

HT4000[®]

***Plasma Arc
Cutting System
- Maintenance -***

***Instruction Manual
801490 - Rev. 3***



HT4000®

**Plasma Arc Cutting System
- Maintenance -**

**Instruction Manual
IM-149
(P/N 801490)**

**for Serial Numbers
beginning with
4000-000194M
4000-000195S**

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WARRANTY

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SAFETY

INTRODUCTION

Abbreviated safety precautions are printed on the power supply.

Before using the plasma arc cutting equipment (including compressed gas), each person operating, maintaining or supervising the use of this equipment must read the following safety instructions.

NOTES, CAUTIONS & WARNINGS

Throughout this manual, notes, cautions, and warnings are used to describe situations that require additional information. The following formats are used for each:

Notes: A note offers additional information, such as an operating tip, that aids the user in operating the plasma system.

Caution: A caution describes a situation that may cause damage to the plasma system and offers advice to avoid or rectify the situation



WARNING



A warning describes a situation that presents a physical danger to the operator, and offers advice to avoid or rectify the situation. Each type of warning displays an applicable danger symbol, ie. fire, explosion, electrical shock, etc.

WARNING



ELECTRIC SHOCK CAN KILL.

- Do not touch live electrical parts.
- Keep all panels and covers in place when the machine is connected to a power source.
- Insulate yourself from work and ground: wear insulating gloves, shoes and clothing.
- Keep gloves, shoes, clothing, work area, torch, and this machinery dry.



EXPLOSION WILL RESULT IF PRESSURIZED CONTAINERS ARE CUT.



ARC RAYS CAN INJURE EYES AND BURN SKIN.

- Wear correct eye and body protection.



NOISE CAN DAMAGE HEARING.

- Wear correct ear protection.



FUMES AND GASES CAN INJURE YOUR HEALTH.

- Keep your head out of the fumes.
- Provide ventilation, exhaust at the arc, or both to keep the fumes and gases from your breathing zone and the general area.
- If ventilation is inadequate, use an approved respirator.



HEAT, SPLATTER AND SPARKS CAUSE FIRE AND BURNS.

- Do not cut near combustible material.
- Do not cut containers that have held combustibles
- Do not have on your person any combustibles such as a butane lighter or matches.
- Pilot arc can cause burns. Keep the torch nozzle away from yourself and others when the switch is depressed.
- Wear correct eye and body protection.

SAFETY

SAFETY INSTRUCTIONS

Burn Prevention

Eye Safety

To protect eyes against burns caused by high-intensity ultraviolet light, sparks and hot metal:

- Wear dark safety glasses/goggles with side shields or a welding helmet. Refer to the chart below for recommended lens shades:

<u>Arc Current</u>			<u>Shield Shade</u>
Up to 100 Amps			Shade No. 8
100 - 200 Amps			Shade No. 10
200 - 400 Amps			Shade No. 12
Over 400 Amps			Shade No. 14

- Replace the glasses/goggles or helmet when the shield becomes pitted or broken.
- Warn other people in the area not to look directly at the arc unless they wear a glasses/goggles or helmet.
- Prepare the cutting area in a manner that reduces the reflection and transmission of ultraviolet light:
 - Paint walls and other surfaces with dark colors to reduce reflection
 - Install protective screens or curtains to reduce ultraviolet transmission.

Skin Safety

To protect skin against burns caused by high-intensity ultraviolet light, sparks and hot metal:

- Wear protective clothing:
 - Gauntlet gloves, safety shoes and hat.
 - Flame-retardant clothing which covers all exposed areas.
 - Cuffless trousers to prevent entry of sparks and slag.
- Hold any hand torch away from your body when pressing the start button because the pilot arc may come on immediately.

- Do not touch the front of the torch when starting it. After cutting, allow time for the front of the torch to cool.

Toxic Fume Prevention



To protect against the danger of toxic fumes which may be produced during cutting:

- Keep the cutting area well-ventilated.
- Remove all chlorinated solvents from the cutting area before cutting. Certain chlorinated solvents decompose when exposed to ultraviolet radiation to form phosgene gas.
- Wear proper breathing mask when cutting galvanized metal and use proper ventilation.
- Do not cut containers with toxic materials inside or containers that have held toxic materials. Clean such containers thoroughly before cutting.



WARNING



Do not cut metal or painted metals containing zinc, lead, cadmium or beryllium unless the operator, or anyone else subjected to the fumes, is wearing respiratory equipment or an air-supplied helmet.

Fire Prevention



Cutting with a plasma system produces hot metal, sparks and slag. Take the following precautions against fire:

- Make fire extinguishers available in the cutting area.
- Remove combustible material from the immediate cutting area to a distance of at least 35 feet (10 meters).
- Quench freshly cut metal or allow metal to cool before handling it or bringing it into contact with combustible materials.
- Never use a plasma system to cut containers with potentially flammable materials inside. Such containers must be thoroughly cleaned prior to cutting.

SAFETY

- Ventilate potentially flammable atmospheres before cutting with a plasma system. Never operate the plasma system in an atmosphere which contains heavy concentrations of dust, flammable gas or combustible liquid vapors.

Electric Shock Prevention



All Hypertherm plasma systems use high voltage (up to 280 VDC) to initiate the plasma arc. Take the following precautions when operating the plasma system:

- Keep your body and clothing dry.
- Do not stand in, sit on or lie on any wet surface when using the plasma system.
- Maintain proper insulation against electrical shock. If you must work in or near a damp area, use extreme caution. Wear insulated gloves and boots.
- Provide a wall-mounted disconnect switch with proper size fuses close to the power supply. This switch allows the operator to turn the power supply off quickly in an emergency situation.
- Conform to all local electrical codes for primary wiring sizes and types.
- Inspect the primary power cord frequently for damage or cracking of the cover. **Bare wiring can kill.** Do not use the system with a damaged power cord. If a power cord is damaged, replace it immediately.
- Inspect the torch leads. Replace if frayed or damaged.
- Never operate the plasma system unless the power supply unit covers are in place. Exposed power supply connections present a severe electrical hazard.
- Do not pick up the workpiece, including the waste cutoff, while you cut. Leave the workpiece in place or on the workbench with the work cable attached at all times.
- Before changing the torch parts, disconnect the main power or unplug the power supply. After changing the torch parts and returning the retaining cap to its operating position, plug the power supply in again.
- Never bypass or shortcut the safety interlocks.
- Before removing a power supply cover for maintenance, disconnect the main power at the wall disconnect switch or unplug the power supply. To avoid exposure to severe electrical hazard, wait five minutes after disconnecting the main power to allow capacitor discharge to occur.

Explosion Prevention



WARNING



The plasma system uses compressed gas. Proper precautions must be observed when handling and using compressed gas equipment and cylinders. Refer to the Standards Index in this manual.

When cutting with the plasma system:

- Do not cut in atmospheres containing explosive dust or vapors.
- Do not cut pressurized cylinders or any closed container.

Pressure Regulators

- Maintain all pressure regulators in proper working condition. Faulty regulators can cause damage or operator injury and must be serviced by trained repair technicians.
- Never use a regulator for any gas other than that for which it is intended.
- Never use a regulator that leaks, creeps excessively or is physically damaged in any way.
- Never attempt to lubricate a regulator with oil or grease.

Compressed Gas Cylinders

- Handle and use compressed gas cylinders in accordance with safety standards published by the Compressed Gas Association (CGA), American Welding Society (AWS) and Canadian Standards Association (CSA).
- Never use a cylinder that leaks or is physically damaged.
- Never use a cylinder that is not upright and secured in place.
- Never move or transport a cylinder without the protective valve cover in place.
- Never use a gas cylinder or its contents for any purpose other than that for which it is intended.
- Never lubricate cylinder valves with oil or grease.

SAFETY

- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use hammers, wrenches or other tools to open stuck cylinder valves.

Hoses

Label and color-code all gas hoses in order to clearly identify the type of gas in each hose. Consult applicable national or local codes.

- Never use the oxygen hose for any gas other than oxygen.
- Replace hose that is damaged by physical abuse or by sparks, heat or open flame.
- Lay hose out straight to prevent kinks.
- Coil excess hose and place it out of the way to prevent damage and to eliminate tripping danger.
- Examine hoses at regular intervals for leaks, wear, loose connections or other hazard.
- Keep hose lengths to a minimum to prevent damage, reduce pressure drop and to prevent possible volume flow restriction.

Hydrogen Detonation with Aluminum Cutting



WARNING



When cutting aluminum underwater or with the water touching the underside of the aluminum, free hydrogen gas may collect under the workpiece. Detonation of the hydrogen gas may occur while plasma cutting under these conditions.

- An effective means of eliminating the possibility of hydrogen detonation is to install an aeration manifold on the floor of the water table. Refer to the **Appendix** section at the rear of this manual for instructions on how to make an aeration manifold.

Grounding

Before operating the plasma system:

- | | |
|--------------------|--|
| Input Power | <ul style="list-style-type: none">• Be sure the power cord is plugged into a properly grounded outlet or that the power cord ground wire is properly connected to the ground in the disconnect box.• If installation of the plasma system involves connecting the power cord to the power supply, ensure that the power cord ground wire is properly connected. Conform to CSA standards by placing the power cord ground wire on the stud first; then place the other wires on top of the power cord ground. Fasten the retaining nut tightly.• Make sure that all electrical connections are tight to avoid excessive heating. |
| Work Table | <ul style="list-style-type: none">• Clamp the work cable with good metal-to-metal contact to the workpiece (not the portion that will fall away) or to the work table. |
| Work Table | <ul style="list-style-type: none">• Connect the work table to a good earth ground. Consult the U.S. National Electrical Code, Article 250, Section H <i>Grounding Electrode System</i>, or other appropriate national or local codes. |

For additional information, refer to the *Standards Index* in this manual.

SAFETY REMINDERS

- All Hypertherm torches are designed with a safety interlock, which turns off the power supply when the retaining cap is loosened.
- Never bypass or shortcut the safety interlocks on any of the plasma system units.
- Never operate the plasma system with any of its covers not in place. This would be hazardous to the operator and other people in the area, and prevents the proper cooling of the equipment.
- Each Hypertherm plasma system is designed to be used only with specific Hypertherm torches. Do not substitute other torches which could overheat and present a potentially dangerous situation to the operator and any personnel in the area.

STANDARDS INDEX

The *Standards Index* contains a list of publications dealing with plasma arc cutting equipment safety practices. For additional information, refer to this *Standards Index*.

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INTRODUCTION & SPECIFICATIONS

INTRODUCTION

The instructions to install, operate and maintain the HT4000 system have been separated into three manuals. The following is a list of the manual titles, part numbers, and contents:

HT4000 Instruction Manual: Installation (#801470)

This manual gives pertinent information for the pre-installation supply requirements, installation, and post-installation requirements for the HT4000 system.

Also included in this manual are specifications of the components of the HT4000 system, system interconnect diagrams, and accompanying drawings.

HT4000 Instruction Manual: Operation (#801480)

This manual describes the controls and indicators for the system units, explains how to start-up and operate the HT4000 system, contains cut chart tables, gives instructions to remove and replace consumable parts, and provides routine inspection and cleaning information.

HT4000 Instruction Manual: Maintenance (#801490)

This manual contains basic troubleshooting tips, and a parts list.

It is our hope that this manual set will aid and answer most questions on installing, operating, and ordering parts for your HT4000 system.

If any questions do arise, please call Customer Service at 1-800-643-0030 or Field Service at 1-800-643-9878.

INTRODUCTION & SPECIFICATIONS

General

Hypertherm's HT4000 is designed as a machine-mounted plasma cutting system for cutting most metals from gauge to two-inch (50mm) thick. A micro-controller on the Master power supply control board helps to provide extended life for the torch consumable parts. To achieve consumable long life, **all cuts must begin and end on the plate surface**; this allows for the proper ramping of gases and DC current to extend the life of the torch nozzle and electrode.

The HT4000 system provides the user with capability of locating the power supply and the torch apart by a maximum of 200 feet. This is accomplished by adding a remote High Frequency (HF) Console.

The HT4000 provides continuously variable current output for optimum cutting performance on all thicknesses of metal. This allows the operator wide variations in cutting speeds on the same thickness of metal. Three nozzle sizes are provided to produce high-quality cuts throughout its range of cut thicknesses.

The HT4000 can be configured for oxygen or nitrogen cutting. For cutting stainless steel, aluminum, and other non-ferrous materials, nitrogen can be used as the plasma gas. When cutting mild (carbon) steel, oxygen can be used as the plasma gas.

The following descriptions briefly describe the purpose and configuration of the major units which comprise the HT4000 System.

HT4000 Master power supply

This unit houses two 100-amp, 15kHz chopper power supplies to produce constant current DC output. Also located in this unit is the Torch Height Control (THC). The power supply interconnects with the HF console, IHS, computer interface, remote V/C, water muffler, gas console, the HT4000 Slave power supply, and the workpiece.

HT4000 Slave power supply

This unit also houses two 100-amp, 15kHz chopper power supplies. When interconnected with the HT4000 Master power supply, up to 400 amps is made available to the cutting system. The Slave interfaces with the Master supply, and the Timer/Counter unit.

High Frequency (HF) Console

This unit houses the high-frequency starting circuit which permits more effective RF shielding and allows the power supplies to be installed at a distance of up to 200 feet from the torch. Also located in the console are two door interlock switches, a cooling water flow switch, injection water flow switch and injection water valve.

INTRODUCTION & SPECIFICATIONS

Remote Voltage/Current (V/C) Control

This unit provides accurate operator control of the arc voltage and current. It includes high intensity LED displays which indicate the setpoints for volts and amperes prior to starting the arc. After the arc is initiated, the displays automatically switch to show the actual values of the voltage and current reached. This unit interfaces with the Master power supply. Three different types of remote V/C Controls are available:

Switch Remote - Includes the voltage and current displays and two potentiometers used to select the desired values. Also included are start and stop switches for the power supply, switches for activating the torch height control (THC), and initial height sensing (IHS) circuits. This unit is for use on guidance machinery that does not include switches to control the initial height sensing and torch height functions.

Digital Remote - Includes the voltage and current displays and two potentiometers used to select the desired values. It is used with guidance machinery that already includes plasma control switches.

Programmable Remote - Includes the voltage and current displays. No switches or potentiometers are included. All functions are controlled by the guidance machinery computer. This unit also interconnects with the computer interface.

Gas Console

This unit houses valves for plasma gas flow control as well as flowmeters for plasma gas and injection water, metering valves for preflow and operating plasma gas flow, a metering valve for adjustment of injection water flow, and three switches: one to choose between oxygen or nitrogen, another to select either test preflow, test operate, or run modes, and a third to adjust flows during operate mode. The gas console interfaces with the gas supplies, the HF console, the valve console, the Master power supply and the torch.

Valve Console

This unit houses a plasma gas metering valve and a preflow/operate solenoid valve. Plasma and preflow gas lines and an interface cable connect the valve console to the gas console. The valve console also interfaces with the torch via a lead set consisting of a plasma gas hose, injection water hose, and a plasma-off cable.

Note: The valve console must be mounted 10 feet (3 m) from the torch.

INTRODUCTION & SPECIFICATIONS

Timer/Counter

The timer/counter is provided so that the number of arc starts and arc time on can be monitored. This unit is interfaced to the HT4000 Slave power supply.

Water Chiller

The water chiller for the HT4000 system is a refrigeration unit that is capable of reducing the water coolant temperature well below ambient air and water supply temperature. Having this capability greatly increases the life of the nozzle and electrode. The water chiller is a three-phase power system that directly interfaces with the HF console. A water supply must be input to the water chiller. A water softener may also be required. See *Water Supply Requirements* in the **Pre-Installation** section of this manual.

Initial Height Sensing (IHS) - Optional

This unit, used with two inductive probes, is designed to automatically detect the workpiece surface and index the torch to the pierce position. This system can be used for underwater, at the water line, or above-water applications. This unit interconnects with the Master power supply and the inductive probes, and requires an air supply to operate.

Water Muffler - Optional

The water muffler for the HT4000 system is an option which greatly improves cutting safety and pollution control capabilities. The water muffler can be used to cut both above and below water. Refer to the Water Muffler Instruction Manual (P/N 801730) for more detailed information.

[illegible]

Width	28-1/4" (71 cm)
Height	35-1/2" (90 cm)
Depth	41-1/4" (104 cm)
Weight	760 pounds (345 kg)

PAC170 Machine Torch (028507)

Maximum cutting thickness	2 inch (50 mm)
Maximum current at 100% duty cycle	400 amps
Plasma Gas Flow	Refer to the <i>Cut Charts</i> in the Operation section of the HT4000 Instruction Manual: Operation (IM148) for specific gas requirements.
Injection Water Flow Rate	0.38 to 0.48 gpm (1.44 to 1.82 l/min)
Water coolant flow rate	1.6 gpm (6.06 l/min)
Weight	3-1/2 pounds (1.59 kg)

Remote High Frequency Console (073052)

Width 16" (41 cm)
Height 16-3/4" (42 cm)
Depth 13-3/4" (35 cm)
Weight 75 pounds (34 kg)

Switch Remote (SR) V/C Control (073053)

Controls

- Start button:**
Activates IHS (if on) and initializes pilot arc.
- Stop button:**
Deactivates main contactor in power supplies.
- IHS On/Off switch:**
Turns IHS system on or off.
- Auto Height On/Off switch:**
Activates THC in Master power supply.
- Voltage adjust pot:**
Adjusts arc cutting voltage and displays value on LEDs.
- Current adjust pot:**
Adjusts arc cutting current and displays value on LEDs.

INTRODUCTION & SPECIFICATIONS

Control Range Current: 100 to 400 Amps
Voltage: 100 to 200 Volts
Control Resolution Current: 20 Amps
Voltage: 5 Volts

Dimensions and Weight:

Width 11-1/2" (29 cm)
Height 5" (13 cm)
Depth 13-1/4" (34 cm)
Weight 6 pounds (2.7 kg)

Digital Remote (DR) V/C Control (055003)

Controls Voltage adjust pot:
Adjusts arc cutting voltage and
displays value on LEDs.
Current adjust pot:
Adjusts arc cutting current and
displays value on LEDs.

Control Range Current: 100 to 400 Amps
Voltage: 100 to 200 Volts
Control Resolution Current: 20 Amps
Voltage: 5 Volts

Dimensions and Weight:

Width 11-1/2" (29 cm)
Height 3" (7.6 cm)
Depth 13-3/8" (34 cm)
Weight 5 pounds-5 oz. (2.4 kg)

Programmable Remote (PR) V/C Control (055004)

Controls None. Controlled through guidance
machinery computer.
Control Range Current: 100 to 400 Amps
Voltage: 100 to 200 Volts
Control Resolution Current: 20 Amps
Voltage: 5 Volts

INTRODUCTION & SPECIFICATIONS

Dimensions and Weight:

Width	11-1/2" (29 cm)
Height	3" (7.6 cm)
Depth	12-1/2" (31.8 cm)
Weight	5 pounds-5 oz. (2.4 kg)

Gas Console (073081)

Dimensions and Weight:

Width	11-1/2 " (29 cm)
Height	14-5/8 " (37 cm)
Depth	4 " (10 cm)
Weight	16 pounds (7.3 kg)

Water Chiller

Refer to Water Chiller Model C Instruction Manual (P/N 800880).

Valve Console (073073)

Dimensions and Weight:

Width	11-1/2 " (29 cm)
Height	4 1/4" (11 cm)
Depth	8" (20 cm)
Weight	14 pounds (6.3 kg)

Initial Height Sensing (053016)

Input Power	120 VAC from power supply
Air Pressure	20 psi (1.4 bar) regulated shop air input to solenoid.

Dimensions and Weight:

Width	9" (23 cm)
Height	4.5" (11 cm)
Depth	11-1/2" (29 cm)
Weight	13 pounds (6 kg)

INTRODUCTION & SPECIFICATIONS

Timer/Counter (073057)

Dimensions and Weight:

Width 6-1/2" (16.5 cm)
Height 2-1/2" (6.4 cm)
Depth 8-5/8" (22 cm)
Weight 3 lbs (1 kg)

Water Muffler - Optional

Refer to Water Muffler Instruction Manual (#801730).

Section 3 MAINTENANCE

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MAINTENANCE

INTRODUCTION

The HT4000, and all Hypertherm plasma systems, undergo rigorous testing prior to shipment and should require little maintenance if proper installation and operation procedures as outlined in instruction manuals #801470 (Installation) and #801480 (Operation) are followed.

After a routine maintenance section, a system initialization startup sequence flowchart is presented. Following the flowchart, an initial checks procedure is given, followed by a troubleshooting guide to aid in servicing the HT4000 system and a troubleshooting guide for the STATUS indicators. A chopper module test procedure and a description of the Master and Slave control board relays have also been included as diagnostic tools.

Note: When referencing components to the wiring diagrams in **Section 5**, designations may appear to be repeated. Ex. C1 appears on sheet 2 of 15 in the wiring diagrams in five separate locations. Sections of the Master power supply on that page are outlined with a dotted box and a label. Within different sections, the same designation may appear. Be certain to check the dotted box label when looking for or cross-referencing HT4000 parts.

It is assumed that the service personnel performing the troubleshooting testing are high-level electronic service technicians that have worked with high voltage electro-mechanical systems. Knowledge of final isolation troubleshooting techniques is also assumed.

In addition to being technically qualified, maintenance personnel must perform all testing with safety in mind. Refer to the *Safety* section for operating precautions and warning formats.

If you need additional assistance or need to order parts, call our Customer Service or Technical Service Group at 1-800-643-9878.



WARNING



SHOCK HAZARD: The large electrolytic capacitor(s) (blue-cased cylinder(s)) store large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge the capacitor(s) with a screwdriver or other implement...explosion, property damage and/or personal injury will result. Wait at least five minutes after turning the power supply off before touching the chopper or the capacitor(s).

ROUTINE MAINTENANCE

The HT4000 system is designed to require little regular maintenance under normal use. The following maintenance checks, are suggested to keep your system in top running condition.

Torch and Torch Leads

Inspection

Inspect the torch and torch leads on a routine basis.

- The torch consumable parts and torch main body should always be inspected prior to cutting. Worn or damaged parts can cause gas and water leaks which can affect the cut quality. Check for pitting and burn marks on the consumable parts and replace, if necessary. See *Changing Consumable Parts* in **Section 3** of the HT4000 Operation Manual (#801480).
- Ensure that all connections are tight, but do not overtighten.
- The torch leads should be checked occasionally for cracking and damage.

Power Supplies

Inspection

Inspect the power supplies on a routine basis.

- Check the exterior for any damage. If there is damage, ensure it does not affect safe operation of the power supply.
- Remove covers and inspect the interior. Check wiring harnesses and connections for wear and damage. Check for loose connections, and look for areas of discoloration due to overheating.

Cleaning

Cleaning the power supply periodically is necessary to keep dust and foreign matter from inside the unit.

- Remove the covers and blow out the unit with compressed air. In an excessively dirty environment, clean the power supply on a weekly basis.

MAINTENANCE

Gas Console

Inspection

Inspect the gas console on a routine basis.

- Check the exterior for any damage. Look for damaged glass tubes in the flowmeters and check the pressure gauges for damage.
- Inspect all interconnecting cables, hoses and leads for wear and damage. Ensure all connections are tight and that there are no leaks. Do not overtighten fittings.

Cleaning

Keep the flowmeters and pressure gauges free of dirt, dust and foreign matter.

Motor Valve Console

Inspection

Inspect the motor valve console on a routine basis.

- Check the exterior for any damage.
- Inspect all interconnecting cables, hoses and leads for wear and damage. Ensure all connections are tight and that there are no leaks. Do not overtighten fittings.

Cleaning

Check the valve console periodically for dust and foreign matter inside the unit.

- Open the cover and blow out the unit with compressed air. It is important to keep the cover closed except when cleaning or maintenance is being performed.

Remote HF Console

Inspection

Inspect the RHF console on a routine basis.

- Check the exterior for any damage. If there is damage, ensure that it does not affect safe operation of the console.
- Open the cover and inspect the interior. Check all cables and hoses for wear and damage. Check for loose connections, look for areas of discoloration due to overheating. Check for plumbing leaks.

Cleaning

- Open the cover and blow out the unit with compressed air. It is important to keep the cover closed except when cleaning or maintenance is being performed.

STARTUP SEQUENCE OF HT4000

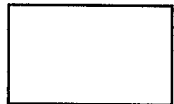
On the following page is a flowchart outlining the startup sequence during proper HT4000 operation. This flowchart details system functioning from the time the POWER ON button is pushed, up to the ready state (before START button is pushed). Shaded boxes represent action taken by the operator. The timing diagram on page 13 of 15 in **Section 5** outlines the functional sequence of the HT4000 system after the START command is given.

The following symbols used in the flowchart are ANSI standard flowcharting symbols. Their names and definitions are as follows:



Terminus

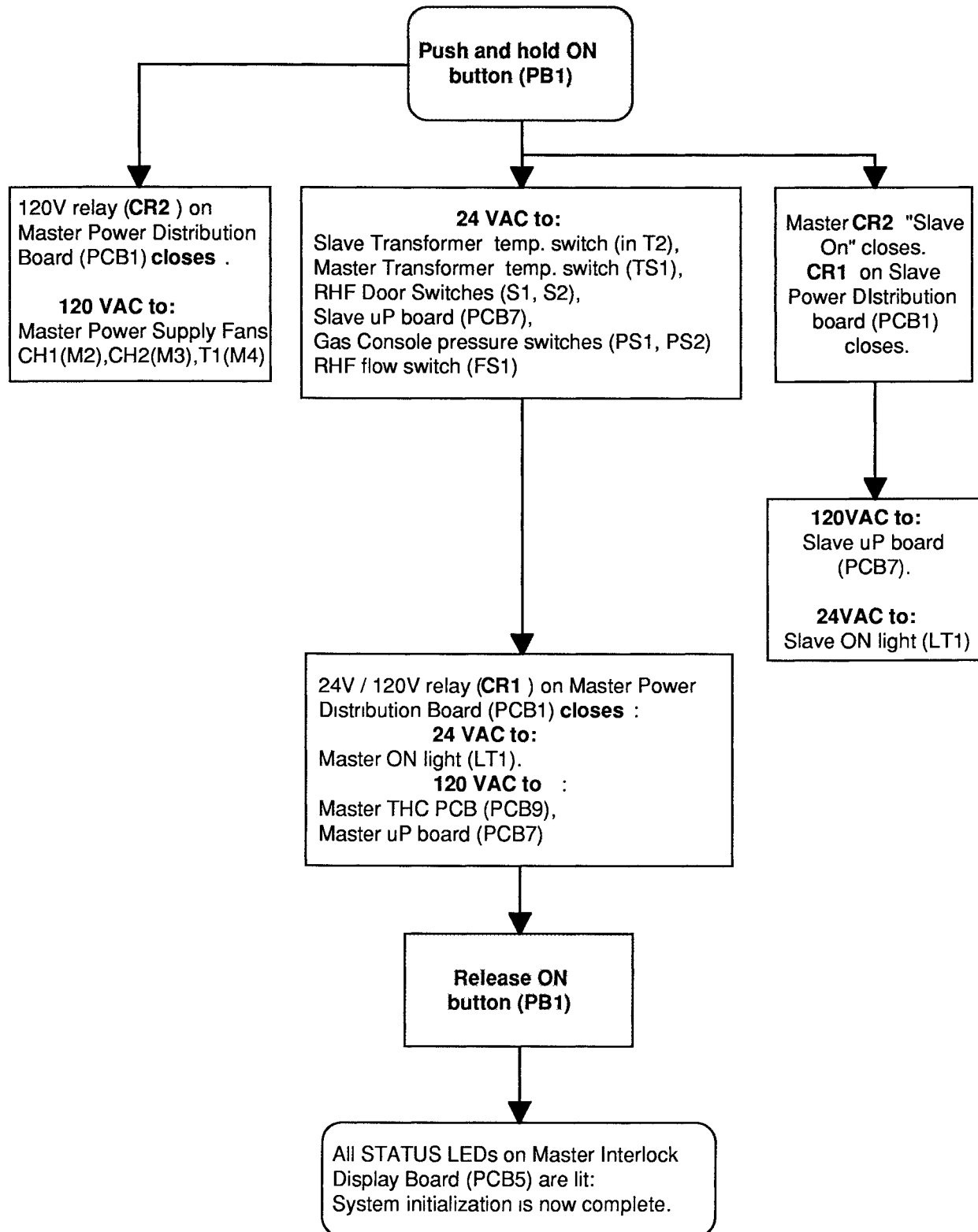
The terminus is used to indicate the beginning or ending point of a flowchart.



**Task/Process
Box**

The process or task box is used to indicate any process or task other than an input/output operation or a decision.

MAINTENANCE



INITIAL CHECKS

Before tracking down specific problems, it is good practice to do a visual check, and verify proper voltages are present at the power source, transformer(s) and power distribution board(s). The following is applicable for both the Master and Slave units.



WARNING



SHOCK HAZARD: Always use caution when servicing a power supply when plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.

1. Disconnect line power by turning main disconnect switch off.
2. Using a Phillips head screwdriver, remove top plate, two side plates, front plate, and rear plate of power unit(s).
3. Inspect interior of power unit(s) for discoloration on pc boards, or other apparent damage. If a component or module is obviously defective upon visual inspection, remove and replace it before doing any testing. Refer to the *Parts List* section to identify parts and part numbers.
4. If no damage is apparent, plug in the power supply unit(s), and apply power by turning on the main disconnect switch.
5. Measure the voltage at TB1 between L1, L2 and L3. Refer to Figure 3-1 for detail of TB1. The voltage between any two of the three points at TB1 should be equal to your supply voltage (200, 220, 240, 380, 415, 480, or 600VAC). If there is a problem at this point, disconnect main power and check connections, power cable, and fuses or circuit breaker at main power disconnect box. Repair and/or replace defective component(s) if necessary.

