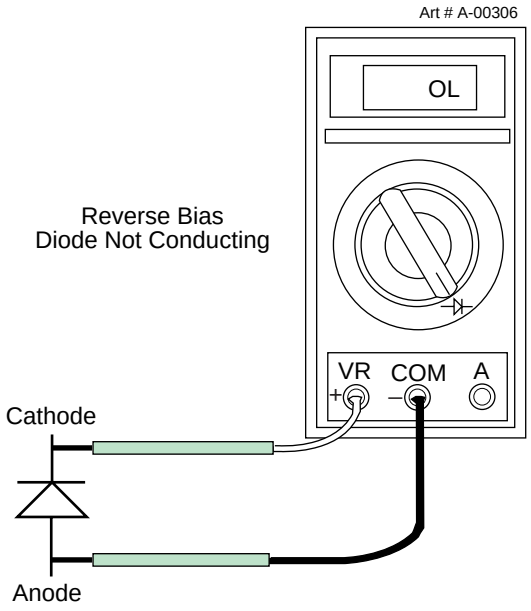



Figure 4-B Testing Diode Reverse Bias

5. If a diode checks bad, replace the diode module.
6. Reconnect all cables to proper terminals.

## D. Input Diode (D1) Without Inrush Circuit 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 #8 or #9 but not both from the input diode (D1) assembly.
2. Set meter on diode test scale.
3. The input diode (D1) assembly contains six standard diodes connected in a three phase full wave circuit. Three diodes are common to the negative terminal and three three are common to the the positive terminal. Test each diode in the forward (R, S, T to +) and reverse (R, S, T to -) direction as shown in Figure 4-C. A properly functioning diode conducts in the forward direction (plus to negative) and blocks in the reverse direction (negative to plus).

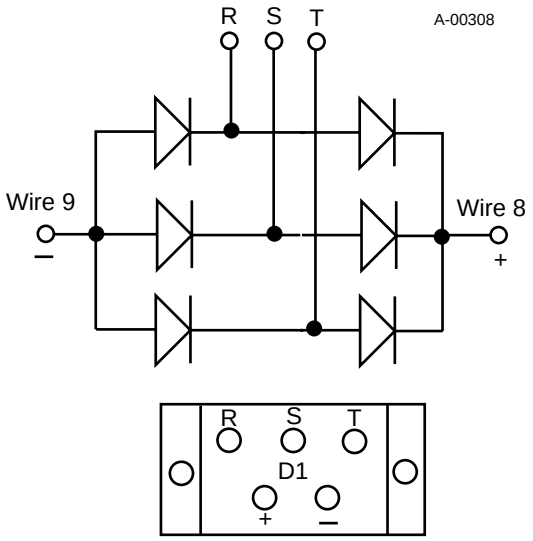



Figure 4-C Testing Input Diode (D1) Assembly (Without Inrush Circuit)

4. If any diode section does not check properly, replace the input diode (D1) assembly per Section 5.03-D.
5. If the input diode (D1) assembly checks are correct, reconnect the lead removed in Step 1 above.

## E. Input Diode (D1) With Inrush Circuit 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 #10 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 three connected to the the R-2 terminal. Test each diode in the forward (R-2 to R, S, T) and reverse (- to R, S, T) direction as shown in Figure 4-D. A properly functioning diode conducts in the forward direction (plus to negative) and blocks in the reverse direction (negative to plus).

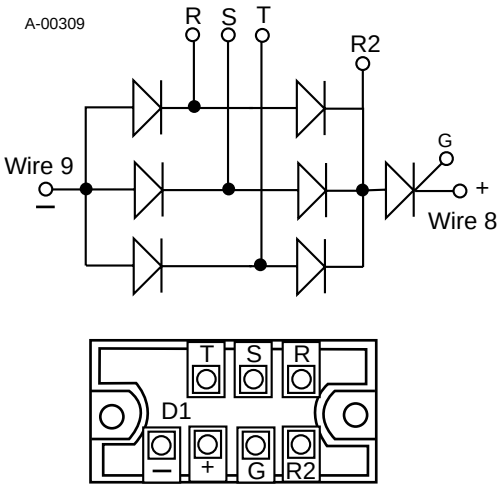



Figure 4-D Testing Input Diode (D1) Assembly (With Inrush Circuit)

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 R-2, G, and positive (+)

b. Check for shorts between R-2 and the (+) terminal.

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

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

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.

## F. Power IGBT (Q1 & Q2) 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 & Q2). 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-E). 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).

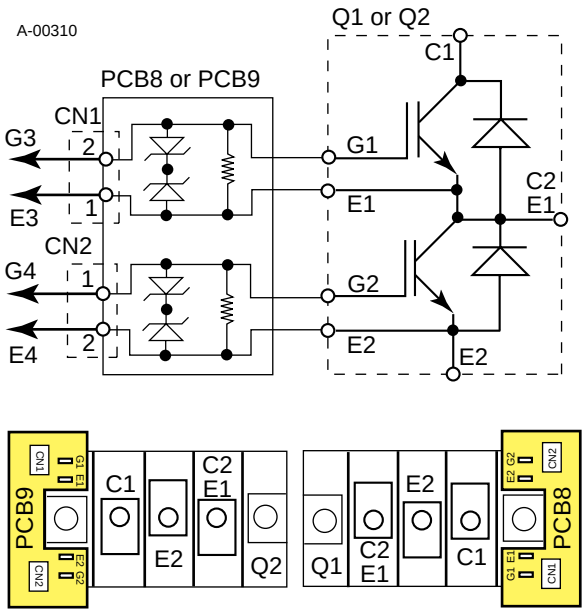



Figure 4-E Testing IGBT Module (Q1 & Q2) Assembly

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 PC board 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 any IGBT module does not check properly, replace the IGBT module per Section 5.03-E.
7. If IGBTchecks 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.

## G. Output Diode 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 diodes in power supply to be tested. Refer to Figure 4-F for style of output diodes being tested.

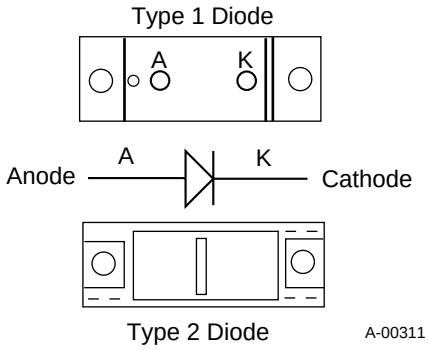



Figure 4-F Testing Output Diode

2. Remove cables from mounting studs on diodes.

***NOTE***

*In Type 2 diodes the cathode is mounted to the heat sink.*

3. Set meter on diode test scale.
4. Test diode in the forward and reverse direction by conecting and then reversing the meter leads across the diode. A properly functioning diode conducts in the forward direction and blocks in the reverse direction.
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.

## H. Input Capacitor (C4 & C5) Test Procedure

1. Check C4 & 5 for case damage (bulge and / or split). Check with ohm meter for shorts or open circuit. Replace if necessary.
2. Remove wire #10 from C5 capacitor.
3. Check resistor network R2 & 3 for proper values. See parts list and exploded view for values and location. Replace if necessary.
4. Check wires 93, 11, 94 to CN13 plug at control / logic board (PCB1) for continuity. Replace if necessary.
5. Reconnect all connection.

## I. Control/Logic Board (PCB1) Test Procedure

The control / logic PCB1 is divided into twelve tests. Each test helps in determining if the control / logic PCB1 is faulty. Perform each test in the order given.

***NOTE***

*All oscilloscope setting are for x1 probe.*

For all test points on control / logic PCB1, use TP1 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 #8 from D1.

b. Remove CN13 plug from control / logic board (PCB1).

c. With power supply turned on, check AC input voltage of power supply on control / logic board (PCB1) at connector CN21 for the following:

CN21 pin 1 to 2 18 VAC

CN21 pin 3 to 2 18 VAC

Pin 2 is common

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

d. Check output DC voltage of power supply on control / logic board (PCB1) for the following:

TP2 to TP1 Regulated +15 VDC

TP3 to TP1 Regulated -15 VDC

TP4 to TP1 Unregulated +24 VDC

TP5 to TP1 Unregulated -24 VDC

TP1 is circuit common

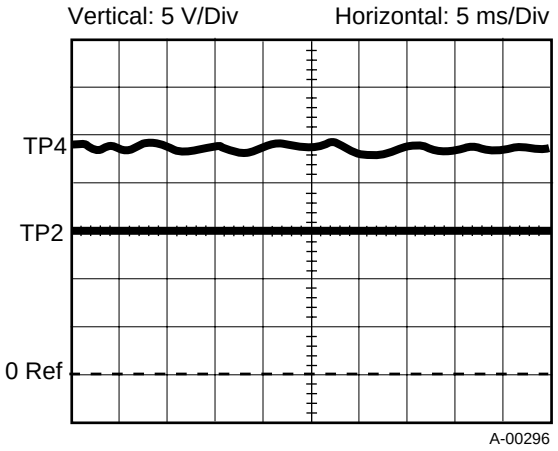



Figure 4-G TP2 and TP4 Waveforms

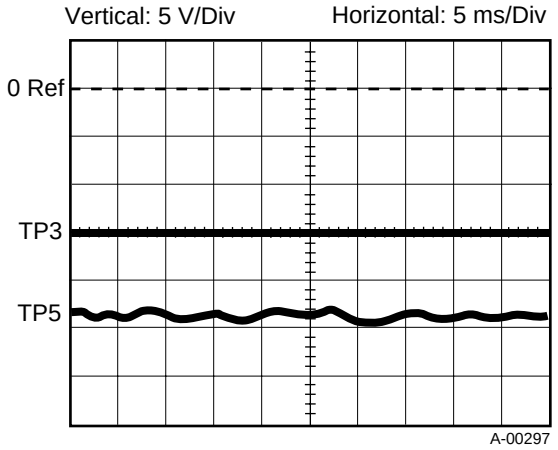



Figure 4-H TP3 and TP5 Waveforms

e. If DC voltage is not present, turn power supply OFF and replace control / logic board (PCB1).

**2. Input Capacitor Balance**

a. With power supply turned OFF, remove connector plug CN13 from the control / logic board (PCB1). Check for resistance at CN13 receptacle as follows:

Pin 1 to Pin 3 Continuity in one direction and an open circuit in the other.

Pin 3 to Pin 5 Continuity in one direction and an open circuit in the other.

Pin 1 to Pin 5 Continuity in one direction and an open circuit in the other.

If readings are not correct, replace control / logic board (PCB1).

b. Disconnect wire #8 from input diode (D1) on input rectifier and connector CN13 plug from control / logic board (PCB1).

c. Turn power supply ON.

d. Check the capacitor imbalance circuit on control / logic board (PCB1) for the following:

TP22 to TP1 Normally +15 VDC; Unbalance voltage less than 10 VDC

TP23 to TP1 Normally +15 VDC; Unbalance voltage less than 10 VDC

TP24 to TP1 Normally +15 VDC

TP25 to TP1 Normally +15 VDC

If voltage values are not correct, turn power supply OFF and replace control / logic board (PCB1).

e. Reconnect input diode (D1) wire #8 and connector CN13 plug.

**3. MCB Trip Circuit**

a. With power supply turned OFF, disconnect wire #8 from input diode (D1) on input rectifier and connector CN20 plug from control / logic board (PCB1).

b. Turn power supply ON

c. Check for +24 VDC at TP27. If voltage is not correct, turn power supply OFF and replace control / logic board (PCB1).

d. Turn power supply OFF and Reconnect input diode (D1) wire #8 and connector CN20 plug.

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

a. With power supply turned OFF, disconnect connector CN18 plug.

b. Check for the following resistances:

CN18 receptacle, pins 1 to 2 4K ohms

CN18 plug, pins 1 to 2 3 ohms

If check at CN18 receptacle is not correct, replace control / logic board (PCB1).

If check at CN18 plug is not correct, replace control / logic board (PCB1).

c. Disconnect wire #8 from input diode (D1) on input rectifier.

d. Turn power supply ON.

e. Check for +15 VDC at TP26. If voltage is not correct, turn power supply OFF and replace control / logic board (PCB1).

f. Turn power supply OFF and reconnect input diode (D1) wire #8 and connector CN18 plug.

**5. LIFT TIG Circuit Test**

a. Turn power supply ON.

b. Set power supply controls for LIFT TIG operation.

c. Close pins A and B of REMOTE 14 pin receptacle.

