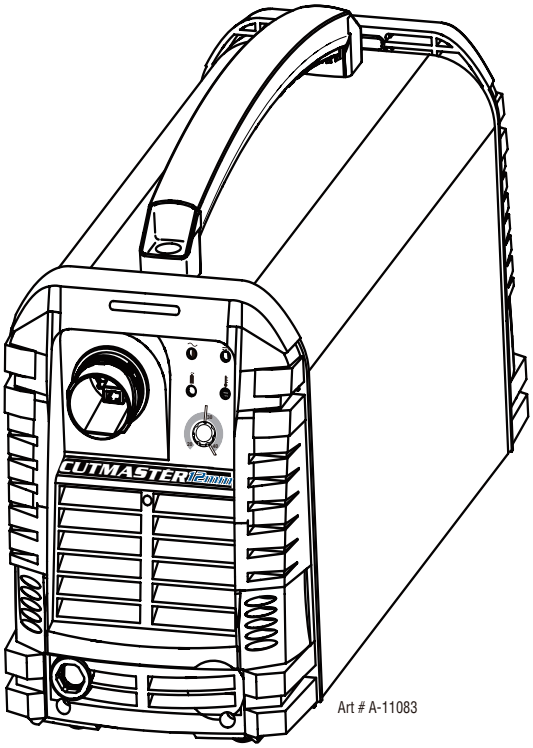
VICTOR®
THERMAL DYNAMICS®

10mm
12mm

CUTMASTER™
PLASMA CUTTING SYSTEM



Art # A-11083

Service Manual

Revision: AB **Issue Date:** May 27, 2013 **Manual No.:** 0-5230
Operating Features:

30 AMP	40 AMP	DC	1 PHASE	240 VAC

CE

VICTOR®
THERMAL DYNAMICS®

WE APPRECIATE YOUR BUSINESS!

Congratulations on your new Thermal Dynamics product. We are proud to have you as our customer and will strive to provide you with the best service and reliability in the industry. This product is backed by our extensive warranty and world-wide service network. To locate your nearest distributor or service provider call +1300 654 674 (Asia Pacific), +1800-462-2782 (Americas) or visit us on the web at **www.cigweld.com.au (Asia Pacific) www.thermal-dynamics.com (Americas and Europe)**

This Service Manual has been designed to instruct you on the correct use and operation of your Thermal Dynamics product. Your satisfaction with this product and its safe operation is our ultimate concern. Therefore please take the time to read the entire manual, especially the Safety Precautions. They will help you to avoid potential hazards that may exist when working with this product. We have made every effort to provide you with accurate instructions, drawings, and photographs of the product(s) we used when writing this manual. However errors do occur and we apologize if there are any contained in this manual.

Due to our constant effort to bring you the best products, we may make an improvement that does not get reflected in the manual. If you are ever in doubt about what you see or read in this manual with the product you received, then check for a newer version of the manual on our website or contact our customer support for assistance.

YOU ARE IN GOOD COMPANY!

The Brand of Choice for Contractors and Fabricators Worldwide.
Thermal Dynamics is a Global Brand of manual and automation Plasma Cutting Products for Victor Technologies International, Inc.

We distinguish ourselves from our competition through market-leading, dependable products that have stood the test of time. We pride ourselves on technical innovation, competitive prices, excellent delivery, superior customer service and technical support, together with excellence in sales and marketing expertise.

Above all, we are committed to developing technologically advanced products to achieve a safer working environment within the welding industry.

WARNINGS

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

While the information contained in this Manual represents the Manufacturer's best judgement, the Manufacturer assumes no liability for its use.

Plasma Cutting Power Source
CutMaster™ 10mm Plant - Part Number 1-4730-6
Cutmaster™ 12mm Plant - Part Number 1-4200-6
SL60 Torch™
Service Manual Number 0-5230

Published by:
Thermal Dynamics Corporation
82 Benning Street
West Lebanon, New Hampshire, USA 03784
(603) 298-5711

www.victortechnologies.com

Publication Date: December 5, 2012
Revision AB Date: May 27, 2013

Record the following information for Warranty purposes:

Where Purchased:_____ _____

Purchase Date:_____

Power Supply Serial #:_____

Torch Serial #:_____ _____

TABLE OF CONTENTS

TABLE OF CONTENTS

SECTION 1: GENERAL INFORMATION

1.01 Notes, Cautions and Warnings

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

NOTE

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

CAUTION

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

WARNING

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

1.02 Important Safety Precautions

WARNING

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

Plasma arc cutting produces intense electric and magnetic emissions that may interfere with the proper function of cardiac pacemakers, hearing aids, or other electronic health equipment. Persons who work near plasma arc cutting applications should consult their medical health professional and the manufacturer of the health equipment to determine whether a hazard exists.

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

GASES AND FUMES

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

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

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

- Always read the Material Safety Data Sheets (MSDS) that should be supplied with the material you are using. These MSDSs will give you the information regarding the kind and amount of fumes and gases that may be dangerous to your health.
- For information on how to test for fumes and gases in your workplace, refer to item 1 in Subsection 1.03, Publications in this manual.
- Use special equipment, such as water or down draft cutting tables, to capture fumes and gases.
- Do not use the plasma torch in an area where combustible or explosive gases or materials are located.
- Phosgene, a toxic gas, is generated from the vapors of chlorinated solvents and cleansers. Remove all sources of these vapors.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code Sec. 25249.5 et seq.)

ELECTRIC SHOCK

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

- Never touch any parts that are electrically “live” or “hot.”
- Wear dry gloves and clothing. Insulate yourself from the workpiece or other parts of the welding circuit.
- Repair or replace all worn or damaged parts.
- Extra care must be taken when the workplace is moist or damp.
- Install and maintain equipment according to NEC code, refer to item 9 in Subsection 1.03, Publications on page 1-4.
- Disconnect power source before performing any service or repairs.
- Read and follow all the instructions in the Operating Manual.

FIRE AND EXPLOSION

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

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

NOISE

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

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

PLASMA ARC RAYS

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

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

NOTE

These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.

Recommended Protective Filters for Electric Welding		
Description of Process	Approximate Range of Welding Current in Amps	Minimum Shade Number of Filter(s)
Manual Metal Arc Welding - covered electrodes (MMAW)	Less than or equal to 100	8
	100 to 200	10
	200 to 300	11
	300 to 400	12
	Greater than 400	13
Gas Metal Arc Welding (GMAW) (MIG) other than Aluminium and Stainless Steel	Less than or equal to 150	10
	150 to 250	11
	250 to 300	12
	300 to 400	13
	Greater than 400	14
Gas Metal Arc Welding (GMAW) (MIG) Aluminium and Stainless Steel	Less than or equal to 250	12
	250 to 350	13
Gas Tungsten Arc Welding (GTAW) (TIG)	Less than or equal to 100	10
	100 to 200	11
	200 to 250	12
	250 to 350	13
	Greater than 350	14
Flux-cored Arc Welding (FCAW) -with or without shielding gas.	Less than or equal to 300	11
	300 to 400	12
	400 to 500	13
	Greater than 500	14
Air - Arc Gouging	Less than or equal to 400	12
Plasma - Arc Cutting	50 to 100	10
	100 to 400	12
	400 to 800	14
Plasma - Arc Spraying	—	15
Plasma - Arc Welding	Less than or equal to 20	8
	20 to 100	10
	100 to 400	12
	400 to 800	14
Submerged - Arc Welding	—	2(5)
Resistance Welding	—	Safety Spectacles or eye shield

Refer to standard AS/NZS 1338.1:1992 for comprehensive information regarding the above table.

Table 1-1 - Protective Filters

1.03 Publications

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

1. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
3. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018
6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES, obtainable from American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING AND ALLIED PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. NFPA Standard 70, NATIONAL ELECTRICAL CODE, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202
12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING, obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3
13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103
14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018

1.04 Servicing Hazards

WARNING

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

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

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

WARNING

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn Off cutting power source and disconnect and lockout input power using line disconnect switch, circuit breakers, or by removing plug from receptacle, or stop engine before servicing unless the procedure specifically requires an energized unit.
- Insulate yourself from ground by standing or working on dry insulating mats big enough to prevent contact with the ground.
- Do not leave live unit unattended.
- If this procedure requires and energized unit, have only personnel familiar with and following standard safety practices do the job.
- When testing a live unit, use the one-hand method. Do not put both hands inside unit. Keep one hand free.
- Disconnect input power conductors from de-energized supply line BEFORE moving a cutting power source.

  SIGNIFICANT DC VOLTAGE exists after removal of input power on inverters.
- Turn Off inverters, disconnect input power, and discharge input capacitors according to instructions in Troubleshooting Section before touching any parts.

WARNING

STATIC (ESD) can damage PC boards.

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

WARNING

FIRE OR EXPLOSION hazard.

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

WARNING

FLYING METAL or DIRT can injure eyes.

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

WARNING

HOT PARTS can cause sever burns.

- Do not touch hot parts bare handed.
- Allow cooling period before working on equipment.
- To handle not parts, use proper tools and/or wear heavy, insulated welding gloves and clothing to prevent burns.

WARNING

EXPLODING PARTS can cause injury.

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

WARNING

SHOCK HAZARD from testing.

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

WARNING

FALLING UNIT can cause injury.

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

WARNING

MOVING PARTS can cause injury,

- Keep away from moving parts such as fans.
- Keep away from pinch points such as drive rolls.
- Have only qualified persons remove panels, covers, or guards for maintenance as necessary.
- Keep hands, hair, loose clothing, and tools away from moving parts.
- Reinstall panels, covers, or guards when maintenance is finished and before reconnecting input power.

WARNING

OVERUSE can cause OVERHEATING.

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

WARNING

READ INSTRUCTIONS.

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

1.05 EMF Information

Considerations About Cutting And The Effects Of High Frequency Electric And Magnetic Fields

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

WARNING

H.F. RADIATION can cause interference.

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

About Implanted Medical Devices:

WARNING

MAGNETIC FIELDS can affect Implanted Medical Devices.

- Wearers of Pacemakers and other Implanted Medical Devices should keep away from servicing areas until consulting their doctor and the device manufacturer.

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

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

1.06 Declaration of Conformity

Manufacturer: Victor Technologies International, Inc.

Address: 82 Benning Street

West Lebanon, New Hampshire 03784

USA

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 2006/95/EC) and to the National legislation for the enforcement of this Directive.

The equipment described in this manual conforms to all applicable aspects and regulations of the "EMC Directive" (European Council Directive 2004/108/EC) and to the National legislation for the enforcement of this Directive.

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

National Standard and Technical Specifications

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

- CSA (Canadian Standards Association) standard C22.2 number 60 for Arc welding equipment.
- UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.
- CENELEC EN50199 EMC Product Standard for Arc Welding Equipment.
- ISO/IEC 60974-1 (BS 638-PT10) (EN 60 974-1) (EN50192) (EN50078) applicable to plasma cutting equipment and associated accessories.
- IEC 60974-10 applicable to Industrial Equipment - generic emissions and regulations
- AS 1674 Safety in welding and allied processes.
- 2001/95/EC RoHS directive.
- AS60974.1 Arc Welding Equipment Welding Power Sources.

  For environments with increased hazard of electrical shock, Power Supplies bearing the S mark conform to EN50192 when used in conjunction with hand torches with exposed cutting tips, if equipped with properly installed standoff guides.

- Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process. This is to ensure the product is safe, when used according to instructions in this manual and related industry standards, and performs as specified. Rigorous testing is incorporated into the manufacturing process to ensure the manufactured product meets or exceeds all design specifications.

Victor Technologies has been manufacturing products for more than 30 years, and will continue to achieve excellence in our area of manufacture.

Notes

SECTION 2 SYSTEM: INTRODUCTION

2.01 How to Use This Manual

To ensure safe operation, read the entire manual, including the chapter on safety instructions and warnings. Throughout this manual, the word WARNING, CAUTION and NOTE may appear. Pay particular attention to the information provided under these headings. These special annotations are easily recognized as follows:

NOTE

Offers helpful information concerning certain operating procedures. Notes will be shown in italics

CAUTION

Refers to possible equipment damage. Cautions will be shown in bold type.

WARNING

Gives information regarding possible personal injury. Warnings will be enclosed in a box such as this.

You will also notice icons from the safety section appearing throughout the manual. These are to advise you of specific types of hazards or cautions related to the portion of information that follows. Some may have multiple hazards that apply and would look something like this:

2.02 Equipment Identification

The unit's identification number (specification or part number), model, and serial number usually appear on a nameplate attached to the machine. Equipment which does not have a nameplate attached to the machine is identified only by the specification or part number printed on the shipping container. Record these numbers for future reference.

2.03 Receipt of Equipment

When you receive the equipment, check it against the invoice to make sure it is complete and inspect the equipment for possible damage due to shipping. If there is any damage, notify the carrier immediately to file a claim. Furnish complete information concerning damage claims or shipping errors to the location in your area listed in the inside back cover of this manual. Include all equipment identification numbers as described above along with a full description of the parts in error.

2.04 Transportation Methods

Disconnect input power conductors from de-energized supply line before moving the cutting power source.

Lift unit with handle on top of case. Use handcart or similar device of adequate capacity. If using a fork lift vehicle, secure the unit on a proper skid before transporting.

2.05 Working Principle

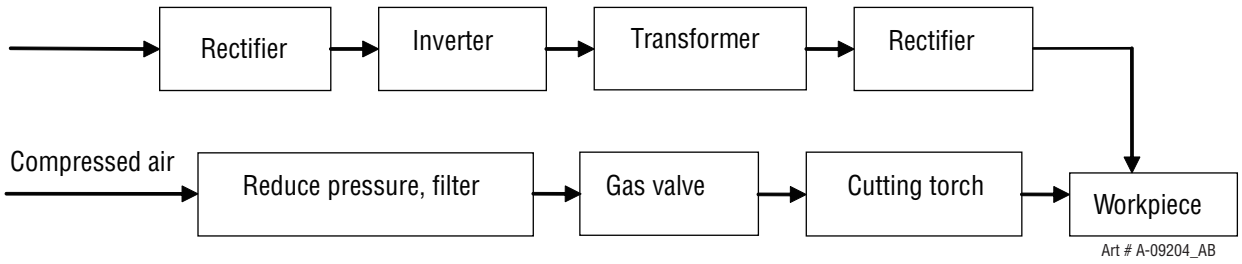


Figure 2-1- Working Principle

2.06 Power Supply Features

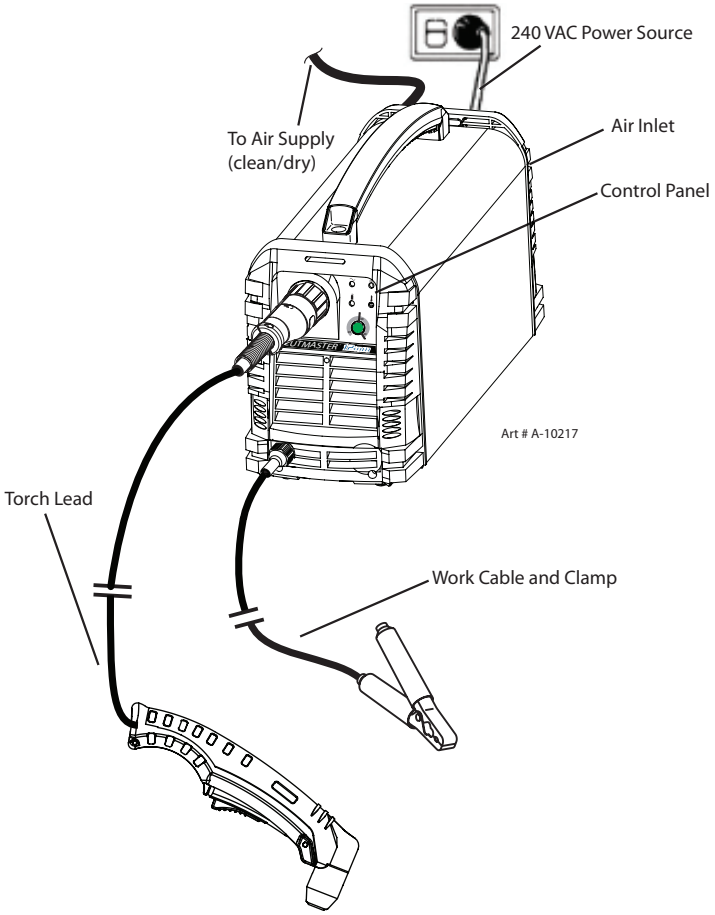


Figure 2-2- Power Supply Features

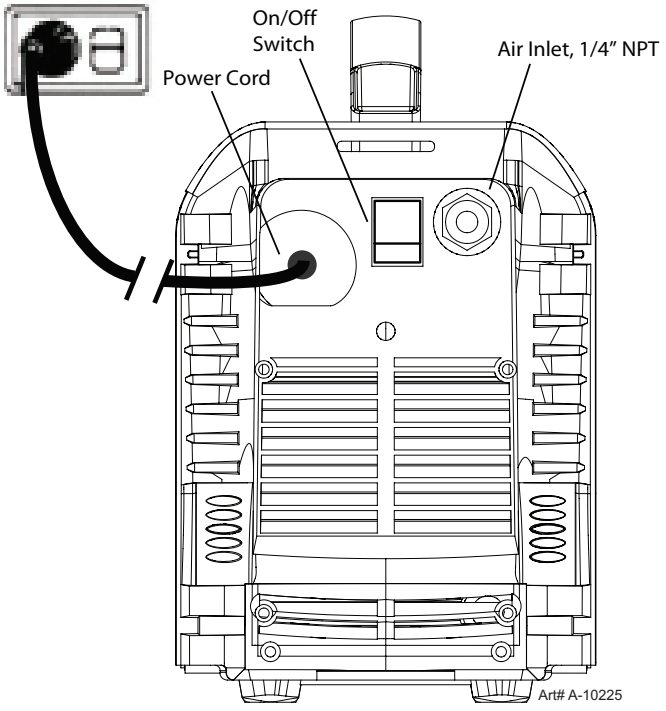


Figure 2-3- Rear with Plug

Notes

SECTION 2TORCH: INTRODUCTION

2T.01 Scope of Manual

This manual contains descriptions, operating instructions and maintenance procedures for the SL60 Plasma Cutting Torch. Service of this equipment is restricted to properly trained personnel; unqualified personnel are strictly cautioned against attempting repairs or adjustments not covered in this manual, at the risk of voiding the Warranty. Read this manual thoroughly. A complete understanding of the characteristics and capabilities of this equipment will assure the dependable operation for which it was designed.

2T.02 Specifications

A. Torch Configurations

1. Hand Torch, Model SL60

The hand torch head is at 75° to the torch handle. The hand torches include a torch handle and torch trigger assembly.

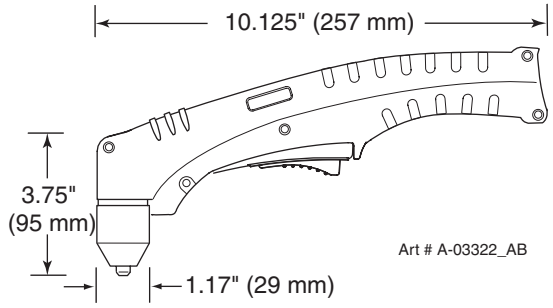


Figure 2T-1 - SL60 Torch

B. Torch Leads Lengths

Hand Torches are available as follows:

- 20 ft / 6.2 m.

C. Torch Parts

Starter Cartridge, Electrode, Tip, Shield Cup

(See "Figure 4-3 - SL60 Torch Parts" on page 4-2.)

D. Parts - In - Place (PIP)

Torch has built-in switch.

12 vdc circuit rating

E. Type Cooling

Combination of ambient air and gas stream through torch.

F. Torch Ratings

SL60 Torch Ratings	
Ambient Temperature	104° F 40° C
Duty Cycle	100% @ 60 Amps @ 400 scfh
Maximum Current	60 Amps
Voltage (V_{peak})	500V
Arc Striking Voltage	7kV

G. Current Ratings

SL60 Current Ratings	
SL60 Torch & Leads	Up to 60 Amps, DC, Straight Polarity

NOTE

Power Supply characteristics will determine material thickness range.

H. Gas Requirements

SL60 Torch Gas Specifications	
Gas (Plasma and Secondary)	Compressed Air
Operating Pressure Refer to NOTE	60-75 psi 4.1 - 5.2 bar
Maximum Input Pressure	125 psi / 8.6 bar
Gas Flow	300-500 scfh 142-235 lpm

WARNING

This torch is not to be used with oxygen (O_2). This torch is not to be use with high frequency starting systems.