MAINTENANCE

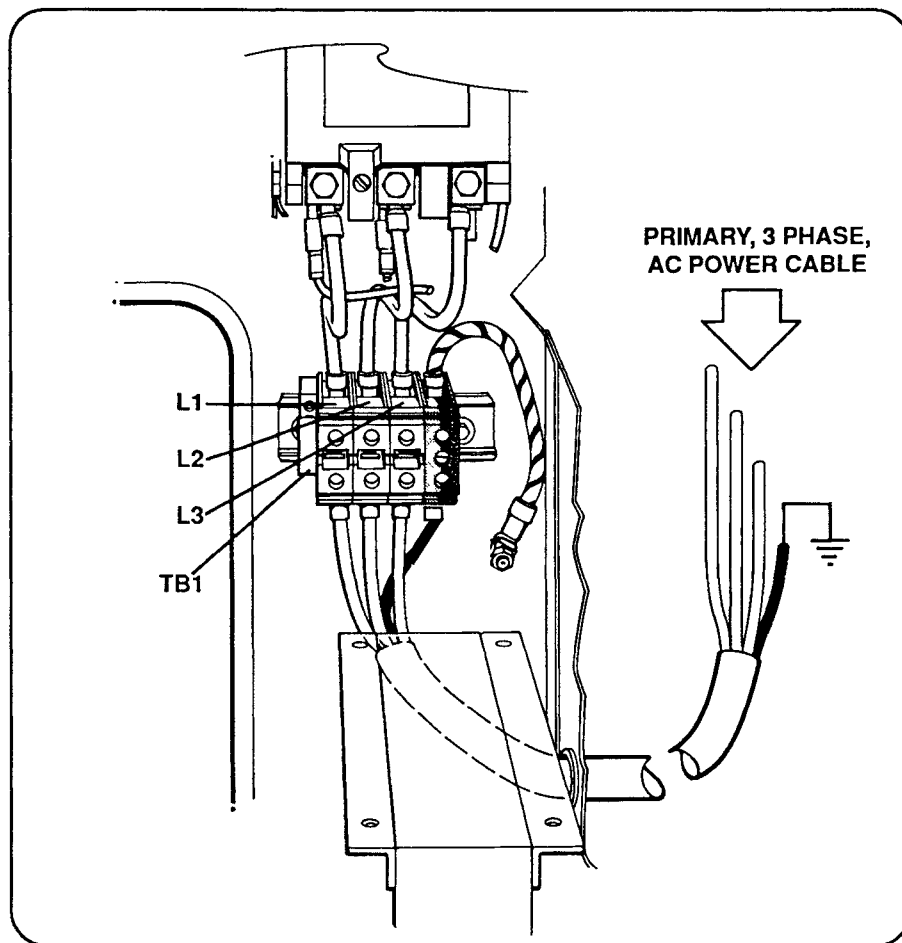


Figure 3-1 Primary Power Measurement Location - HT4000 Master & Slave

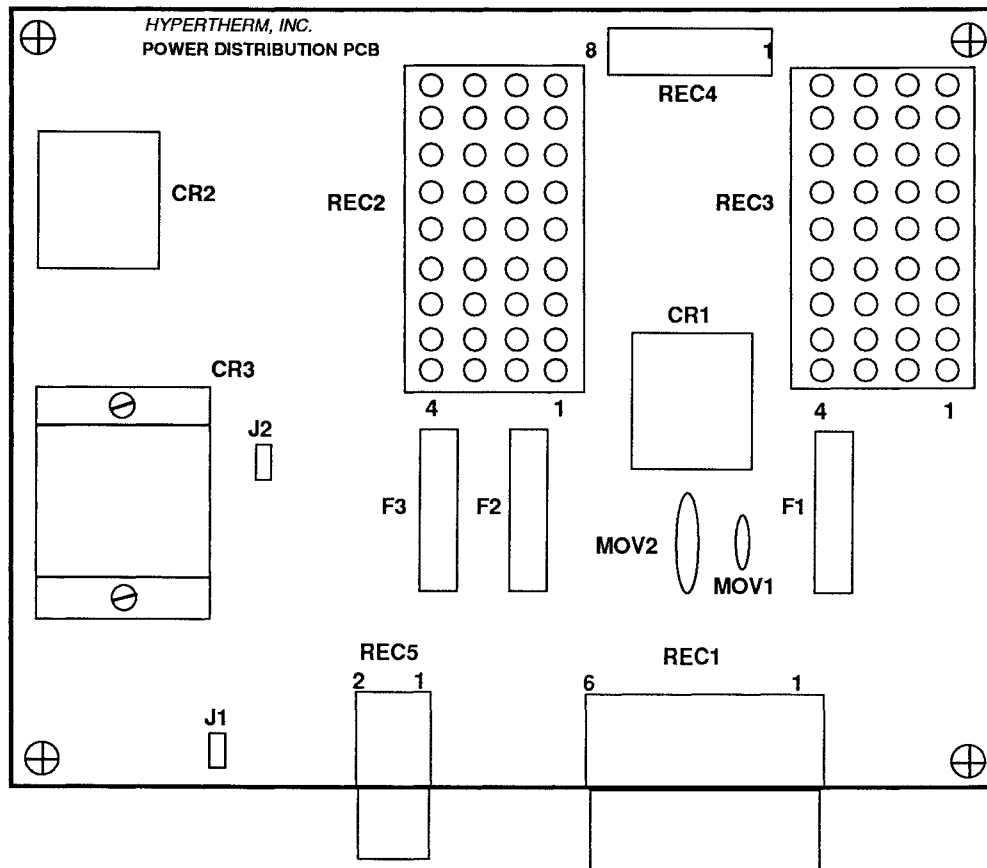


Figure 3-2 Power Distribution Board PCB1

6. Measure voltage at power distribution board PCB1. Refer to Figure 3-2 for detail of PCB1. Look on the board for fuses F1, F2, and F3. Measurements between each fuse and chassis ground should be as follows:

F1: 24VAC
F2: 120VAC
F3: 240VAC

If voltages are not present, or incorrect at one or more of these points, disconnect power and troubleshoot PCB1 fuses and associated pins, connectors and wiring between power distribution board connector REC1 and transformer secondary T1.

Also, check main power fuses F1, and F2 and associated wiring and connections between T1, CON1, and L1 and L2 (including linkboard if applicable).

Repair and/or replace defective component(s) if necessary.

MAINTENANCE

TROUBLESHOOTING

The troubleshooting section is presented by following normal operational sequence.

Before troubleshooting for specific problems, be sure that unit passes *Initial Checks* as outlined earlier in this section.



WARNING



SHOCK HAZARD: Always use caution when servicing a power supply when the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death. If questions or problems arise during servicing, call the Hypertherm Technical Services Department at 1-800-643-0030.

Problem	Possible Causes and Solutions
1. The green POWER ON pushbutton switch PB1 is pressed, but the fans are not operating and the green POWER ON indicator does not light.	1.1. <i>The green POWER ON (1) PB1 pushbutton is defective.</i> Check that switch is operating correctly, and that good contact is being made. The POWER ON switch is normally open. 1.2. <i>The red POWER OFF (0) PB2 pushbutton is defective.</i> Check that switch is operating correctly, and that good contact is being made. The POWER OFF switch is normally closed. 1.3. <i>Associated wiring not making good contact.</i> Check wiring and repair or replace, if necessary.
2. The green POWER ON pushbutton switch PB1 is pressed, the POWER ON indicator lights, but the fans are not running.	2.1. <i>CR2 on the Master power distribution board (PCB1) is defective.</i> Check that CR2 switches when POWER ON pushbutton is pressed. See Figure 3-2 for location of CR2. If CR2 is defective, unsolder CR2 and replace. 2.2. <i>Terminal lugs located at the fans (see Figure 4-1 for location of fans) are not seated together securely and/or not getting 120VAC from power distribution board.</i> • Check pins, connectors and associated wiring for good continuity.

MAINTENANCE

Problem	Possible Causes and Solutions
	• Check for 120VAC at the terminals.
	2.3. PL2 and REC2 on power distribution board (see Figure 3-2 for location of REC2) are not seated together well. Check pins, connectors and associated wiring for good continuity. Repair or replace, if necessary.
3. The green POWER ON pushbutton switch PB1 is pressed, the fans are operating, but the green POWER ON indicator does not light.	3.1. Pushbutton PB1 was not held down long enough. Press and hold PB1 for a minimum of five seconds. 3.2. Relay CR1 on the Master power distribution board (PCB1) is defective. Check that CR1 switches when POWER ON pushbutton is pressed. See Figure 3-2 for location of CR1. If CR1 is defective, unsolder CR1 and replace. 3.3. One or more of the green STATUS LEDs does not light, indicating a fault condition. Release PB1 and observe that all the STATUS LEDs go out. Press and hold PB1 again to observe which indicators are not lit. The LEDs are connected in series, so the topmost LED that is not lit is the first problem that must be corrected. To troubleshoot STATUS fault conditions, see <i>Status LED Troubleshooting</i> later in this section.
4. The green POWER ON indicator is lit, the START command is given and red DC ON indicator is lit, but there is no high frequency and no pilot arc.	4.1. There is no spark between the spark gap electrodes. (Spark gap assembly is located in the RHF console) Clean (with emery cloth), align, and/or regap (.020" per gap) the electrodes, if necessary. Ensure that the electrode surfaces between the gaps are flat. If surfaces are rounded, replace and regap. • Visually inspect the high voltage transformer T1 in the RHF console for leaking oil or overheating. See Figure 4-15 for location of T1. Replace T1 if leaking or overheating. • Check for 120VAC at T1 after START command is given. Note that door interlock switch S1 has to be closed in order to pass the START sequence. Switch will close in both IN position, and if pulled OUT.

MAINTENANCE

Problem	Possible Causes and Solutions
	• If there is <u>no</u> 120VAC at T1, use wiring diagrams and check pins, connectors and associated wiring from T1 to Master control board PCB7. If connections are O.K., there may be a problem with control PCB7. • If there <u>is</u> 120VAC at T1, shut down system and remove capacitors C3 and C4 in RHF console. Restart system and see if a faint spark is now observed across the gaps. • If a spark is <u>not</u> observed at the gaps, replace T1. If there <u>is</u> a spark, shut down system, and replace capacitors C3 and C4. (Always replace the capacitors in pairs).
	4.2. There is no high frequency at the torch. Check for a shorted torch, a damaged pilot arc lead, or loose lead connections. Replace the torch or pilot arc lead or tighten the lead connections.
5. The green POWER ON indicator is lit, the torch START command is given and the red DC ON indicator lights, and there is high frequency, but there is no pilot arc.	5.1. Pilot arc relay CR1 is not closing (not getting 120VAC from Master control PCB7). See if the CR1 relay contacts close after the START command is given. (See Figure 4-3 for location of CR1) If CR1 does <u>not</u> close: • With an AC voltmeter across the relay, see if 120VAC is coming from PCB7 after START command is given. • If there is no 120VAC, check connectors, terminals, pins, and associated wiring to PCB7. • If wiring is O.K., there may be a problem with PCB7. 5.2. Pilot arc relay CR1 is defective. If there <u>is</u> 120VAC across the relay (see above steps), and CR1 does not close, replace CR1. 5.3. Main contactor (CON1) or PCB7 is defective. • With an AC voltmeter, see if contactor CON1 is getting 24VAC after START command is given. (See Figure 4-6 for location of CON1)

MAINTENANCE

Problem	Possible Causes and Solutions
	If there is no 24VAC, check pins, connectors and associated wiring from CON1 to PCB7. • If wiring is O.K., PCB7 may be defective. • If CON1 is getting 24VAC from PCB7 as described above, measure the voltage between all terminals 1A, 1B and 1C and 2A, 2B and 2C of main transformer T2 after the START command is given (See sheet 2 of 15 in Section 5). The voltage between any two of the three points should be equal to 200VAC. If there is no voltage at any of the above points, replace CON1. If there is voltage at some but not all of the above points, check wiring and connections to and from T2. If wiring checks out OK, return to <i>Initial Checks</i> section and repeat steps 1-5. 5.4. Choppers are defective or not functioning. See <i>Chopper Module Test Procedure</i> later in this section to troubleshoot.
6. The unit stops cutting during cut, or cuts poorly.	6.1. Arc not transferring to workpiece. Check work cable. Good contact must be made in order for the arc to transfer to the workpiece. Connect or repair the work cable. 6.2. There is insufficient air or gas pressure. Check gas inlet pressure specifications under <i>Cut Charts</i> in Operation section of HT4000 Operation Manual (#801480). Check plasma and shield gas pressures in TEST and RUN modes as specified under <i>Cut Charts</i> in Operation section of HT4000 Operation Manual (#801480). 6.3. Torch is getting insufficient current. Check the arc current setting for the type and thickness of metal you are cutting from the <i>Cut Charts</i> in the Operation section of HT4000 Operation Manual (#801480).

MAINTENANCE

Problem

Possible Causes and Solutions

6.4. *The power supply has overheated.*

Shut down system and wait for unit to cool down. If unit will not restart, see *Status LED Troubleshooting* guide later in this section.

6.5. *Choppers are defective or not functioning.*

See *Chopper Module Test Procedure* later in this section.

STATUS LED TROUBLESHOOTING

Be certain that the power supply has been through the *Initial Checks* as outlined earlier in this section before troubleshooting STATUS LEDs.

When any one of the STATUS LEDs does not light, there is a fault condition that must be corrected in order for the HT4000 power supply to become operational. The LEDs are connected in series, so the upper-most light that does not light represents the first condition that must be corrected.

See wiring diagrams in **Section 5** for reference.

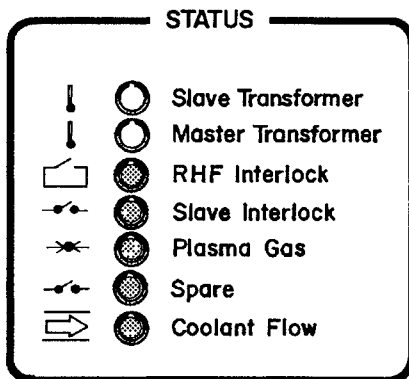
Problem	Possible Causes and Solutions
1. Slave Transformer LED not lit:	1.1. Slave Transformer T2 is overheating. This LED will light when main Slave transformer (T2) is operating in a normal temperature range (under 165° C). Temperature switch TS1 will open and turn off LED when transformer overheats. - If transformer is not hot, take TS1 connector apart and check for continuity. TS1 is normally closed. - Check pins, connectors and associated wiring from TS1 to REC3 of PCB1. - If transformer T2 is excessively hot, it needs to cool down. Leave the fans running, and try restarting the unit after one hour. If transformer still overheats, re-check incoming voltage (See <i>Initial Checks</i> earlier in this section). If incoming voltage is OK, T2 may need to be replaced.
2. Master Transformer LED not lit:	2.1. Master Transformer T2 is overheating. This LED will light when the main transformer (T2) is operating in a normal temperature range (under 165° C). Temperature switch TS1 will open and turn off LED when transformer overheats. - If transformer is not hot, take TS1 connector apart and check for continuity. TS1 is normally closed. - Check pins, connectors and associated wiring from TS1 to REC3 of PCB1. - If transformer T2 is excessively hot, it needs to cool down. Leave the fans running, and try restarting the unit after one hour. If transformer still overheats, re-check incoming voltage (See <i>Initial Checks</i> earlier in this section).

MAINTENANCE

Problem

Possible Causes and Solutions

3. RHF Interlock LED not lit:



in this section). If incoming voltage is OK, T2 may need to be replaced.

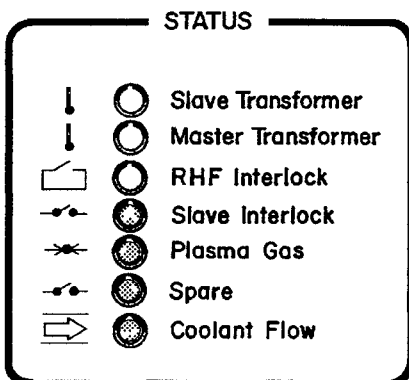
3.1. Door switch S1 and/or S2 in remote HF console is not closed.

This LED will light when 24VAC is able to complete a path through S1 and S2 in the RHF console. S1 and S2 are closed when the doors of the RHF console are shut.

- Verify continuity between pins 34&35 of the RHF cable on the 1X4 connector end. (See sheet 6 of 15 in **Section 5**)
- Verify that S1 and S2 are functioning correctly.
- Check cable, connectors and associated wiring from REC3 of PCB1 to remote HF console.

Repair and/or replace defective component(s), if necessary.

4. Slave Interlock LED not lit:



4.1. Slave control PCB7 not on.

This LED will light when 24VAC is able to complete a path to pins 13&14 of REC4 on Slave PCB7. If PCB7 has not been powered on, the circuit can not be completed.

- Verify that power has been applied to Slave PCB7.

If Slave PCB7 is on, go to step 4.2.

If Slave PCB7 is not on:

- Check for 120VAC at pins 7&8 of REC2 of Slave PCB1.
- Check for 24VAC at pins 3&4 of REC3 of Slave PCB1.

If there is no 120VAC at pins 7&8 and/or no 24VAC at pins 3&4, trace paths back to Master CR2 "Slave On" (See sheet 8 of 15 in **Section 5**).

If there is no 120VAC or 24VAC at the output of Master CR2, trace path back to pins 5&6 of REC3 of Master PCB1. (Master CR2 relay is turned on by 24VAC).

Repair and/or replace defective component(s), if necessary.

4.2. Slave PCB7 defective.

If power has been applied to Slave PCB7, check for 24VAC between pin 20 of REC3 of Master PCB1 and chassis

MAINTENANCE

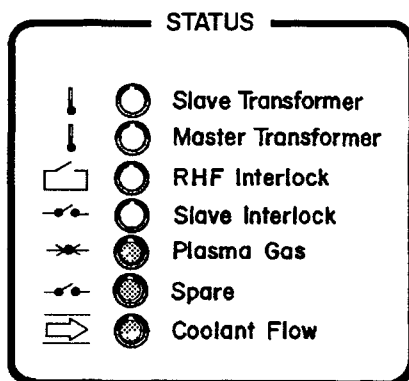
Problem

Possible Causes and Solutions

ground. If there is no 24VAC there, check connectors and associated wiring from REC3 of Master PCB1 to REC4 of Slave PCB7.

If wiring is OK, Slave PCB7 may need to be replaced.

5. Plasma GAS LED not lit:



5.1. Plasma gas pressure too low.

This LED will light when PS1 and PS2 in the gas console close after sensing plasma gas pressure of at least **100 psi (6.9 bar)**.

- Verify that both N₂ and O₂ incoming plasma gas pressures are **120 psi (8.2 bar)**.
- Check for gas leaks or loose gas connections if pressure is inadequate.

5.2. PS1 and/or PS2 in gas console not functioning.

- Check wiring, cables and connectors from REC3 of Master PCB1 to pins 14&15 of gas console 3X1 receptacle.

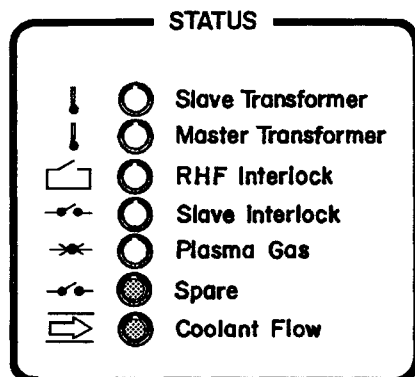
If wiring is OK, and inlet gas pressure is OK, PS1 and PS2 may need to be replaced

Repair and/or replace defective component(s), if necessary.

MAINTENANCE

Problem

6. Spare LED not lit:



Possible Causes and Solutions

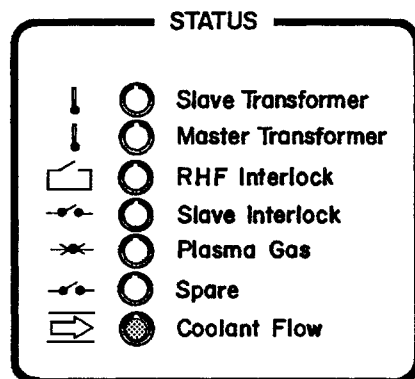
6.1. No jumper between pins 27&28 of REC3 of Master PCB1.

This LED will light when there is a short circuit between pins 27&28 of REC3 of Master PCB1.

- Verify that there is continuity between pins 27&28 of Master PCB1.

Repair and/or replace defective component(s), if necessary.

7. Coolant Flow LED not lit:



7.1. Coolant flow too slow.

This LED will light when flowswitch FS1 in the RHF console closes after sensing a coolant flow of at least **1.25 gpm (4.7 l/m)** to the torch.

- Verify that water chiller is plugged in and is ON.
- Verify that water supply is connected to water chiller and is ON.
- Verify that there are no leaks from water chiller to RHF console to torch.

7.2. Flow switch FS1 in HF console not functioning.

- Check cable, and wiring from REC3 of Master PCB1 to pins 7&8 of RHF console 2X1 connector for continuity.

If wiring is OK and inlet coolant flow is OK, FS1 may need to be replaced.

Repair and/or replace defective component(s), if necessary.

CHOPPER MODULE TEST PROCEDURE

This procedure applies to either Master or Slave power supply.

Note: Take voltages with a digital multimeter capable of storing min. and max. readings.



WARNING



SHOCK HAZARD: Use extreme care when working near the chopper modules. The large electrolytic capacitor(s) (blue-cased cylinder(s)) store large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge the capacitor(s) with a screwdriver or other implement...explosion, property damage and/or personal injury will result.

1. Turn all power to the HT4000 system OFF.
Disconnect mating receptacles in the HF console to disable the high frequency transformer T1. See Figure 4-15 for location of T1.
Note: RHF console door must be reshut before attempting to start system.
2. Remove large fuses F3 and F4. Check to see if fuse(s) is (are) open.
3. Place the positive lead to the + side of the bridge and the negative lead to the – side of the bridge. See Fig. 3-3. Note that actual connection points are hidden by cap support bracket in Fig. 3-3.
4. Turn power to the HT4000 ON, and start system up. After the START command has been given, check voltage. The input to the chopper at these points should be about +280 VDC. If the input is O.K. and corresponding fuse F3 or F4 was blown, replace the chopper module.
If there is no +280 VDC input, check input to bridge for shorts. Also, check contactor (CON1), connections and associated wiring to the contactor. Repair and/or replace defective component(s) if necessary.
5. If voltage from above step is +280 VDC and corresponding fuse is not blown, check output of CH1 by putting the positive lead of the voltmeter at point #48A and placing the negative lead on point #39A. (Check output of CH2 by placing positive lead of voltmeter on point #48B and negative lead on point #39B.)
6. Turn the system on and press the START command. After the START command has been given, check the voltage. If the output from each chopper at these points is +280 VDC, then choppers are OK.
7. If the chopper does not output +280 VDC, check to see if LED1 logic power light is on. If LED1 is not on, check if 120V is going to JP6. If there is no

MAINTENANCE

120V at JP6, check wiring back to power distribution board. Repair or replace defective component(s), if necessary.

Also check to see if LED3 is turning green when enabled (normal condition). If LED1 is on and LED3 is red when enabled (fault condition), then make sure that JP9 is seated properly. If JP9 is connected, disconnect one side of the thermo switch wire (TS1) and try again. If voltage comes up and LED3 turns green, the unit is either too hot or thermo switch is shorted. Allow unit to cool and repeat test. If LED3 still turns green, replace chopper module.

8. If chopper still does not output 280V after completing step 7, there may be a problem with the control signal or the chopper module. The chopper drive signal comes from the control board PCB7 as an analog level from 0 to +8 VDC, which varies the duty cycle and subsequent output current of the chopper.

To determine if there is a problem with the chopper modules or with control board PCB7, proceed as follows:

- Ensure that high frequency is still disabled (see step 1).
- Disconnect PL7 from REC3 on PCB7.
- Place voltmeter across output of chopper and press the START command.
- If the voltmeter reads +280 VDC, then replace control board PCB7.
- If the voltmeter reads 0 volts, then replace corresponding chopper module CH1 or CH2.

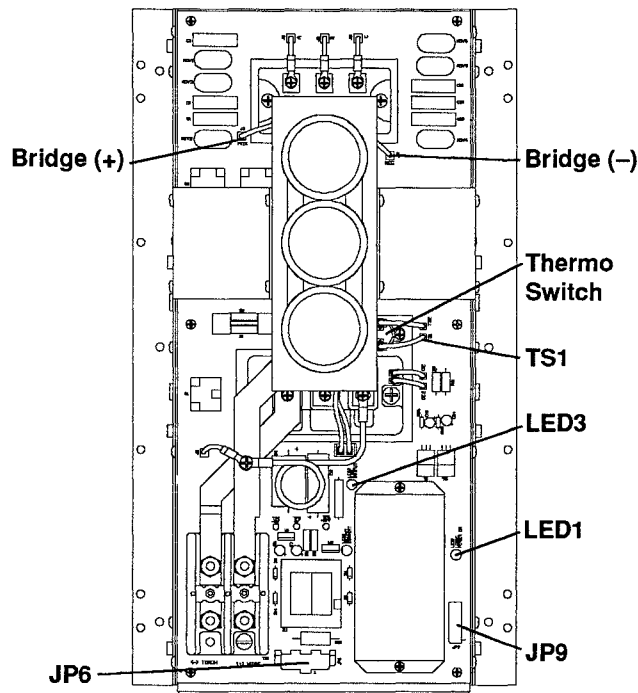


Figure 3-3 Chopper Module - Front View

RELAYS ON PCB7

Master μ P Control PCB7

The following are the left-to-right physical locations of the Master control board relays and their function. Microprocessor ports are labeled in each relay. Refer also to sheet 15 of 15 in **Section 5** to reference port assignments.

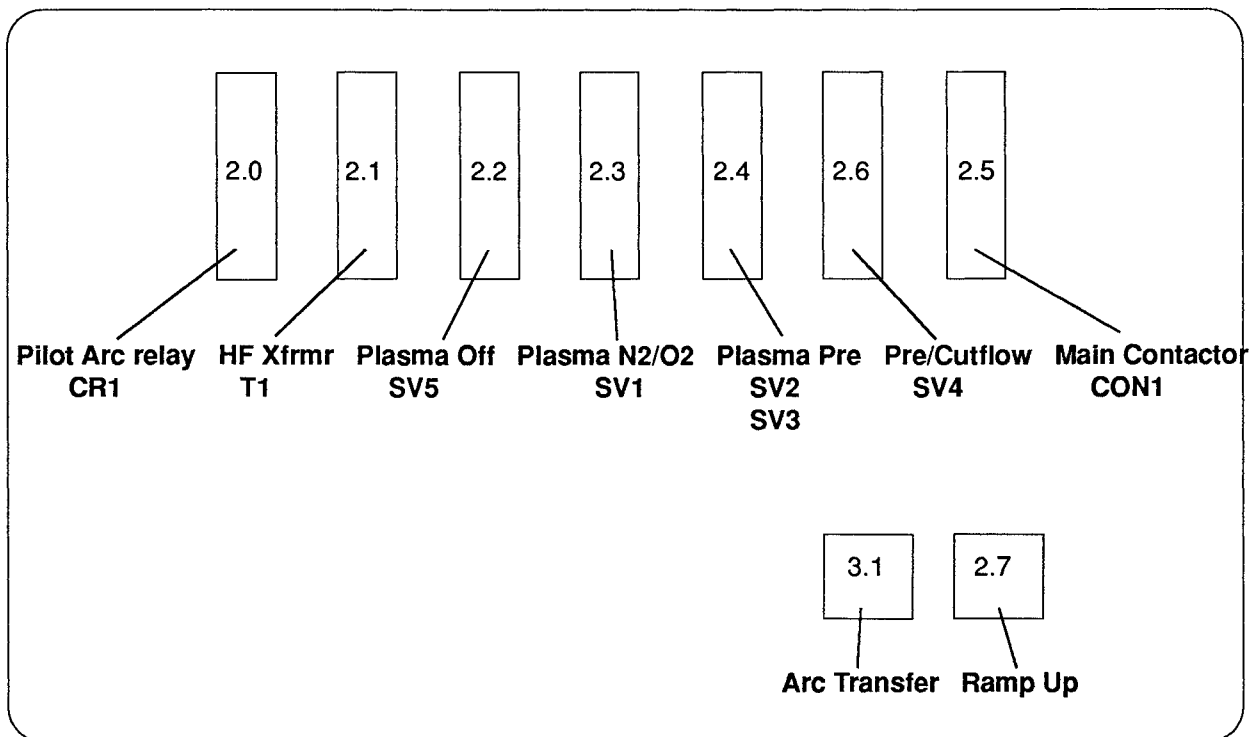


Figure 3-4 Relays on Master μ P Control PCB7

MAINTENANCE

RELAYS ON PCB7 (Cont.)

Slave μ P Control PCB7

The following are the left-to-right physical locations of the Slave control board relays and their function. Microprocessor ports are labeled in each relay. Refer also to sheet 15 of 15 in **Section 5** to reference port assignments.

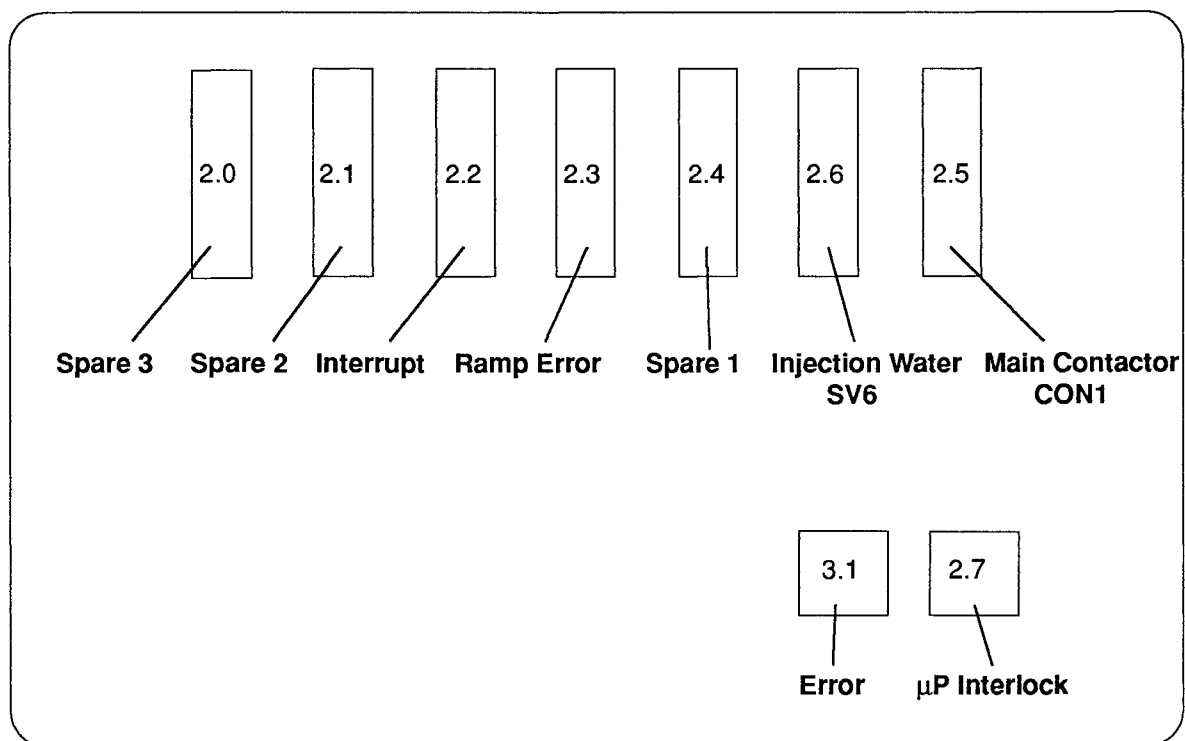


Figure 3-5 Relays on Slave μ P Control PCB7

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PARTS LIST

INTRODUCTION

In this section, a parts list breakdown with accompanying drawings for the HT4000 plasma torch system system is given.

The format to list and call out Hypertherm parts is as follows:

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029320	Chopper SA, 15KW, HT4000	CH1	1
1	001232	Bracket, HT4000 Chopper Module		2
2	004304	Bracket, Cap Mtg.		1
35	041118	PC BD Assy Snubber	PCB1	1
	009282	Cap: Pol .022μF 10% 250V	C1-C6 (onPCB1)	6
	009353	MOV, 250V, 40A	MOV1-3	3
36	041121	Chop Mod MAX100/80/200	PCB3	1

Item: Refers to item call out on opposing page.
Number (Ex. 1) refers to numbered call out ① on opposing page.

Part Number: Refers to Hypertherm part numbers.
Bold part numbers (Ex. **029320**) signify parent or subassemblies that contain additional items.

Normal-style part numbers (Ex. 001232) signify items under parent or subassembly.

Description: Describes the item.
Bold descriptions not indented (Ex. **Chopper SA, 15KW, HT4000**) signify parent assemblies that contain additional items.

Normal-style part numbers that are indented (Ex. Bracket, HT4000 Chopper Module) signify items under parent or subassembly. In this example, parent is **Chopper SA, 15KW, HT4000**.

Bold descriptions that are indented (Ex. **PC BD Assy Snubber**) represent subassemblies that are under a parent assembly.