***NOTE***

*Do not touch Tungsten to work (open circuit condition).*

d. Check the LIFT TIG circuit (open condition) on control / logic board (PCB1) for the following:

TP38 to TP1 0 VDC

TP45 to TP1 Low Condition (0 VDC)

TP47 to TP1 High Condition (+15 VDC)

If levels are not correct, turn power supply OFF and replace control / logic board (PCB1).

e. Touch Tungsten to work (short circuit condition).

f. Check the LIFT TIG circuit (short circuit condition) on control / logic board (PCB1) for the following:

TP38 to TP1 +15 VDC

TP45 to TP1 High Condition (+15 VDC)

TP47 to TP1 Low Condition (0 VDC)

If levels are not correct, turn power supply OFF and replace control / logic board (PCB1).

**6. Precharge Circuit Test**

a. Turn power supply OFF.

b. Turn power supply ON and check the precharge circuit on control / logic board (PCB1) for the following:

TP28 to TP1 0 VDC

TP29 to TP1 Normally 0 VDC; +15 VDC during initial charge

The indication at TP29 should start at 0 VDC, goto +15 VDC for approximately 3 seconds, then return to 0 VDC.

If levels are not correct, turn power supply OFF and replace control / logic board (PCB1).

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

a. With power supply turned OFF, disconnect connector CN25 plug.

b. Turn power supply ON.

c. Check the close loop current feedback circuit on control / logic board (PCB1) for the following at CN25 receptacle:

Pin 1 to TP1 -15 VDC

Pin 2 to TP1 0 VDC; PCB Common

Pin 3 to TP1 0 to 4 VDC; 1 VDC per 100 Amps of output current

Pin 4 to TP1 +15 VDC

If voltage values are not correct, turn power supply OFF and replace control / logic board (PCB1).

d. Check the close loop current feedback circuit on control / logic board (PCB1) for the following:

TP12 to TP1 0 to 4 VDC; 1 VDC per 100 Amps of output current

TP37 to TP1 0 VDC; +15 VDC when output current detected

If voltage values are not correct, turn power supply OFF and replace control / logic board (PCB1).

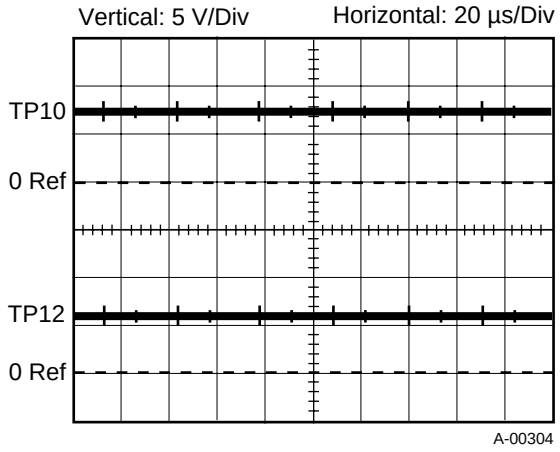



Figure 4-I TP10 and TP12 Waveforms

e. Turn power supply OFF and reconnect connector CN25 plug.

**8. Close Loop Voltage Feedback Test**

a. With power supply turned OFF, disconnect connector CN22 plug.

b. Check CN22 plug, pins 1 to 4 for 0.4 ohms. If check at CN22 plug is not correct, check wires #24 and #26 for loose connection. If wires are okay then check CN22 connector on control / logic board (PCB1) for 5 ohms from pin 1 to 4. If value is not correct then replace the control / logic board.

c. Turn power supply ON.

d. Check the close loop voltage feedback circuit on control / logic board (PCB1) for the following:

TP13 to TP1 0 to 7 VDC; 1 VDC per 10 V of output voltage

If voltage value is not correct, turn power supply OFF and replace control / logic board (PCB1).

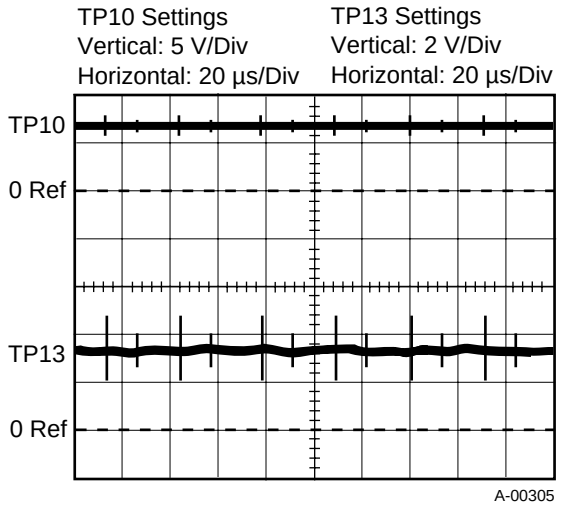



Figure 4-J TP10 and TP13 Waveforms

e. Turn power supply OFF and reconnect connector CN22 plug.

**9. ARC Control Test**

a. Turn power supply ON.

b. Check the ARC control circuit on control / logic board (PCB1) for the following:

TP11 to TP1 0 to +10 VDC

If level is not correct, turn power supply OFF and replace control / logic board (PCB1).

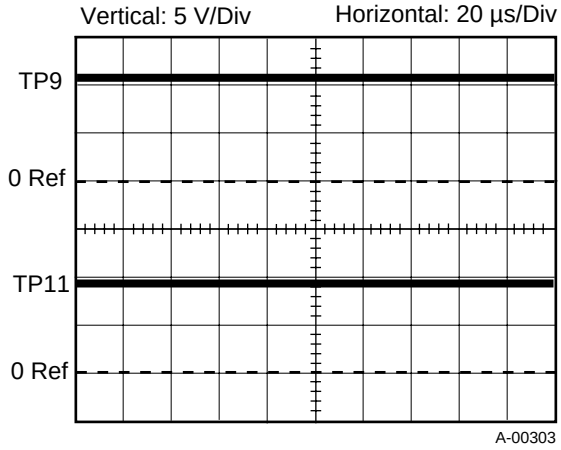



Figure 4-K TP9 and TP11 Waveforms

**10. AMPERAGE Test**

a. Turn power supply ON.

b. Check the AMPERAGE output reference signal on control / logic board (PCB1) for the following:

TP9 to TP1 0 to +10 VDC

If level is not correct, turn power supply OFF and replace control / logic board (PCB1).

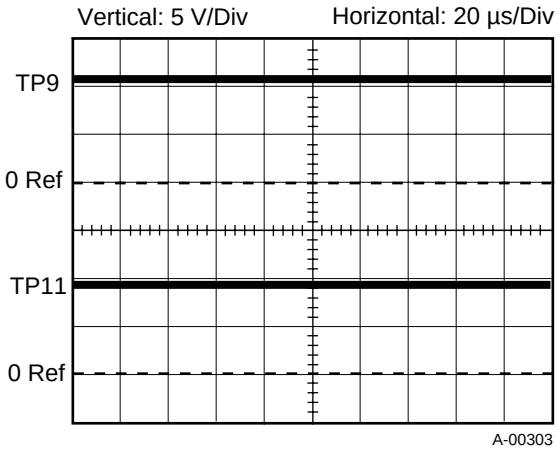



Figure 4-L TP9 and TP11 Waveforms

c. On front panel of power supply set AMPERAGE switch to PANEL position.

d. Check the AMPERAGE reference signal on control / logic board (PCB1) for the following:

TP10 to TP1 0 to +7 VDC

If level is not correct, turn power supply OFF and replace control / logic board (PCB1).

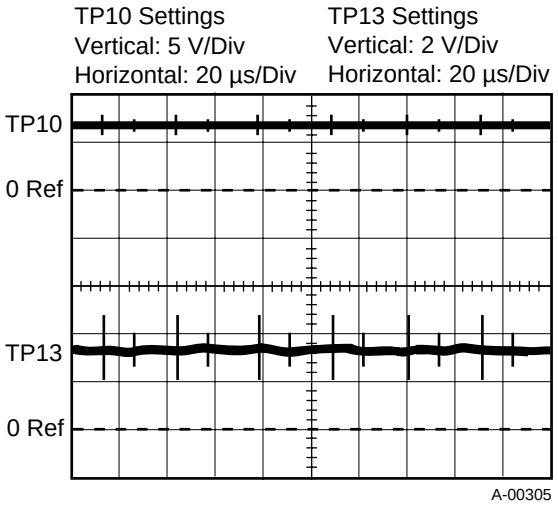



Figure 4-M TP10 and TP12 Waveforms

**11. IC1 & Gate Drive Test**

a. Turn power supply OFF and disconnect wire #8 from D1.

b. Turn power supply ON.

c. On front panel of power supply set contactor switch to PANEL position.

d. Check the inverter ON / OFF signal on control / logic board (PCB1) for the following:

TP14 to TP1 0 VDC (Inverter running)

+14 VDC (Inverter Stopped)

If voltage values are not correct, turn power supply OFF and replace control / logic board (PCB1).

e. Check to verify output of IC1 pulse waveform per the following:

TP16 to TP1 15 V Square Wave

TP17 to TP1 15 V Square Wave

If signals are not correct, turn power supply OFF and replace control / logic board (PCB1).

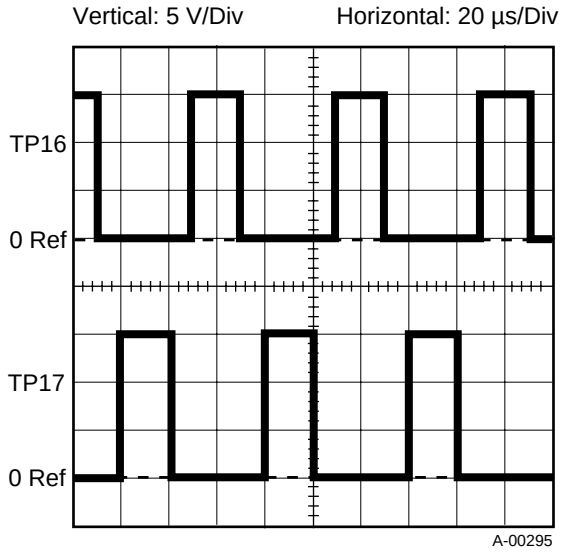



Figure 4-N TP16 and TP17 Waveforms

f. Turn power supply OFF and reconnect wire #8 to D1.

g. Disconnect CN9, CN10, CN11, and CN12 from the control / logic board (PCB1).

h. Turn power supply ON.

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

TP18 to TP1 20 V (Approx.) Square Wave

TP19 to TP1 20 V (Approx.) Square Wave

TP20 to TP1 20 V (Approx.) Square Wave

TP21 to TP1 20 V (Approx.) Square Wave

If signals are not correct, turn power supply OFF and replace control / logic board (PCB1).

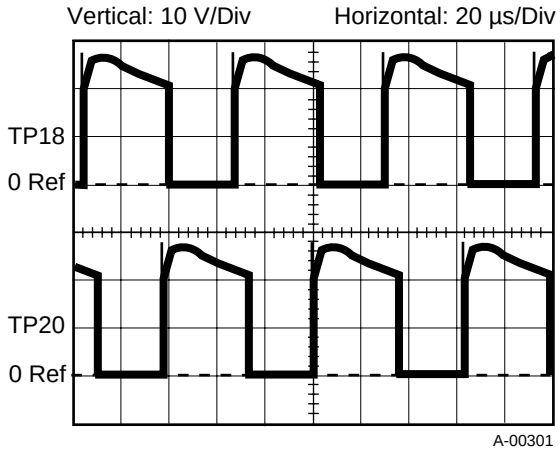



Figure 4-O TP18 and TP20 Waveforms No Load Condition

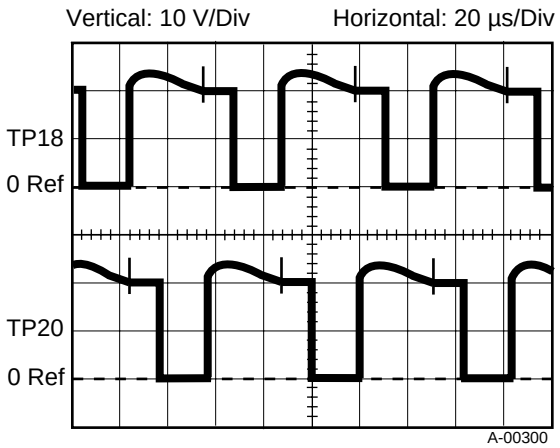



Figure 4-P TP18 and TP20 Waveforms Rated Load Condition

### J. HF TIG Circuit Test

1. With power supply turned OFF, check the resistance of R18 (300 ohms).
2. Turn power supply ON and check for 200 VAC between CN4 pin 1 of TIG Sequencer PCB2 and CN1 pin 63 of High Frequency PCB3.

