

# ***Hypertherm***<sup>®</sup>

## **Powermax65**<sup>®</sup>

## **Powermax85**<sup>®</sup>

Plasma Arc Cutting Systems



Service Manual

807120 | Revision 4 | English

Environmental stewardship is one of Hypertherm's core values, and it is critical to our success and our customers' success. We are striving to reduce the environmental impact of everything we do. For more information: [www.hypertherm.com/environment](http://www.hypertherm.com/environment).

# ***Powermax65***

# ***Powermax85***

## **Service Manual**

**807120**

**Revision 4 – March 2022**

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Hanover, NH USA  
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# ELECTROMAGNETIC COMPATIBILITY (EMC)

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## Introduction

Hypertherm's CE-marked equipment is built in compliance with standard EN60974-10. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN60974-10 may not be adequate to completely eliminate interference when the affected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

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

## Installation and use

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions.

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

## Assessment of area

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

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

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

## Methods of reducing emissions

### Mains supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply.

Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure.

## Maintenance of cutting equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way, except as set forth in and in accordance with the manufacturer's written instructions. For example, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

## Cutting cables

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

## Equipotential bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered.

However, metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode (nozzle for laser heads) at the same time.

The operator should be insulated from all such bonded metallic components.

### Earthing of the workpiece

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

Note: The cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is provided in IEC 60974-9, Arc Welding Equipment, Part 9: Installation and Use.

### Screening and shielding

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

## Attention

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage or injury caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty, and will constitute misuse of the Hypertherm Product.

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

## General

Hypertherm Inc. warrants that its Products shall be free from defects in materials and workmanship for the specific periods of time set forth herein and as follows: if Hypertherm is notified of a defect (i) with respect to the plasma power supply within a period of two (2) years from the date of its delivery to you, with the exception of Powermax brand power supplies, which shall be within a period of three (3) years from the date of delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you, with the exception of the HPRXD short torch with integrated lead, which shall be within a period of six (6) months from the date of delivery to you, and with respect to torch lifter assemblies within a period of one (1) year from its date of delivery to you, and with respect to Automation products one (1) year from its date of delivery to you, with the exception of the EDGE Pro CNC, EDGE Pro Ti CNC, MicroEDGE Pro CNC, and ArcGlide THC, which shall be within a period of two (2) years from the date of delivery to you, and (iii) with respect to HyIntensity fiber laser components within a period of two (2) years from the date of its delivery to you, with the exception of laser heads and beam delivery cables, which shall be within a period of one (1) year from its date of delivery to you.

This warranty shall not apply to any Powermax brand power supplies that have been used with phase converters. In addition, Hypertherm does not warranty systems that have been damaged as a result of poor power quality, whether from phase converters or incoming line power. This warranty shall not apply to any product which has been incorrectly installed, modified, or otherwise damaged.

Hypertherm provides repair, replacement or adjustment of the Product as the sole and exclusive remedy, if and only if the warranty set forth herein properly is invoked and applies. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight pre paid by the customer. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph and with Hypertherm's prior written consent.

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

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

## Patent indemnity

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm's specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will have the right to defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party. You shall notify Hypertherm promptly upon learning of any action or threatened action in connection with any such alleged infringement (and in any event no longer than fourteen (14) days after learning of any action or threat of action), and Hypertherm's obligation to defend shall be conditioned upon Hypertherm's sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

## Limitation of liability

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

## National and local codes

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

## WARRANTY

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### Liability cap

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

### Insurance

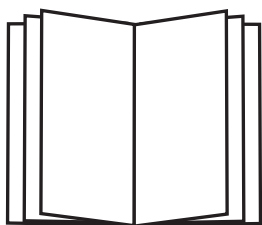
At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the products.

### Transfer of rights

You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty. Within thirty (30) days before any such transfer occurs, you agree to notify in writing Hypertherm, which reserves the right of approval. Should you fail timely to notify Hypertherm and seek its approval as set forth herein, the Warranty set forth herein shall be null and void and you will have no further recourse against Hypertherm under the Warranty or otherwise.



## WARNING!



Before operating any Hypertherm equipment, read the safety instructions in your product's manual and in the *Safety and Compliance Manual* (80669C). Failure to follow safety instructions can result in personal injury or in damage to equipment.

Copies of the manuals may accompany the product in electronic and printed formats. You can also obtain copies of the manuals, in all languages available for each manual, from the "Documents library" at [www.hypertherm.com](http://www.hypertherm.com).



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## Section 1

### SPECIFICATIONS

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### Safety information

Before you set up and operate your Hypertherm system, read the separate *Safety and Compliance Manual* included with your system for important safety information.

### System description

The Powermax65 and Powermax85 are highly portable, 65-amp and 85-amp, handheld and mechanized plasma cutting systems appropriate for a wide range of applications. The Powermax systems use air or nitrogen to cut electrically conductive metals, such as mild steel, stainless steel, or aluminum. Smart Sense™ technology automatically adjusts the gas pressure according to cutting mode and torch lead length for optimum cutting.

The Powermax65 can cut thicknesses up to 1 inch (25 mm) with a handheld torch and pierce thicknesses up to 5/8 inch (16 mm). The Powermax85 can cut thicknesses up to 1-1/4 inches (32 mm) and pierce thicknesses up to 3/4 inch (19 mm). FastConnect™ provides a simple push-button torch connection to the power supply for quick torch changes.

The typical handheld Powermax system includes a Duramax™ series 75° hand torch with a consumables box and work lead cable. Reference materials include: operator manual, quick setup card, registration card, setup DVD, and safety manual.

The typical mechanized Powermax system includes a Duramax series 180° full-length machine torch with a consumables box, work lead cable, and remote-start pendant. Reference materials include: operator manual, quick setup card, registration card, setup DVD, and safety manual.

You can order additional styles of torches, consumables, and accessories – such as the plasma cutting guide – from any Hypertherm distributor. See the *Parts* section for a list of spare and optional parts.

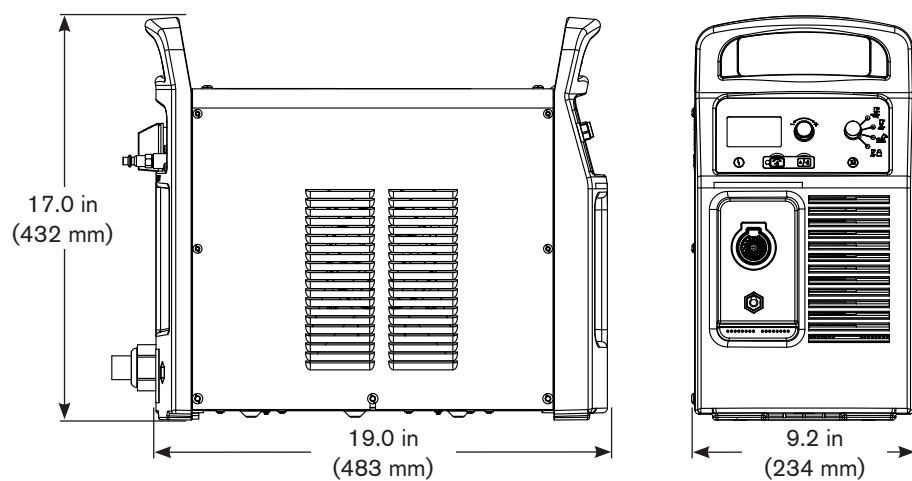
Powermax65 and Powermax85 power supplies are shipped without a plug on the power cord. See Section 2 *Power Supply Setup* for more information.

## Where to find information

System specifications such as size, weight, detailed electrical specifications, and cut speeds can be found in this section. For information on:

- Setup requirements, including power requirements, grounding, power cord configurations, extension cord requirements, and generator recommendations – see Section 2, *Power Supply Setup*.
- Handheld and machine torch consumables, cut charts, and torch setup information – see Section 3, *Torch Setup*.
- Information about the controls and LEDs, steps for system operation, and hints for improving cut quality – see Section 4, *Operation*.
- Maintenance and repair – see the troubleshooting section.
- Replacing components – see the *Component replacement* section (Service Manual).
- Part numbers and ordering information for accessories, consumables, and replacement parts – see the *Parts* section.
- Timing and schematic diagrams – see the *Wiring diagrams* section (Service Manual).

### Power supply dimensions





## Component weights

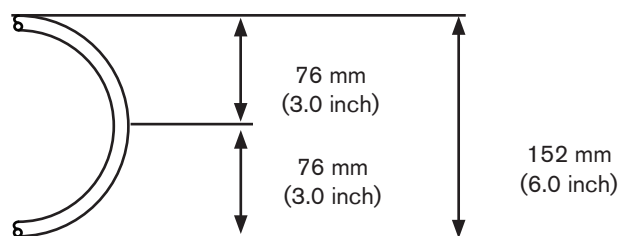
	<b>65 A CSA</b>	<b>65 A CE/CCC</b>	<b>85 A CSA</b>	<b>85 A CE/CCC</b>
	<b>lbs (kg)</b>	<b>lbs (kg)</b>	<b>lbs (kg)</b>	<b>lbs (kg)</b>
Power supply	54.1 (24.5)	47.0 (21.3)	59.9 (27.2)	50.4 (22.8)

	<b>65/85 A</b>
	<b>lbs (kg)</b>
Hand torch 7.6 m (25 ft)	6.8 (3.1)
Hand torch 15 m (50 ft)	12.2 (5.5)
Hand torch 23 m (75 ft)	17.6 (8.0)

Machine torch 7.6 m (25 ft)	7.6 (3.4)
Machine torch 15 m (50 ft)	13.2 (6.0)
Machine torch 23 m (75 ft)	18.8 (8.5)

	<b>65 A</b>	<b>85 A</b>
	<b>lbs (kg)</b>	<b>lbs (kg)</b>
Work lead 7.6 m (25 ft)	2.8 (1.3)	6.8 (3.1)
Work lead 15 m (50 ft)	5.0 (2.3)	7.5 (3.4)
Work lead 23 m (75 ft)	6.9 (3.1)	10.6 (4.8)

The recommended minimum bend radius for Powermax65/85 torch leads is 76 mm (3.0 inches).



Diameter = 2 x Radius = 152 mm (6.0 inches)

## SPECIFICATIONS

### Powermax65 power supply ratings

Rated open-circuit voltage (U <sub>0</sub> ) CSA, 1-phase, 3-phase CE/CCC, 3-phase	CSA 296 VDC CE/CCC 270 VDC		
Output characteristic*	Drooping		
Rated output current (I <sub>2</sub> )	20 – 65 A		
Rated output voltage (U <sub>2</sub> )	139 VDC		
Duty cycle at 40° C (104° F) (See data plate on power supply for more information on duty cycle.)	CSA  CCC/CE	50% @ 65 A, 230 – 600 V, 1/3 PH 40% @ 65 A, 200 – 208 V, 1/3 PH 100% @ 46 A, 230 – 600 V, 1/3 PH 50% @ 65 A, 380/400 V, 3 PH 100% @ 46 A, 380/400 V, 3 PH	
Operating temperature	14° to 104° F (-10° to 40° C)		
Storage temperature	-13° to 131° F (-25° to 55° C)		
Power factor 200 – 480 V CSA, 1-phase 200 – 600 V CSA, 3-phase 380/400 V CCC/CE, 3-phase	0.99 – 0.97 0.94 – 0.73 0.94		
R <sub>sce</sub> – Short Circuit Ratio (CE/CCC models only)	U <sub>1</sub> – Volts AC rms, 3PH		R <sub>sce</sub>
	400 VAC		225.7
EMC classification CISPR 11 (CE/CCC models only)*	Class A		
Input voltage (U <sub>1</sub> )/ Input current (I <sub>1</sub> ) at rated output (U <sub>2</sub> MAX, I <sub>2</sub> MAX) (See Section 2 Power Supply Setup for more information.)	CSA  CCC/CE**,+	200/208/240/480 V, 1 PH, 50/60 Hz 52/50/44/22 A 200/208/240/480/600 V, 3 PH, 50/60 Hz 32/31/27/13/13 A 380/400 V, 3 PH, 50/60 Hz 15.5/15 A	
Gas type	Air		Nitrogen
Gas quality	Clean, dry, oil-free per ISO 8573-1 Class 1.2.2		99.95% pure
Recommended gas inlet flow rate/pressure	Cutting: 400 scfh, 6.7 scfm (190 slpm) @ 85 psi (5.9 bar) Maximum Removal gouging: 450 scfh, 7.5 scfm (210 slpm) @ 70 psi (4.8 bar) Maximum Control gouging: 450 scfh, 7.5 scfm (210 slpm) @ 70 psi (4.8 bar)		

\* Defined as a plot of output voltage versus output current.

\*\* Equipment complies with IEC 61000-3-12 provided that the short-circuit power  $S_{sc}$  is greater than or equal to 2035 KVA at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power  $S_{sc}$  greater than or equal to 2035 KVA.

† Equipment complies with IEC 61000-3-11 provided that the supply impedance,  $Z_{max}$ , is 0.201 or less. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a impedance of 0.201 or less.

‡ WARNING: This Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There may be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated disturbances.

## SPECIFICATIONS

### Powermax85 power supply ratings

Rated open-circuit voltage ( $U_0$ ) CSA, single-phase, 3-phase CCC/CE, 3-phase	CSA CCC/CE	305 VDC 270 VDC
Output characteristic*	Drooping	
Rated output current ( $I_2$ )	25 – 85 A	
Rated output voltage ( $U_2$ )	143 VDC	
Duty cycle at 40° C (104° F) (See data plate on power supply for more information on duty cycle.)	CSA      CCC/CE	60% @ 85 A, 230 – 600 V, 3 PH 60% @ 85 A, 480 V, 1 PH 50% @ 85 A, 240 V, 1 PH 50% @ 85 A 200 – 208 V, 3 PH 40% @ 85 A 200 – 208 V, 1 PH 100% @ 66 A, 230 – 600 V, 1/3 PH 60% @ 85 A, 380/400 V, 3 PH 100% @ 66 A, 380/400 V, 3 PH
Operating temperature	14° to 104° F (-10° to 40° C)	
Storage temperature	-13° to 131° F (-25° to 55° C)	
Power factor 200 – 480 V CSA, 1-phase 200 – 600 V CSA, 3-phase 380/400 V CCC/CE, 3-phase	0.99 – 0.96 0.94 – 0.76 0.94	
$R_{sce}$ – Short Circuit Ratio (CCC/CE models only)	$U_1$ – Volts AC rms, 3PH	$R_{sce}$
	400 VAC	225.7
EMC classification CISPR 11 (CCC/CE models only)†	Class A	
Input voltage ( $U_1$ )/ Input current ( $I_1$ ) at rated output ( $U_{2\text{ MAX}}$ , $I_{2\text{ MAX}}$ ) (See Section 2 <i>Power Supply Setup</i> for more information.)	CSA   CCC/CE**,†	200/208/240/480 V, 1 PH, 50/60 Hz 70/68/58/29 A 200/208/240/480/600 V, 3 PH, 50/60 Hz 42/40/35/18/17 A 380/400 V, 3 PH, 50/60 Hz 20.5/19.5 A
Gas type	Air	Nitrogen
Gas quality	Clean, dry, oil-free per ISO 8573-1 Class 1.2.2	99.95% pure
Recommended gas inlet flow rate/pressure	Cutting: 400 scfh, 6.7 scfm (190 slpm) @ 85 psi (5.9 bar) Maximum Removal gouging: 450 scfh, 7.5 scfm (210 slpm) @ 70 psi (4.8 bar) Maximum Control gouging: 450 scfh, 7.5 scfm (210 slpm) @ 70 psi (4.8 bar)	

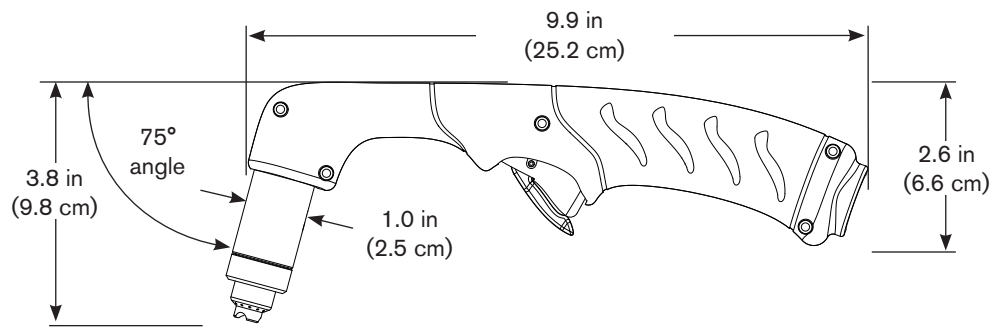
\* Defined as a plot of output voltage versus output current.

\*\* Equipment complies with IEC 61000-3-12 provided that the short-circuit power  $S_{sc}$  is greater than or equal to 2035 KVA at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power  $S_{sc}$  greater than or equal to 2035 KVA.

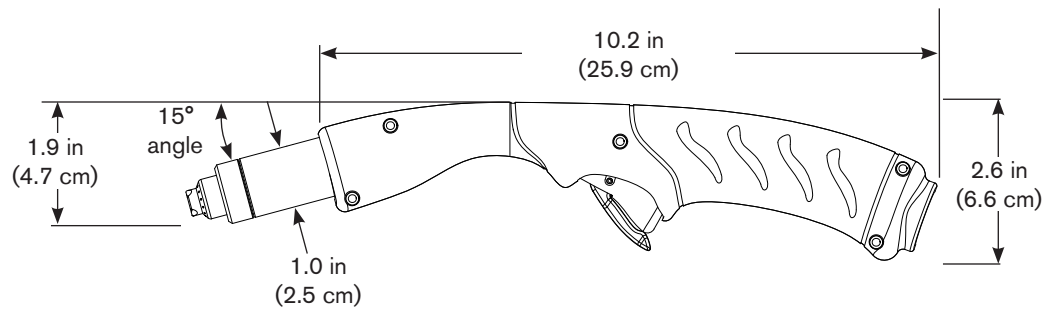
† Equipment complies with IEC 61000-3-11 provided that the supply impedance,  $Z_{max}$ , is 0.201 or less. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a impedance of 0.201 or less.

‡ WARNING: This Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There may be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated disturbances.

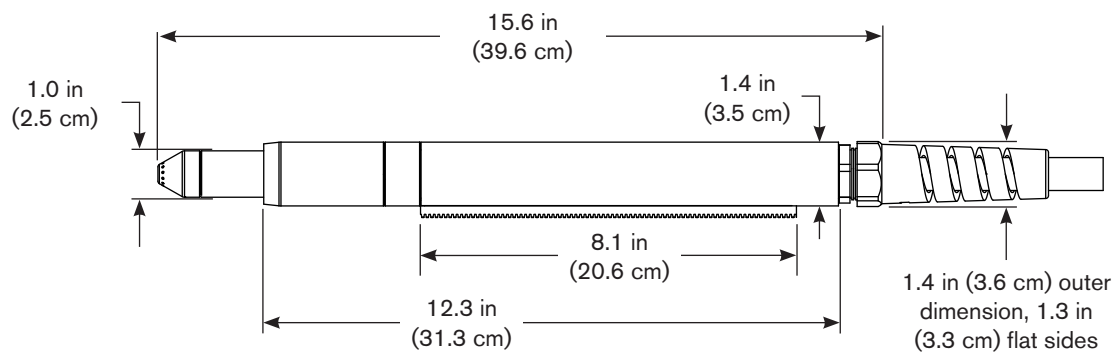
**Duramax 75° hand torch dimensions**



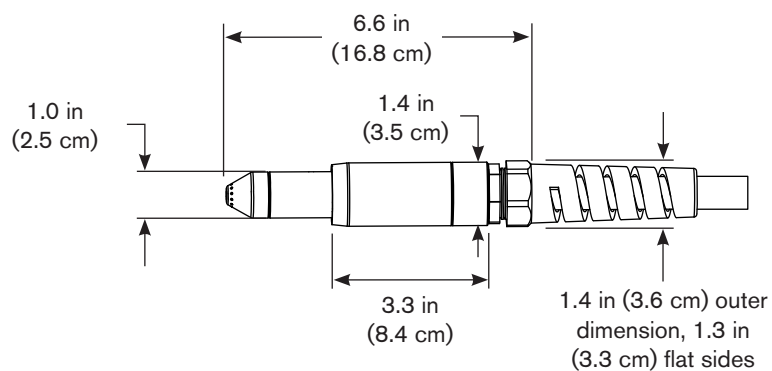
**Duramax 15° hand torch dimensions**



## Duramax 180° full-length machine torch dimensions



## Duramax 180° mini machine torch dimensions



### Powermax65 cutting specifications

<b>Handheld cut capacity (material thickness)</b>	
Recommended cut capacity at 20 ipm (500 mm/min)*	3/4 in (19 mm)
Recommended cut capacity at 10 ipm (250 mm/min)*	1 in (25 mm)
Severance capacity at 5 ipm (125 mm/min)*	1-1/4 in (32 mm)
<b>Pierce capacity (material thickness)</b>	
Pierce capacity for handheld cutting, or mechanized cutting with torch height control	5/8 in (16 mm)
Pierce capacity for mechanized cutting without torch height control	1/2 in (12 mm)
<b>Maximum cut speed** (mild steel)</b>	
1/4 in (6 mm)	145 ipm (4000 mm/min)
1/2 in (12 mm)	50 ipm (1400 mm/min)
3/4 in (19 mm)	24 ipm (600 mm/min)
1 in (25 mm)	12 ipm (320 mm/min)
<b>Gouging capacity</b>	
Maximum Removal metal removal rate on mild steel	10.7 lbs/hr (4.8 kg/hr)
Maximum Control metal removal rate on mild steel	7.5 lbs/hr (3.4 kg/hr)
<b>Duramax series torch weights (refer to 1-5 <i>Component weights</i>)</b>	
<b>Duty cycle and voltage information (refer to 1-6 <i>Powermax65 power supply ratings</i>)</b>	

\* Cut capacity speeds are not necessarily maximum speeds. They are the speeds that must be achieved to be rated at that thickness.

\*\* Maximum cut speeds are the results of Hypertherm's laboratory testing. Actual cutting speeds may vary based on different cutting applications.



## Powermax85 cutting specifications

<b>Handheld cut capacity (material thickness)</b>	
Recommended cut capacity at 20 ipm (500 mm/min)*	1 in (25 mm)
Recommended cut capacity at 10 ipm (250 mm/min)*	1-1/4 in (32 mm)
Severance capacity at 5 ipm (125 mm/min)*	1-1/2 in (38 mm)
<b>Pierce capacity (material thickness)</b>	
Pierce capacity for handheld cutting, or mechanized cutting with torch height control	3/4 in (19 mm)
Pierce capacity for mechanized cutting without torch height control	5/8 in (16 mm)
<b>Maximum cut speed** (mild steel)</b>	
1/4 in (6 mm)	200 ipm (5500 mm/min)
1/2 in (12 mm)	70 ipm (2000 mm/min)
3/4 in (19 mm)	36 ipm (900 mm/min)
1 in (25 mm)	21 ipm (550 mm/min)
1-1/4 in (32 mm)	13 ipm (330 mm/min)
<b>Gouging capacity</b>	
Maximum Removal metal removal rate on mild steel	19.5 lbs/hr (8.8 kg/hr)
Maximum Control metal removal rate on mild steel	13.7 lbs/hr (6.2 kg/hr)
<b>Duramax series torch weights (refer to 1-5 Component weights)</b>	
<b>Duty cycle and voltage information (refer to 1-8 Powermax85 power supply ratings)</b>	

\* Cut capacity speeds are not necessarily maximum speeds. They are the speeds that must be achieved to be rated at that thickness.

\*\* Maximum cut speeds are the results of Hypertherm's laboratory testing. Actual cutting speeds may vary based on different cutting applications.

### Symbols and marks

Your product may have one or more of the following markings on or near the data plate. Due to differences and conflicts in national regulations, not all marks are applied to every version of a product.



#### **S mark**

The S mark indicates that the power supply and torch are suitable for operations carried out in environments with increased hazard of electrical shock according to IEC 60974-1.



#### **CSA mark**

Products with a CSA mark meet the United States and Canadian regulations for product safety. The products were evaluated, tested, and certified by CSA-International. Alternatively, the product may have a mark by one of the other Nationally Recognized Testing Laboratories (NRTL) accredited in both the United States and Canada, such as UL or TÜV.



#### **CE mark**

The CE marking signifies the manufacturer's declaration of conformity to applicable European directives and standards. Only those versions of products with a CE marking located on or near the data plate have been tested for compliance with the European Low Voltage Directive and the European Electromagnetic Compatibility (EMC) Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the product with a CE marking.



#### **Eurasian Customs Union (CU) mark**

CE versions of products that include an EAC mark of conformity meet the product safety and EMC requirements for export to Russia, Belarus, and Kazakhstan.



#### **GOST-TR mark**

CE versions of products that include a GOST-TR mark of conformity meet the product safety and EMC requirements for export to the Russian Federation.



#### **C-Tick mark**

CE versions of products with a C-Tick mark comply with the EMC regulations required for sale in Australia and New Zealand.



#### **CCC mark**

The China Compulsory Certification (CCC) mark indicates that the product has been tested and found compliant with product safety regulations required for sale in China.



#### **UkrSEPRO mark**

The CE versions of products that include a UkrSEPRO mark of conformity meet the product safety and EMC requirements for export to the Ukraine.






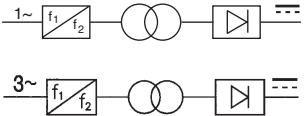













#### **Serbian AAA mark**

CE versions of products that include a AAA Serbian mark meet the product safety and EMC requirements for export to Serbia.

## IEC symbols

The following symbols may appear on the power supply data plate, control labels, switches, LEDs, and LCD screen.

	Direct current (DC)		Power is ON
	Alternating current (AC)		Power is OFF
	Plasma torch cutting		An inverter-based power source, either 1-phase or 3-phase
	Plate metal cutting		Volt/amp curve, "drooping" characteristic
	Expanded metal cutting		Power is ON (LED)
	Gouging		System fault (LED)
	AC input power connection		Inlet gas pressure fault (LCD)
	The terminal for the external protective (earth) conductor		Missing or loose consumables (LCD)
			Power supply is out of temperature range (LCD)



## Section 2

### POWER SUPPLY SETUP

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*In this section:*

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### Unpack the Powermax65 or Powermax85 system

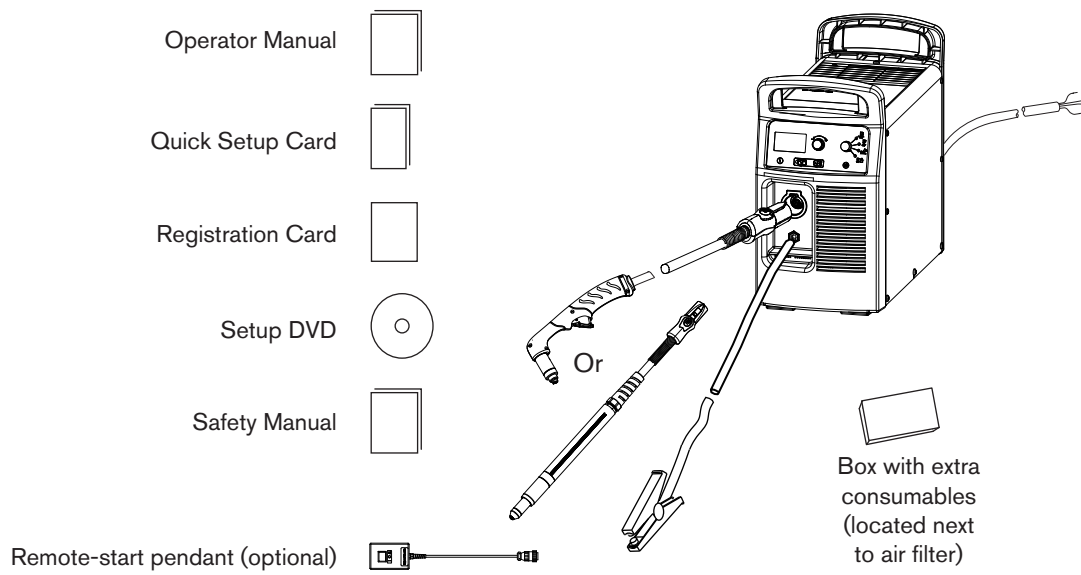
1. Verify that all items on your order have been received in good condition. Contact your distributor if any parts are damaged or missing.
2. Inspect the power supply for damage that may have occurred during shipping. If there is evidence of damage, refer to "Claims" below. All communications regarding this equipment must include the model number and the serial number located on the back of the power supply.
3. Before you set up and operate this Hypertherm system, read the separate *Safety and Compliance Manual* included with your system for important safety information.

### Claims

- **Claims for damage during shipment** – If your unit was damaged during shipment, you must file a claim with the carrier. Hypertherm will furnish you with a copy of the bill of lading upon request. If you need additional assistance, call the nearest Hypertherm office listed in the front of this manual.
- **Claims for defective or missing merchandise** – If any component is missing or defective, contact your Hypertherm distributor. If you need additional assistance, call the nearest Hypertherm office listed in the front of this manual.

## Contents

Verify the items in the box against the illustration.



### Position the power supply

Locate the power supply near an appropriate power receptacle for your installation: 200 – 480 volts (CSA 1-phase), 200 – 600 volts (CSA 3-phase), or 380/400 volts (3-phase CCC/CE). The power supply has a 10-foot (3 m) power cord. Allow at least 10 inches (0.25 m) of space around the power supply for proper ventilation.

The power supply is not suitable for use in rain or snow.

To avoid toppling, do not set the power supply on an incline greater than 10 degrees.

### Prepare the electrical power

Hypertherm (designated HYP on the data plate) input current ratings are used to determine conductor sizes for power connection and installation instructions. The HYP rating is determined under maximum normal operating conditions and the higher HYP input current value should be used for installation purposes.

The maximum output voltage will vary based on your input voltage and the circuit's amperage. Because the current draw varies during startup, slow-blow fuses are recommended as shown in the charts below. Slow-blow fuses can withstand currents up to 10 times the rated value for short periods of time.



**Caution: Protect the circuit with appropriately sized time-delay (slow-blow) fuses and a line-disconnect switch.**



## **Install a line-disconnect switch**

Use a line-disconnect switch for each power supply so that the operator can turn off the incoming power quickly in an emergency. Locate the switch so that it is easily accessible to the operator. Installation must be performed by a licensed electrician according to national and local codes. The interrupt level of the switch must equal or exceed the continuous rating of the fuses. In addition, the switch should:

- Isolate the electrical equipment and disconnect all live conductors from the incoming supply voltage when in the OFF position.
- Have one OFF and one ON position that are clearly marked with O (OFF) and I (ON).
- Have an external operating handle that can be locked in the OFF position.
- Contain a power-operated mechanism that serves as an emergency stop.
- Have appropriate slow-blow fuses installed. See 2-6 *Power connection for the Powermax65* or 2-8 *Power connection for the Powermax85* for recommended fuse sizes.

## **Requirements for grounding**

To ensure personal safety, proper operation, and to reduce electromagnetic interference (EMI), the power supply must be properly grounded.

- The power supply must be grounded through the power cord according to national and local electrical codes.
- Single-phase service must be of the 3-wire type with a green or green/yellow wire for the protective earth ground and must comply with national and local requirements. Do not use a 2-wire service.
- Three-phase service must be of the 4-wire type with a green or green/yellow wire for protective earth ground and must comply with national and local requirements.
- Refer to the separate *Safety and Compliance Manual* included with your system for more information on grounding.

### Power connection for the Powermax65

The Powermax65 CSA model is a universal power supply that can configure itself to operate with AC voltages from 200 to 600, 1- or 3-phase. The CCC/CE model is 380/400 V, 3-phase only. The rated output is 25 – 65 A, 139 VDC.

CSA model	Single-phase			Three-phase				
Input voltage	200 – 208	230 – 240	480	200 – 208	230 – 240	400	480	600
Input current at 9.0 kw output	52	44	22	32	27	15	13	13
Input current during arc stretch	74	74	38	45	45	27	23	23
Fuse (slow-blow)	80	80	40	50	50	30	25	25

CE/CCC model	Three-phase
Input voltage	380/400
Input current at 9.0 kw output	15.5/15
Input current during arc stretch	27
Fuse (slow-blow)	30

### Single-phase power cord (not for CE/CCC model)

To operate your Powermax65 on 1-phase power, you will need to install an appropriate power cord. Refer to 2-10 *Single-phase power cord installation* for instructions.



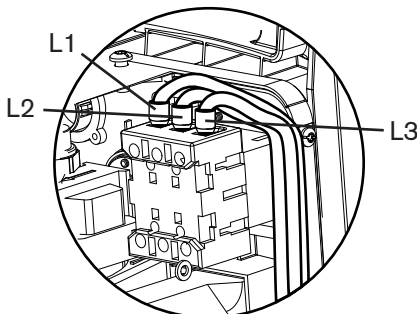
**Caution:** When using the Powermax65 CSA model power supply with a 1-phase power source, replace the supplied power cord with an 8 AWG (10 mm<sup>2</sup>) 3-wire power cord. The power cord must be connected by a licensed electrician. (CE/CCC model is 3-phase only.)

### Three-phase power cord – plug installation

The Powermax65 power supplies are shipped with an 8 AWG 4-wire power cord on CSA models. A 2.5 mm<sup>2</sup>, 4-wire style H07RN-F\* power cord is provided on CE/CCC models. To operate the Powermax65, use a plug that meets national and local electrical codes. The plug must be connected to the power cord by a licensed electrician.