PARTS LIST

In this example, parent assembly is **Chopper SA, 15KW, HT4000** and subassembly **PC BD Assy Snubber** contains additional items

Designator: Represents a cross reference to wiring diagrams or pneumatic diagrams.
(Ex. **CH1** refers to chopper assembly CH1 shown in wiring diagrams)

Note: When referencing components to the wiring diagrams in **Section 5**, designations may appear to be repeated. Ex: C1 appears on sheet 2 of 15 in the wiring diagrams in five separate locations. Sections of the Master power supply on that page are outlined with a dotted box and a label. Within different sections, the same designation may appear. Be certain to check the dotted box label when looking for or cross-referencing HT4000 parts.

Qty.: Refers to the number of items in the parent or subassembly.

PARTS LIST

FINDING PART NUMBERS

On the following page is an interconnect diagram with reference numbers to system components, cabling and hosing. Find the system component reference number in the diagram, and find the same reference number in the parts list. Components with many parts (such as the HT4000 Master power supply) are additionally broken down to major components and subassemblies.

Ex:



Refers to ① in the parts list.

Note: Some components common to both the Master and Slave power supplies are shown and referenced together.

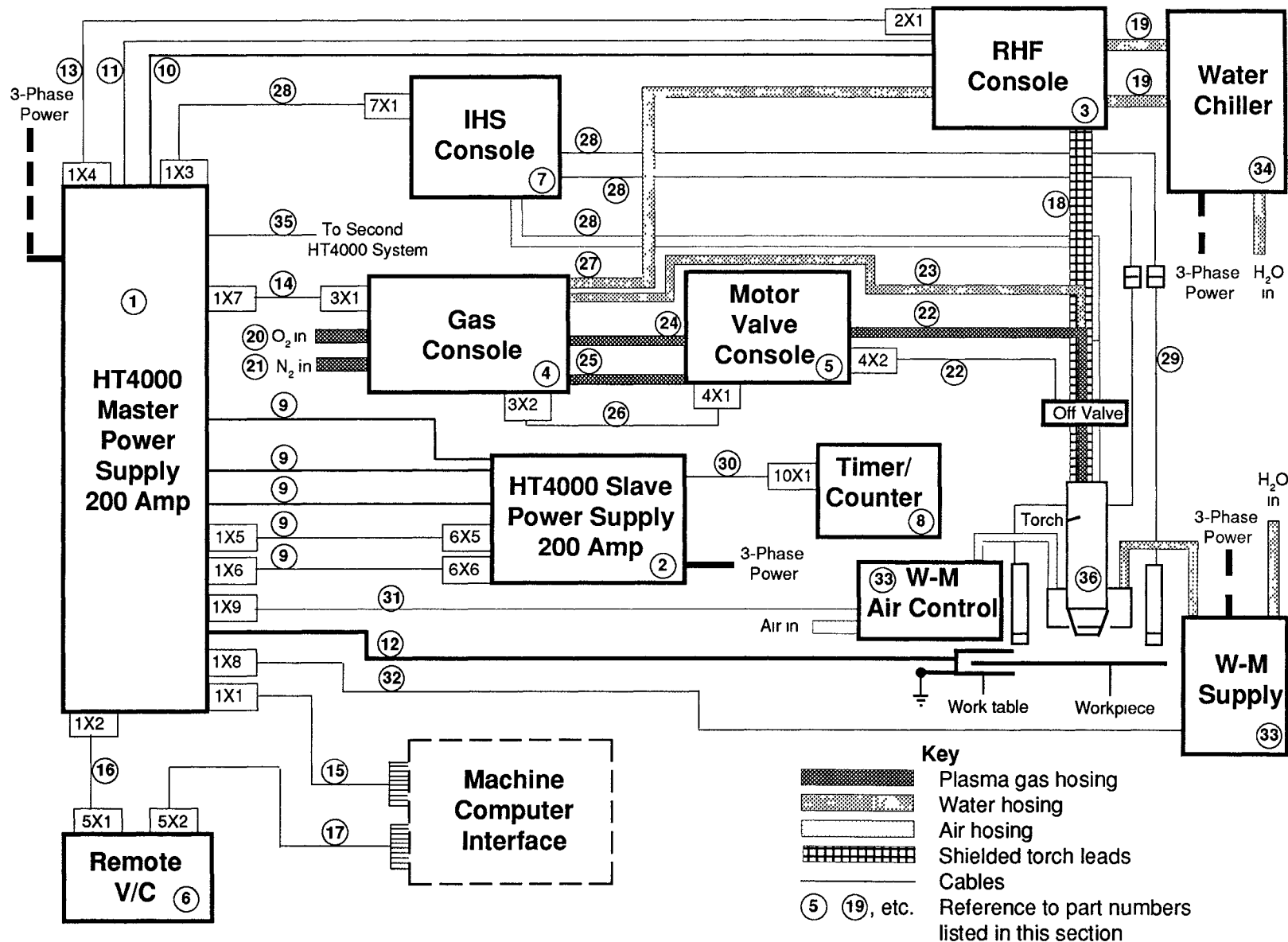


Figure 4-PL HT4000 Interconnect System Diagram with IHS and Water Muffler

PARTS LIST

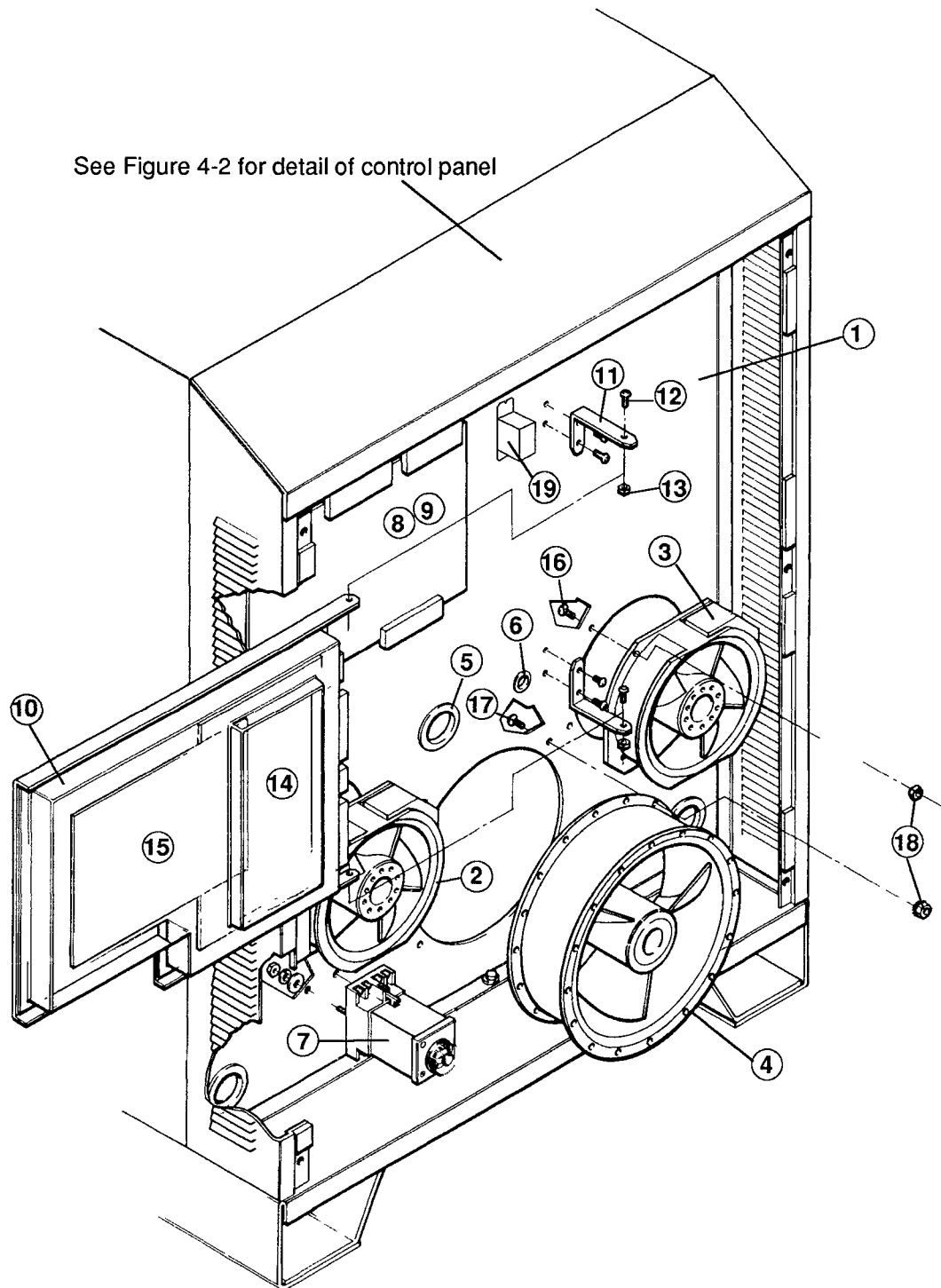


Figure 4-1 HT4000 Master Power Supply - Front Panel

PARTS LIST

HT4000 Master Power Supply (1) : Front Wall Outside

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029637	Enslosure SA, Master		1
1	001233	Panel, HT4000 Front		1
2	027080	Fan 225 CFM 120VAC 50/60Hz	M3	1
3	027080	Fan 225 CFM 120VAC 50/60Hz	M2	1
4	027079	Fan 450-550 CFM 120VAC 50/60Hz	M4	1
5	008509	Bushing 1.75 MTG X 1.37 ID		3
6	008245	Bushing, 7/8" Hole X 11/16" ID		1
7	027265	Timer DPDT Solid State 5A	CR3	1
8	041269	PCB Assy: HT4000 Miprcs	PCB7	1
9	081005	Firmware: HT4000 Master		1
	029675	HT4000 THC SA		
10	001297	Cov. HT4000 THC Dust		1
11	004338	Hinge - THC Pan, HT4000		2
12	075092	M/S, 10-32 X 1/2, PH, Pan, S/Z		6
13	075160	Kepnut, 10-32, S/Z		2
14	041290	PCB Assy: HT4000 THC M other	PCB9	1
15	041186	PCB Assy: HT4000 Torch Hght Cntrl	PCB10	1
16	075078	M/S, 8-32 X 5/8, PH, Pan, S/Z		8
17	075073	M/S, 8-32 X 1/2, PH, Pan, S/Z		4
18	075159	Kepnut, 8-32, S/Z		12
19	003074	Rly: 24VAC 10A DPDT	CR4	1

PARTS LIST

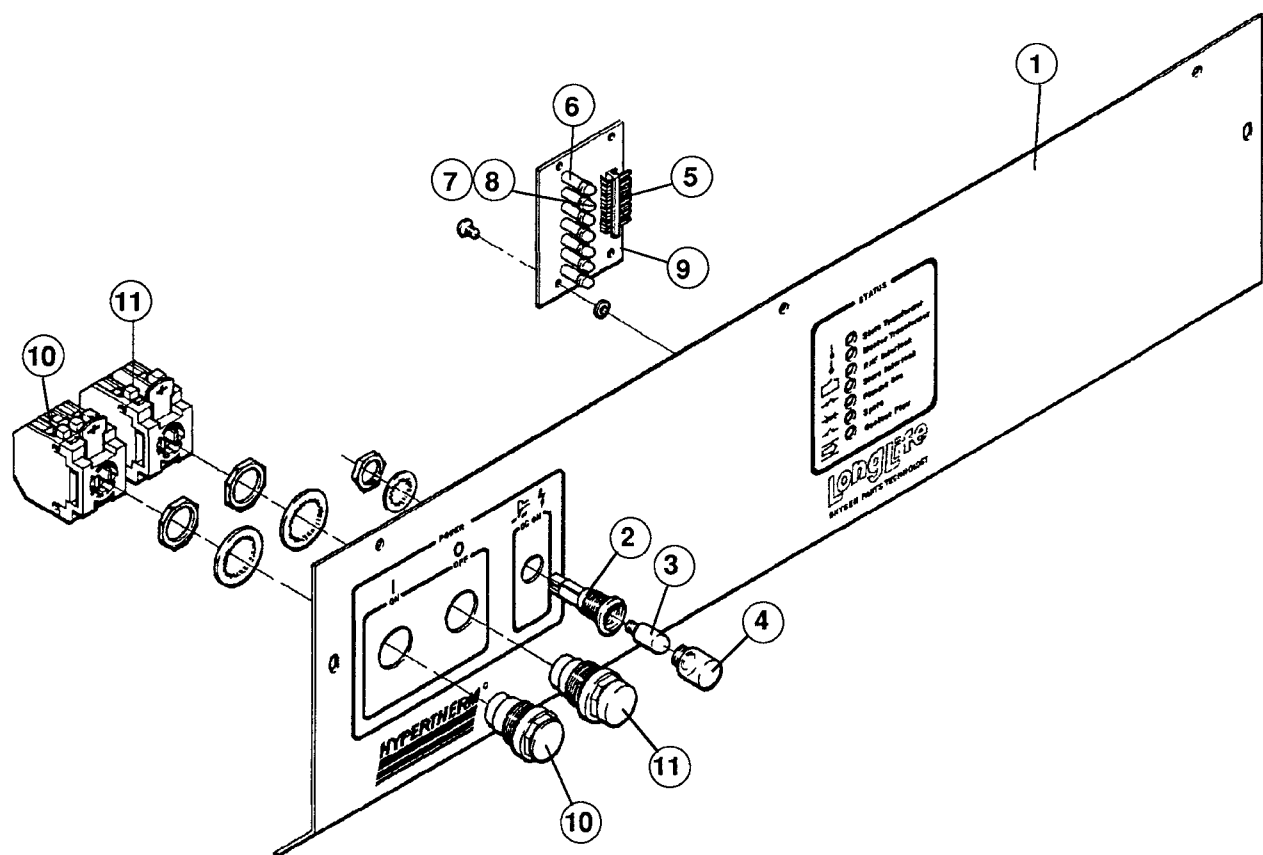


Figure 4-2 HT4000 Master Power Supply - Control Panel

PARTS LIST

HT4000 Master Power Supply ① : Control Panel

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029637	Enclosure SA, Master		1
	029745	Contr Pnl SA, HT4000		1
1	001398	Pnl: HT4000 Mstr Cont		1
2	005088	Lamp holder		1
3	005168	Bulb, 28VDC, 40 ma	LT2	1
4	005091	Lens: Red for 005088		1
	041149	PC BD Assy Intlk Dsply 200/1070	PCB5	1
5	008516	Post Header, 8-pin RA MTA-156		1
6	008517	Standoff, .19 OD .12 ID .50 LG		7
7	009399	Diode, Ind LED Grn		7
8	009705	Clip & Retain ring, T1-3/4 LED		7
9	041148	PC BD only Intlk Dsply 200/1070		1
	029655	Harness SA		1
10	005121	Pushbutton, 2 NO Green Illumin	PB1/LT1	1
11	005122	Pushbutton, 2 NC Red Extended	PB2	1

PARTS LIST

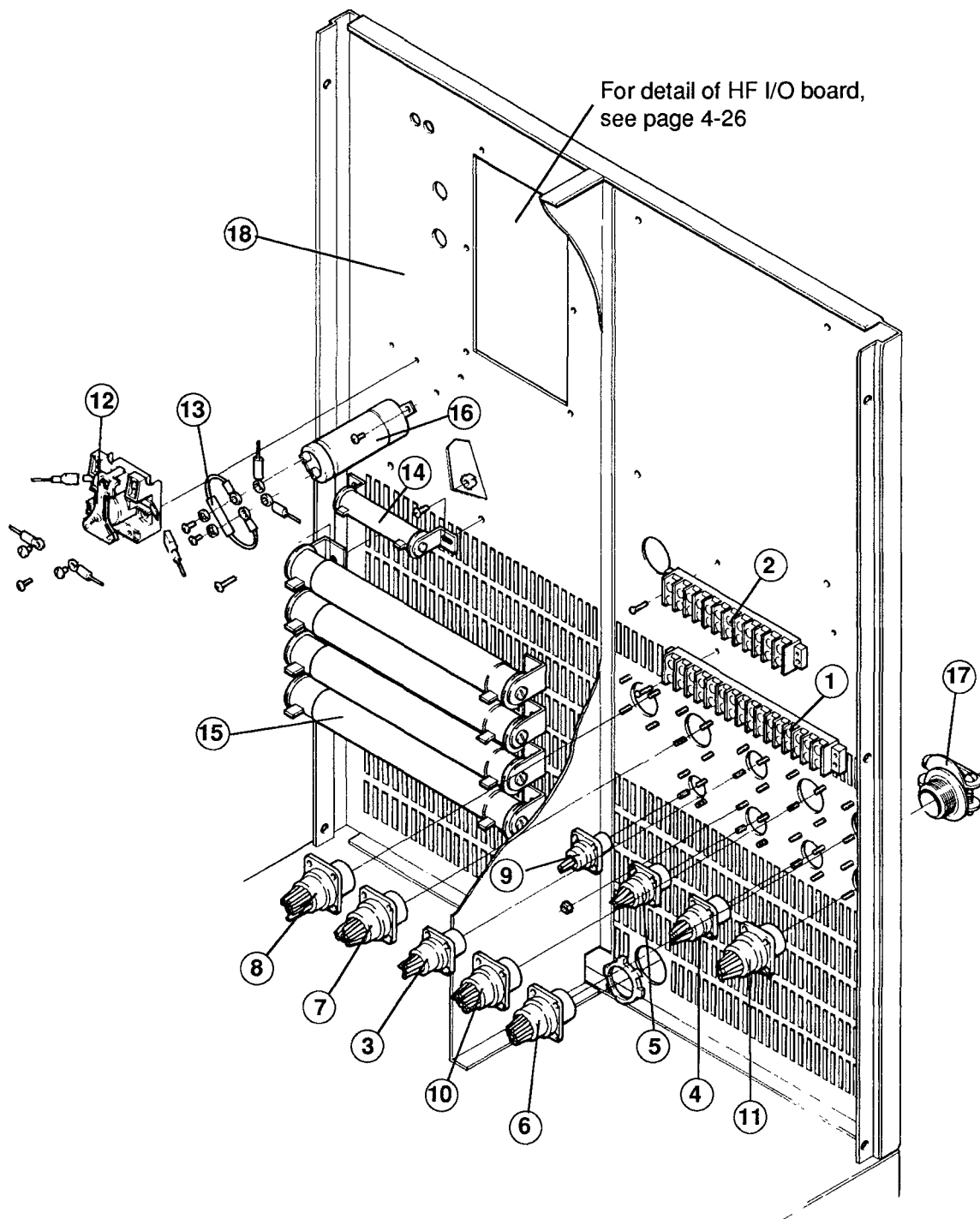


Figure 4-3 HT4000 Master Power Supply -- Rear Wall Inside

PARTS LIST

HT4000 Master Power Supply ① : Rear Wall Inside

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029637	Encl SA HT4100/4000 Master		
	029655	Harness HT4000 MA Main		
1	008073	Terminal Strip (16)	TB3	1
2	008079	Terminal Strip (12)	TB4	1
3	008201	RCPT Shell: CPC 17-14 Rvs Sex	1X3	1
4	008201	RCPT Shell: CPC 17-14 Rvs Sex	1X6	1
5	008201	RCPT Shell: CPC 17-14 Rvs Sex	1X9	1
6	008208	Receptacle, 23-37, Rev sex	1X2	1
7	008208	Receptacle, 23-37, Rev sex	1X4	1
8	008208	Receptacle, 23-37, Rev sex	1X7	1
9	008210	RCPT Shell: CPC 11-4 Rev Sex	1X8	1
10	008447	Receptacle, 23-37, Std Sex CPC	1X1	1
11	008447	Receptacle, 23-37, Std Sex CPC	1X5	1
12	003021	Relay, 120VAC NO SPST	CR1	1
13	009015	Res: 10K Ohm, 10W	R5	1
14	009438	Res: 5 Ohm, 50W	R4	1
15	009684	Res: 4 Ohm 420W W/Brkt	R6A-R6D	4
16	009506	Cap: 250μF, 350VDC	C1	1
17	008610	Strain relief, 1.5 ID, 1.5NPT		1
18	001400	Pnl:HT4000/4100 MA Rear		1

PARTS LIST

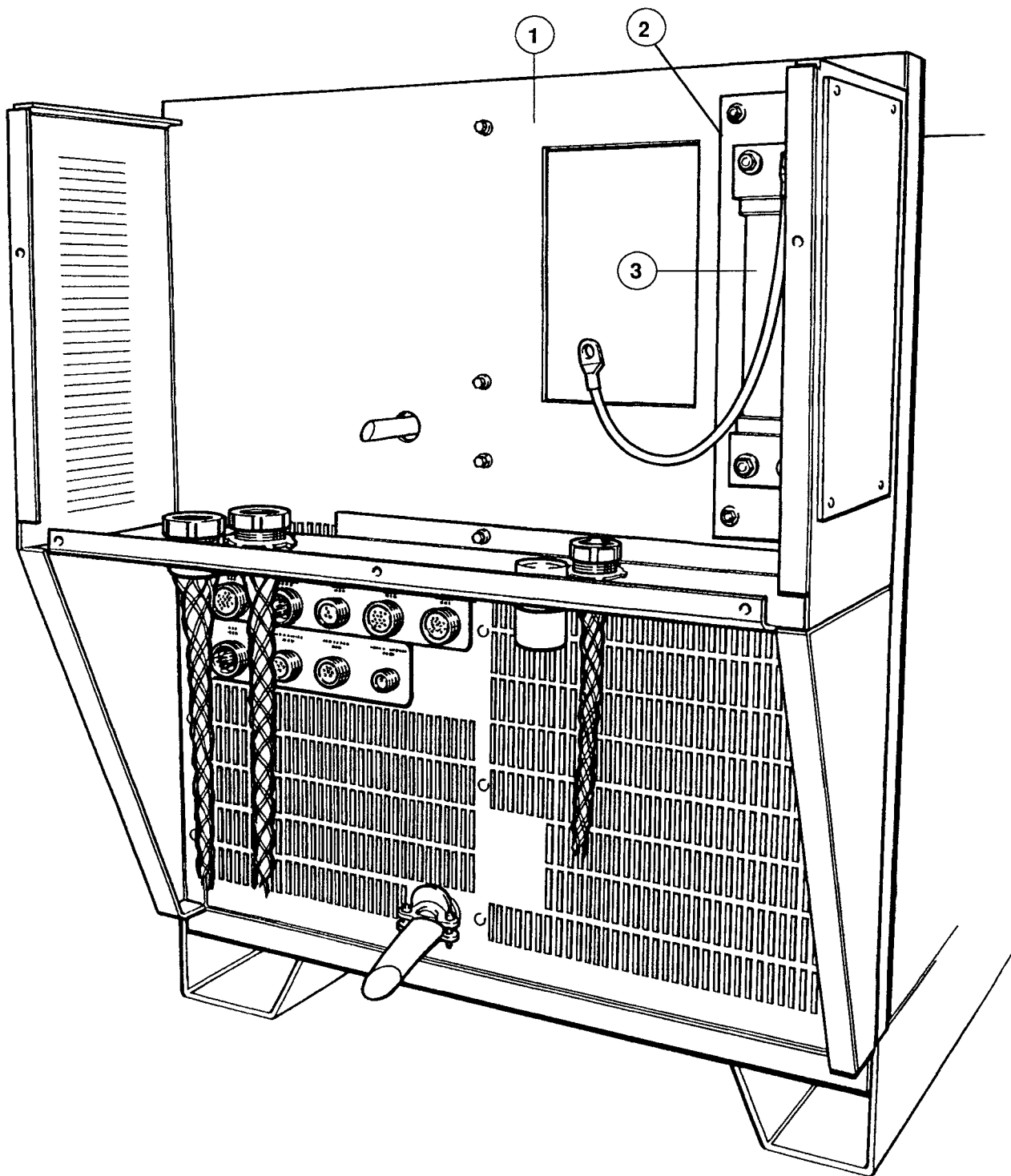


Figure 4-4 HT4000 Master Power Supply -- Rear Wall Outside

PARTS LIST

HT4000 Master Power Supply ① : Rear Wall Outside

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029637	Enclosure SA HT4000 Master		1
1	001400	Pnl: HT4000/4100 MA Rear		1
2	002209	Brkt: Shunt		1
3	007030	Shunt: 600A 100 MV 100%	R3	1

PARTS LIST

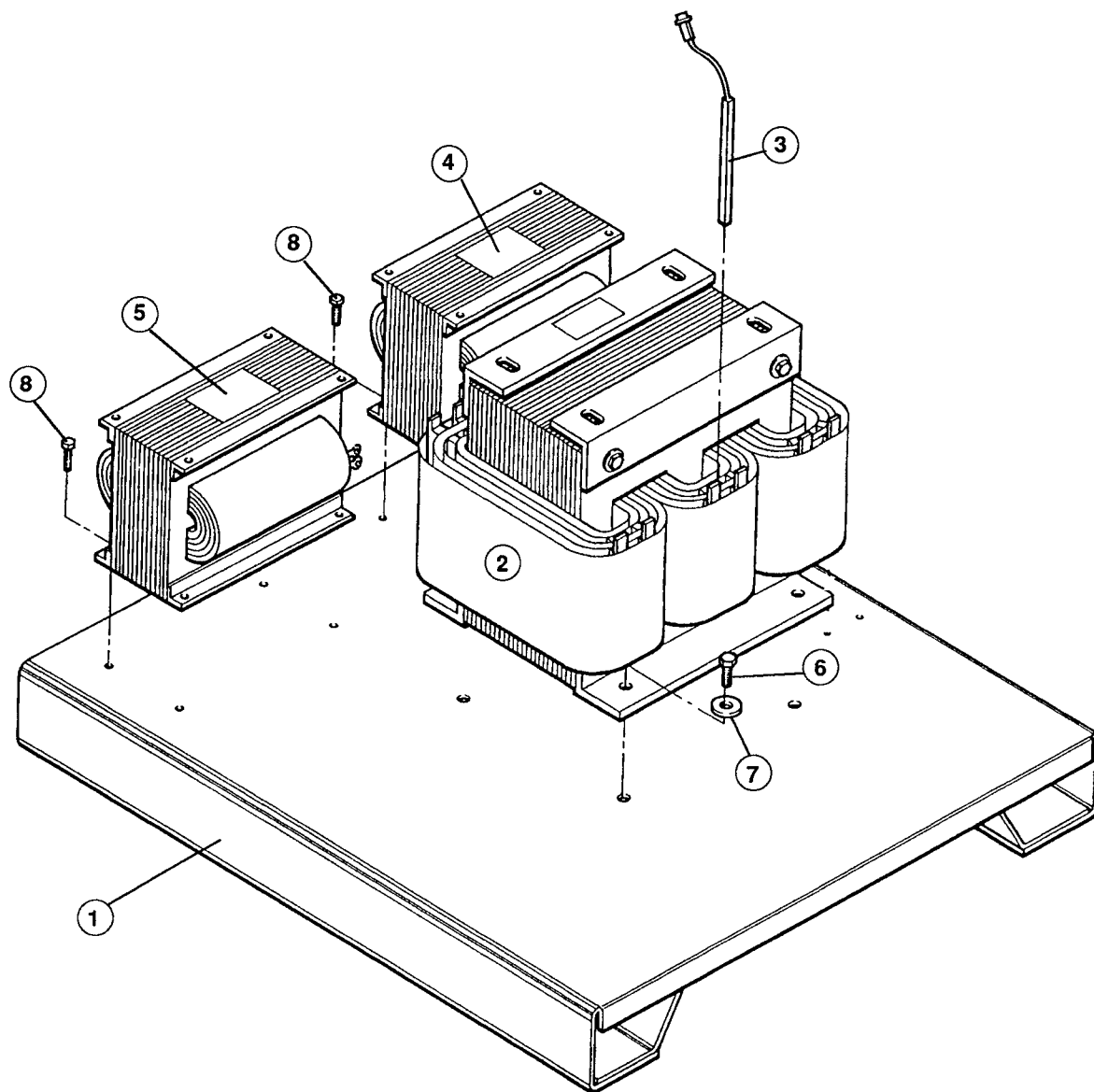


Figure 4-5 HT4000 Master & Slave Power Supplies - Base Plate and Components

PARTS LIST

HT4000 Master & Slave Power Supplies (1), (2) : Base Plate and Components

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	001229	Base, HT4000		1
2	014111	Transformer 30KW 200V/3PH/50	T2	1
	014078	Transformer 30KW 240-480V/3PH/60	T2	1
	014088	Transformer 30KW 380-415V/3PH/50	T2	1
	014082	Transformer 30KW 600V/3PH/60	T2	1
3	005102	Thermostat, 160°C, 6 Amp	TS1	1
	029637	Enclosure SA, Master		1
4	014080	Inductor, 4mh 100A	L1	1
5	014080	Inductor, 4mh 100A	L2	1
	029638	Enclosure SA, Slave		
4	014080	Inductor, 4mh 100A	L1	1
5	014080	Inductor, 4mh 100A	L2	1
6	075241	M/S, 1/4-20 X 1/2, SL, IHW, S/Z		4
7	075199	Flwshr, 1/2, .532, 1.06, .099, S/Z		4
8	075242	M/S, 1/4-20 X 3/4, SL, IHW, S/Z		1