   If level is not correct, turn OFF power supply and replace TIG Sequencer PCB2.
3. Check the signals for the High Frequency circuit on the control / logic board (PCB1) for the following at CN19 receptacle:

   Pin 1 to TP1 0 VDC; PCB Common

   Pin 3 to TP1 +15 VDC

   Pin 4 to TP1 0 VDC (Inverter OFF)

   +7.5 VDC (Inverter ON)

   Pin 5 to TP1 0 VDC (OUTPUT CONTACTOR to ON)

   +15 VDC (OUTPUT CONTACTOR to REMOTE 14)

   Pin 6 to TP1 0 VDC (OUTPUT CONTACTOR to REMOTE 14 or Process Selector to STICK mode)

   +15 VDC (OUTPUT CONTACTOR to ON except STICK mode)

   Pin 7 to TP1 +24 VDC

   If signals are not correct, turn OFF power supply and replace control / logic board (PCB1).
4. Turn power supply OFF.

## 4.08 Control/Logic Board (PCB1) Adjustments

The Control / Logic printed circuit 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 Control / Logic printed circuit board (PCB1):

| Model (Type) | PCB1 Number |
|---|---|
| 208-230 / 460 VAC | WK-2611, U06 |
| 460 / 575 VAC | WK-2611 S01, U07 |
| 380 / 415 VAC | WK-2611 S02, U08 |

### B. Adjustment References

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

| Reference | Description |
|---|---|
| VR1 | Output Current **Minimum** |
| VR2 | Output Current **Maximum** |
| VR3 | Output Current **Limit** |
| VR4 | Dead Time |
| VR5 | Basic Oscillation |
| VR6 | Output Voltage Detection |
| VR10 | Minimum Pulse Width for LIFT TIG |
| VR11 | MINI LINK Threshold Level |

### C. Special Adjustment

Models (type) 460 / 575 VAC sold in Canada must have the MINI LINK adjusted properly as follows:

If the input voltage is to be less than 505 VAC then adjust VR11 to turn ON the MINI LINK.

If the input voltage is to be greater than 515 VAC then adjust VR11 to turn OFF the MINI LINK.

### D. Adjustments

#### 1. Initial Setup

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

a. PROCESS selector to STICK Mode

b. OUTPUT CONTACTOR selector to REMOTE 14

c. AMPERAGE selector to PANEL

d. Amperage (A) control fully counter clockwise

e. ARC control fully counter clockwise

f. No Remote Connection

**2. Basic Oscillation (VR5)**

a. Connect the channel of the oscilloscope to TP15 and the common to TP1.

b. Turn ON power to the unit.

c. The sawtooth waveform should be approximately 3.2 volts at 31.5µs (refer to Figure 4-Q).

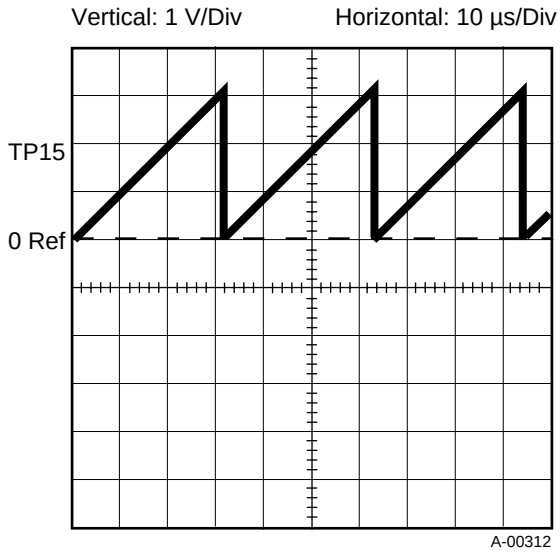



Figure 4-Q Basic Oscillation Waveform at TP15

d. If the waveform is not correct, adjust VR5 for the correct waveform.

**3. Dead Time (VR4)**

a. Connect the one channel of the oscilloscope to TP16, one channel to TP17 and the common to TP1.

b. The dead time is the time between the trailing edge of the waveform at TP16 and the leading edge of the waveform at TP17 (refer to Figure 4-R). This time should be approximately 2µs.

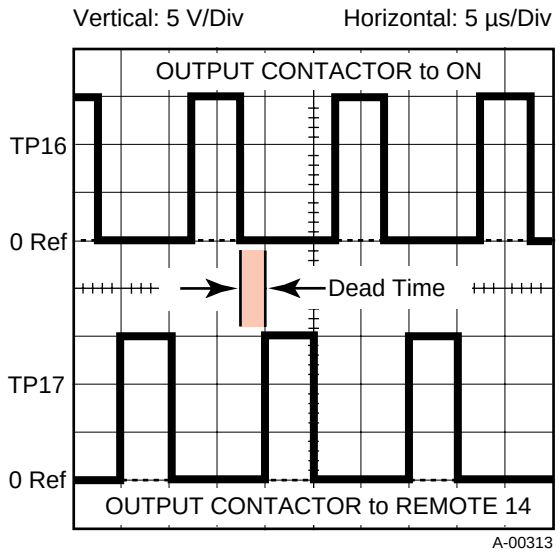



Figure 4-R Dead Time at TP16 and TP17

c. If the waveform is not correct, adjust VR4 for the correct waveform.

**4. Minimum Output Current (VR1)**

a. Set the OUTPUT CONTACTOR selector to the REMOTE 14 position.

b. Short output by connecting negative and positive output terminal leads together.

c. Set the AMPERAGE selector to PANEL position.

d. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit.

e. Adjust the amperage (A) control until the meter indicates 5 amperes.

f. Turn amperage (A) control fully counterclockwise.

g. Set OUTPUT CONTACTOR selector to ON position.

h. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit. The current indicated should be 5 amperes (± 1).

i. If the current indication is not correct, adjust VR1 until the meter indicates the proper value.

**5. Maximum Output Current (VR2)**

a. Set the OUTPUT CONTACTOR selector to the REMOTE 14 position.

b. Short output by connecting negative and positive output terminal leads together.

c. Set the AMPERAGE selector to PANEL position.

d. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit.

e. Turn amperage (A) control fully clockwise.

g. Set OUTPUT CONTACTOR selector to ON position. The current indicated should be 375 amperes (± 5).

i. If the current indication is not correct, adjust VR2 until the meter indicates the proper value.

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

a. Set the OUTPUT CONTACTOR selector to the REMOTE 14 position.

b. Short output by connecting negative and positive output terminal leads together.

c. Set process selector switch to MIG mode.

d. Set OUTPUT CONTACTOR selector to ON position.

e. Set the AMPERAGE selector to PANEL position.

f. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit.

g. Turn amperage (A) control fully clockwise. The current indicated should be 410 amperes (± 5).

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

**7. Output Detection Voltage (VR6)**

a. Set the OUTPUT CONTACTOR selector to the REMOTE 14 position.

b. Connect the channel of the oscilloscope to TP13 and the common to TP1.

c. Connect a 5 ohm 100 watt resistor across the output negative and positive terminal leads.

d. Turn amperage (A) control fully clockwise.

e. Set OUTPUT CONTACTOR selector to ON position. The voltage should go from approximately 0 volts to 7 volts (refer to Figure 4-S)

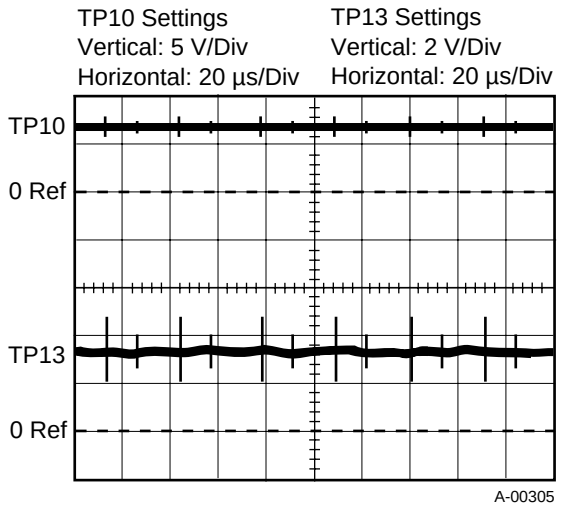



Figure 4-S Output Detection Voltage at TP13

f. Set the AMPERAGE selector to PANEL position.

g. Place METER selector on optional Digital Meter to the 'A' position to indicate amperage. If the optional Digital Meter is not installed then use a clamp on amperage meter around the output loop between the positive (+) and negative (-) output terminals of the unit.

h. Turn amperage (A) control fully clockwise. The current indicated should be 5 amperes (± 1).

i. If the output voltage detection is not correct, adjust VR6 for the proper value.

**8. Minimum Pulse Width For LIFT TIG (VR10)**

a. Connect the channel of the oscilloscope to TP16 and the common to TP1.

b. The pulse width of the displayed waveform should be 2µs (±0.1).

c. If the minimum pulse width is not correct, adjust the width using VR10 for the proper value.

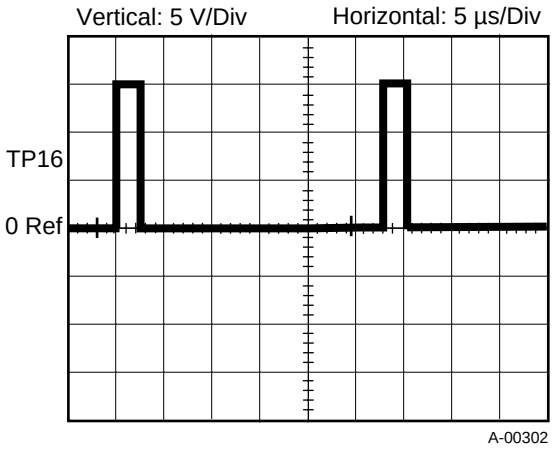



Figure 4-T Minimum Pulse Width at TP16

## 4.09 Circuit Descriptions

### A. SMART LINK Operation

Smart Link incorporates a Inrush circuit and input voltage sensing circuit. When MCB1 is turned on the Inrush circuit provides a precharging of the input capacitors. MC-1 will close after the input capacitors have charged to full operating voltage. Aprox. 5 seconds to charge the input capacitors. During precharge the control / logic 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 MCB1 is in the OFF position as follows:

230 / 460 model configured to 460 volt

380-415 model configured to 415 volt

460 / 575 model configured to 575 volt

The following describes each model and their SMART-LINK operation:

**230/460 volt model:**

When MCB1 is turned on, the Logic Board samples the incoming primary voltage between L1 & L2. With 230 volt single or three phase input voltage applied, the logic board will send a signal to MC-2 to close. A time delay of 3 to 4 seconds will be noticed before MC-2 energizes. When MC-2 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, MC-2 is not energized. The power devices and control transformer stay in a series configuration.

**380-415 volt model:**

MC-2 contactor is not required to parallel or series the input power circuitry as in the 230 / 460 volt model. When MCB is turned on the logic board only requires the inrush circuitry to operate.

**460-575 volt model:**

When MCB1 is turned on, the Logic Board samples incoming primary voltage between L1 & L2. With 460 volt supplied, the Logic Board will send a signal to MC-2 to close. A time delay of 3 to 4 second will be noticed before MC-2 energizes. When MC-2 closes the control transformer will configure to 460 volt on the primary windings. This is referred to as Mini Link. The input Power circuit remains in the same configuration for 460 & 575 volt input.

# SECTION 5: REPAIRS & REPLACEMENT PROCEDURES

## 5.01 Introduction

This Section describes parts replacement procedures and all cable repairs which may be performed on the Model 300GTS Inverter Arc Welder.

Under not circumstances are field repairs to be attempted on Printed Circuit 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 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 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.
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 Disassembly & Replacement

***WARNING***

*Disconnect primary power at the source before assembling or disassembling this unit.*

### A. Opening Enclosure

1. Turn off MCB1 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. Remove the two screws on the bottom of the unit securing the plastic enclosure to the metal framing of the unit.
4. Remove the ten bolts securing the rest of the plastic enclosure to the metal framing.
5. To remove the plastic enclosure pull it open, away from the top of the frame, and slide it up from the bottom.
6. Close the enclosure by reversing the above steps.

### B. Fuse Replacement

1. Open the unit as described in paragraph “A” above.
2. Locate and remove the old fuse.
3. Install the replacement fuse and close up the power supply by reversing the procedure in Step 1.