NOTE

Operating pressure varies with torch model, operating amperage, and torch leads length. Refer to gas pressure settings charts for each model.

2T.03 Introduction to Plasma

A. Plasma Gas Flow

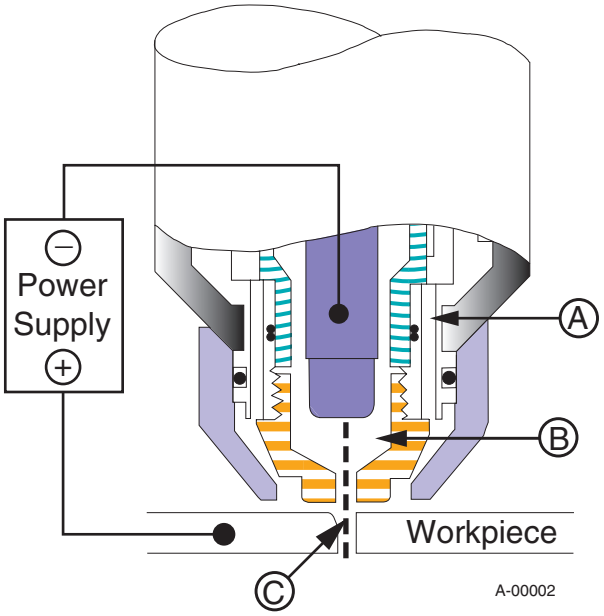
Plasma is a gas which has been heated to an extremely high temperature and ionized so that it becomes electrically conductive. The plasma arc cutting and gouging processes use this plasma to transfer an electrical arc to the workpiece. The metal to be cut or removed is melted by the heat of the arc and then blown away.

While the goal of plasma arc cutting is separation of the material, plasma arc gouging is used to remove metals to a controlled depth and width.

In a Plasma Cutting Torch a cool gas enters Zone B, where a arc between the electrode and the torch tip heats and ionizes the gas. The main cutting arc then transfers to the workpiece through the column of plasma gas in Zone C.

By forcing the plasma gas and electric arc through a small orifice, the torch delivers a high concentration of heat to a small area. The stiff, constricted plasma arc is shown in Zone C. Direct current (DC) straight polarity is used for plasma cutting, as shown in the illustration.

Zone A channels a secondary gas that cools the torch. This gas also assists the high velocity plasma gas in blowing the molten metal out of the cut allowing for a fast, slag - free cut.



Typical Torch Head Detail

B. Gas Distribution

The single gas used is internally split into plasma and secondary gases.

The plasma gas flows into the torch through the negative lead, through the starter cartridge, around the electrode, and out through the tip orifice.

The secondary gas flows down around the outside of the torch starter cartridge, and out between the tip and shield cup around the plasma arc.

C. Pilot Arc

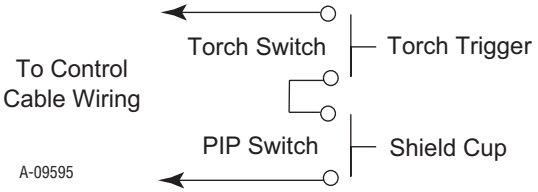
When the torch is started a pilot arc is established between the electrode and cutting tip. This pilot arc creates a path for the main arc to transfer to the work.

D. Main Cutting Arc

DC power is also used for the main cutting arc. The negative output is connected to the torch electrode through the torch lead. The positive output is connected to the workpiece via the work cable and to the torch through a pilot wire.

E. Parts - In - Place (PIP)

The torch includes a 'Parts - In - Place' (PIP) circuit. When the shield cup is properly installed, it closes a switch. The torch will not operate if this switch is open.



Parts - In - Place Circuit Diagram for Hand Torch

SECTION 3: INSTALLATION

3.01 Unpacking

1. Use the packing lists to identify and account for each item.

A. Contents List for CutMaster 10mm Plant Part No. 1-4730-6

Description	Quantity
CM 10mm Power Source	1
Work cable and clamp 5m (installed)	1
Carry bag	1
SL60 Torch (Including SL60 Torch 20 ft/6.2m w/ATC, consumables set, spare parts kit)	1
Shoulder Strap	1
Operating Manual	1

Table 3-1- Contents List for CutMaster 10mm Plant

B. Contents List for CutMaster 12mm Plant Part No. 1-4200-6

Description	Quantity
CM 12mm Power Source	1
Work cable and clamp 5m (installed)	1
Carry bag	1
SL60 Torch (Including SL60 Torch 20 ft/6.2m w/ATC, consumables set, spare parts kit)	1
Shoulder Strap	1
Operating Manual	1

Table 3-2- Contents List for CutMaster 12mm Plant

2. Inspect each item for possible shipping damage. If damage is evident, contact your distributor and / or shipping company before proceeding with the installation.

3. Record Power Source and Torch model and serial numbers, purchase date and vendor name, in the information block at the front of this manual.

3.02 Lifting Options

The Power Source includes a handle for **hand lifting only.** Be sure unit is lifted and transported safely and securely.

WARNING

DO NOT touch live electrical parts.

Disconnect input power cord before moving unit.

WARNING

FALLING EQUIPMENT can cause serious personal injury and can damage equipment.

HANDLE is not for mechanical lifting.

- *Only persons of adequate physical strength should lift the unit.*
- *Lift unit by the handle, using two hands. Do not use straps for lifting.*
- *Use optional cart or similar device of adequate capacity to move unit.*
- *Place unit on a proper skid and secure in place before transporting with a fork lift or other vehicle.*

3.03 Air Supply Connections

A. Connecting Air Supply to Unit

The connection is the same for compressed air or industrial compressed air in gas cylinders.

1. Connect the gas line to the compressed air inlet port at the appropriate pressure.

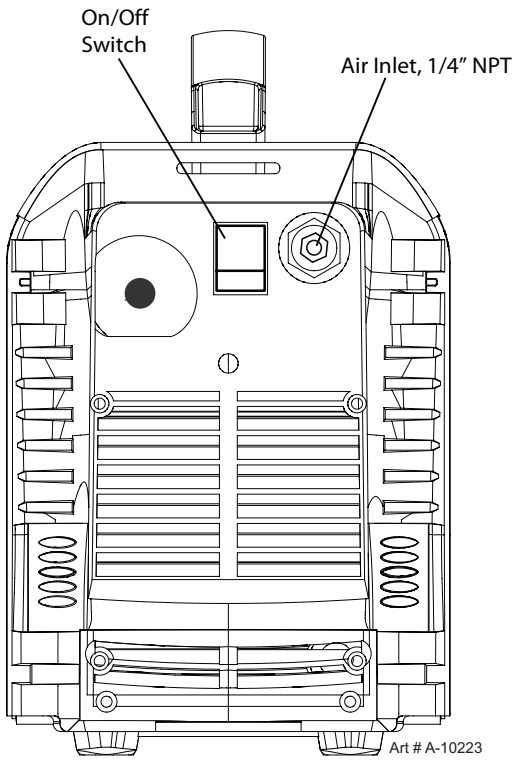


Figure 3-1 - Gas Connection to Compressed Air Input

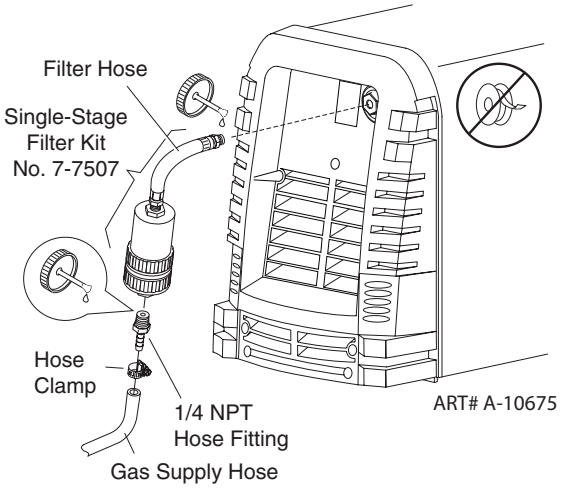


Figure 3-2 - Optional Single - Stage Filter Installation for Compressed Air Input

B. Using Industrial Compressed Air In Gas Cylinders

When using industrial compressed air in gas cylinders as the gas supply:

1. Refer to the manufacturer's specifications for installation and maintenance procedures for high pressure gas regulators.
2. Examine the cylinder valves to be sure they are clean and free of oil, grease or any foreign material. Briefly open each cylinder valve to blow out any dust which may be present.
3. The cylinder must be equipped with an adjustable high-pressure regulator capable of outlet pressures up to 100 psi (6.9 bar) maximum and flows of at least 250 scfh [Standard cubic foot per hour] (120 lpm) [liter per minute].
4. Connect gas supply hose to the cylinder.

NOTE

Pressure should be set at 100 psi (6.9 bar) at the high pressure gas cylinder regulator.

Supply hose must be at least 1/4 inch (6mm) internal diameter.

For a secure seal, apply thread sealant to the fitting threads, according to manufacturer's instructions. DO NOT use Teflon tape as a thread sealer, as small particles of the tape may break off and block the small gas passages in the torch.

3.04 Power Source Specifications

A. CutMaster 10mm Plant Part No. 1-4730-6

CUTMASTER 10mm Power Source Specifications	
Input Power	240 VAC (+/-15%), 1 Phase, 50/60Hz
Output Current	20-30 Amps @ 240VAC
CUTMASTER 10mm Power Source Duty Cycle (Note 1)	
Ambient Temperature	104° F (40° C)
Duty Cycle	40% @ 240VAC
Rated Current	30 Amps @ 240VAC
SL60 Torch Gas Requirements (See Section 2T.02)	
Note	
Note 1: Duty Cycle is the percentage of time the system can be operated without overheating. Duty cycle is reduced if primary input voltage (AC) is low or the DC voltage is higher than shown in this chart.	
Note 2: Air supply must be free of oil, moisture, and other contaminants. Excessive oil and moisture may cause double-arcing, rapid tip wear, or even complete torch failure. Contaminants may cause poor cutting performance and rapid electrode wear. Optional filters provide increased filtering capabilities.	

Table 3-3- CUTMASTER 10mm Plant Power Source Specifications

B. CutMaster 12mm Plant Part No. 1-4200-6

CUTMASTER 12mm Power Source Specifications	
Input Power	240 VAC (+-15%), 1 Phase, 50/60Hz
Output Current	20-40 Amps @ 240VAC
CUTMASTER 12mm Power Source Duty Cycle (Note 1)	
Ambient Temperature	104° F (40° C)
Duty Cycle	40% @ 240VAC
Rated Current	40 Amps @ 240VAC
SL60 Torch Gas Requirements (See Section 2T.02)	
Note	
Note 1: Duty Cycle is the percentage of time the system can be operated without overheating. Duty cycle is reduced if primary input voltage (AC) is low or the DC voltage is higher than shown in this chart.	
Note 2: Air supply must be free of oil, moisture, and other contaminants. Excessive oil and moisture may cause double-arcing, rapid tip wear, or even complete torch failure. Contaminants may cause poor cutting performance and rapid electrode wear. Optional filters provide increased filtering capabilities.	

Table 3-4- CUTMASTER 12mm Plant Power Source Specifications

NOTE

IEC Rating is determined as specified by the International Electro-Technical Commission. These specifications include calculating an output voltage based upon power supply rated current. To facilitate comparison between power supplies, all manufacturers use this output voltage to determine duty cycle.

TDC Rating is determined using an output voltage representative of actual output voltage during cutting with a TDC torch. This voltage may be more or less than IEC voltage, depending upon choice of torch, consumables, and actual cutting operation.

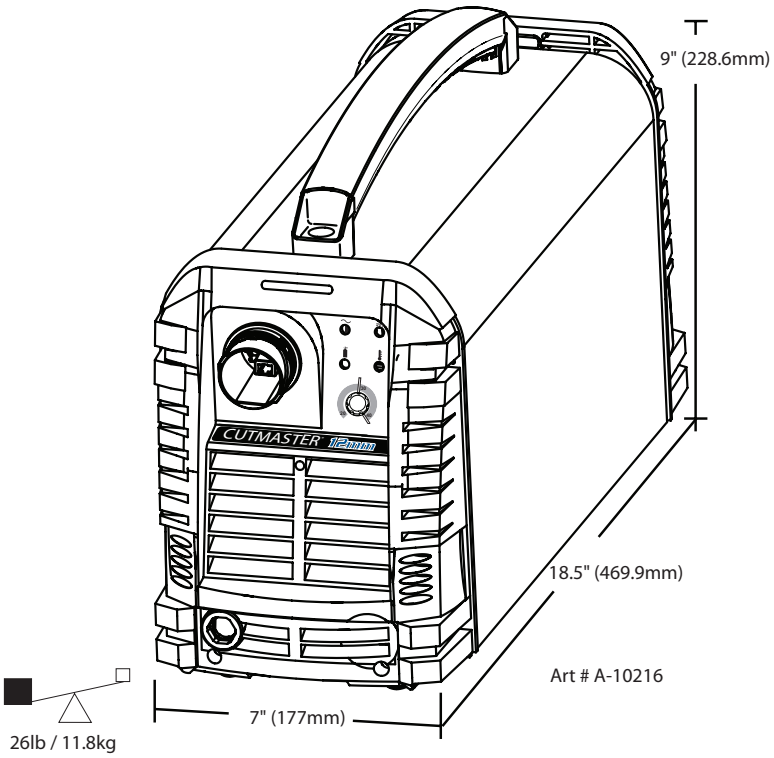


Figure 3-3 - Power Source Dimensions & Weight

NOTE

Weight includes torch & leads, input power cord, and work cable with clamp.

CAUTION

Provide clearance for proper air flow through the Power Source. Operation without proper air flow will inhibit proper cooling and reduce duty cycle.

3.05 Input Wiring Specifications

CUTMASTER 10mm Input Power Requirements					
Input		Power Input	Current Input	Current Input	Suggested Sizes (See Note)
Voltage	Frequency	(kVA)	Max (Amps)	I_1eff (Amps)	Fuse (Amps)
(Volts-AC)	(Hz)	1-Ph	1-Ph	1-Ph	1-Ph
240	50/60	3.8	15.6	9.9	16
Line Voltages with Suggested Circuit Protection					
Motor start fuses or thermal circuit breakers are recommended for this application. Check local requirements for your situation in this regard.					

CUTMASTER 12mm Input Power Requirements					
Input		Power Input	Current Input	Current Input	Suggested Sizes (See Note)
Voltage	Frequency	(kVA)	Max (Amps)	I_1eff (Amps)	Fuse (Amps)
(Volts-AC)	(Hz)	1-Ph	1-Ph	1-Ph	1-Ph
240	50/60	5.0	20.8	13	16
Line Voltages with Suggested Circuit Protection					
Motor start fuses or thermal circuit breakers are recommended for this application. Check local requirements for your situation in this regard.					

NOTE

Refer to Local and National Codes or local authority having jurisdiction for proper wiring requirements. Cable size is de-rated based on the Duty Cycle of the equipment.

The suggested sizes are based on flexible power cable with power plug installations.

Cable conductor temperature used is 167° F (75° C).

Notes

SECTION 4 SYSTEM: OPERATION

4.01 Control Panel

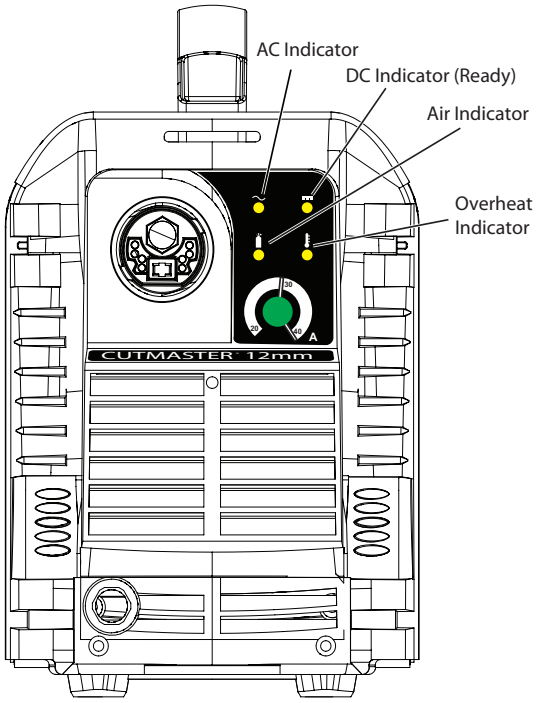


Figure 4-1 - Front Control Panel

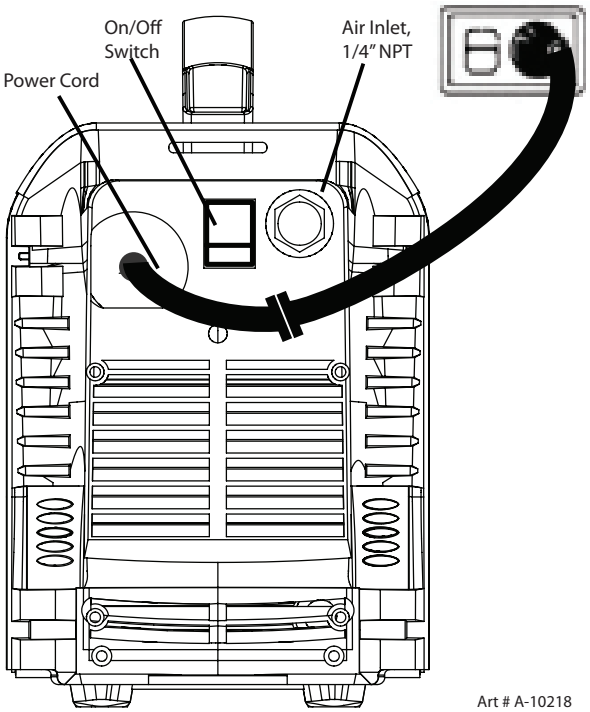


Figure 4-2 - Rear Controls

1. ON/OFF Switch (Power Switch)

Controls input power to the Power Source. I is ON, O is OFF.

2. (A) Output Current Control

Sets the desired output current. If the overload protection (fuse or circuit breaker) on the input power circuit opens frequently, either reduce cutting output, reduce the cutting time, or connect the unit to more adequate input power. For 240V input power, the maximum output is 40 Amps. Refer to Section 2 for input power requirements.

3. ~ AC Indicator

Steady light indicates Power Source is ready for operation.

4. OVERHEAT Indicator (TEMP Indicator)

Indicator is normally OFF. Indicator is ON when internal temperature *exceeds* normal limits. Allow the unit to run with the fan ON until the temp indicator turns OFF.

5. AIR Indicator

AIR indicator light should be ON when there is sufficient gas pressure.

6. ⎓ READY (DC Indicator)

Indicator is ON when DC output circuit is active.

4.02 Preparations for Operating

At the start of each operating session:

WARNING

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

NOTE

All consumables must be correctly installed and maintained to ensure correct operation.

A. Torch Parts Selection

Check the torch for proper assembly and appropriate torch parts. The torch parts must correspond with the type of operation, and with the amperage output of this Power Source (40 amps maximum). Use only genuine Thermal Dynamics parts with this torch.