PARTS LIST

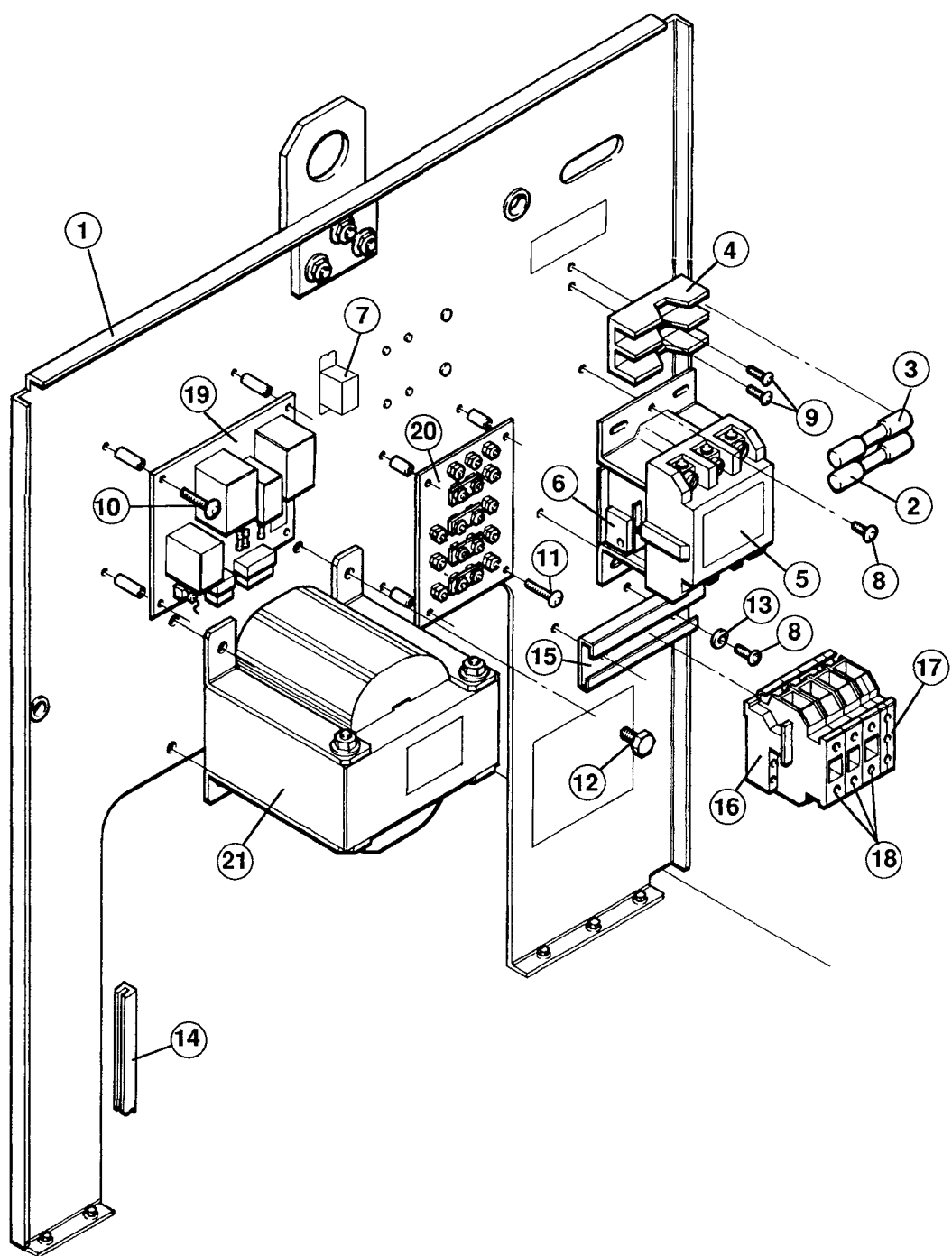


Figure 4-6 HT4000 Master & Slave Power Supplies - Center Wall Right Side

PARTS LIST

HT4000 Master & Slave Power Supplies ①, ② : Center Wall Right Side

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	001230	Panel, MAX200 Center		1
2	*008551	Fuse, 7.5 Amp, 600V	F1	1
2	**008709	Fuse, 20Amp, 500V	F1	1
3	*008551	Fuse, 7.5 Amp, 600V	F2	1
3	**008709	Fuse, 20Amp, 500V	F2	1
4	008301	Fuseholder, 2 Pole, 30 amp		1
5	003092	Contactor, 90A 3 Pole 24VAC	CON1	1
6	003093	Switch, aux contactor	S2 CON1	1
7	003074	Relay:24VAC 10A DPDT	CR2	1
8	075237	M/S, 10-32 X 3/8, PH, TRS, SSB		5
9	075062	M/S, 6-32 X 1/2, SL, Pan, S/Z		2
10	075055	M/S, 6-32 X 5/8, PH, Rnd, S/Z		4
11	075056	M/S, 6-32 X 1, PH, Rnd, S/Z		4
12	075241	M/S, 1/4-20 X 1/2, SL, IHW, S/Z		2
	075160	Kepnut, 1/4-20, S/Z		2
13	075200	Flwshr, #10, .250, .562, .047, S/Z		2
14	008603	Grommet Strip		18"
	029316	Incoming Power TB1 SA, MAX200	TB1	1
15	004290	Rail, 400E TB12/200 TB1		1
16	008295	Holder, E/UK Term Block End		1
17	008358	Terminal Block		1
18	008485	Terminal Block		3
19	041147	PC BD Assy Pwr Dist 200/1070	PCB1	1
20	°029359	Linkboard SA, 240-480V	LB1	1
21	029422	Cont Xf'mer SA 200V	T1	1
	029318	Cont Xf'mer SA 240-480V	T1	1
	029362	Cont Xf'mer SA 380-415V	T1	1
	029404	Cont Xf'mer SA 600V	T1	1

* Used when incoming power is 415V, 480V or 600V

** Used when incoming power is 200V, 240V or 380V

° Available only with 240 or 480V power supplies

PARTS LIST

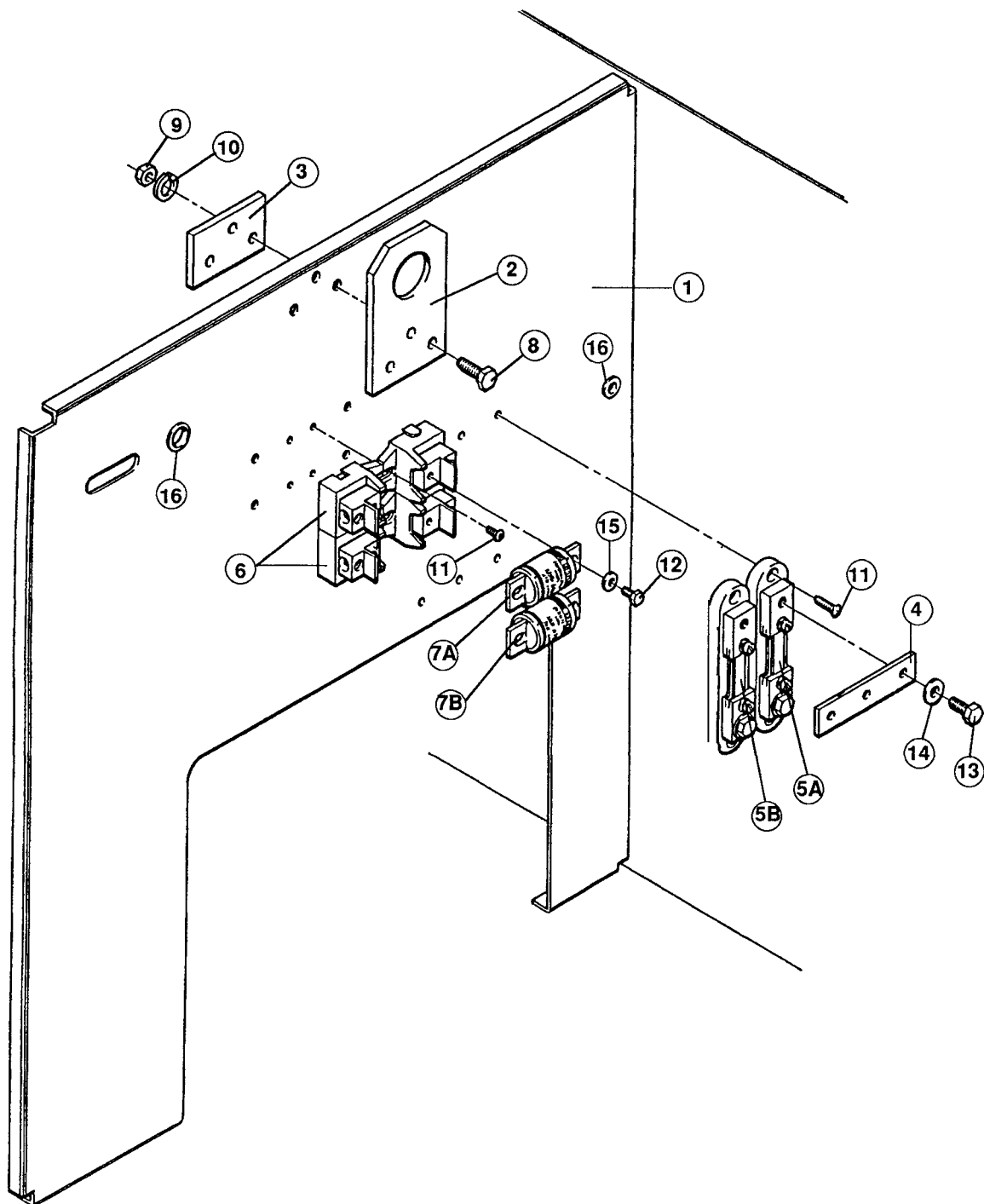


Figure 4-7 HT4000 Master & Slave Power Supplies - Center Wall Left Side

PARTS LIST

HT4000 Master & Slave Power Supplies (1) , (2) : Center Wall Left Side

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	001230	Panel, HT4000 Center		1
2	004261	Bar, Lift, MAX100 & 80		1
3	004262	Plate, Lift, MAX100 & 80		1
4	004334	Busbar, HT4000 Shunt		1
5A	007022	Shunt, 100A, 100mv	R2	1
5B	007022	Shunt, 100A, 100mv	R1	1
6	008316	Fuseholder, 100A		2
7A	008317	Fuse, Semiconductor 125A, 250V	F3	1
7B	008317	Fuse, Semiconductor 125A, 250V	F4	1
8	075137	Hhdcap, 3/8-16 X 1 1/4, Hex, S/Z		3
9	075166	Hexnut, 3/8-16, S/Z		3
10	075194	Lkwshr, 3/8, Splitlock		3
11	075092	M/S, 10-32 X 1/2, PH, Pan		10
12	075241	M/S, 1/4-20 X 1/2, SL, IHW		4
13	075136	Hhdcap, 3/8-16 X 3/4, Hex, S/Z		3
14	075216	Flwshr, 5/16		3
15	075192	Lkwshr, 1/4, Splitlock		4
16	008245	Bushing, 7/8" hole X 11/16" ID		2

PARTS LIST

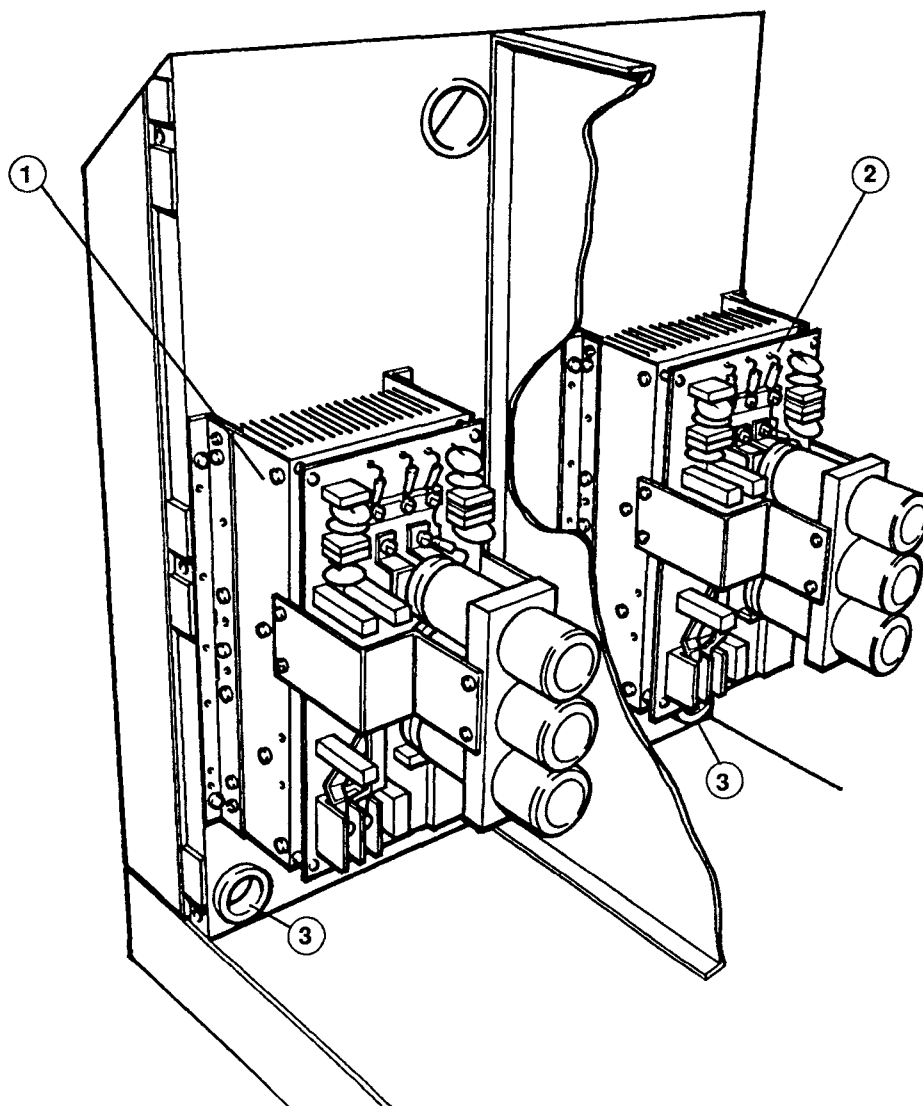


Figure 4-8 HT4000 Master & Slave Power Supplies - Front Wall Inside

PARTS LIST

HT4000 Master & Slave Power Supplies ①, ② : Front Wall Inside

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
1	029922	CH130 Chopper SA	CH1	1
2	029922	CH130 Chopper SA	CH2	1
3	008509	Bushing 1.75 MTG X 1.37 ID		3

PARTS LIST

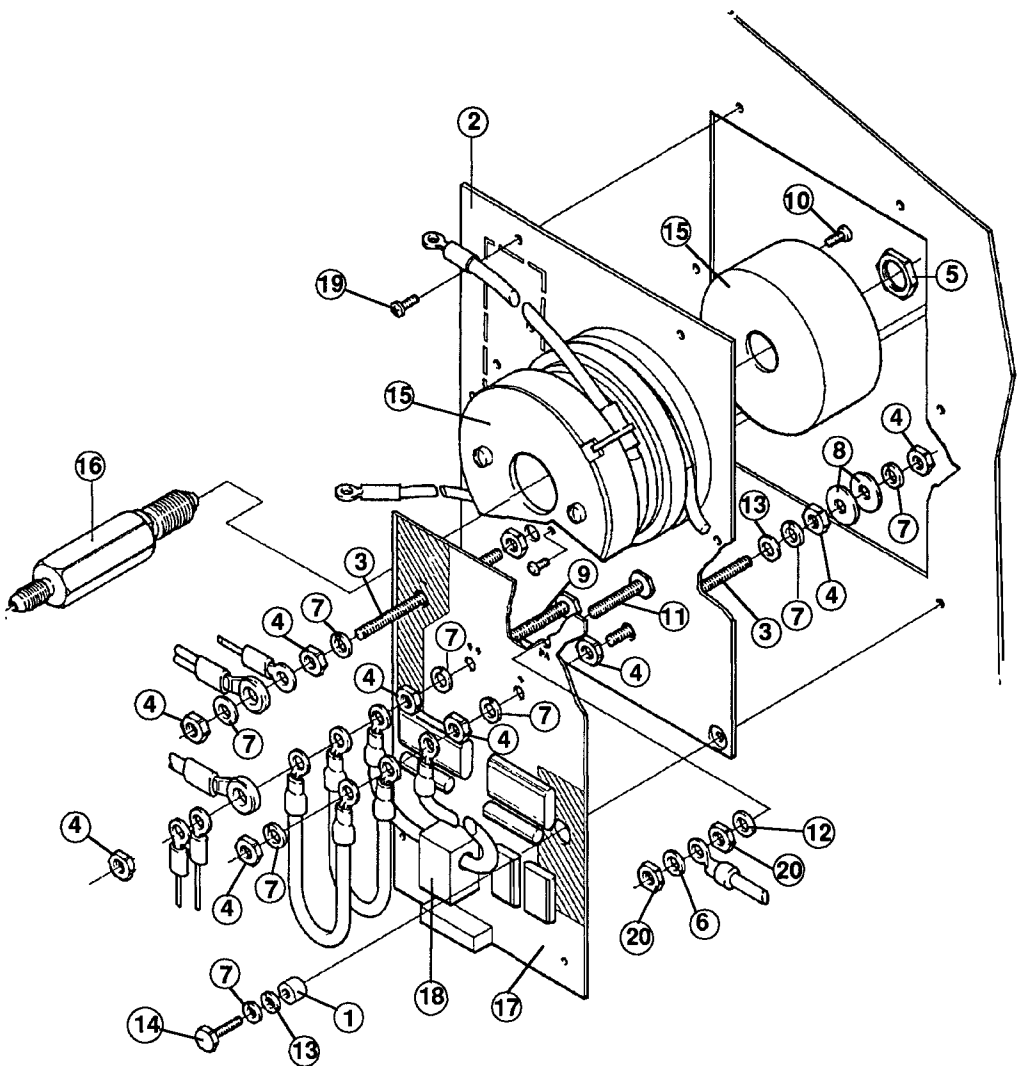


Figure 4-11 HT4000 Master & Slave Power Supplies - High Frequency & I/O PCB Assembly

PARTS LIST

HT4000 Master & Slave Power Supplies (1) (2): High Frequency and I/O PCB

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029806	4000/4100 HF & I/O PCB SA		1
1	004313	Spacer, .42ID X .750 X .50 lg		1
2	041152	Panel, MAX200 Output		1
3	004311	Standoff, MAX200 Anode		2
4	075153	Hexnut, 3/8-16, Finish, Brs		11
5	075156	Hexnut, 1/2-20, Finish/Jam, Brs		1
6	075193	Lkwshr, 5/16, Splitlock		2
7	075194	Lkwshr, 3/8, Splitlock, Brz		10
8	075217	Flwshr, 3/8, .390,.875,.063, Brs		5
9	075229	Bolt, 3/8-16 X 1 1/2, FTH, Hex, Brs		1
10	075335	M/S, 8-32 X 1/2, SL, Bin, Nyl		3
11	075347	Bolt, 5/16 X 11/4, Hex, Brz		1
12	075360	Flwshr, 5/16, .328,.520,.032, Brs		1
13	075361	Flwshr, 3/8, .394, .625, .032, Brs		2
14	075408	Hhdtap Bolt, 3/8-16 X 2", Hex, Brs		1
15	009356	Coil, A.C.T., 8G THHN	T1	1
16	004136	Connector, cathode		1
17	041145	PC BD Assy MAX200 I/O	PCB8	1
18	029202	Current Sensor SA	CS1	1
19	075072	M/S, 8-32 X 1/2		6
20	075152	Hexnut, 5/16-18 Finish Brs		2

PARTS LIST

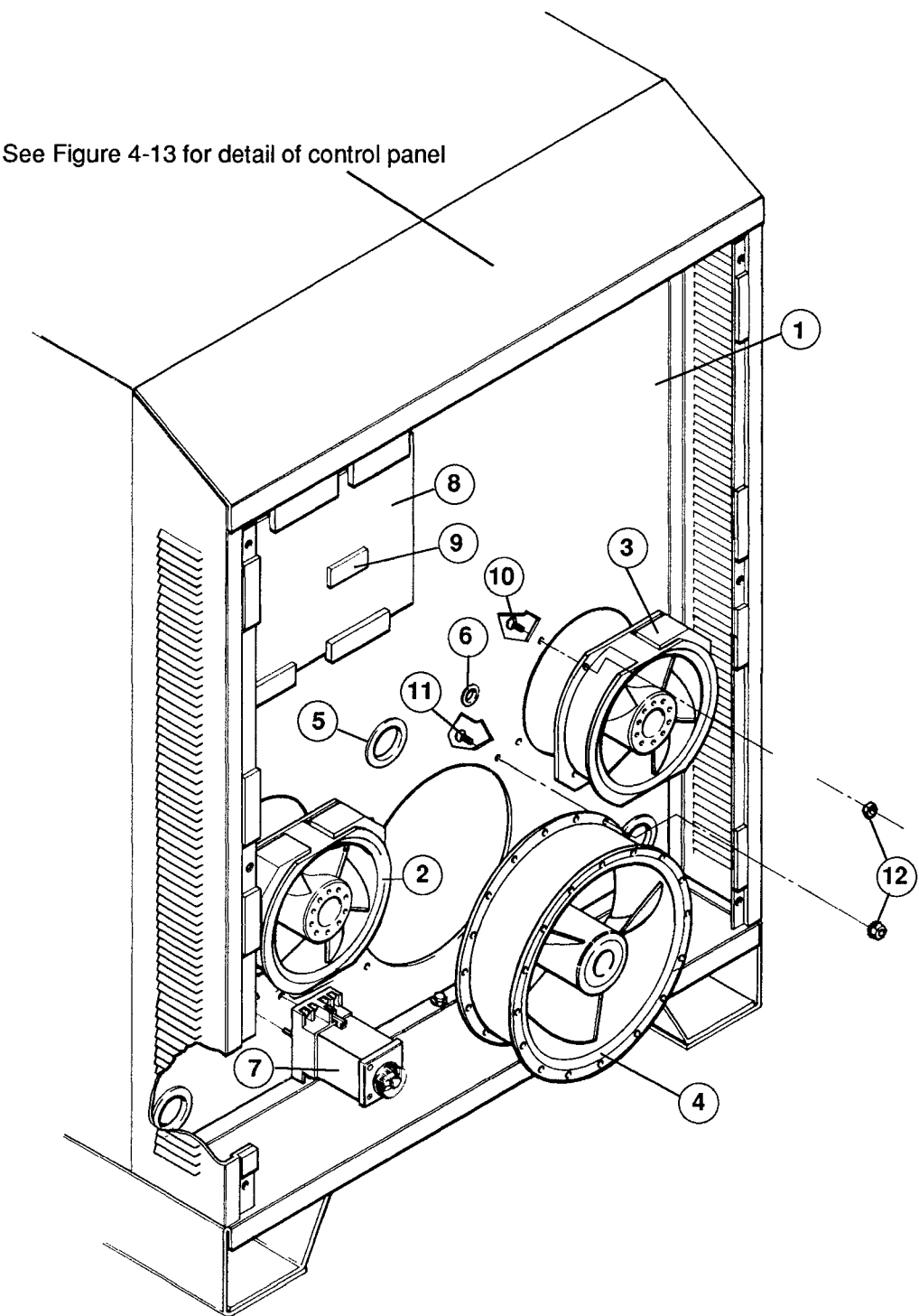


Figure 4-12 HT4000 Slave Power Supply -- Front Wall Outside

PARTS LIST

HT4000 Slave Power Supply ② : Front Panel

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029638	Enslosure SA, Slave		1
1	001233	Panel, HT4000 Front		1
2	027080	Fan 225 CFM 120VAC 50/60Hz	M3	1
3	027080	Fan 225 CFM 120VAC 50/60Hz	M2	1
4	027079	Fan 450-550 CFM 120VAC 50/60Hz	M4	1
5	008509	Bushing 1.75 MTG X 1.37 ID		3
6	008245	Bushing, 7/8" Hole X 11/16" ID		1
7	027265	Timer DPDT Solid State 5A	CR3	1
8	041270	PCB Assy: HT4000 Slave Cont.	PCB7	1
9	081006	Firmware: HT4000 Slave		1
10	075078	M/S, 8-32 X 5/8, PH, Pan, S/Z		8
11	075073	M/S, 8-32 X 1/2, PH, Pan, S/Z		4
12	075159	Kepnut, 8-32, S/Z		12

PARTS LIST

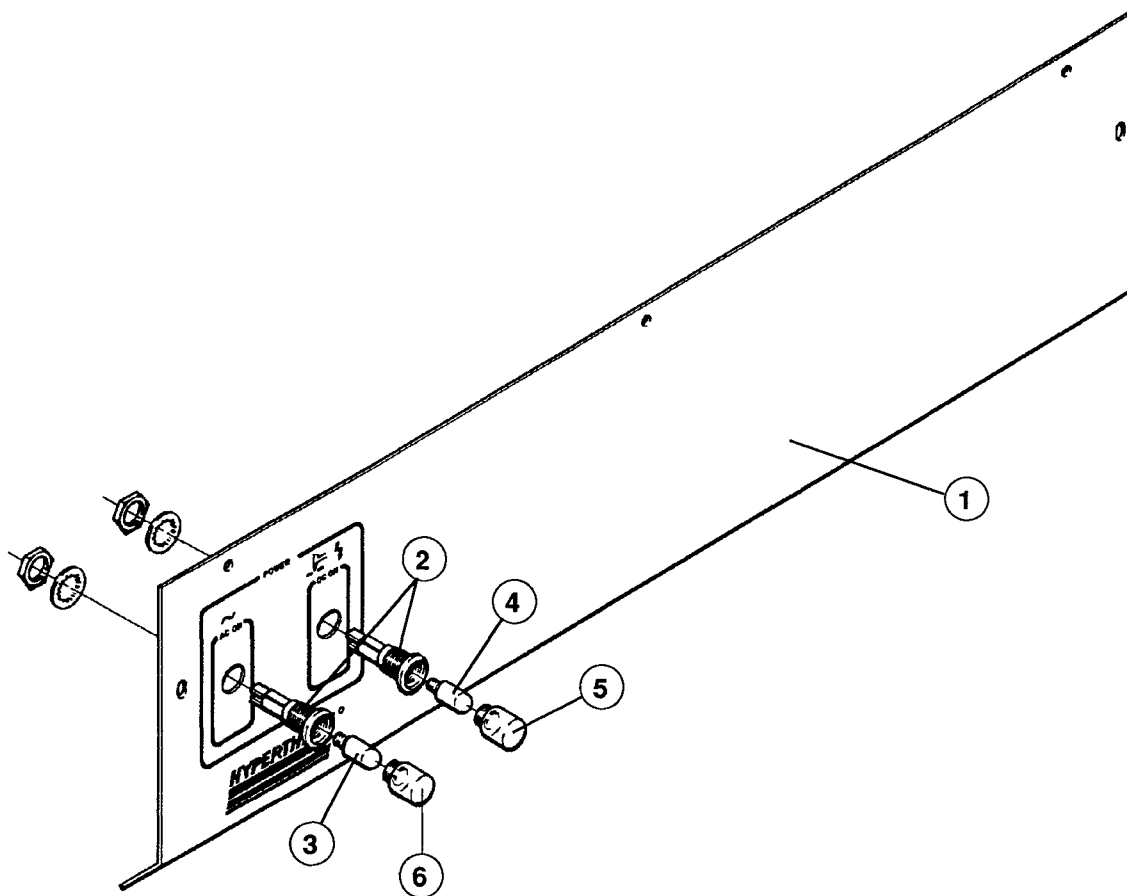


Figure 4-13 HT4000 Slave Power Supply -- Control Panel

PARTS LIST

HT4)00 Slave Power Supply ② : Control Panel

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029638	Enclosure SA, Slave		1
	029640	Contr Pnl SA, HT4000 Slave		1
1	001399	Pnl: HT4000 Slave Cont		1
2	005088	Lamp holder		2
3	005168	Bulb, 28VDC, 40 ma	LT1	1
4	005168	Bulb, 28VDC, 40 ma	LT2	1
5	005091	Lens: Red for 005088		1
6	005089	Lens: Wht for 005088		1

PARTS LIST

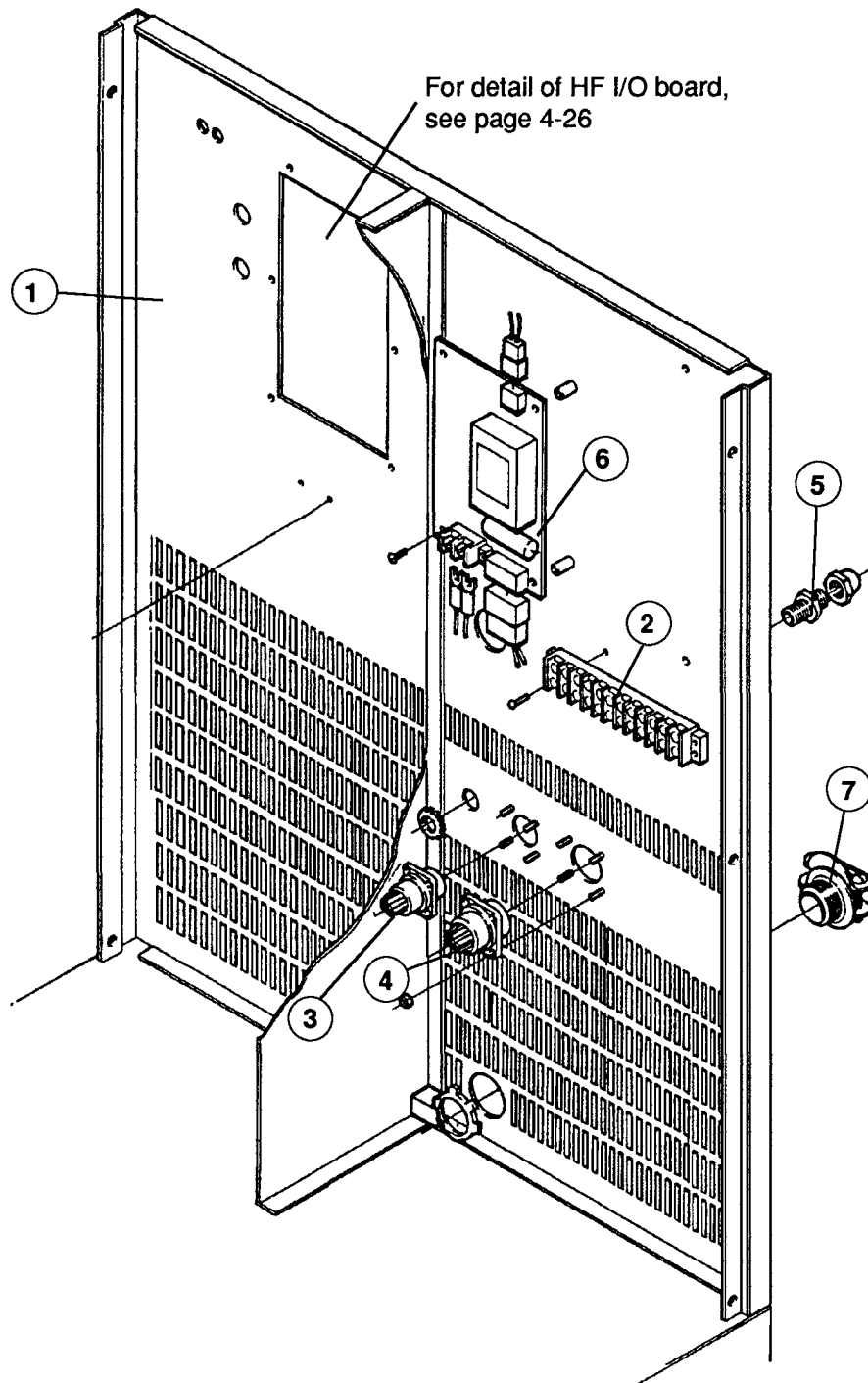


Figure 4-14 HT4000 Slave Power Supply -- Rear Wall Inside

PARTS LIST

HT4000 Slave Power Supply (2) : Rear Wall Inside

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	029638	Encl SA HT4000/4000 Slave		
1	001401	Pnl:HT4000/4100 Slave Rear		1
	029639	Harness SA HT4000/4000 Slave		
2	008079	Terminal Strip (12)	TB4	1
3	008178	RCPT Shell: CPC 23-24 Std Sex	6X5	1
4	008201	RCPT Shell: CPC 17-14 Rvs Sex	6X6	1
5	008212	Strainrlf: 1/2NPT X .197-.354		1
6	041274	PCB Assy Iso-Amp		1
7	008610	Strain relief, 1.5 ID, 1.5NPT		1