The procedure is similar to installing a single-phase power cord as shown in the section 2-10 *Single-phase power cord installation*. The figure below shows the additional wire connected to L3.

- \* Style H07RN-F cord is a harmonized, heavy duty, flexible, rubber insulated, black neoprene jacketed multi-conductor IEC60245-4 / EN50525 European power cord with “CE” printed on the cord. The H07RN-F cord used by Hypertherm also has CCC certification to GB/T 5013.4 with “CCC” printed on the cord.



### Power connection for the Powermax85

The Powermax85 CSA model is a universal power supply that can configure itself to operate with AC voltages from 200 to 600, 1- or 3-phase (600 V 3-phase only). The CCC/CE model is 380/400 V, 3-phase only. The rated output is 25 – 85 A, 143 VDC.

CSA model	Single-phase			Three-phase				
Input voltage	200 – 208	230 – 240	480	200 – 208	230 – 240	400	480	600
Input current at 12.2 kw output	70	60	29	42	36	21	18	17
Input current during arc stretch	98	98	50	60	60	38	31	30
Fuse (slow-blow)	100	100	50	60	60	40	30	30

CE/CCC model	Three-phase
Input voltage	380/400
Input current at 12.2 kw output	20.5/20
Input current during arc stretch	38
Fuse (slow-blow)	40

**Single-phase power cord (not for CE/CCC model)**

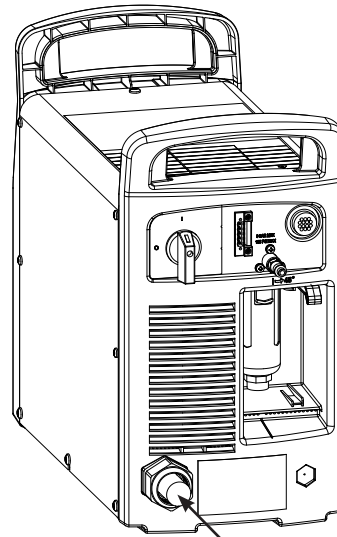
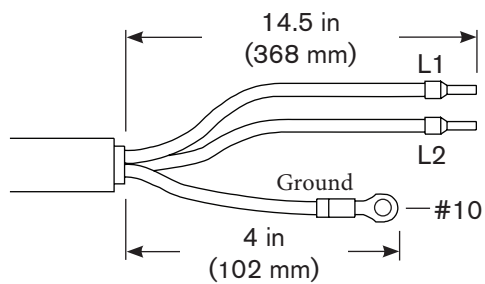
To operate your Powermax85 on 1-phase power, you will need to install an appropriate power cord. Refer to 2-10 *Single-phase power cord installation* for instructions.



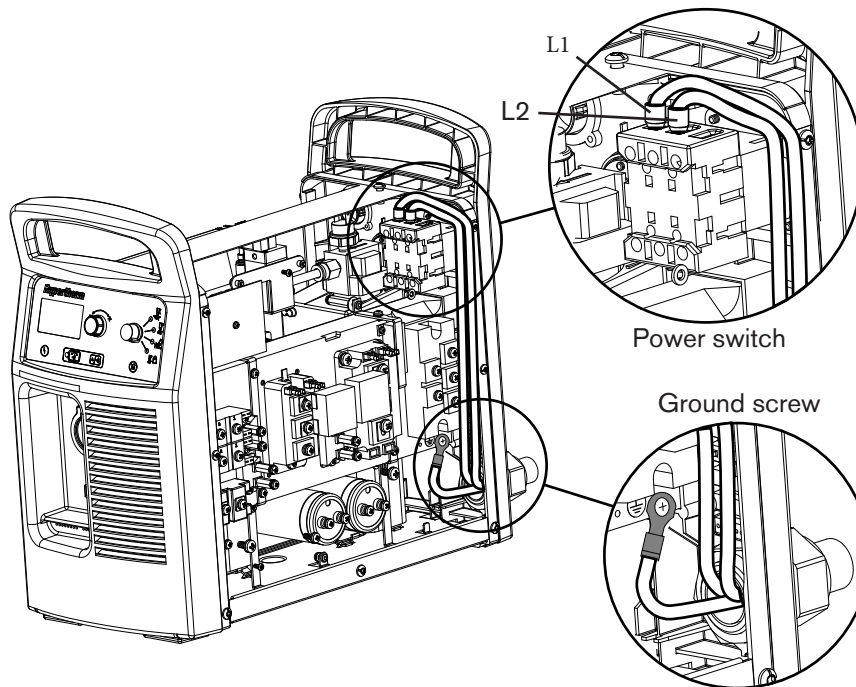
**Caution:** When using the Powermax85 CSA model power supply with a 1-phase power source, replace the supplied power cord with a 6AWG (16 mm<sup>2</sup>) 3-wire power cord. The power cord must be connected by a licensed electrician. (CE/CCC model is 3-phase only.)

### Single-phase power cord installation

Strip and prepare the power cord wires as shown below.



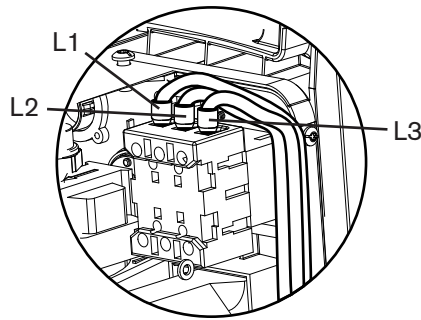
Route lead through strain relief and tighten



### Three-phase power cord – plug installation

The Powermax85 power supplies are shipped with an 8 AWG 4-wire power cord on CSA models. A 4 mm<sup>2</sup>, 4-wire style H07RN-F\* power cord is provided on CE/CCC models. To operate the Powermax85, use a plug that meets national and local electrical codes. The plug must be connected to the power cord by a licensed electrician.

The procedure is similar to installing a single-phase power cord as shown in the section 2-10 *Single-phase power cord installation*. The figure below shows the additional wire connected to L3.



\* Style H07RN-F cord is a harmonized, heavy duty, flexible, rubber insulated, black neoprene jacketed multi-conductor IEC60245-4 / EN50525 European power cord with “CE” printed on the cord. The H07RN-F cord used by Hypertherm also has CCC certification to GB/T 5013.4 with “CCC” printed on the cord.

### Extension cord recommendations

Any extension cord must have an appropriate wire size for the cord length and system voltage. Use a cord that meets national and local codes.

The table on the next page provides the recommended gauge sizes for various lengths and input voltages. The lengths in the tables are the length of the extension cord only; they do not include the power supply's power cord.

**Extension cord specifications**

Extension cord length		< 10 ft (< 3 m)	10 – 25 ft (3 – 7.6 m)	25 – 50 ft (7.5 – 15 m)	50 – 100 ft (15 – 30 m)	100 – 150 ft (30 – 45 m)
<b>65 A CSA</b>						
Input voltage (VAC)	Phase	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )
200 – 240	1	8 (10)	8 (10)	8 (10)	6 (16)	4 (25)
480	1	12 (4)	12 (4)	12 (4)	10 (6)	10 (6)
200 – 240	3	10 (6)	10 (6)	10 (6)	8 (10)	6 (16)
400/480	3	12 (4)	12 (4)	12 (4)	12 (4)	12 (4)
600	3	12 (4)	12 (4)	12 (4)	12 (4)	12 (4)
<b>65 A CE/CCC</b>						
Input voltage (VAC)	Phase	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>
380	3	4	4	4	4	4
400	3	4	4	4	4	4
<b>85 A CSA</b>						
Input voltage (VAC)	Phase	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )	AWG (mm <sup>2</sup> )
200 – 240	1	6 (16)	6 (16)	6 (16)	4 (25)	2 (35)
480	1	10 (6)	10 (6)	10 (6)	8 (10)	8 (10)
200 – 240	3	8 (10)	8 (10)	8 (10)	6 (16)	4 (25)
400/480	3	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)
600	3	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)
<b>85 A CE/CCC</b>						
Input voltage (VAC)	Phase	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>
380	3	6	6	6	6	6
400	3	6	6	6	6	6



## Engine-driven generator recommendations

Generators used with the Powermax65 or Powermax85 should satisfy the following requirements:

### CSA

- 1-phase, 50/60 Hz, 230/240 VAC
- 3-phase, 50/60 Hz, 200-600 VAC (480 VAC recommended for best performance)

### CE/CCC

- 3-phase, 50/60 Hz, 380/400 VAC (400 VAC recommended for best performance)

Engine drive rating	System output current	Performance (arc stretch)
20 kw	85 A	Full
15 kw	70 A	Limited
15 kw	65 A	Full
12 kw	65 A	Limited
12 kw	40 A	Full
8 kw	40 A	Limited
8 kw	30 A	Full

Note: Based on the generator rating, age, and condition, adjust the cutting current as needed.

If a fault occurs while using a generator, turning the power switch quickly to OFF and then to ON again (sometimes called a “quick reset”) may not clear the fault. Instead, turn OFF the power supply and wait 30 to 45 seconds before turning ON again.

### Prepare the gas supply

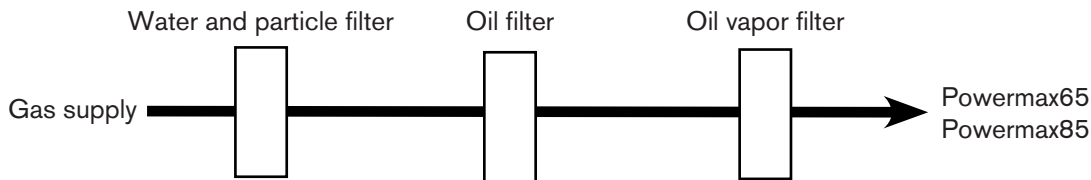
The gas supply can be shop-compressed or cylinder-compressed. A high-pressure regulator must be used on either type of supply and must be capable of delivering gas to the air inlet on the power supply.

If the supply quality is poor, cut speeds decrease, cut quality deteriorates, cutting thickness capability decreases, and the life of the consumables shortens. To address these issues, use an optional air filtration system. See *Additional gas filtration*, below.

For optimal performance, the gas should be compliant with ISO8573-1:2010, Class 1.2.2 (that is, it should have a maximum number of solid particulate per m<sup>3</sup> of <20,000 for particle sizes in the range of 0.1-0.5 microns, <400 for particle sizes in the range of 0.5-1 microns, and <10 for particle sizes in the range of 1-5 microns). The maximum water vapor dew point should be <-40° C (-40° F). The maximum oil (aerosol, liquid, and vapor) content should be less than 0.1 mg/m<sup>3</sup>.

### Additional gas filtration

When site conditions introduce moisture, oil, or other contaminants into the gas line, use a 3-stage coalescing filtration system. A 3-stage filtering system works as shown below to clean contaminants from the gas supply.



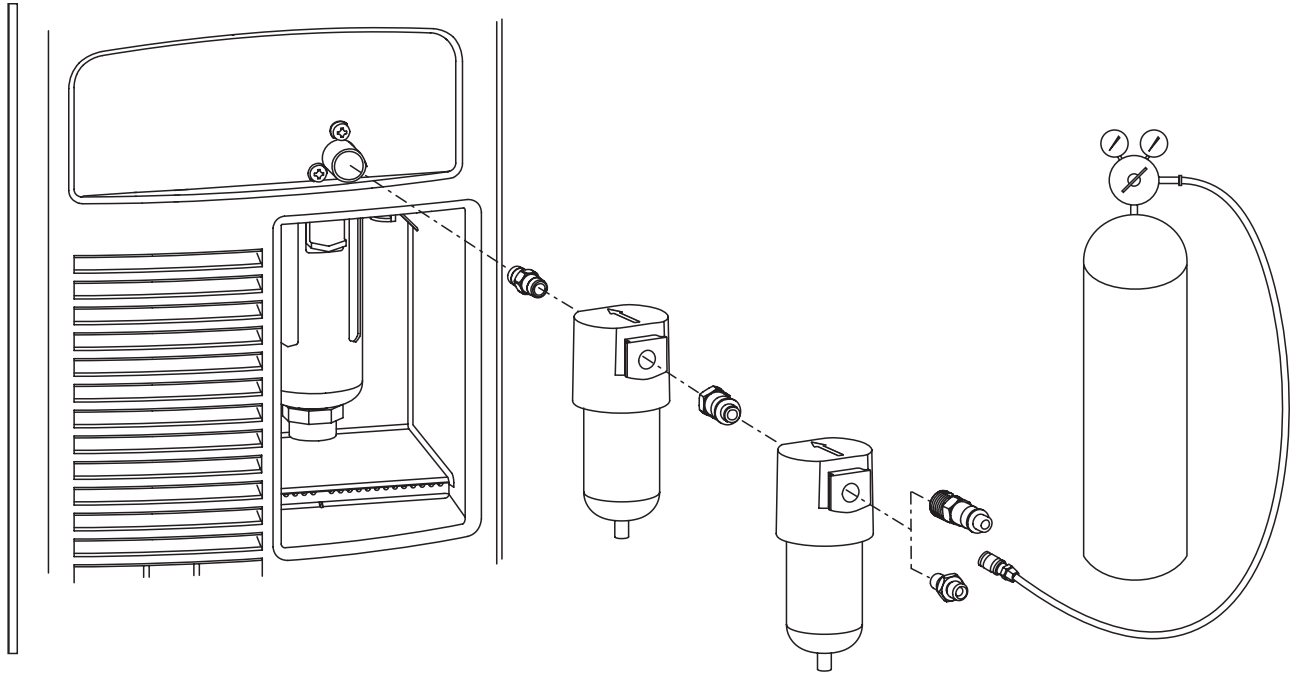
The filtering system should be installed between the gas supply and the power supply. Additional gas filtration may increase the required minimum inlet pressure.

Hypertherm offers these optional external filter kits:

- ❶ The Eliminer moisture removal air filter kit (128647) removes water and dirt from the gas supply. For more information, refer to Field Service Bulletin 804180.
- ❷ The oil removal air filter kit (428719) removes oil, oil vapor, and dirt from the gas supply. For more information, refer to Field Service Bulletin 809610.

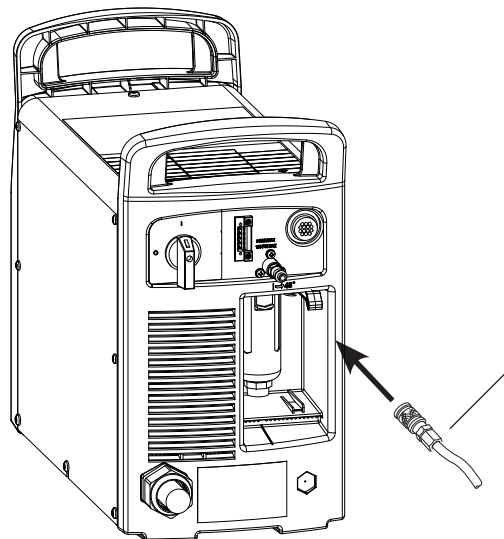
Note: For additional parts related to these filter kits, see page 7-21 *Accessory parts*.

If you use both external filters, install them in the order shown to prevent damage to the gas line and equipment.



### Connect the gas supply

Connect the gas supply to the power supply using an inert-gas hose with a 3/8 inch (9.5 mm) internal diameter and a 1/4 NPT quick-disconnect coupler, or a 1/4 NPT x G-1/4 BSPP (CE/CCC units) quick-disconnect coupler.



The recommended inlet pressure while gas is flowing is 85 – 135 psi (5.9 – 9.3 bar).



### WARNING

**Do not allow the gas supply pressure to exceed 135 psi (9.3 bar). The filter bowl may explode if this pressure is exceeded.**

### Minimum inlet pressure (while gas is flowing)

This table shows the minimum required inlet pressure when the recommended inlet pressure is not available.

	Torch lead length		
	7.6 m (25 ft)	15 m (50 ft)	23 m (75 ft)
Cutting	75 psi (5.2 bar)	80 psi (5.5 bar)	85 psi (5.9 bar)
Maximum Removal gouging	60 psi (4.1 bar)	65 psi (4.5 bar)	70 psi (4.8 bar)
Maximum Control gouging	60 psi (4.1 bar)	65 psi (4.5 bar)	70 psi (4.8 bar)

### Gas flow rates

Cutting	400 scfh, 6.7 scfm (190 slpm) at a minimum 85 psi (5.9 bar)
Maximum Removal gouging	450 scfh, 7.5 scfm (210 slpm) at a minimum 70 psi (4.8 bar)
Maximum Control gouging	450 scfh, 7.5 scfm (210 slpm) at a minimum 70 psi (4.8 bar)

## Section 3

### TORCH SETUP

---

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### Introduction

Duramax™ series handheld and machine torches are available for the Powermax65 and Powermax85 systems. The FastConnect™ quick-disconnect system makes it easy to remove the torch for transport or to switch from one torch to the other if your applications require the use of different torches. The torches are cooled by ambient air and do not require special cooling procedures.

This section explains how to set up your torch and choose the appropriate consumables for the job.

### Consumable life

How often you need to change the consumables on your Powermax65 or Powermax85 will depend on a number of factors:

- The thickness of the metal being cut.
- The average length of the cut.
- Whether you are doing machine or hand cutting.
- The air quality (presence of oil, moisture, or other contaminants).
- Whether you are piercing the metal or starting cuts from the edge.
- Proper torch-to-work distance when gouging or cutting with unshielded consumables.
- Proper pierce height.
- Whether you are cutting in “continuous pilot arc” mode or normal mode. Cutting with a continuous pilot arc causes more consumable wear.

Under normal conditions, the electrode will wear out first during machine cutting and the nozzle will wear out first when hand cutting.

A general rule is that a set of consumables lasts approximately 2 to 3 hours of actual “arc on” time for hand cutting, depending on these factors. For mechanized cutting, consumables should last about 3 to 5 hours.

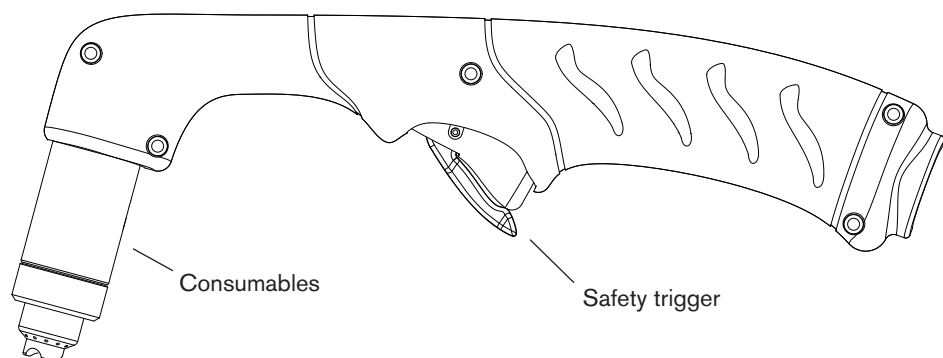
You will find more information about proper cutting techniques in Section 4, *Operation*.

### CopperPlus™ electrode for Duramax torches

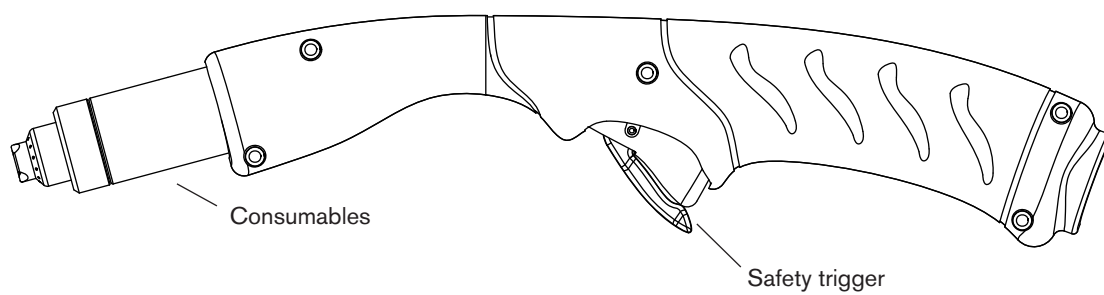
The CopperPlus electrode (part number 220777) delivers at least two times longer consumable life over standard consumables (Hypertherm consumables designed for the system). This electrode is designed exclusively for use with Duramax torches when cutting metal 12 mm (1/2 inch) and under, and is compatible with 40 A to 105 A settings.

## Hand torch setup

### Duramax 75° hand torch



### Duramax 15° hand torch



### Choose the hand torch consumables

Hypertherm includes a box of consumables with your system. Both styles of hand torches shown on the previous page use the same consumables.

Hand torches use shielded consumables. Therefore, you can drag the torch tip along the metal.

Consumables for hand cutting are shown on the next page. Notice that the retaining cap and electrode are the same for cutting, gouging, and FineCut® applications. Only the shield, nozzle, and swirl ring are different.

These 2 sets of gouging consumables can be used for both hand cutting and machine cutting:

- Maximum Removal gouging – For aggressive metal removal, deep gouge profiles, and extreme metal washing.
- Maximum Control gouging – For more precise metal removal, shallower gouge profiles, and light metal washing.

For the best cut quality on thin materials, you may prefer to use FineCut consumables, or use a 45 A nozzle and reduce the amperage to that setting.

To cut or gouge in hard to access or confined spaces, use HyAccess™ consumables. These 65 A consumables extend the reach of the general-purpose (standard) consumables by approximately 7.5 cm (3 inches). You can expect to achieve approximately the same cut thicknesses and cut quality as with the general-purpose consumables at 65 A.

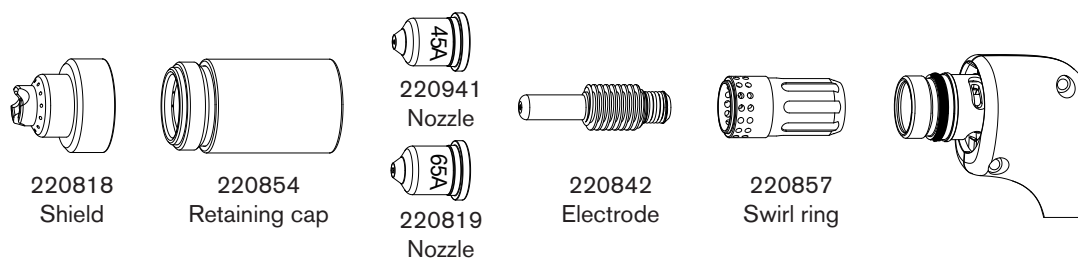
Two HyAccess nozzles are available:

- One standard nozzle designed for a broad range of cutting applications
- One gouging nozzle designed specifically for gouging

When the tip of either nozzle wears out, replace the entire nozzle.

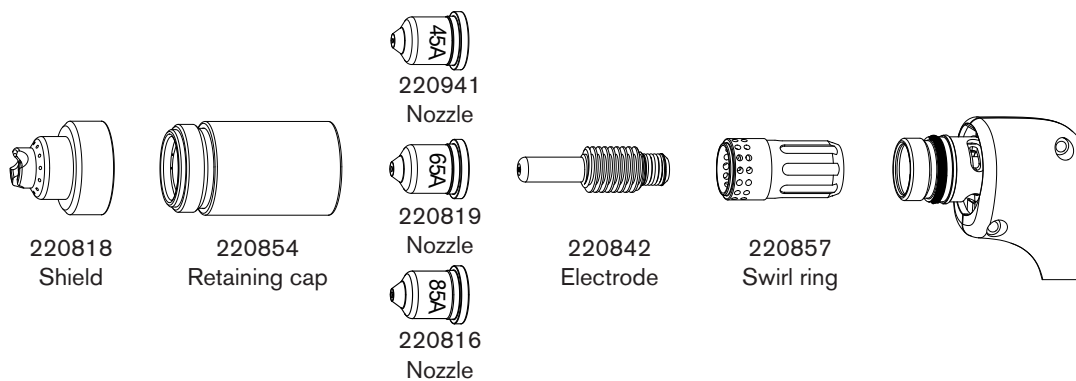
### Hand torch consumables

#### Drag-cutting consumables: Powermax65

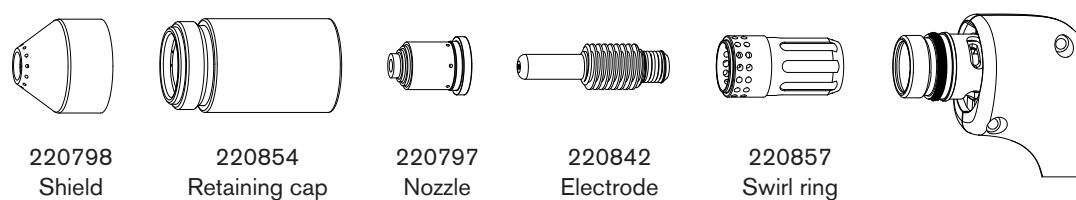




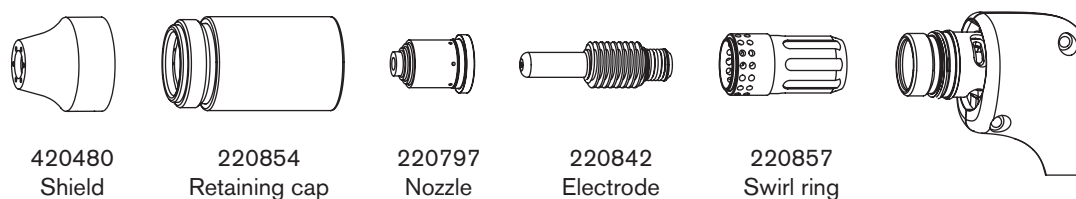
**Drag-cutting consumables: Powermax85**



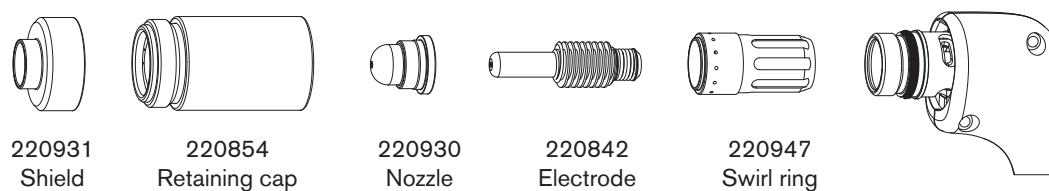
**Maximum Removal gouging consumables**



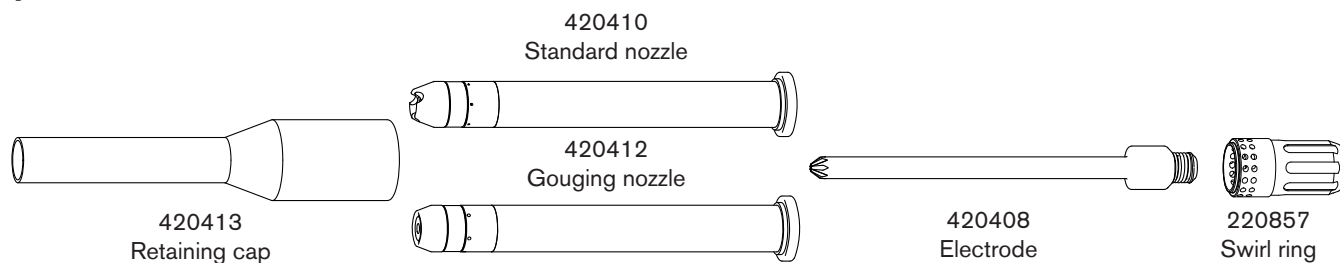
**Maximum Control gouging consumables**



**FineCut® consumables**



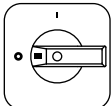


**HyAccess 65 A consumables**



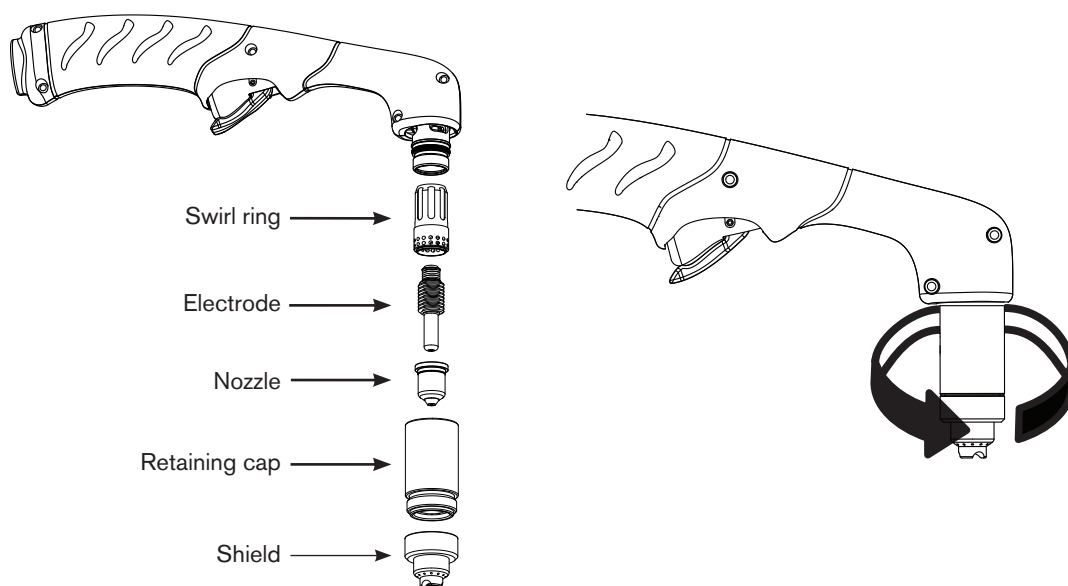
## TORCH SETUP

### Install the hand torch consumables

		<b>WARNING</b> <b>INSTANT-ON TORCHES</b> <b>PLASMA ARC CAN CAUSE INJURY AND BURNS</b>
	<b>The plasma arc comes on immediately when the torch trigger is activated. Make sure the power is OFF before changing consumables.</b>	

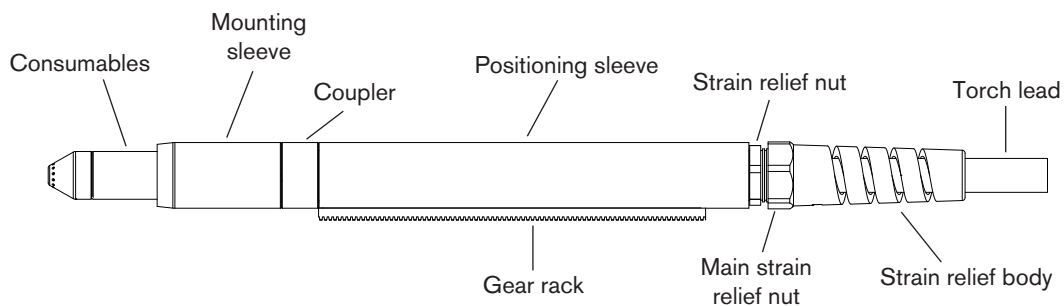
To operate the hand torch, a complete set of consumable parts must be installed: shield, retaining cap, nozzle, electrode, and swirl ring.

With the power switch in the OFF (O) position, install the torch consumables as shown below.

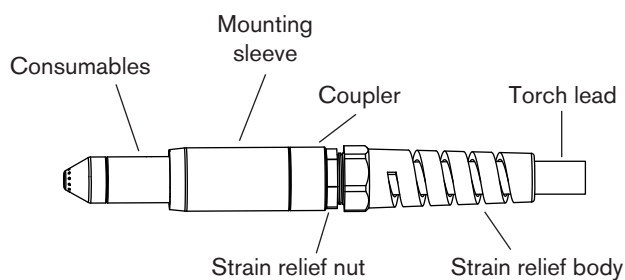


## Machine torch setup

### Duramax 180° full-length machine torch



### Duramax 180° mini machine torch



Before using either style of machine torch, you must:

- Mount the torch on your cutting table or other equipment.
- Choose and install the consumables.
- Align the torch.
- Attach the torch lead to the power supply.
- Set up the power supply for remote starting with either the remote-start pendant or a machine interface cable.

### Converting a full-length machine torch to a mini machine torch

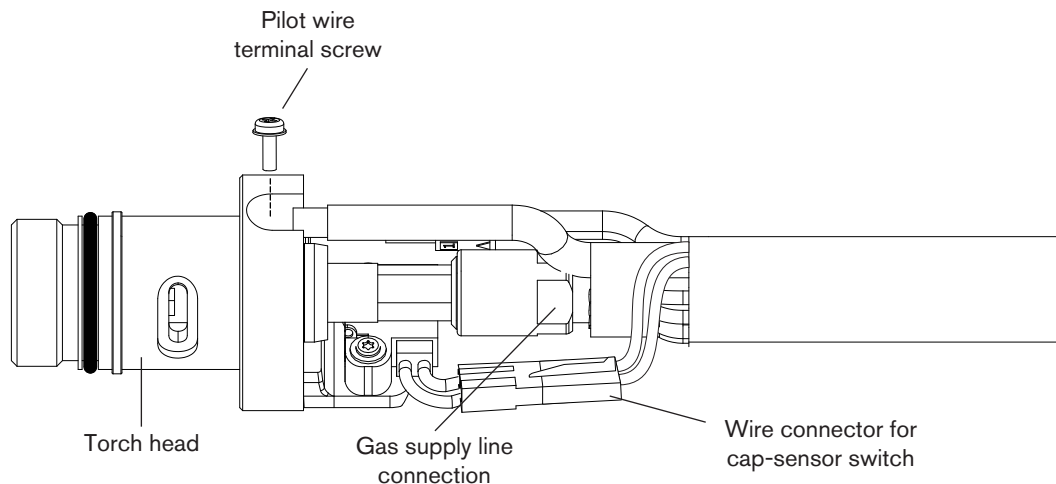
You can convert a full-length machine torch to a mini machine torch by removing the positioning sleeve.