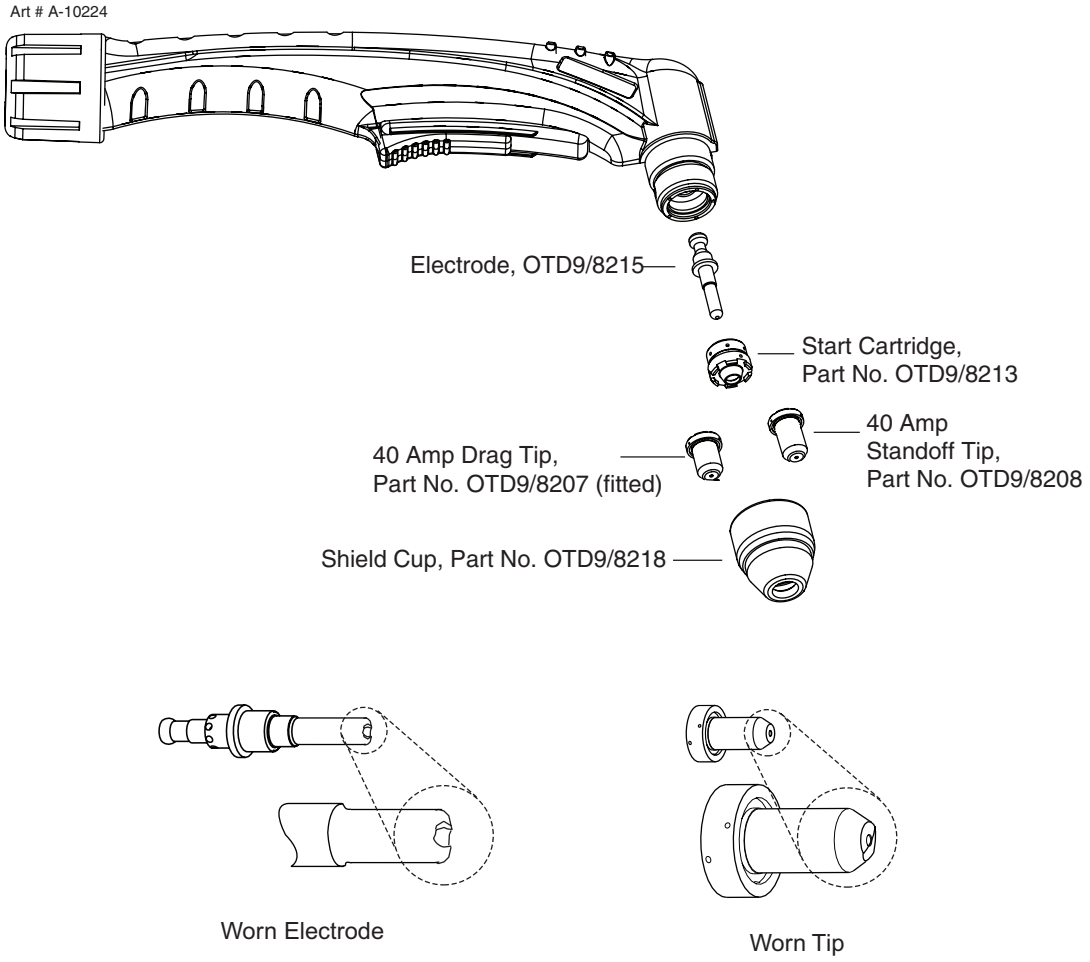


Figure 4-3 - SL60 Torch Parts

NOTE

When operating the torch in a normal condition, some gas vents through the gap between the shield cup and torch handle. DO NOT attempt to over tighten the shield cup as irreparable damage to internal components may result.

B. Torch Connection

Check that the torch is properly connected.

C. Check Primary Input Power Source

1. Check the power source for proper input voltage. Make sure the input power source meets the power requirements for the unit per Section 2, Specifications.
2. Connect the input power cable (or close the main disconnect switch) to supply power to the system.

D. Gas Selection

1. Ensure gas source meets requirements listed in Section 2T.
2. Check connections and turn gas supply ON.

E. Connect Work Cable

Clamp the work cable to the workpiece or cutting table. The area must be free from oil, paint and rust. Connect only to the main part of the workpiece; do not connect to the part to be cut off.

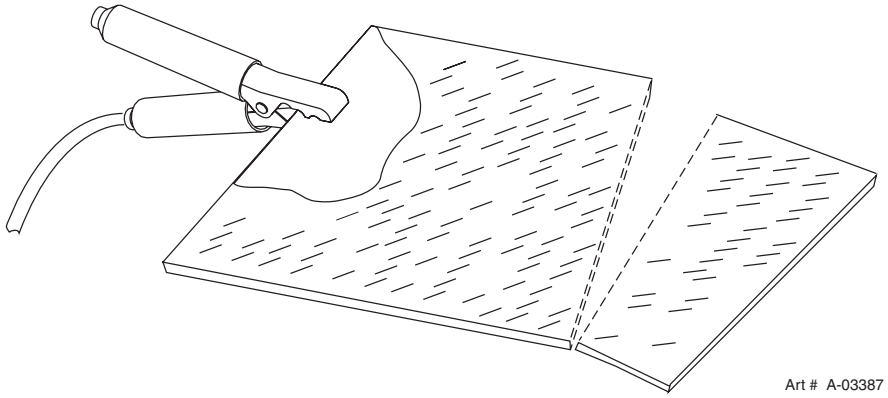


Figure 4-4 - Work Cable Connection

F. Power ON

Place the Power Source ON/OFF switch to the ON (I) position. Power indicator ~ turns ON.

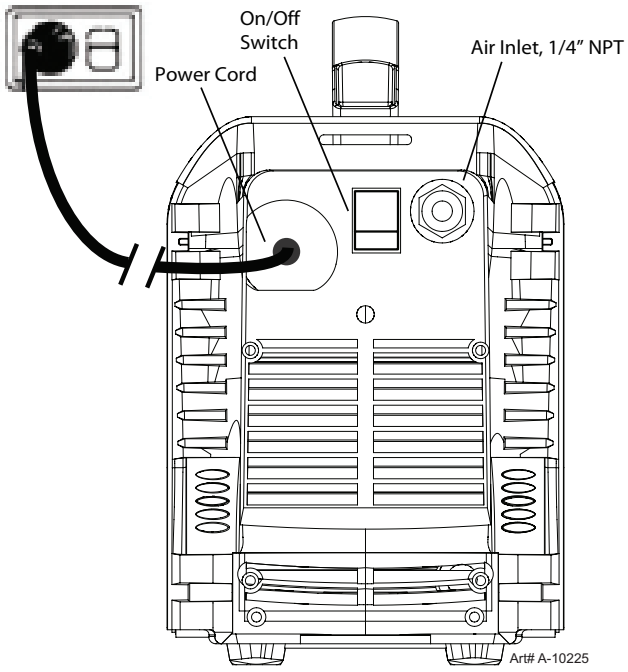


Figure 4-5 - Rear Panel with ON/OFF Switch

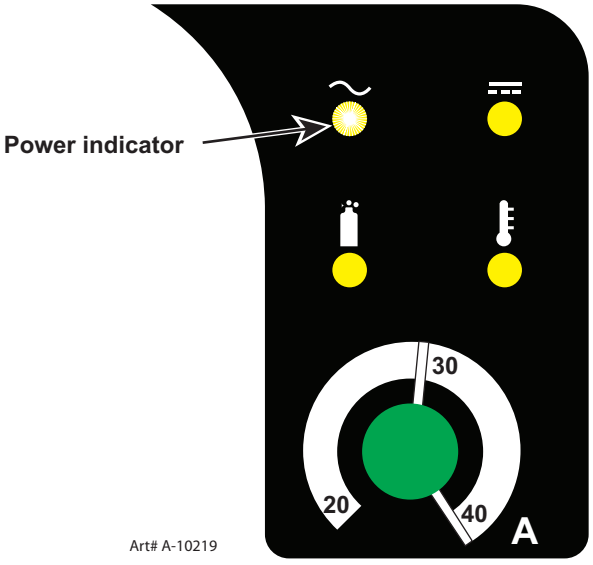


Figure 4-6 - Front Panel with Power ON/OFF Indicator

4.03 Sequence of Operation

The following is a typical sequence of operation for this Power Source.

1. Place the ON/OFF switch on the Power Source to ON (up) position.
   a. AC indicator ~ turns ON; fan turns ON.

NOTE

During initial power up, there will be a delay of about 2 seconds before the AC Indicator light will illuminate and the pre-flow gas and fan starts. The gas will automatically flow from torch for approximately 10 seconds (only after the AC Indicator lamp is illuminated) (The AC Indicator lamp and fan turns ON approximately 2 seconds after the ON/OFF switch is enabled), this is a process that makes sure all inputs (gas, input power, torch connection, and torch parts) are acknowledged for proper operation.

2. Wear protective clothing, including welding gloves and appropriate eye protection (See Table 1-1). Place tip on workpiece and pull trigger. Arc will initiate and start cutting material.

• Standoff Cutting With Hand Torch

NOTE

For best performance and parts life, always use the correct parts for the type of operation.

A. The torch can be comfortably held in one hand or steadied with two hands. Position the hand to press the Trigger on the torch handle. With the hand torch, the hand may be positioned close to the torch head for maximum control or near the back end for maximum heat protection. Choose the holding technique that feels most comfortable and allows good control and movement.

NOTE

The tip should never come in contact with the workpiece except during drag cutting operations.

B. Depending on the cutting operation, do *one* of the following:

a). For drag cutting, place the tip on the plate holding the torch at an angle to the plate so that only one edge of the tip is in contact with the plate. This prevents damage to the tip during the piercing process.

b). For standoff cutting, hold the torch tip on the workpiece, pull the trigger. After the arc is initiated lift the tip to 1/8" - 3/8" (3-4mm) off the work.

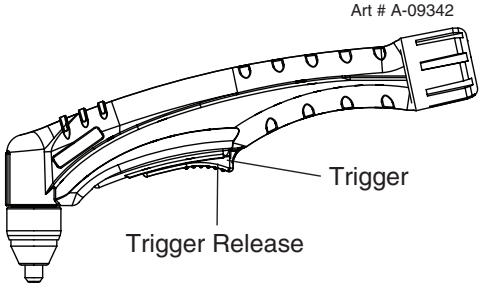


Figure 4-7 Torch Trigger Release

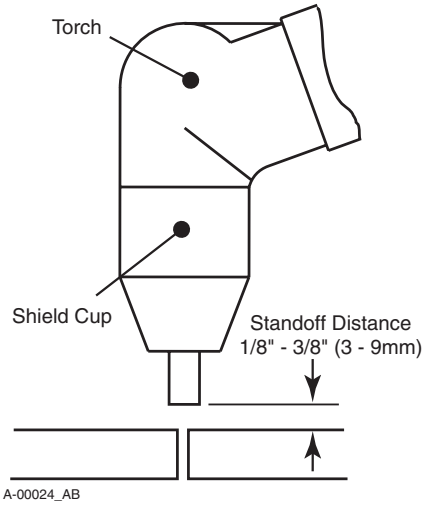


Figure 4-8 Standoff Distance

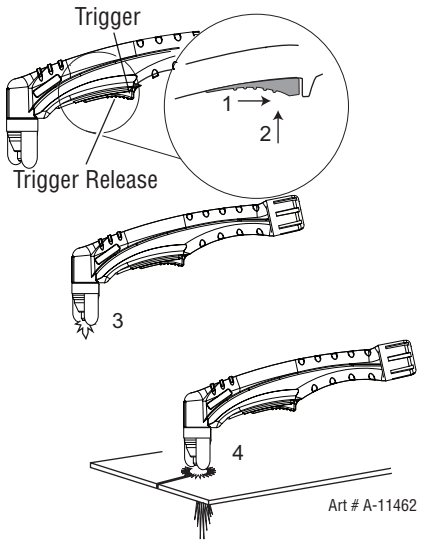


Figure 4-9 Standoff Cutting

NOTE

When the shield cup is properly installed, there is a slight gap between the shield cup and the torch handle. Gas vents through this gap as part of normal operation. DO NOT attempt to force the shield cup to close this gap. Forcing the shield cup against the torch head or torch handle can damage components.

- **Drag Cutting With a Hand Torch**

  Drag cutting works best on metal 1/4" (6mm) thick or less.

NOTE

For best parts performance and life, always use the correct parts for the type of operation.

A. Install the drag cutting tip and set the output current.
B. The torch can be comfortably held in one hand or steadied with two hands. Position the hand to press the Trigger on the torch handle. With the hand torch, the hand may be positioned close to the torch head for maximum control or near the back end for maximum heat protection. Choose the holding technique that feels most comfortable and allows good control and movement.
C. Keep the torch in contact with the workpiece during the cutting cycle.
D. Hold the torch away from your body.
E. Slide the trigger release toward the back of the torch handle while simultaneously squeezing the trigger. The arc will start.

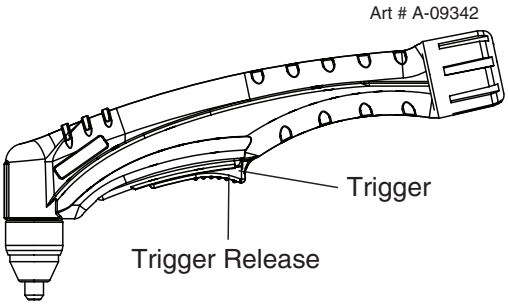


Figure 4-10 - Torch Trigger Release

F. Place the torch tip on the work. The main arc will transfer to the work.

NOTE

The gas preflow and postflow are a characteristic of the Power Source and not a function of the torch.

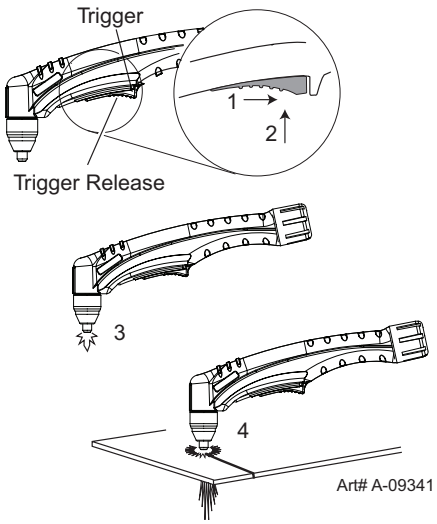


Figure 4-11 - Drag Cutting

G. Cut as usual. Simply release the trigger assembly to stop cutting.
H. Follow normal recommended cutting practices as provided herein.

3. Complete cutting operation.

NOTE

If the torch is lifted too far from the workpiece while cutting, the main arc will stop and the pilot arc will automatically restart.

4. Release the torch trigger.
   a. Main arc stops.
5. Set the Power Source ON/OFF switch to OFF (down position).
   a. AC indicator ~ turns OFF.
6. Set the main power disconnect to OFF, or unplug input power cord.
   a. Input power is removed from the system.

4.04 Cut Quality

NOTE

Cut quality depends heavily on setup and parameters such as torch standoff, alignment with the workpiece, cutting speed, gas pressures, and operator ability.

Refer to Appendix pages for additional information as related to the Power Source used.

Cut quality requirements differ depending on application. For instance, nitride build-up and bevel angle may be major factors when the surface will be welded after cutting. Dross-free cutting is important when finish cut quality is desired to avoid a secondary cleaning operation. The following cut quality characteristics are illustrated in the following figure:

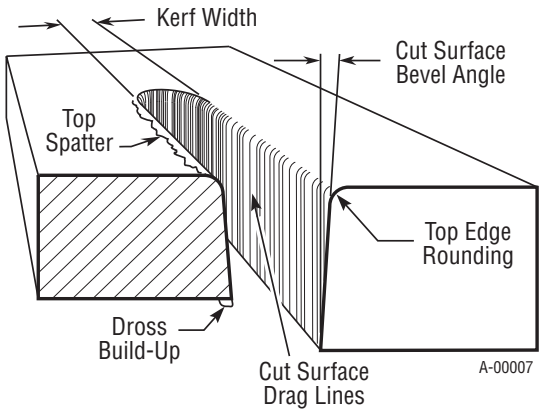


Figure 4-12 - Cut Quality Characteristics

Cut Surface

The desired or specified condition (smooth or rough) of the face of the cut.

Nitride Build-Up

Nitride deposits can be left on the surface of the cut when nitrogen is present in the plasma gas stream. These buildups may create difficulties if the material is to be welded after the cutting process.

Bevel Angle

The angle between the surface of the cut edge and a plane perpendicular to the surface of the plate. A perfectly perpendicular cut would result in a 0° bevel angle.

Top-Edge Rounding

Rounding on the top edge of a cut due to wearing from the initial contact of the plasma arc on the workpiece.

Bottom Dross Buildup

Molten material which is not blown out of the cut area and resolidifies on the plate. Excessive dross may require secondary cleanup operations after cutting.

Kerf Width

The width of the cut (or the width of material removed during the cut).

Top Spatter (Dross)

Top spatter or dross on the top of the cut caused by slow travel speed, excess cutting height, or cutting tip whose orifice has become elongated.

4.05 General Cutting Information

WARNING

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

Frequently review the Important Safety Precautions at the front of this manual. Be sure the operator is equipped with proper gloves, clothing, eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece while the torch is activated.

CAUTION

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

NOTE

Handle torch leads with care and protect them from damage.

Torch Standoff

Improper standoff (the distance between the torch tip and workpiece) can adversely affect tip life as well as shield cup life. Standoff may also significantly affect the bevel angle. Reducing standoff will generally result in a more square cut.

Edge Starting

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

Direction of Cut

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

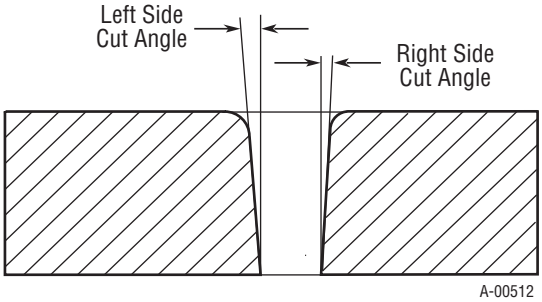


Figure 4-13 - Side Characteristics of Cut

To make a square-edged cut along an inside diameter of a circle, the torch should move counterclockwise around the circle. To keep the square edge along an outside diameter cut, the torch should travel in a clockwise direction.

Dross

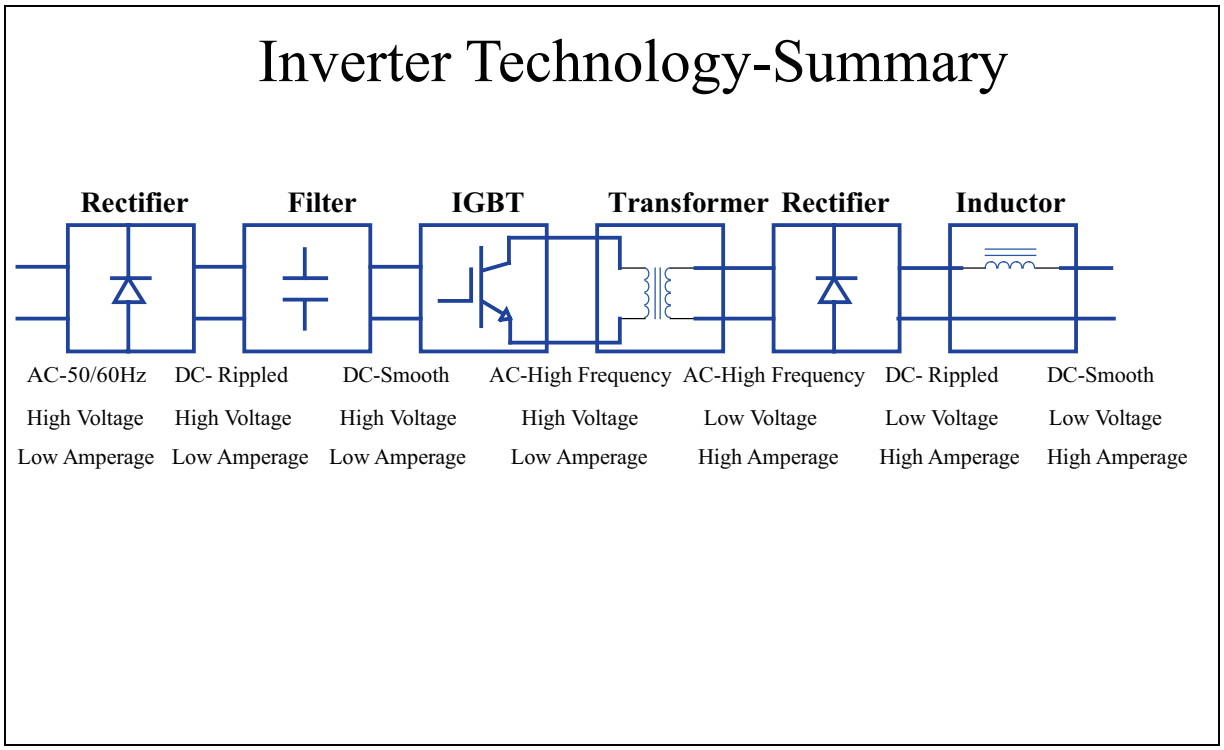
When dross is present on carbon steel, it is commonly referred to as either "high speed, slow speed, or top dross". Dross present on top of the plate is normally caused by too great a torch to plate distance. "Top dross" is normally very easy to remove and can often be wiped off with a welding glove. "Slow speed dross" is normally present on the bottom edge of the plate. It can vary from a light to heavy bead, but does not adhere tightly to the cut edge, and can be easily scraped off. "High speed dross" usually forms a narrow bead along the bottom of the cut edge and is very difficult to remove. When cutting a troublesome steel, it is sometimes useful to reduce the cutting speed to produce "slow speed dross". Any resultant cleanup can be accomplished by scraping, not grinding.