PARTS LIST

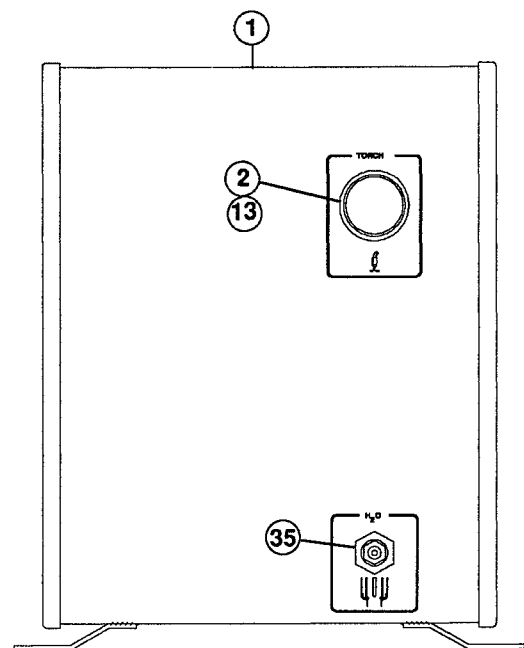
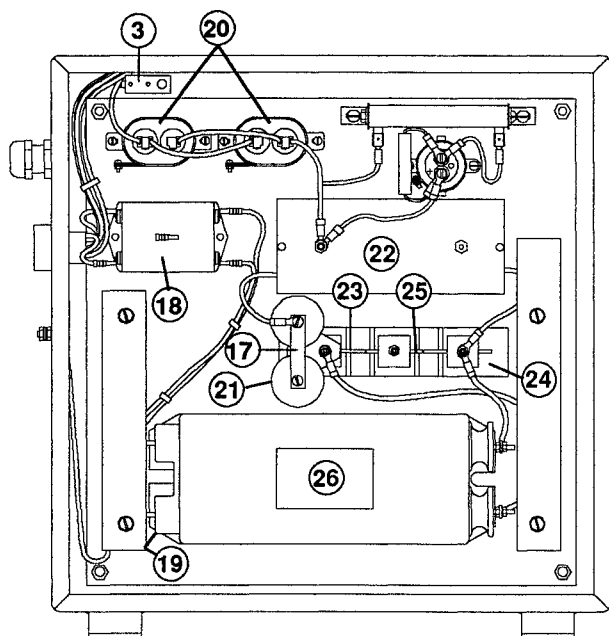
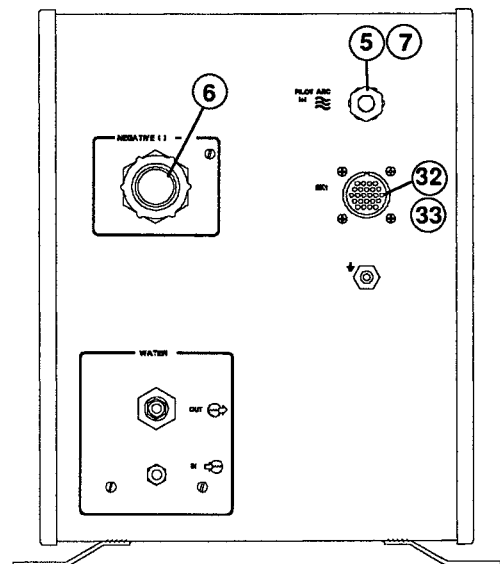
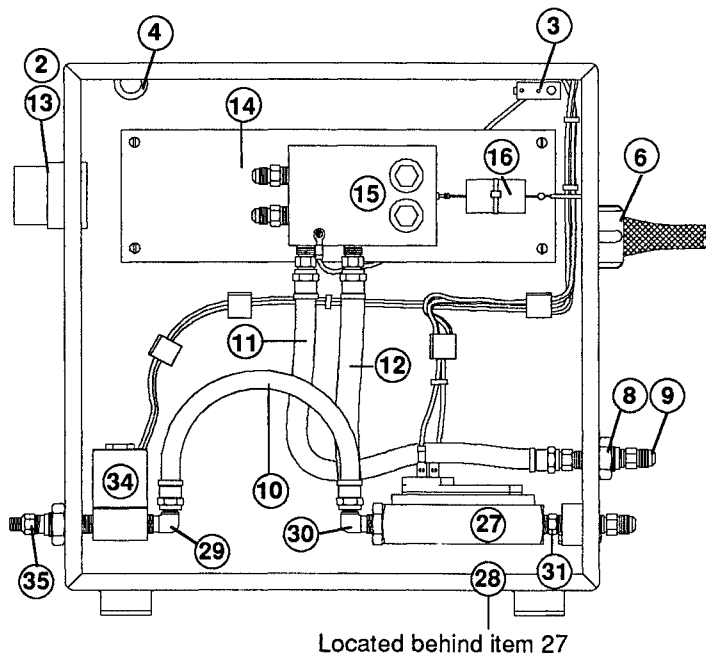


Figure 4-15 Remote High Frequency Console

PARTS LIST

Remote High Frequency Console (3) (073052)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	073052	HT4000 RHF Console		
1	001407	Encl: HT4000 RHF CSL		1
2	004078	Shld Adptr:200/400/500/HD1070		1
3	005100	Switch, Door Interlock	S1, S2	2
4	008082	Bshg: 1/2 ID X 5/8 Hole		3
5	008212	Strainrlf: 1/2NPT X .197-.354		1
6	008482	Strainrlf, .92/1.25 Dia		1
7	008643	Locknut, 1/2" NPT		1
8	015001	Adapter, Bulkhead, 1/4 NPTF		2
9	015012	Adapter, 1/4 NPT X #6		3
10	024040	Hose Assy, #4 X 12"		1
11	024111	Hose Assy, #6 X 13"		1
12	024256	Hose Assy, #6 X 6-1/2"		1
13	027014	Lockwasher, UW 004078 SH Adapt		1
	029641	Neg Bus SA		1
14	002135	Pnl: Neg Bus		1
15	004074	Blk: 200/400/500 Cath Neg Bus		1
16	009224	Cap, Pol .22 µF 1000 WVDC 10%		1
	029642	Hi Freq SA		1
17	004144	Bar:009350 Spk Gap Cap Mtg		1
18	009040	Filter, AC, 3 Amp 3Wl	FL1	1
19	009214	Cap, Pol .047µF 1000WV		1
20	009246	Cap, Poly-Paper .5µF 2500V	C2A,C2B	2
21	009280	Cap: .002µF 15kV	C3,C4	2
22	009320	Inductor, Hi Freq Coil	T2	1
	009321	Spark Gap Assy	SG1	1
23	004061	Electd: Spk Gap 1/8 X 1.6		2
24	004081	Base:500L/400/200 Spk Gap Porc.		1
25	004089	Electd: Spk Gap 1/8 X 2		1
26	014004	Transformer; 5000V 30 MA	T1	1
	029658	Kobold Flsw Manf SA HT4000		1
27	005139	Flsw: 0.25 GPM SPST 1/4 NPT	FS2	1
28	005140	Flsw:1.20 GPM SPST 1/4 NPT	FS1	1
29	015014	Adapter 90, 1/4 NPT x #4		1
30	015015	Adapter 90, 1/4 NPT X #6		1
31	015510	Nipple 1/4 X Cl, Hex		2
	029659	Harn: HT4000 RHF Csl		1
32	008193	Rcpt Shell: CPC 17-16 Std Sex	2X1	1
33	008205	Pin: 18-16 AWG Type III		10
34	006031	Sol Valve:350# 1/4 FPT 120V NC	SV6	1
35	015047	Adapt, 1/4 MNPT X ACC "A" /LH		1

PARTS LIST

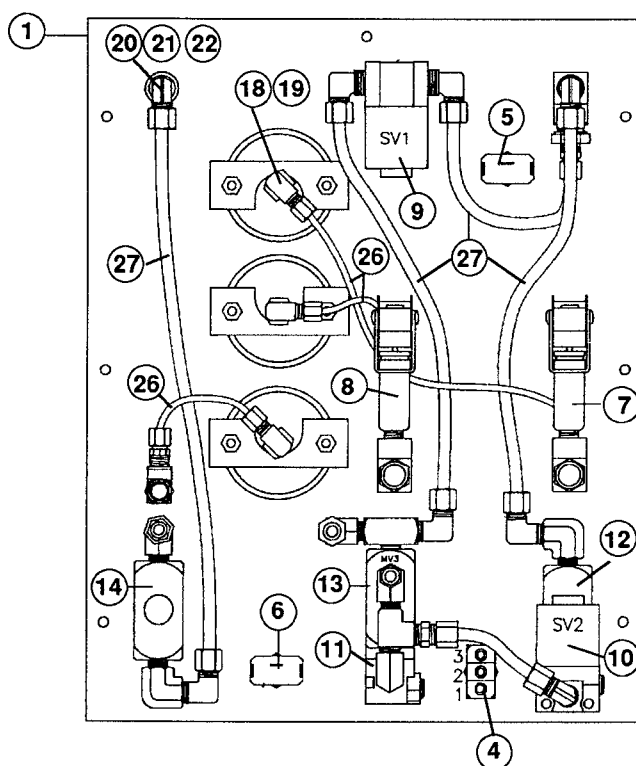
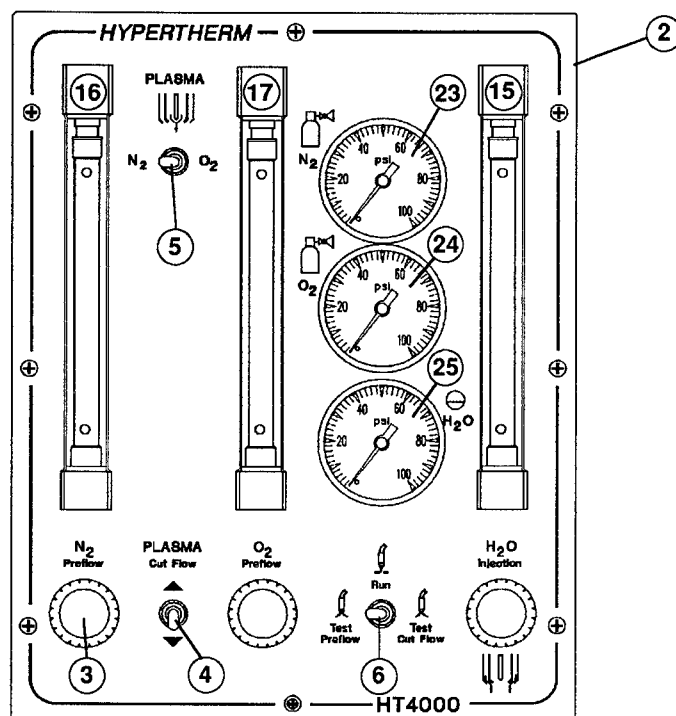


Figure 4-16 Gas Console

PARTS LIST

Gas Console (4) (073081)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	073081	HT4000 Gas Console		
1	001335	Encl: HT4000/4100/2000 Gas Csl		1
	029757	Front Pnl SA HT4000 Gas Csl		1
2	001402	Pnl:Front Gas Cnsl HT4000		1
3	004117	Cap:Ndl Valve		3
4	005042	Tgl Sw: SP MOM ON/OFF/ON	S3	1
5	005044	Tgl Sw: SPDT Maint ON/ON	S1	1
6	005156	Tgl Sw: SPDT Maint ON/OFF/ON	S2	1
7	005162	PressSw:0-200 PSI 1/8 NPT	PS1	1
8	005162	PressSw:0-200 PSI 1/8 NPT	PS2	1
9	006057	Sol Valve: 150# 1/SFPT 120V 3W	SV1	1
10	006057	Sol Valve: 150# 1/SFPT 120V 3W	SV2	1
11	006057	Sol Valve: 150# 1/SFPT 120V 3W	SV3	1
12	006064	Meter Valve:1/8 FPT .062 Orf	MV2	1
13	006064	Meter Valve:1/8 FPT .062 Orf	MV3	1
14	006064	Meter Valve:1/8 FPT .062 Orf	MV4	1
15	011056	Flowmeter, 0.45 GPM/1.9 SCFM	FM3	1
	011057	Flowtube/BT-8 Float:0-10 SC Cal. 2%		1
	011008	Shield, Plastic, 63S0503M0010		1
16	011056	Flowmeter, 0.45 GPM/1.9 SCFM	FM1	1
	011057	Flowtube/BT-8 Float:0-10 SC Cal. 2%		1
	011008	Shield, Plastic, 63S0503M0010		1
17	011053	Flowmeter, 7.8 GPM/44CFH	FM2	1
	011058	Flowtube/BP-8 Float:0-10 SC Cal. 2%		1
	011008	Shield, Plastic, 63S0503M0010		1
18	015135	Insert, 1/8 OD Brass		6
19	015136	Fitting 90 1/8 Tube X 1/8 NPTF		3
20	015139	Fitting 90, 1/4 Tube X 1/4 NPT		1
21	015608	Sleeve, Delrin 1/4" OD		10
22	015609	Insert Brass (1/4 OD)		10
23	022020	Gauge:Press 160 Psi/Bar Pnl Mt	PG1	1
24	022020	Gauge:Press 160 Psi/Bar Pnl Mt	PG2	1
25	022024	Gauge:Press 200 Psi/Bar	PG3	1
26	046048	Tubing, 1/8 OD Blk Air Brake		1.6ft
27	046078	Tubing, 1/4 OD X .040 Blk Nyl		3.4ft

PARTS LIST

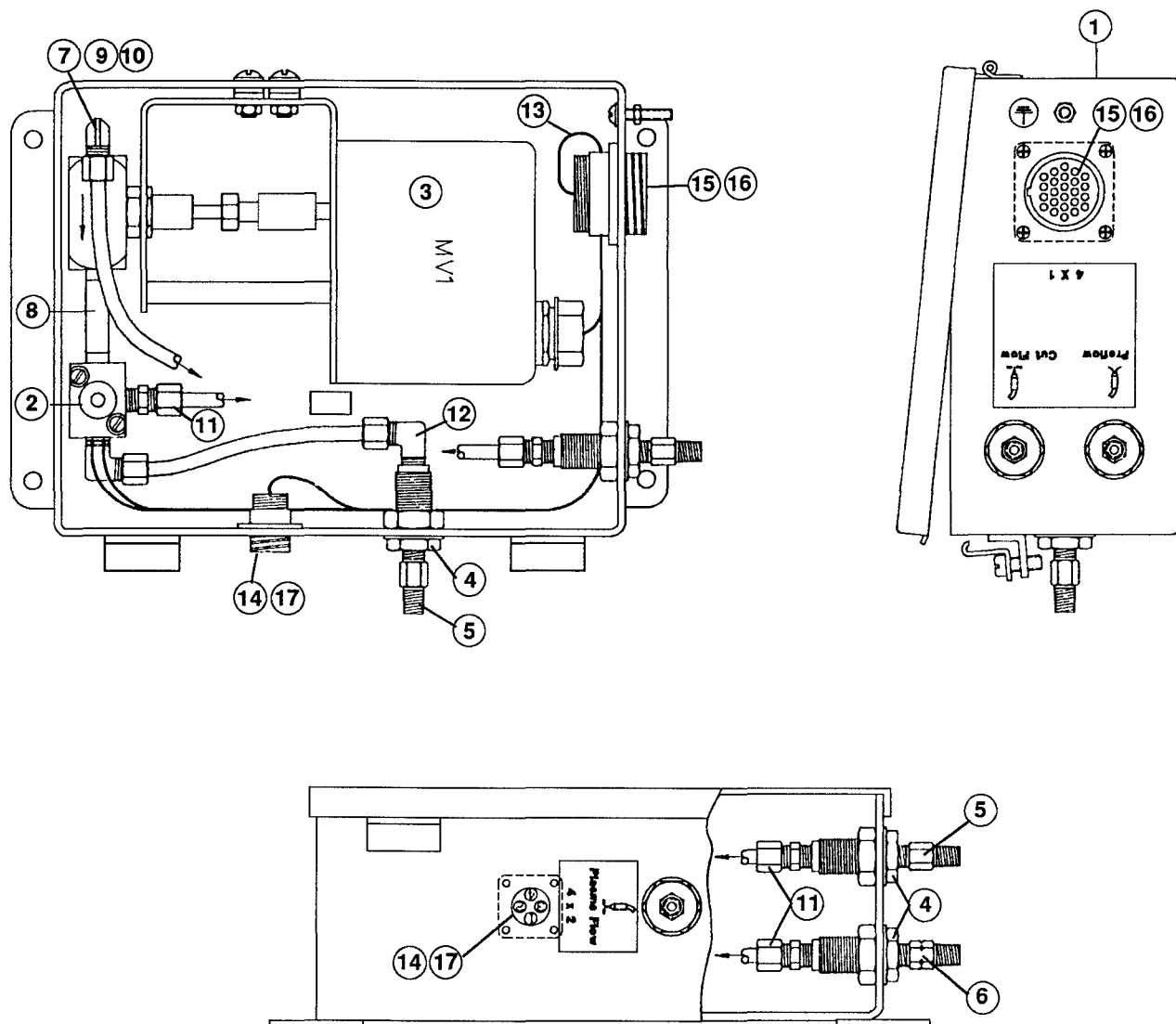


Figure 4-17 Motor Valve Console

PARTS LIST

Motor Valve Console (5) (073073)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	073073	Motor Valve Console, HT4000		
1	002218	Encl: HT4000 Mtr Valve Csl		1
2	006057	Sol Valve: 150# 1/8FPT 120V 3W	SV4	1
3	006063	Mtr Valve: Elec 1/8FPT .125 orf	MV1	1
4	015050	Adapter, Bulkhead, 1/8 X 1-1/2		3
5	015116	Adapter, 1/8 NPT X Oxy 'A'		2
6	015210	Adapter, 1/8 NPT X Acet 'A'-LH		1
7	015530	Street Elbow 1/8		1
8	015588	Nipple, 1/8 X 2"		1
9	015608	Sleeve, Delrin 1/4" OD		6
10	015609	Insert Brass (1/4 OD)		6
11	015611	Connector Male 1/4 Tube X 1/8		3
12	015612	Elbow, Male 1/4 Tube X 1/8 NPT		3
13	029759	Harn: HT4000 Mtr Valve Csl		1
14	008210	Rcpt Shell: CPC 11-4 Rvs Sex	4X2	1
15	008447	Receptacle, 23-37, Std Sex CPC	4X1	1
	029765	Wire GP: HT4000 Mtr Valve Csl		1
16	008176	Pin: 24-20 AWG Type III + CRP		
17	008186	Skt: 24-20 AWG Type III + CRP		3

PARTS LIST

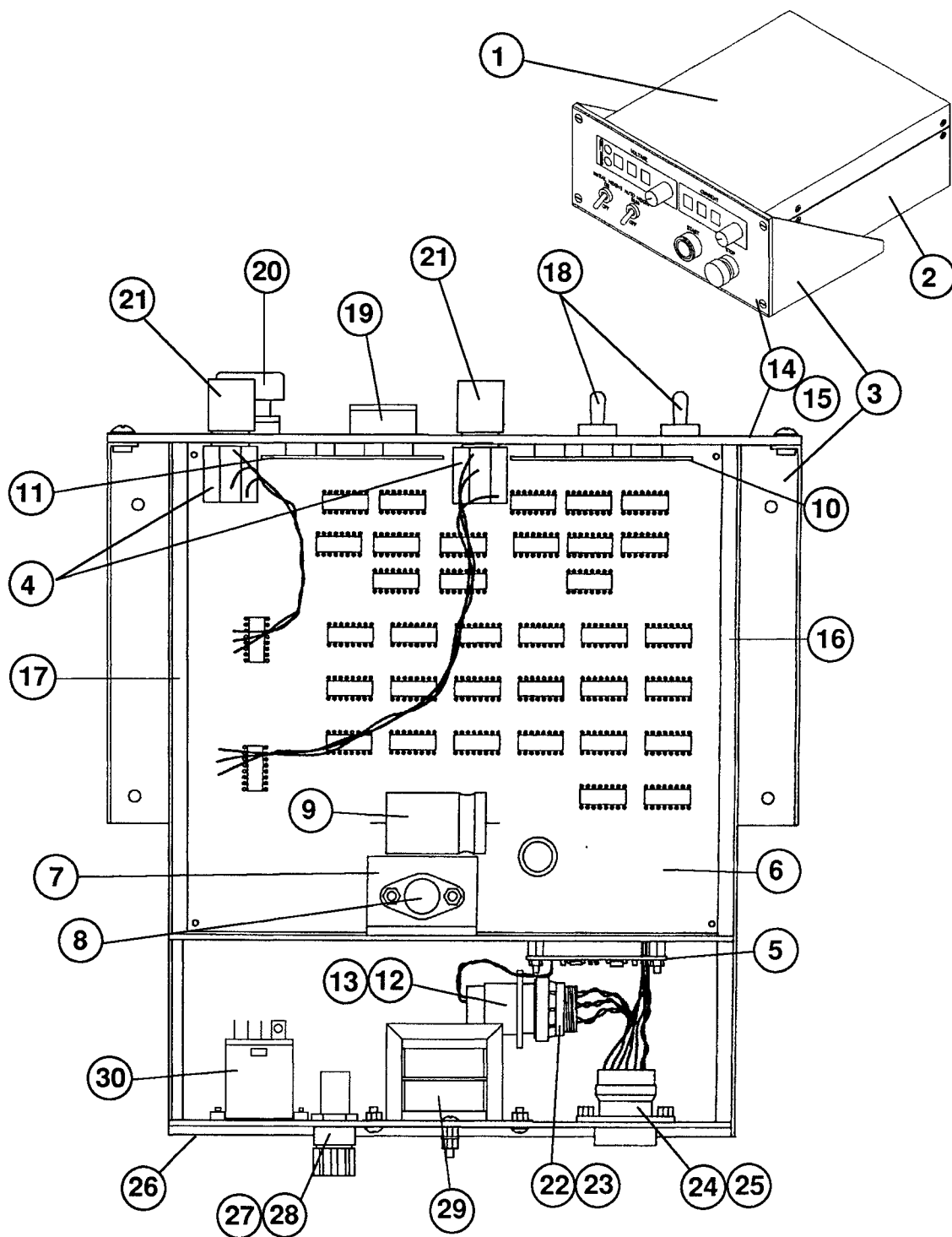


Figure 4-18 Remote V/C - Switch Remote (SR) Control Station

PARTS LIST

Remote V/C ⑥ : Switch Remote (SR) Control Station (073053)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
	073053	Control Station, SW Rem V/C	1
1	002107	Cov: DR/PR V/C Top	1
2	002125	Cov: SR V/C Bot	1
3	004123	Bracket, Mtg, SR V/C HT400	1
	029302	Filter PNL-PCB SA DR/SR V/C	1
4	009336	Potentiometer, 500 Ohm 10 Turn	2
5	041070	PC BD Assy Opto-Iso HT400	1
	008097	Terminal, PC HHS 2022C	4
6	041187	PC BD Assy Dig/Sta V/C MAX200	1
7	004116	Heatsink, DR/PR SR V/C HT400	1
8	042059	IC, LM340AK-5.0	1
9	009274	Capacitor, 2600 UF 15VDC	1
10	041076	PC BD Assy Rem Volt Disp	1
11	041077	PC BD Assy Rem Curr Disp	1
12	008175	Receptacle, Shell 13-9 Size	1
13	008176	Pin, 20-24 AWG Type III+	6
	074016	Term 22-18 .250 FEM QC Insul	2
	074038	Term 22-18 FEM QC Insul	11
	074041	Term 22-18 #6 Ring Uninsul	1
	074067	Term 22-18 .25 MAL QC Insul	2
	002179	Encl:MAX200 SR V/C	1
14	001243	Pl: MAX200 SR Fr	1
15	001141	Flg: HT400 SR V/C Mdl Fr	1
16	001137	FR: HT400 DR/PR/ST V/C Mdl LS	1
17	001138	FR: HT400 DR/PR/ST V/C Mdl RS	1
18	005044	Switch, Tog 1PI Maint On/On	2
19	005082	Switch, PB, Green, Full Guard	1
20	005083	Switch, PB, Red, Mushroom Head	1
21	008164	Knob	2
	029304	Harness, SA MAX200, SR V/C	1
22	008185	Plug, Shell 13-9 Size	1
23	008186	Socket, 20-24 AWG Type III+	6
24	008193	Receptacle, Shell 17-16 Size	1
25	008176	Pin, 20-24 AWG Type III+	14
	074016	Term, 22-18 .250 FEM QC Insul	2
	074027	Term, 22-16 #6 LCK Fork Insul	4
	074038	Term, 22-18 FEM QC Insul	11
	074041	Term 22-18 #6 Ring Uninsul	1
	074053	Term 22-18 FEM QC Insul	4
	074067	Term 22-18 .25 MAL QC Insul	2
	029301	Rear Panel SA, MAX200	1
26	002176	Pnl: MAX200 SR V/C Rear	1
27	008069	Fuse, 3/8 Amp 313, 375	1
28	008165	Fuseholder, Rem V/C HT400	1
29	014012	Transf'mer, DR/PR/SR V/C HT400	1
30	003096	Relay: 24VAC DPDT Bifurcated Cont	1

PARTS LIST

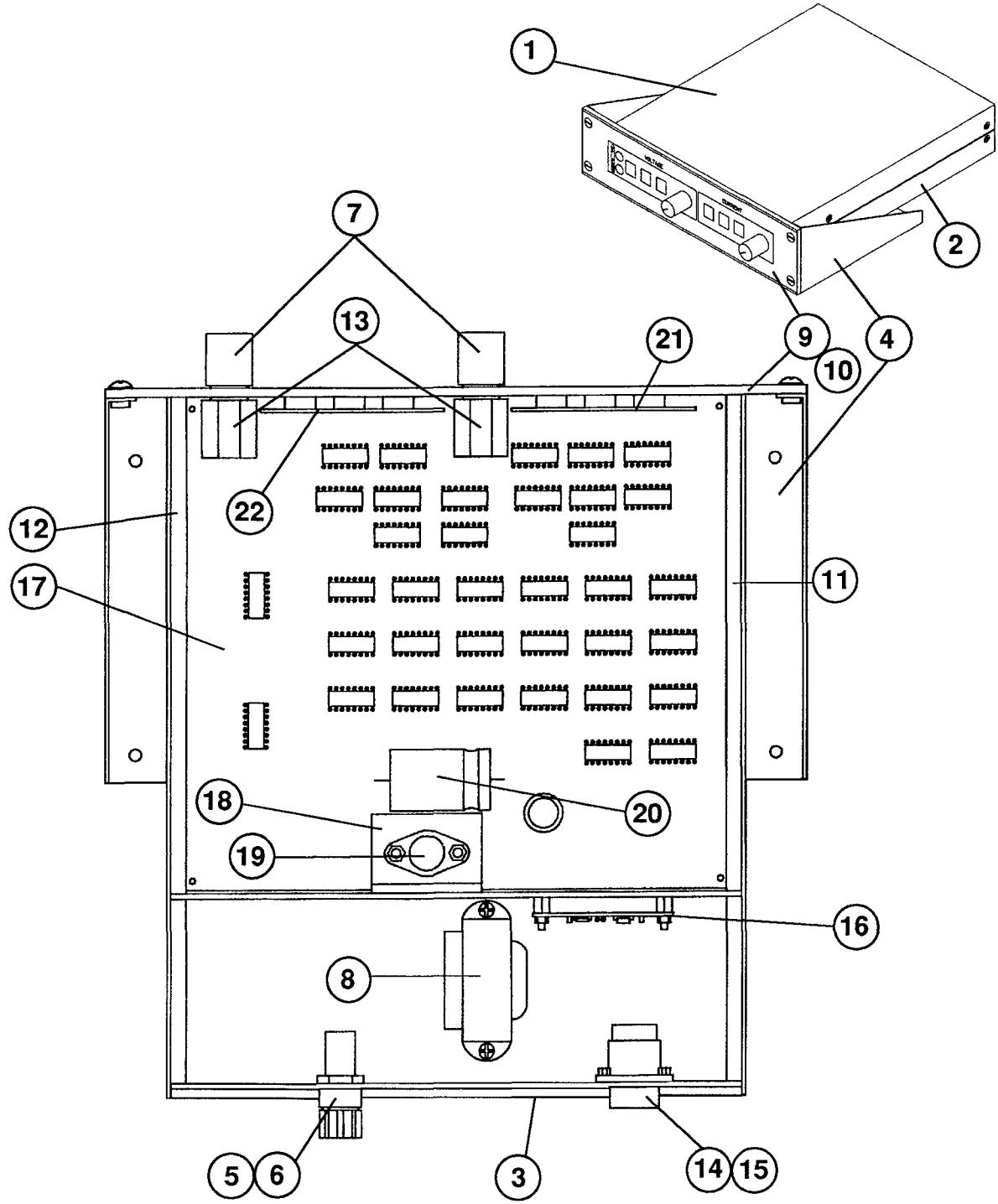


Figure 4-19 Remote V/C - Digital (DR) Control Station

PARTS LIST

Remote V/C ⑥ : Digital (DR) Control Station (055003)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
	055003	Control Station, Digital V/C (DR)	1
1	002107	Cov: DR/PR V/C Top	1
2	002106	Cov: DR/PR V/C Bottom	1
3	002119	Panel, Rear, DR V/C	1
4	004119	Bracket, Mtg, DR/PR V/C	1
5	008069	Fuse, 3/8 Amp 313, 375	1
6	008165	Fuseholder, REM V/C	1
7	008164	Knob	2
8	014012	Transf'mer, DR/PR/SR V/C	1
	002118	Encl, Assy DR V/C	1
9	001133	PI: HT400 DR V/C MDL FR	1
10	001131	Fig: HT400 DR/PR V/C MDL Fr	1
11	001137	FR: HT400 DR/PR/ST V/C Mdl LS	1
12	001138	FR: HT400 DR/PR/ST V/C Mdl RS	1
	029068	Filter PNL-PCB SA DR/SR V/C	1
13	009336	Potentiometer, 500 Ohm 10 turn	2
14	008175	Receptacle, Shell Size 13-9	1
15	008176	Pin, 20-24 AWG Type III+	6
	074016	Term 22-18 .250 FEM QC Insul	2
	074038	Term 22-18 FEM QC Insul	11
	074041	Term 22-18 #6 Ring Uninsul	1
	074067	Term 22-18 .25 MAL QC Insul	2
16	041070	PC BD Assy Opto-Iso	1
	008097	Terminal, PC HHS 2022C	4
17	041075	PC BD Assy Dig/Sta DR/SR V/C	1
18	004116	Heatsink, DR/PR SR V/C	1
19	042059	IC, LM340AK-5.0	1
20	009274	Capacitor, 2600 UF 15VDC	1
	008097	Terminal, PC HHS 2022C	11
	008098	Terminal, PC CAM	9
21	041076	PC BD Assy Rem Volt Disp	1
22	041077	PC BD Assy Rem Curr Disp	1