## C. Control/Logic PCB Assembly Replacement

1. Open the unit as described in paragraph "A" above.
2. Carefully remove all cable connections to the Control / Logic PCB Assembly noting the location of each.
3. Slide the PCB up and out of the unit.
4. 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.*

5. Reinstall the replacement Control / Logic PCB Assembly by reversing the above procedure and noting the following:

| Connector | Description of Cable |
|---|---|
| CN1 | HOT LEVEL Potentiometer |
| CN2 | AMPERAGE Potentiometer |
| CN3 | Contactor Switch |
| CN4 | AMPERAGE signal selector switch and output to Filter PCB |
| CN5 | Process selector switch |
| CN6 | Optional Digital meter |
| CN8 | REMOTE 14 pin receptacle pins M & N |
| CN9 | G1/E1 of IGBT Q1 |
| CN10 | G1/E1 of IGBT Q2 |
| CN11 | G2/E2 of IGBT Q1 |
| CN12 | G2/E2 of IGBT Q2 |
| CN13 | Input capacitor imbalance circuit |
| CN14 | Inrush contactor coil |
| CN15 | Control voltage to drive MC2 |
| CN16 | Smart Link & Mini Link contactor |
| CN17 | Mechanical state sense |
| CN19 | TIG Sequencer and HF control |
| CN18 | Over-current detect of IGBT |
| CN20 | Trip coil |
| CN21 | AC supply for control/logic board |
| CN22 | Main transformer AC output voltage sense |
| CN23 | DC output detect |
| CN25 | Output current detect |
| CN26 | Power & Warning lamp |
| CN27 | Temperature sensors |
| CN28 | Arc control potentiometer |

## D. Input Diode (D1) Replacement

The procedure is the same for both types of input diode (D1) assemblies with or without the inrush circuit.

1. Open the unit 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 (D1) assembly to the heatsink.
4. Carefully remove the old input diode (D1) assembly.
5. Clean the residue of old heatsink compound from the surface where the input diode (D1) was installed.
6. Apply a thin layer of Dow Corning #340 or equivalent heatsink compound to the mounting surface of the replacement input diode (D1) assembly.
7. Install the replacement input diode (D1) assembly onto the heatsink and secure in place with the screws removed in Step 3 above.
8. Torque the screws to 20 inch-lbs.
9. Reconnect all leads removed in Step 2 above to the proper terminals.

## E. IGBT Module (Q1 or Q2) Replacement

1. Open the unit as described in paragraph "A" above.
2. Mark and disconnect all leads to the IGBT module (Q1 or Q2) assembly.
3. Remove the screws securing the IGBT module (Q1 or Q2) assembly to the heatsink.
4. Using a 30 watt soldering iron remove IGBT Gate PCB (PCB8) or IGBT Gate PCB (PCB9) from the IGBT module to be replaced.
5. Carefully solder IGBT Gate PCB (PCB8) or IGBT Gate PCB (PCB9) to the replacement IGBT module.

***NOTE***

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

6. Clean the residue of old heatsink compound from the surface where the IGBT module was installed.
7. Apply a thin layer of Dow Corning #340 or equivalent heatsink compound to the mounting surface of the replacement IGBT module (Q1 or Q2).
8. Install the replacement IGBT module (Q1 or Q2) assembly onto the heatsink and secure in place with the 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.

# 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:** Complete Systems

**Section 6.04:** Replacement Parts (Before January 1994)

**Section 6.05:** Replacement Parts (January 1994 and After)

***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. Address all inquiries to your authorized Thermal Dynamics distributor.

## 6.03 Complete Systems

Complete systems include: Power supply with primary power cable, two male plugs, and operating manual.

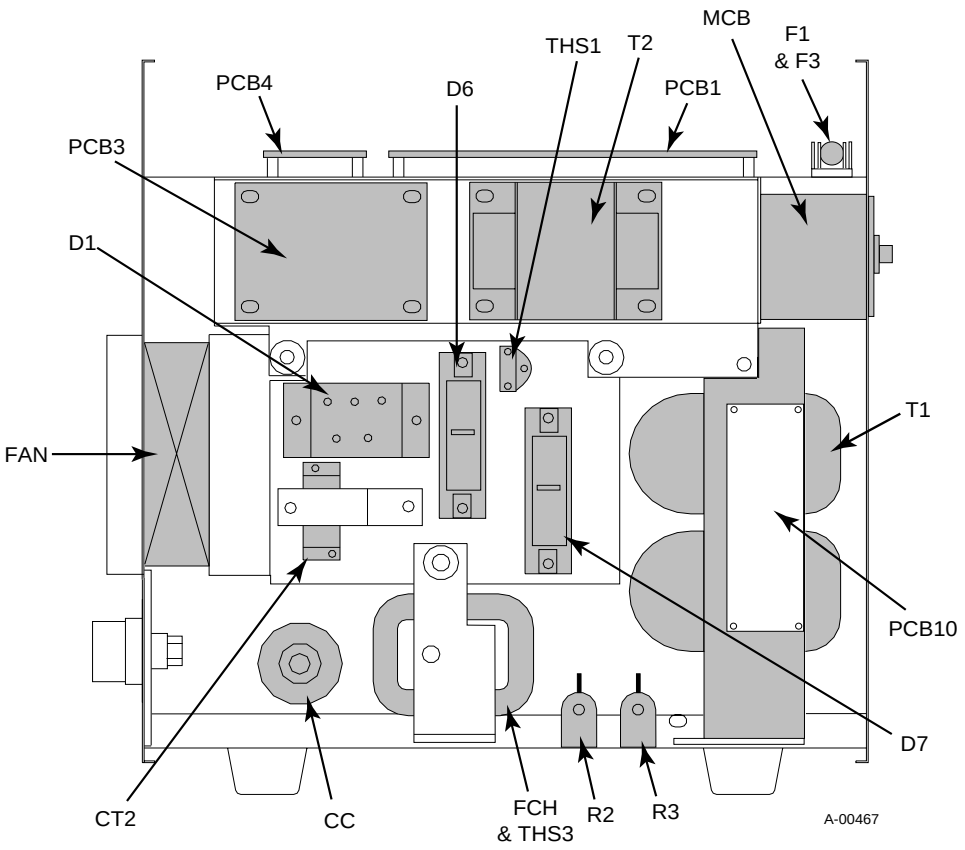
| Catalog # | Description |
|---|---|
| 10-1004 | 208 / 230 / 460 VAC, 50 / 60 Hz, Single / Three-Phase |
| 10-1005 | 380 / 400 / 415 VAC, 50 / 60 Hz, Single / Three-Phase |
| 10-1006 | 575 VAC, 50 / 60 Hz, Single / Three-Phase |

## 6.04 Replacement Parts (Before January 1994)

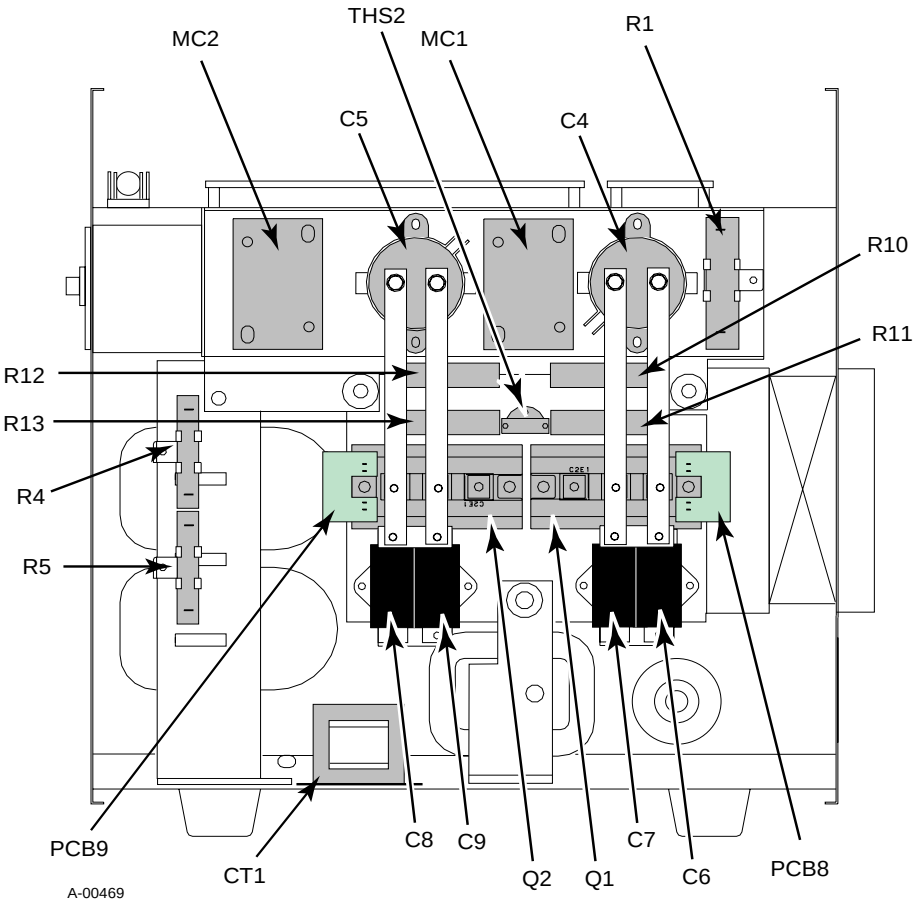
The parts in the following parts list are for units manufactured before January 1994. Locate the part required by the "Reference" column and then go across to the type ("Model") column. The catalog number for the part is listed for each type model. Parts with "—" are not used on that type model.

| Reference | Qty | Description | Model 230/460 | Model 380/415 | Model 460/575 |
|---|---|---|---|---|---|
| PL1/PL2 | 1 | Pilot Lamp Assembly | 10-2236 | 10-2236 | 10-2236 |
| F1 | 1 | Fuse 3A 600V | 10-2237 | 10-2237 | 10-2237 |
| F2 & F3 | 1 | Fuse 2A, 250V | 10-2206 | 10-2206 | 10-2206 |
| CT1 | 1 | Current Transformer | 10-2160 | 10-2160 | 10-2160 |
| CT2 | 1 | Current Transformer | 10-2161 | 10-2161 | 10-2161 |
| S1 | 1 | Process Selector Switch | 10-2240 | 10-2240 | 10-2240 |
| S2 & S3 | 1 | Amperage & Contactor Switches | 10-2239 | 10-2239 | 10-2239 |
| MC1 | 1 | Magnetic Contactor | 10-2117 | 10-2117 | 10-2117 |
| MC2 | 1 | Magnetic Contactor | 10-2118 | — | 10-2242 |
| | 1 | Aux. Contacts for 10-2118 | 10-2287 | — | — |
| THS1 & THS2 | 1 | Thermal Switch | 10-2238 | 10-2238 | 10-2238 |
| MCB1 | 1 | Molded Case C.B. | 10-2116 | 10-2115 | 10-2115 |
| VR1, VR2 & VR3 | 1 | Amperage, Arc & Hot Level Controls | 10-2124 | 10-2124 | 10-2124 |
| VR4 & VR5 | 1 | Pre & Post Flow Controls | 10-2125 | 10-2125 | 10-2125 |
| R1 | 1 | Resistor | 10-2207 | 10-2207 | 10-2207 |
| R2 & R3 | 1 | Resistor | 10-2209 | 10-2209 | 10-2210 |
| R4 & R5, R10 - R13 | 1 | Resistor | 10-2211 | 10-2211 | 10-2211 |
| R6-R9 | 1 | Resistor | 10-2212 | 10-2212 | 10-2212 |
| R14 & R15 | 1 | Resistor | 10-2213 | 10-2213 | 10-2213 |
| R18 | 1 | Resistor | 10-2214 | 10-2214 | 10-2214 |
| R19 | 1 | Resistor | 10-2228 | — | — |
| C4 & C5 | 1 | Capacitor | 10-2120 | 10-2120 | 10-2121 |
| C6- C9 | 1 | Capacitor | 10-2119 | 10-2119 | 10-2119 |
| C10 & C13 | 1 | Capacitor | 10-2215 | 10-2215 | 10-2216 |
| C14 & C15 | 1 | Capacitor | 10-2217 | 10-2217 | 10-2217 |
| C17 | 1 | Capacitor | 10-2241 | 10-2241 | 10-2241 |
| C18 & C19 | 1 | Capacitor | 10-2219 | 10-2219 | 10-2219 |
| C20 | 1 | Capacitor | 10-2220 | — | — |
| Q1 & Q2 | 1 | Transistor | 10-2113 | 10-2113 | 10-2114 |
| D1 | 1 | Diode | 10-2158 | 10-2156 | 10-2157 |
| D2 & D3 | 1 | Diode | 10-2111 | 10-2111 | 10-2111 |
| D4 & D5 | 1 | Diode | 10-2112 | 10-2112 | 10-2112 |
| D6 & D7 | 1 | Diode | 10-2110 | 10-2110 | 10-2110 |
| SA6 & SA7 | 1 | Surge Surpressor | 10-2221 | 10-2221 | 10-2221 |
| FAN | 1 | Cooling Fan | 10-2159 | 10-2159 | 10-2159 |
| T1 | 1 | Transformer | 10-2224 | 10-2222 | 10-2223 |
| T2 | 1 | Transformer | 10-2149 | 10-2148 | 10-2155 |
| T3 | 1 | Transformer | 10-2153 | 10-2151 | 10-2153 |
| FCH | 1 | DC Reactor | 10-2225 | 10-2225 | 10-2225 |
| CON1 | 1 | 14-Pin Receptacle | 10-2135 | 10-2135 | 10-2135 |
| SOL | 1 | Solenoid Valve | 10-2154 | 10-2154 | 10-2154 |
| PCB1 | 1 | Control/Logic PCB | 10-2104 | 10-2102 | 10-2103 |
| PCB2 | 1 | Gas Control PCB | 10-2108 | 10-2108 | 10-2108 |
| PCB3 | 1 | High Frequency PCB | 10-2109 | 10-2109 | 10-2109 |
| PCB4 | 1 | Filter PCB | 10-2163 | 10-2163 | 10-2163 |
| PCB7 | 1 | Optional Digital Panel Meter PCB | 10-2146 | 10-2146 | 10-2146 |
| PCB8 & PCB9 | 1 | IGBT Gate PCB | — | 10-2147 | — |
| PCB10 | 1 | Surge Absorber PCB | 10-2164 | 10-2145 | 10-2165 |
| TO | 1 | Output Terminal | 10-2227 | 10-2227 | 10-2227 |
| | 1 | Case Left & Right Side | 10-2202 | 10-2202 | 10-2202 |
| | 4 | Rubber Foot | 10-2244 | 10-2244 | 10-2244 |