Note: If you are converting a full-length machine torch to a mini machine torch *and* mounting the torch at the same time, skip this section and follow the instructions in 3-10 *Mount the torch*.

Refer to the figures in the section 3-7 *Machine torch setup* and follow these instructions.

Note: While disconnecting and reconnecting the torch parts, maintain the same orientation between the torch head and torch lead. Twisting the torch head in relation to the torch lead can cause damage.

1. Disconnect the torch lead from the power supply and remove the consumables from the torch.
2. Unscrew the strain relief body from the strain relief nut and slide the strain relief body back along the torch lead.
3. Unscrew the strain relief nut from the positioning sleeve and slide the nut back along the torch lead.
4. Unscrew the positioning sleeve from the coupler.
5. Unscrew the coupler from the mounting sleeve.
6. Remove the three screws from the consumables end of the mounting sleeve and slide the mounting sleeve off the front of the torch body.



7. Disconnect the wire connector for the cap-sensor switch.
8. Remove the screw that secures the torch's pilot wire to the torch body.
9. Use 1/4-inch and 3/8-inch wrenches, or adjustable wrenches, to loosen the nut that secures the gas supply line to the torch lead. Set the torch body aside.
10. Slide the coupler and positioning sleeve off the front of the torch lead.
11. Slide the coupler over the torch lead.
12. Reconnect the gas line to the torch lead.
13. Reattach the torch's pilot wire to the torch body using the screw.
14. Reconnect the cap-sensor switch's wire connector.
15. Slide the mounting sleeve over the front of the torch body. Align the slot on the front of the mounting sleeve (next to one of the three screw holes) with the cap-sensor plunger on the torch body.
16. Attach the mounting sleeve to the torch body using the three screws.
17. Screw the coupler into the mounting sleeve.
18. Screw the strain relief nut into the coupler.
19. Screw the strain relief body into the strain relief nut.

### Mount the torch

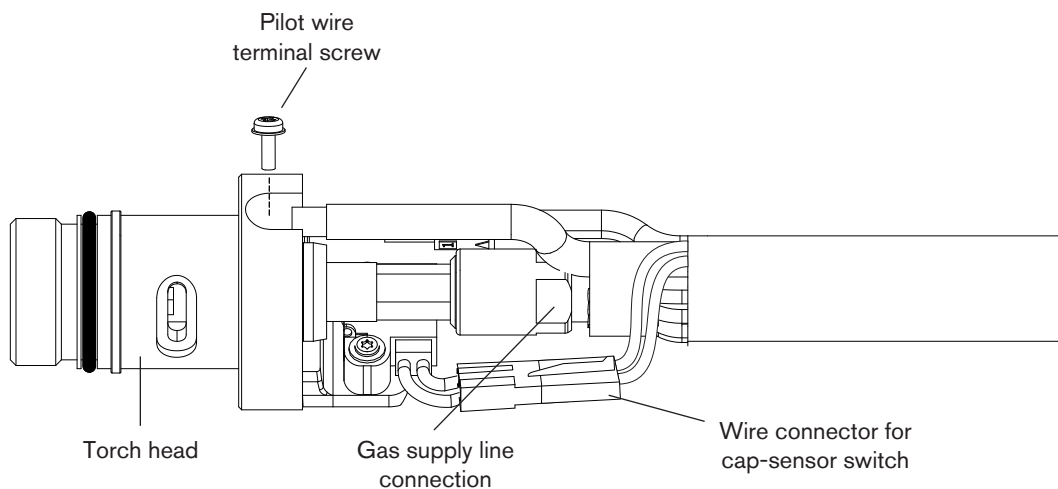
Depending on the type of cutting table you have, you may or may not need to disassemble the torch to route it through the track and mount it. If your cutting table's track is large enough for you to thread the torch through it without removing the torch body from the lead, do so and then attach the torch to the lifter per the manufacturer's instructions.

**Note:** The Duramax machine torches can be mounted on a wide variety of X-Y tables, track burners, pipe bevelers, and other equipment. Install the torch per the manufacturer's instructions and follow the instructions below for disassembly if necessary.

If you need to disassemble and reassemble the torch, refer to the figures in the section 3-7 *Machine torch setup* and follow these instructions.

**Note:** While disconnecting and reconnecting the torch parts, maintain the same orientation between the torch head and torch lead. Twisting the torch head in relation to the torch lead can cause damage.

1. Disconnect the torch lead from the power supply and remove the consumables from the torch.
2. Unscrew the strain relief body from the strain relief nut and slide the strain relief body back along the torch lead.
3. Unscrew the strain relief nut from the positioning sleeve (full-length machine torch) and slide the nut back along the torch lead.
4. Unscrew the positioning sleeve from the coupler.
5. Unscrew the coupler from the mounting sleeve.
6. Remove the three screws from the consumables end of the mounting sleeve and slide the mounting sleeve off the front of the torch body.



7. Disconnect the wire connector for the cap-sensor switch.
8. Remove the screw that secures the torch's pilot wire to the torch body.
9. Use 1/4-inch and 3/8-inch wrenches, or adjustable wrenches, to loosen the nut that secures the gas supply line to the torch lead. Set the torch body aside.

Note: Cover the end of the gas line on the torch lead with tape to keep dirt and other contaminants from getting in the gas line when you route the lead through the track.

10. Slide the coupler, positioning sleeve (full-length machine torch), strain relief nut, and strain relief body off the front of the torch lead.
11. If you do not need the gear rack on a full-length machine torch, slide the gear rack from the positioning sleeve toward the consumables end of the sleeve.
12. Route the torch lead through the cutting table's track.
13. Slide the strain relief body and strain relief nut over the torch lead.
14. If you are mounting a full-length machine torch, slide the positioning sleeve over the torch head.
15. Slide the coupler over the torch lead.
16. Reconnect the gas line to the torch lead.
17. Reattach the torch's pilot wire to the torch body using the screw.
18. Reconnect the cap-sensor switch's wire connector.
19. Slide the mounting sleeve over the front of the torch body. Align the slot on the front of the mounting sleeve (next to one of the three screw holes) with the cap-sensor plunger on the torch body.
20. Attach the mounting sleeve to the torch body using the three screws.
21. Screw the coupler into the mounting sleeve.
22. If you are mounting a full-length machine torch, screw the positioning sleeve into the coupler.
23. Reconnect the strain relief nut and strain relief body.
24. Attach the torch to the lifter per the manufacturer's instructions.

**Choose the machine torch consumables**

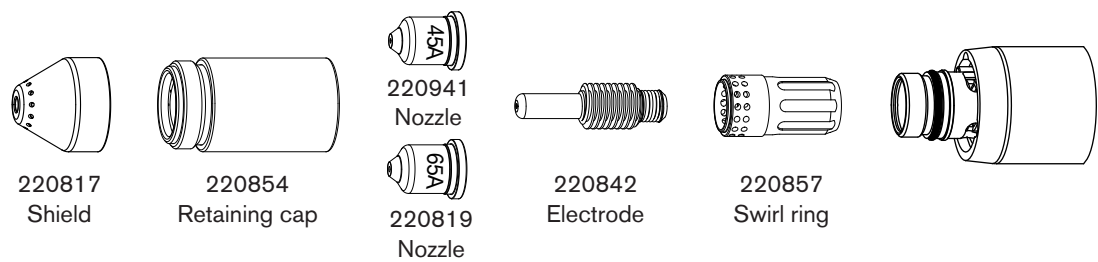
Powermax systems with the Duramax 180° full-length machine torch or Duramax 180° mini machine torch are shipped with a box of consumables. In addition, an ohmic-sensing retaining cap is available for use with shielded consumables.

With shielded consumables, the torch tip may touch the metal when cutting. With unshielded consumables, you must keep the torch a small distance, about 2-3 mm (.08-.12 inch), away from the metal. Unshielded consumables generally have a shorter life than shielded consumables. Depending upon which system you order, you may receive a starter consumable kit with a standard retaining cap or ohmic retaining cap.

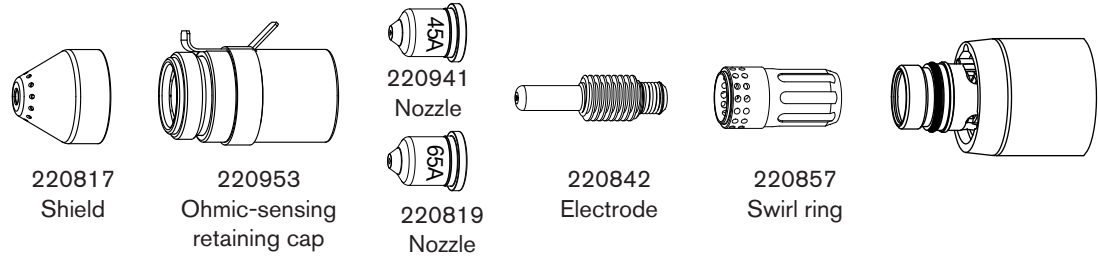
Both styles of machine torches use the same consumables.

**Machine torch consumables**

**Mechanized shielded consumables: Powermax65**

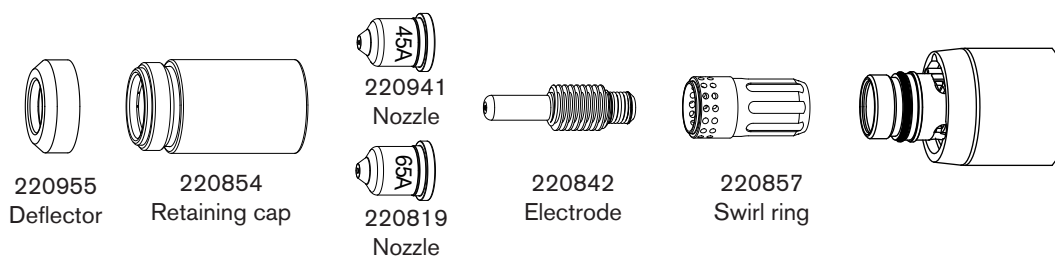


**Mechanized shielded with ohmic consumables: Powermax65**

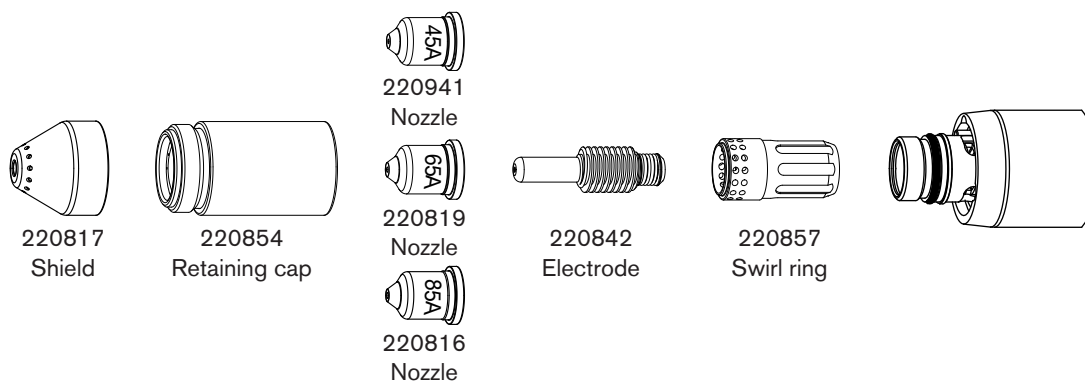




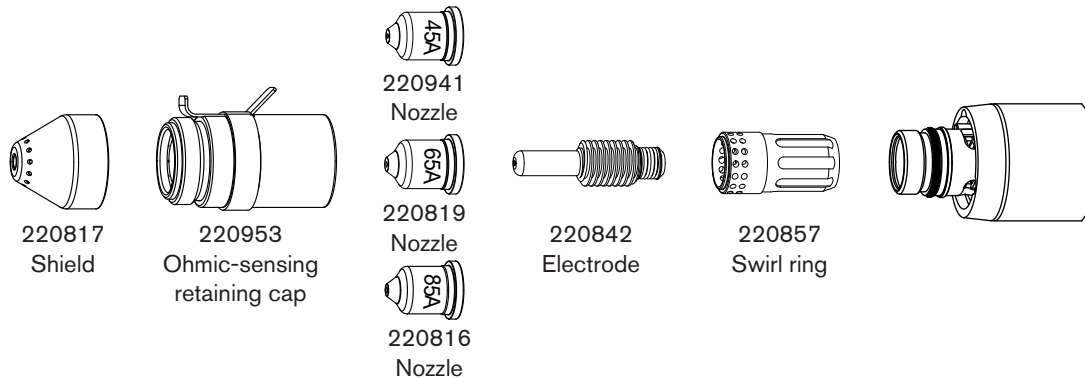
**Mechanized unshielded consumables: Powermax65**



**Mechanized shielded consumables: Powermax85**



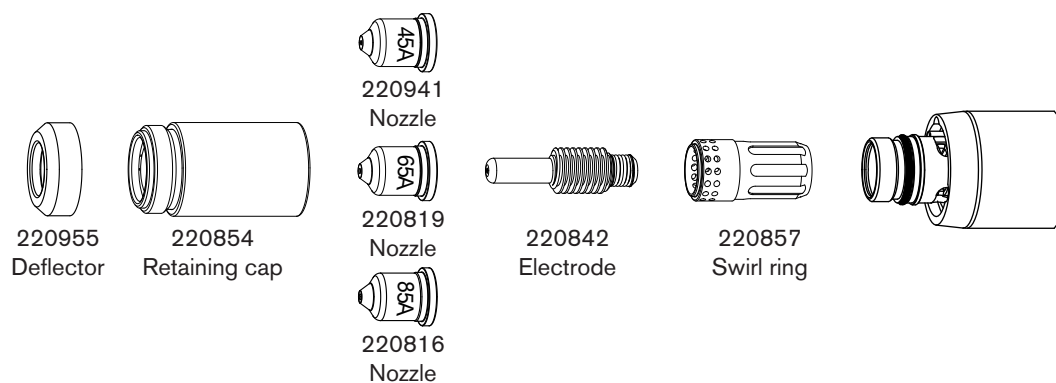
**Mechanized shielded with ohmic consumables: Powermax85**



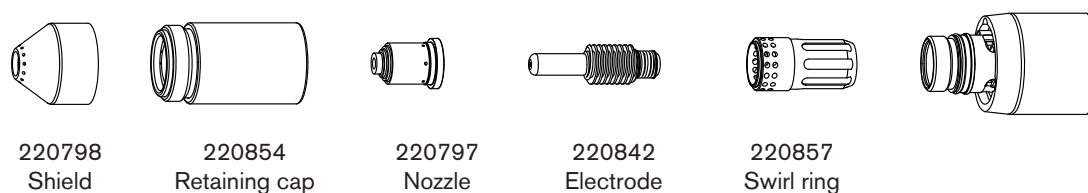
## TORCH SETUP

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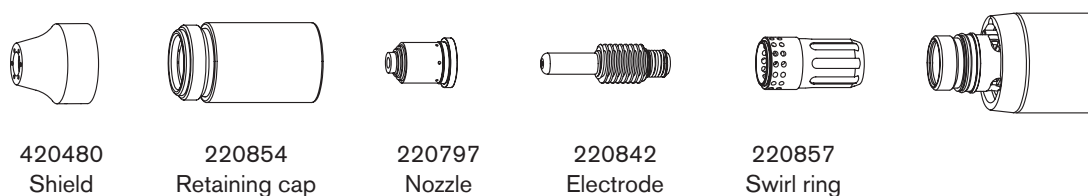
### Mechanized unshielded consumables: Powermax85



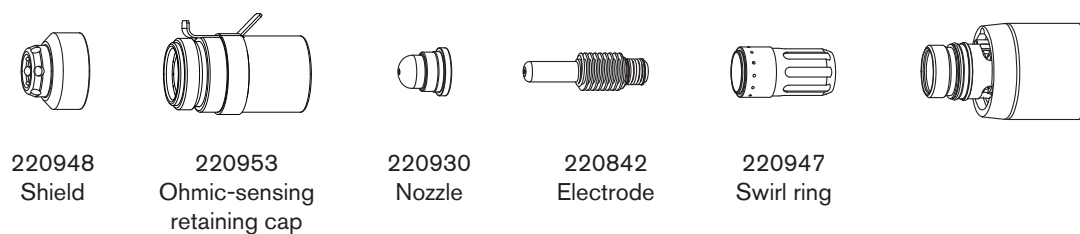
### Maximum Removal gouging consumables



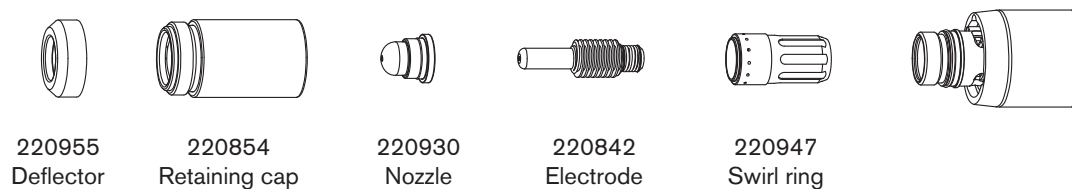
### Maximum Control gouging consumables





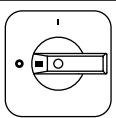
### FineCut® shielded consumables



### FineCut® unshielded consumables



## Install the machine torch consumables

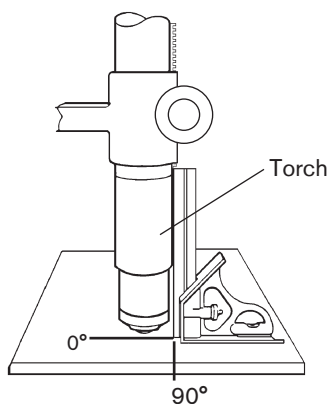
		<b>WARNING</b> <b>INSTANT-ON TORCHES</b>  <b>PLASMA ARC CAN CAUSE INJURY AND BURNS</b>
	<b>The plasma arc comes on immediately when the torch is activated. Make sure the power is OFF before changing the consumables.</b>	

To operate the machine torch, a complete set of consumable parts must be installed: shield, retaining cap, nozzle, electrode, and swirl ring.

With the power switch in the OFF (O) position, install the machine torch consumables in a manner similar to the hand torch consumables. Refer to 3-6 *Install the hand torch consumables*.

## Aligning the torch

Mount the machine torch perpendicular to the workpiece in order to get a vertical cut. Use a square to align the torch at 0° and 90°.



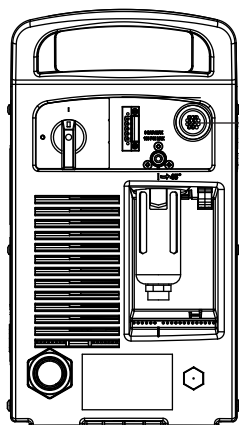
### Connecting an optional remote-start pendant

Powermax65 and Powermax85 configurations with a Duramax machine torch can include an optional remote-start pendant.

- Part number 128650: 25 foot (7.6 m)
- Part number 128651: 50 foot (15 m)
- Part number 128652: 75 foot (23 m)
- Part number 428755: 150 foot (45 m)

Remove the receptacle cover and plug the Hypertherm remote-start pendant into the receptacle on the rear of the power supply.

Note: The remote-start pendant is for use only with a machine torch. It will not operate if a handheld torch is installed.



Receptacle for the  
remote-start pendant or a  
machine interface cable.

## Connecting an optional machine interface cable

The Powermax65 and Powermax85 power supplies are equipped with an optional, factory-installed, five-position voltage divider that is designed to be safely connected without tools. The built-in voltage divider provides a scaled down arc voltage of 20:1, 21.1:1, 30:1, 40:1, and 50:1 (maximum output of 18 V). An optional receptacle on the rear of the power supply provides access to the scaled down arc voltage and signals for arc transfer and plasma start.

**Note:** The factory presets the voltage divider to 50:1. To change the voltage divider to a different setting, refer to 3-20 *Setting the five-position voltage divider*.

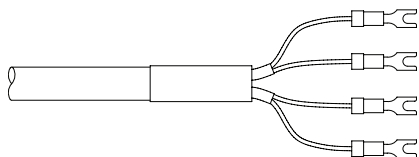
**Notice:** The voltage divider PCB is a simple resistive divider of raw arc voltage. To prevent ground loops and electrical interference, *you must isolate the divided arc signal*.



**Caution:** The factory-installed voltage divider PCB supplies a voltage that is in proportion to the arc voltage. The DIP switch settings on the voltage divider PCB control the output in open circuit conditions, to a maximum output of one of the following voltages: 18 V for Powermax65/85, 15 V for Powermax65/85/105 SYNC. This output is an impedance-protected, functional extra-low voltage (ELV) output. This type of output prevents shock, energy, and fire under normal conditions at the machine interface receptacle and in single-fault conditions with the machine interface wiring. The voltage divider PCB is not fault tolerant and ELV outputs do not comply with safety extra-low voltage (SELV) requirements for direct connection to electrical devices.

Hypertherm offers several choices of machine interface cables for the Powermax65 and Powermax85:

- To use the built-in voltage divider that provides a scaled down arc voltage in addition to signals for arc transfer and plasma start:
  - Use part number 228350 (7.6 m, 25 ft) or 228351 (15 m, 50 ft) for wires terminated with spade connectors. This cable is required if you want to connect a torch height controller to the power supply.
  - Use part number 123896 (15 m, 50 ft) for a cable terminated with a D-sub connector. (Compatible with Hypertherm's Edge Ti and Sensor PHC products.)
- To use signals for arc transfer and plasma start only, use either part number 023206 (7.6 m, 25 ft) or part number 023279 (15 m, 50 ft). These cables have spade connectors as shown below.



## TORCH SETUP

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Note: The cover on the machine interface receptacle prevents dust and moisture from damaging the receptacle when not in use. This cover should be replaced if damaged or lost (part number 127204).

See the *Parts* section for more information.

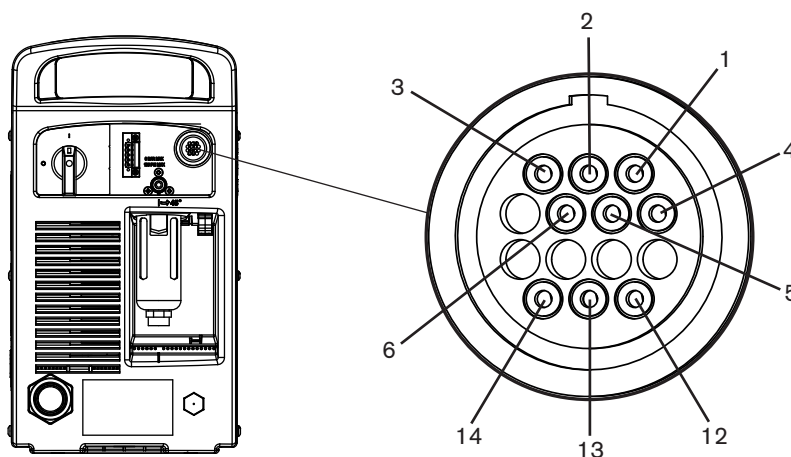
Installation of the machine interface cable must be performed by a qualified service technician. To install a machine interface cable:

1. Turn OFF the power and disconnect the power cord.
2. Remove the machine interface receptacle's cover from the rear of the power supply.
3. Connect the Hypertherm machine interface cable to the power supply.
4. If you are using a cable with a D-sub connector on the other end, plug it into the appropriate pin connector on the torch height controller or CNC. Secure it with the screws on the D-sub connector.

If you are using a cable with wires and spade connectors on the other end, terminate the machine interface cable inside the electrical enclosure of listed and certified torch height controllers or CNC controllers to prevent unauthorized access to the connections after installation. Verify that the connections are correct and that all live parts are enclosed and protected before operating the equipment.

Note: The integration of Hypertherm equipment and customer-supplied equipment including interconnecting cords and cables, if not listed and certified as a system, is subject to inspection by local authorities at the final installation site.

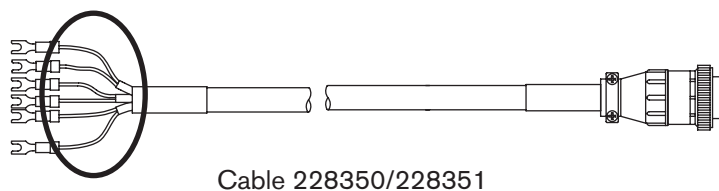
The connector sockets for each type of signal available through the machine interface cable are shown in the figure below. The table provides details about each signal type.



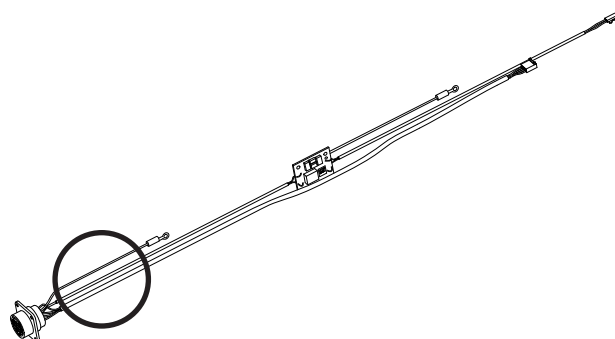
Refer to the following table when connecting the Powermax65 or Powermax85 to a torch height controller or CNC controller with a machine interface cable.

Signal	Type	Notes	Connector sockets	External cable wires	Internal cable wires
Start (start plasma)	Input	Normally open. 18 VDC open circuit voltage at START terminals. Requires dry contact closure to activate.	3	Green	Black
			4	Black	Red
Transfer (start machine motion)	Output	Normally open. Dry contact closure when the arc transfers. 120 VAC/1 A maximum at the machine interface relay or switching device (supplied by the customer).	12	Red	White
			14	Black	Green
Voltage divider	Output	Divided arc signal of 20:1, 21.1:1, 30:1, 40:1, 50:1 (provides a maximum of 18 V). Arc voltage sockets 5 and 6 are used for pin-to-pin connection to legacy cables. Sockets 1 and 2 are duplicate arc voltage sockets for future use. Sockets 1 and 2 are not used for most installations.	5, 1 (-) (Electrode)	Black (-)	Black (-)
			6, 2 (+) (Work)	White (+)	Red (+)
Ground	Ground		13		Green/yellow

**External cable wires**



**Internal cable wires**



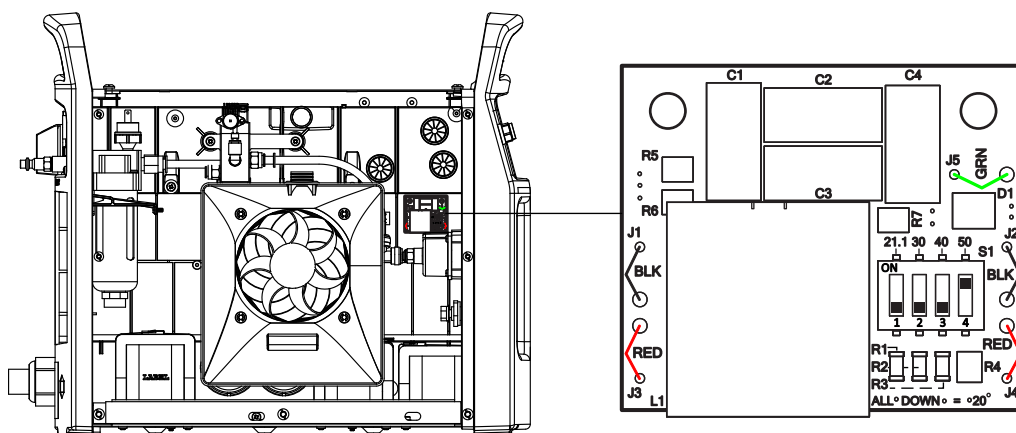
## TORCH SETUP

### Setting the five-position voltage divider

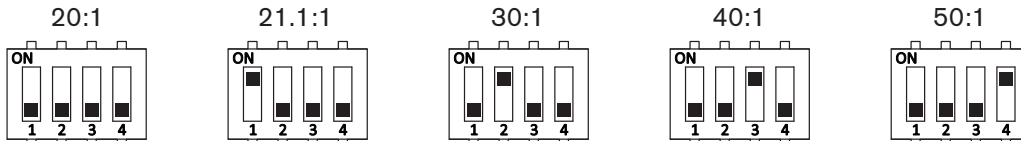
To change the factory preset voltage divider from 50:1 to a different setting:

1. Turn OFF the power supply and disconnect the power cord.
2. Remove the power supply cover.
3. Locate the voltage divider DIP switches on the left side of the power supply.

Note: The figure below shows the default setting (50:1) with the number 4 switch up.





4. Set the DIP switches to one of the following settings.



5. Replace the power supply cover.

### Accessing raw arc voltage

To access divided raw arc voltage, refer to Field Service Bulletin 807060.

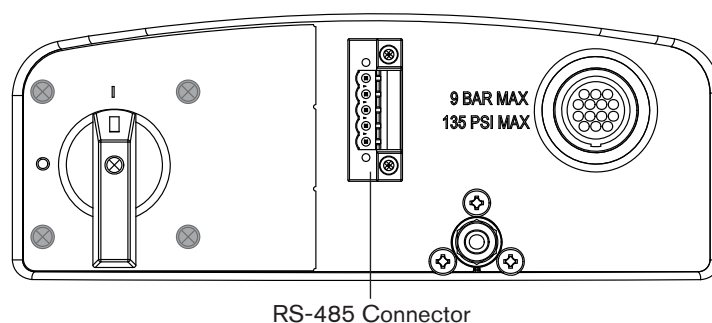
		<b>WARNING HIGH VOLTAGE AND CURRENT</b>
<p>Connecting directly to the plasma circuit for access to raw arc voltage increases the risk of shock hazard, energy hazard, and fire hazard in the event of a single fault. The output voltage and the output current of the circuit are specified on the data plate.</p>		



## Connecting an optional RS-485 serial interface cable

The RS-485 serial interface connector on the back of the power supply allows you to connect an external device to your Powermax. For example, you can remotely operate the Powermax with a CNC controller.

The Powermax power supply must be equipped with a factory-installed (or user-installed) RS-485 serial interface connector on the rear panel. The receptacle on the rear of the power supply provides access to the RS-485 board inside the power supply.



If your power supply is not equipped with the RS-485 connector, order kit 228539, "Powermax65/85/105 RS-485 board with cables". Follow the installation instructions in Application Note 807220. To search for and download the Application Note, log into Xnet at [www.hypertherm.com](http://www.hypertherm.com) and click the "Documents library" link.

With the RS-485 connector installed:

1. Shut off the power supply.
2. Connect the RS-485 cable from your external device to the receptacle on the back of the Powermax power supply.

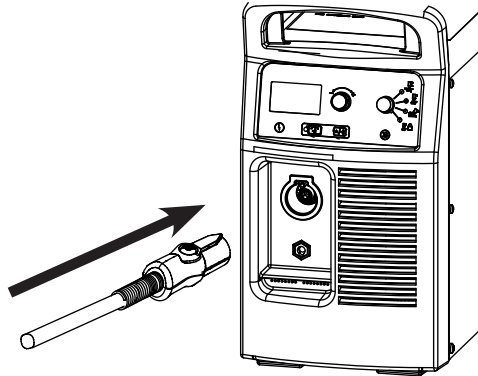
### Serial port cables

The following serial cables are available with the specified lengths and connectors:

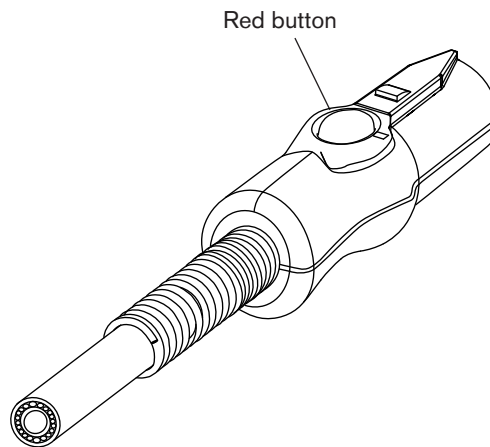
- 223236 – RS-485 cable, unterminated, 7.6 m (25 feet)
- 223237 – RS-485 cable, unterminated, 15 m (50 feet)
- 223239 – RS-485 cable, 9-pin D-sub connector for Hypertherm controls, 7.6 m (25 feet)
- 223240 – RS-485 cable, 9-pin D-sub connector for Hypertherm controls, 15 m (50 feet)

### Connecting the torch lead

The Powermax65 and Powermax85 are equipped with FastConnect™, a quick-disconnect system for connecting and disconnecting handheld and machine torch leads. When connecting or disconnecting a torch, first turn OFF the system. To connect either torch, push the connector into the receptacle on the front of the power supply.



To remove the torch, press the red button on the connector and pull the connector out of the receptacle.



## Using the cut charts

The following sections provide cut charts for each set of mechanized consumables. A consumable diagram with part numbers precedes each set of charts. For each consumable type, there are Metric and English charts for mild steel, stainless steel, and aluminum.

Note: For cut charts on using F5 gas to cut stainless steel, refer to the *Use F5 to Cut Stainless Steel* application note (809060). You can download this document from the Documents library at [www.hypertherm.com](http://www.hypertherm.com).