PARTS LIST

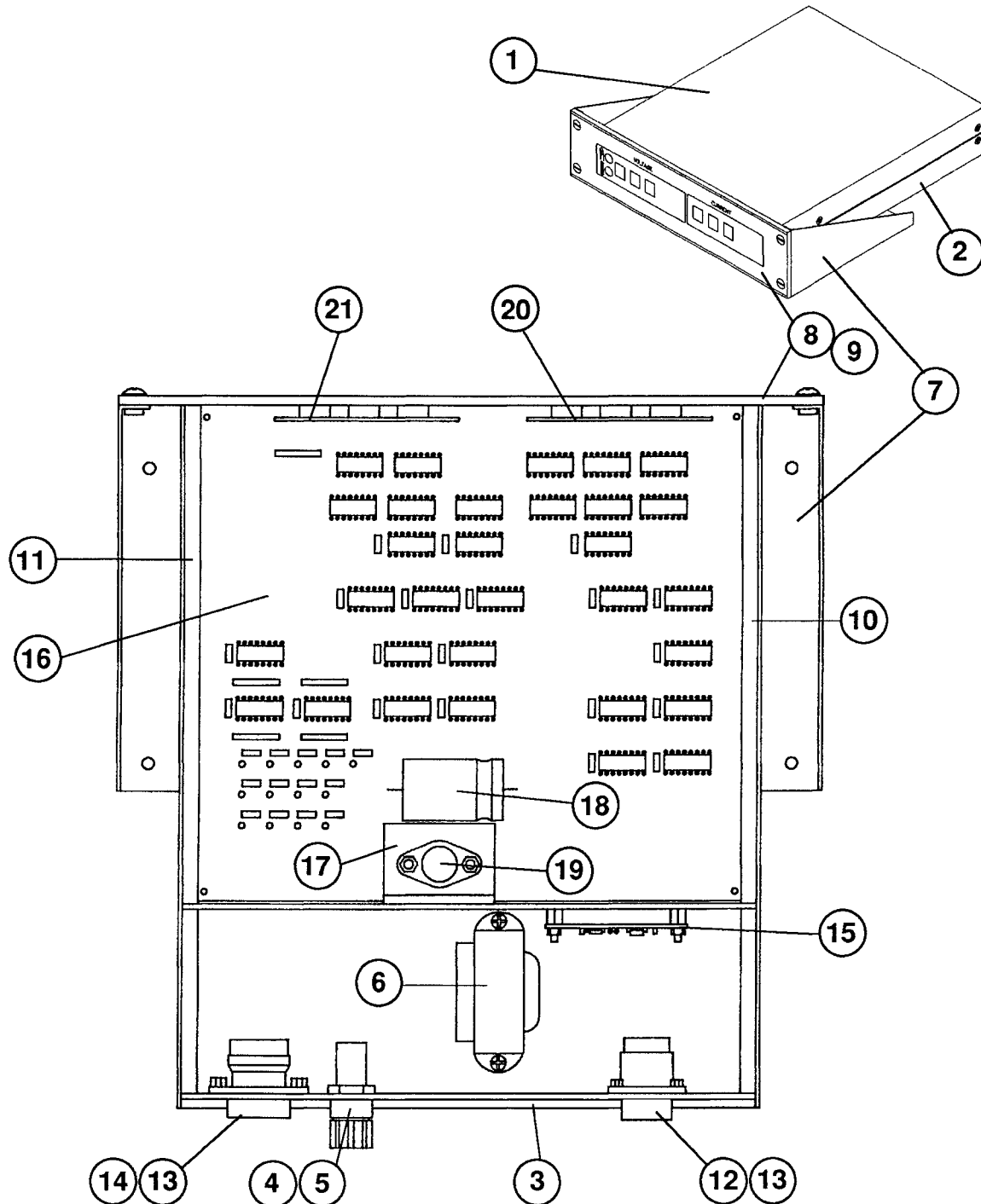


Figure 4-20 Remote V/C - Programmable (PR) Control Station

PARTS LIST

Remote V/C (6) : Programmable (PR) Control Station (055004)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
	055004	Control, Programmable V/C	1
1	002107	Cov: DR/PR V/C Top	1
2	002106	Cov: DR/PR V/C Bottom	1
3	002123	Panel, Rear, PR V/C	1
4	008069	Fuse, 3/8 Amp 313, 375	1
5	008165	Fuseholder, REM V/C	1
6	014012	Transf'mer, DR/PR/SR V/C	1
7	004119	Bracket, Mtg, DR/PR V/C	1
	002122	Encl Assy, PR V/C	1
8	001139	PL: HT400 PR V/C MDL FR	1
9	001131	Flg: HT400 DR/PR V/C MDL Fr	1
10	001137	FR: HT400 DR/PR/ST V/C Mdl LS	1
11	001138	FR: HT400 DR/PR/ST V/C Mdl RS	1
	029089	Filter PNL-PCB SA PR V/C	1
12	008175	Receptacle, Shell 13-9 Size	1
13	008176	Pin, 20-24 AWG Type III+	22
14	008193	Recp, CPC 17-16 Standard Sex	1
	074016	Term 22-18 .250 FEM QC Insul	2
	074038	Term 22-18 FEM QC Insul	5
	074041	Term 22-18 #6 Ring Uninsul	4
	074067	Term 22-18 .25 MAL QC Insul	2
15	041070	PC BD Assy Opto-Iso	1
	008097	Terminal, PC HHS 2022C	4
16	041085	PC BD Assy, PR V/C	1
17	004116	Heatsink, DR/PR SR V/C	1
18	009274	Capacitor, 2600 UF 15VDC	1
19	042059	IC, LM340AK-5.0	1
	008097	Terminal, PC HHS 2022C	18
	008098	Terminal, PC CAM	7
20	041076	PC BD Assy, Rem Volt Disp	1
21	041077	PC BD Assy, Rem Curr Disp	1

PARTS LIST

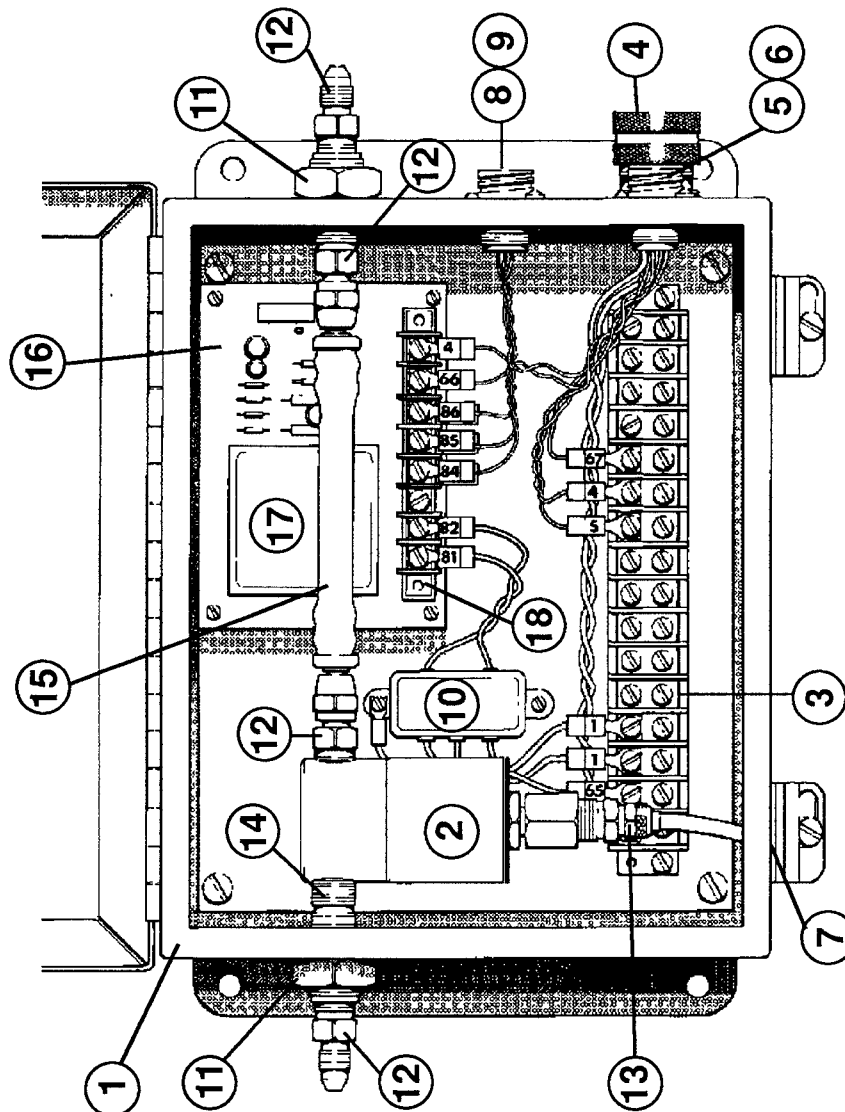


Figure 4-21 IHS Console

PARTS LIST

IHS Console (7) (053016)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
	053016	Control Module, IND IHS, HT400	
1	002095	Encl., Control Module UW-IHS	1
2	006021	Valve, SOL 75# 1/4 NPTF	1
3	008073	Terminal Strip (16)	1
4	008071	Strain Relief, 1/2 X .375-.500	1
5	008175	Receptacle, Shell Size 13-9	1
6	008176	Pin, 20-24 AWG Type III+	7
7	008177	Grommet, HHS 91107	1
8	008186	Socket, 20-24 AWG Type III+	8
9	008210	Receptacle, 11-4	2
10	009041	Filter, AC, 1 Amp 1B3	1
11	015001	Adapter, Bulkhead, 1/4 NPTF	2
12	015005	Adapter, 1/4 NPT x #4	4
	015006	Swivel, #4	1
13	015100	Adapter, 1/4 NPT x 1/4 Poly	1
14	015502	Nipple, 1/4 x CL	1
15	024038	Hose Assy, #4 x 7"	1
16	041043	PC BD Assy UW-IHS	1
17	041023	Power Source, IHS	1
18	008094	Terminal Strip (8)	1

PARTS LIST

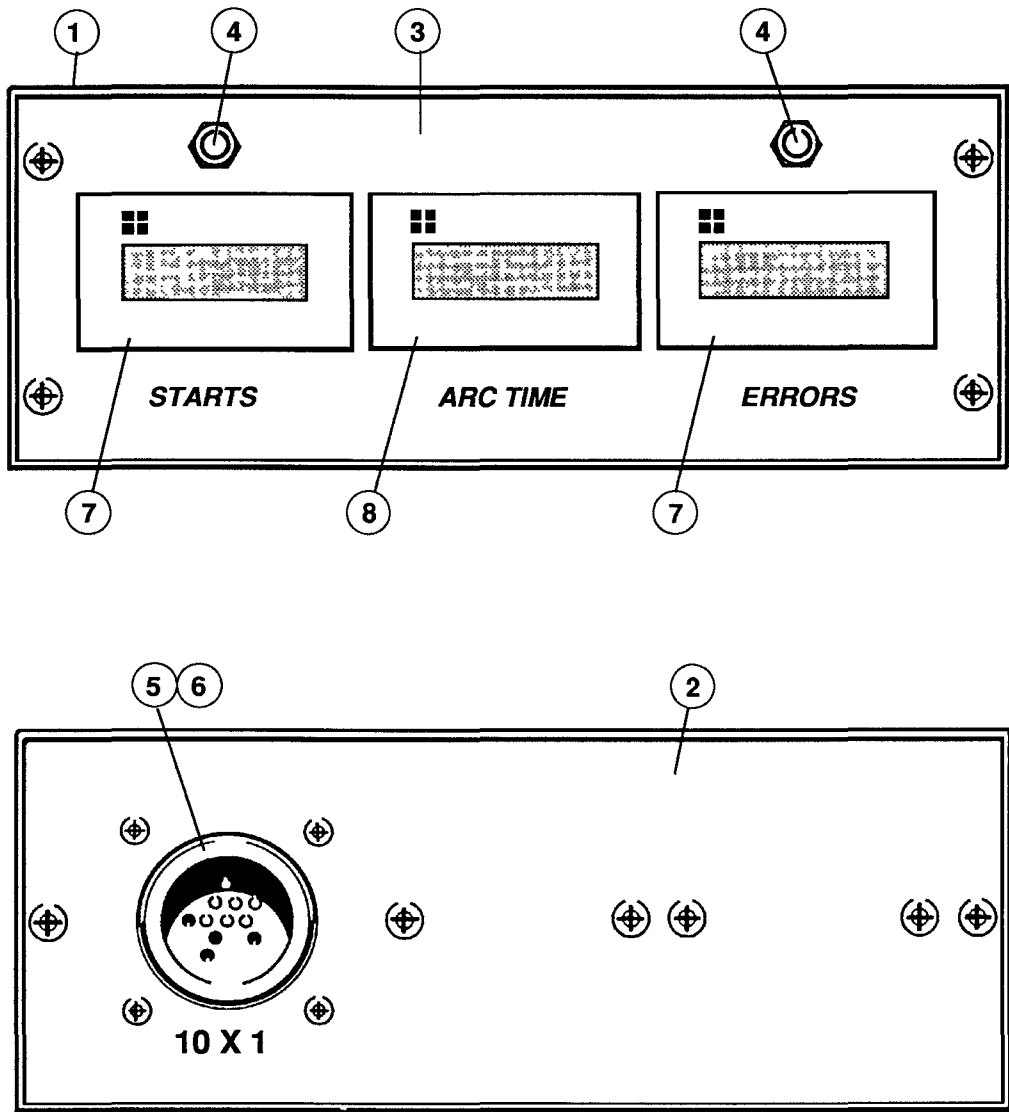


Figure 4-22 Timer/Counter

PARTS LIST

Timer / Counter (8) (073057)

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Designator</u>	<u>Qty.</u>
	073057	HT4000/4100 Cntr-Tmr		
1	001068	Encl:DCC/PCC/RCC RVR		1
2	001391	Pnl:DCC RCVR Rear		1
3	001392	Pnl:DCC RCVR Front		1
4	005161	PB Sw:Blk SPST NO Sub-Mini		2
5	008176	Pin:24-20 AWG Type III + CRP		4
6	008193	RCPT Shell:CPC 17-16 Std Sex	10X1	1
7	027274	Counter, Self Powered LCD		2
8	027275	Meter, Elapsed Time LCD		1
—	003140	Relay:120VAC DP AU Cont (See HT4000/4100 wiring diagram)		2

PARTS LIST

INTERCONNECTING CABLES, LEADS AND HOSES

<u>Part Number</u>	<u>Ref.</u>	<u>Description</u>	<u>Rcptcl/Plug Designations</u>	<u>Qty.</u>
028506	⑨	MPS/SPS Interconnecting Cable Set, 10 Ft.	—	1
028734		Lead: HT4000 Master/Slave Interconnect		
023501		Cable, I/O	1X5/6X5	1
023502		Cable, Current	1X6/6X6	1
023508		Negative/Positive Cable, 2/0 X 3/8 Lug, 10 Ft.	—	2
023509		Ground Strap, 12 AWG X 5/16, 10 Ft.	—	1
	⑩	MPS/RHF Console, Negative Cable, 4/0	—	1
023136		Cable, 20 Ft. (6.1 m)		
023078		Cable, 25 Ft. (7.6 m)		
023101		Cable, 30 Ft. (9.2 m)		
023135		Cable, 40 Ft. (12 m)		
023079		Cable, 50 Ft. (15 m)		
023124		Cable, 75 Ft. (23 m)		
023080		Cable, 100 Ft. (30.5 m)		
023081		Cable, 150 Ft. (46 m)		
023316		Cable, 180 Ft. (55 m)		
023188		Cable, 200 Ft. (61 m)		
023815		Cable, 250 Ft. (76 m)		
023643		Cable, 300 Ft. (92 m)		
	⑪	MPS/RHF Console, Pilot Arc Cable		
023615		Cable, 25 Ft. (7.5 m)		
023521		Cable, 50 Ft. (15 m)		
023522		Cable, 75 Ft. (23 m)		
023523		Cable, 100 Ft. (30.5 m)		
023524		Cable, 150 Ft. (46 m)		
023525		Cable, 200 Ft. (61 m)		
023580		Cable, 300 Ft. (91.5 m)		
	⑫	MPS/Ground, Work Cable (+)	—	1
023136		Cable, 20 Ft. (6.1 m)		
023078		Cable, 25 Ft. (7.6 m)		
023101		Cable, 30 Ft. (9.2 m)		
023135		Cable, 40 Ft. (12 m)		
023079		Cable, 50 Ft. (15 m)		
023124		Cable, 75 Ft. (23 m)		
023080		Cable, 100 Ft. (30.5 m)		
	⑬	MPS/RHF Console, HF Cable	1X4/2X1	1
023503		Cable, 50 Ft. (15 m)		
023504		Cable, 75 Ft. (23 m)		
023505		Cable, 100 Ft. (30 m)		
023506		Cable, 150 Ft. (46 m)		
023507		Cable, 200 Ft. (61 m)		
023579		Cable, 300 Ft. (91.5 m)		

PARTS LIST

INTERCONNECTING CABLES, LEADS AND HOSES (Cont.)

<u>Part Number</u>	<u>Ref.</u>	<u>Description</u>	<u>Rcptcl/Plug Designations</u>	<u>Qty.</u>
	(14)	MPS/Gas Console Cable	1X7/3X1	1
023496		Cable, 50 Ft. (15 m)		
023497		Cable, 75 Ft. (23 m)		
023498		Cable, 100 Ft. (30 m)		
023499		Cable, 150 Ft. (46 m)		
023500		Cable, 200 Ft. (61 m)		
023819		Cable, 300 Ft. (92 m)		
023576		Cable, 350 Ft. (107 m)		
	(15)	MPS/Computer Interface Cable	1X1/CI	1
023334		Cable, 25 Ft. (7.6 m)		
023335		Cable, 50 Ft. (15 m)		
023336		Cable, 75 Ft. (23 m)		
023337		Cable, 100 Ft. (30 m)		
023338		Cable, 150 Ft. (46 m)		
023339		Cable, 200 Ft. (61 m)		
	(16)	MPS/SR V/C Control Cable	1X2/5X1	1
023319		Cable, 25 Ft. (7.6 m)		
023328		Cable, 50 Ft. (15 m)		
023329		Cable, 75 Ft. (23 m)		
023330		Cable, 100 Ft. (30.5 m)		
023331		Cable, 150 Ft. (46 m)		
023332		Cable, 200 Ft. (61 m)		
	(16)	MPS/DR V/C & PR V/C Control Cable	1X2/5X1	1
023346		Cable, 25 Ft. (7.6 m)		
023347		Cable, 50 Ft. (15 m)		
023348		Cable, 75 Ft. (23 m)		
023349		Cable, 100 Ft. (30.5 m)		
023350		Cable, 150 Ft. (46 m)		
023351		Cable, 200 Ft. (61 m)		
023818		Cable, 300 Ft. (92 m)		
	(17)	PR V/C/Computer Interface Control Cable	5X2/CI	1
023098		Cable, 10 Ft. (3 m)		
023099		Cable, 25 Ft. (7.6 m)		
023100		Cable, 50 Ft. (15 m)		
	(18)	HF Con/Torch, Shld Coolant Water/Torch Pwr Lead Set	—	1
028508		Lead Set, 10 Ft. (3 m)		
028509		Lead Set, 15 Ft. (4.5 m)		
028510		Lead Set, 20 Ft. (6 m)		

PARTS LIST

INTERCONNECTING CABLES, LEADS AND HOSES (Cont.)

<u>Part Number</u>	<u>Ref.</u>	<u>Description</u>	<u>Rcptcl/Plug Designations</u>	<u>Qty.</u>
028511		Lead Set, 25 Ft. (7.6 m)		
028512		Lead Set, 30 Ft. (9 m)		
028513		Lead Set, 35 Ft. (10.7 m)		
028514		Lead Set, 40 Ft. (12 m)		
028515		Lead Set, 45 Ft. (13.7 m)		
028516		Lead Set, 50 Ft. (15 m)		
	(19)	RHF Cons/Water Chiller, Cooling Water Hoses		2
028440		Hose set, 15 Ft (4.6 m)		
028441		Hose set, 25 Ft (7.6 m)		
028442		Hose set, 50 Ft (15 m)		
028443		Hose set, 75 Ft (23 m)		
028444		Hose set, 100 Ft (31 m)		
028445		Hose set, 150 Ft (46 m)		
		Supply Hosing		
024155	(20)	O ₂ to Gas Console, Hose Assy, 3/8 Blu, 50 Ft (15 m)		1
024112	(21)	N ₂ to Gas Console, Hose Assy, #6, 50 Ft (15 m)		1
029650	(22)	Motor Valve Cons/Torch SA	—	1
023804		Cable:170/610/2000Torch Off-V 10'		1
024212		Hose Assy:3/16Blue RH'A' 10'		1
024253		Hose Assy:1/4Blue RH'A' 12"		1
029649		Off-Valve SA:PAC170 Torch		1
	(23)	Gas Console to Torch		1
		Injection Water Hosing		
024032		Hose, 10 Ft. (3 m)		
024261		Hose, 11Ft. 5 In. (3.5 m)		
024033		Hose, 15 Ft. (4.6 m)		
024018		Hose, 20 Ft. (6.1 m)		
024034		Hose, 25 Ft. (7.6 m)		
024035		Hose, 30 Ft. (9.2 m)		
024036		Hose, 35 Ft. (10.7 m)		
024258		Hose, 50 Ft. (15 m)		

PARTS LIST

INTERCONNECTING CABLES, LEADS AND HOSES (Cont.)

<u>Part Number</u>	<u>Ref.</u>	<u>Description</u>	<u>Rcptcl/Plug Designations</u>	<u>Qty.</u>
		Gas Console to Motor Valve Console		
	(24)	Plasma Preflow gas hosing	—	1
024316		Hose, 5 Ft. (1.5 m)		
024307		Hose, 10 Ft. (3 m)		
024320		Hose, 15 Ft. (4.6 m)		
024308		Hose, 20 Ft. (6.1 m)		
024321		Hose, 25 Ft. (7.6 m)		
024309		Hose, 30 Ft. (9.2 m)		
024322		Hose, 35 Ft. (10.7 m)		
024310		Hose, 40 Ft. (12.2 m)		
024323		Hose, 45 Ft. (13.7 m)		
024311		Hose, 50 Ft. (15 m)		
024420		Hose, 56 Ft. (17 m)		
024367		Hose, 60 Ft. (18.5 m)		
024357		Hose, 75 Ft. (23 m)		
024358		Hose, 100 Ft. (31 m)		
	(25)	Plasma Cut Flow Gas Hosing	—	1
024317		Hose, 5 Ft. (1.5 m)		
024026		Hose, 10 Ft. (3 m)		
024027		Hose, 15 Ft. (4.6 m)		
024017		Hose, 20 Ft. (6.1 m)		
024028		Hose, 25 Ft. (7.6 m)		
024029		Hose, 30 Ft. (9.2 m)		
024030		Hose, 35 Ft. (10.7 m)		
024031		Hose, 40 Ft. (12.2 m)		
024207		Hose, 45 Ft. (13.7 m)		
024340		Hose, 50 Ft. (15 m)		
024419		Hose, 56 Ft. (17 m)		
024127		Hose, 60 Ft. (18.5 m)		
024343		Hose, 75 Ft. (23 m)		
024344		Hose, 100 Ft. (31 m)		
	(26)	Cable, Gas Console to Motor Valve Console	3X2,4X1	1
023619		Cable, 5 Ft. (1.5 m)		
023646		Cable, 15 Ft. (4.6 m)		
023647		Cable, 20 Ft. (6 m)		
023583		Cable, 25 Ft. (7.6 m)		
023648		Cable, 30 Ft. (9 m)		
023649		Cable, 35 Ft. (10.7 m)		
023650		Cable, 40 Ft. (12 m)		
023651		Cable, 45 Ft. (13.7 m)		
023584		Cable, 50 Ft. (15.2 m)		
023811		Cable, 56 Ft. (17 m)		
023691		Cable, 60 Ft. (18.5 m)		
023654		Cable, 75 Ft. (23 m)		

PARTS LIST

INTERCONNECTING CABLES, LEADS AND HOSES (Cont.)

<u>Part Number</u>	<u>Ref.</u>	<u>Description</u>	<u>Rcptcl/Plug Designations</u>	<u>Qty.</u>
		Gas Console to RHF Console	—	1
	(27)	Injection Water Hosing		
024032		Hose, 10 Ft. (3 m)		
024261		Hose, 11Ft. 5 In. (3.5 m)		
024033		Hose, 15 Ft. (4.6 m)		
024018		Hose, 20 Ft. (6.1 m)		
024034		Hose, 25 Ft. (7.6 m)		
024035		Hose, 30 Ft. (9.2 m)		
024036		Hose, 35 Ft. (10.7 m)		
024258		Hose, 50 Ft. (15 m)		
	(27)	Injection Water Hosing (Cont.)		
024128		Hose, 60 Ft. (18.5 m)		
024345		Hose, 75 Ft. (23 m)		
024346		Hose, 100 Ft. (31 m)		
		Inductive IHS Lead Sets		
028244	(28)	Lead Set, 25 Ft.	—	1
023111		MPS/IHS Control Cable, 25 Ft.	1X3/7X1	1
023115		IHS/Inductor Sensor Assy, Cable, 40 Ft.	P15, P16/P17, P18	2
024144		IHS/IHS Probe Assy Air Cylinder Hose, 50 Ft.	—	1
028245	(28)	Lead Set, 50 Ft.	—	1
023112		MPS/IHS Control Cable, 50 Ft.	1X3/7X1	1
023115		IHS/Inductor Sensor Assy, Cable, 40 Ft.	P15, P16/P17, P18	2
024144		IHS/IHS Probe Assy Air Cylinder Hose, 50 Ft.	—	1
028282	(28)	Lead Set, 75 Ft.	—	1
023155		MPS/IHS Control Cable, 75 Ft.	1X3/7X1	1
023115		IHS/Inductor Sensor Assy, Cable, 40 Ft.	P15, P16/P17, P18	2
024144		IHS/IHS Probe Assy Air Cylinder Hose, 50 Ft.	—	1
028246	(28)	Lead Set, 100 Ft.	—	1
023113		MPS/IHS Control Cable, 100 Ft.	1X3/7X1	1
023115		IHS/Inductor Sensor Assy, Cable, 40 Ft.	P15, P16/P17, P18	2
024144		IHS/IHS Probe Assy Air Cylinder Hose, 50 Ft.	—	1
028247	(28)	Lead Set, 150 Ft.	—	1
023114		MPS/IHS Control Cable, 150 Ft.	1X3/7X1	1
023115		IHS/Inductor Sensor Assy, Cable, 40 Ft.	P15, P16/P17, P18	2
024144		IHS/IHS Probe Assy Air Cylinder Hose, 50 Ft.	—	1
028356	(28)	Lead Set, 200 Ft.	—	1
023284		MPS/IHS Control Cable, 200 Ft.	1X3/7X1	1
023115		IHS/Inductor Sensor Assy Cable, 40 Ft.	P15, P16/P17, P18	2
024144		IHS/IHS Probe Assy Air Cylinder Hose, 50 Ft.	—	1

PARTS LIST

INTERCONNECTING CABLES, LEADS AND HOSES (Cont.)

<u>Part Number</u>	<u>Ref.</u>	<u>Description</u>	<u>Rcptcl/Plug Designations</u>	<u>Qty.</u>
005074	(29)	Inductive Probe Assy Cable	—	2
023514	(30)	Timer/Counter cable, 10 Ft. (3 m)	10X1	1
023697		Timer/Counter cable, 25 Ft. (7.6 m)		
023698		Timer/Counter cable, 50 Ft. (15 m)		
023699		Timer/Counter cable, 75 Ft. (23 m)		
023700		Timer/Counter cable, 100 Ft. (30 m)		
023701		Timer/Counter cable, 150 Ft. (46 m)		
	(31)	Cable, W-M Air Control to MPS	—	1
023624		Cable, 25 Ft. (7.6 m)		
023444		Cable, 50 Ft. (15 m)		
023625		Cable, 75 Ft. (23 m)		
023626		Cable, 100 Ft. (30 m)		
023627		Cable, 150 Ft. (46 m)		
023628	Cable, 200 Ft. (61 m)			
	(32)	Cable, W-M Pump to MPS	—	1
023445		Cable, 50 Ft. (15.2 m)		
023617		Cable, 75 Ft. (23 m)		
023803		Cable, 100 Ft. (31 m)		
	(33)	Refer to Water Muffler instruction manual IM65 (#801730)		
	(34)	Refer to Water Chiller instruction manual IM88 (#800880)		
	(35)	Hold Cable, MPS to MPS	—	1
023340		Cable, 15 Ft. (4.6 m)		
023341		Cable, 25 Ft. (7.6 m)		
023342		Cable, 50 Ft. (15 m)		
023343		Cable, 100 Ft. (30 m)		
023344		Cable, 150 Ft. (46 m)		

PARTS LIST

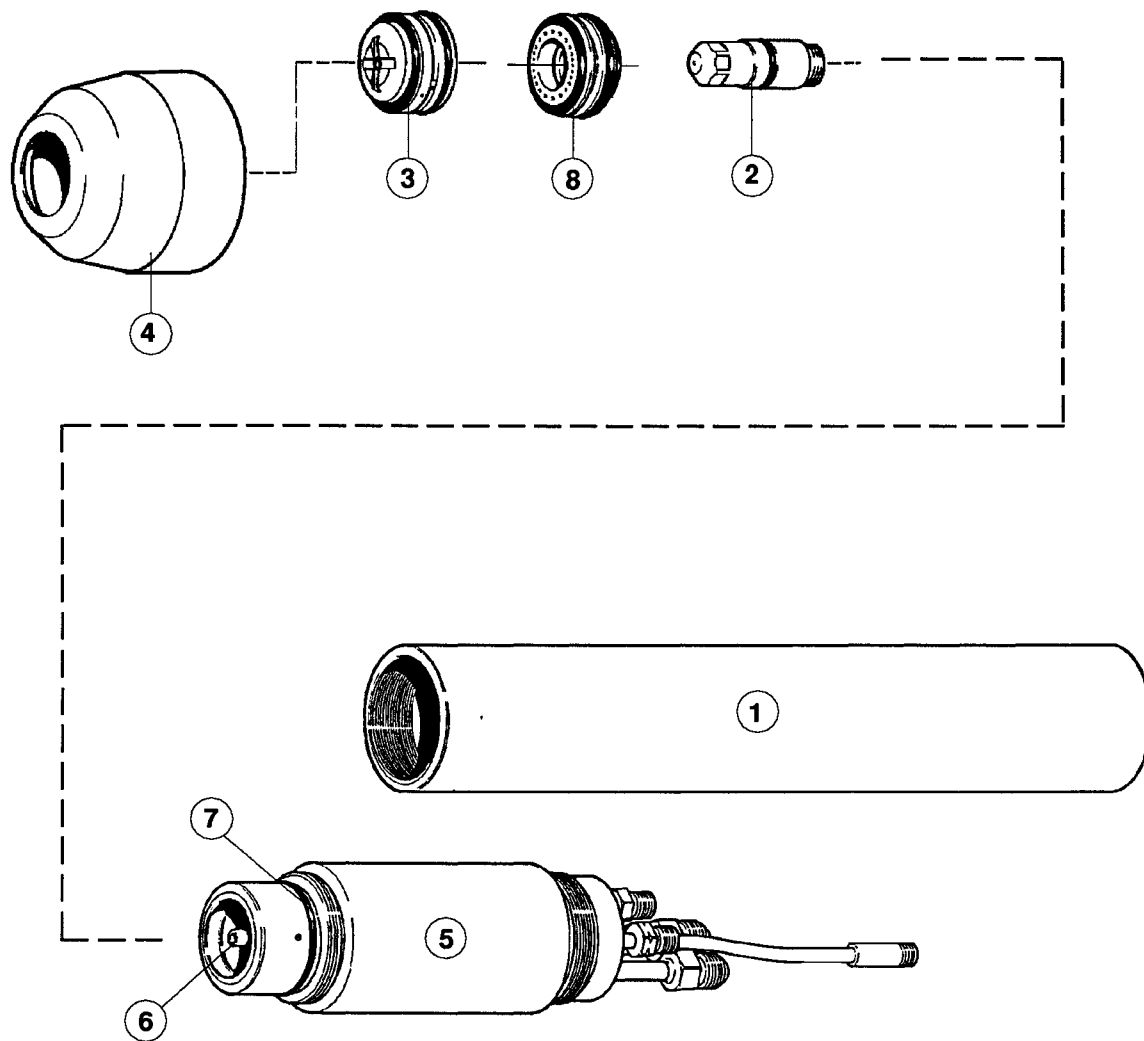


Figure 4-23 PAC170 Machine Torch Assembly

PARTS LIST

PAC170 MACHINE TORCH ASSEMBLY (36) (028507)

PAC170 Machine Torch Assembly

<u>Item</u>	<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
	028507	PAC170 Machine Torch Assy	
1	020041	Sleeve, Insul,	1
2	020663	Electrode, Oxygen	1
3	020086	Nozzle, .099 Oxygen	1
4	020579	Cap, Nozzle Retaining	1
5	020328	Torch Main Body	1
6	020990	Water Tube:400/600/170	1
7	044028	"O" Ring, Buna	1
8	020623	Swirl Ring: PAC170/HT4000	1

HT4000 Torch Mounting Bracket

<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
020046	Brkt w/Clevis:2" Tch Mtg (Standard)	1
029044	Tch Mntg SA:2" (for IHS system)	

PAC170 Consumable Parts Kit (028520)

<u>Part Number</u>	<u>Description</u>	<u>Qty.</u>
001067	Box, Gray Plastic	1
004147	Electrode Gauge Assy	1
020039	Swirl Ring, .120	2
020082	Electrode, N2	3
020084	Nozzle, .166, N2	5
020086	Nozzle, .099, O2	5
020579	Cap, Nozzle Retaining	1
020089	Nozzle, .120, N2	3
020623	Swirl Ring, PAC170	3
020663	Electrode, PAC170 O2	5
025028	O-Ring Kit	1
027001	Wrench, Electrode	1
027012	Lubricant, Silicon	1
027347	Water Tube Tool	1

PARTS LIST

LEAD PACKAGES

HT4000 Power Supply to Remote HF Console - Cables

Part Number	Length
028639	50 ft (15 m)
028640	75 ft (23 m)
028641	100 ft (31 m)
028642	150 ft (46 m)
028643	200 ft (62 m)
028644	300 ft (93 m)

Gas Console to Motor Valve Console - Cable and Hoses

Part Number	Length
028667	15 ft (4.6 m)
028668	20 ft (6.1 m)
028646	25 ft (7.6 m)
028669	30 ft (9.2 m)
028670	35 ft (10.7 m)
028671	40 ft (12.2 m)
028672	45 ft (13.7 m)
028647	50 ft (15.2 m)

PARTS LIST

RECOMMENDED SPARE PARTS

Power Supplies

Part Number	Description	Designation	Qty.	Page (Ref) Showing Item
005121	Pushbutton: 2 NO Green Illumin	PB1/LT1	2	4-9
005122	Pushbutton: 2 NC Red Extended	PB2	2	4-9
005168	Bulb: 28VDC, 40ma	LT2	2	4-9,4-31
027080	Fan: 225CFM 120VAC 50/60 Hz	M2,M3	1	4-7,4-29
027079	Fan: 450-550 CFM 120VAC 50/60 Hz	M4	1	4-7,4-29
041269	PCB Assy: HT4000 Master Controller	PCB7	1	4-7
041270	PCB Assy: HT4000 Slave Controller	PCB7	1	4-29
081005	Firmware: HT4000 Master		2	4-7
081006	Firmware: HT4000 Slave		2	4-29
027265	Timer: DPDT Solid State 5A	CR3	1	4-7,4-29
041290	PCB Assy: HT4000 THC Mother	PCB9	1	4-7
041186	PCB Assy: HT4000 THC	PCB10	1	4-7
003074	Relay: 24VAC 10A DPDT	CR4	1	4-7
003021	Relay: 120VAC NO SPST	CR1	1	4-11
009684	Resistor: 4 Ohm 420W w/Bracket	R6A-R6D	4	4-11
005102	Thermostat: 160°C, 6 Amp	TS1	2	4-15
008551	Fuse: 7.5 Amp, 600V	F1,F2	4	4-17
008709	Fuse: 20 Amp, 500V	F1,F2	4	4-17
003092	Contactor: 90A 3 Pole, 24VAC	CON1	2	4-17
003093	Switch: Aux. Contactor	S2 CON1	2	4-17
003074	Relay: 24VAC 10A DPDT	CR2	1	4-17
041147	PCB Assy: Power Distribution	PCB1	2	4-17
008317	Fuse: Semiconductor 125A, 250V	F3,F4	4	4-19
029922	Chopper SA: 15 kW, HT4000	CH1,CH2	2	4-21
009356	Coil: Air Core Transformer, 8AWG	T1	1	4-27
029202	Current Sensor SA	CS1	2	4-27
041274	PCB Assy: HT4000 Iso-Amp		1	4-33

PARTS LIST

RECOMMENDED SPARE PARTS (CONT.)