Right Side Before
January 1994




Left Side Before
January 1994

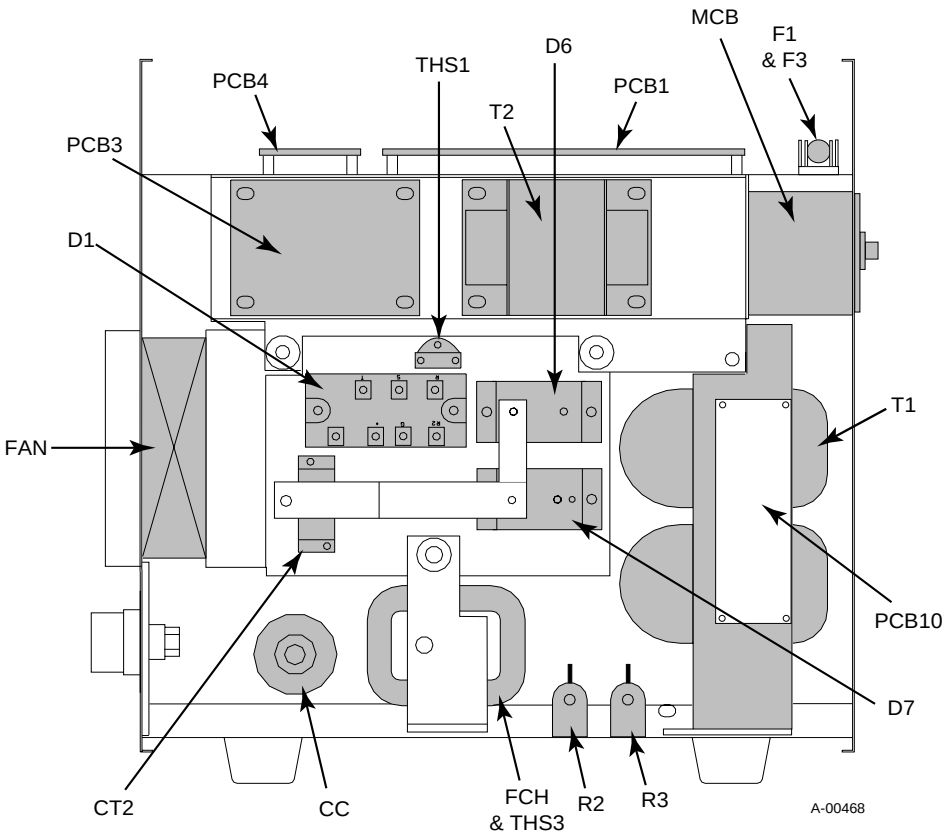


## 6.05 Replacement Parts (January 1994 and After)

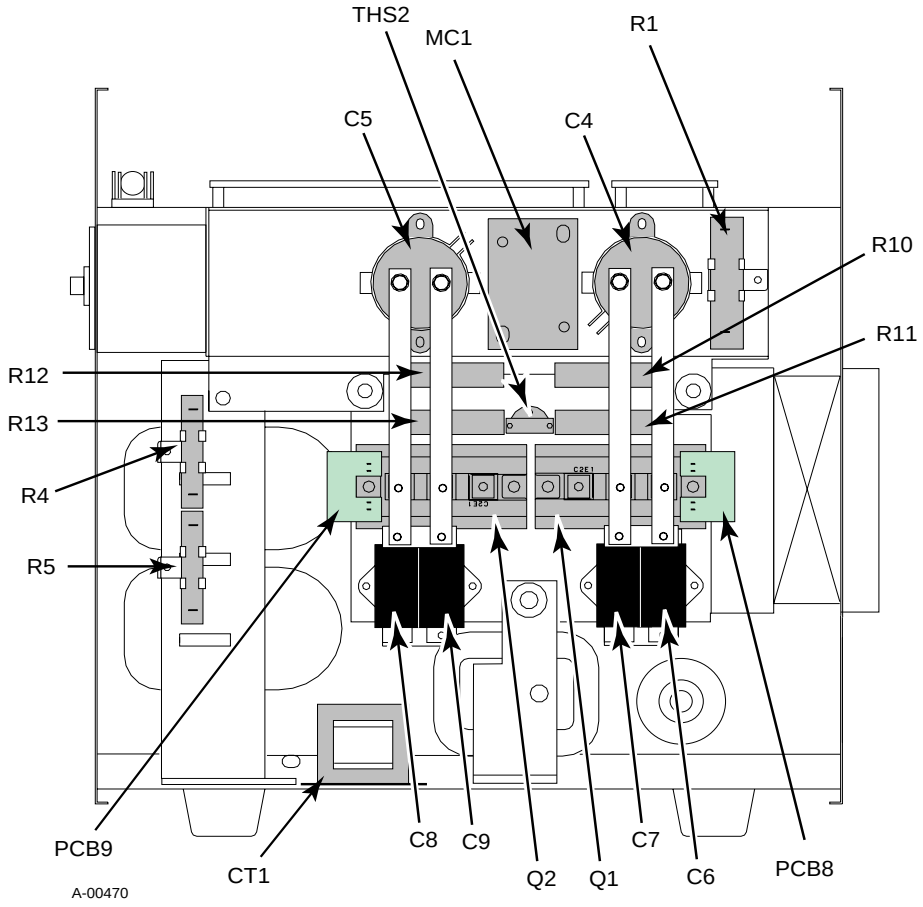
The parts in the following parts list are for units manufactured in and after January 1994. Locate the part required by the "Reference" column and then go across to the type ("Model") column. The catalog number for the part is listed for each type model. Parts with "—" are not used on that type model.

| Reference | Qty | Description | Model 230/460 | Model 380/415 | Model 460/575 |
|---|---|---|---|---|---|
| PL1/ PL2 | 1 | Pilot Lamp Assembly | 10-2236 | 10-2236 | 10-2236 |
| F1 | 1 | Fuse 5A 600V | 10-2274 | 10-2274 | 10-2274 |
| F2 & F3 | 1 | Fuse 2A, 250V | 10-2206 | 10-2206 | 10-2206 |
| CT1 | 1 | Current Transformer | 10-2160 | 10-2160 | 10-2160 |
| CT2 | 1 | Current Transformer | 10-2161 | 10-2161 | 10-2161 |
| S1 | 1 | Switch | 10-2196 | 10-2196 | 10-2196 |
| S2 &S3 | 1 | Switch | 10-2252 | 10-2252 | 10-2252 |
| MC2 | 1 | Magnetic Contactor | 10-2118 | — | 10-2242 |
| | 1 | Aux. Contacts for 10-2118 | 10-2287 | — | — |
| THS1 & THS2 | 1 | Thermal Switch | 10-2238 | 10-2238 | 10-2238 |
| MCB1 | 1 | Molded Case C.B. | 10-2116 | 10-2115 | 10-2115 |
| SOL | 1 | Solenoid Valve | 10-2154 | 10-2154 | 10-2154 |
| VR1 & VR2 | 1 | Amperage & Arc Controls | 10-2124 | 10-2124 | 10-2124 |
| VR4 & VR5 | 1 | Pre & Post Flow Controls | 10-2125 | 10-2125 | 10-2125 |
| R1 | 1 | Resistor | 10-2207 | 10-2207 | 10-2207 |
| R2 & R3 | 1 | Resistor | 10-2209 | 10-2209 | 10-2210 |
| R6 - R9 | 1 | Resistor | 10-2212 | 10-2212 | 10-2212 |
| R10 - R13 | 1 | Resistor | 10-2211 | 10-2211 | 10-2211 |
| R14 & R15 | 1 | Resistor | 10-2213 | 10-2213 | 10-2213 |
| R18 | 1 | Resistor | 10-2275 | 10-2275 | 10-2275 |
| R19 | 1 | Resistor | 10-2228 | — | — |
| C4 & C5 | 1 | Capacitor | 10-2120 | 10-2120 | 10-2121 |
| C6- C9 | 1 | Capacitor | 10-2119 | 10-2119 | 10-2119 |
| C10 & C13 | 1 | Capacitor | 10-2215 | 10-2215 | 10-2216 |
| C14 & C15 | 1 | Capacitor | 10-2217 | 10-2217 | 10-2217 |
| C17 | 1 | Capacitor | 10-2241 | 10-2241 | 10-2241 |
| C18 & C19 | 1 | Capacitor | 10-2219 | 10-2219 | 10-2219 |
| C20 | 1 | Capacitor | 10-2220 | — | — |
| C21 | 1 | Capacitor | 10-2270 | 10-2270 | 10-2270 |
| C22 | 1 | Capacitor | 10-2637 | 10-2637 | 10-2637 |
| Q1 & Q2 | 1 | Transistor | 10-2113 | — | 10-2114 |
| Q1 | 1 | Transistor | — | 10-2628 | — |
| D1 | 1 | Diode | 10-2653 | 10-2629 | 10-2629 |
| D6 & D7 | 1 | Diode | 10-2630 | 10-2630 | 10-2630 |
| SA7 | 1 | Surge Surpressor | 10-2221 | 10-2221 | 10-2221 |
| FAN | 1 | Cooling Fan | 10-2159 | 10-2159 | 10-2159 |
| T1 | 1 | Transformer | 10-2650 | 10-2631 | 10-2655 |
| T2 | 1 | Transformer | 10-2149 | 10-2148 | 10-2155 |
| FCH | 1 | DC Reactor | 10-2632 | 10-2632 | 10-2632 |
| CON1 | 1 | 14-Pin Receptacle | 10-2135 | 10-2135 | 10-2135 |
| PCB1 | 1 | Control/Logic PCB | 10-2648 | 10-2647 | 10-2649 |
| PCB2 | 1 | Gas Control PCB | 10-2108 | 10-2108 | 10-2108 |
| PCB3 | 1 | High Frequency PCB | 10-2109 | 10-2109 | 10-2109 |
| PCB4 | 1 | Filter PCB | 10-2163 | 10-2163 | 10-2163 |
| PCB7 | 1 | Optional Digital Panel Meter PCB | 10-2146 | 10-2146 | 10-2146 |
| PCB8 & PCB9 | 1 | IGBT Gate PCB | — | 10-2147 | — |
| PCB10 | 1 | Surge Absorber PCB | 10-2164 | 10-2145 | 10-2165 |
| TO | 1 | Output Terminal | 10-2227 | 10-2227 | 10-2227 |
| CC | 1 | Coupling Coil | 10-2633 | 10-2633 | 10-2633 |
| | 1 | Case Left & Right Side | 10-2202 | 10-2202 | 10-2202 |