Each chart contains the following information:

- Material Thickness – Thickness of the workpiece (metal plate being cut).
- Torch-to-Work Distance – For shielded consumables, the distance between the shield and the workpiece during cutting. For unshielded consumables, the distance between the nozzle and the workpiece during cutting.
- Initial Pierce Height – Distance between the shield (shielded) or the nozzle (unshielded) and the workpiece when the torch is triggered, prior to descending to the cut height.
- Pierce Delay Time – Length of time the triggered torch remains stationary at the pierce height before the torch starts the cutting motion.
- Best Quality Settings (cut speed and voltage) – Settings that provide the starting point for finding the best cut quality (best angle, least dross, best cut-surface finish). Adjust the speed for your application and table to obtain the desired result.
- Production Settings (cut speed and voltage) – 80% of the maximum speed ratings. These speeds result in the greatest number of cut parts, but not necessarily the best possible cut quality.

Note: The arc voltage increases as the consumables wear and the voltage setting should be increased to maintain the correct Torch-to-Work Distance.

Each cut chart lists hot and cold air flow rates.

- Hot air flow rate – Plasma is on, the system is operating at running current, and the system is in a steady state at the default system pressure (automatic mode).
- Cold air flow rate – Plasma is off and the system is in a steady state with air flowing through the torch at the default system pressure.

Note: Hypertherm collected the data under laboratory test conditions using new consumables.

**Estimated kerf-width compensation**

The widths in the tables below are for reference. The data are obtained with the “Best Quality” settings. Differences between installations and material composition may cause actual results to vary from those shown in the tables.

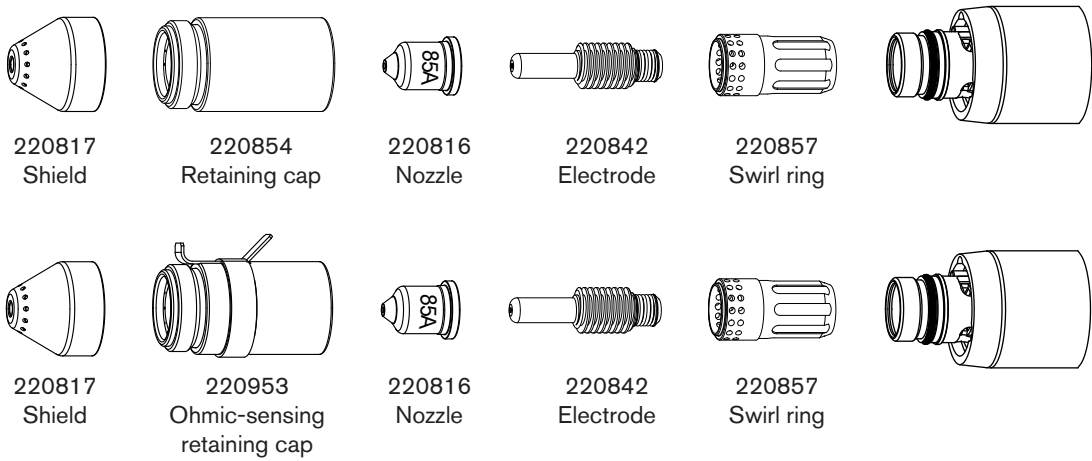
**Estimated kerf-width compensation – Metric (mm)**

Process	Thickness (mm)									
	0.5	1	2	3	6	8	10	12	16	20
	Mild Steel									
85A Shielded				1.7	1.8	1.9	2.0	2.2	2.4	2.6
65A Shielded			1.6	1.6	1.8	1.9	2.0	2.2	2.3	
45A Shielded	1.1	1.1	1.4	1.5	1.7					
FineCut	0.7	0.7	1.3	1.3						
85A Unshielded			1.7	1.8	1.9	2.0	2.1	2.1	2.3	
65A Unshielded			1.6	1.6	1.7	1.8	1.9	2.0		
45A Unshielded	0.5	0.9	1.3	1.3						
Stainless Steel										
85A Shielded				1.6	1.8	1.9	2.1	2.3	2.4	2.5
65A Shielded			1.4	1.5	1.8	1.9	2.0	2.2	2.4	
45A Shielded	0.9	1.1	1.5	1.6	1.8					
FineCut	0.6	0.6	1.0	1.4						
85A Unshielded			1.7	1.7	1.8	1.9	2.1	2.2	2.4	
65A Unshielded			1.6	1.6	1.8	1.8	1.9	2.0		
45A Unshielded	0.5	1.0	1.3	1.5	1.5					
Aluminum										
85A Shielded				2.0	1.9	2.0	2.1	2.2	2.4	2.6
65A Shielded			1.9	1.9	1.9	2.0	2.1	2.3	2.5	
45A Shielded		1.5	1.5	1.6	1.5					
85A Unshielded			1.9	1.9	1.9	2.0	2.0	2.1	2.2	
65A Unshielded			1.8	1.8	1.8	1.8	1.9	2.0		
45A Unshielded		1.6	1.5	1.4	1.5					

## Estimated kerf-width compensation – English (inches)

Process	Thickness (inches)									
	22GA	18GA	14GA	10GA	3/16	1/4	3/8	1/2	5/8	3/4
	Mild Steel									
85A Shielded				0.068	0.071	0.073	0.078	0.090	0.095	0.100
65A Shielded			0.062	0.065	0.068	0.070	0.076	0.088	0.090	0.091
45A Shielded	0.035	0.054	0.055	0.061	0.065	0.066				
FineCut	0.024	0.043	0.049	0.051						
85A Unshielded				0.070	0.073	0.075	0.080	0.085	0.090	
65A Unshielded			0.062	0.064	0.066	0.068	0.075	0.081		
45A Unshielded	0.020	0.050	0.051	0.054	0.057	0.059				
Stainless Steel										
85A Shielded				0.065	0.068	0.070	0.080	0.094	0.095	0.096
65A Shielded			0.056	0.062	0.068	0.073	0.076	0.090	0.093	0.096
45A Shielded	0.032	0.055	0.058	0.067	0.069	0.069				
FineCut	0.018	0.036	0.040	0.055						
85A Unshielded				0.068	0.070	0.072	0.080	0.090	0.095	
65A Unshielded			0.061	0.064	0.067	0.070	0.072	0.080		
45A Unshielded	0.020	0.054	0.052	0.060	0.058	0.058				
Aluminum										
		1/32	1/16	1/8	3/16	1/4	3/8	1/2	5/8	3/4
85A Shielded				0.080	0.078	0.075	0.080	0.090	0.095	0.100
65A Shielded			0.073	0.074	0.075	0.076	0.083	0.091	0.100	
45A Shielded		0.059	0.061	0.065		0.060				
85A Unshielded				0.075	0.075	0.075	0.080	0.082	0.088	
65A Unshielded			0.070	0.070	0.070	0.070	0.072	0.079		
45A Unshielded		0.062	0.058	0.057		0.061				

**85 A shielded consumables**



**85A Shielded  
Mild Steel**

Air flow rate - slpm/scfh	
Hot	190 / 400
Cold	235 / 500

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
3	1.5	3.8	250	0.1	6800	122	9200	120
4				0.2	5650	122	7300	122
6				0.5	3600	123	4400	125
8					2500	125	3100	127
10					1680	127	2070	128
12		4.5	300	0.7	1280	130	1600	130
16				1.0	870	134	930	133
20		6.0	400	1.5	570	137	680	136
25		Edge Start			350	142	450	141
30					200	146	300	144

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.06	0.15	250	0.2	250	122	336	121
3/16 in				0.2	185	123	220	123
1/4 in				0.5	130	123	160	126
3/8 in					70	126	86	127
1/2 in					45	131	56	131
5/8 in		0.18	300	1.0	35	134	37	133
3/4 in		0.24	400	1.5	24	136	29	135
7/8 in		Edge Start			19	139	22	138
1 in					13	142	17	141
1-1/8 in					9	145	13	143
1-1/4 in					7	148	10	146

## TORCH SETUP

85A Shielded  
Stainless Steel

Air flow rate - slpm/scfh	
Hot	190 / 400
Cold	235 / 500

### Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		
					Cut Speed	Voltage	Cut Speed	Voltage	
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts	
3	1.5	3.8	250	0.1	7500	122	9200	120	
4				0.2	6100	122	7500	120	
6				0.5	3700	122	4600	122	
8					2450	124	3050	124	
10		4.5	300	0.7	1550	127	1900	126	
12					1100	131	1400	130	
16				1.0	700	135	760	134	
20		Edge Start				480	138	570	137
25						300	143	370	141

### English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.06	0.15	250	0.2	275	122	336	120
3/16 in					200	122	240	121
1/4 in				0.5	130	122	164	122
3/8 in					65	126	80	125
1/2 in		0.18	300	1.0	36	132	48	131
5/8 in					28	135	30	134
3/4 in		Edge Start			20	137	24	136
7/8 in					16	140	19	139
1 in					11	143	14	141



**85A Shielded  
Aluminum**

Air flow rate - slpm/scfh	
Hot	190 / 400
Cold	235 / 500

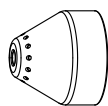
**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		
					Cut Speed	Voltage	Cut Speed	Voltage	
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts	
3	1.5	3.8	250	0.1	8000	122	9400	121	
4				0.2	6500	123	8000	123	
6				0.5	3800	126	4900	126	
8					2650	130	3470	129	
10		4.5	300	1920	132	2500	131		
12				1450	134	1930	133		
16				1.0	950	139	1200	137	
20		Edge Start				600	143	880	141
25						380	146	540	144

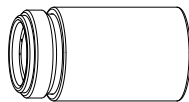
**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
1/8 in	0.06	0.15	250	0.2	300	122	360	121
1/4 in				0.5	130	127	172	127
3/8 in					80	132	104	131
1/2 in		0.18	300	50	135	68	133	
5/8 in				1.0	38	139	48	137
3/4 in				Edge Start			25	142
7/8 in		20	144				29	142
1 in		14	146				20	144

### 65 A shielded consumables



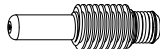
220817  
Shield



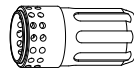
220854  
Retaining cap



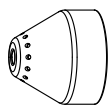
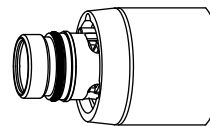
220819  
Nozzle



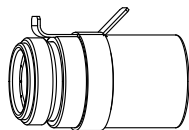
220842  
Electrode



220857  
Swirl ring



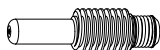
220817  
Shield



220953  
Ohmic-sensing  
retaining cap



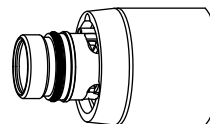
220819  
Nozzle



220842  
Electrode



220857  
Swirl ring



**65A Shielded**
**Mild Steel**
**Air flow rate - slpm/scfh**

Hot	160 / 340
Cold	220 / 470

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
3	1.5	3.8	250	0.2	5200	125	6100	123
4				0.5	4250	125	5100	124
6					2550	127	3240	127
8					1700	129	2230	128
10		4.5	300	0.7	1100	131	1500	129
12				1.2	850	134	1140	131
16		6.0	400	2.0	560	138	650	136
20		Edge Start			350	142	450	142
25					210	145	270	145

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.06	0.15	250	0.1	190	125	224	123
3/16 in				0.2	140	126	168	125
1/4 in				0.5	90	127	116	127
3/8 in				0.7	45	130	62	129
1/2 in		0.18	300	1.2	30	135	40	132
5/8 in		0.24	400	2.0	23	138	26	136
3/4 in		Edge Start			15	141	19	141
7/8 in					12	143	14	143
1 in					8	145	10	145

## TORCH SETUP

**65A Shielded  
Stainless Steel**

Air flow rate - slpm/scfh	
Hot	160 / 340
Cold	220 / 470

### Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
2	1.5	3.8	250	0.1	8100	125	10000	121
3				0.2	6700	125	8260	123
4				0.5	5200	125	6150	124
6					2450	126	2850	126
8				0.7	1500	129	1860	129
10		4.5	300		960	132	1250	132
12				750	135	920	134	
16		Edge Start			500	139	500	139
20					300	143	370	143

### English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		
					Cut Speed	Voltage	Cut Speed	Voltage	
	in	in	%	seconds	ipm	Volts	ipm	Volts	
10GA	0.06	0.15	250	0.1	240	125	296	123	
3/16 in				0.2	155	126	168	125	
1/4 in				0.5	80	126	96	126	
3/8 in				0.7	40	131	52	131	
1/2 in		0.18	300	1.2	26	136	32	135	
5/8 in				Edge Start			20	139	20
3/4 in		14					142	15	142

**65A Shielded  
Aluminum**

Air flow rate - slpm/scfh	
Hot	160 / 340
Cold	220 / 470

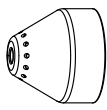
**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		
					Cut Speed	Voltage	Cut Speed	Voltage	
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts	
2	1.5	3.8	250	0.1	8800	121	10300	122	
3				0.2	7400	124	8800	124	
4				0.5	6000	126	7350	125	
6					3200	130	4400	128	
8				0.7	1950	133	2750	130	
10		4.5	300		1200	136	1650	132	
12			1.2	1000	138	1330	136		
16		Edge Start				650	143	800	141
20						380	147	560	145

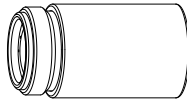
**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
1/16 in	0.06	0.15	250	0.1	365	121	428	121
1/8 in					280	124	336	124
1/4 in				0.5	105	131	152	128
3/8 in				0.7	50	135	68	131
1/2 in		0.18	300	1.2	35	139	48	138
5/8 in		Edge Start			26	143	32	141
3/4 in					16	146	24	144

### 45 A shielded consumables



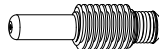
220817  
Shield



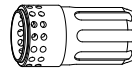
220854  
Retaining cap



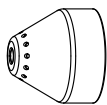
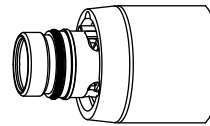
220941  
Nozzle



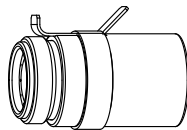
220842  
Electrode



220857  
Swirl ring



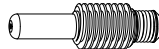
220817  
Shield



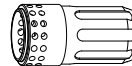
220953  
Ohmic-sensing  
retaining cap



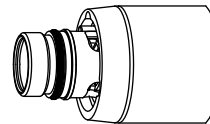
220941  
Nozzle



220842  
Electrode



220857  
Swirl ring



## 45A Shielded

## Mild Steel

## Air flow rate - slpm/scfh

Hot 150 / 310

Cold 210/ 450

## Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
0.5	1.5	3.8	250	0.0	9000	128	12500	126
1					9000	128	10800	128
1.5				0.1	9000	130	10200	129
2				0.3	6600	130	7800	129
3				0.4	3850	133	4900	131
4					2200	134	3560	131
6				0.5	1350	137	2050	132

## English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
26GA	0.06	0.15	250	0.0	350	128	500	128
22GA					350	128	450	128
18GA				0.1	350	129	400	128
16GA					350	130	400	129
14GA				0.2	270	130	320	129
12GA				0.4	190	133	216	131
10GA					100	134	164	131
3/16 in				0.5	70	135	108	132
1/4 in				0.6	48	137	73	132

## TORCH SETUP

45A Shielded  
Stainless Steel

Air flow rate - slpm/scfh	
Hot	150 / 310
Cold	210/ 450

### Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
0.5	1.5	3.8	250	0.0	9000	130	12500	129
1					9000	130	10800	130
1.5				0.1	9000	130	10200	130
2				0.3	6000	132	8660	131
3				0.4	3100	132	4400	132
4					2000	134	2600	134
6				0.5	900	140	1020	139

### English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
26GA	0.06	0.15	250	0.0	350	130	500	129
22GA					350	130	450	129
18GA				0.1	350	130	400	130
16GA					350	130	400	130
14GA				0.2	250	132	360	131
12GA				0.4	140	132	206	131
10GA					100	133	134	134
3/16 in				0.5	52	135	58	135
1/4 in				0.6	30	141	35	140



**45A Shielded**
**Aluminum**

Air flow rate - slpm/scfh	
Hot	150 / 310
Cold	210/ 450

**Metric**

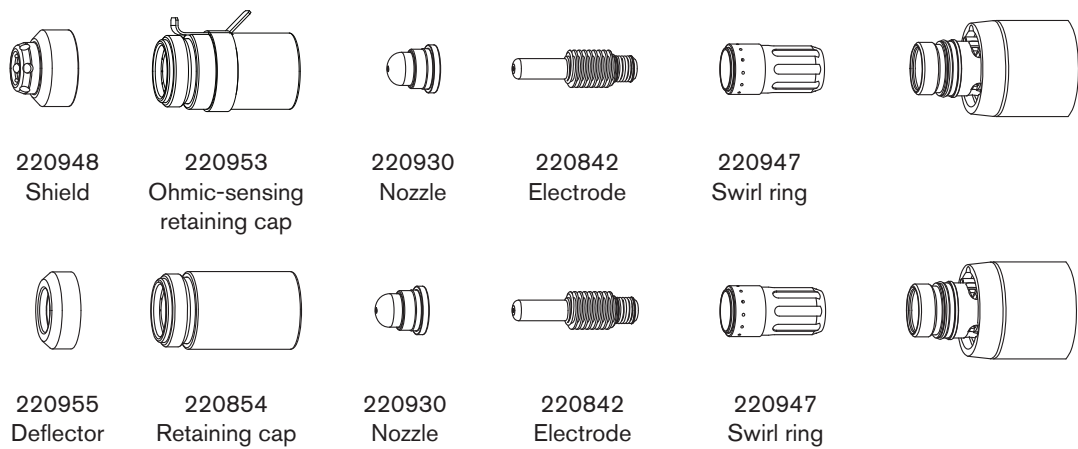
Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
1	1.5	3.8	250	0.0	8250	136	11000	136
2				0.1	6600	136	9200	135
3				0.2	3100	139	6250	134
4				0.4	2200	141	4850	135
6				0.5	1500	142	2800	137

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
1/32 in	0.06	0.15	250	0.0	325	136	450	136
1/16 in				0.1	325	136	400	136
3/32 in				0.2	200	136	328	134
1/8 in				0.4	100	140	224	134
1/4 in				0.5	54	142	96	137

**FineCut® consumables**

Note: The cut charts in this section apply to both shielded and unshielded consumables.



**FineCut**  
**Mild Steel**

Air flow rate - slpm/scfh	
Hot	155 / 330
Cold	215 / 460

**Metric**

Material Thickness	Amps	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings	
						Cut Speed	Voltage
mm	A	mm	mm	%	seconds	(mm/min)	Volts
0.5	40	1.5	3.8	250	0.0	8250	78
0.6						8250	78
0.8						8250	78
1	45				0.2	8250	78
1.5					0.4	6400	78
2						4800	78
3					0.5	2500	78
4					0.6	1900	78

**English**

Material Thickness	Amps	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings	
						Cut Speed	Voltage
	A	in	in	%	seconds	ipm	Volts
26GA	40	0.06	0.15	250	0.0	325	78
24GA						325	78
22GA					0.1	325	78
20GA						325	78
18GA	45				0.2	325	78
16GA					0.4	250	78
14GA						200	78
12GA					0.5	120	78
10GA						95	78

## TORCH SETUP

**FineCut**  
**Stainless Steel**

Air flow rate - slpm/scfh	
Hot	155 / 330
Cold	215 / 460

### Metric

Material Thickness	Amps	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings	
						Cut Speed	Voltage
mm	A	mm	mm	%	seconds	(mm/min)	Volts
0.5	40	0.5	2.0	400	0.0	8250	68
0.6						8250	68
0.8					0.1	8250	68
1	45				0.2	8250	68
1.5					0.4	6150	70
2						4800	71
3					0.5	2550	80
4					0.6	1050	84

### English

Material Thickness	Amps	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings	
						Cut Speed	Voltage
	A	in	in	%	seconds	ipm	Volts
26GA	40	0.02	0.08	400	0.0	325	68
24GA						325	68
22GA					0.1	325	68
20GA						325	68
18GA	45				0.2	325	68
16GA					0.4	240	70
14GA						200	70
12GA					0.5	120	80
10GA					0.6	75	80

**Low Speed FineCut**
**Mild Steel**

Air flow rate – slpm/scfh	
Hot	155 / 330
Cold	215 / 460

**Metric**

Material Thickness	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended	
						Cut Speed	Voltage
mm	A	mm	mm	%	seconds	(mm/min)	Volts
0.5	30	1.5	3.8	250	0.0	3800	69
0.6						3800	68
0.8					0.1	3800	70
1 *	40				0.2	3800	72
1.5 *					0.4	3800	75
2	45					3700	76
3					0.5	2750	78
4					0.6	1900	78

**English**

Material Thickness	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended	
						Cut Speed	Voltage
	A	inches	inches	%	seconds	ipm	Volts
26GA	30	0.06	0.15	250	0.0	150	70
24GA						150	68
22GA					0.1	150	70
20GA						150	71
18GA	40				0.2	150	73
16GA *					0.4	150	75
14GA *	150					76	
12GA	45				0.5	120	78
10GA						95	78

\*Not a dross-free cut.

## TORCH SETUP

Low Speed FineCut  
Stainless Steel

Air flow rate – slpm/scfh	
Hot	155 / 330
Cold	215 / 460

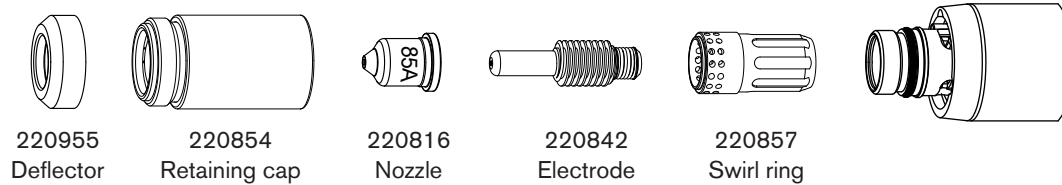
### Metric

Material Thickness	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended	
						Cut Speed	Voltage
mm	A	mm	mm	%	seconds	(mm/min)	Volts
0.5	30	0.5	2.0	400	0.0	3800	69
0.6						3800	69
0.8					0.1	3800	69
1	40				0.15	3800	69
1.5					0.4	2900	69
2						2750	69
3	45				0.5	2550	80
4					0.6	1050	80

### English

Material Thickness	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended	
						Cut Speed	Voltage
	A	in	in	%	seconds	ipm	Volts
26GA	30	0.02	0.08	400	0.0	150	69
24GA						150	69
22GA					0.1	150	69
20GA						150	69
18GA	40				0.2	145	69
16GA					0.4	115	69
14GA						110	69
12GA	45				0.5	120	80
10GA					0.6	75	80

**85 A unshielded consumables**



## TORCH SETUP

85A Unshielded

Mild Steel

Air flow rate - slpm/scfh

Hot 190 / 400

Cold 235 / 500

Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
3	2.0	5.0	250	0.1	6240	118	9000	117
4				0.2	5250	118	7200	117
6				0.5	3450	120	4400	119
8					2400	121	3100	121
10					1560	123	2070	122
12		6.0	300	0.7	1200	126	1600	124
16		Edge Start			820	132	930	128
20					540	137	640	132
25					320	143	400	137

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.08	0.20	250	0.2	230	118	328	117
3/16 in					175	119	220	118
1/4 in				0.5	125	120	160	119
3/8 in					65	122	86	122
1/2 in		0.24	300	0.6	42	127	56	125
5/8 in		Edge Start			33	131	37	128
3/4 in					23	136	27	131
7/8 in					18	140	21	134
1 in					12	144	15	138



**85A Unshielded  
Stainless Steel**

Air flow rate - slpm/scfh	
Hot	190 / 400
Cold	235 / 500

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		
					Cut Speed	Voltage	Cut Speed	Voltage	
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts	
2	2.0	5.0	250	0.1	8550	117	11300	116	
3					7000	118	9660	117	
4				0.2	5600	118	7800	118	
6					0.5	3400	120	4570	121
8				2250		121	2970	122	
10		6.0	300	0.5	1430	123	1840	124	
12				0.7	1000	129	1340	128	
16		Edge Start				650	134	730	133
20						360	138	570	137

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.08	0.20	250	0.2	250	118	352	118
3/16 in					180	119	249	119
1/4 in				0.5	120	120	160	121
3/8 in					60	122	77	123
1/2 in		0.24	300	0.6	35	131	46	129
5/8 in		Edge Start			26	134	29	133
3/4 in					17	137	24	136

## TORCH SETUP

### 85A Unshielded

#### Aluminum

#### Air flow rate - slpm/scfh

Hot 190 / 400

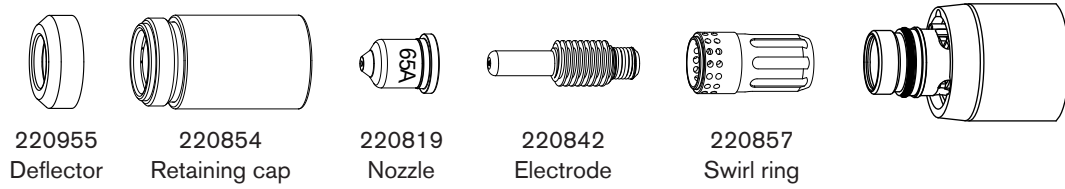
Cold 235 / 500

#### Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		
					Cut Speed	Voltage	Cut Speed	Voltage	
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts	
2	2.0	5.0	250	0.1	8700	118	11200	118	
3					7350	120	9600	119	
4				0.2	6000	122	8100	120	
6					0.5	3300	125	4930	122
8						2350	127	3250	124
10		6.0	300	0.5	1800	128	2140	127	
12				0.7	1300	133	1720	130	
16		Edge Start				840	139	1130	134
20						470	144	700	138

#### English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
1/8 in	0.08	0.20	250	0.2	280	120	368	119
3/16 in					200	123	271	120
1/4 in				0.5	110	126	172	122
3/8 in					75	127	88	126
1/2 in		0.24	300	0.6	45	135	62	131
5/8 in		Edge Start			34	139	45	134
3/4 in					22	143	32	137

**65 A unshielded consumables**

## TORCH SETUP

65A Unshielded

Mild Steel

**Air flow rate - slpm/scfh**

Hot 160 / 340

Cold 220 / 470

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
3	2.0	5.0	250	0.2	5200	118	6330	118
4				0.5	4250	118	5250	118
6					2550	120	3560	120
8					1620	123	2230	121
10		6.0	300	0.7	970	127	1500	122
12		Edge Start			760	129	1140	124
16					500	134	650	129
20					280	138	400	133

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.08	0.20	250	0.1	190	118	232	118
3/16 in				0.2	135	119	172	119
1/4 in				0.5	90	120	116	120
3/8 in		0.24	300	0.7	40	126	62	122
1/2 in		Edge Start			27	130	40	125
5/8 in					20	134	26	129
3/4 in					13	137	18	132

**65A Unshielded  
Stainless Steel**

Air flow rate - slpm/scfh	
Hot	160 / 340
Cold	220 / 470

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
2	2.0	5.0	250	0.1	7950	117	10300	116
3				0.2	6600	118	8500	117
4				0.5	5050	119	6500	119
6					2300	121	3070	121
8				0.7	1400	123	1900	122
10		6.0	300	0.7	920	126	1250	123
12		Edge Start			710	130	925	127
16					430	135	500	133

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
10GA	0.08	0.20	250	0.1	235	118	304	118
3/16 in				0.2	150	120	194	120
1/4 in				0.5	75	121	100	121
3/8 in		0.24	300	0.7	38	125	52	122
1/2 in		Edge Start			25	132	32	129
5/8 in					17	135	20	133

## TORCH SETUP

65A Unshielded

Aluminum

**Air flow rate - slpm/scfh**

Hot 160 / 340

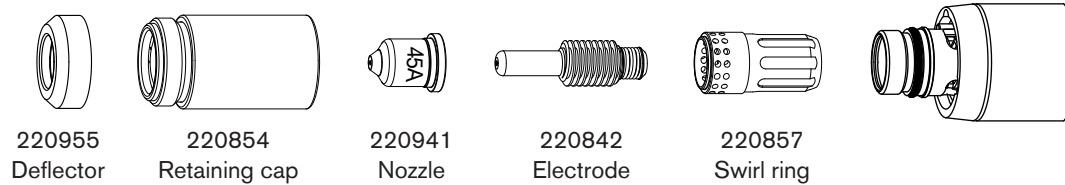
Cold 220 / 470

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
2	2.0	5.0	250	0.1	7750	123	11300	122
3				0.2	6550	124	9500	123
4				0.5	5400	125	7640	124
6					3000	127	3900	126
8				0.7	1800	130	2460	127
10		6.0	300	0.7	1100	133	1640	129
12		Edge Start			900	135	1250	133
16					600	139	700	136

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
1/16 in	0.08	0.20	250	0.1	325	122	476	122
1/8 in					250	124	360	123
3/16 in					175	125	245	124
1/4 in				0.5	100	127	128	126
3/8 in		0.24	300	0.7	45	132	68	128
1/2 in		Edge Start			32	136	44	134
5/8 in					24	138	28	136

**45 A unshielded consumables**

## TORCH SETUP

45A Unshielded

Mild Steel

Air flow rate - slpm/scfh	
Hot	150 / 310
Cold	210 / 450

Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
0.5	1.5	3.8	250	0.0	9000	120	12500	120
1					9000	120	10800	121
1.5				0.1	7700	120	10200	121
2				0.3	6150	119	7800	122
3				0.4	3950	121	4900	123
4					2350	123	3560	124
6				0.5	1400	126	2050	124

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
26GA	0.06	0.15	250	0.0	350	120	500	120
22GA					350	120	450	120
18GA				0.1	350	119	400	121
16GA					300	121	400	121
14GA				0.2	250	119	320	122
12GA				0.4	200	120	216	123
10GA					100	123	164	124
3/16 in				0.5	85	122	108	124
1/4 in				0.6	48	127	73	124



**45A Unshielded  
Stainless Steel**

Air flow rate - slpm/scfh	
Hot	150 / 310
Cold	210 / 450

**Metric**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
0.5	1.5	3.8	250	0.0	9000	121	12500	119
1					9000	121	10800	119
1.5				0.1	9000	121	10200	120
2				0.3	6000	122	9600	120
3				0.4	3250	123	4750	120
4					1900	128	3000	122
6				0.5	700	130	1450	124

**English**

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
26GA	0.06	0.15	250	0.0	350	120	500	119
22GA					350	120	450	119
18GA				0.1	350	118	400	119
16GA					350	121	400	120
14GA				0.2	300	122	400	120
12GA				0.4	150	121	224	120
10GA					100	125	140	121
3/16 in				0.5	42	131	88	123
1/4 in				0.6	25	130	48	124

## TORCH SETUP

### 45A Unshielded

### Aluminum

#### Air flow rate - slpm/scfh

Hot	150 / 310
Cold	210 / 450

### Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
1	1.5	3.8	250	0.0	7400	126	11000	121
2				0.1	4400	127	9200	123
3				0.2	2800	129	6250	125
4				0.4	2100	132	4700	126
6				0.5	1050	135	2250	127

### English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
	in	in	%	seconds	ipm	Volts	ipm	Volts
1/32 in	0.06	0.15	250	0.0	325	126	450	121
1/16 in				0.1	200	126	400	122
3/32 in				0.2	150	127	328	124
1/8 in				0.4	100	130	224	125
1/4 in				0.5	36	136	72	127

## Section 4

### OPERATION

---

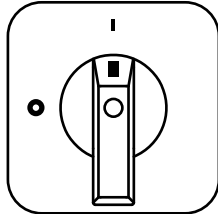
*In this section:*

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### Controls and indicators

The Powermax65 and Powermax85 power supplies have the following: ON/OFF switch, adjustment knob, automatic/manual pressure setting mode selector, current/gas selector, operating mode switch, indicator LEDs, and a status screen.

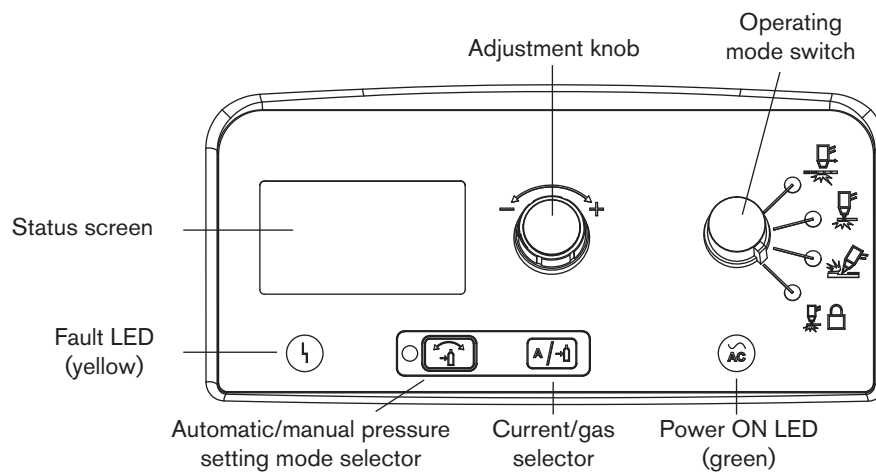
#### Rear controls



#### ON (I)/OFF (O) power switch

Activates the power supply and its control circuits.

#### Front controls and LEDs



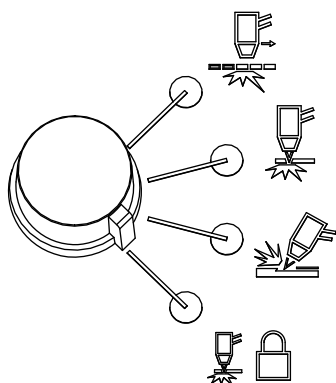
#### Fault LED (yellow)

When illuminated, this LED indicates that there is a fault with the power supply. For information about these fault conditions and how to correct them, refer to section 5.



#### Power ON LED (green)

When illuminated, this LED indicates that the power switch has been set to I (ON) and that the safety interlocks are satisfied. When blinking, the power supply has a fault.