Remote High Frequency Console

Part Number	Description	Designation	Qty.	Page (Ref)
				Showing Item
009246	Cap: Poly-Paper .5μF 2500V	C2A,C2B	2	4-35
009280	Cap: .002μF 15 15kV	C3,C4	2	4-35
004061	Electrode:Sprk Gap 1/8 x 1.6		2	4-35
004089	Electrode:Sprk Gap 1/8 x 2		1	4-35
014004	Transformer:5000V 30mA	T1	1	4-35
005139	Flowswitch:0.25 GPM SPST 1/4 NPT	FS2	1	4-35
005140	Flowswitch:1.20 GPM SPST 1/4 NPT	FS1	1	4-35
006031	Solenoid Valve:350# 1/4 FPT 120V NC	SV6	1	4-35

Gas Console

Part Number	Description	Designation	Qty.	Page (Ref)
				Showing Item
005162	Pressure Switch:0-200psi 1/8 NPT	PS1,PS2	1	4-37
006057	Solenoid Valve: 150# 1/8FPT 120V 3W	SV1-3	1	4-37
011056	Flowmeter: 0.45 GPM/1.9SCFM	FM1,FM3	2	4-37
011007	Float: Tungsten Carbide for 011056		2	4-37
011057	Tube: SK 1/4"-33-G5-2FS for 011056		2	4-37
011053	Flowmeter: 7.8 GPM/44CFH	FM2	1	4-37
011055	Float: Glass 1/4" Diameter for 011053		1	4-37
011058	Tube: SK 1/4"-33-G5-2FS for 011053		1	4-37
011008	Shield: Plastic, for 011053 or 011056		1	4-37
022020	Gauge: Pressure, 160 psi/bar, Panel Mnt	PG1-3	1	4-37

Motor Valve Console

Part Number	Description	Designation	Qty.	Page (Ref)
				Showing Item
006057	Solenoid Valve: 150# 1/8FPT 120V 3W	SV4	1	4-39
006063	Motor Valve: Electric 1/8FPT .125 Orifice	MV1	1	4-39

Section 5 WIRING DIAGRAMS

In this section:

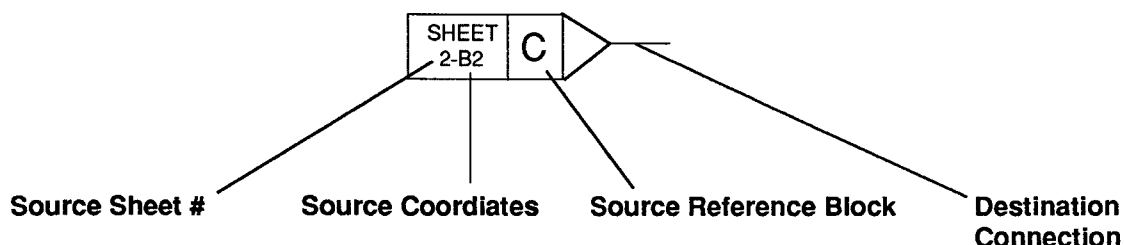
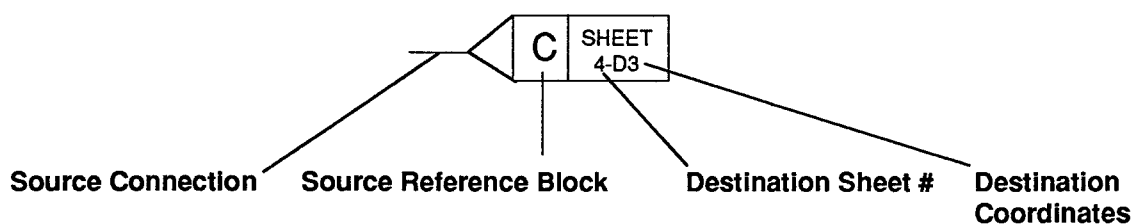
Introduction.....	5-2
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WIRING DIAGRAMS

INTRODUCTION

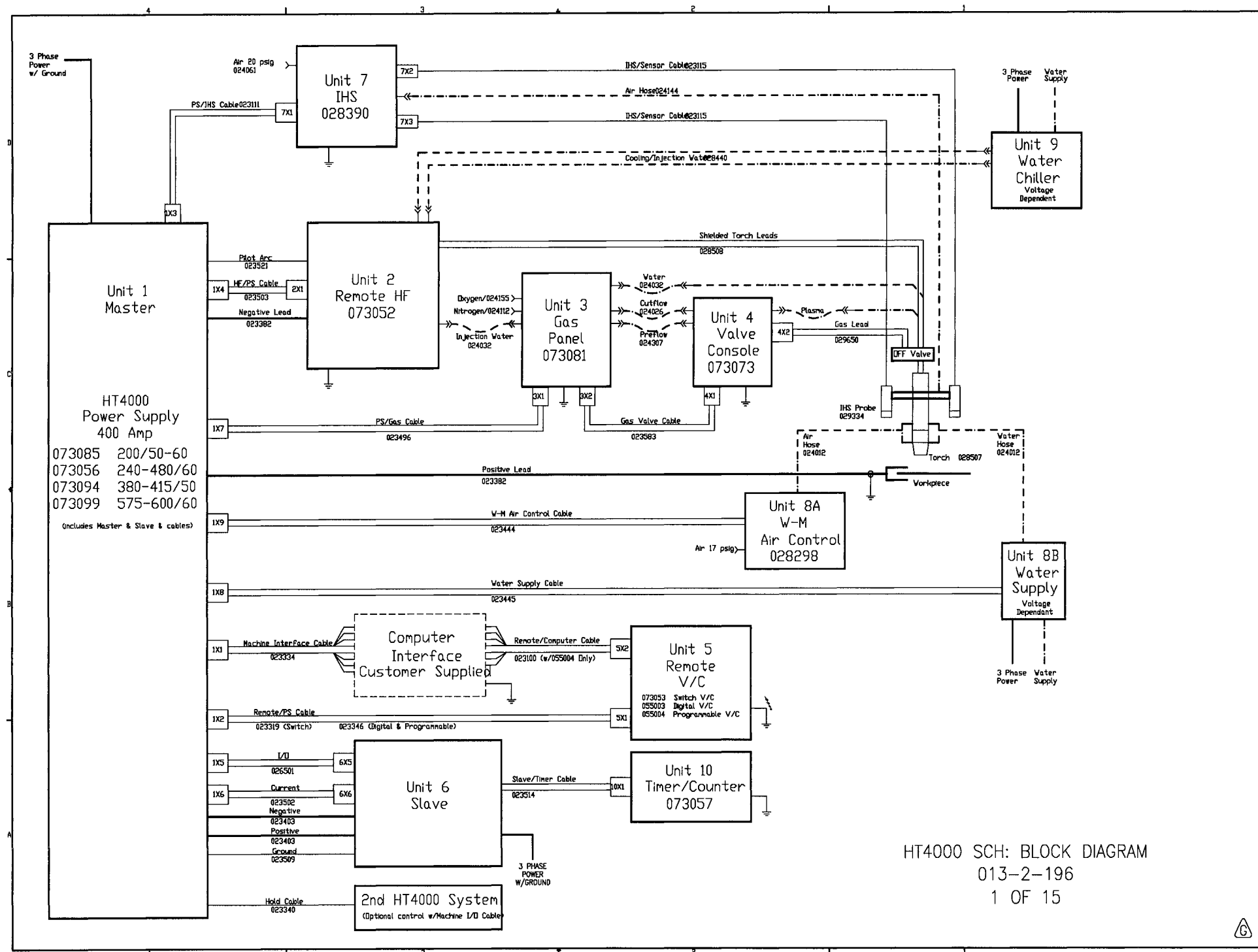
This section contains the wiring diagrams for the HT4000 system. When tracing a signal path or referencing with the **Parts List** or **Troubleshooting** sections, please be aware of the following format to assist you in understanding the wiring diagrams' organization:

- Sheet numbers are located in the lower right-hand corner of each sheet.
- Page-to-page referencing is done in the following manner:

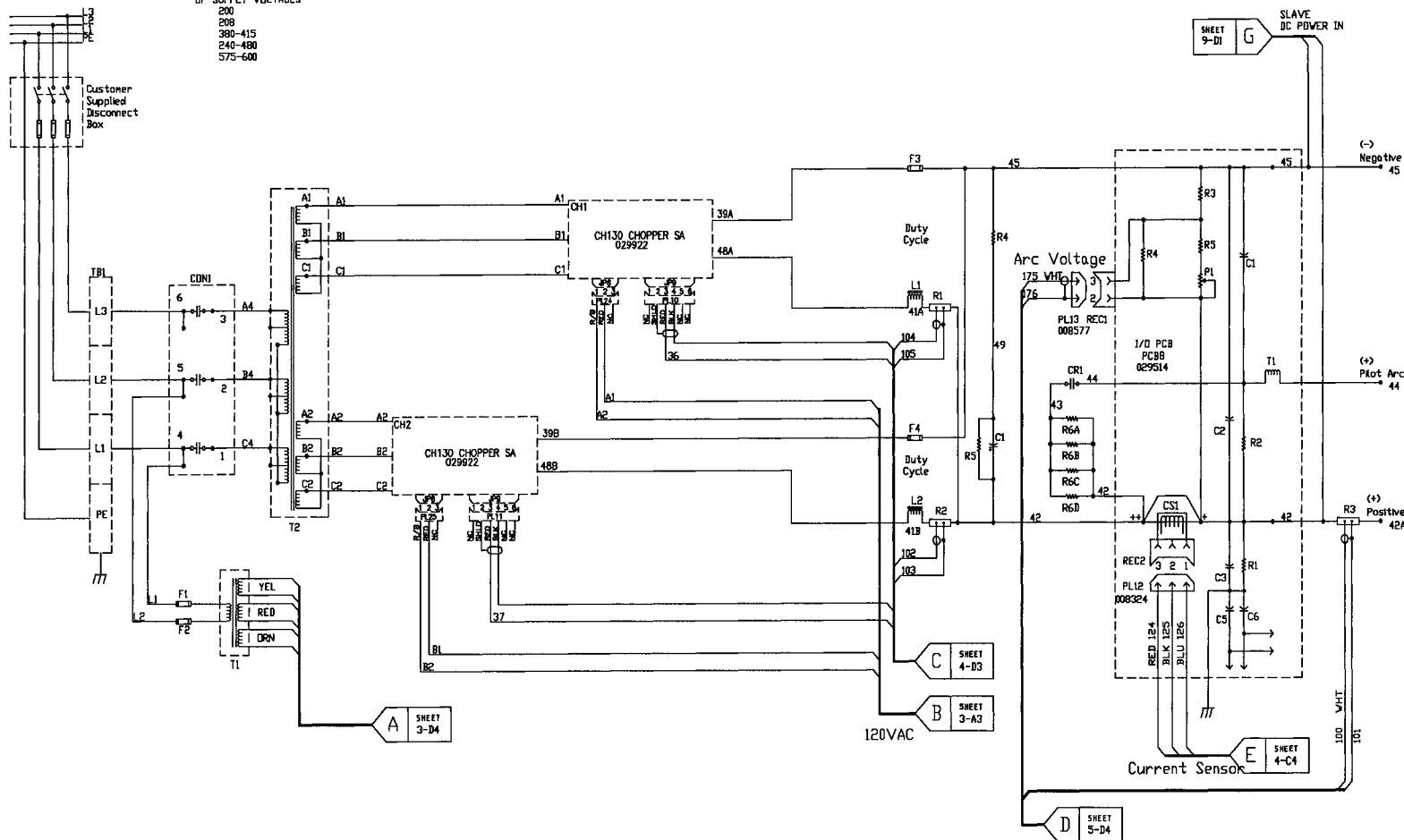


Destination and **Source Coordinates** refer to letters A-D on the Y-axis of each sheet and numbers 1-4 on the X-axis of each sheet. Lining up the coordinates will bring you to the source or destination blocks (similar to a road map).

- When referencing components to the wiring diagrams, designations may appear to be repeated. Ex. C1 appears on sheet 2 of 15 in the wiring diagrams in five separate locations. Sections of the Master power supply on that page are outlined with a dotted box and a label. Within different sections, the same designation may appear. Be certain to check the dotted box label when looking for or cross-referencing HT4100 parts.

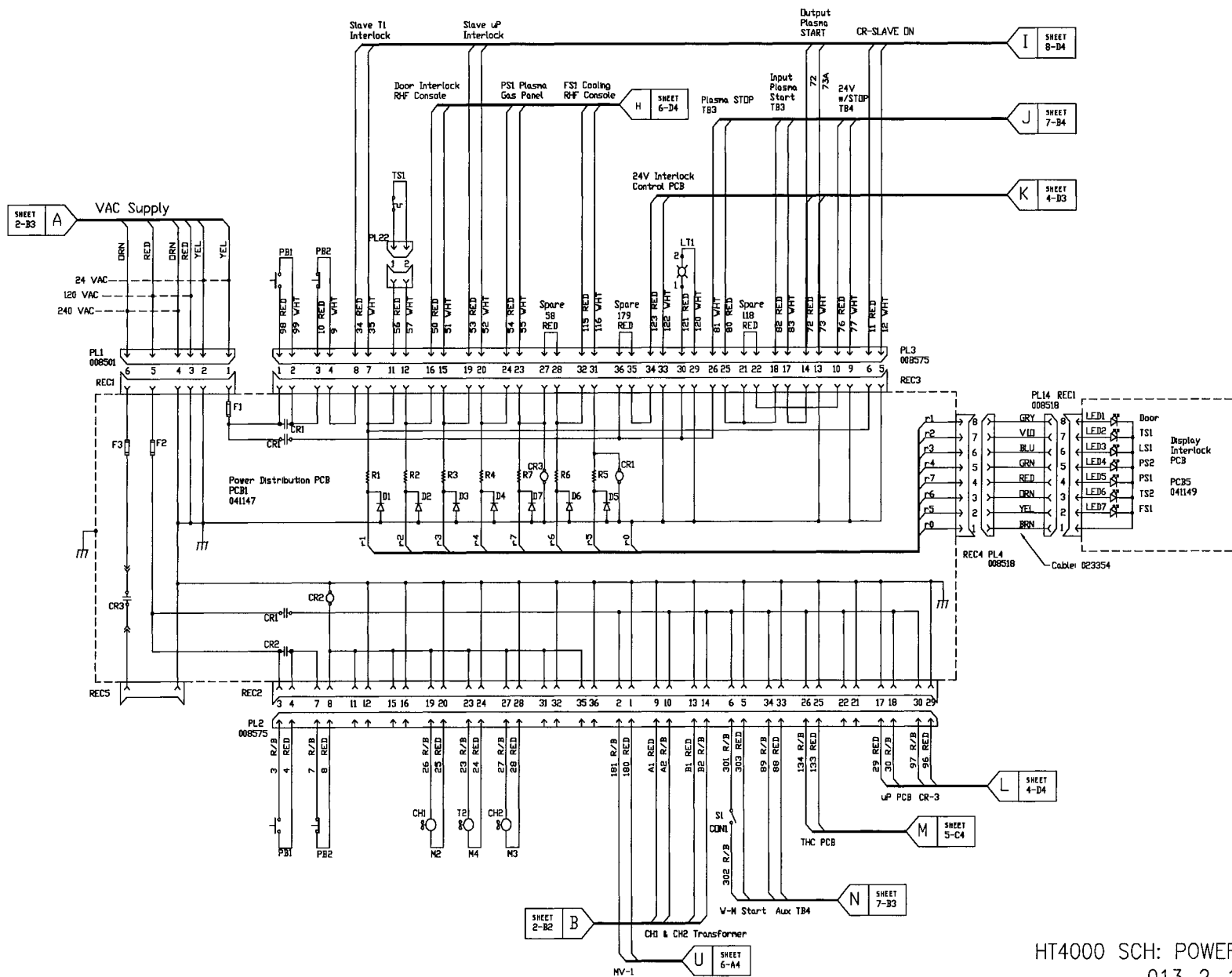


NOTE: SEE SHEET 12 OF 15
FOR WIRING DIAGRAMS
OF SUPPLY VOLTAGES:-
200
208
380-415
240-480
575-600

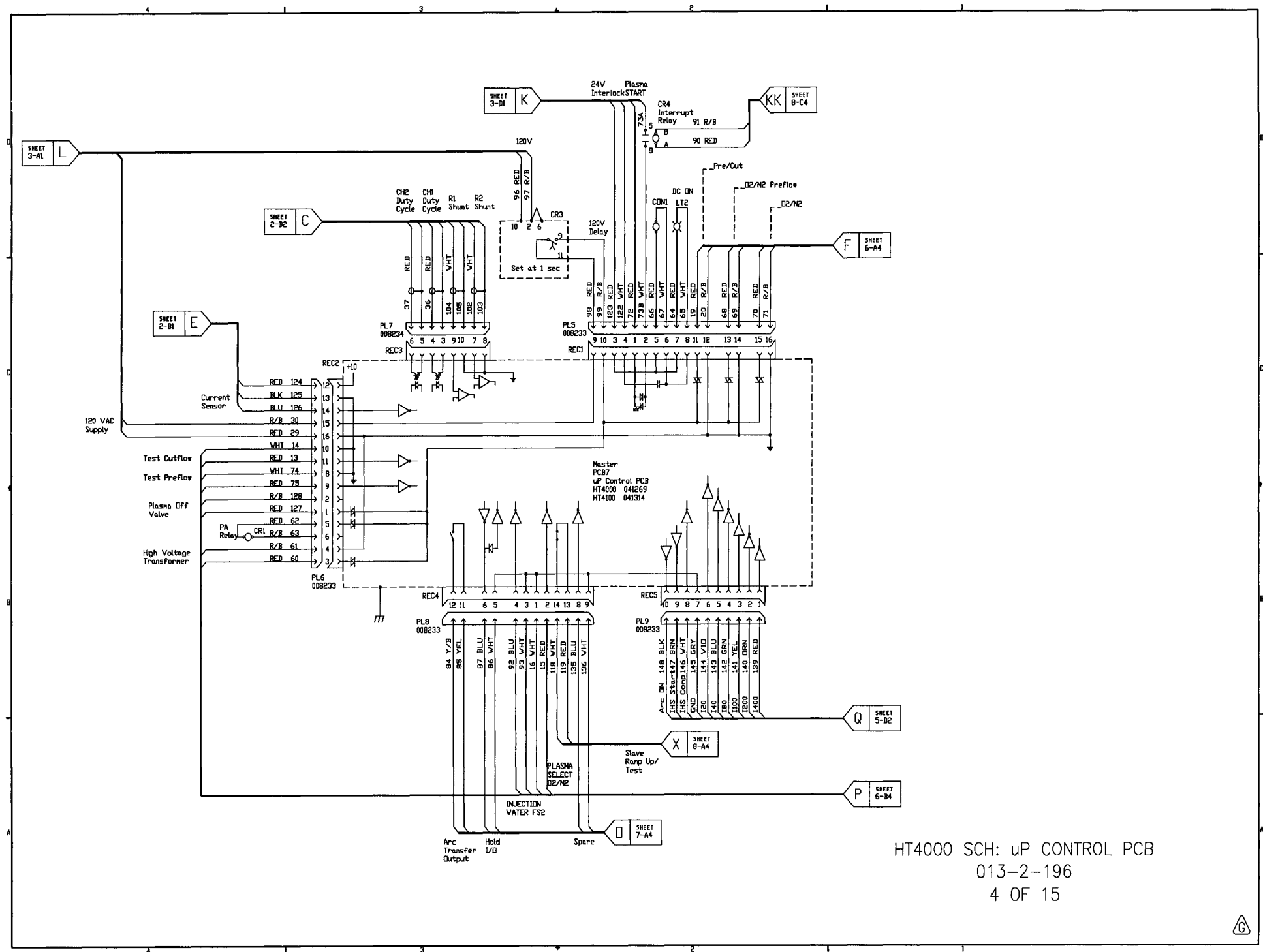


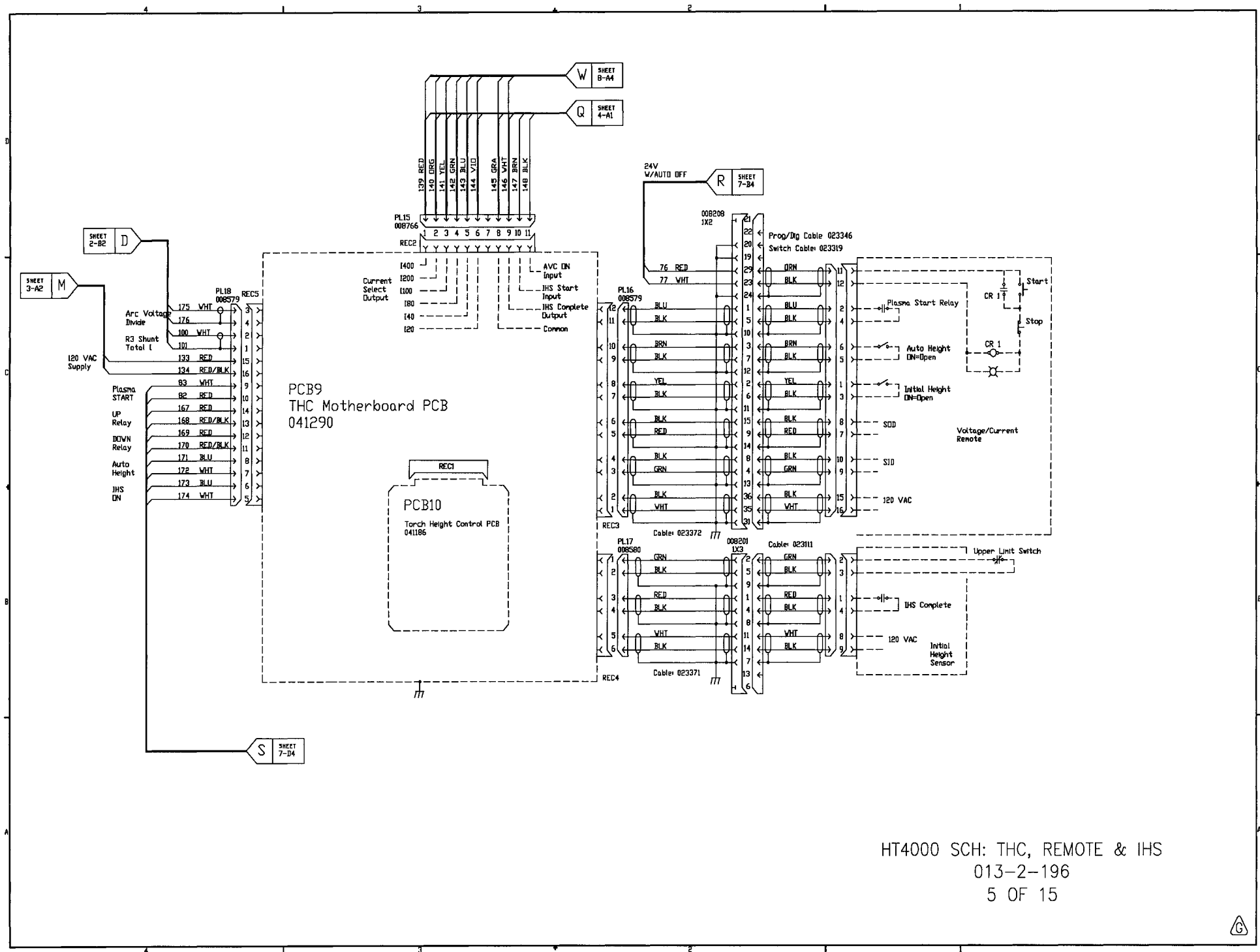
HT4000 SCH: DC POWER
013-2-196
2 OF 15





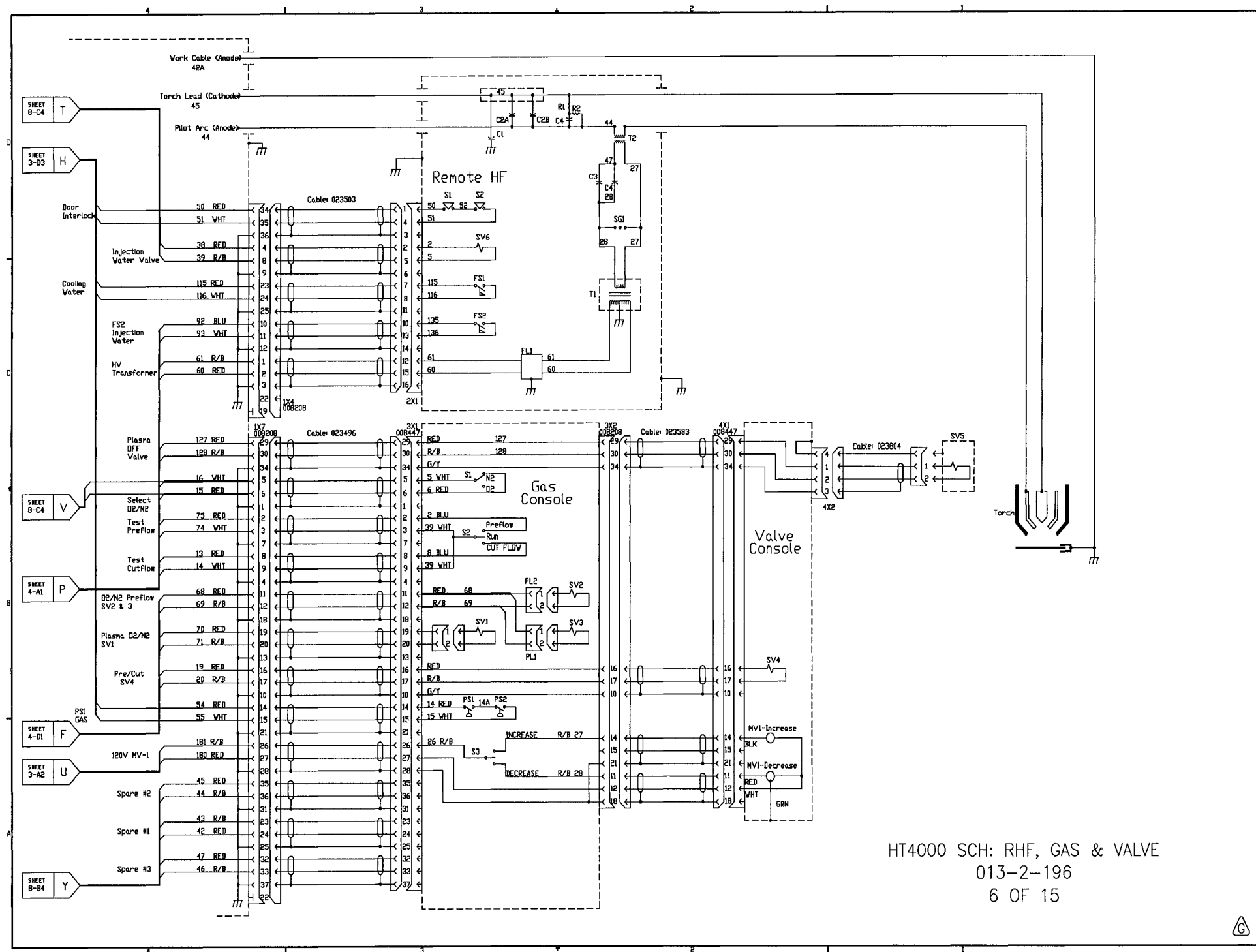
HT4000 SCH: POWER DISTRIBUTION
013-2-196
3 OF 15