Notes

SECTION 5:
THEORY OF OPERATION

5.01 Inverter Design

What does the word inverter mean?
The term inverter refers to the ability to change DC power into AC. Inverter power supplies immediately rectify the incoming AC to DC, and then the transistors create a higher frequency AC. The higher frequency AC then goes on to a much smaller main transformer than in a conventional power supply. The AC is then rectified to extremely smooth DC. The diagram to the below shows the basic electrical wiring of a DC output inverter power supply.



Art # A-09846_AB

Figure 5-1- Inverter Technology

Notes

SECTION 6: TROUBLESHOOTING

6.01 Basic Troubleshooting-Power Source Faults

WARNING

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

Common Faults Symptom LED Indicators

A. AC indicator ~ OFF

1. Main input power cord does not connect to power distribution net.
   a. Connect the power cord.
2. Power ON/OFF switch in OFF (down) position.
   a. Turn switch to ON (up) position.
3. Actual input voltage does not correspond to voltage of unit.
   a. Verify that the input line voltage is correct.
4. Faulty components in unit
   a. Have an Accredited CIGWELD service provider repair or replace as required.

B. AC indicator ~ blinking

1. Indicator blinking (1 sec ON/1 Sec OFF, Gas may also pulse 3 times).
   a. Check for missing torch parts or not properly installed. Turn ON/OFF switch to OFF position and restart the machine by turning the power switch to ON.
2. Indicator blinking (1 sec ON/3 Sec OFF).
   a. Check for worn or sticking torch parts. Replace if necessary.
3. Indicator blinking (3 sec ON/3 Sec OFF).
   a. Torch switch was depressed before machine was completely powered up. Turn ON/OFF switch to OFF position and restart the machine by turning the power switch to ON.

C. Air indicator OFF

1. Gas pressure too low. Check supply pressure.
   a. Check and adjust to proper setting.

D. TEMP indicator ON, (AC indicator ~ ON)

1. Unit air flow obstructed.
   a. Check for blocked air flow around the unit and correct condition.
2. Fan blocked.
   a. Check for blocked status and correct condition.
3. Unit is overheated.
   a. Keep the machine plugged in and turned on for five minutes. This will allow the fan to run and cool the machine.
4. Faulty components in unit
   a. Have an Accredited CIGWELD service provider repair or replace as required.

E. Torch will not pilot, when torch trigger is activated.

1. Faulty parts in torch
   a. Check torch parts per section 4.02; replace as needed.
2. Gas pressure too low
   a. Adjust supply pressure to proper setting value.
3. Faulty components in unit
   a. Have an Accredited CIGWELD service provider repair or replace as required.

F. No cutting output when torch is activated; AC indicator ~ ON, gas flows, fan turns.

1. Torch is not connected properly to power supply.
   a. Check torch connection to power supply.
2. Working cable not connected to work piece, or connection is poor.
   a. Make sure that work cable has a proper connection to a clean, dry area of the work piece.
3. Faulty components in unit
   a. Have an Accredited CIGWELD service provider repair or replace as required.
4. Faulty torch
   a. Return for repair or have qualified technician repair.

G. Torch cuts but not adequately

1. Incorrect setting of output current control
   a. Check and adjust to proper setting.
2. Working cable connection to work piece is poor.
   a. Make sure that work cable has a proper connection to a clean, dry area of the work piece.
3. Faulty components in unit
   a. Return for repair or have qualified technician repair.

H. Output is restricted, and can not be controlled.

1. Input or output connection is poor.
   a. Check all input and output connection leads.
2. Working cable connection to work piece is poor.
   a. Make sure that work cable has a proper connection to a clean, dry area of the work piece.
3. Faulty components in unit

a. Have an Accredited CIGWELD service provider repair or replace as required.

I. Cutting output is unstable or inadequate.

1. Input or output connection is poor
   a. Check all input and output connection leads.
2. Working cable connection is poor.
   a. Make sure that work cable has a proper connection to a clean, dry area of the work piece.
3. Low or fluctuating input voltage
   a. Have electrician check input line voltage under load.

J. Hard to startup

1. Torch parts worn (consumables)
   a. Turn off input power, remove shield cup, tip, start cartridge, and electrode and check them all. If the electrode or cutting tip is worn out, replace them. If the start cartridge does not move freely, replace it. If there is too much spatter on shield cup, replace it.

K. Arc goes out while operating. Arc can't be restarted when torch trigger is activated.

1. Power Supply is overheated (TEMP indicator ON).
   a. Let unit cool down for at least 5 minutes. Make sure the unit has not been operated beyond duty cycle limit.
2. Fan blades blocked (TEMP indicator ON).
   a. Check and clear blades.
3. Air flow blocked
   a. Check for blocked air flow around the unit and correct condition.
4. Gas pressure is too low. (Air indicator ON when torch trigger is activated.)
   a. Check gas source. Adjust to proper setting value.
5. Torch parts worn
   a. Check torch shield cup, cutting tip, start cartridge and electrode. Replace as needed.
6. Faulty component in unit
   a. Have an Accredited CIGWELD service provider repair or replace as required.

L. Torch cuts but not well.

1. Current control is set too low.
   a. Increase the current setting.

2. Torch is being moved too fast across work piece

    a. Reduce cutting speed.

3. Excessive oil or moisture in torch

    a. Hold torch 1/8 inch (3 mm) from clean surface while purging and observe oil or moisture buildup (do not activate torch). If there are contaminants in the gas, additional filtering may be needed.

4. Torch parts worn

    a. Check torch shield cup, cutting tip, start cartridge and electrode. Replace as needed.

M. When torch trigger is activated gas in torch flows and then stops, but will not pilot. AC indicator light blinking.

1. Torch parts not properly installed in torch. There may have been an attempt to remove torch parts without turning off ON/OFF power switch to OFF on unit.

    a. Turn ON/OFF switch to OFF position and then check to make sure torch parts are properly installed.

    b. Turn ON/OFF switch to OFF and then back to ON.

6.02 Checking Unit Before Applying Power

The following safety information shall be read before starting troubleshooting and servicing.

1. Turn SW1 to OFF position, and disconnect unit from primary line voltage before working on unit.
2. Significant DC voltage can remain on capacitors after unit is OFF. Wait until all front panel LED's are OFF before removing case.
3. Check DC bus voltage according to Section 6.06 after removing case and make sure the DC bus voltage is closed 0V.
4. Before troubleshooting or applying power to unit, complete the checks through 6.05 and 6.14, to avoid causing further damage.

6.03 Tools Needed for Troubleshooting and Servicing

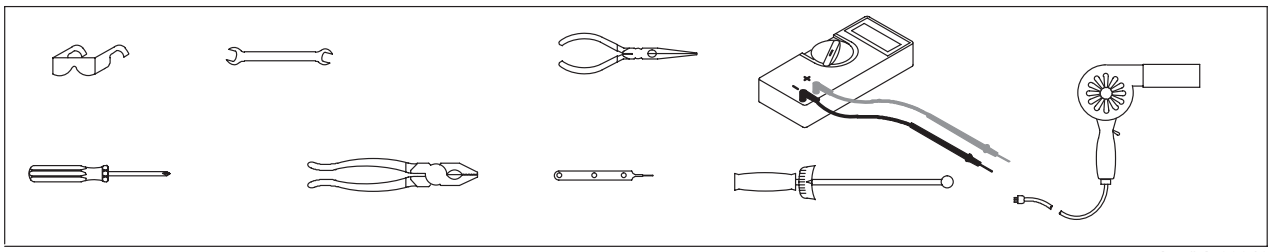


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Figure 6-1 Tools Needed for Troubleshooting and Servicing

- Digital Multimeter
- DC Clip-on ammeter
- Screwdriver and spanner
- CRO (20 Mhz bandwidth) & isolating transformer

6.04 Case Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding.

Remove the ten screws from the case and remove the case panel.

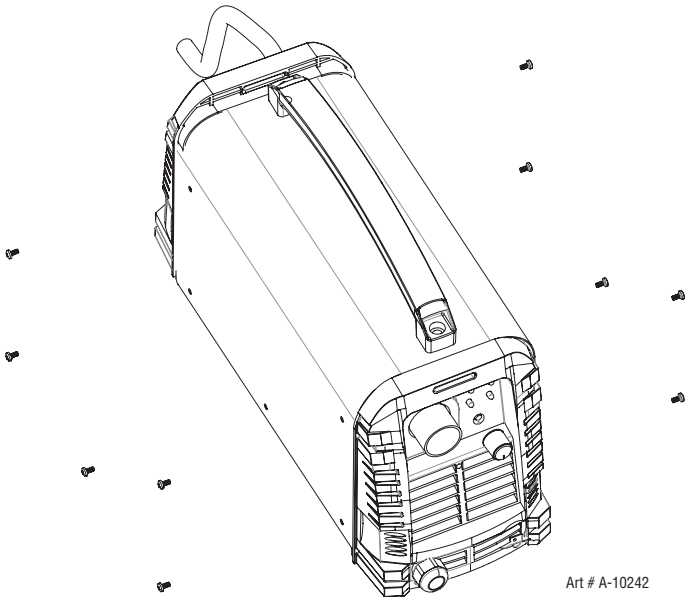

Figure 6-2 Case Removal View

6.05 Visually Inspect

WARNING

Read and follow safety information in Section 6.02 before proceeding.

1. Take out clear protective sheet over main inverter board.

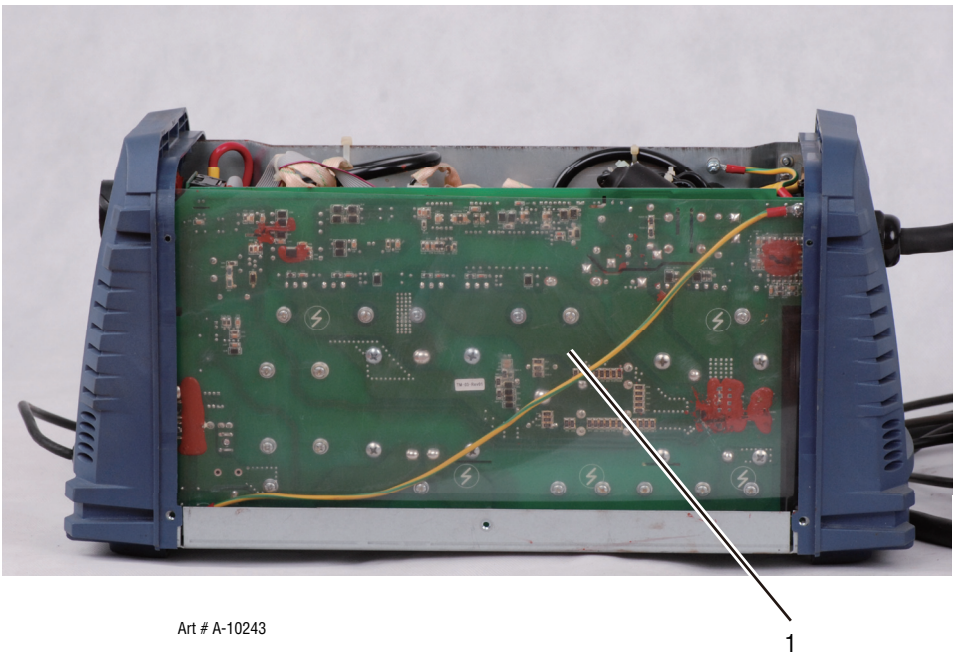

Figure 6-3 Clear Protective Sheet Removal View

2. Visually inspect the inside of the Power Source. The levels of current present in these units can cause burning or arcing of PCB, transformers, switches, or rectifier when a failure occurs. Carefully inspect all components within these units. Look in particular for the following:

   a) Loose or broken wires or connectors.

   b) Burned or scorched parts or wires or evidence of arcing.

   c) Any accumulation of metal dust or filings that may have caused shorting or arcing.

If any parts are damaged, they must be replaced. Refer to the Spare Parts section for a complete list of components used in the Power Source, as well as how to access and remove the failed parts.

Locate the faulty component(s) then repair or replace where necessary.

6.06 Preliminary Check of the Main Inverter Board

WARNING

Read and follow safety information in Section 6.02 before proceeding.

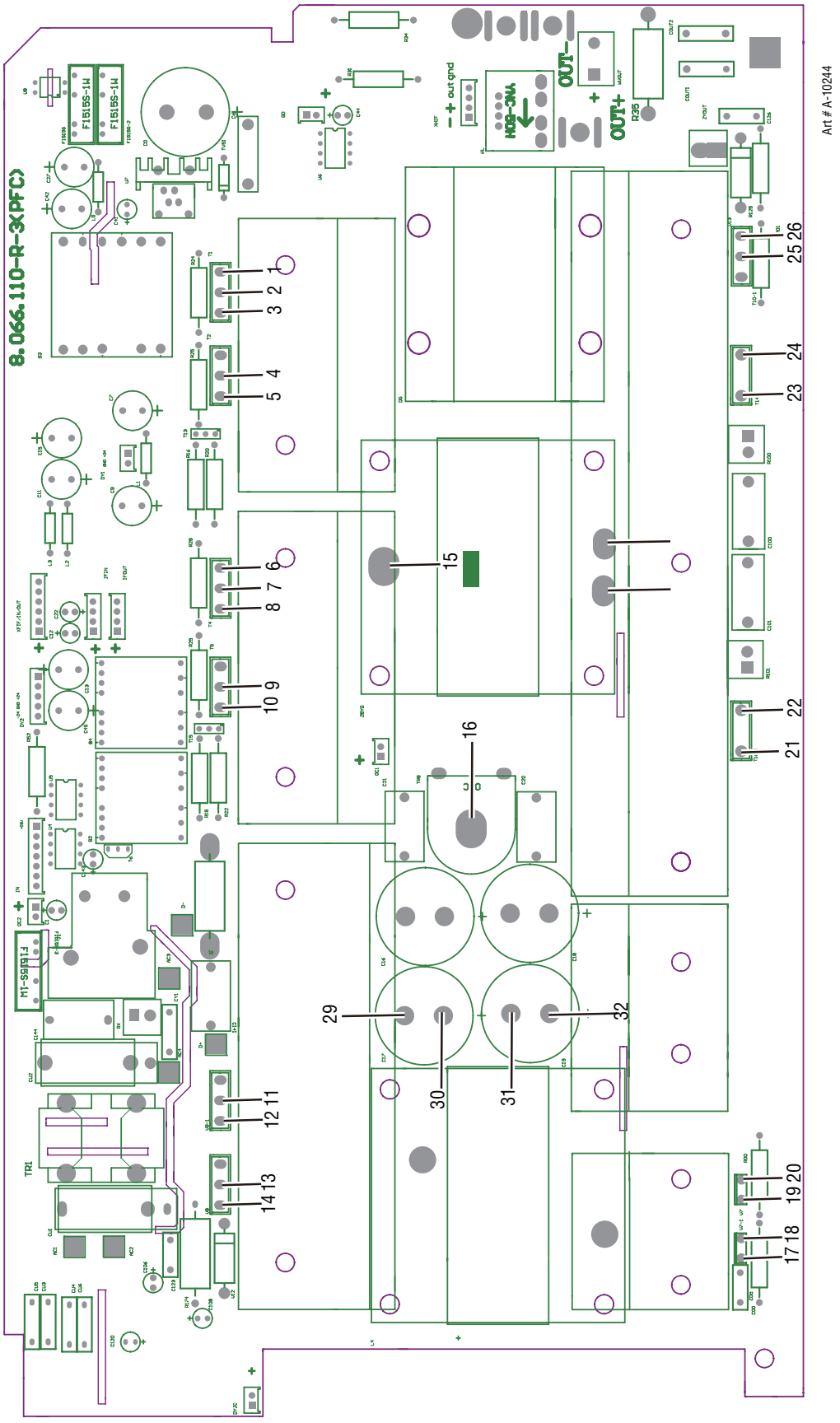

Figure 6-4 Main Inverter Board

DC Bus Testing	Multimeter Lead Placement	Voltage with Supply voltage OFF
Upper capacitor bank	Positive meter lead to TP 30 Negative meter lead to TP 29	0 VDC
Lower capacitor bank	Positive meter lead to TP 32 Negative meter lead to TP 31	0 VDC

Table 6-1 DC BUS, Multimeter Set to Measure DC volts

IGBT Testing	Multimeter Lead Placement	Diode Voltage
IGBT 1	Positive meter lead to TP 3	0.2000 to 0.8000 VDC
	Negative meter lead to TP 2	
IGBT 2	Positive meter lead to TP 5	0.2000 to 0.8000 VDC
	Negative meter lead to TP 4	
IGBT 3	Positive meter lead to TP 8	0.2000 to 0.8000 VDC
	Negative meter lead to TP 7	
VIGBT 4	Positive meter lead to TP 10	0.2000 to 0.8000 VDC
	Negative meter lead to TP 9	
PFC IGBT 1	Positive meter lead to TP 14	0.2000 to 0.8000 VDC
	Negative meter lead to TP 13	
PFC IGBT2	Positive meter lead to TP 12	0.2000 to 0.8000 VDC
	Negative meter lead to TP 11	
PILOT IGBT1	Positive meter lead to TP 26	0.2000 to 0.8000 VDC
	Negative meter lead to TP 25	

Table 6-2 IGBT's, Multimeter Set to Measure Diode Voltage

6.07 Check Main ON/ OFF Switch

WARNING

Read and follow safety information in Section 6.02 before proceeding.

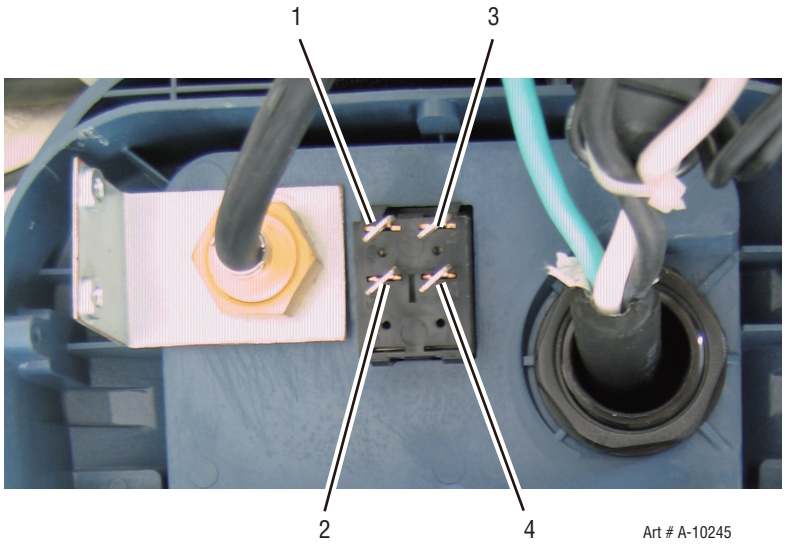

Figure 6-5 Main ON/ OFF Switch View

Power Switch Testing	Multimeter Lead Placement	Impedance
Switch ON	Positive meter lead to TP 1 Negative meter lead to TP 2	0 to 1 Ω
Switch ON	Positive meter lead to TP 3 Negative meter lead to TP 4	0 to 1 Ω
Switch OFF	Positive meter lead to TP 1 Negative meter lead to TP 2	> 1k Ω
Switch OFF	Positive meter lead to TP 3 Negative meter lead to TP 4	> 1k Ω

Table 6-3 Power Switch, Multimeter set to measure ohms (Ω)

6.08 Check Pressure Switch

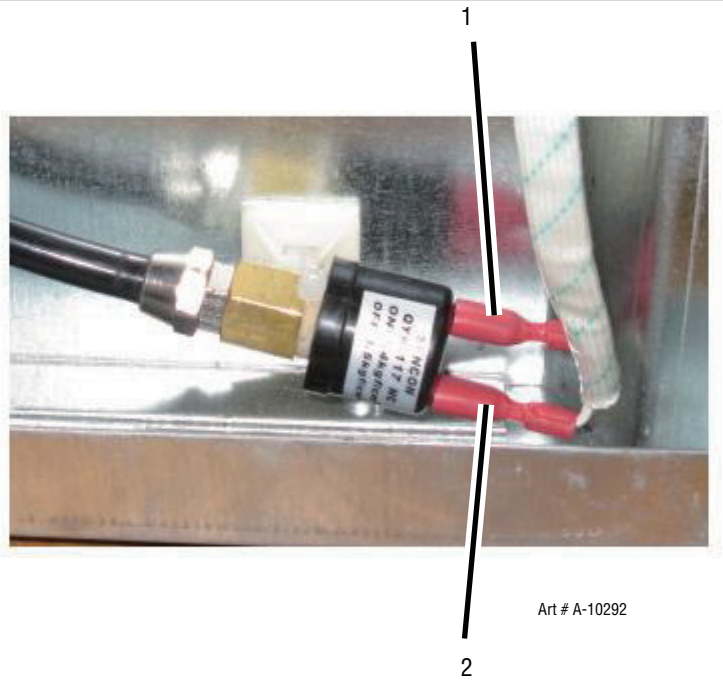

Figure 6-6 Pressure Switch View

Turn ON the power switch, disconnect the contact of the pressure switch and start the test as below:

1. Pressure switch open

When the pressure is up to 3.5kgf/cm^2 (49.78 PSI), the pressure switch turns OFF.