### Operating mode switch

The operating mode switch can be set in one of four positions:

- Continuous pilot arc. Cuts expanded metal or grate.
- Non-continuous pilot arc. Cuts or pierces metal plate. This is the standard setting for normal drag-cutting.
- Gouge. Gouges metal plate.
- Torch lock. Same as the non-continuous pilot arc mode except the torch is locked in the ON position when you release the trigger during a cut.



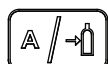
### Automatic/manual pressure setting mode selector

The selector switches between automatic and manual mode. In automatic mode, the power supply automatically sets the gas pressure based upon the torch type and lead length and the adjustment knob sets only the amperage. In manual mode, the adjustment knob sets either the gas pressure or the amperage. This LED is illuminated in manual mode.

**Note:** Manual mode should be used by experienced users who need to optimize the gas setting (override the automatic gas setting) for a specific cutting application.

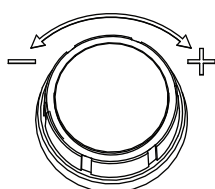
When you switch from manual mode to automatic mode, the power supply automatically sets the gas pressure and the amperage setting is unchanged. When you switch from automatic mode to manual mode, the power supply remembers the previous manual gas pressure setting and the amperage setting is unchanged.

When you reset the power, the power supply remembers the previous mode, gas pressure, and amperage settings.



### Current/gas selector

When in manual mode, this selector toggles between amperage and gas pressure for manual adjustments using the adjustment knob.

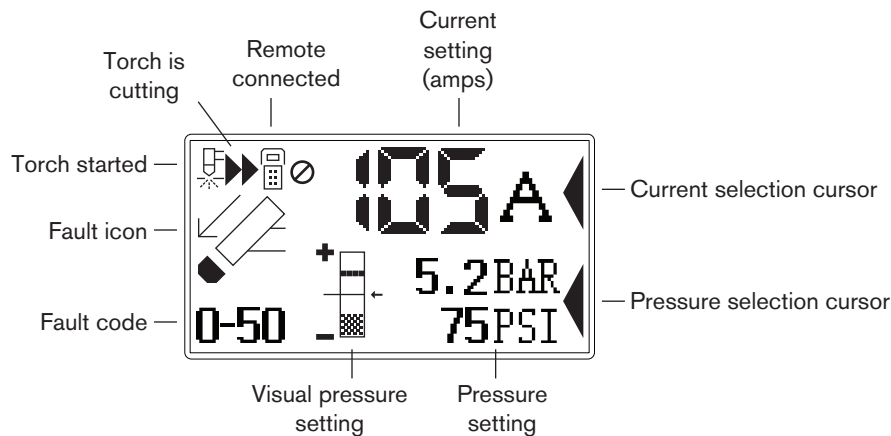


### Adjustment knob

This knob adjusts the amperage. When operating in manual mode, this knob can also adjust the gas pressure, overriding the automatic setting for optimized applications.

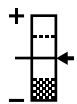
### Status screen

The status screen shows system status and fault information.



### Gas pressure indicators

In manual mode, the gas pressure is displayed in bar and psi. The gas pressure bar is also a visual indicator of the gas pressure.



#### Gas pressure bar

When the arrow is centered in the vertical bar (the reference pressure of the automatic pressure setting), the gas pressure is set to the preset (factory-defined) value. If the pressure is higher than the preset value, the arrow appears above the mid-point of the bar. If the pressure is lower than the preset value, the arrow appears below the mid-point of the bar.

**Note:** In automatic mode, the power supply adjusts the pressure to the preset value. You can use manual mode to adjust the pressure to satisfy the needs of a particular cutting job. Refer to 4-10 *Manually adjusting the gas pressure*.

### System status icons

The screen displays icons to indicate the system's status.



#### Torch started

Indicates that the torch has received a start signal and has initiated a pilot arc.



#### Torch is cutting

Indicates that the cutting arc has transferred to the metal and the torch is cutting.



#### Remote control

Indicates that a remote control is controlling the power supply. All local controls are disabled.

## Fault codes

When a power supply or torch fault occurs, the system displays a fault code in the lower-left corner of the status screen and displays a corresponding fault icon above the code. The first digit is always zero. The other two digits identify the problem. Refer to section 5 for troubleshooting information.

**Note:** Only one fault code is displayed. If more than one fault occurs at the same time, only the fault code with the highest priority is displayed.

## Fault icons

The fault icons that appear on the left side of the status screen are described below. A fault code also appears to identify the fault. Refer to section 5 for troubleshooting information.



### Warning

The system continues to run.



### Fault

The system stops cutting. If you can not correct the problem and restart the system, contact your distributor or Hypertherm Technical Service.



### Error

The system requires service. Contact your distributor or Hypertherm Technical Service.



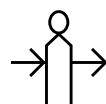
### Torch cap sensor

Indicates that the consumables are loose, improperly installed, or missing. Turn OFF the power, properly install the consumables, and turn ON the system again to reset the power supply.



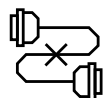
### Temperature

Indicates that the temperature of the power supply power module is outside the acceptable operating range.



### Gas

Indicates that the gas is disconnected from the rear of the power supply or there is a problem with the gas supply.



### Internal Serial Communications Interface

Indicates a problem with the SCl communications between the control board and the DSP board.

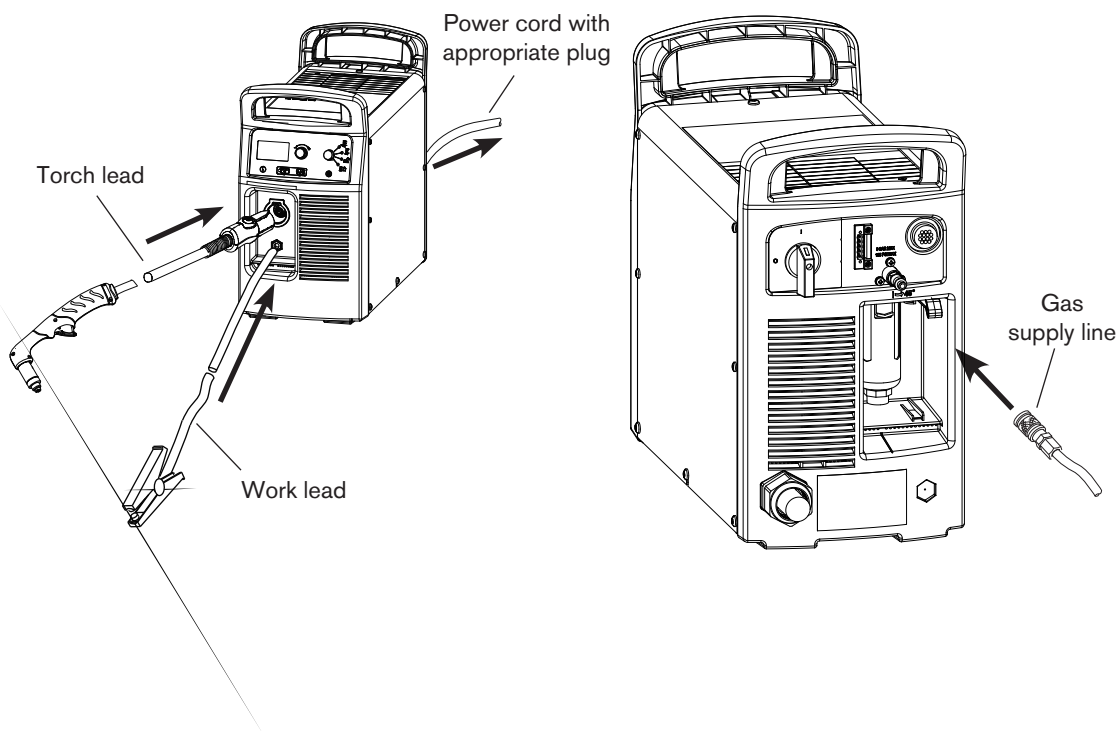
### Operating the Powermax65 or Powermax85

Follow the steps below to begin cutting or gouging with the Powermax65 or Powermax85.

#### Connect the electrical power, gas supply, and torch lead

For information on connecting the proper power cord with plug to the power supply, refer to Section 2, *Power Supply Setup*.

Plug in the power cord and connect the gas supply line. For more information about the electrical requirements and the gas supply requirements of the Powermax65 and Powermax85, see Section 2, *Power Supply Setup*. To connect the torch, push the FastConnect™ connector into the receptacle on the front of the power supply. You will attach the work lead in the next section.





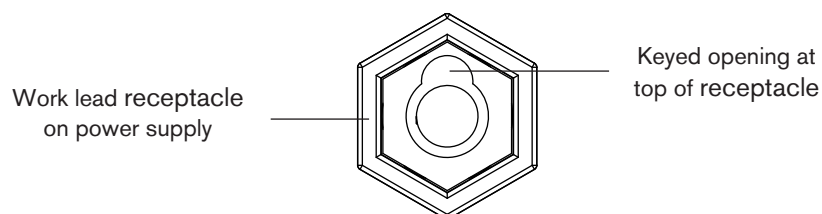
## Attach the work lead to the power supply



**Caution:** Make sure you use a work lead that is appropriate for your power supply. Use a 65 A work lead with the Powermax65. Use an 85 A work lead with the Powermax85. The amperage is marked near the rubber boot of the work lead connector.

1. Insert the work lead connector into the receptacle on the front of the power supply.

Note: The receptacle is keyed. Align the key on the work lead connector with the opening at the top of the receptacle on the power supply.



2. Push the work lead connector all the way into the receptacle on the power supply and turn clockwise, approximately 1/4 turn, until the connector is fully seated against the stop in order to achieve an optimal electrical connection.



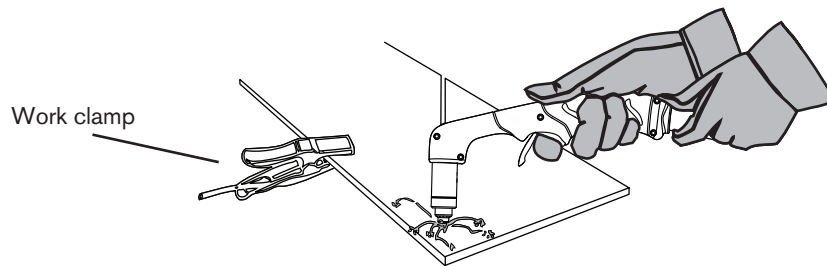
**Caution:** Ensure the work lead is fully seated in the receptacle to prevent overheating.

### Attach the work clamp to the workpiece

The work clamp must be connected to the workpiece while you are cutting. If you are using the Powermax65 or Powermax85 with a cutting table, you can connect the work lead directly to the table instead of attaching the work clamp to the workpiece. See your table manufacturer's instructions.

Note the following:

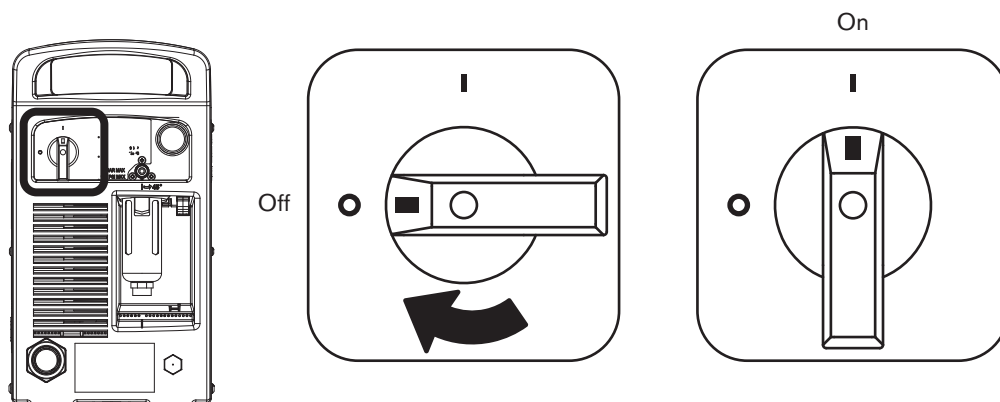
- Ensure that the work clamp and the workpiece make good metal-to-metal contact. Remove rust, dirt, paint, coatings, and other debris to ensure the power supply makes proper contact with the workpiece.
- For the best cut quality, attach the work clamp as close as possible to the area being cut.
- **Do not attach the work clamp to the portion of the workpiece to be cut away.**



**Caution:** Do not attach the work clamp under water. If the power supply is below the work clamp, water can enter the power supply via the work lead and cause severe damage.

## Turn ON the system

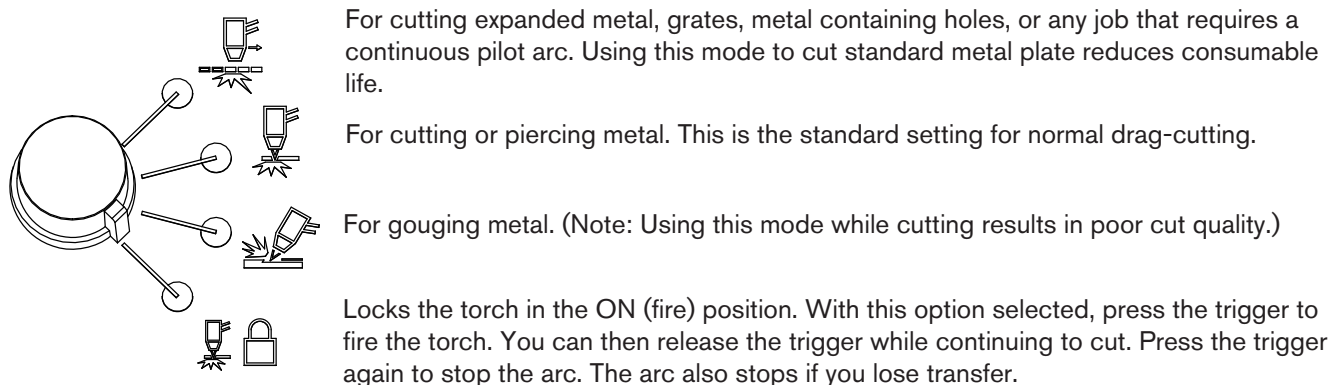
Set the ON/OFF switch to the ON (I) position.



## Set the operating mode switch

Use the operating mode switch to select the type of work you want to perform.

In automatic gas mode, Smart Sense™ technology automatically adjusts the gas pressure according to the selected cutting mode and torch lead length for optimum cutting.



### Check the indicators

Verify the following:

- The green power ON LED on the front of the power supply is illuminated.
- The Fault LED is *not* illuminated.
- No error icons appear in the status screen.

If a fault icon appears in the status screen, or the Fault LED is illuminated, or the power ON LED is blinking, correct the fault condition before continuing. Refer to Section 5 for troubleshooting information.

### Manually adjusting the gas pressure

For normal operations, the power supply automatically adjusts the gas pressure. If you need to adjust the gas pressure for a specific application, you can use manual mode to do so.

Note: Manual mode should be used by experienced users who need to optimize the gas setting (override the automatic gas setting) for a specific cutting application.

When you switch from manual mode to automatic mode, the power supply automatically sets the gas pressure and the amperage setting is unchanged. When you switch from automatic mode to manual mode, the power supply remembers the previous manual gas pressure setting and the amperage setting is unchanged.

When you reset the power, the power supply remembers the previous mode, gas pressure, and amperage settings.

To adjust the pressure:

1. Press the automatic/manual pressure setting mode selector so that the LED next to the selector illuminates. Refer to the diagram in 4-2 *Front controls and LEDs*.
2. Press the current/gas selector until the selection cursor is opposite the gas pressure setting in the status screen.
3. Turn the adjustment knob to adjust the gas pressure to the desired level. Watch the arrow in the pressure bar as you adjust the pressure.

## **Adjusting the current (amperage)**

Turn the adjustment knob to adjust the current for your particular cutting application.

If the system is in manual mode, do the following to adjust the amperage.

1. Press the current/gas selector until the selection cursor is opposite the amperage setting in the status screen.
2. Turn the adjustment knob to change the amperage.
3. If you wish to exit manual mode, press the automatic/manual pressure setting mode selector. The LED goes off.

Note: When you exit manual mode, the gas pressure resets to the factory-optimized value.

When you switch between manual mode and automatic mode, the power supply retains the amperage setting. When you reset the power, the power supply returns to the previous mode (automatic mode or manual mode) and remembers the previous amperage setting.

### Understanding duty-cycle limitations

The duty cycle is the amount of time, in minutes, that a plasma arc can remain on within a 10-minute period when operating at an ambient temperature of 104° F (40° C).

With a Powermax65:

- At 65 A, the arc can remain on for 5 minutes out of 10 minutes without causing the unit to overheat (50% duty cycle).
- At 59 A, the arc can remain on for 6 minutes out of 10 (60%).
- At 46 A, the arc can remain on for 10 minutes out of 10 (100%).

With a Powermax85:

- At 85 A, the arc can remain on for 6 minutes out of 10 minutes without causing the unit to overheat (60% duty cycle).
- At 74 A, the arc can remain on for 8 minutes out of 10 (80%)
- At 66 A, the arc can remain on for 10 minutes out of 10 (100%).

If the duty cycle is exceeded, the power supply overheats, the temperature fault icon appears in the status screen, the arc shuts off, and the cooling fan continues to run. You can not resume cutting until the temperature fault icon disappears and the fault LED goes off.

## Using the hand torch



**WARNING**  
**INSTANT-ON TORCHES**  
**PLASMA ARC CAN CAUSE INJURY AND BURNS**

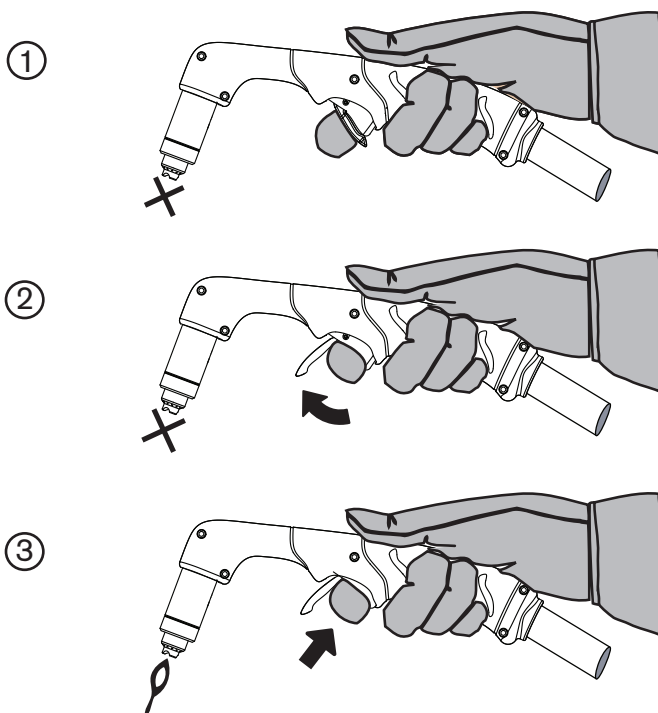
Plasma arc comes on immediately when the torch trigger is activated.

The plasma arc will cut quickly through gloves and skin.

- Wear correct and appropriate protective equipment.
- Keep away from the torch tip.
- Do not hold the workpiece and keep your hands clear of the cutting path.
- Never point the torch toward yourself or others.

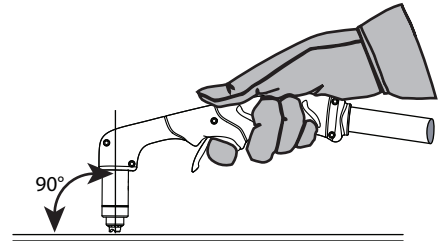
## Operate the safety trigger

The hand torches are equipped with a safety trigger to prevent accidental firings. When you are ready to use the torch, flip the trigger's safety cover forward (toward the torch head) and press the red torch trigger as shown below.

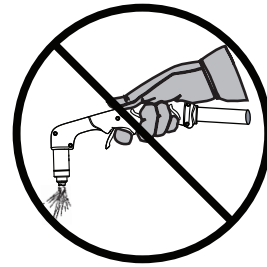


### Hand torch cutting hints

- Drag the torch tip lightly along the workpiece to maintain a steady cut.
- While cutting, make sure that sparks exit from the bottom of the workpiece. The sparks should lag slightly behind the torch as you cut ( $15^{\circ}$  —  $30^{\circ}$  angle from vertical).
- If sparks spray up from the workpiece, move the torch more slowly, or set the output current higher.
- With either the 75-degree or 15-degree hand torch, hold the torch nozzle perpendicular to the workpiece so that the nozzle is at a  $90^{\circ}$  angle to the cutting surface. Observe the cutting arc as the torch cuts.



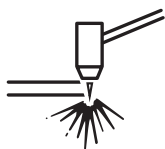
- If you fire the torch unnecessarily, you will shorten the life of the nozzle and electrode.



- Pulling, or dragging, the torch along the cut is easier than pushing it.
- For straight-line cuts, use a straight edge as a guide. To cut circles, use a template or a radius cutter attachment (a circle cutting guide). See the *Parts* section for part numbers for the Hypertherm plasma cutting guides for cutting circles and making bevel cuts.



## Start a cut from the edge of the workpiece



1. With the work clamp attached to the workpiece, hold the torch nozzle perpendicular (90°) to the edge of the workpiece.



2. Press the torch's trigger to start the arc. Pause at the edge until the arc has cut completely through the workpiece.

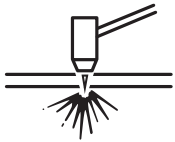


3. Drag the torch tip lightly across the workpiece to proceed with the cut. Maintain a steady, even pace.



## OPERATION

### Pierce a workpiece



#### WARNING

**SPARKS AND HOT METAL CAN INJURE EYES AND BURN SKIN. When firing the torch at an angle, sparks and hot metal will spray out from the nozzle. Point the torch away from yourself and others.**

1. With the work clamp attached to the workpiece, hold the torch at an approximate  $30^\circ$  angle to the workpiece with the torch tip within  $1/16$  inch (1.5 mm) of the workpiece before firing the torch.
2. Fire the torch while still at an angle to the workpiece. Slowly rotate the torch to a perpendicular ( $90^\circ$ ) position.
3. Hold the torch in place while continuing to press the trigger. When sparks exit below the workpiece, the arc has pierced the material.
4. When the pierce is complete, drag the nozzle lightly along the workpiece to proceed with the cut.



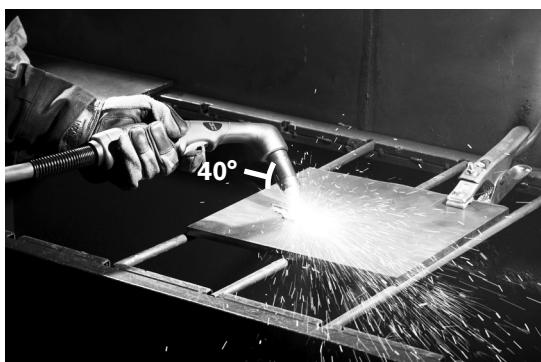
## Gouge a workpiece



### WARNING

**SPARKS AND HOT METAL CAN INJURE EYES AND BURN SKIN. When firing the torch at an angle, sparks and hot metal will spray out from the nozzle. Point the torch away from yourself and others.**

1. Hold the torch so that the torch tip is within 1/16 inch (1.5 mm) from the workpiece before firing the torch.



2. Hold the torch at a 40° angle with the nozzle about 1/4 — 1/2 inch (6 — 12 mm) from the workpiece. Press the trigger to obtain a pilot arc. Transfer the arc to the workpiece.



3. Pull the torch back and stretch the arc to 1-1/4 inch (32 mm). Push the plasma arc in the direction of the gouge you want to create. Increase standoff to create a shallower and wider gouge.

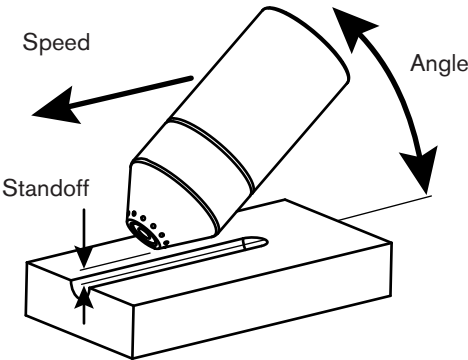
Keep a small distance between the torch tip and the molten metal to avoid reducing consumable life or damaging the torch.

Changing the torch's angle changes the dimensions of the gouge.

OPERATION

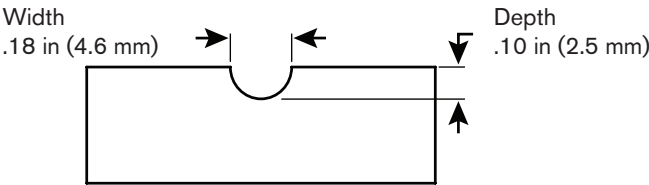
Gouge profile

You can vary the gouge profile by varying the speed of the torch over the workpiece, varying the torch-to-work standoff distance, varying the angle of the torch to the workpiece, and varying the current output of the power supply.

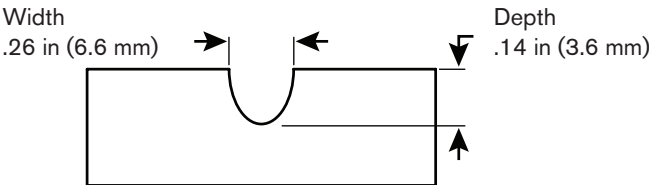


Operating parameters	
Speed	20 – 25 ipm (50.8 – 63.5 cm/min)
Standoff	1/4 – 3/8 in (6.4 – 9.5 mm)
Angle	35 – 40°

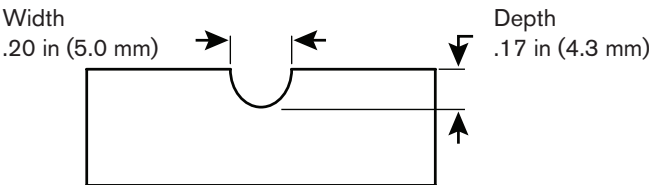
Typical Maximum Control Gouge Profile for 65 A



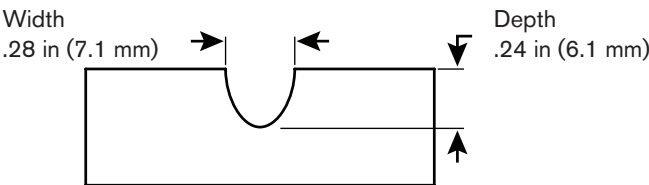
Typical Maximum Removal Gouge Profile for 65 A



Typical Maximum Control Gouge Profile for 85 A



Typical Maximum Removal Gouge Profile for 85 A



### **Varying the gouge profile**

The following actions have the stated effects on the gouge profile:

- **Increasing the speed** of the torch will **decrease width** and **decrease depth**.
- **Decreasing the speed** of the torch will **increase width** and **increase depth**.
- **Increasing the standoff** of the torch will **increase width** and **decrease depth**.
- **Decreasing the standoff** of the torch will **decrease width** and **increase depth**.
- **Increasing the angle** of the torch (more vertical) will **decrease width** and **increase depth**.
- **Decreasing the angle** of the torch (less vertical) will **increase width** and **decrease depth**.
- **Increasing the current** of the power supply will **increase width** and **increase depth**.
- **Decreasing the current** of the power supply will **decrease width** and **decrease depth**.

### Common hand-cutting faults

The torch does not cut completely through the workpiece. The causes can be:

- The cut speed is too fast.
- The consumables are worn.
- The metal being cut is too thick for the selected amperage.
- Gouging consumables are installed instead of drag-cutting consumables.
- The work clamp is not attached properly to the workpiece.
- The gas pressure or gas flow rate is too low.

Cut quality is poor. The causes can be:

- The metal being cut is too thick for the amperage.
- The wrong consumables are being used (gouging consumables are installed instead of drag-cutting consumables, for example).
- You are moving the torch too quickly or too slowly.

The arc sputters and consumables life is shorter than expected. The cause can be:

- Moisture in the gas supply.
- Incorrect gas pressure.
- Consumables incorrectly installed.

## Using the machine torch

Since the Powermax with a machine torch can be used with a wide variety of cutting tables, track burners, pipe bevelers, and so on, you will need to refer to the manufacturer's instructions for specifics on operating the machine torch in your configuration. However, the information in the following sections will help you optimize cut quality and maximize consumable life.

### Ensure the torch and table are set up correctly

- Use a square to align the torch at right angles to the workpiece in two dimensions.
- The torch may travel more smoothly if you clean, check and “tune” the cutting table's rails and drive system. Unsteady machine motion can cause a regular, wavy pattern on the cut surface.
- Ensure that the torch does not touch the workpiece during cutting. Contact with the workpiece can damage the shield and nozzle and affect the cut surface.

### Understand and optimize cut quality

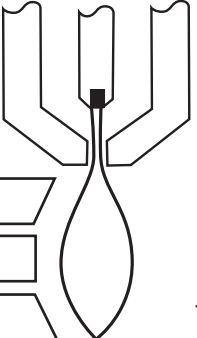
There are several factors to consider in cut quality:

- Cut angle — The degree of angularity of the cut edge.
- Dross — The molten material that solidifies on the top or bottom of the workpiece.
- Straightness of the cut surface — The cut surface can be concave or convex.

The following sections explain how these factors can affect cut quality.

#### Cut or bevel angle

- A positive cut angle, or bevel, results when more material is removed from the top of the cut than from the bottom.
- A negative cut angle results when more material is removed from the bottom of the cut.

<b>Problem</b> Negative cut angle Square cut Positive cut angle		<b>Cause</b> The torch is too low.	<b>Solution</b> Raise the torch; or if you are using a torch height control, increase the arc voltage.
		The torch is too high.	Lower the torch; or if you are using a torch height control, decrease the arc voltage.

Note: The squarest cut angle will be on the *right* side with respect to the forward motion of the torch. The left side will always have some degree of bevel.

To determine whether a cut-angle problem is being caused by the plasma system or the drive system, make a test cut and measure the angle of each side. Next, rotate the torch 90° in its holder and repeat the process. If the angles are the same in both tests, the problem is in the drive system.

If a cut-angle problem persists after “mechanical causes” have been eliminated (see 4-21 *Ensure the torch and table are set up correctly*), check the torch-to-work distance, especially if the cut angles are all positive or all negative. Also consider the material being cut: if the metal is magnetized or hardened, you are more likely to experience cut angle problems.

### Dross

Some amount of dross will always be present when cutting with air plasma. However, you can minimize the amount and type of dross by adjusting your system correctly for your application.

Excess dross appears on the top edge of both pieces of the plate when the torch is too low (or voltage is too low when using a torch height control). Adjust the torch or adjust the voltage in small increments (5 volts or less) until the dross is reduced.

Low-speed dross forms when the torch’s cutting speed is too slow and the arc angles ahead. It forms as a heavy, bubbly deposit at the bottom of the cut and can be removed easily. Increase the speed to reduce this type of dross.

High-speed dross forms when the cutting speed is too fast and the arc angles behind. It forms as a thin, linear bead of solid metal attached very close to the cut. It is more firmly attached to the bottom of the cut than at low speed and is difficult to remove. To reduce high-speed dross:

- Decrease the cutting speed.
- Decrease the torch-to-work distance.



## **To pierce a workpiece using the machine torch**

As with the hand torch, you can start a cut with the machine torch at the edge of the workpiece or by piercing the workpiece. Piercing will result in a shorter consumable life than with edge starts.

The cut charts include a column for the recommended torch height when starting a pierce. For the Powermax65 and Powermax85, the pierce height is generally 2.5 times the cutting height. Refer to the cut charts for specifics.

The pierce delay must be sufficiently long that the arc can pierce the material before the torch moves, but not so long that the arc “wanders” while trying to find the edge of a large hole. As consumables wear, this delay time may need to be increased. Pierce delay times given in the cut charts are based on average delay times throughout the life of the consumables.

When piercing materials close to the maximum thickness for a specific process, consider the following important factors:

- Allow a lead-in distance approximately equal to the thickness of the material being pierced. For example, 20 mm (3/4 in) material requires a 20 mm lead-in.
- To avoid damage to the shield from the buildup of molten material created by the pierce, do not allow the torch to descend to cut height until it has cleared the puddle of molten material.
- Different material chemistries can have an adverse effect on the pierce capability of the system. In particular, high-strength steel with a high manganese or silicon content can reduce the maximum pierce capability. Hypertherm calculates mild steel parameters with certified A-36 plate.
- Using a “flying pierce” (that is, starting torch motion immediately after transfer and during the pierce process) can extend the piercing capability of the system in some cases. Because this can be a complex process that can damage the torch or other components, a stationary or edge start is recommended.

### Common machine-cutting faults

The torch's pilot arc will initiate, but will not transfer. Causes can be:

- The work cable is not making good contact with the cutting table or the cutting table is not making good contact with the workpiece.
- The torch-to-work distance is too large.

The workpiece is not totally penetrated, and there is excessive sparking on the top of the workpiece. Causes can be:

- The consumables are worn and need to be replaced. For optimized performance in a mechanized application, replace the nozzle and the electrode together.
- The work cable is not making good contact with the cutting table or the cutting table is not making good contact with the workpiece.
- The current (amperage) is set too low. See Section 3, *Torch Setup* for more information.
- The cut speed is too high. See the cut charts in Section 3, *Torch Setup*, for more information.
- The metal being cut exceeds the maximum capacity for the selected amperage. See Section 1, *Specifications*.