Right Side January 1994
and After




Left Side January 1994
and After



# APPENDIX I: CONTROL/LOGIC BOARD (PCB1) CONNECTOR REFERENCE

| Connector | Reference | Description |
|---|---|---|
| CN1 | VR3 | HOT LEVEL Potentiometer connectioins |
| CN2 | VR1 | Amperage (A) Potentiometer connections |
| CN3 | PCB6-2 | Contactor Switch |
| CN4 | PCB6-3 | AMPERAGE signal selector switch and Filter board |
| CN5 | PCB6-1 | Process selector switch |
| CN6 | PCB7 | Optional Digital Meter connection |
| CN8 | | To 14 pin receptacle pins M & N |
| CN9 | PCB8 | G1/E1 of IGBT Q1 |
| CN10 | PCB9 | G1/E1 of IGBT Q2 |
| CN11 | PCB8 | G2/E2 of IGBT Q1 |
| CN12 | PCB9 | G2/E2 of IGBT Q2 |
| CN13 | | Input capacitor imbalance circuit |
| CN14 | MC1 | Inrush contactor coil |
| CN15 | T2 | Control voltage to drive MC2 |
| CN16 | MC2 | Smart Link & Mini Link contactor |
| CN17 | MC2 | Mechanical state sense |
| CN18 | CT1 | Over current detect of IGBT |
| CN19 | | TIG Sequencer controls |
| CN20 | MCB1 | Trip coil |
| CN21 | T2 | AC supply for control/logic board |
| CN22 | T1 | Main transformer AC output voltage sense |
| CN23 | | DC output detect - Used on LIFT TIG models only |
| CN25 | CT2 | Output current detect |
| CN26 | PL1 /PL2 | Power & warning lamp |
| CN27 | THS1/THS2 | Temperature sensors |
| CN28 | VR2 | Arc control potentiometer |

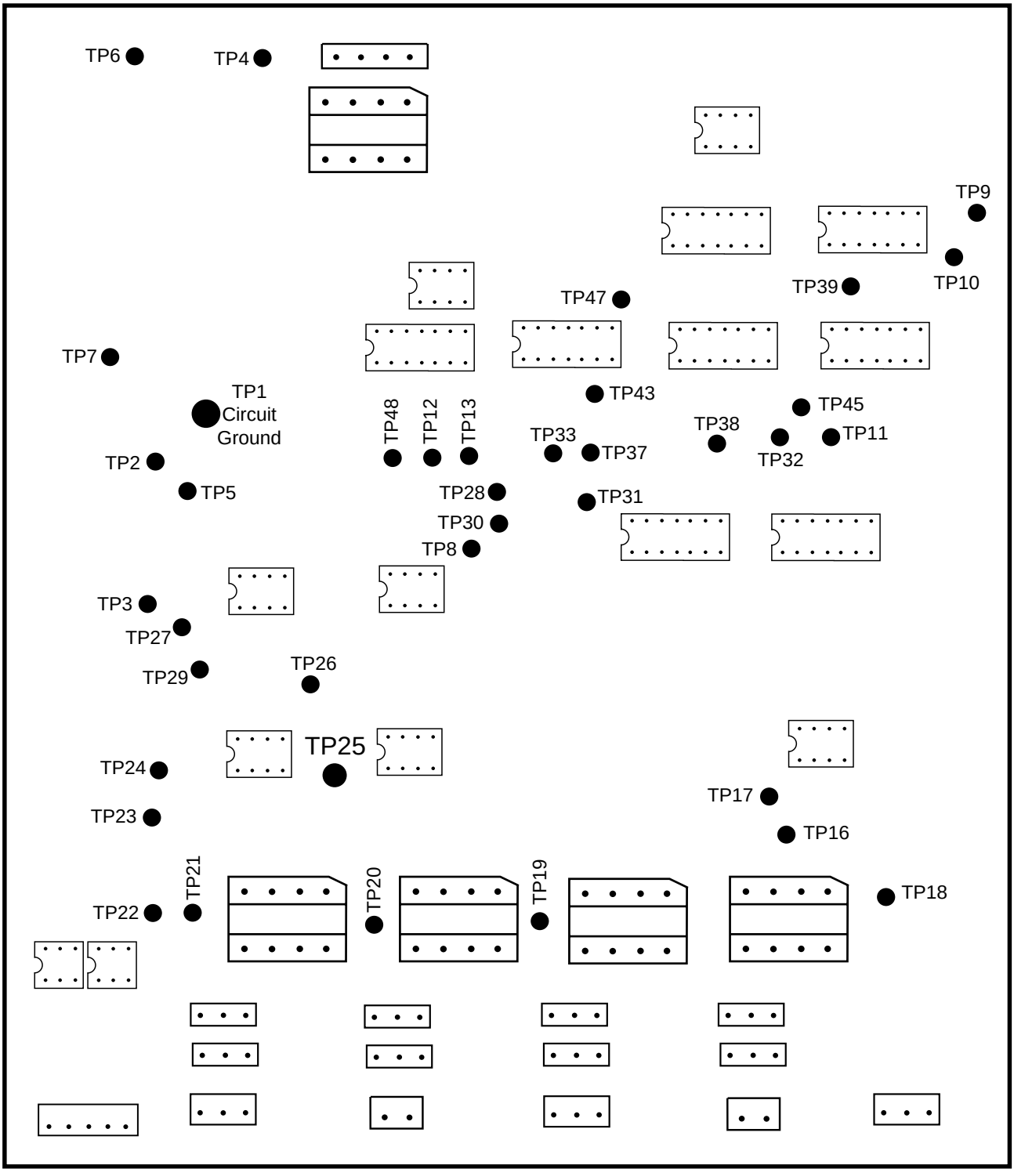
# APPENDIX II: CONTROL/LOGIC BOARD (PCB1) CONNECTOR SIGNALS

| Connector | Pin | Value | Description |
|---|---|---|---|
| CN1 | 1 | 0 V | Mimimum level of hot current signal |
| | 2 | 0 to +10 VDC | Reference signal of hot current signal; Return from VR3 |
| | 3 | 0 to +10 VDC | Amp/ volt reference signal for use with hot start current level |
| | 4 | | Not Used |
| | 5 | | Not Used |
| CN2 | 1 | 0 V | Minimum level of amp/ volt signal |
| | 2 | 0 to +10 VDC | Reference signal of amp/ volt from amp/ volt adjuster (VR1) |
| | 3 | +10 VDC | Maximum level of amp/ volt signal |
| | 4 | | Not used |
| CN3 | 1 | 0 V | Circuit common and chassis common |
| | 2 | 0 V | Contactor OFF |
| | | +24 VDC | CONTACTOR, signal when PANEL position |
| CN4 | 1 | 0 V | PCB common |
| | 2 | 0 to +10 VDC | Remote amperage control input command signal |
| | 3 | 0 to +10 VDC | Remote amperage reference signal |
| CN5 | 1 | +15 VDC | When select NIG process |
| | 2 | +15 VDC | When select SCRATCH TIG process |
| | 3 | +15 VDC | When select HF TIG process |
| | 4 | +15 VDC | When select LIFT TIG process |
| | 5 | +15 VDC | When select STICK process |
| | 6 | +15 VDC | Process selection signal |
| CN6 | 1 | +15 VDC | |
| | 2 | 0 V | PCB common |
| | 3 | -15 VDC | Amp/ volt preset signal |
| | 4 | 0 to +15 VDC | Amp/ volt preset signal |
| | 5 | 0 to +10 VDC | +1 VDC per 10 VDC of output |
| | 6 | 0 to +4 VDC | +1 VDC per 100 A of output |
| | 7 | | Not used |
| CN8 | 1-2 | Continuity | Dry contact when output current is detected |
| CN9 | 1-2 | +18 V peak | Gate pulse output |
| CN10 | 1-2 | +18 V peak | Not used |
| | 3 | | Not used |
| CN11 | 1-2 | +18 V peak | Gate pulse output |
| CN12 | 1-2 | +18 V peak | Gate pulse output |
| | 3 | | Not used |
| CN13 | 1 | | Connect with C4 (-) |
| | 2 | | Not used |
| | 3 | | Connect with cross point of R2 and R3 |
| | 4 | | Not used |
| | 5 | | Connect with C5 (+) |
| CN14 | 1-2 | | Dry contact as drive MC1 |
| NOTE - All values with respect to test point TP1 on main PCB1 logic board. | | | |

| Connector | Pin | Value | Description |
|---|---|---|---|
| CN15 | 1 | 250 VAC | Normal close of CR5 on PCB1 |
| | 2 | | Not used |
| | 3 | 100 VAC | Normal open of CR5 on PCB1 |
| | 4 | Not used | |
| | 5 | 100 VAC | Common of CR5 on PCB1 |
| CN16 | 1 | 100 VAC | Normal open of CR2 on PCB1 |
| | 2 | | Not used |
| | 3 | 100 VAC | Common of CR2 onf PCB1 |
| CN17 | 1 | 0 V | MC2 off |
| | | +10 VDC | MC2 off or no contact of MC2 |
| CN18 | 1-2 | | Current waveform of IGBT,1V peak of 24 A peak |
| CN19 | 1 | 0V | PCB common |
| | 2 | | Not used |
| | 3 | +15 VDC | |
| | 4 | 0 to +7.5 VDC | Inverter signal OFF (0 VDC); ON (+15 VDC) |
| | 5 | 0 to +15 VDC | Output current detect - OUTPUT CONTACTOR to ON (0 VDC); OUTPUT CONTACTOR to REMOTE 14 (+15 VDC) |
| | 6 | 0 to +15 VDC | OUTPUT CONTACTOR TO REMOTE 14 or Process Selector to STICK mode (0 VDC); OUTPUT CONTACTOR to ON except STICK mode (+15 VDC) |
| | 7 | +24 VDC | |
| CN20 | 1 | +24 VDC | |
| | 2 | 0 V | If trip else (or normally) +24 VDC |
| CN21 | 1 | 18 VAC | |
| | 2 | 0 V | Circuit common |
| | 3 | 18 VAC | |
| CN22 | 1-2 | 70 V peak | Pulse waveform of T1 secondary |
| CN23 | 1-2 | 70 VDC | Approximately at no load |
| CN25 | 1 | -15 VDC | |
| | 2 | 0 V | PCB common |
| | 3 | 0 to 4 VDC | Current signal 1 VDC per 100 amp output current |
| | 4 | +15 VDC | |
| CN26 | 1 | 0 V | If warning then +24 VDC normally |
| | 2 | +24 VDC | |
| | 3 | | PCB common |
| | 4 | +24 VDC | |
| CN27 | 1 | 0 V | PCB common |
| | 2 | 0 V | If temperature over +24 VDC normally |
| CN28 | 1 | 0 V | Minimum level of arc (inductor) signal |
| | 2 | 0 to 10 VDC | Reference signal of arc (Inductor) control |
| | 3 | +10 VDC | Maximum level arc (inductor) control signal. |
| NOTE - All values with respect to test point TP1 on main PCB1 logic board. | | | |

# APPENDIX III: CONTROL/LOGIC BOARD (PCB1) TEST POINT SIGNALS

| Connector | Value | Description |
|---|---|---|
| TP1 | Common | Circuit common |
| TP2 | +15 VDC | Regulated Vcc of control circuit |
| TP3 | -15 VDC | Regulated Cee of control circuit |
| TP4 | +24 VDC | Unregulated. Used for relays drive and detect point of over voltage. |
| TP5 | -24 VDC | Unregulated. Not used in PCB1. Output to 17-pin receptacle |
| TP6 | +24 VDC | Unregulated. Use for SMART LINK or MINI LINK circuit |
| TP7 | | Common line of SMART LINK circuit |
| TP8 | -15 VDC | Normally |
| | +15 VDC | When input voltage is low (approximately -25% of rated). |
| TP9 | 0 to +10 VDC | Amp/ volt output reference signal |
| TP10 | | Amp/ volt reference signal |
| TP11 | 0 to +10 VDC | Arc/ inductor control reference signal |
| TP12 | 0 to +4 VDC | Output current signal. 1 VDC per 100 A of output current |
| TP13 | 0 to +7 VDC | Output voltage signal. 1 VDC per 10 V of output voltage |
| TP14 | 0 V | Inverter on |
| | +14 VDC | Inverter off |
| TP15 | | Sawtooth waveform 32 KHz basic clock of PWM |
| TP16 | | Square pulse waveform when OUTPUT CONTACTOR to ON |
| TP17 | | Same as TP16 |
| TP18 | | Waveform of pulse trans drive |
| TP19 | | Same as TP18 |
| TP20 | | Same as TP18 |
| TP21 | | Same as TP18 |
| TP22 | 0/ +15 VDC | +15 VDC normally, but if less than 10 VDC then unbarance voltage of C4 and C5 |
| TP23 | 0/ +15 VDC | Same as TP22 |
| TP24 | +15 VDC | Normally |
| TP25 | +15 VDC | Normally |
| TP26 | +15 VDC | Normally |
| TP27 | +24 VDC | Normally |
| TP28 | 0 VDC | Normally, but if error then +15 VDC |
| TP29 | 0 VDC | Normally, but +15 VDC in period of initial charge |
| TP30 | 0/ +15 VDC | O V when OUTPUT CONTACTOR to ON, else +15 VDC |
| TP31 | +15 VDC | When Process Selector to STICK mode |
| TP32 | +15 VDC | When Process Selector to LIFT TIG mode |
| TP33 | +15 VDC | When Process Selector to LIFT TIG mode |
| TP37 | 0/ +15 VDC | Current detect signal +15 VDC when output current detected |
| TP38 | 0/ +15 VDC | Short detect signal +15 VDC when output is shorted |
| TP43 | | “H” if output is short, else “L” |
| TP 45 | | “H” if output is short in LIFT TIG mode, else “L” |
| TP47 | | “L” if output is short in LIFT TIG mode, else “H" |
| TP48 | | “L” after peroid of hot start in HF TIG mode, else “H" |
| NOTE - All values with respect to test point TP-1 on main PCB1 logic board. | | |