2. Pressure switch closed

When the pressure is less than 2.4kgf/cm^2 (34.13 PSI), the pressure switch turns ON and the resistance between 1 and 2 is about 0.1Ω.

6.09 Check Regulator

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Figure 6-7- Regulator View

Turn ON the power switch and start the test as below:

When solenoid valve is ON,adjust the knob 1. If the pressure is continuously adjustable, the regulator is OK.

6.10 Check Main Input Rectifier

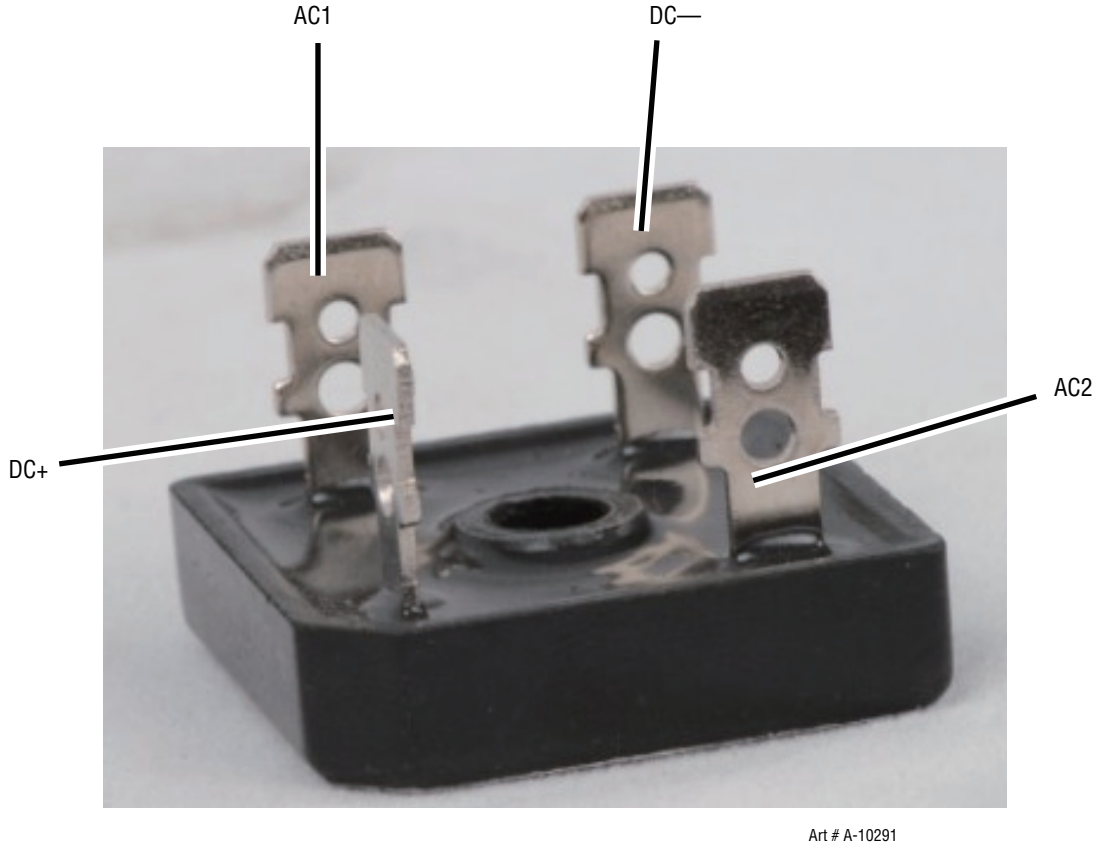


Figure 6-8 Main Input Rectifier

Remove the main input rectifier from the heatsink and start the testing.

Input Rectifier Testing	Multimeter Lead Placement	Diode Voltage
AC1 to DC+	Positive meter lead to AC1 Negative meter lead to TP DC+	0.2 – 0.8 VDC
AC2 to DC+	Positive meter lead to AC2 Negative meter lead to TP DC+	0.2 – 0.8 VDC
AC1 to DC-	Positive meter lead to TP DC- Negative meter lead to TP AC1	0.2 – 0.8 VDC
AC2 to DC-	Positive meter lead to TP DC- Negative meter lead to TP AC2	0.2 – 0.8 VDC

Table 6-4 Input Rectifier, Multimeter Set to Measure Diode Voltage

Measurements may be made directly onto the main input rectifier. AC1 and AC2 may be measured from the pins on the mains supply plug with the main power switch set to the ON position.

6.11 DC Bus Voltage Measurement

Apply voltage to the Power Source.

Warning

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

Once power is applied to the Power Source, there are extremely hazardous voltage and power levels present.

Do not touch any live parts.

Refer to Figure 6-4 in Section 6.06 for Main Inverter Board.

DC Bus Testing	Multimeter Lead Placement	Voltage with Supply voltage ON
Upper capacitor bank	Positive meter lead to TP 30 Negative meter lead to TP 29	192 VDC +/-10%
Lower capacitor bank	Positive meter lead to TP 31 Negative meter lead to TP 32	192 VDC +/-10%
Overall capacitor bank	Positive meter lead to TP 29 Negative meter lead to TP 32	384 VDC +/-10%

Table 6-5 DC BUS, Multimeter Set to Measure DC volts

NOTE

These DC voltages are at nominal mains supply voltage of 240VAC.

6.12 Check of Control PCB

WARNING

Read and follow safety information in Section 6.02 before proceeding.

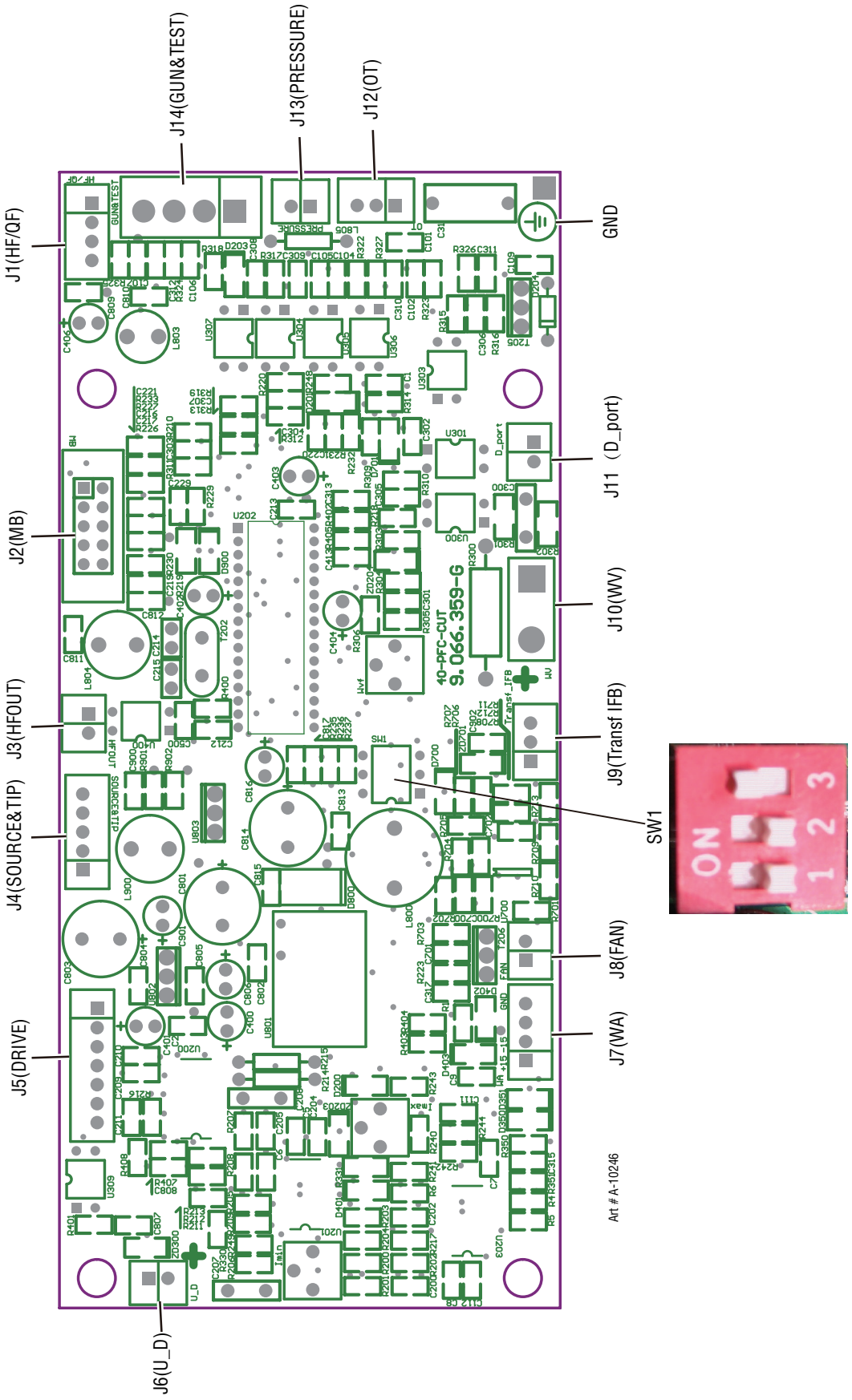


Figure 6-9 Control PCB

HF/QF Header Pin	Pin function	Signal
1	GND	0VDC
2	Control circuit power source	27VDC
3	Negative of solenoid control signal	0VDC (when soleniod is on)
4	Positive of solenoid control signal	27VDC

Table 6-6 HF/QF Header Pin Function

MB Header Pin	Pin function	Signal
1	Current control potentiometer	0 — 4VDC
2	N/A	N/A
3	Fault indicator signal	2VDC (when indication lights up)
4	N/A	N/A
5	Control circuit power supply	5VDC
6	GND	0VDC
7	Power indication signal	2VDC
8	N/A	N/A
9	Work indication signal	2VDC
10	Power indication signal	2VDC

Table 6-7 MB Header Pin Function

HFOUT Header Pin	Pin function	Signal
J3	N/A	N/A

Table 6-8 HFOUT Header Pin Function

SOURCE & TIP Header Pin	Pin function	Signal
1	Positive of TIP test signal	5VDC
2	TIP test signal	5VDC (when machine dose no work) 0VDC the machine is woking
3	Control circuit power source	24VDC
4	GND	0VDC
5	Control circuit power source	-24VDC

Table 6-9 SOURCE & TIP Header Pin Function

DRIVE Header Pin	Pin function	Signal
1	Drive circuit power	+15VDC
2	IGBT 1 pwm drive signal	15V p-p square wave
3	IGBT 2 pwm drive signal	15V p-p square wave
4	IGBT 2 pwm drive signal	15V p-p square wave
5	IGBT 1 pwm drive signal	15V p-p square wave
6	Overcurrent signal	>7VDC when over primary current protection
7	GND	0VDC

Table 6-10 DRIVE Header Pin Function

U_D Header Pin	Pin function	Signal
1	Feedback of input voltage	41VDC(input 240vac)
2	GND	0VDC

Table 6-11 U_D Header Pin Function

WA Header Pin	Pin function	Signal
1	Power source of current sensor	15VDC
2	Power source of current sensor	-15VDC
3	Output current feedback	
4	GND	0VDC

Table 6-12 WA Header Pin Function

FAN Header Pin	Pin function	Signal
1	Power source of fan	24VDC
2	0VDC(fan negative)when fan is on	0VDC

Table 6-13 FAN Header Pin Function

Transf IFB Header Pin	Pin function	Signal
1	Pilot ARC current feedback signal	-0.8VDC +5VDC(A main cutting arc is established)
2	GND	0VDC
3	N/A	N/A

Table 6-14 Transf IFB Header Pin Function

WV Header Pin	Pin function	Signal
1	Positive of voltage feedback	Machine output +
2	Negative of voltage feedback	Machine output _

Table 6-15 WV Header Pin Function

D_port Header Pin	Pin function	Signal
1	+12VDC	+12VDC
2	Pilot ARC IGBT drive signal	

Table 6-16 D_port Header Pin Function

OT Header Pin	Pin function	Signal
1	N/A	N/A
2	Thermostat (0VDC when thermostat closed)	
3	GND	0VDC

Table 6-17 OT Header Pin Function

PRESSURE Header Pin	Pin function	Signal
1	Pressure switch signal	Pressure switch(0dc when switch closed otherwise 4VDC)
2	GND	0VDC

Table 6-18 PRESSURE Header Pin Function

GUN& TEST Header Pin	Pin function	Signal
1	GND	0VDC
2	Gun switch signal	0VDC when switch ON otherwise 27VDC
3	Cup test signal	0VDC
4	Cup test signal	0VDC when the cup is fixed otherwise 27VDC

Table 6-19 GUN& TEST Header Pin Function

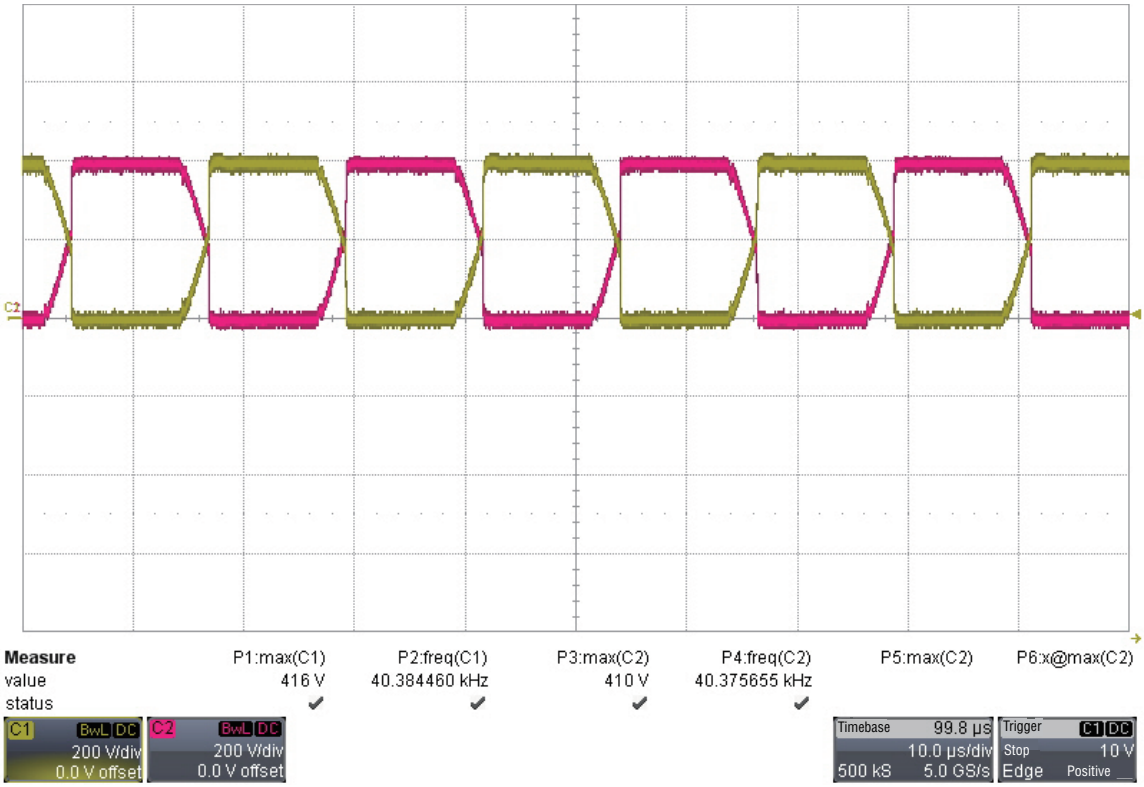
6.13 Waveforms

NOTE

All waveforms below are taken with ISOLATED oscilloscope probes. These parts being measured are MAINS potential. An isolating transformer should be used for the oscilloscope, or isolated probes should be used. If an isolating transformer is used, the frame of the oscilloscope may be live, and suitable care should be taken to avoid electric shock.

1. Vds of inverter IGBT at no load

   TP C1: 4 and 5 C2: 9 and 10 (Testpoints refer to main inverter board in Sec. 6.06).



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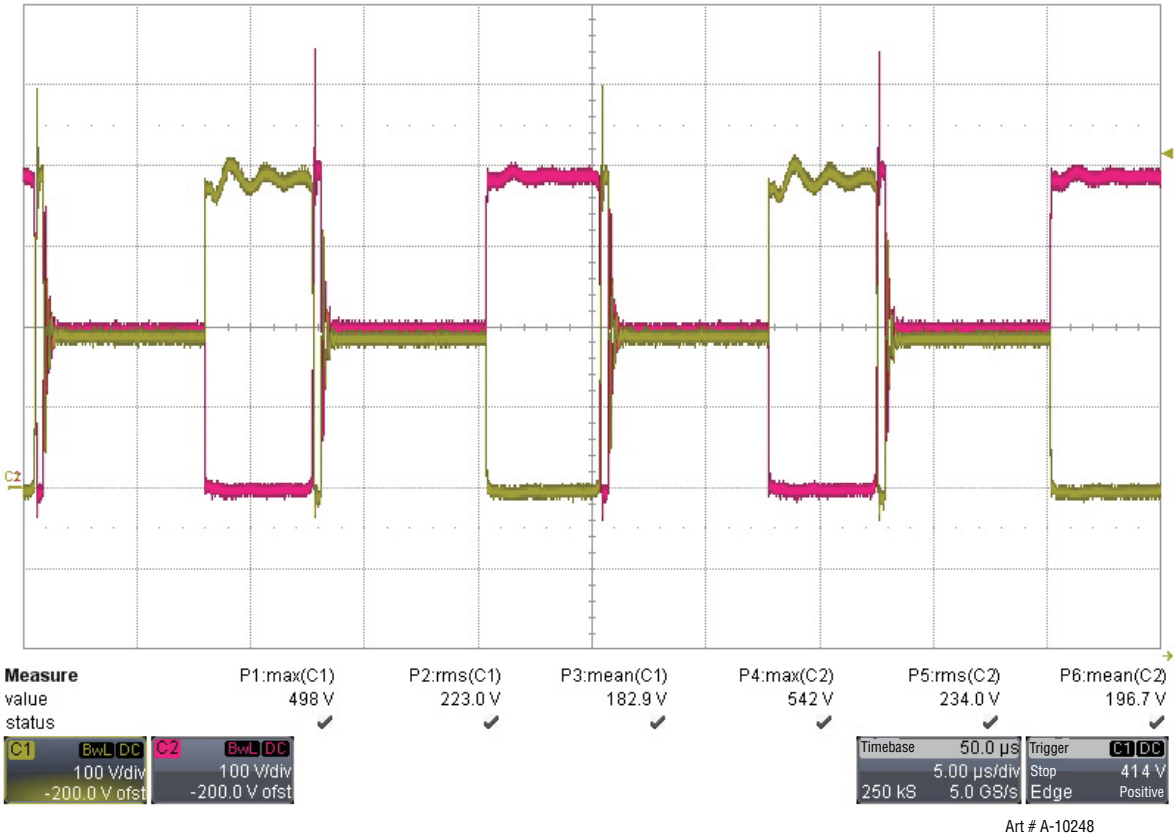
2. Vds of inverter IGBT at full load

TP C1: 4 and 5 C2: 9 and 10 (Testpoints refer to main inverter board in Sec. 6.06).



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6.14 Main Circuit Description

WARNING

Turn off power and disconnect mains supply plug from receptacle before working on the unit. Allow two minutes for capacitors to discharge after disconnection from mains supply voltage.