Dross forms on the bottom of the cut. Causes can be:

- The consumables are worn and need to be replaced. For optimized performance in a mechanized application, replace the nozzle and the electrode together.
- The cutting speed is not correct. Refer to the cut charts in Section 3, *Torch Setup*, for more information.
- The current (amperage) is set too low. Refer to the cut charts in Section 3, *Torch Setup*, for more information.

The cut angle is not square. Causes can be:

- The consumables are worn and need to be replaced. For optimized performance in a mechanized application, replace the nozzle and the electrode together.
- The direction of the torch travel is incorrect. The high-quality cut is always on the right with respect to the forward motion of the torch.
- The distance between the torch and the workpiece is not correct.
- The cutting speed is not correct. Refer to the cut charts in Section 3, *Torch Setup*, for more information.

The consumables' life is shortened. Causes can be:

- The arc current, arc voltage, travel speed, and other variables are not set as recommended in the cut charts.
- Firing the arc in the air (beginning or ending the cut off of the plate surface). Starting at the edge is acceptable as long as the arc makes contact with the workpiece when started.
- Starting a pierce with an incorrect torch height. Refer to the cut charts for the specific initial pierce height.

# TROUBLESHOOTING AND SYSTEM TESTS

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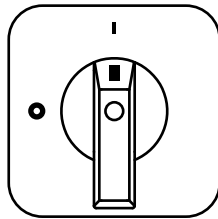
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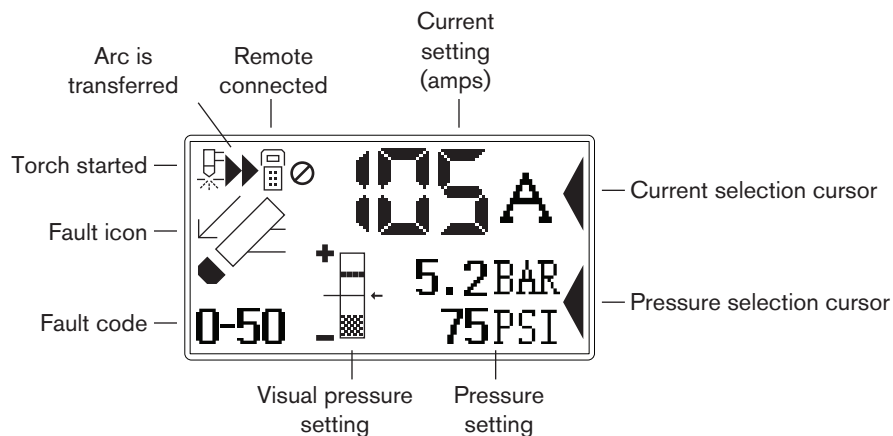
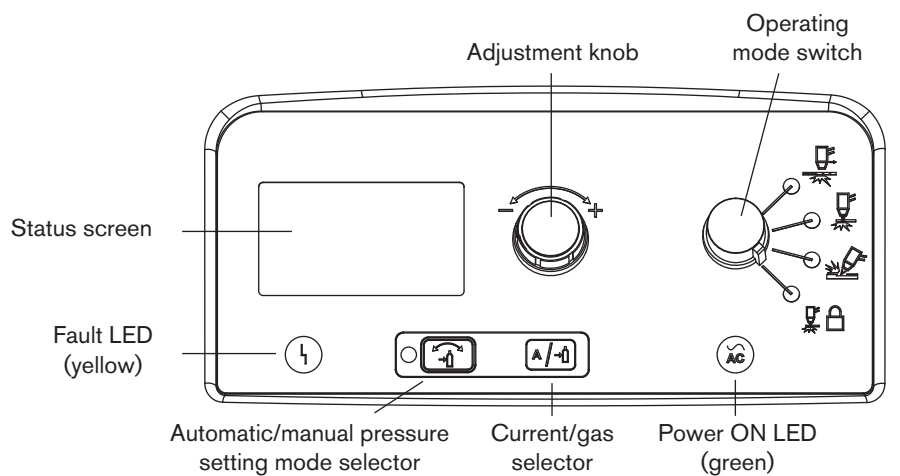
## Controls and indicators

The Powermax65 and Powermax85 controls and indicators are described in Section 4, *Operation*. These figures are included for reference.



### ON (I)/OFF (O) power switch

Activates the power supply and its control circuits.



### Theory of operation

#### General

Refer to “Sequence of operation” below and Section 8, *Wiring diagrams*.

#### 200 – 600 V CSA 1- or 3-phase power supply functional description

AC power enters the system through the power switch (S1) to the input diode bridge (D50). The voltage from the bridge supplies the power factor correction (PFC) boost converter, which provides a nominal 760 VDC bus voltage. The bus supplies voltage and current to the inverter and the flyback circuit (DC to DC converter) on the power board (PCB3). The power board provides noise suppression and spike protection. A “soft start” is implemented via the power board resistors (RT4, RT5) and relays (K2, K3).

The PFC boost converter consists of an insulated gate bipolar transistor (IGBT Q11), PFC choke, and control circuit. It provides a 760 VDC bus voltage when the input AC voltage is between 200 and 540 VAC. At 600 VAC, the nominal bus voltage is 840 VDC.

The inverter consists of a dual IGBT package (Q12), the power transformer, an output current sensor, and the control circuit. The inverter operates as a pulse-width modulated half-bridge circuit driving an isolation transformer. The output of the isolation transformer is rectified by the output bridge (D48 and D51).

The output circuitry consists of 2 current sensors located on the power board, the pilot arc IGBT (Q13), and the output choke.

The digital signal processor (PCB2) monitors and regulates the system's operation and safety circuits. The amperage adjustment knob on the control board (PCB1) is used to set the output current to the desired value: 20 – 65 amps for the Powermax65 or 25 – 85 amps for the Powermax85. The system compares the set-point to the output current by monitoring the current sensors and adjusting the output of the inverter IGBTs (Q12).

### **380/400 V CCC/CE 3-phase power supply functional description**

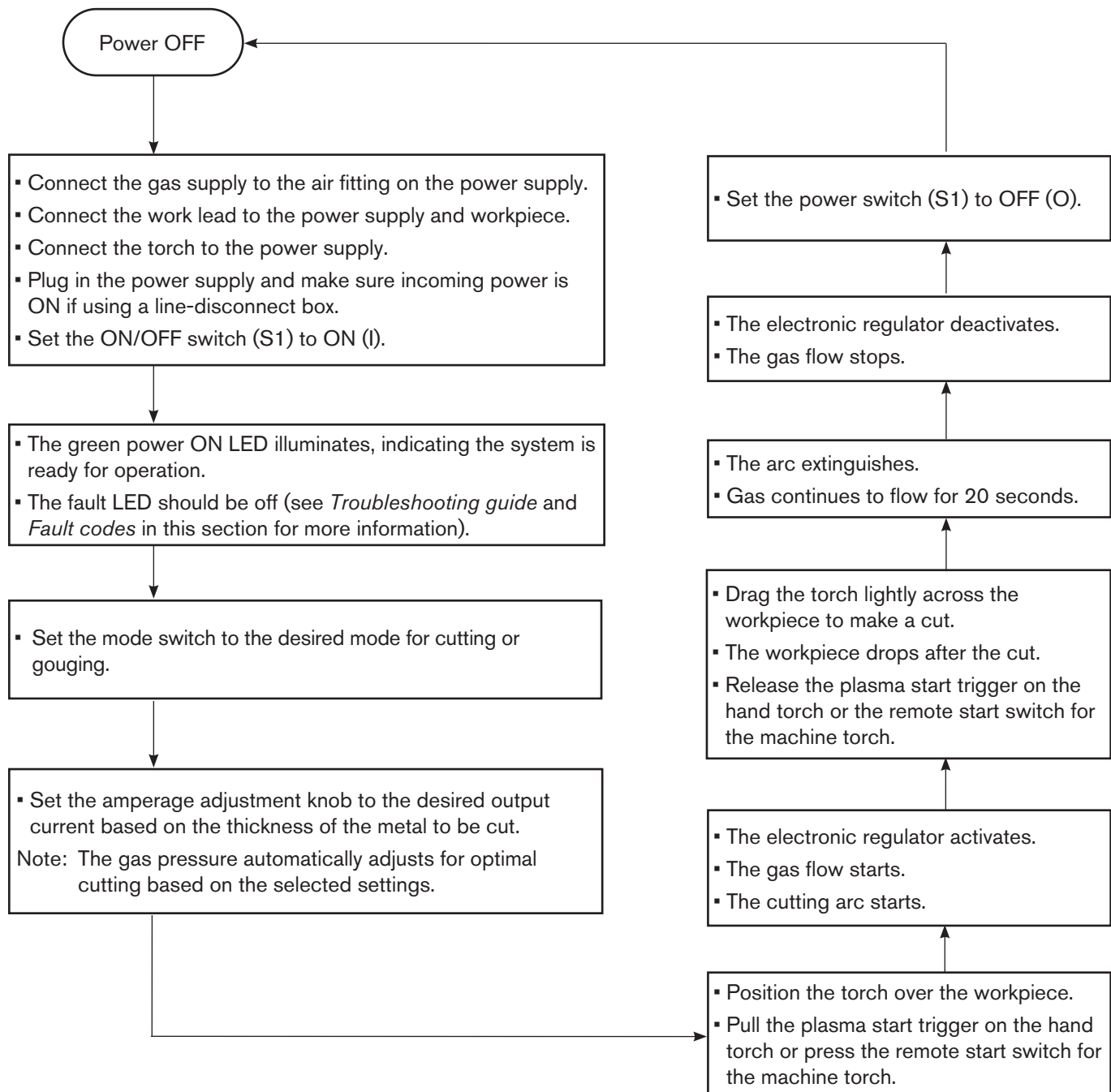
AC power enters the system through the power switch (S1) to the input diode bridge (D45). The voltage from the bridge provides a nominal 530 to 560 VDC bus voltage. The bus supplies voltage and current to the inverter and the flyback circuit (DC to DC converter) on the power board (PCB3). The power board provides noise suppression and spike protection. A “soft start” is implemented via the power board resistors (RT4, RT5) and relay (K2).

The inverter consists of a dual IGBT package (Q9), the power transformer, a current sensor, and the control circuit. The inverter operates as a pulse-width modulated half-bridge circuit driving an isolation transformer. The output of the isolation transformer is rectified by the output bridge (D44 and D46).

The output circuitry consists of 2 current sensors located on the power board, the pilot arc IGBT (Q10), and the output choke.

The digital signal processor (PCB2) monitors and regulates the system’s operation and safety circuits. The amperage adjustment knob on the control board (PCB1) is used to set the output current to the desired value: 20 – 65 amps for the Powermax65 or 25 – 85 amps for the Powermax85. The system compares the set-point to the output current by monitoring the current sensors and adjusting the output of the inverter IGBTs. (Q9).

### Sequence of operation





## Troubleshooting preparation

The complexity of the circuits requires that service technicians have a working knowledge of inverter power supply theory. In addition to being technically qualified, technicians must perform all testing with safety in mind.

If questions or problems arise during servicing, call the Hypertherm Technical Services team listed in the front of this manual.

## Test equipment

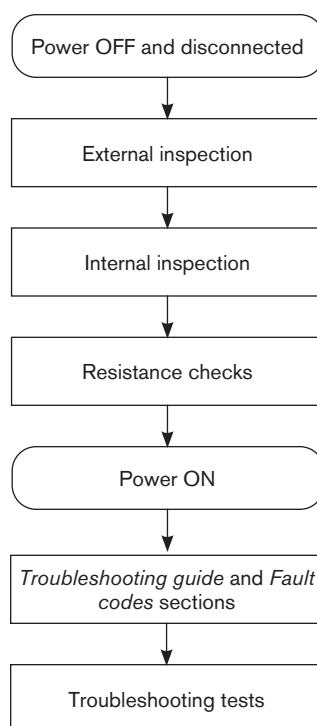
- Multimeter with a variety of test leads. Newer power boards contain test points with a diameter of 2.25 mm (0.09 inches) that accept miniature banana plugs (for example, Pamona® 2945 plugs). Earlier-style power boards contain larger test point openings that require the use of test hooks. See page 5-40.
- IGBT (insulated gate bipolar transistor) tester (part number 128883)






## Troubleshooting procedures and sequence

When performing the troubleshooting procedures:

- Read the *Safety and Compliance Manual* (80669C) for detailed safety information.
- Refer to Section 6, *Component Replacement*.
- Refer to Section 7, *Parts*.
- Refer to Section 8, *Wiring Diagrams*.

After the problem has been located and repaired, refer to the “Sequence of operation” flow diagram in this section to test the power supply for proper operation.



	<b>DANGER</b>
	<b>ELECTRIC SHOCK CAN KILL</b> <ul style="list-style-type: none"><li>▪ Turn off the power and remove the input power plug from its receptacle before removing the cover from the power supply. If the power supply is connected directly to a line disconnect box, switch the line disconnect to OFF (O). In the U.S., use a “lock-out / tag-out” procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.</li><li>▪ Do not touch live electrical parts! If power is required for servicing, use extreme caution when working near live electrical circuits. Dangerous voltages exist inside the power supply that can cause serious injury or death.</li><li>▪ Do not attempt to repair the power board or control board. Do not cut away or remove any protective conformal coating from either board. To do so will risk a short circuit between the AC input circuit and the output circuit and may result in serious injury or death.</li></ul>
	<b>HOT PARTS CAN CAUSE SEVERE BURNS</b> <ul style="list-style-type: none"><li>▪ Allow the power supply to cool before servicing.</li></ul>
	<b>MOVING BLADES CAN CAUSE INJURY</b> <ul style="list-style-type: none"><li>▪ Keep hands away from moving parts.</li></ul>
	<b>STATIC ELECTRICITY CAN DAMAGE CIRCUIT BOARDS</b> <ul style="list-style-type: none"><li>▪ Put on a grounded wrist strap before handling PC boards.</li></ul>

### External inspection

1. Inspect the exterior of the power supply for damage to the cover and external components, such as the power cord and plug.
2. Inspect the torch and the torch lead for damage.
3. Inspect the consumables for damage or wear.

### Internal inspection

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the 8 small screws from the power supply cover.
3. Remove the 8 large screws from the power supply cover.
4. Lift the cover off the power supply.
5. Remove the component barrier from the power board side of the power supply. The barrier is flexible and can be bent slightly for removal. Be certain to replace the barrier when you are finished working on the power supply.
6. Inspect the inside of the power supply, especially on the side with the power board. Look for broken or loose wiring connections, burn and char marks, damaged components, and so on. Repair or replace as necessary.

### Initial resistance check

All resistance values must be taken with the power cord disconnected and all internal power supply wires attached. Perform the steps in Internal inspection before continuing in this section.

- If resistance values are not close ( $\pm 25\%$ ) to the values given in this section, isolate the problem by removing wires attached to the resistance check points or component until the problem is found.
- After the problem has been located and repaired, refer to the Sequence of operation flow diagram in this section to test the power supply for proper operation.

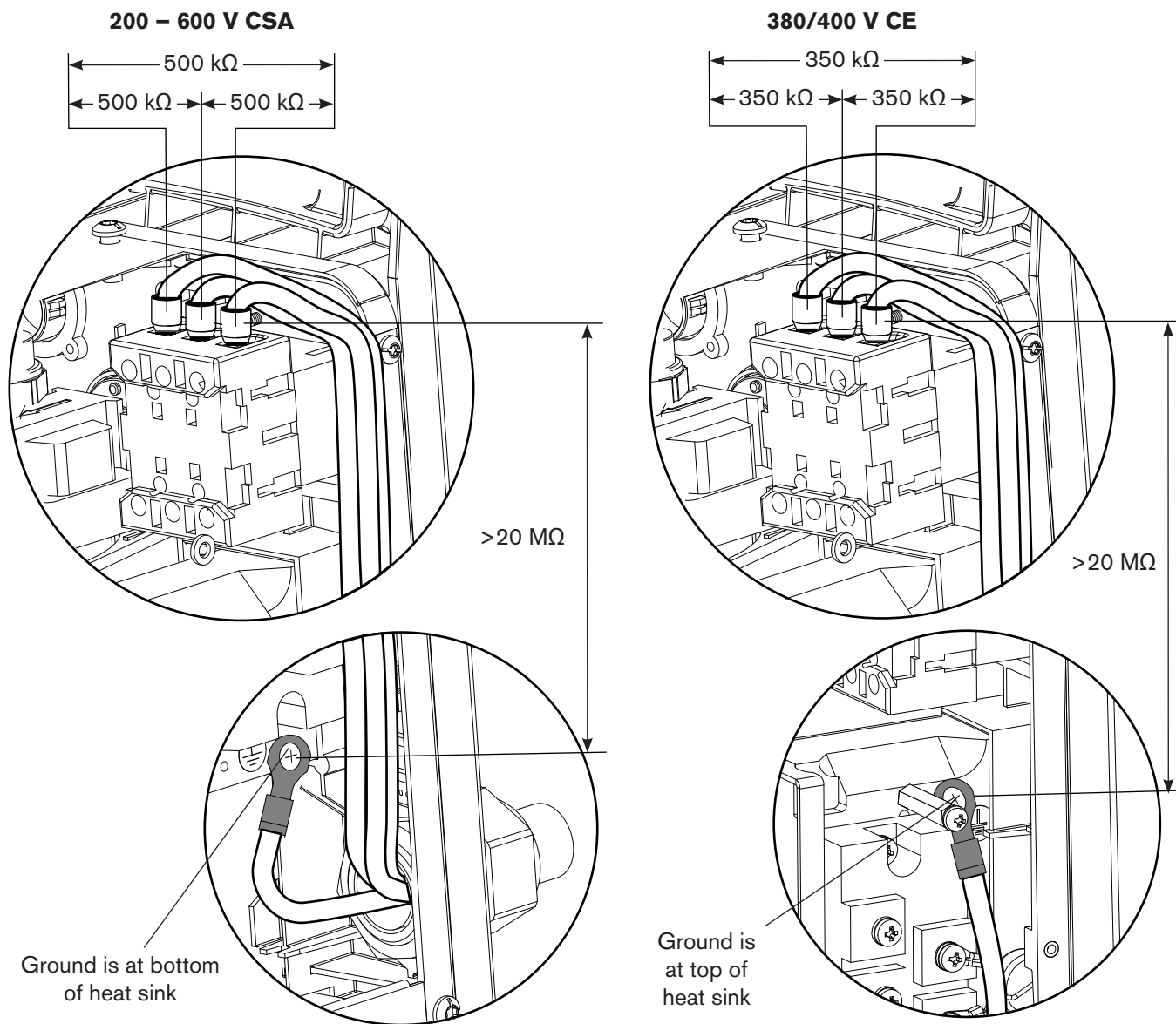
### Check the power switch

Refer to the figures and table on the following pages.

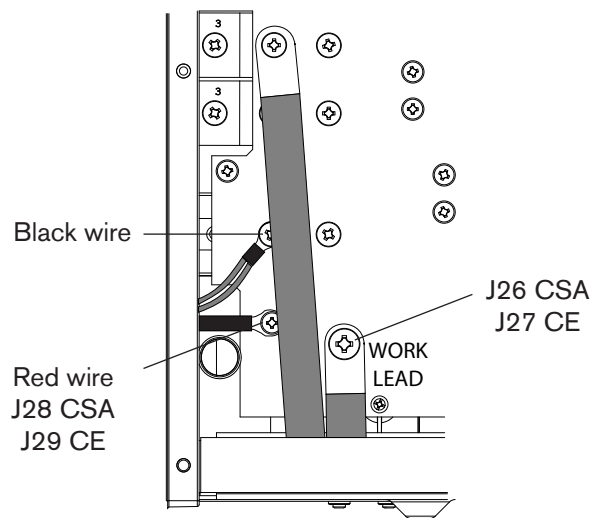
1. With the power disconnected and the torch removed from the power supply, set the ON/OFF switch (S1) to ON (I).
2. Check the resistance across the input leads (the leads are labeled L1, L2, and L3 on the power switch).
  - 200-600 V CSA: resistance across the input leads = 500 k $\Omega$ .
  - 380/400 V CE: resistance across the input leads = 350 k $\Omega$ .
3. Check the resistance from the input leads to ground to verify that it reads as open. For all power supplies, the resistance from input to ground should read as > 20 M $\Omega$ .

Note: With the power disconnected and the ON/OFF switch (S1) set to OFF (O), all circuits should read as open.  
The electrical values shown are  $\pm 25\%$ .

4. Check the output resistance for the values shown in the table.



Measure resistance from	200 – 600 V CSA power board location	380/400 V CE power board location	Approximate values
Work lead to nozzle	J26 to black wire	J27 to black wire	230 kΩ
Work lead to electrode	J26 to red wire	J27 to red wire	15 kΩ
Electrode to nozzle	red wire to black wire	red wire to black wire	230 kΩ
Output to ground			> 20 MΩ

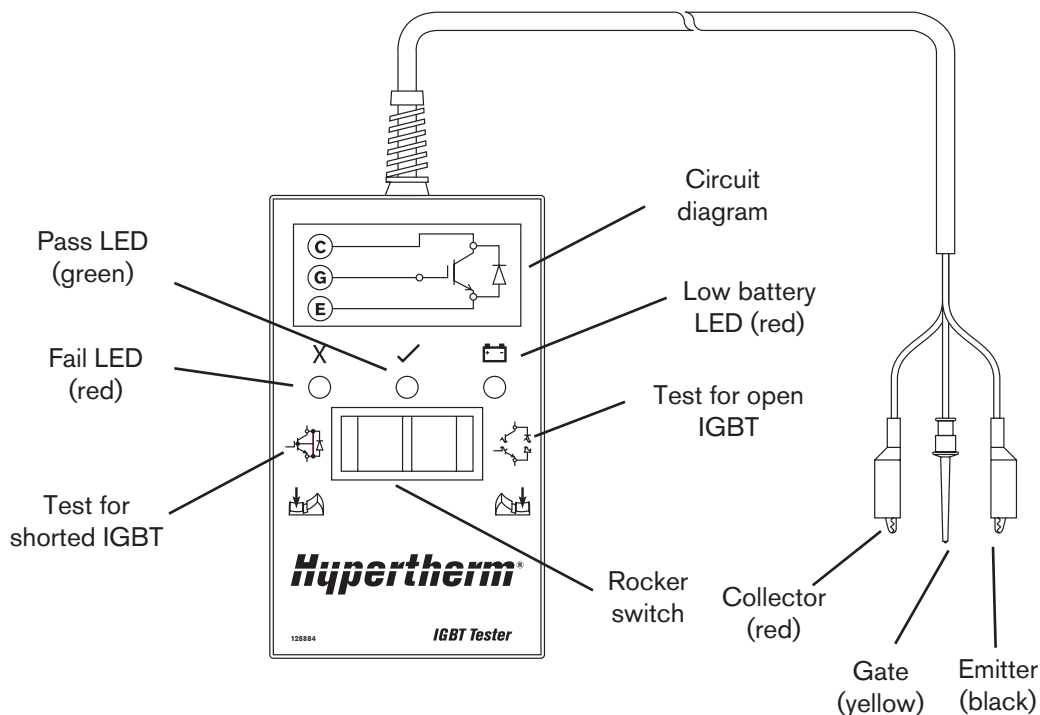


If no problems were found during the visual inspection or the initial resistance check, and the power supply still does not operate correctly, see the Troubleshooting guide.

**Note:** The Troubleshooting guide provides most probable causes and solutions. Study the system wiring diagram and understand the theory of operation before troubleshooting. Before purchasing any major replacement component, verify the problem with Hypertherm Technical Service or the nearest Hypertherm repair facility.

### Hypertherm IGBT tester

Use the Hypertherm IGBT (insulated gate bipolar transistor) tester (part number 128883) as described in the following sections or assemble your own IGBT tester from the schematic diagram shown on page 5-15 *Schematic for building an IGBT tester* and use it to test the IGBTs.



### Indicator LEDs and device tests

- ✓ Green “pass” LED  
When illuminated, this LED indicates that the IGBT passed the test for an open IGBT when switch is pressed to the right or for a short-circuited IGBT when switch is pressed to the left.
- X Red “fail” LED  
When illuminated, this LED indicates that the IGBT failed the test for an open IGBT when switch is pressed to the right or for a short-circuited IGBT when switch is pressed to the left.
- 🔋 Red “low battery” LED  
When illuminated, this LED indicates that the remaining voltage in the battery is insufficient to power the test circuitry. Replace the battery.

Note: The Hypertherm IGBT tester requires a minimum of 8 V to power its circuitry properly.

## IGBT test preparation

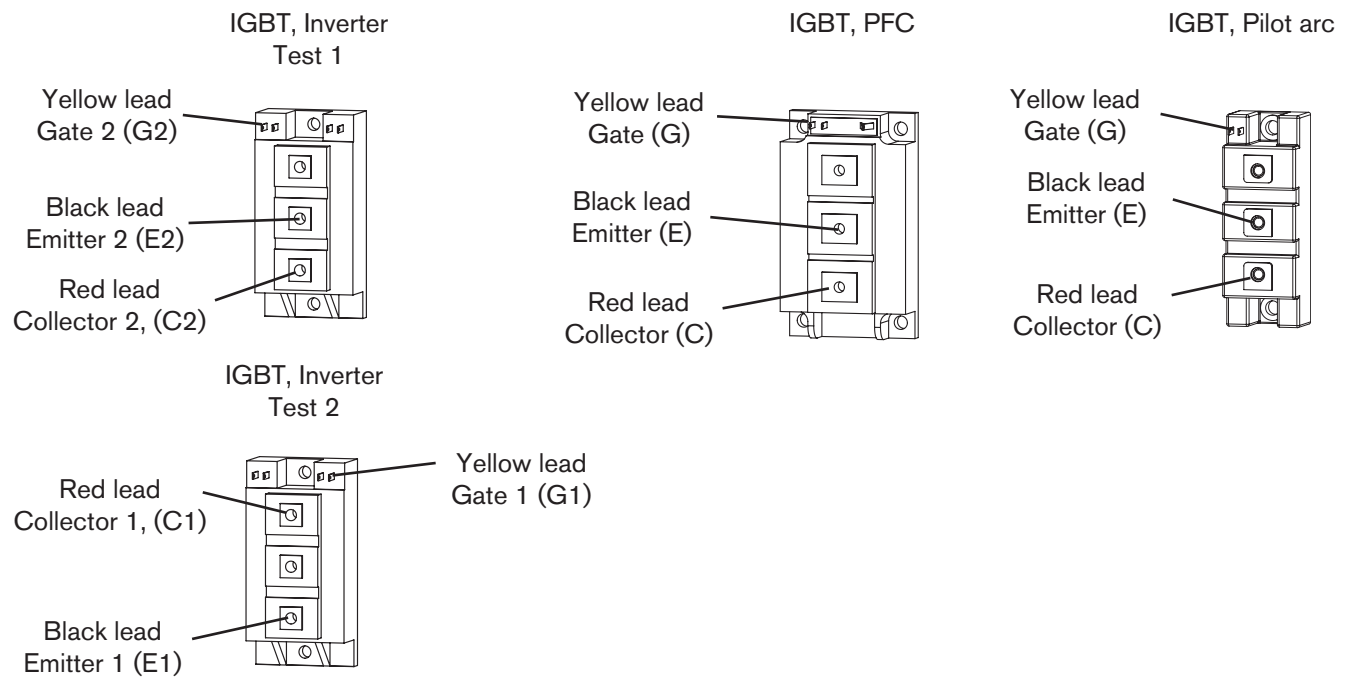
Before testing with the Hypertherm IGBT tester, connect the colored leads to the IGBT as shown on the next page.

**Note:** Before an IGBT can be tested, it must be electrically isolated from all circuits. If the IGBT is installed in a power supply, remove the power board and any lead connections before testing.



**Caution: Failure to isolate the IGBT may result in false readings and/or damage to the IGBT tester.**

The illustrations below depict three common configurations of an IGBT. Each connection on the IGBT will be labeled with an abbreviation. They may be labeled as C, E, G or 1, 2, 3 with a schematic that shows numbers and pin functions.



### IGBT device test using the Hypertherm tester

Using the Hypertherm IGBT tester, press and hold the switch in the desired position to perform each test described in the following table.

Switch Position	LED			This may mean	Corrective action
	Fail	Pass	Battery		
Left	X	-	-	IGBT is short-circuited	Replace IGBT
Left	-	X	-	IGBT passed the short-circuit test	None
Left	-	-	X	Battery below 8 V	Replace battery
Left	-	-	-	Dead battery	Replace battery
Right	X	-	-	IGBT is open	Replace IGBT
Right	-	X	-	IGBT passed the open test	None
Right	-	-	X	Battery below 8 V	Replace battery
Right	-	-	-	Dead battery	Replace battery

### Troubleshoot the Hypertherm IGBT tester

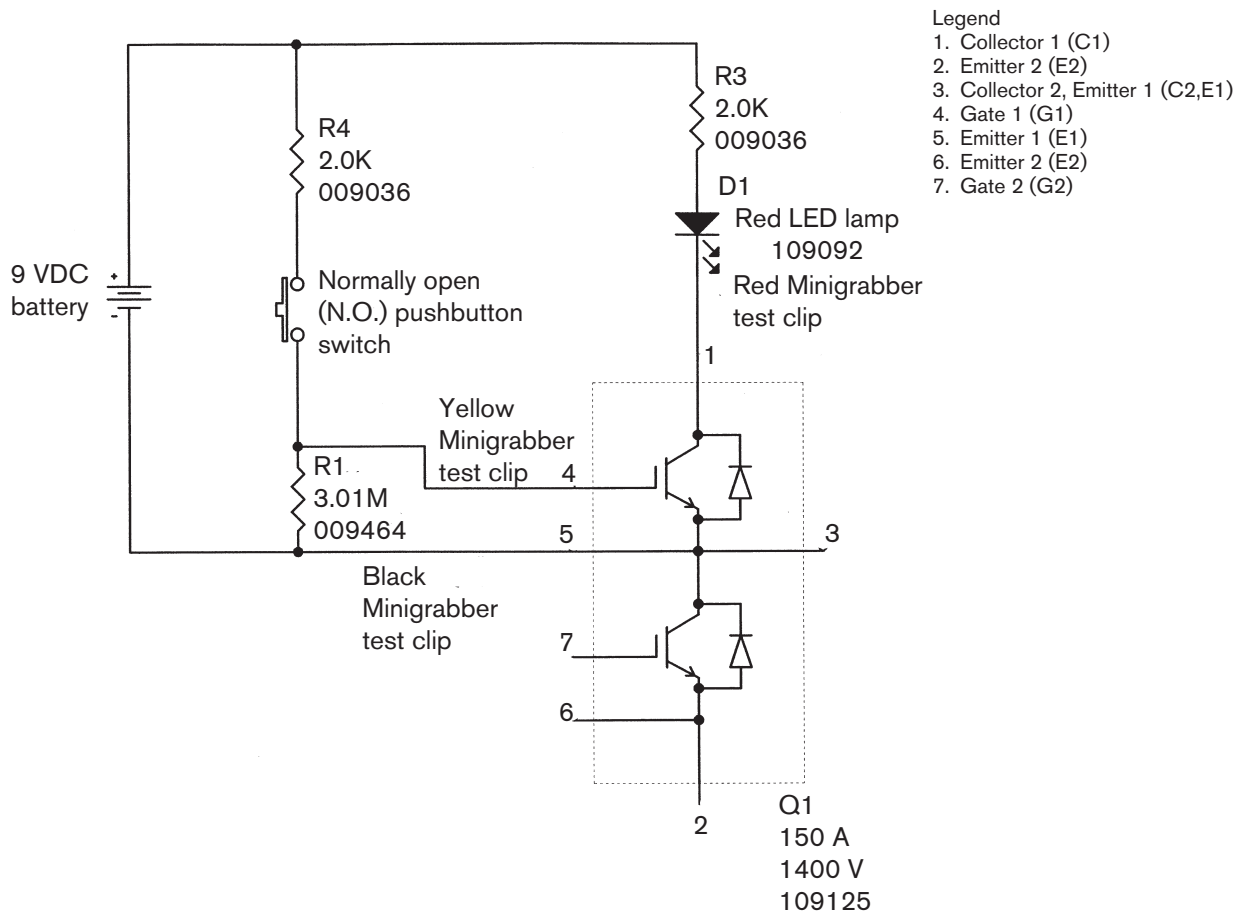
1. Inspect the leads and the IGBT tester for damage.
2. Verify that the battery voltage is greater than 8 V.
3. Test the IGBT Tester, itself, as shown below. If the results do not match the table, replace the lead connections.