TP6
TP4
TP9
TP10
TP39
TP47
TP7
TP1
Circuit
Ground
TP43
TP48
TP12
TP13
TP33
TP37
TP38
TP45
TP11
TP32
TP2
TP5
TP28
TP31
TP30
TP8
TP3
TP27
TP29
TP26
TP25
TP24
TP17
TP23
TP16
TP21
TP20
TP19
TP18
TP22

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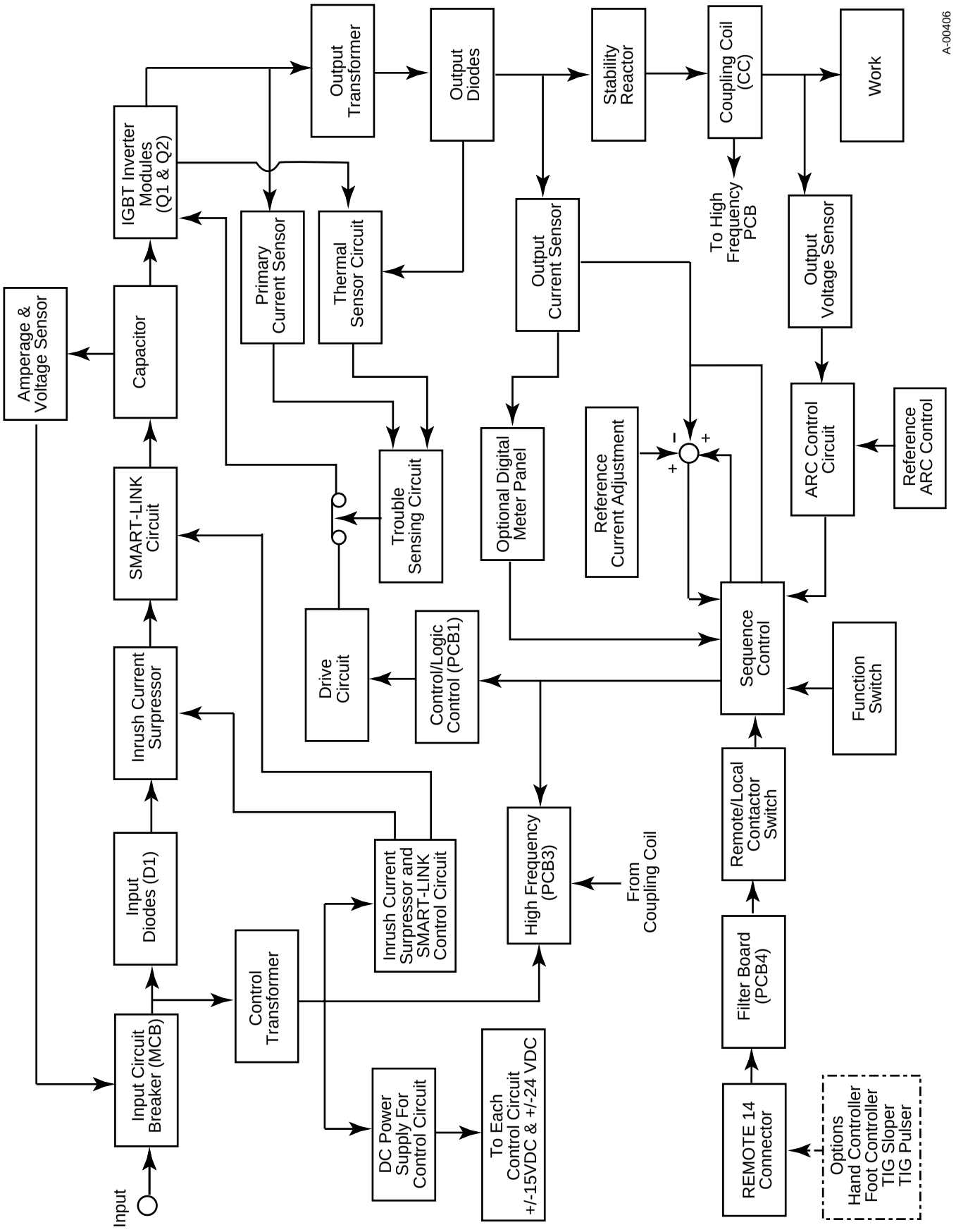
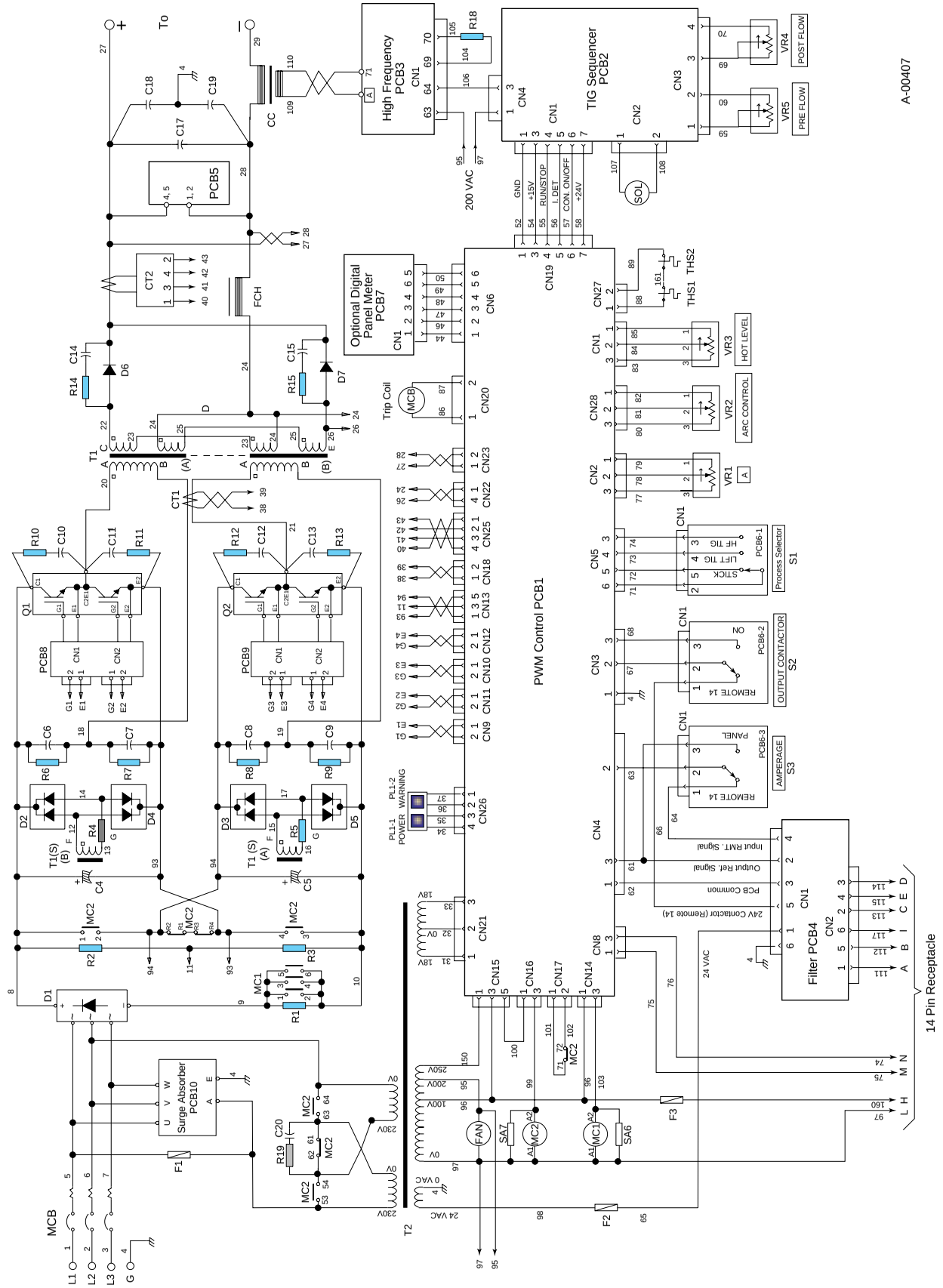
# APPENDIX IV: SYSTEM BLOCK DIAGRAM