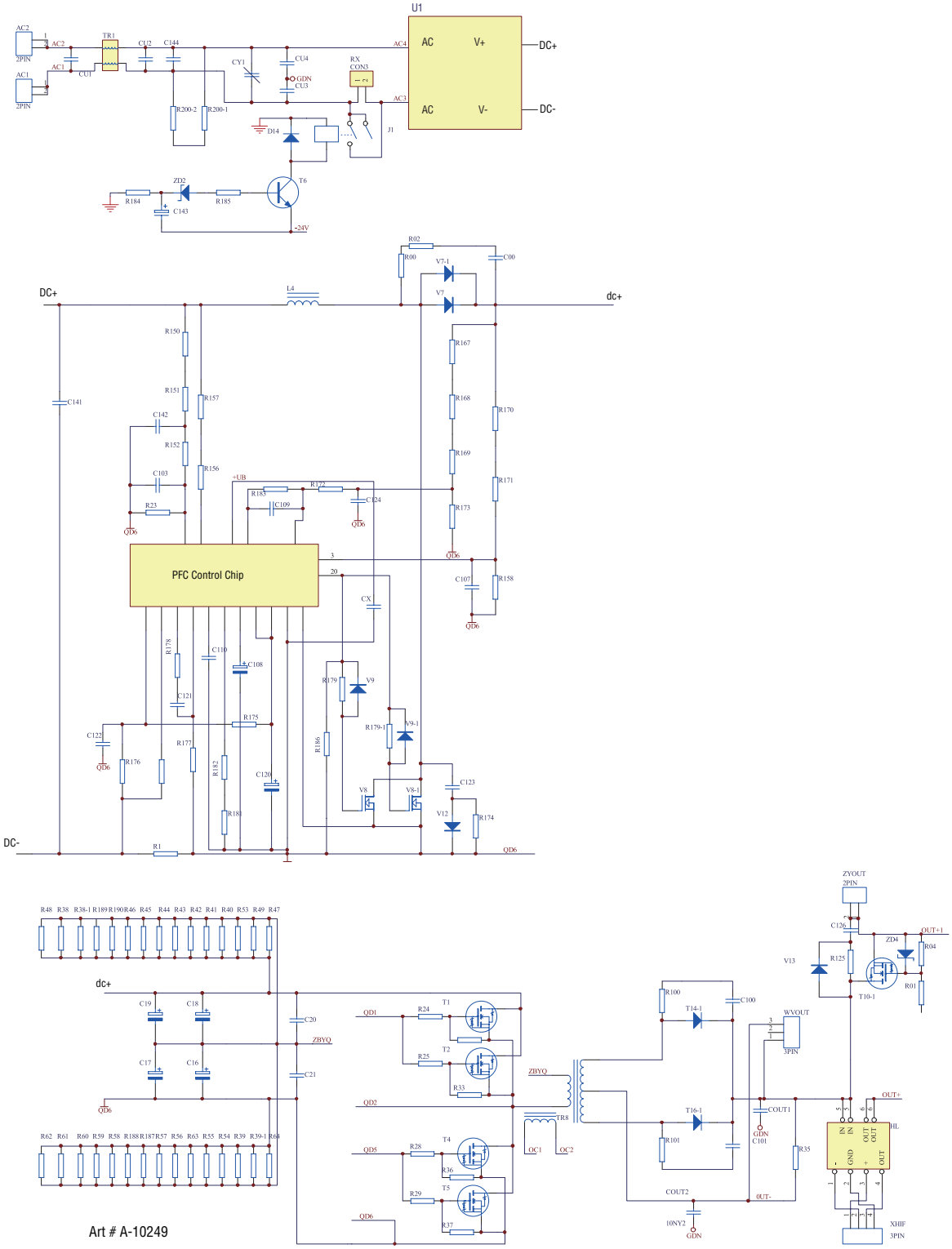

Figure 6-10 Main Circuit Description

The mains supply voltage is connected via a double pole switch to the input rectifier U1 through an EMC filter. Overvoltage protection is provided by varistor CY1.

The rectifier circuit converts the inputted AC voltage to DC voltage. The input current is controlled through being compared with reference wave. The reference point is a pure sine wave which derives from the source voltage. The PFC control chip will be used to generate suitable gate signal to drive V8 and V8-1, ensuring the current is sinusoidal.

The boost diode output charges the main capacitor bank (C16, C17, C18, C19, C20 and C21) to high voltage. In-rush current limiting is provided by a high power resistor which is then bypassed by relay J1 after a few seconds.

The primary igbt transistors (T1, T2, T4, and T5) switch the transformer primary at high frequency and varying duty cycle. The transformer return wire is taken from the junction of the capacitors C20 and C21 (the voltage at this point is approximately half the DC bus voltage).

Secondary output voltage from the transformer is rectified by the output diodes (T14-1 and T16-1) to DC. This DC is controlled by the PWM of the primary side igbt transistors, and is filtered by an inductor before connecting to the output terminals.

A thermal overload device (thermistor) is fixed to the rectifier heatsink. When an over temperature occurs, the control circuit inhibits the trigger and the output. The thermal overload indicator LED on the front panel is illuminated.

The current transformer TR8 provides a signal to the control circuit to indicate both transformer primary current, and also detect transformer saturation. The Hall effect current sensor is powered from regulated + & - 15VDC supplies and provides a voltage signal proportional to the output DC cutting current to allow the control circuit to regulate cutting current.

6.15 Circuit Diagram

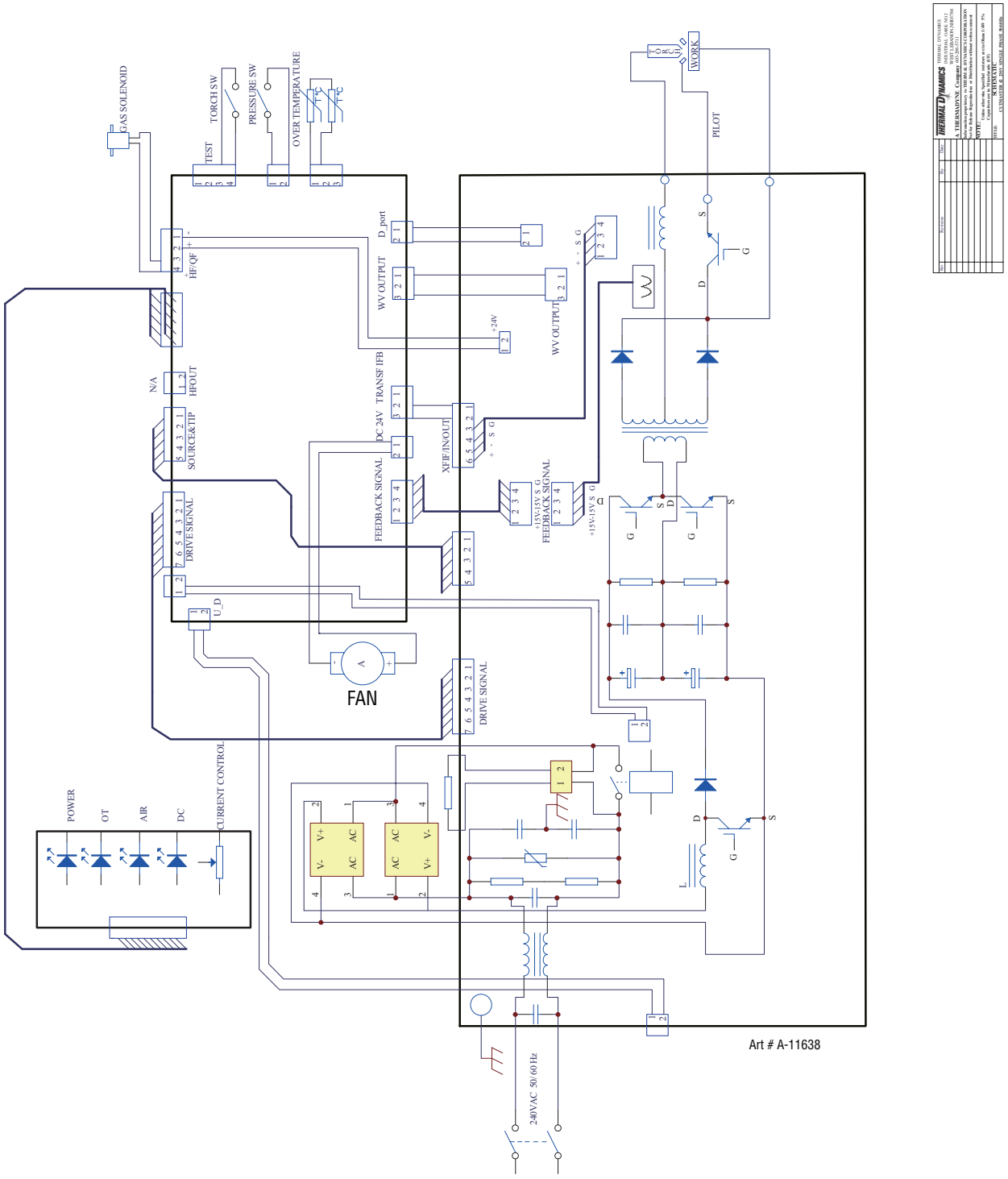

Figure 6-11 Circuit Diagram

SECTION 6 TORCH: SERVICE

6T.01 General Maintenance

Cleaning Torch

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

WARNING

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

DO NOT touch any internal torch parts while the AC indicator light of the Power Source is ON.

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

CAUTION

Dry the torch thoroughly before reinstalling.

O-Ring Lubrication

An O-Ring on the Torch Head and ATC Male Connector requires lubrication on a scheduled basis. This will allow the o-rings to remain pliable and provide a proper seal. The o-rings will dry out, becoming hard and cracked if the lubricant is not used on a regular basis. This can lead to potential performance problems.

It is recommended to apply a very light film of o-ring lubricant (Catalog # 8-4025) to the o-rings on a weekly basis.

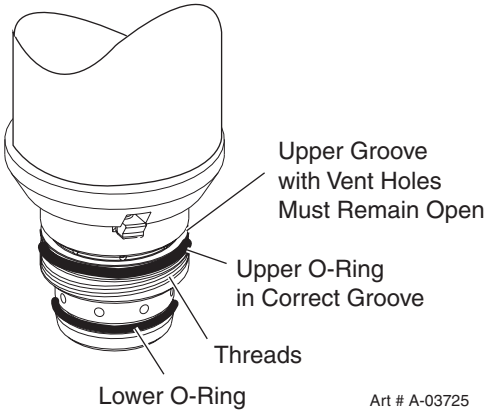

Figure 6T-1 - Torch Head O-Ring

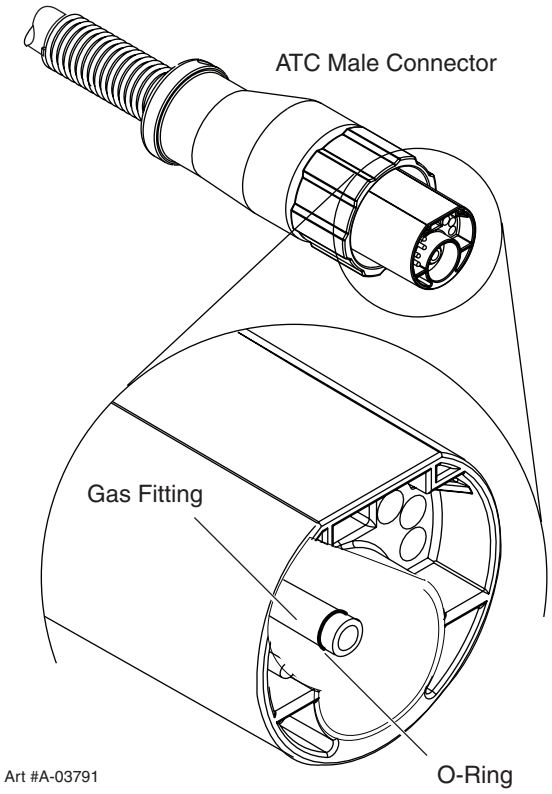

Figure 6T-2 - ATC O-Ring

CAUTION

DO NOT use other lubricants or grease, they may not be designed to operate within high temperatures or may contain "unknown elements" that may react with the atmosphere. This reaction can leave contaminants inside the torch. Either of these conditions can lead to inconsistent performance or poor parts life.

6T.02 Inspection and Replacement of Consumable Torch Parts

WARNING

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

DO NOT touch any internal torch parts while the AC indicator light of the Power Source is ON.

Remove the consumable torch parts as follows:

NOTE

The shield cup holds the tip and starter cartridge shield cup in place. Position the torch with the shield cup facing upward to prevent these parts from falling out when the cup is removed.

1. Unscrew and remove the shield cup from the torch.

NOTE

Slag built up on the shield cup that cannot be removed may effect the performance of the system.

2. Inspect the cup for damage. Wipe it clean or replace if damaged.

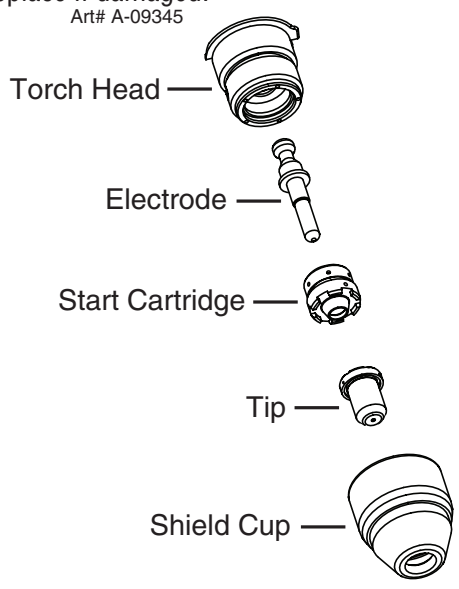

Figure 6T-3 - Consumable Parts

3. Remove the tip. Check for excessive wear (indicated by an elongated or oversized orifice). Clean or replace the tip if necessary.

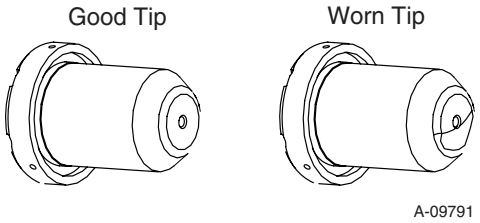

Figure 6T-4 - Tip Wear

4. Remove the starter cartridge. Check for excessive wear, plugged gas holes, or discoloration. Check the lower end fitting for free motion. Replace if necessary.

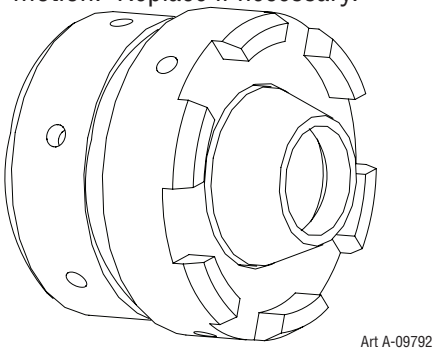

Figure 6T-5 - Start Cartridge

5. Pull the electrode straight out of the torch head. Check the face of the electrode for excessive wear. Refer to Figure 5-6.

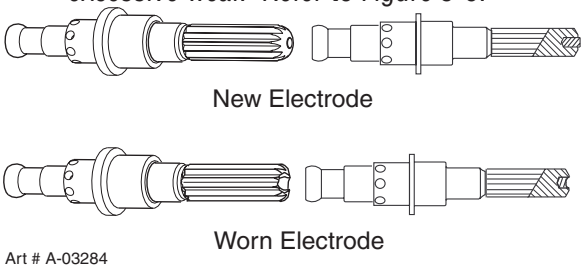

Figure 6T-6 - Electrode Wear

6. Reinstall the electrode by pushing it straight into the torch head until it clicks.
7. Reinstall the desired starter cartridge and tip into the torch head.
8. Hand tighten the shield cup until it is seated on the torch head. If resistance is felt when installing the cup, check the threads before proceeding.

SECTION 7:
DISASSEMBLY PROCEDURE

7.01 Safety Precautions for Disassembly

WARNING

Read and follow safety information in Section 6.02 before proceeding.

Unplug unit before beginning Disassembly procedure.

7.02 Control PCB Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding the disassembly.

Remove case (refer to 6.04) before removing control PCB.

Refer to graphics on page 7-3.

1. M4 Screw. Remove 4 screws from Control panel.
2. Disconnect HF/QF harness from HF/QF connector.
3. Disconnect MB harness from MB connector.
4. Disconnect SOURCE&TIP harness from SOURCE&TIP connector.
5. Disconnect DRIVE harness from DRIVE connector.
6. Disconnect U-D harness from U-D connector.
7. Disconnect WA harness from WA connector.
8. Disconnect FAN harness from FAN connector.
9. Disconnect TRANF-IFB harness from TRANF-IFB connector.
10. Disconnect WV harness from WV connector.
11. Disconnect D-PORT harness from D-PORT connector.
12. Disconnect OT harness from OT connector.
13. Disconnect PRESSURE harness from PRESSURE connector.
14. Disconnect GUN&TEST harness from GUN&TEST connector.

Refer to Figure 6-9 in Section 6.12 for control PCB.

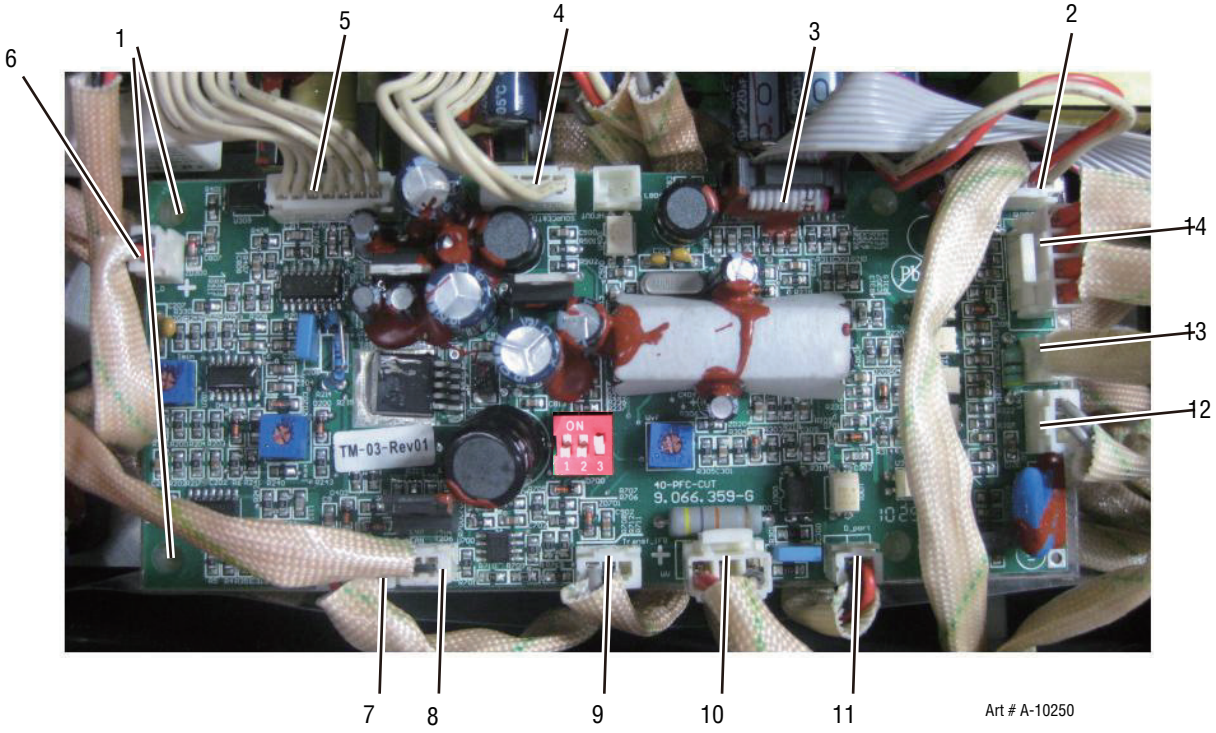

Figure 7-1 Removing Control PCB

7.03 Front Panel Assembly Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding the disassembly.

1. Unscrew the ten screws from the case panel and remove it.
2. Unscrew the two screws on front panel
3. Unplug the three harnesses from control PCB as shown in photo on following page.
4. Remove the two screws fixing the harnesses connecting front PCB with main power PCB.