Connect leads	Short test	Open test
None	Pass	Fail
Red to Black	Fail	Pass



## Schematic for building an IGBT tester

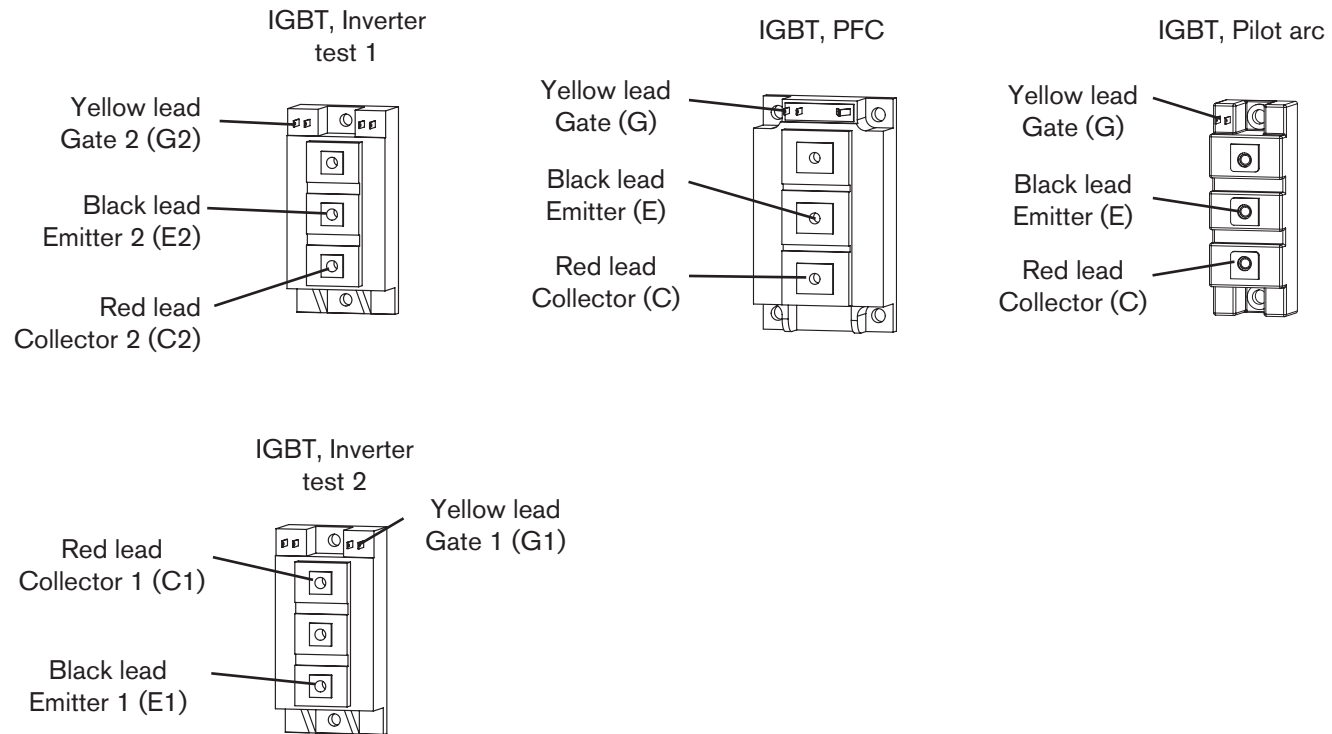


### IGBT device test using a non-Hypertherm tester

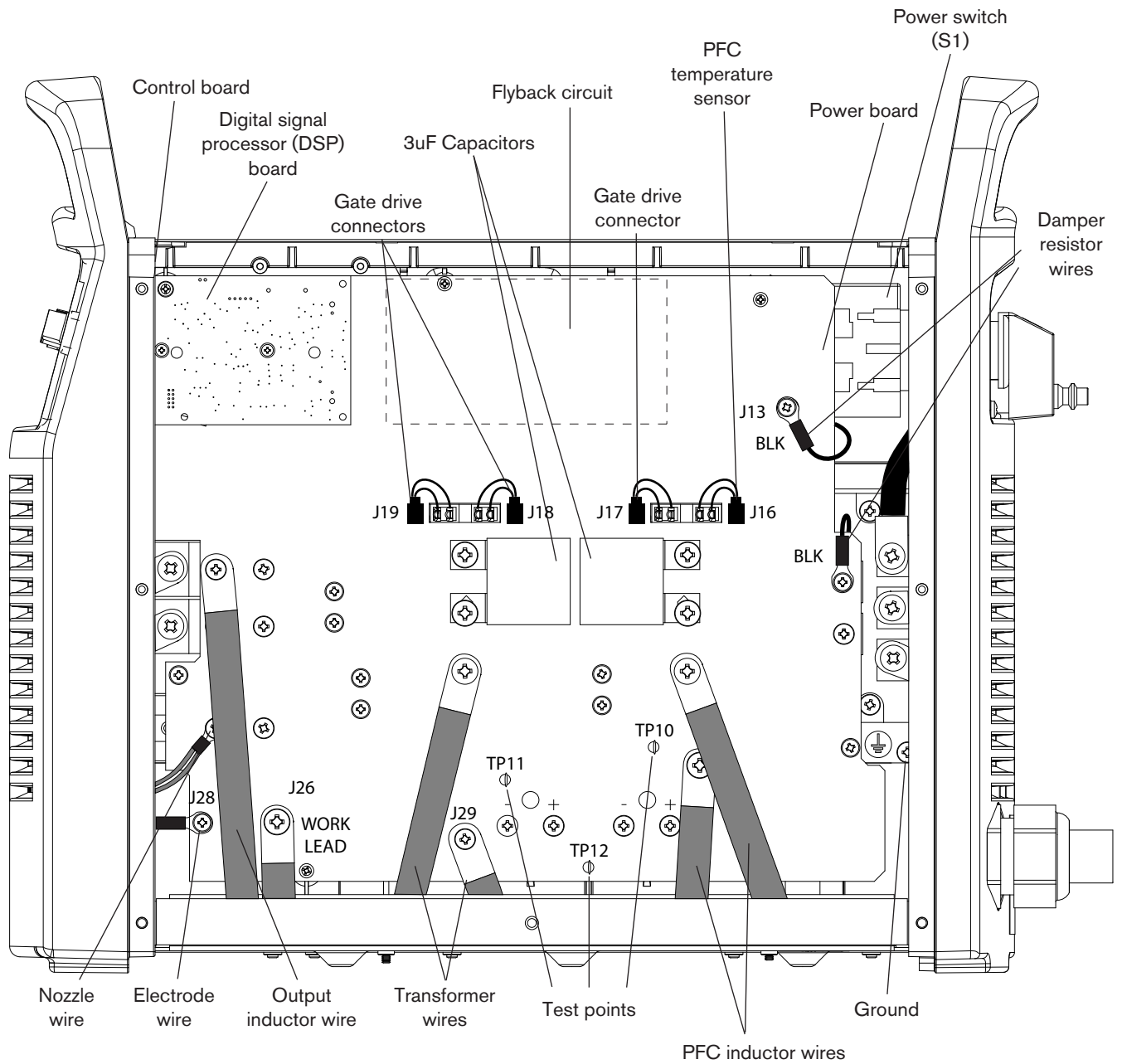
The device tester shown on page 5-15 *Schematic for building an IGBT tester* has one LED and one pushbutton switch that are used in combination to perform two tests.

Note: Before an IGBT can be tested, it must be electrically isolated from all circuits. If the IGBT is installed in a power supply, remove the power board and any lead connections before testing.

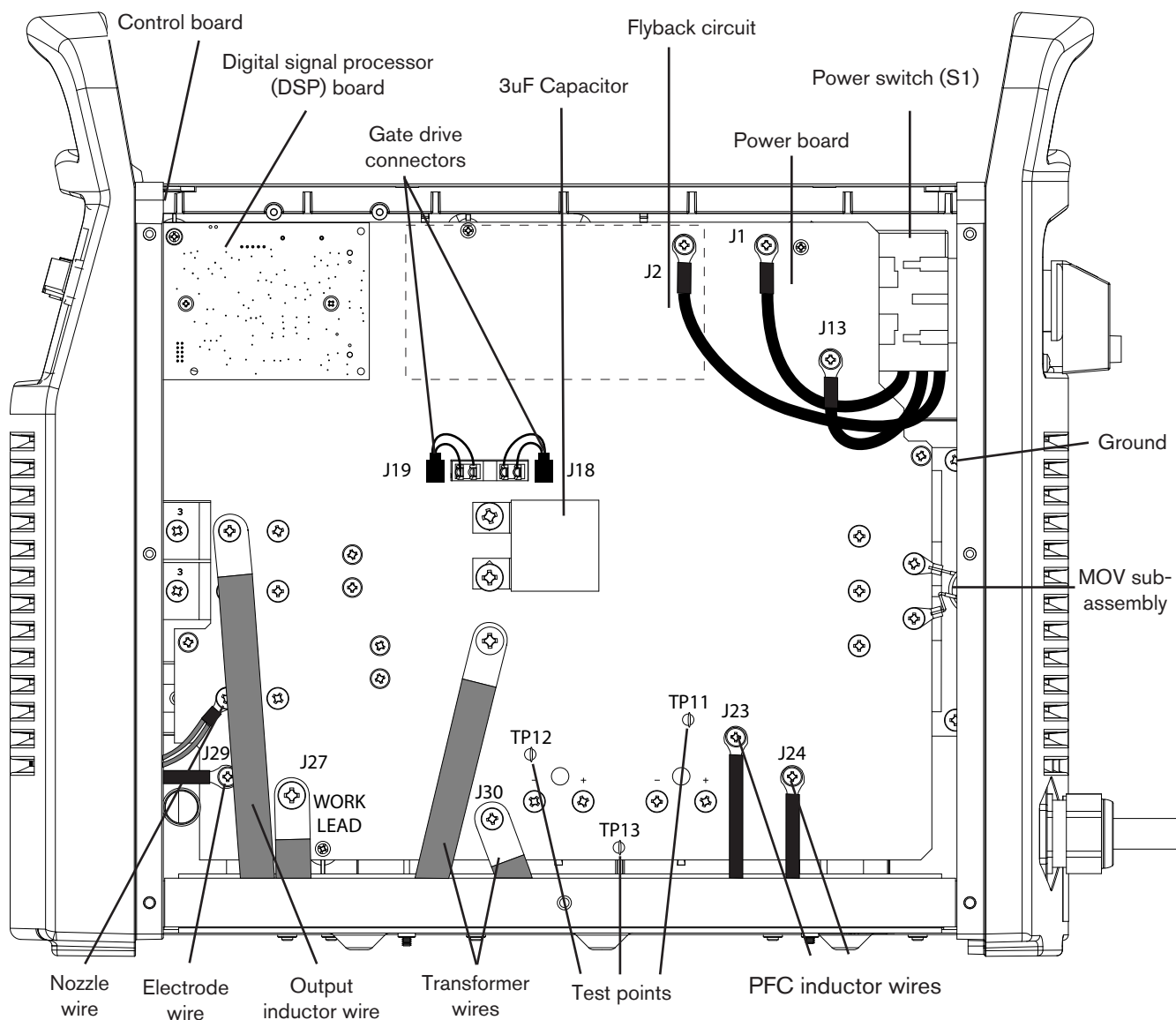
1. Inspect the IGBT for cracks or black marks. If damaged, replace the IGBT.
2. Verify that the 9 V battery reads greater than (>) 8.0 V.
3. Connect the test leads as shown below.
4. With the test leads connected and without pressing the pushbutton switch, the LED should not illuminate. If the LED is illuminated, then the IGBT is shorted. Replace the IGBT.
5. With the test leads connected, press the pushbutton switch. This time, the LED should illuminate. If the LED does not illuminate, then the IGBT is open. Replace the IGBT.



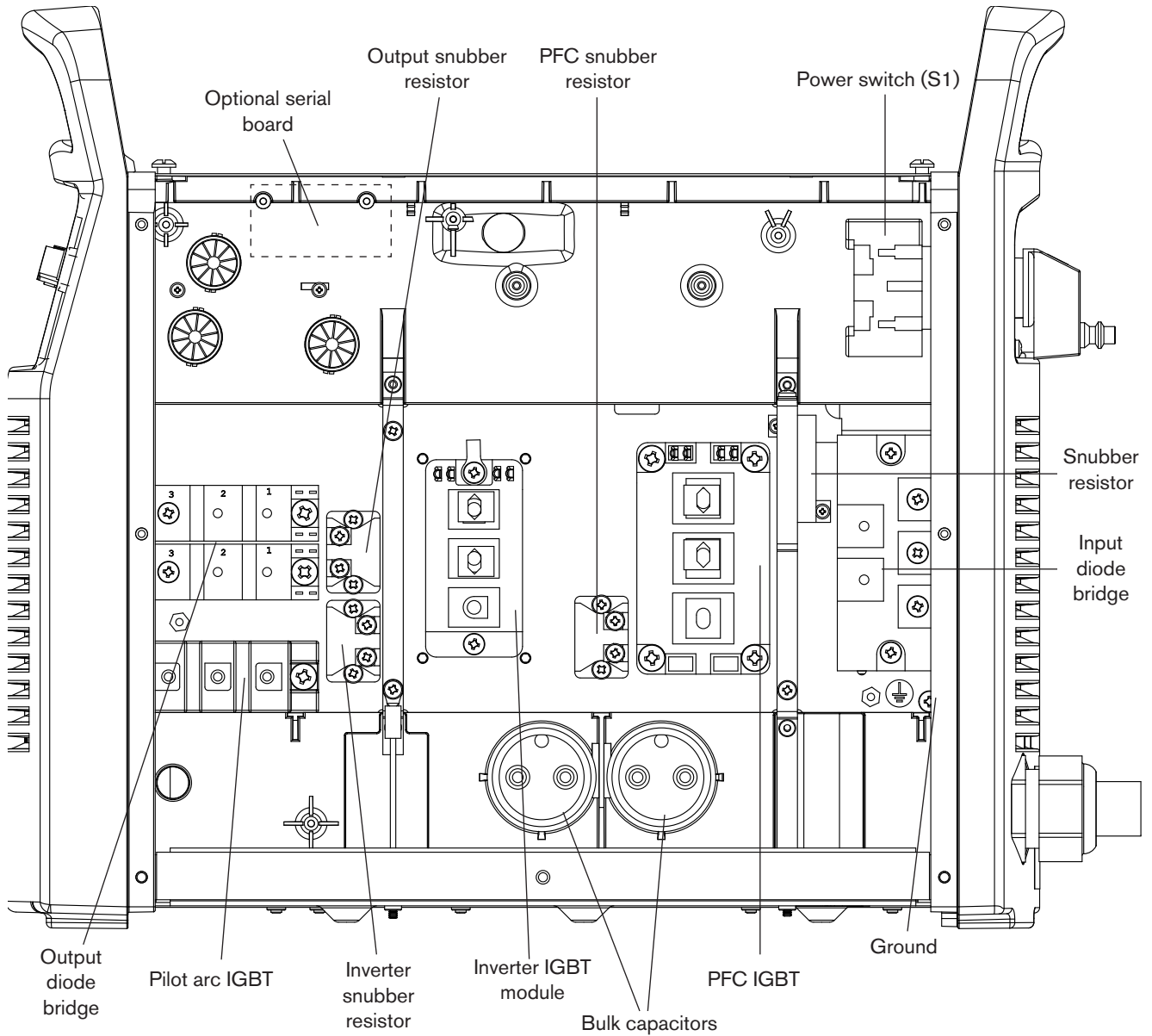
## 200 – 600 V CSA power supply overview



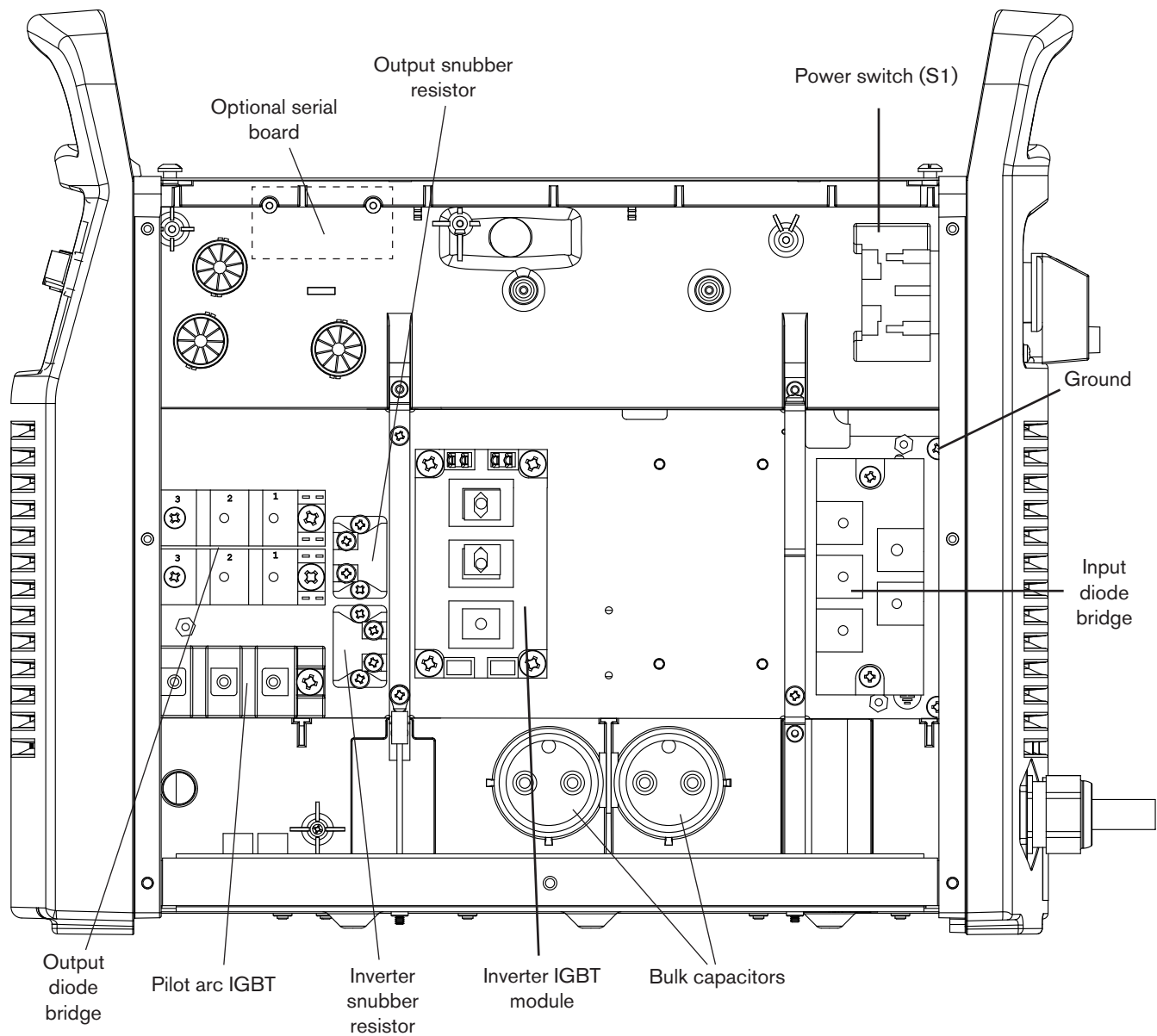
### 380/400 V CCC/CE power supply overview



## 200 – 600 V CSA power supply overview (power board removed)



### 380/400 V CCC/CE power supply overview (power board removed)



## Fault codes

Fault codes displayed on the LCD screen in “service mode” are in the format N-nn-n. Fault codes displayed on the LCD screen in “operator mode” have one fewer digit and appear in the format N-nn. The tables in this section show all digits.

The fault priority is assigned based on the fault code value: the higher the number, the higher the fault priority. Only one fault code is set at one time. If more than one fault occurs at the same time, only the fault with the highest priority is set.

## Displaying the service screen

For troubleshooting faults, display the service screen by simultaneously pressing the automatic/manual and current/gas mode selectors for approximately two (2) seconds. The service screen displays.

	I*	65/	65	C	32	B	100	
	P	69/	68	G	0	IP:	18	
	VL:	495	TI:	29	TP:	33		
	VB:	762	AH:	0.0				
	F0-00-0	T85H25				SD/E		
①	000	2-20-0	000	0-00-0				②
③	000	0-00-0	000	0-00-0				④
⑤	000	0-00-0	000	0-00-0				⑥

Designator	Description
I	Current set/read
C	LCD contrast
B	LCD brightness (percent)
P	Pressure set/read
G	Gas test enable (1)/disable (0)
IP	Boost circuit current (not present in CE machines)
VL	Incoming AC line voltage
TI	Inverter module temperature (°C)
TP	Boost module temperature (°C), not present in CE machines
VB	DC bus voltage
AH	Arc hours
F	Live fault code
T	Torch identifier (amps/H hand or M machine/lead length in feet)
S	DSP/Control board software versions
1 – 6	1 is the most recent fault code; 6 is the oldest fault code

Note: Fault codes beginning with zero (0-nn-n) are not recorded in the fault log.

To move the field selector (\*) between fields, press the current/gas mode selector. The asterisk indicates the selected field. You can alter the I, C, B, P, and G fields by turning the adjustment knob.

To toggle between (I) Current set/read and (P) Pressure set/read, press the automatic/manual mode selector. The LED is illuminated when the Pressure set/read field is selected.

To exit the service screen, simultaneously press the automatic/manual and current/gas mode selectors. The operator screen displays.

### Important fault icons

One of the following fault icons may appear on the LCD display in operator mode:



#### **Warning**

The system continues to operate.



#### **Fault**

The system stops cutting and is able to recover when the fault is cleared.



#### **Error**

The system needs service.

### Performing a cold restart

Sometimes a “cold restart” clears the fault. When a cold restart is recommended in one of the Solutions below, do the following:

1. Power OFF the machine.
2. Wait 20 seconds or until the red LED near the top of the DSP board blinks.
3. Power ON the machine.



## Fault codes and solutions

Each table below describes a fault category and suggests solutions for each fault code. Several of the fault descriptions show a test number. If the listed solutions do not resolve the problem, refer to page 5-38 *System tests* and perform the indicated numbered test.




### 0-00-n

These fault codes indicate non-hardware faults.



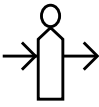

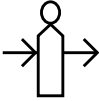
Fault code	Description ( <i>System test number</i> )	Power LED	Fault LED	Fault icon	Solutions
0-00-0	None	On	Off	–	No errors



### 0-nn-n

These fault codes identify operational faults. On the operator screen, the last digit is omitted. Display the service screen for more information on faults 11, 19, 30, 40, 60, and 99.






Fault code	Description ( <i>System test number</i> )	Power LED	Fault LED	Fault icon	Solutions
0-11-0	Remote controller cut mode invalid	On	Off		<p>There is a problem with the remote controller or the software interface to the system. The system cannot interpret the cut mode, cut current, or pressure information coming from the controller.</p> <ul style="list-style-type: none"> <li>Fix the controller.</li> <li>Check the interface cable.</li> </ul>
0-11-1	Remote controller current invalid				
0-11-2	Remote controller pressure invalid				
0-12-0	Low input gas pressure: Warning ( <b>Test 10</b> ) (DSP firmware revision E or before)	On	Off		<ul style="list-style-type: none"> <li>Adjust the gas inlet pressure as needed.</li> </ul>
0-12-1	Output gas pressure high (DSP firmware revision J or later) or low (prior to DSP firmware revision J) (Refer to 5-21 <i>Displaying the service screen</i> )	On	Off		<ul style="list-style-type: none"> <li>Adjust the gas inlet pressure as needed.</li> <li>Check for kinked or blocked air lines.</li> <li>Perform Test 10.</li> </ul>
0-12-2	Output gas pressure low (DSP firmware revision J or later) or high (prior to DSP firmware revision J) (Refer to 5-21 <i>Displaying the service screen</i> )				<ul style="list-style-type: none"> <li>The gas subsystem is not working properly. Check the valve.</li> <li>Perform Test 10.</li> </ul>
0-12-3	Output gas pressure unstable (DSP firmware revision J or later; Refer to 5-21 <i>Displaying the service screen</i> )				



## TROUBLESHOOTING AND SYSTEM TESTS

Fault code	Description (System test number)	Power LED	Fault LED	Fault icon	Solutions
0-13-0	AC input unstable (line resonance): Warning	Blinks (3 Hz)	Off		<ul style="list-style-type: none"> <li>Perform a cold restart.</li> <li>If the fault does not clear, correct the power source. Change the character, generally the impedance, of the line.</li> </ul>
0-19-9	Power board hardware protection. One or more major power board hardware faults (or electrical noise) detected: Warning.  Fault 0-19-9 can occur three (3) times before becoming a 0-99 fault.	On	On		<p>The inverter shuts down and does not fire again for several seconds. If the fault is caused by electrical noise, the fault clears in a few seconds and the machine operates normally.</p> <p>If a true fault continues to occur, the 0-99 fault code appears on the operator screen. Access the fault log in the service screen to identify the major fault.</p>
0-20-0	Low gas pressure ( <b>Test 10</b> )  The gas pressure has fallen below the minimum pressure for that process, mode, and lead length.	On	On		<p>Ensure the gas line is properly installed.</p> <p>Replace the air filter element if dirty.</p> <p>Replace the gas supply line if restricted.</p> <p>Ensure the inlet pressure is 85 to 135 PSI (5.9 to 9.3 bar).</p>
0-21-0	Gas flow lost while cutting ( <b>Test 9</b> )	On	On		<p>The DSP monitors the nozzle to electrode voltage and if it detects a rapid change in that voltage, the inverter shuts down. Usually this indicates a rapid loss of gas pressure from a kinked or blocked air supply line.</p> <ul style="list-style-type: none"> <li>Correct any gas supply restrictions and restart the power supply.</li> <li>Check the torch lead for leaks or kinking.</li> </ul>
0-22-0	No gas input	On	On		<ul style="list-style-type: none"> <li>Restore the gas supply.</li> <li>Restart the power supply.</li> </ul>

Fault code	Description (System test number)	Power LED	Fault LED	Fault icon	Solutions
0-30-0	Torch stuck open ( <b>Test 6</b> ) The nozzle and electrode are not touching after a start is received.	On	On		<ul style="list-style-type: none"> <li>If incorrect consumables are installed or the consumables became loose or were removed while the power supply is ON, turn OFF the power supply, correct the problem and then turn ON the power supply to clear this fault.</li> <li>Inspect the torch for signs of wet or oily air.</li> <li>Inspect the torch for any signs of damage or pitting on the electrode contact surface.</li> <li>If the consumables appear to be installed correctly, the torch may be damaged. Test with a known working torch.</li> <li>For a 0-30-1 fault code, place the unit in gas test mode (refer to page 5-21 <i>Displaying the service screen</i>). Enter "manual mode", move to "G" (gas), and use the adjustment knob to toggle to "1" (gas test mode). Ensure that only the dump valve light is on during the gas test. Toggle back to "0" and exit "manual mode." Replace the regulator if necessary.</li> <li>If the problem persists, contact your Hypertherm distributor or authorized repair facility.</li> </ul>
0-30-1	Torch stuck closed ( <b>Test 6</b> ) <ul style="list-style-type: none"> <li>The nozzle and electrode will not separate after a start is received.</li> <li>The regulator may not be functioning properly.</li> </ul>				
0-40-0	PFC/Boost IGBT module under temperature ( <b>Test 4</b> )	On	On		<p>For an over-temperature fault, leave the machine powered ON and confirm that the fan is operating (Test 11). Ensure adequate air flow around the unit.</p> <p>Ensure the cover is placed with the air fins on the fan side of the power supply.</p> <p>If the duty cycle has been exceeded, let the unit cool and work within the duty cycle limits listed in the <i>Operation</i> section.</p> <p>For an under-temperature (&lt;-22°F or -30°C) fault, move the unit to a warmer location.</p> <p>The inverter temperature sensor is a thermistor mounted on the heat sink beside the inverter IGBT module. Its room temperature resistance is about 10 kΩ.</p>
0-40-1	PFC/Boost IGBT module over temperature ( <b>Test 4</b> )				
0-40-2	Inverter IGBT module under temperature ( <b>Test 4</b> )				
0-40-3	Inverter IGBT module over temperature ( <b>Test 4</b> )				


## TROUBLESHOOTING AND SYSTEM TESTS

Fault code	Description (System test number)	Power LED	Fault LED	Fault icon	Solutions
0-50-0	Retaining cap off ( <b>Test 8</b> )	On	On		<ul style="list-style-type: none"> <li>Verify that proper consumables and retaining cap are installed. Replace damaged parts. Refer to section <i>Torch Setup</i>.</li> <li>With the retaining cap installed, check for continuity between pins 5 and 7 at the torch connector.</li> <li>If the consumables appear to be installed correctly, the torch may be damaged. Test with a known working torch.</li> <li>After correcting the problem, perform a cold restart.</li> </ul>
0-51-0	Start/trigger signal on at power up ( <b>Test 7</b> )  This situation indicates that the power supply is receiving a start signal at power-up. It is sometimes referred to as a "stuck start."	On	On		<p>If the power supply is turned on while the torch trigger is pressed, the system is disabled.</p> <ul style="list-style-type: none"> <li>Release the trigger and cycle the power to the machine.</li> <li>Check for continuity between Pin 6 and Pin 7 of the torch connector. There should be very low resistance when the torch trigger is pulled.</li> <li>Test with a known working torch.</li> </ul>
0-52-0	Torch not connected	On	On		<ul style="list-style-type: none"> <li>Plug a torch lead into the FastConnect receptacle on the front of the power supply and recycle the power switch.</li> </ul>
0-60-0	Phase loss ( <b>Test 1</b> )	On	On		<p>Wear proper personal protection equipment when checking the voltage.</p> <ul style="list-style-type: none"> <li>Check for proper voltage (phase to phase and phase to ground) at the power source and at the machine.</li> </ul>
0-60-1	Under voltage ( <b>Test 1</b> )				<ul style="list-style-type: none"> <li>Increase the supply voltage.</li> </ul>
0-60-2	Over Voltage ( <b>Test 1</b> )				<ul style="list-style-type: none"> <li>Decrease the supply voltage.</li> </ul>
0-61-0	AC input unstable: Shutdown	On	On		<ul style="list-style-type: none"> <li>Test the machine from another AC power source.</li> <li>Power down and correct the line resonance problem before continuing.</li> </ul>

Fault code	Description ( <i>System test number</i> )	Power LED	Fault LED	Fault icon	Solutions
0-98-0	Internal communication failure  The control board and the DSP are not communicating.	On	On		<ul style="list-style-type: none"> <li>Perform a cold restart.</li> <li>Confirm that the connecting ribbon cable is installed properly between the control board and the DSP board.</li> </ul>
0-99-0	System hardware fault (service required)  Indicates a major fault with the system.	On	On		<ul style="list-style-type: none"> <li>Display the service screen.</li> <li>A qualified service technician must service the system. Contact your distributor or authorized repair facility.</li> </ul>

## 1-nn-n


These fault codes usually relate to the DSP board and can only be seen on the service screen.

Fault code	Description ( <i>System test number</i> )	Power LED	Fault LED	Fault icon	Solutions
1-00-0	Digital signal processor fault	On	On		<p>These are internal processor checks and are not likely to be caused by a hardware failure.</p> <ul style="list-style-type: none"> <li>Perform a cold restart.</li> </ul> <p>If that doesn't fix the problem, it is possible that the DSP or Power board have failed.</p>
1-10-0	A/D converter fault				
1-20-0	I/O fault				

## TROUBLESHOOTING AND SYSTEM TESTS


### 2-nn-n

These fault codes usually relate to either the DSP or the power board and can only be seen on the service screen.


Fault code	Description ( <i>System test number</i> )	Power LED	Fault LED	Fault icon	Solutions
2-00-0	Analog to Digital (A/D) converter value out of range	On	On		<ul style="list-style-type: none"> <li>Perform a cold restart.</li> </ul> <p>If that doesn't fix the problem, it is possible that the DSP or Power board have failed.</p>
2-01-0	Auxiliary switch disconnected				<ul style="list-style-type: none"> <li>Check the auxiliary switch cable.</li> <li>Perform Test 12.</li> </ul>
2-10-0	Inverter module temp sensor open ( <b>Test 4</b> )				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> </ul>
2-10-1	Inverter module temp sensor shorted ( <b>Test 4</b> )				<ul style="list-style-type: none"> <li>Check the resistance across the thermistor. It should be about 10 kΩ at room temperature.</li> </ul> <p>If no problems are found, it is possible that the inverter heat sink temperature sensor assembly (228805) has failed.</p>
2-11-0	Pressure sensor open ( <b>Test 10</b> )				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> </ul>
2-11-1	Pressure sensor shorted ( <b>Test 10</b> )				<ul style="list-style-type: none"> <li>If necessary, replace the pressure sensor (kit 228689)</li> </ul>
2-20-0	Torch ID  The DSP does not recognize the torch.				<ul style="list-style-type: none"> <li>Confirm that the torch is seated properly in the connector.</li> <li>Inspect the connector for the proper pin-out.</li> </ul>

## 3-nn-n


These fault codes relate to the power board and can only be seen on the service screen.