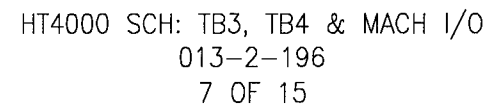


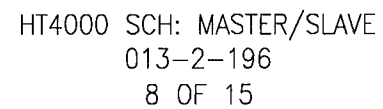


HT4000 SCH: THC, REMOTE & IHS
013-2-196
5 OF 15



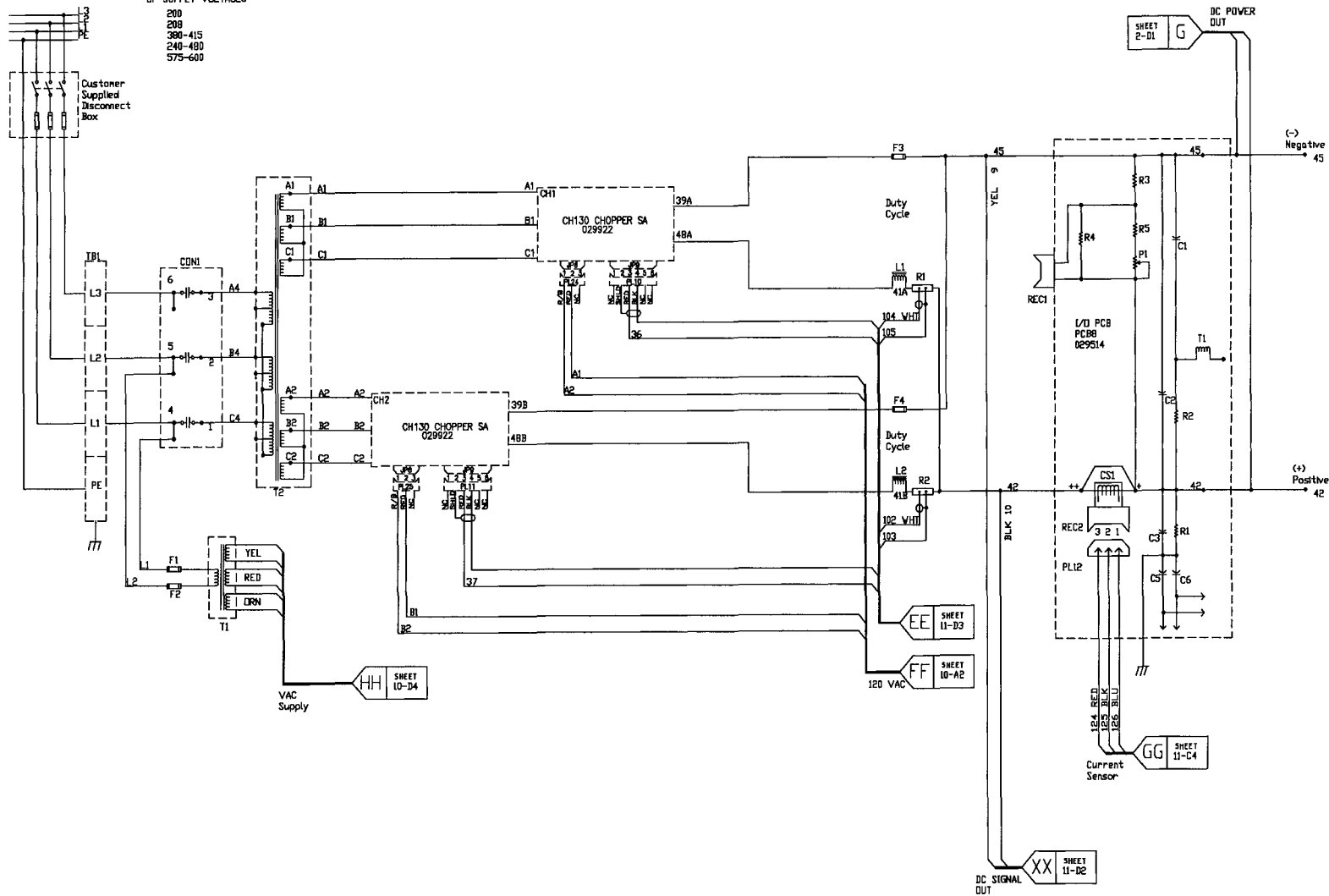




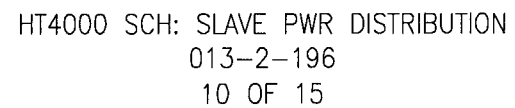


NOTE: SEE SHEET 12 OF 15
FOR WIRING DIAGRAMS
OF SUPPLY VOLTAGES-

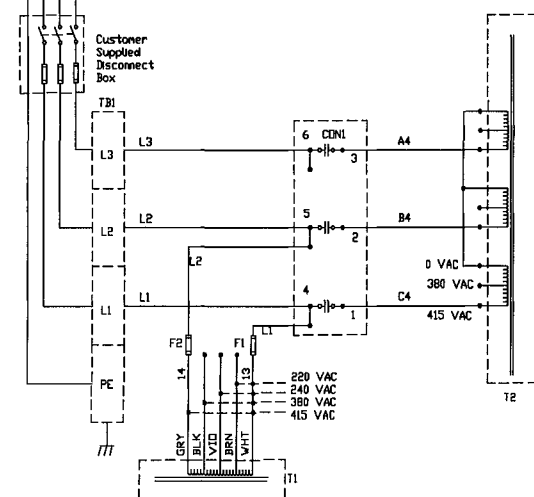
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208
380-415
240-480
575-600



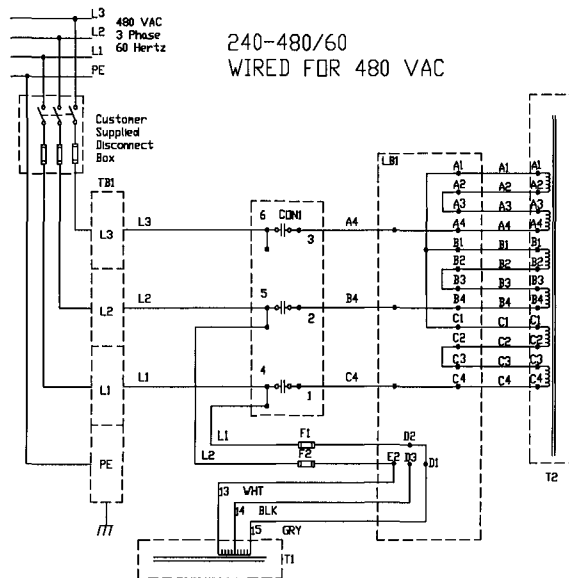
HT4000 SCH: SLAVE DC POWER
013-2-196
9 OF 15



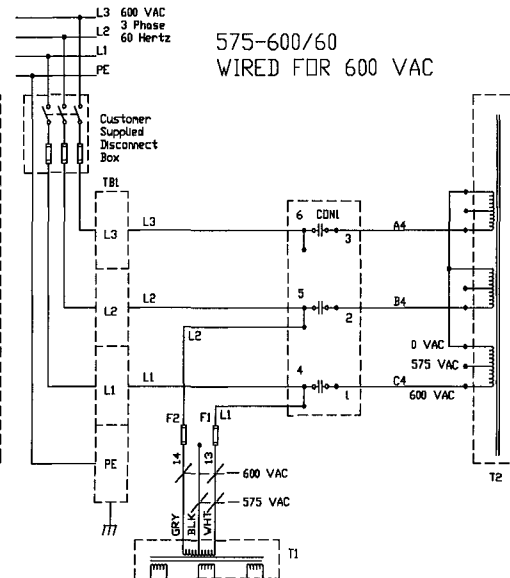
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WIRED FOR 415 VAC



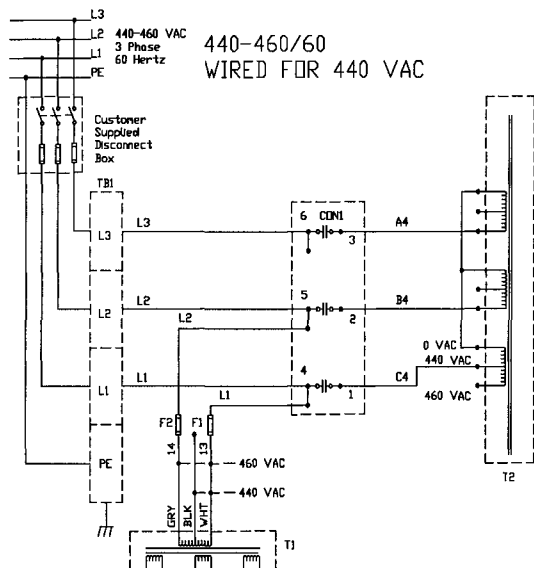
240-480/60
WIRED FOR 480 VAC



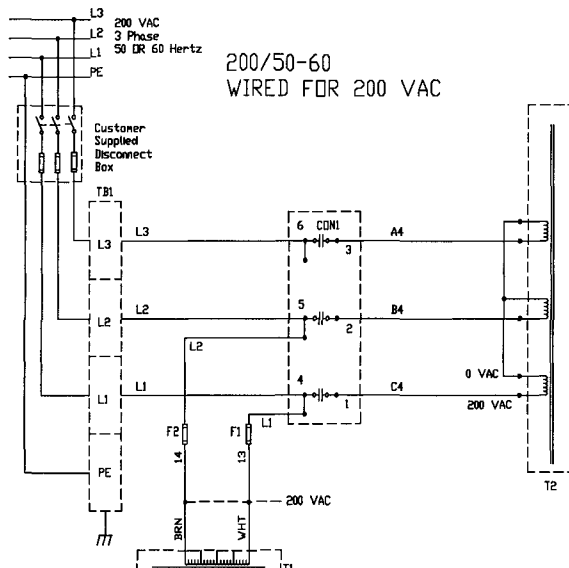
575-600/60
WIRED FOR 600 VAC



440-460/60
WIRED FOR 440 VAC



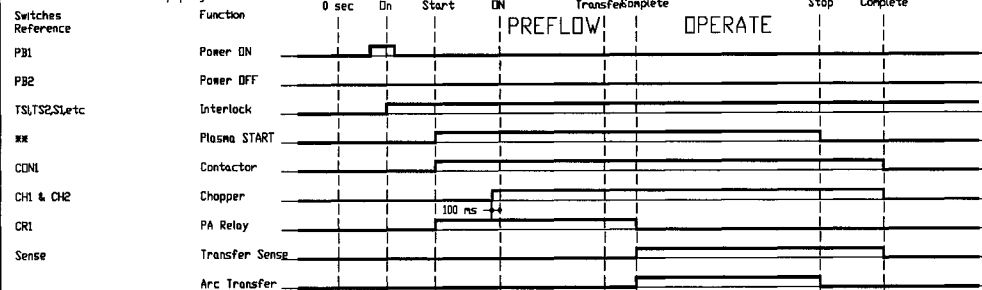
200/50-60
WIRED FOR 200 VAC



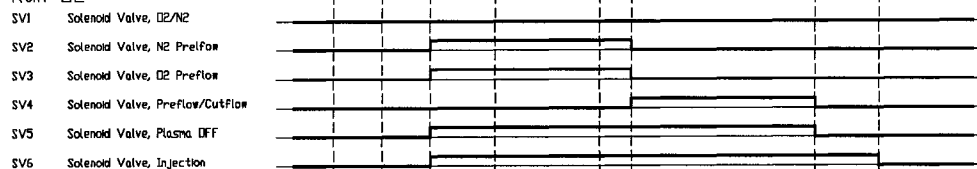
HT4000 SCH: PWR SPLY ALL VOLTAGES
013-2-196
12 OF 15



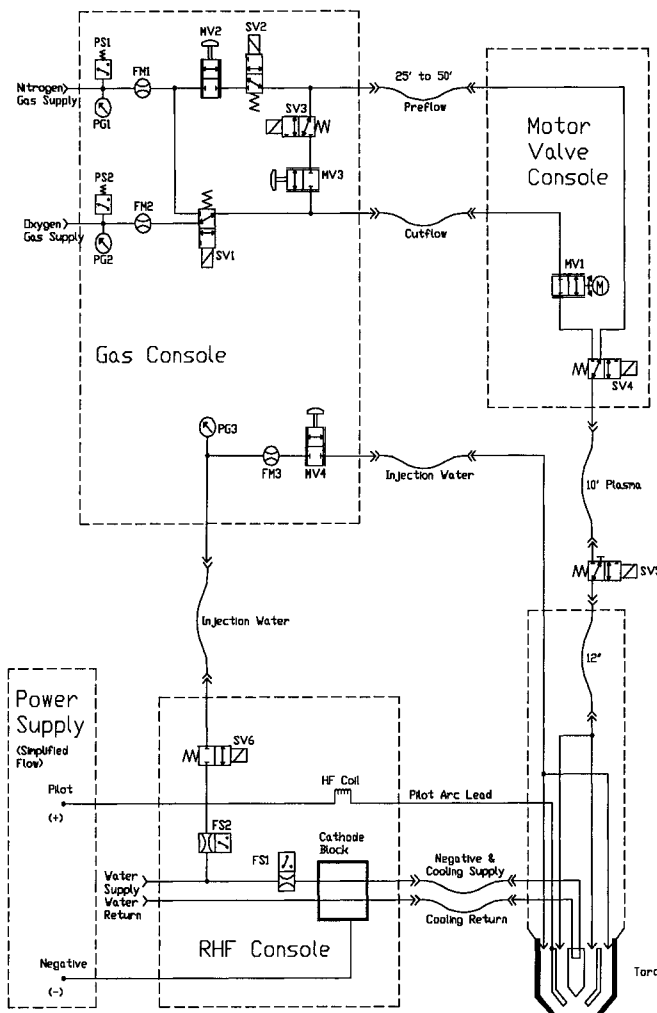
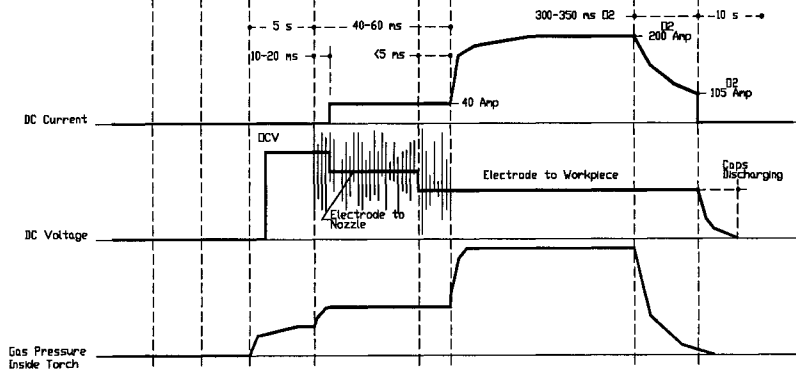
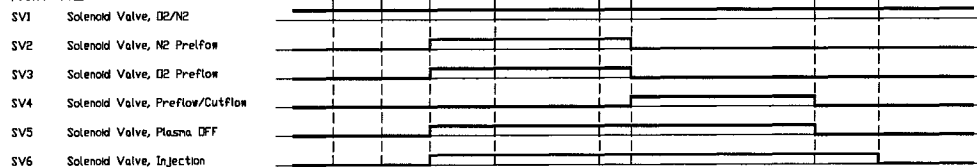
Power Supply



Run O2



Run N2



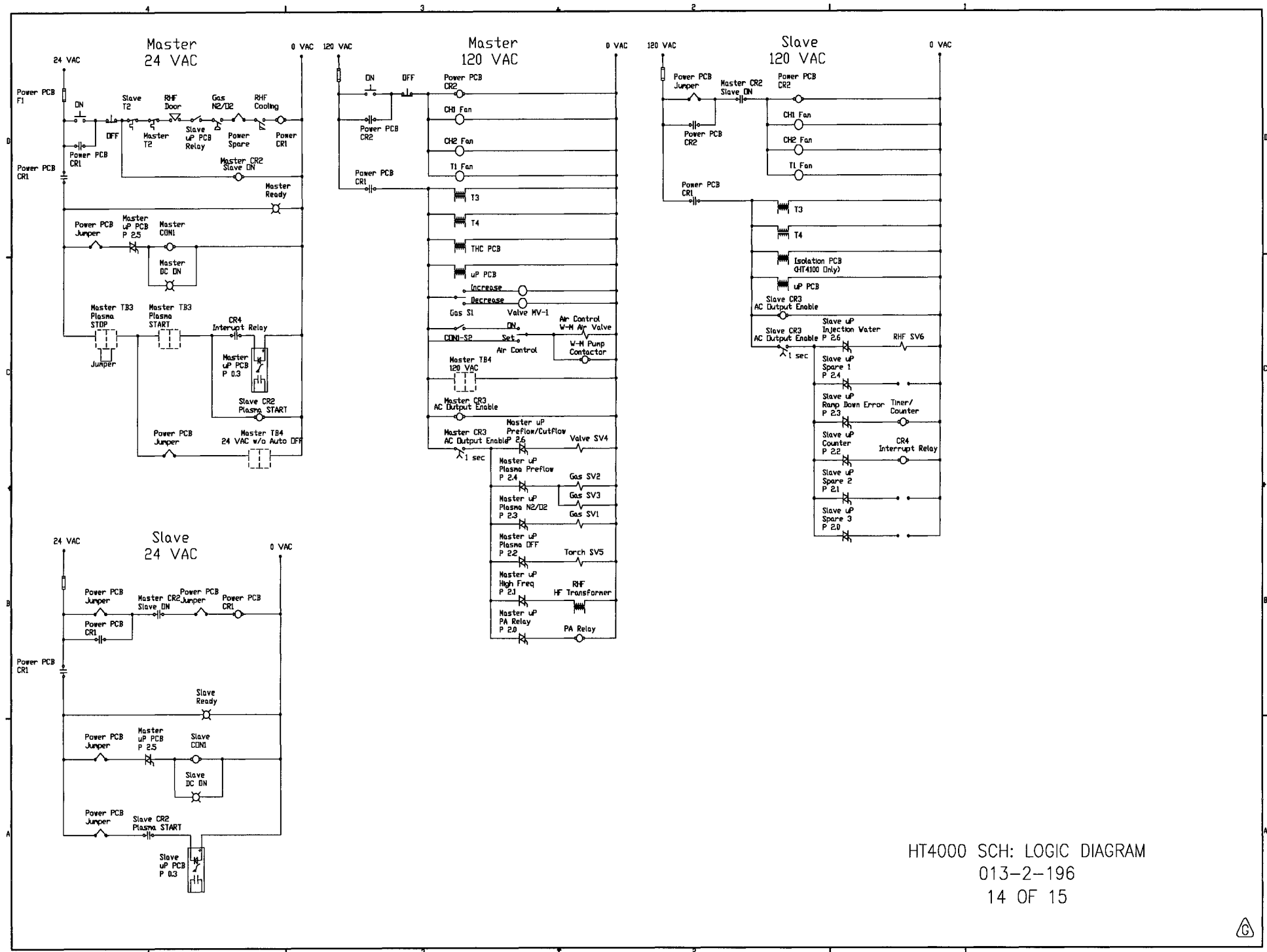
FM1 Flow Meter, Nitrogen
 FM2 Flow Meter, Oxygen
 FM3 Flow Meter, Injection Water
 FS1 Flow Switch, Cooling Water
 FS2 Flow Switch, Injection Water
 PG1 Pressure Gauge, Nitrogen Inlet
 PG2 Pressure Gauge, Oxygen Inlet
 PG3 Pressure Gauge, Injection
 PS1 Pressure Switch, Nitrogen Inlet
 PS2 Pressure Switch, Oxygen Inlet

MV1 Metering Valve, Plasma Motor
 MV2 Metering Valve, N2 Preflow
 MV3 Metering Valve, O2 Preflow
 MV4 Metering Valve, Injection Water
 SV1 Solenoid Valve, O2/N2
 SV2 Solenoid Valve, N2 Preflow
 SV3 Solenoid Valve, O2 Preflow
 SV4 Solenoid Valve, Preflow/Operate
 SV5 Solenoid Valve, Plasma OFF
 SV6 Solenoid Valve, Injection Water

1 = Normally Closed
 2 = Common
 3 = Normally Open

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24VAC Signal

Current Sensor

Gas S2

HOLD

2nd HT4000

R/F FS2

Gas S1

THC PCB

AVC On

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Port	HT4000/041269	I/O
0.0	Transfer	Input
0.1	Test Outflow	Input
0.2	Test Preflow	Input
0.3	Plasma START	Input
0.4	Spare	Input
0.5	Spare	Output
0.6	Hold	Input
0.7	Hold	Output
1.0	Injection Water FS2	Input
1.1	Plasma Select N2/O2	Input
1.2	Set 20	Input
1.3	Set 40	Input
1.4	Set 80	Input
1.5	Set 100	Input
1.6	Set 200	Input
1.7	Set 400	Input
1.8	Watchdog (Internal)	Output
1.9	JHS Complete	Input
2.0	PA Relay	120V Output
2.1	High Frequency	120V Output
2.2	Plasma OFF	120V Output
2.3	Plasma N2/O2	120V Output
2.4	Plasma Preflow	120V Output
2.5	Contactor	24V Output
2.6	Contactor	24V Output
2.7	Preflow/Outflow	120V Output
3.0	Slave Ramp Up	NC Relay
3.1	JHS Start	Output
3.2	Arc DN	NO Relay
3.3	Arc DN	Output
3.4	Chopper DN (Internal)	Output
3.5	Set Duty (Internal)	Output
3.6	Current 1 (Internal)	Input
3.7	Current 2 (Internal)	Input

Master uP

Port	HT4000/041270	I/O
0.0	Spare	Input
0.1	Plasma Select N2/O2	Input
0.2	Spare	Input
0.3	Plasma START	Input
0.4	Spare	Input
0.5	Spare	Output
0.6	Spare	Input
0.7	Spare	Output
1.0	Slave Ramp Up	Input
1.1	Set 20	Input
1.2	Set 40	Input
1.3	Set 80	Input
1.4	Set 100	Input
1.5	Set 200	Input
1.6	Set 400	Input
1.7	Watchdog (Internal)	Output
1.8	JHS Complete	Input
2.0	Spare 3	120V Output
2.1	Spare 2	120V Output
2.2	Interrupt Relay	120V Output
2.3	Ramp Down Error	120V Output
2.4	Spare 1	120V Output
2.5	Contactor	24V Output
2.6	Contactor	24V Output
2.7	Injection Water	120V Output
3.0	uP Interlock	NC Relay
3.1	JHS Start	Output
3.2	SPARE	NO Relay
3.3	SPARE	Output
3.4	Chopper (Internal)	Output
3.5	Set Duty (Internal)	Output
3.6	Current 1 (Internal)	Input
3.7	Current 2 (Internal)	Input

Slave uP

HT4000 SCH: uP SIGNALS

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Section 6 STANDARDS INDEX

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STANDARDS INDEX

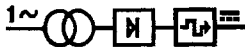
For further information concerning safety practices to be exercised with plasma arc cutting equipment, please refer to the following publications:

1. ANSI Standard Z49.1, *Safety in Welding and Cutting*, obtainable from the American Welding Society, 550 LeJeune Road, P.O. Box 351020, Miami, FL 33135.
2. NIOSH, *Safety and Health in Arc Welding and Gas Welding and Cutting*, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
3. OSHA, *Safety and Health Standards*, 29FR 1910, obtainable from the 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 the 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 the 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 the American Welding Society, 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135.
8. NFPA Standard 51, *Oxygen — Fuel Gas Systems for Welding and Cutting*, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.
9. NFPA Standard 70-1978, *National Electrical Code*, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.
10. NFPA Standard 51B, *Cutting and Welding Processes*, obtainable from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.
11. CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Cylinders*, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.
12. CSA Standard W117.2, *Code for Safety in Welding and Cutting*, obtainable from the Canadian Standards Association Standard Sales, 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada.
13. NWSA booklet, *Welding Safety Bibliography*, obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103.

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14. American Welding Society Standard AWS F4.1, *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 LeJeune Road, P.O. Box 351040, Miami, FL 33135.
15. ANSI Standard Z88.2, *Practices for Respiratory Protection*, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
16. Canadian Electrical Code Part 1, *Safety Standards for Electrical Installations*, obtainable from the Canadian Standards Association, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W1R3.

IEC SYMBOLS USED

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

AERATION MANIFOLD FOR PLASMA CUTTING ALUMINUM

Introduction

When plasma arc cutting aluminum, free hydrogen gas may be generated by the cutting process. The high temperature of the plasma process causes disassociation of oxygen and hydrogen from the water in the water table. The hot aluminum, which has a high affinity for oxygen, then combines with the oxygen leaving free hydrogen.

An effective means of avoiding free hydrogen buildup is to install an aeration manifold on the floor of the water table to replenish the oxygen content of the water.

Making an Aeration Manifold - Figure b-1

Make an **Aeration Manifold** with two-inch (50 mm) PVC tubing with one-inch (25 mm) **Distribution Lines** connected to it. Drill 1/8 inch (3 mm) holes every six inches (150 mm) in the distribution lines. Cap the ends of the distribution lines and install the lines so that oxygen is delivered to all parts of the cutting area.

Connect the manifold to a shop air line. Set a pressure regulator to obtain a steady stream of bubbles.

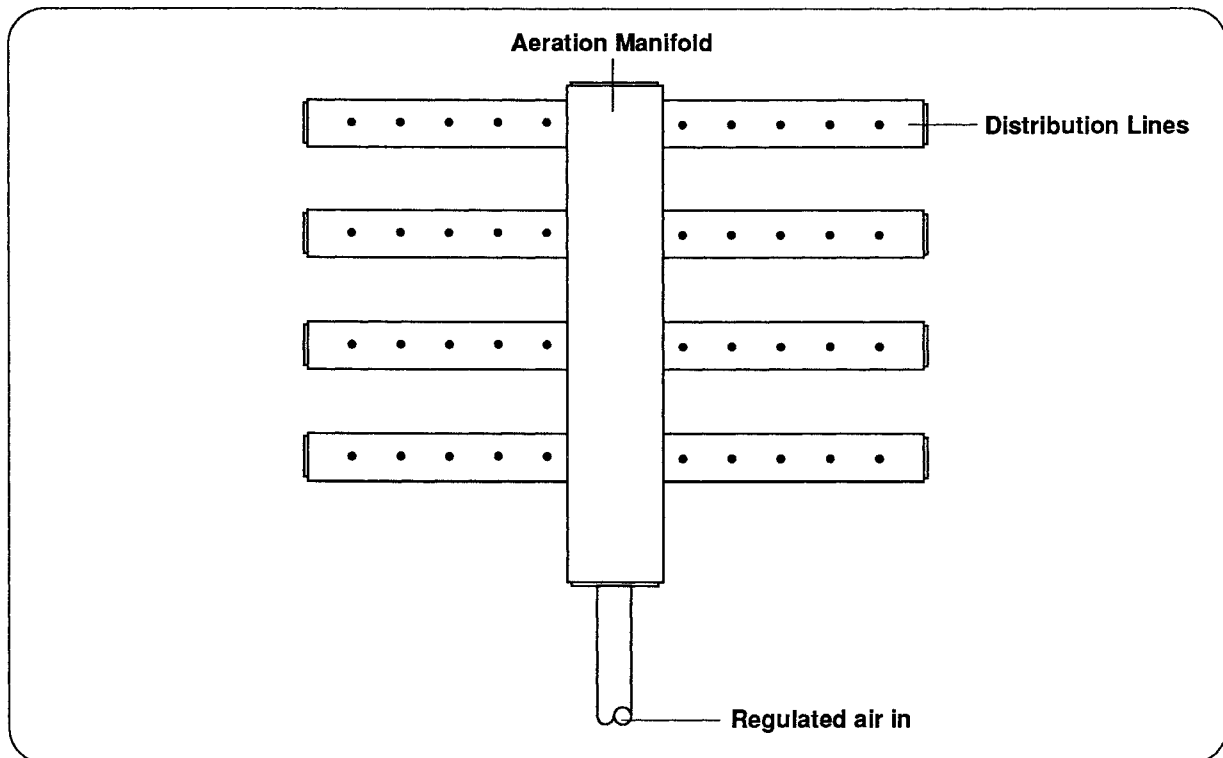


Figure b-1 Aeration Manifold

GLOSSARY

AC	Alternating Current. Motion of current alternately in one direction, then the other. The number of times per second the direction changes (the "frequency") is measured in hertz.
amp	Amperes. Measurement of the electron flow (the number of electrons per second) in an electrical circuit.
anode	The "positive" (+) side of a DC power source. Electrons leave the cathode and move toward the anode; ions move in the opposite direction. Plasma cutting requires the work and the nozzle to be the anode, and the electrode to be the cathode.
arc	Motion of electricity in a gas.
AWG	American Wire Gauge. Defines the diameter of wires.
bar	A unit of pressure equal to one million dynes per square centimeter.
breaker	A device which interrupts an electrical current if the current exceeds a preset amperage setting. Breakers can be returned to their conducting (non-interrupting) state by some mechanical action, such as flipping a switch.
cap	Nozzle retaining cap. Holds the swirl ring, electrode and nozzle inside the torch.
capacitor	A device that stores electric energy in the form of voltage.
cathode	The "negative" (-) side of a DC power source. (See anode)
consumable	Electrode, nozzle, swirl ring and retaining cap.
CSA	Canadian Standards Association. A product standards and testing agency.
current	Movement of electricity, measured in amperes. Current is said to move in a direction opposite that of electron flow.
DC	Direct Current. Motion of current in one direction only, from anode (+) to cathode (-).
dross	Globs of metal hanging around the kerf, usually on the bottom side.
duty cycle	Percentage of on-time (measured in minutes) in a 10 minute period in which a device can be operated.
electricity	Fundamental property of atoms that atoms can have their electrons pulled away ("ionized") and then the electrons can move about in metals or gases. An atom missing one or more electrons is called an ion. Both electrons and ions can move about in gases.

GLOSSARY

electrode	A part inside the torch connected to the cathode (-) of the power supply. Electrons come out of the electrode.
ferrule	A ring of metal surrounding the end of a cable or wire to strengthen a connection.
fuse	A protective device which melts when the current running through it exceeds the usage rating.
ground	An electrical connection buried in the earth to establish a voltage of zero (0) volts.
Hertz (Hz)	Measurement of "frequency" of an AC voltage or current in cycles per second.
IEC	International Electrotechnical Commission. An international standards organization
interlock	A safety device which must be activated before another device can be activated.
ion	An atom which has an excess or shortage of electrons.
IP	International Protection. An IEC designator, describing the degree of protection an enclosure offers against entry of objects and water.
I_1	Rated supply current. The supply current to the power source at a rated cutting condition (given U_1 , U_2 and I_2).
I_2	Rated output cutting current
kerf	Slit made in a workpiece by a cutting torch.
kilowatt	Thousand (kilo) watts. Measurement of electrical power.
LED	Light Emitting Diode. An electronic indicator lamp.
line	As in "line voltage." Utility voltage from a branch circuit (wall outlet).
liters/minute	A measure of gas flow.
nozzle	Tip of the plasma torch, made from copper, out of which the plasma arc comes. The nozzle pinches the plasma arc. It is usually an anode (+)
OCV	Open Circuit Voltage. U_0 The highest voltage from a electrical power supply. It occurs when the power supply is on and active but not producing a plasma arc.
pilot arc	A plasma arc that attaches to the torch nozzle rather than the work.
plasma	An electrically charged gas is said to be "ionized". A cloud of ionized gas together with its electrons is called "plasma."

GLOSSARY

plasma arc	Movement of electric current in a plasma (ionized gas). An intensely hot and bright arc which exists between the cathode (-) (electrode) and the anode (+) (either the nozzle or the work).
pressure	Force per unit area.
psi	Pounds per Square Inch. Measurement of gas pressure.
quench	Put in water to cool.
regulator	A mechanical device to control the outlet pressure of a gas supply.
ripple	Unwanted variations in current or voltage from an electrical power supply.
scfm	Standard cubic feet per minute. A measurement of gas flow.
single phase	An alternating current carried by only two wires. In the U.S. the "hot" carries the AC voltage and the "neutral" is at approximately "ground" voltage. The "ground" wire carries current only in fault conditions.
swirl ring	An insulating ring that separates the electrode from the nozzle and causes the air inside the plasma torch to swirl and aid in squeezing the arc
transfer	A pilot arc <i>transfers</i> to the work when the plasma arc leaves the surface of the nozzle and attaches to the work.
U_o	Rated Open Circuit Voltage occurring at the rated input voltage (U_1).
U_1	Rated Supply Voltage. The supply voltage for which the power source is constructed.
U_2	Conventional load voltage. The output load voltage at which rated input current (I_1), rated output current (I_2) and duty cycle (X) are measured.
VAC	Volts Alternating Current.
VDC	Volts Direct Current.
volt	Measurement of electrical force required to move an electric current through an electrical circuit.
watt	Measurement of electrical power. The ability to heat the work equivalent to a current of one ampere times an electrical force of one volt.
work(piece)	The object to be cut.
X	Duty cycle at a given U_1 , U_2 and I_2 .