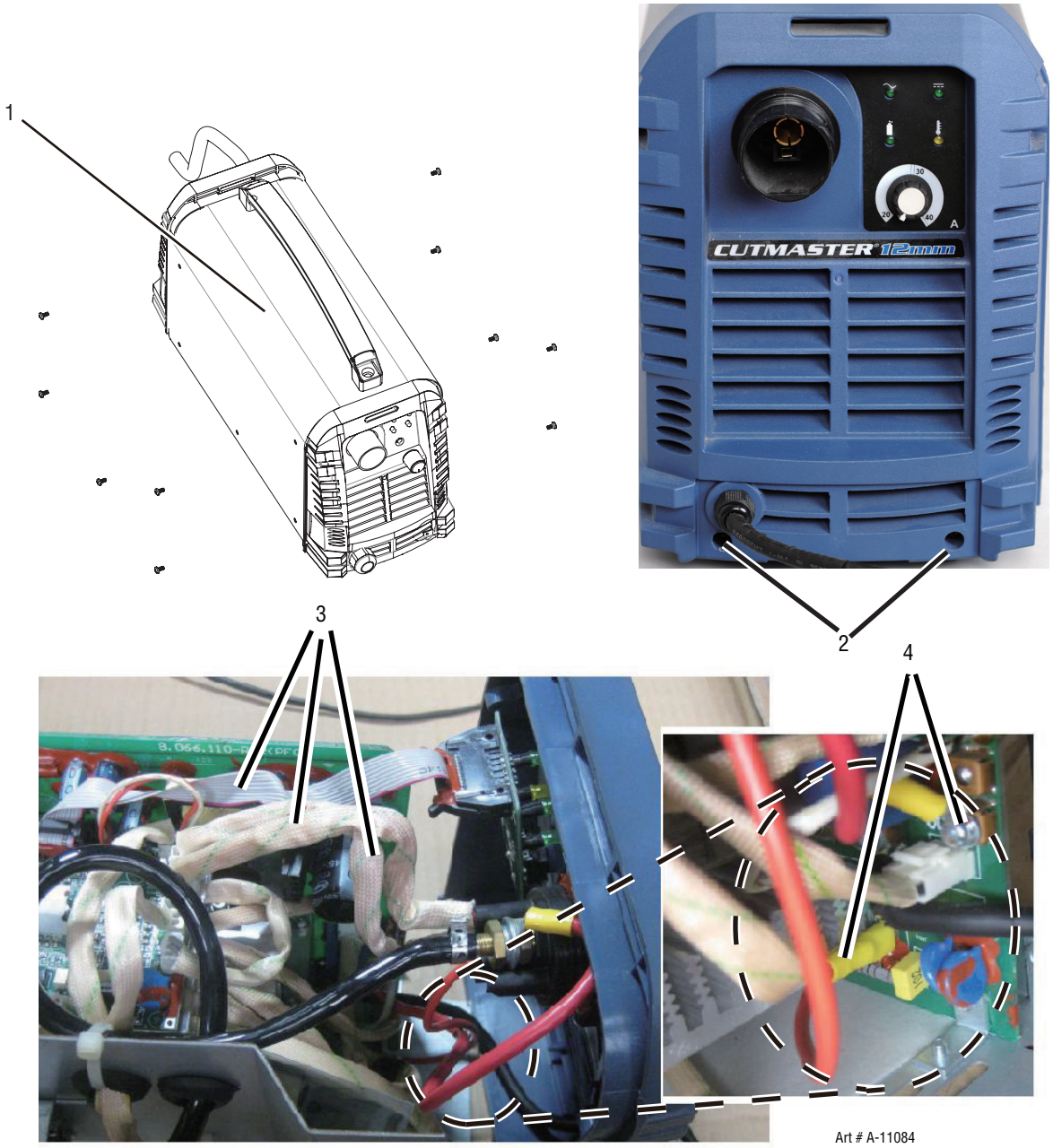

Figure 7-2 Removing Front Panel Assembly

7.04 Front Panel (Operator Interface) PCB Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding the disassembly.

1. Remove the screw on the potentiometer knob.
2. Remove the nut.
3. Remove the front PCB.

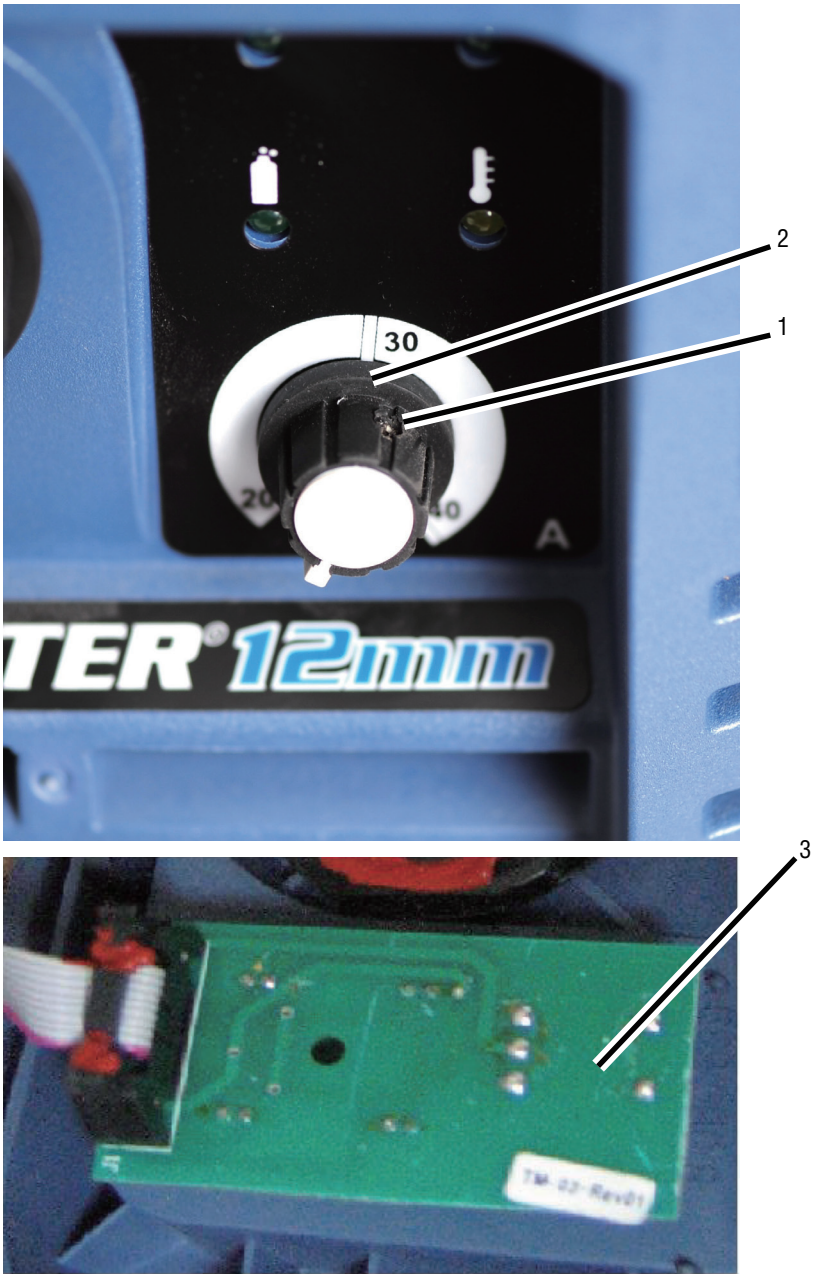

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Figure 7-3 Removing Front PCB

7.05 Rear Panel Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding the disassembly.

1. Remove screws on rear panel.
2. Remove the three screws.
3. Terminals from supply cable.

   Disconnect two terminals from switch.
4. Wires from main PCB1.

   Disconnect the two terminals from switch.
5. Goung wire terminal.

   Remove the nut.

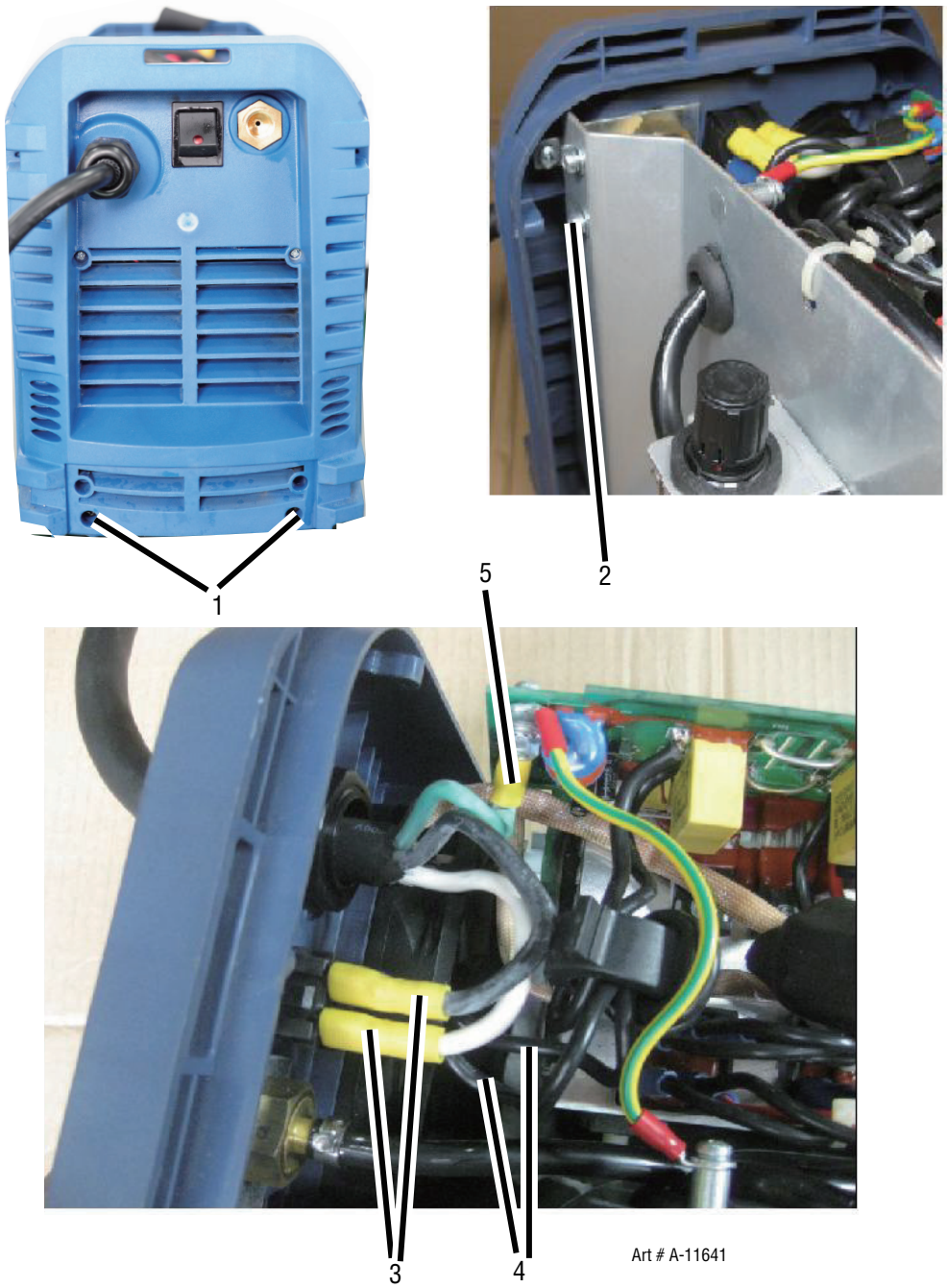


Figure 7-4 Removing Rear Panel

7.06 Power Switch S1 and Power Cord Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding the disassembly.

1. Gas inlet. Remove gas inlet from rear panel.
2. SW locking tabs

   Squeeze the locking tabs and push SW out from the rear panel.
3. Loosen the cable anchorage.
4. Remove fan.
5 Pull the Input Power Cord out.

Figure 7-5 Removing Power Switch and Power Cord

7.07 Base Panel Removal

WARNING

Read and follow safety information in Section 6.02 before proceeding the disassembly.

1. Remove central panel screws.
2. Remove main power PCB assembly screws.

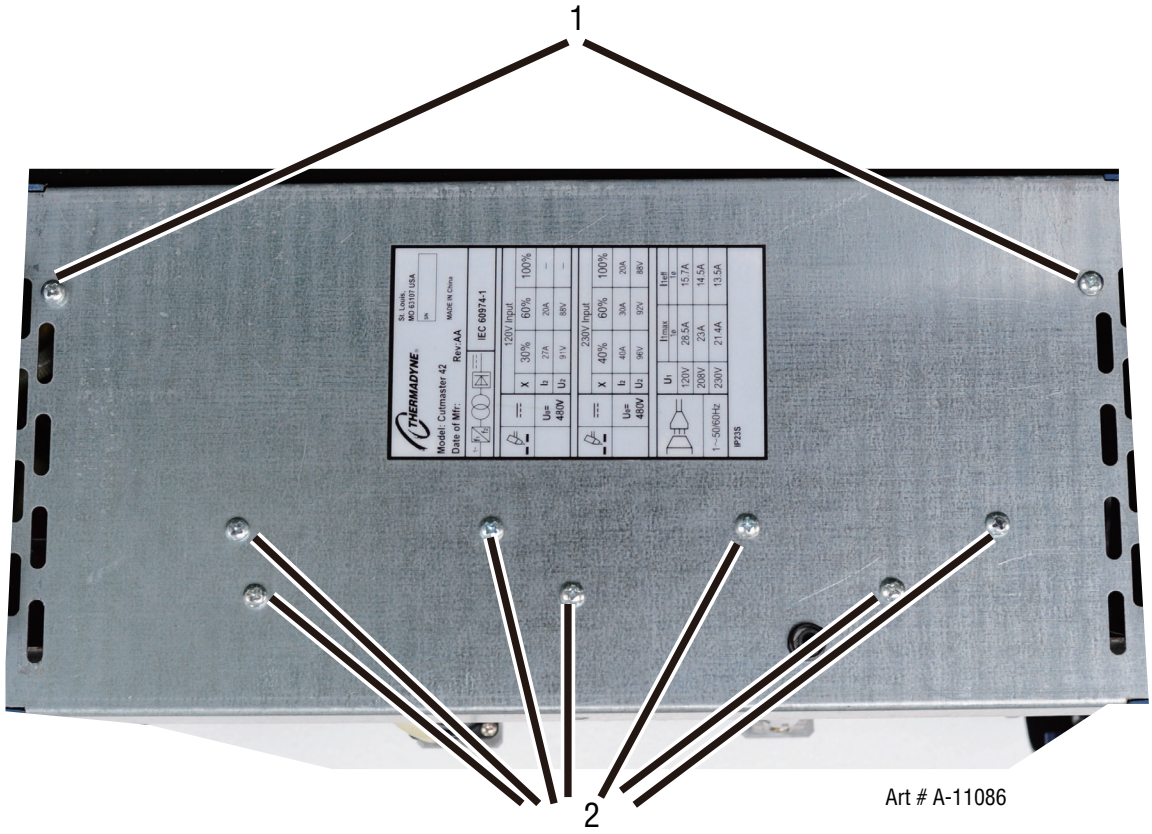


Figure 7-6 Removing Base Panel

Notes

SECTION 8:
ASSEMBLY PROCEDURES

8.01 Installing Base Board

1. Place main power PCB assembly
2. Install main power PCB assembly screws
3. Install central Panel Screws.

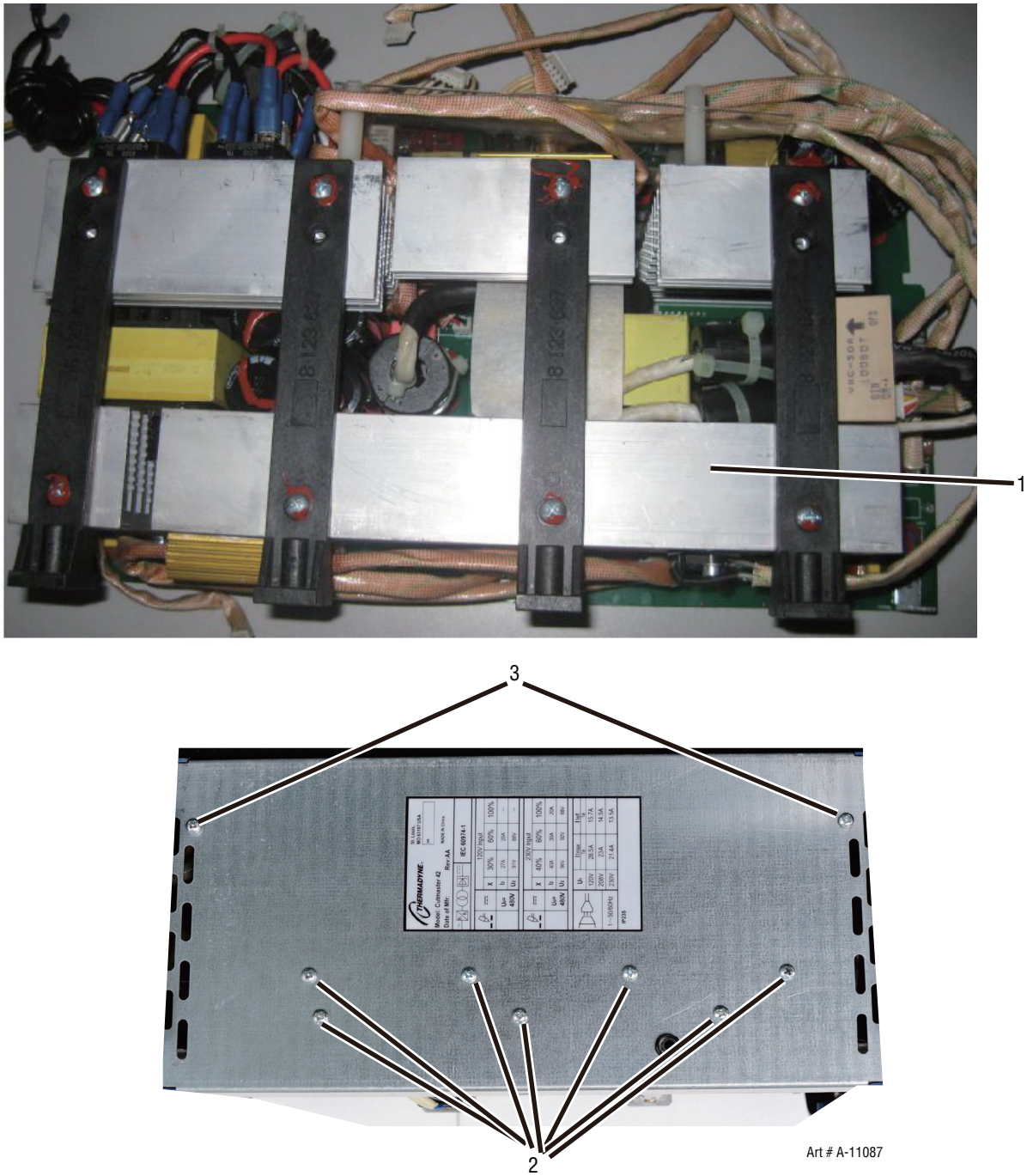
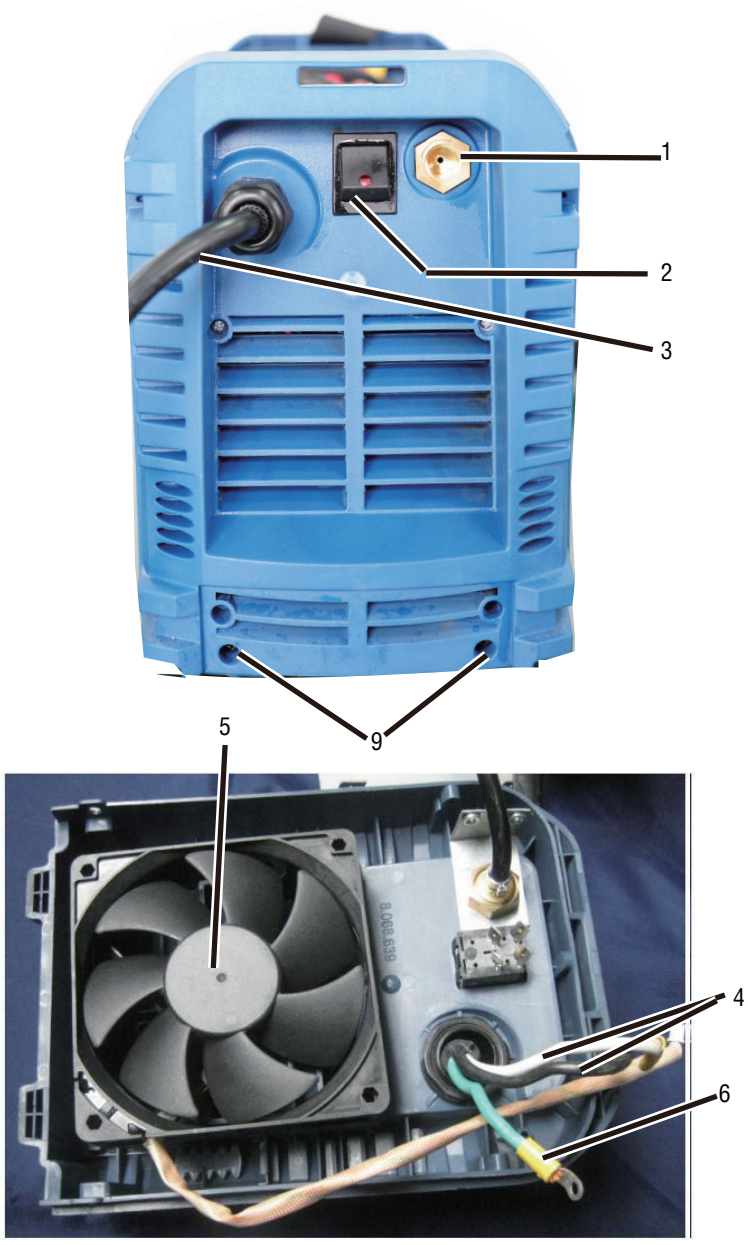


Figure 8-1 Installing Base Board

8.02 Installing Rear Panel

1. Install gas inlet.
2. Install ON/OFF switch
3. Install wire cord.
4. Reconnect Input Wire on the ON/OFF switch.
5. Install fan.
6. Install ground wire.
7. Reconnect AC Input wire on Main Power PCB to power ON/OFF switch.
8. Reconnect the three screws.
9. Reconnect Rear Panel screws.