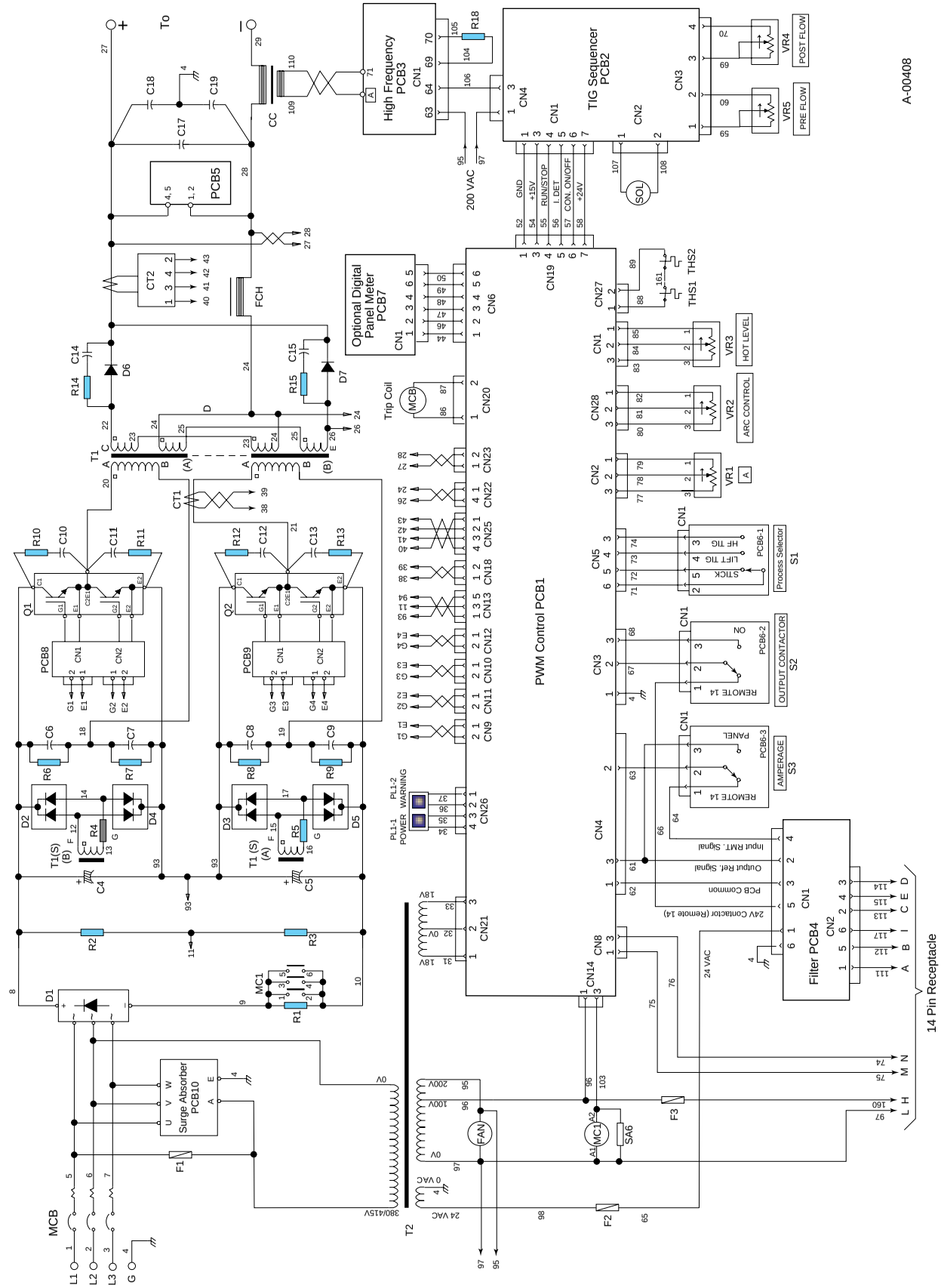


# APPENDIX V: INTERCONNECTION DIAGRAM
# 208/230/460V UNIT WITH MECHANICAL INRUSH CIRCUIT



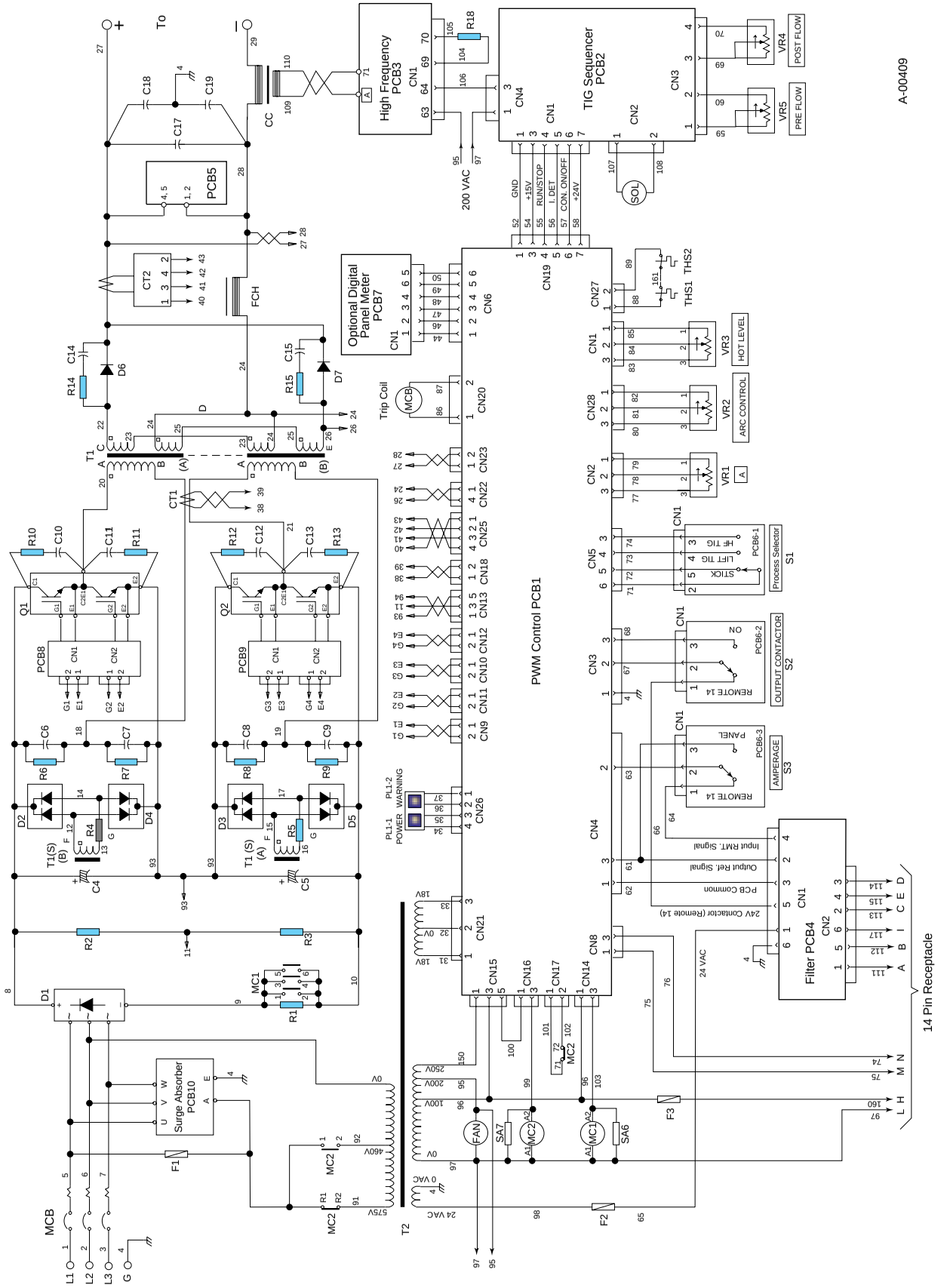

**NOTE: For Solid State Inrush Power Circuit refer to Appendix VIII**

# APPENDIX VI: INTERCONNECTION DIAGRAM
# 380/415V UNIT WITH MECHANICAL INRUSH CIRCUIT



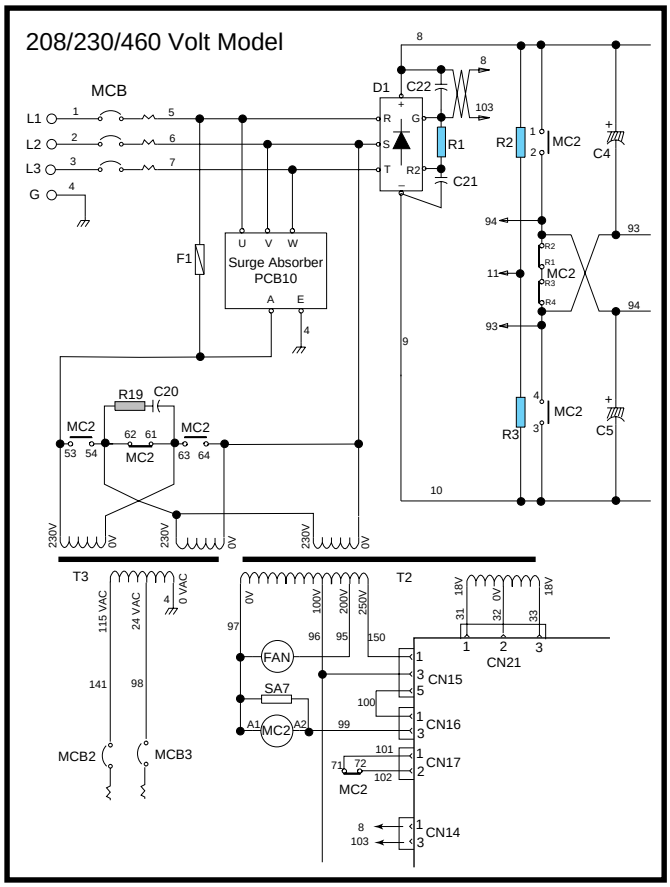

**NOTE: For Solid State Inrush Power Circuit refer to Appendix VIII**

# APPENDIX VII: INTERCONNECTION DIAGRAM
# 460/575V UNIT WITH MECHANICAL INRUSH CIRCUIT

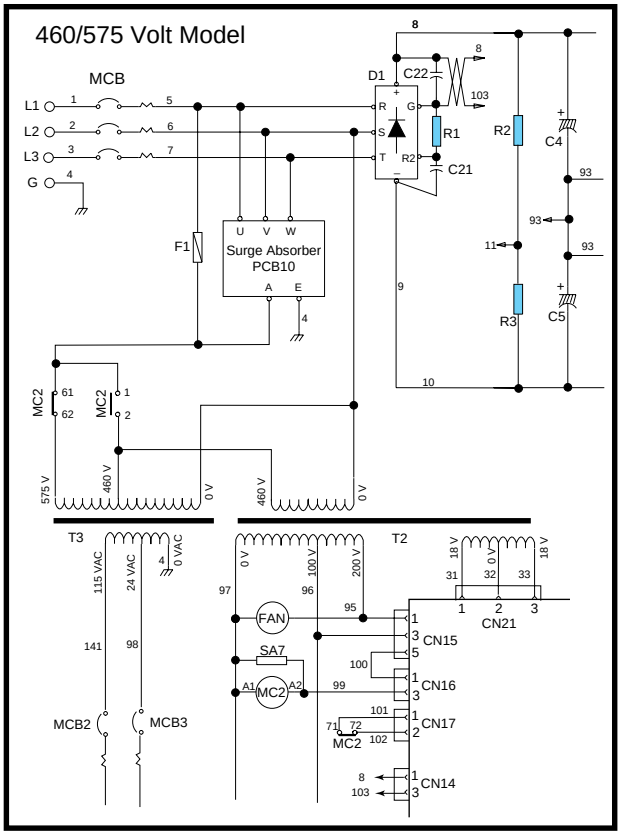


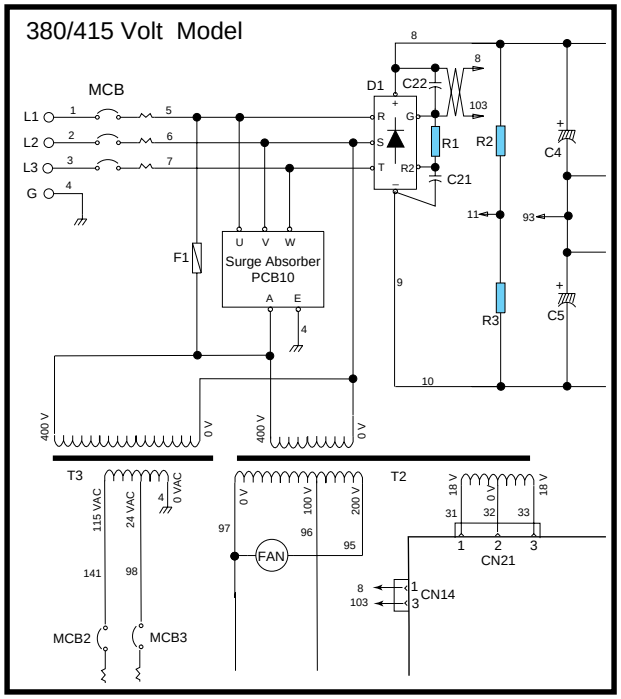

**NOTE: For Solid State Inrush Power Circuit refer to Appendix VIII**

# APPENDIX VIII: INPUT POWER SOLID STATE INRUSH CIRCUIT DIAGRAMS




**NOTE: For Mechanical Inrush Power Circuits refer to Appendix V, VI or VII**

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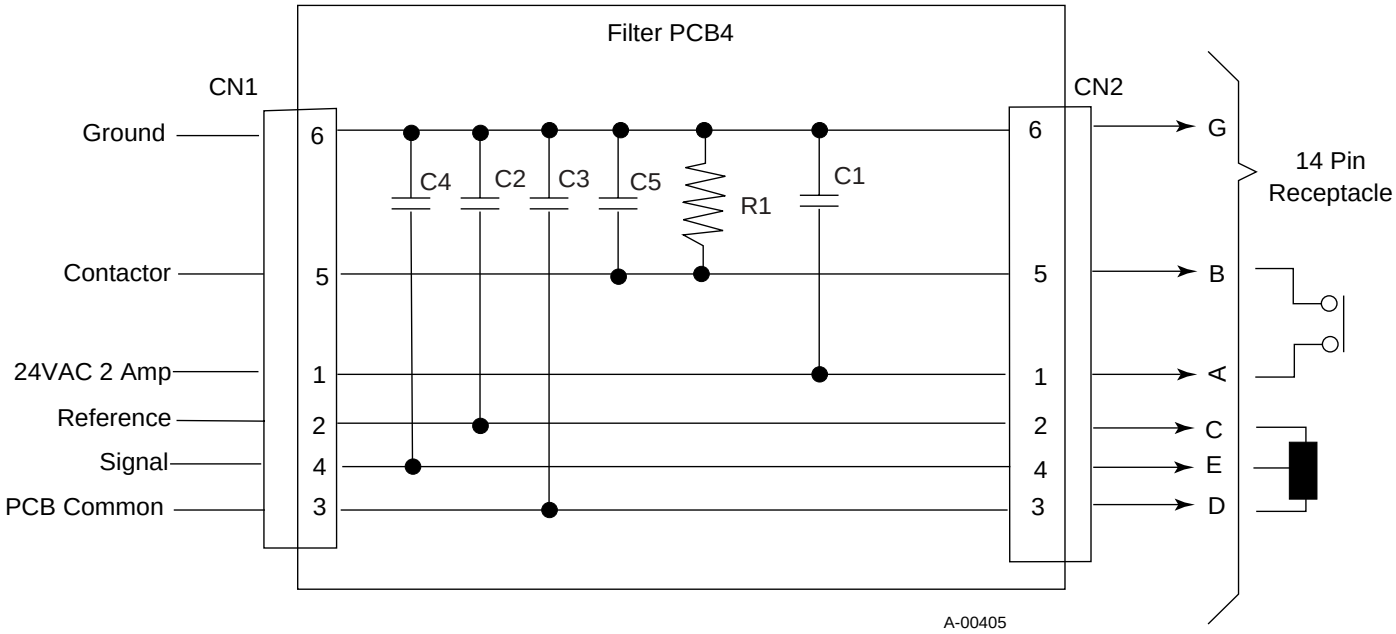
# APPENDIX IX: FILTER PC BOARD (PCB4) DIAGRAM



# INDEX

## L



## M



## O



## P



## R



## S

## T



## V



## W