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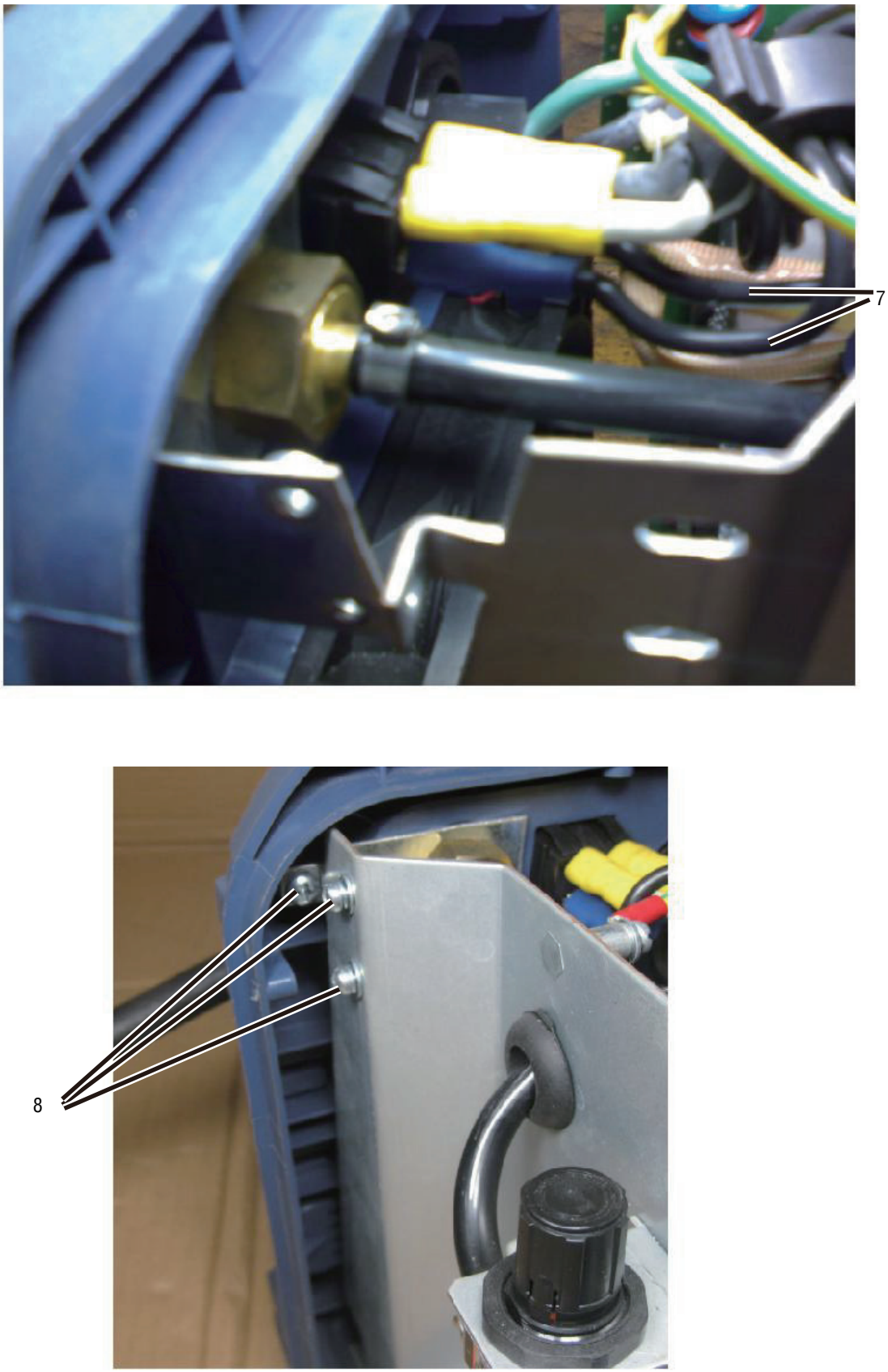


Art # A-10258

Figure 8-2 Installing Rear Panel

8.03 Installing Front Panel

1. Place front panel PCB assembly into front panel. Install the nut and screw.
2. Reconnect three harnesses to control PCB.
3. Reconnect two red wires and install the screws.
4. Install the front panel screws.

Figure 8-3 Installing Front Panel

8.04 Installing Main Control PCB and Clear Cover Sheet

1. Install 4 screws.
2. Plug harness into HF/QF connector
3. Plug harness into MB connector
4. Plug harness into SOURCE&TIP connector
5. Plug harness into DRIVE connector
6. Plug harness into U-D connector
7. Plug harness into WA connector
8. Plug harness into FAN connector
9. Plug harness into TRANF-IFB connector
10. Plug harness into WV connector
11. Plug harness into D-PORT connector
12. Plug harness into OT connector
13. Plug harness into PRESSURE connector
14. Plug harness into GUN&TEST connector
15. Install clear protective sheet.

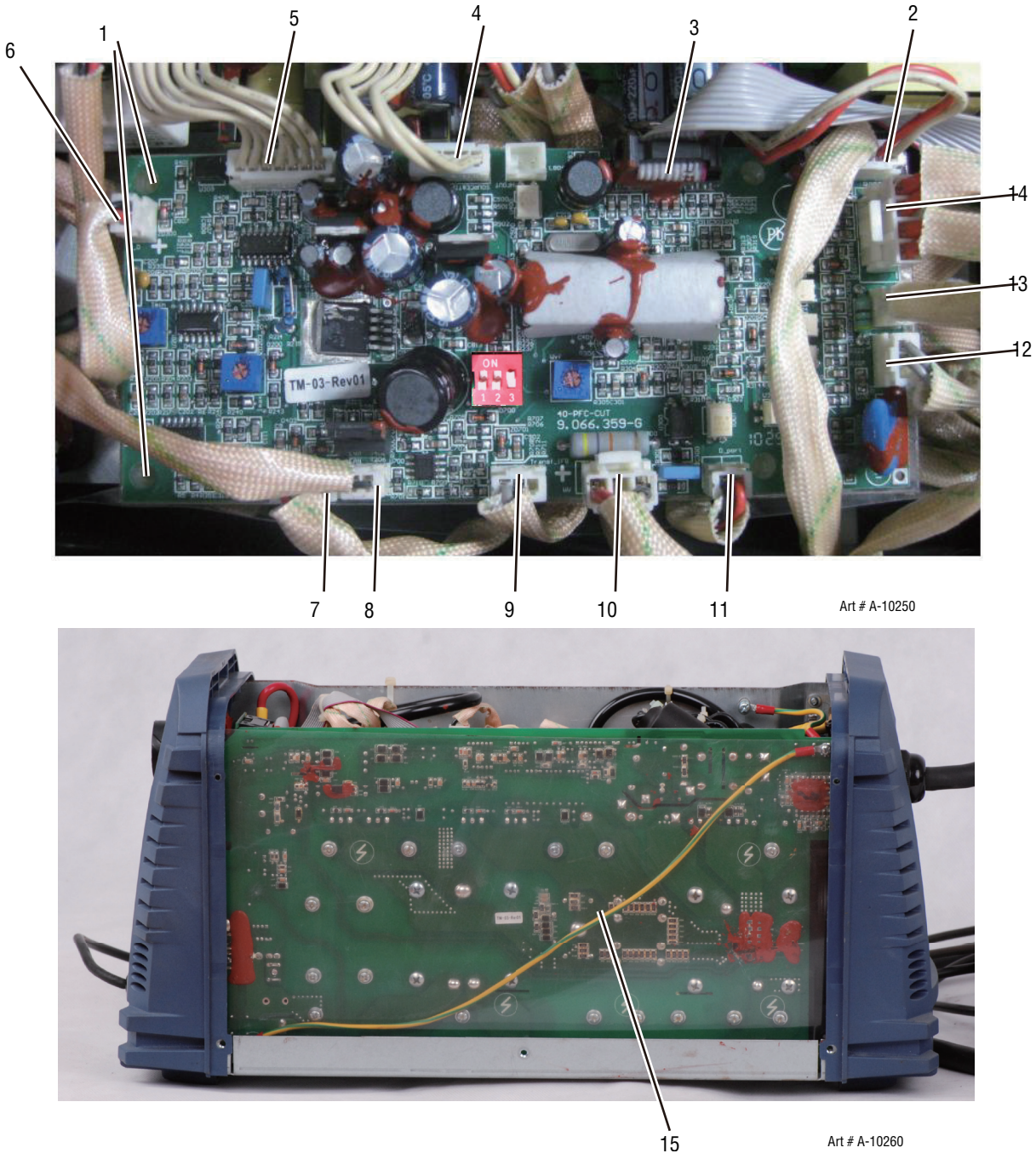


Figure 8-4 Installing Main Control PCB and Clear Cover Sheet

Please refer to Figure 6-9 in Section 6.12 for control PCB.

8.05 Installing Case

1. Install Case.
2. Install the ten screws and tighten them.

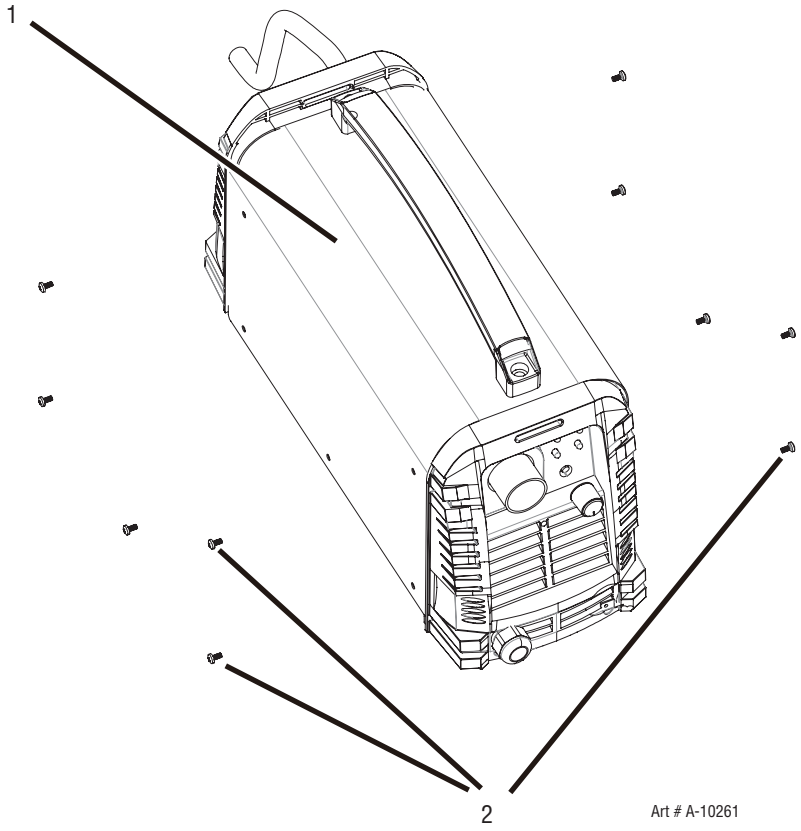


Figure 8-5 Installing the Case

Notes

SECTION 9:
REPLACEMENT PARTS

9.01 Introduction

A. Parts List Breakdown

The parts list provides a breakdown of all replaceable components.

B. Returns

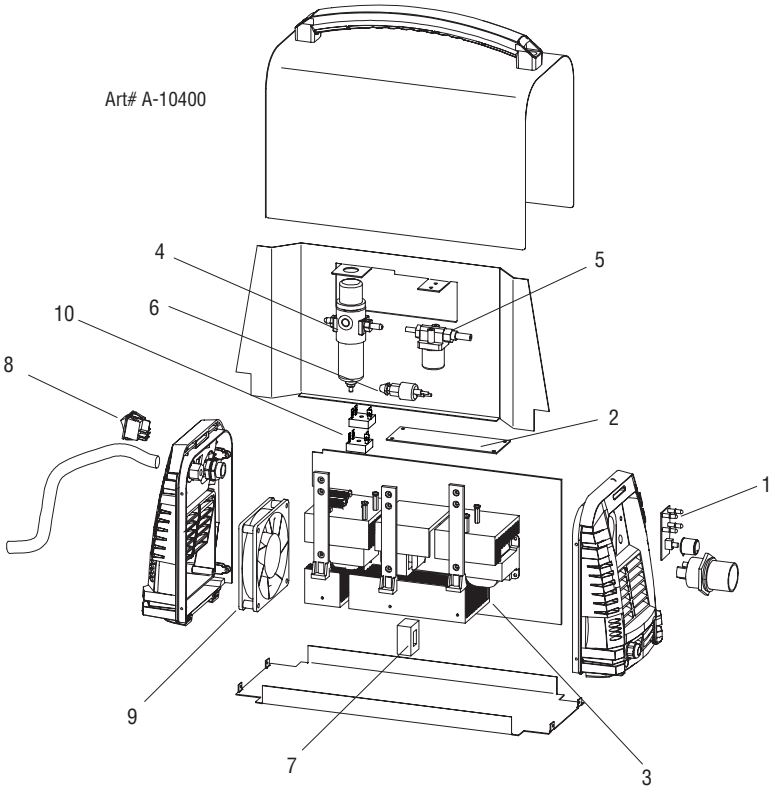
If a product must be returned for service, contact your distributor. Materials returned without proper authorization will not be accepted.

C. Ordering Information

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

9.02 Power Source Replacement Parts

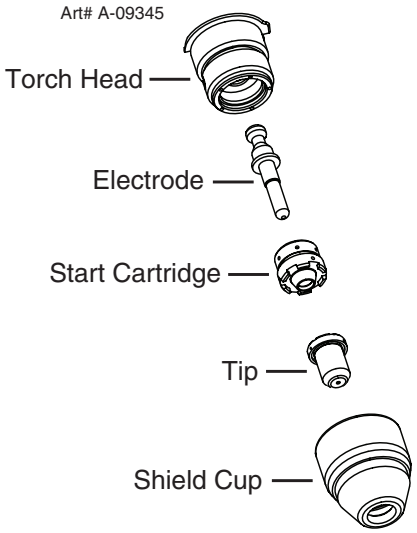
Item #	Qty	Description	Catalog #
1	1	Logic PCB assembly 10mm & 12mm	9-0076
2	1	Control PCB assembly 10mm	9-7555
2	1	Control PCB assembly 12mm	9-0077
3	1	Main PCB assembly 10mm	9-7556
3	1	Main PCB assembly 12mm	9-0079
4	1	Air Regulator 10mm & 12mm	9-0081
5	1	Solenoid assembly 10mm & 12mm	9-0082
6	1	Pressure Switch 10mm & 12mm	9-0075
7	1	Hall Current Sensor 10mm & 12mm	9-0088
8	1	ON/OFF Switch 10mm & 12mm	9-0074
9	1	Cooling Fan 10mm & 12mm	9-0042
10	1	Input Rectifier 10mm & 12mm	9-0049



Parts 9-1 - Power Source

9.03 SL60 Replacement Parts

Item #	Qty	Description	Part No
1	1	Electrode, 30-120 Amp	OTD9/8215
2	1	Start Cartridge	OTD9/8213
3	1	Tip, 40A Drag (fitted)	OTD9/8207
	1	Tip, 40A Standoff	OTD9/8208
4	1	Shield Cup	OTD9/8218
N/S	1	SL60 Torch w/20 ft (6,2m) leads (not shown)	OTD7/5204



Parts 9-2 - Electrode Parts

9.04 Options and Accessories

Qty	Description	Part No
1	Single - Stage Filter Kit	7-7507
1	Circle cutting guide	OTD7/3291
1	Roller & radius cutting guide	OTD7/7501
1	ATC 7.6m Torch, torch lead extension	OTD7/7545

Statement of Warranty

LIMITED WARRANTY: Subject to the terms and conditions established below, Victor Technologies warrants to the original retail purchaser that new Thermal Dynamics CUTMASTER® plasma cutting systems sold after the effective date of this warranty are free of defects in material and workmanship. Should any failure to conform to this warranty appear within the applicable period stated below, Victor Technologies shall, upon notification thereof and substantiation that the product has been stored operated and maintained in accordance with Victor Technologies's specifications, instructions, recommendations and recognized industry practice, correct such defects by suitable repair or replacement.

This warranty is exclusive and in lieu of any warranty of merchantability or fitness for a particular purpose.

Victor Technologies will repair or replace, at its discretion, any warranted parts or components that fail due to defects in material or workmanship within the time periods set out below. Victor Technologies must be notified within 30 days of any failure, at which time Victor Technologies will provide instructions on the warranty procedures to be implemented.

Victor Technologies will honor warranty claims submitted within the warranty periods listed below. All warranty periods begin on the date of sale of the product to the original retail customer or 1 year after sale to an authorized Victor Technologies Distributor.

LIMITED WARRANTY PERIOD

Product	Power Source Components (Parts and Labor)	Torch and Leads (Parts and Labor)
CUTMASTER 10mm	3 Years	1 Year
CUTMASTER 12mm	3 Years	1 Year

This warranty does not apply to:

1. Consumable Parts, such as tips, electrodes, shield cups, o-rings, starter cartridges, gas distributors, fuses, filters.
2. Equipment that has been modified by an unauthorized party, improperly installed, improperly operated or misused based upon industry standards.

In the event of a claim under this warranty, the remedies shall be, at the discretion of Victor Technologies:

1. Repair of the defective product.
2. Replacement of the defective product.
3. Reimbursement of reasonable costs of repair when authorized in advance by Victor Technologies.
4. Payment of credit up to the purchase price less reasonable depreciation based on actual use.

These remedies may be authorized by Victor Technologies and are FOB West Lebanon, NH or an authorized Victor Technologies service station. Product returned for service is at the owner's expense and no reimbursement of travel or transportation is authorized.

LIMITATION OF LIABILITY: Victor Technologies 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 customer of distributors (hereinafter "Purchaser") for service interruption. The remedies of the Purchaser set forth herein are exclusive and the liability of Victor Technologies 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 the goods covered by or furnished by Victor Technologies 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 liability is based.

This warranty becomes invalid if replacement parts or accessories are used which may impair the safety or performance of any Victor Technologies product.

This warranty is invalid if the Thermal Dynamics product is sold by non-authorized persons.

Effective March 15, 2011

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THERMAL DYNAMICS®

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