Fault code	Description (System test number)	Power LED	Fault LED	Fault icon	Solutions
3-00-0	DC bus voltage ( <b>Test 5</b> ) DC bus voltage is out of range.	On	On		<ul style="list-style-type: none"> <li>Inspect the PFC Boost circuitry (CSA)</li> <li>Test the PFC Boost IGBT (CSA)</li> </ul>
3-10-0	Fan speed ( <b>Test 11</b> ) The fan speed is below the minimum speed.				<ul style="list-style-type: none"> <li>Clean the fan assembly.</li> </ul>
3-10-1	Fan ( <b>Test 11</b> )				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> <li>If necessary, replace the fan assembly.</li> </ul>
3-11-0	PFC module temp sensor open ( <b>Test 4</b> )				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> <li>If necessary, replace the PFC/Boost IGBT module.</li> </ul>
3-11-1	PFC module temp sensor shorted ( <b>Test 4</b> )				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> <li>If necessary, replace the PFC/Boost IGBT module.</li> </ul>
3-11-2	PFC module temp sensor circuit error				<ul style="list-style-type: none"> <li>Check the temperature circuit on the power board. If Test 4 is good, replace the power board.</li> </ul>
3-20-0	Fill valve ( <b>Test 9</b> ) Indicates that the Fill Valve is not connected.				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> <li>If necessary, replace the electronic regulator. (Kit 228687)</li> </ul>
3-20-1	Dump valve ( <b>Test 9</b> ) Indicates that the Dump Valve is not connected.				<ul style="list-style-type: none"> <li>Check the associated wiring.</li> <li>If necessary, replace the electronic regulator. (Kit 228687)</li> </ul>
3-20-2	Valve ID ( <b>Test 9</b> )				<p>The DSP does not recognize the electronic regulator.</p> <ul style="list-style-type: none"> <li><b>CSA units:</b> Verify that the jumper at J4 is in the correct position. See wiring diagram on page 8-4.</li> <li><b>CE units:</b> Verify that the jumper at J6 is in the correct position. See wiring diagram on page 8-5.</li> </ul>
3-20-3	Electronic regulator is disconnected ( <b>Test 9</b> ) The electronic regulator is not drawing current.				<ul style="list-style-type: none"> <li>Inspect the associated wiring, particularly the 7-pin connector.</li> <li>If necessary, replace the electronic regulator. (Kit 228687)</li> </ul>

## TROUBLESHOOTING AND SYSTEM TESTS

Fault code	Description (System test number)	Power LED	Fault LED	Fault icon	Solutions
3-41-0	Drive fault	On	On		If an activation signal is sent to a device and the device does not activate (machine motion relay or in-rush relay for example) this fault will occur.
3-42-0	5 or 24 VDC fault ( <b>Test 5</b> )				The 5 or 24 VDC supply from the flyback circuit is out of range.
3-42-1	18 VDC fault				The 18 VDC supply from the flyback circuit is out of range. ▪ Replace the power board.
3-43-0	Inverter capacitors unbalanced ( <b>Test 2</b> )				Voltage across one or both inverter caps is more than 25% different than nominal. ▪ CSA units have a 760 VDC bus voltage. ▪ Nominal is 380 VDC for each cap. ▪ Fault condition: < 275 or > 485 VDC across either capacitor. ▪ CE units at 400 VAC have a 560 VDC bus voltage. ▪ Nominal is 280 VDC for each cap. ▪ Fault condition: <200 or> 360 VDC across either capacitor. ▪ Test the IGBT module. ▪ Test the inverter capacitors. (2200µF)
3-44-1	PFC over current				High current in the PFC/Boost circuit. ▪ Test the PFC IGBT. ▪ Replace it if faulty. ▪ If necessary, replace the power board.



Fault code	Description ( <i>System test number</i> )	Power LED	Fault LED	Fault icon	Solutions
3-51-1	Inverter saturation fault (the inverter is over current)	On	On		Upper and lower inverter IGBTs are gating (being activated) in phase rather than 180° out of phase. <ul style="list-style-type: none"><li>▪ Test the two inverter IGBTs in the module.</li><li>▪ Do “Test 3 – Output diodes”.</li><li>▪ Replace the module if either is faulty.</li><li>▪ If necessary, replace the power board.</li></ul>
3-52-0	Shoot through				
3-60-0	Power board				The DSP does not recognize the power board. The code is for future machines where the current DSP board will not work with future power boards.
3-70-0	Internal serial communications fault				There is a fault with the communication between the DSP and Power board. <ul style="list-style-type: none"><li>▪ Check the board connector.</li><li>▪ If necessary, replace either the DSP or Power board.</li></ul>

### Troubleshooting guide

Note: Fault icons and corresponding fault codes appear in the user display for many errors. If a fault code appears, refer to page 5-21 *Fault codes* before using this troubleshooting guide.

The following table provides an overview of the most common problems that can arise when using the Powermax65 or Powermax85 and explains how to solve them. See page 5-38 *System tests* for detailed test procedures.

Problem	Meaning	Causes	Solution
The ON/OFF power switch is set to ON (I), but the power ON LED is not illuminated.	There is insufficient voltage to the control circuits or a short-circuited power component.	No voltage, improper voltage applied to the unit, a faulty power switch (S1), or a faulty input diode.	<ul style="list-style-type: none"><li>▪ Check to see that the system is plugged into an appropriately-sized circuit and that the circuit breaker has not been tripped.</li><li>▪ Verify that the power is ON at the main power panel or at the line-disconnect switch box.</li><li>▪ Verify that the line voltage is not too low (more than 15% below the rated voltage).</li><li>▪ Perform Test 1 to check the incoming voltage and the power switch.</li><li>▪ Perform Test 12 on CSA units.</li></ul>
		Faulty power board (PCB3), fan, or solenoid valve.	<ul style="list-style-type: none"><li>▪ Perform Test 5 to check the flyback circuit.</li></ul>
		Faulty power board (PCB3) or IGBT.	<ul style="list-style-type: none"><li>▪ Perform Tests 1, 2, and 3 and replace any faulty components.</li></ul>
		Faulty control board (PCB1).	<ul style="list-style-type: none"><li>▪ Replace the control board (PCB1).</li></ul>
		Faulty DSP board.	<ul style="list-style-type: none"><li>▪ Replace the DSP board.</li></ul>

<b>Problem</b>	<b>Meaning</b>	<b>Causes</b>	<b>Solution</b>
The power ON LED is illuminated and no fault codes are displayed, but no gas flows when the torch trigger is pulled.	The start signal is not reaching the control board.	<ul style="list-style-type: none"> <li>▪ The torch or torch lead may be damaged.</li> <li>▪ The power board may be faulty.</li> <li>▪ The control board may be faulty.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Inspect the torch and torch lead for damage.</li> <li>▪ Verify that the start icon appears on the LCD screen when the trigger is pulled. If it does not, perform Test 7 to check the start signal from the power board.</li> </ul>
Power ON LED blinks or goes out while cutting.	A power component is shorted.	▪ Faulty fan.	▪ Perform Test 11.
		▪ Faulty power board (PCB3) or IGBT.	▪ Perform Tests 1, 2, or 3.
		▪ Faulty control board (PCB1).	
The arc does not transfer to the workpiece.	Poor continuity exists between the work lead and the workpiece.	<ul style="list-style-type: none"> <li>▪ The workpiece is dirty.</li> <li>▪ The work clamp is damaged.</li> <li>▪ The pierce height distance is too large.</li> <li>▪ The transfer current sensor is bad.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Clean the area where the work clamp contacts the workpiece to ensure a good metal-to-metal connection.</li> <li>▪ Inspect the work clamp for damage and repair as necessary.</li> <li>▪ If the pierce height distance is too large, move the torch closer to the workpiece and fire the torch again.</li> <li>▪ If the transfer current sensor is bad, replace the power board.</li> </ul>
Gas flows from the torch at power-up when neither the torch trigger nor a remote start is activated.	The electronic regulator, power board (PCB3), or control board (PCB1) is faulty.	<ul style="list-style-type: none"> <li>▪ Faulty electronic regulator.</li> <li>▪ Faulty power board (PCB3).</li> <li>▪ Faulty control board (PCB1).</li> </ul>	▪ Perform Test 9.
	The incoming gas pressure is too high.	▪ The gas pressure from the compressor or cylinder may be too high.	▪ Check the gas supply to make sure that it does not exceed 135 psi (9.3 bar). If necessary, reduce the pressure.

## TROUBLESHOOTING AND SYSTEM TESTS

Problem	Meaning	Causes	Solution
When pressing the torch trigger or start switch, gas flows from the torch, but the torch does not fire or fires for only a short duration.	Worn or damaged consumables.	<ul style="list-style-type: none"> <li>Overused or improperly installed consumables.</li> </ul>	<ul style="list-style-type: none"> <li>Replace consumables.</li> </ul>
	Damaged torch or lead assembly.	<ul style="list-style-type: none"> <li>Electrode is not moving properly in the torch or the torch lead is damaged.</li> </ul>	<ul style="list-style-type: none"> <li>Perform Test 6.</li> </ul>
	Insufficient or excessive gas flow.	<ul style="list-style-type: none"> <li>Gas pressure is too high or too low, or the gas supply is leaking or restricted.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure the inlet pressure is 85 to 135 PSI (5.9 to 9.3 bar).</li> <li>Repair air leaks or restrictions.</li> <li>Manually adjust the gas pressure on the power supply.</li> </ul>
	Poor air quality.	<ul style="list-style-type: none"> <li>Air filter element is dirty.</li> <li>Moisture or contaminants in the gas supply line.</li> </ul>	<ul style="list-style-type: none"> <li>Replace the air filter element.</li> <li>Add appropriate filtration and purge the lines with nitrogen to flush out oil and moisture.</li> </ul>
	Insufficient input power.	Undersized electrical supply installation: <ul style="list-style-type: none"> <li>Breaker or fuse.</li> <li>Supply wire.</li> <li>Extension cord.</li> </ul>	<ul style="list-style-type: none"> <li>Verify that the external electrical power is installed according to Section 2, <i>Specifications</i>.</li> </ul>
	Faulty inverter IGBT	<ul style="list-style-type: none"> <li>Faulty inverter IGBT.</li> </ul>	<ul style="list-style-type: none"> <li>Use an IGBT tester to check the inverter IGBT.</li> </ul>
	Capacitor voltage imbalance on the power board.	<ul style="list-style-type: none"> <li>Faulty resistors on the power board (PCB3) or faulty bulk capacitor(s).</li> </ul>	<ul style="list-style-type: none"> <li>Perform Tests 1, 2, or 3.</li> <li>If the voltage across the capacitors is not balanced, replace the power board (PCB3).</li> </ul>

Problem	Meaning	Causes	Solution
Arc goes out while cutting or intermittently will not fire.	The arc lost contact with the workpiece.	<ul style="list-style-type: none"> <li>The work lead or work lead connection may be faulty.</li> <li>The material being cut may require the use of continuous pilot arc mode.</li> </ul>	<ul style="list-style-type: none"> <li>If you are cutting expanded metal, grate, or any metal with holes, set the mode switch to continuous pilot arc mode.</li> <li>Check for loose connections at the work clamp and at the power supply.</li> <li>Reposition the work lead on the workpiece.</li> <li>Clean the cutting surface to ensure a better connection with the work lead.</li> </ul>
	Faulty fan.	<ul style="list-style-type: none"> <li>The fan could be overloading the flyback circuit.</li> </ul>	<ul style="list-style-type: none"> <li>Perform Tests 5 and 11.</li> </ul>
The cut quality is poor or the cut does not sever the metal.	The consumables are worn, there is a poor work lead connection, the output from the power supply is too low, the power board is producing low current, or the selected cutting mode is incorrect..	<ul style="list-style-type: none"> <li>The consumables need to be replaced</li> </ul>	<ul style="list-style-type: none"> <li>Inspect the consumables and replace if necessary.</li> </ul>
		<ul style="list-style-type: none"> <li>The work lead may be damaged or not properly connected to the work piece</li> </ul>	<ul style="list-style-type: none"> <li>Inspect the work lead for damage. Reposition it and clean the work surface to ensure good contact.</li> </ul>
		<ul style="list-style-type: none"> <li>The amperage adjustment knob may be set too low.</li> </ul>	<ul style="list-style-type: none"> <li>Increase the amperage as needed.</li> </ul>
		<ul style="list-style-type: none"> <li>The power board (PCB3) may be faulty.</li> </ul>	<ul style="list-style-type: none"> <li>Perform Tests 1, 2, and 3 and replace any faulty components.</li> </ul>
		The cutting mode switch is in the wrong position for the cutting operation.	<ul style="list-style-type: none"> <li>Ensure the cutting mode switch is in the correct position.</li> </ul>
		<ul style="list-style-type: none"> <li>Faulty pilot arc IGBT.</li> </ul>	<ul style="list-style-type: none"> <li>Turn the power OFF, remove the consumables, and check the resistance between the cathode and the work clamp. If the resistance is less than 5 k<math>\Omega</math>, check the resistance across the pilot arc IGBT (two screws on 08). If the resistance is less than 5 k<math>\Omega</math>, replace the pilot arc IGBT.</li> </ul>

## TROUBLESHOOTING AND SYSTEM TESTS

Problem	Meaning	Causes	Solution
While in continuous pilot arc mode, the pilot arc extinguishes when you move the plasma arc off the work piece while still pulling the torch's trigger.	The continuous pilot arc feature is not working.	<ul style="list-style-type: none"> <li>The mode switch may be set incorrectly</li> </ul>	<ul style="list-style-type: none"> <li>Verify that the mode switch is set to continuous pilot arc.</li> </ul>
		<ul style="list-style-type: none"> <li>The power board (PCB3) or the control board (PCB1) may be faulty.</li> </ul>	<ul style="list-style-type: none"> <li>Perform Tests 1, 2, and 3 and replace the power board (PCB3) or control board PCB1) if necessary.</li> </ul>
The arc extinguishes, but re-ignites when the torch trigger is pressed again.	The consumables are worn or damaged, the gas filter element is contaminated, or the input gas pressure is not at the proper level.	<ul style="list-style-type: none"> <li>The consumables need to be replaced.</li> </ul>	<ul style="list-style-type: none"> <li>Replace the consumables as needed.</li> </ul>
		<ul style="list-style-type: none"> <li>The gas filter element needs to be replaced.</li> </ul>	<ul style="list-style-type: none"> <li>Replace the gas filter's element if it is contaminated.</li> </ul>
		<ul style="list-style-type: none"> <li>The gas pressure is too high or too low.</li> </ul>	<ul style="list-style-type: none"> <li>Manually adjust the gas pressure as needed.</li> </ul>
The arc sputters and hisses.	The gas filter element is contaminated, or the input gas line contains moisture.	<ul style="list-style-type: none"> <li>The gas filter element needs to be replaced.</li> </ul>	<ul style="list-style-type: none"> <li>Replace the gas filter's element if it is contaminated.</li> </ul>
		<ul style="list-style-type: none"> <li>The input gas supply needs to be cleaned.</li> </ul>	<ul style="list-style-type: none"> <li>Inspect the gas line for moisture. If necessary, install or repair the gas filtration to the power supply. See Section 2, <i>Power Supply Setup</i>, for more information.</li> </ul>

Problem	Meaning	Causes	Solution
Machine does not cut well (does not appear to be cutting at full cutting power) and the arc does not time out after 5 seconds.	Inadequate ground.	<ul style="list-style-type: none"> <li>Poor work lead connection.</li> </ul>	<ul style="list-style-type: none"> <li>Verify that the work lead is attached to the workpiece and the workpiece is free of rust, paint, or other coatings.</li> </ul>
		<ul style="list-style-type: none"> <li>Damaged work lead.</li> </ul>	<ul style="list-style-type: none"> <li>Check the resistance across the work lead. If the resistance is greater than 3 <math>\Omega</math>, repair or replace the work lead.</li> </ul>
		<ul style="list-style-type: none"> <li>Faulty pilot arc IGBT.</li> </ul>	<ul style="list-style-type: none"> <li>Turn the power OFF, remove the consumables, and check the resistance between the cathode and the work piece. If the resistance is less than 5 k<math>\Omega</math>, check the resistance across the pilot arc IGBT (two screws on 08). If the resistance is less than 5 k<math>\Omega</math>, replace the pilot arc IGBT.</li> </ul>
	Low output from the power supply.	<ul style="list-style-type: none"> <li>Faulty control board.</li> </ul>	<ul style="list-style-type: none"> <li>Replace the control board.</li> </ul>
		<ul style="list-style-type: none"> <li>Current is set too low.</li> </ul>	<ul style="list-style-type: none"> <li>Increase the current as needed.</li> </ul>
Nothing displays on the status screen even though the ON/OFF power switch is set to ON (I) and the power ON LED is illuminated.	There is insufficient voltage to the control circuits or a short-circuited component.	<ul style="list-style-type: none"> <li>No voltage or improper voltage applied to the unit, or a blown fuse.</li> </ul>	<ul style="list-style-type: none"> <li>Check to see that the system is plugged into an appropriately-sized circuit and that the circuit breaker has not been tripped.</li> <li>Verify that the power is ON at the main power panel or at the line-disconnect switch box.</li> <li>Verify that the line voltage is not too low (more than 15% below the rated voltage).</li> <li>Verify that the fuses in the disconnect are not blown.</li> </ul>
		<ul style="list-style-type: none"> <li>The fan inside the power supply short-circuited</li> </ul>	<ul style="list-style-type: none"> <li>Turn the power OFF. Disconnect the fan from J3 (CSA units) or J5 (CE units) on the power board. Turn the power back ON. If the status screen comes on, replace the fan.</li> </ul>

### System tests

Test #	Description	Associated fault codes
1	Voltage input	0-60-ALL
2	DC power bus	3-43-0
3	Output diode bridge	General
4	Temperature out of range	0-40-ALL, 2-10-ALL, 3-11-ALL
5	Flyback (DC to DC) circuit	3-00-0, 3-42-ALL, 3-43-ALL
6	Torch stuck open	0-30-ALL
7	Start signal	General, 0-51-0
8	Torch cap-sensor switch	0-50-0
9	Electronic regulator	0-21-0, 3-20-ALL
10	Pressure sensor	0-12-0, 0-20-0, 2-11-ALL
11	Fan	3-10-ALL
12	Power switch auxiliary	Unreported interlock at START

Before performing any tests do the Internal inspection and the Resistance check in Test 2 below. These tests should only be performed by a qualified service technician. Wear the proper personal protective equipment and use approved tools and measurement equipment.

Before purchasing a major replacement component, verify the problem with Hypertherm Technical Service (1-800-643-9878) or the nearest Hypertherm repair facility.

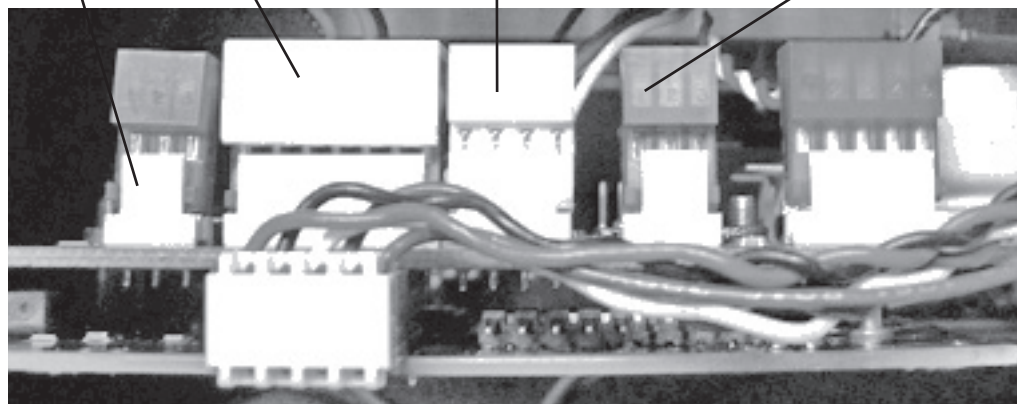
Several connectors require you to remove a white cap to access the test points. The figure below shows examples of connectors located at the top of the power board. You can pry off most covers with your thumbnail. However, you may need to use a small blade screwdriver to carefully pry off some of the covers. Be careful not to bend or break the connectors.

Pressure sensor  
J5 (CSA), J7 (CE)

Electronic regulator  
J4 (CSA), J6 (CE)

Fan  
J3 (CSA), J5 (CE)

Inverter temperature sensor  
J2 (CSA), J4 (CE)





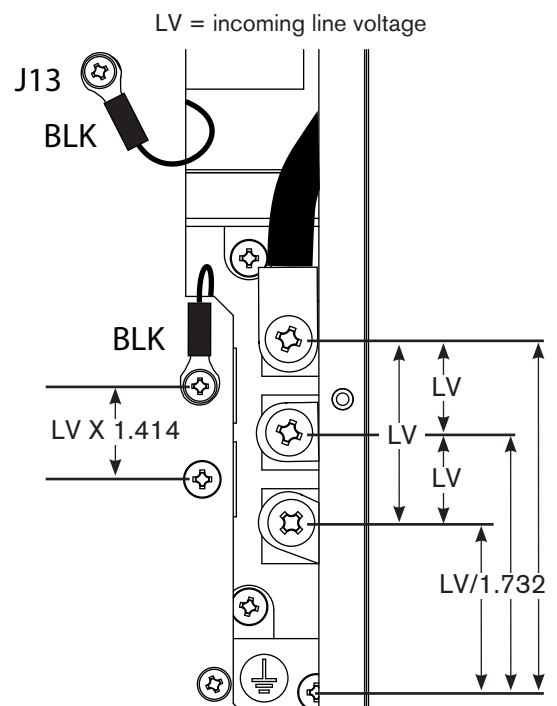
## Test 1 – Voltage input

Symptom: Voltage fault (0-60-0, -1 or -2)

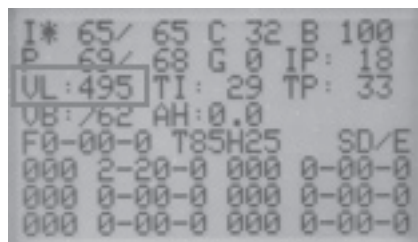
- Check the line voltage at the power switch (S1).
- Check the input voltage to the input diode bridge.
  - The AC voltage between any 2 input wires should equal the line voltage.
- If there is proper voltage to the power switch, and low voltage to the input diode, replace the power switch.
- Check the output voltage of the input diode bridge.
  - Output VDC = Line Voltage x 1.414 VDC.

Note: All values are  $\pm 15\%$ .

Single phase		Three phase	
L	Black (CSA)	L1	Black (CSA) Brown (CE)
N	White (CSA)	L2	White (CSA) Black (CE)
PE	Green (CSA)	L3	Red (CSA) Gray (CE)
		PE	Green (CSA) Green/Yellow (CE)



- If there is a fault and the diode bridge output value is correct:
  - Display the service screen and confirm that the value "VL" is  $\pm 15\%$  of AC line voltage.




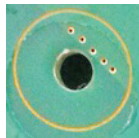
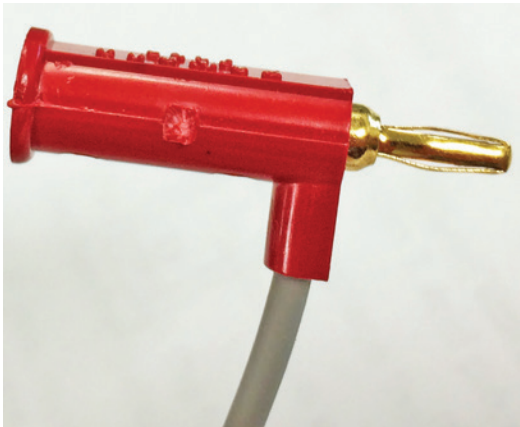
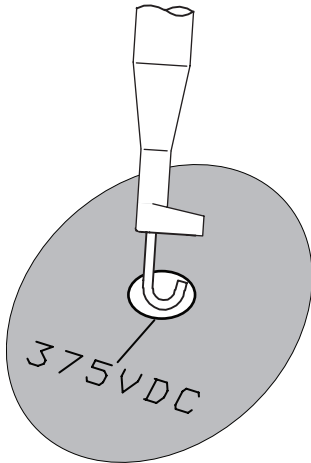
- If there is a fault and the “VL” value is correct:
  - Do a check for a short-circuited fan. Remove the fan connector from the power board at J3 (CSA units) or J5 (CE units). Another indication of a short-circuited fan is when nothing shows on the LCD screen. If the LCD screen comes on after you disconnect the fan, replace the fan.
  - If the fan is the problem, replace the fan. If the fan is not the problem, perform the steps in “Test 5 – Flyback circuit (DC minor voltages)” on 5-46 that are related to the fan.
- If the problem continues, verify the DSP board by replacing it with a known good board.
- If the DSP board is not the problem, replace the power board and the PFC IGBT (CSA units only).

### Test 2 – DC Power Bus

#### Resistance check

Note: All resistance values must be taken with the power cord disconnected and all internal power supply wires attached.

- Remove the mounting screws from the bulk capacitors and pull the caps away from the power board.
- Measure resistances described in the tables on page 5-41.
  - Use the table below to identify how to attach to the test points on the power board based on the power board design in your system.
- Replace the bulk capacitor mounting screws before power-up.

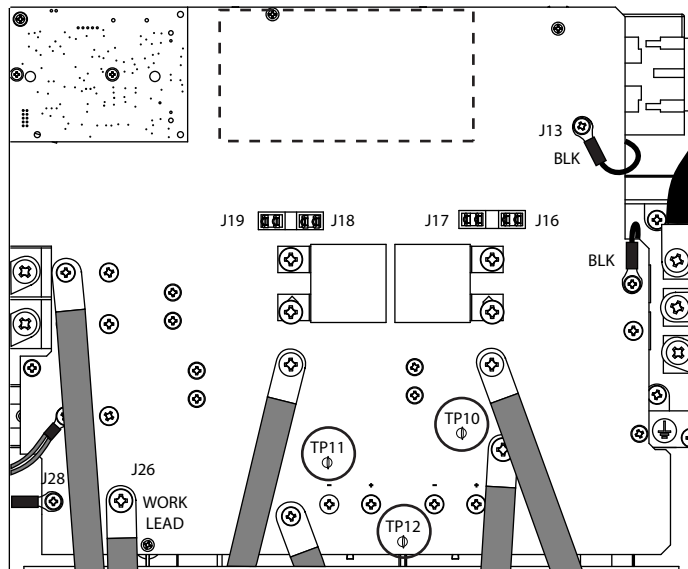
Current power board design	Prior power board design
Each test point lined with copper ring 	No metal ring around test points 
Use miniature banana plugs (Pamona® 2945 plugs or similar) 	Use test hooks 

**Note:** If miniature banana plugs are not available, use small test clips that you can attach to the copper contacts in the test point openings on the power board.

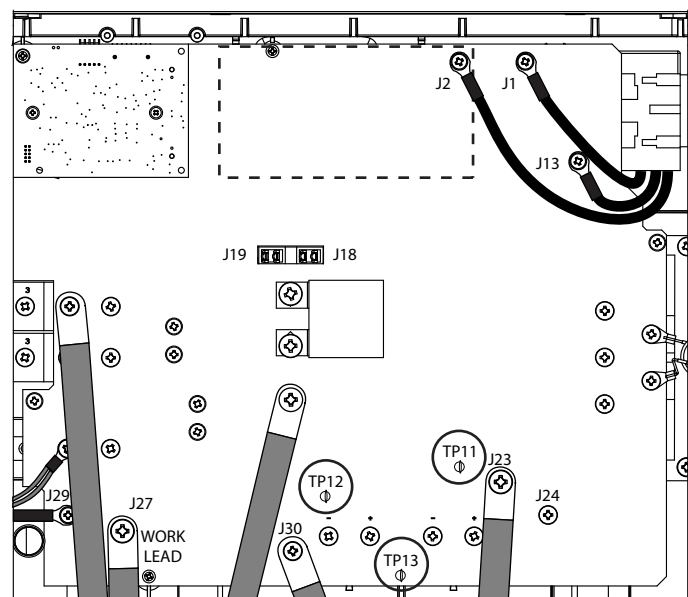


**Caution:** Do not use a multimeter with test leads for this test. This can cause a short-circuit between the bus and the heatsink. Follow the instructions in this test procedure to properly attach to the test point openings in the power board.

CSA	
Test points	Value
TP 10 and 12	25 k $\Omega$
TP 11 and 12	25 k $\Omega$



CE	
Test points	Value
TP 11 and 13	18 k $\Omega$
TP 12 and 13	18 k $\Omega$



## TROUBLESHOOTING AND SYSTEM TESTS

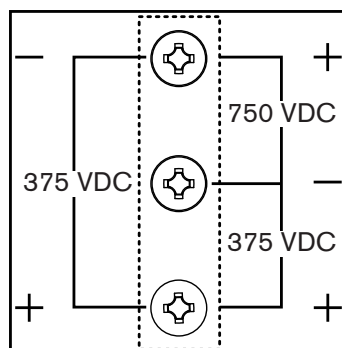
### Voltage check

All voltages must be measured with the input power connected and the machine on.

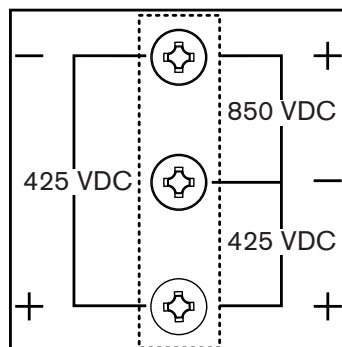
Note: Wear proper personal protective equipment (PPE) before testing powered equipment. All values are  $\pm 15\%$ .

- Check the inverter IGBT voltages as described below.
- The voltage measured across the bulk capacitors (half the bus voltage or the smaller values above) should be the same before and during torch operation.

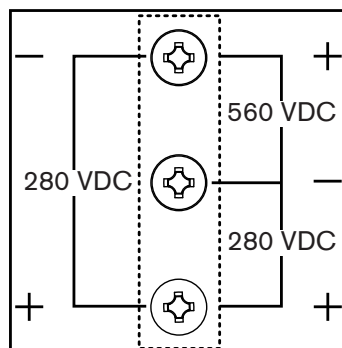
**CSA 200-480 VAC  
input**



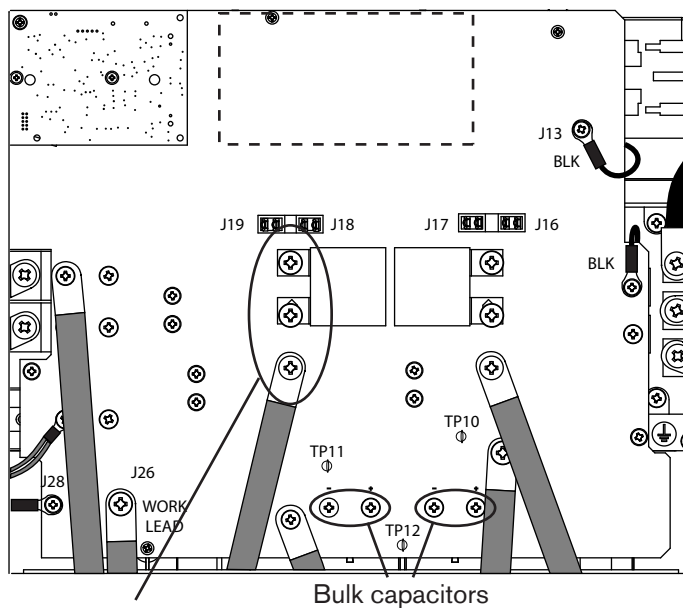
**CSA 600 VAC  
input**



**CE 400 VAC  
input**

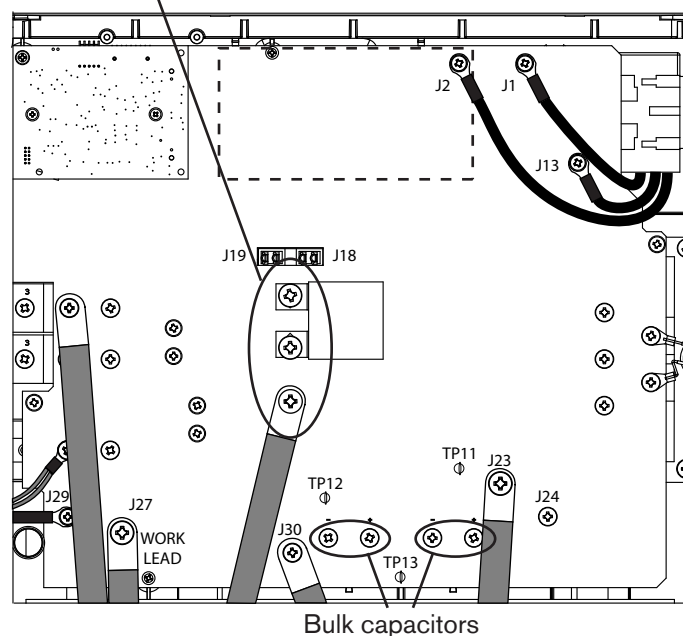


**CSA**

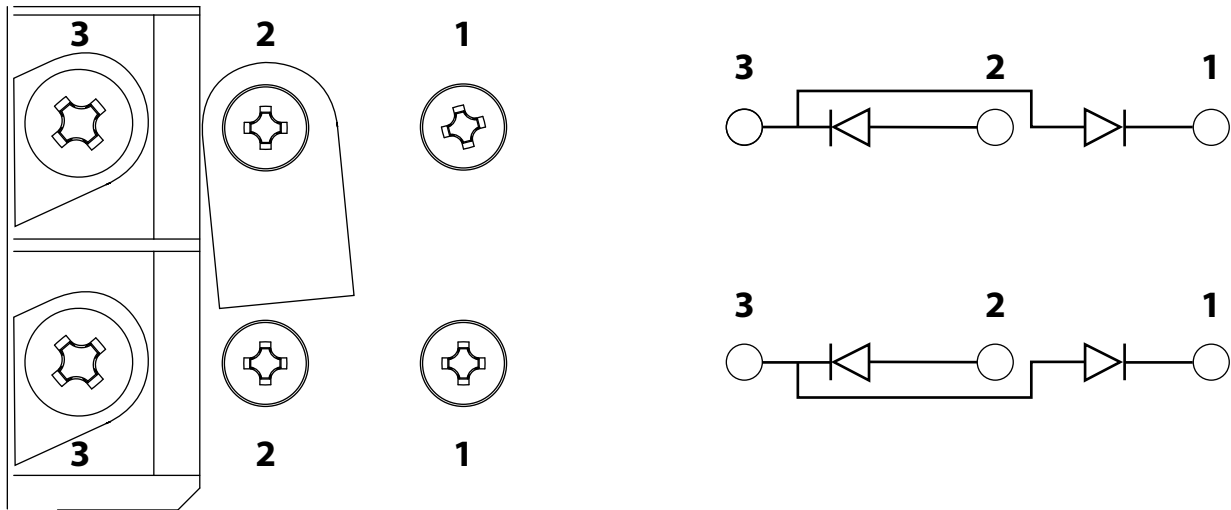


Inverter IGBT  
module

**CE**



Bulk capacitors

**Test 3 – Output diodes**

- Check the four diodes in the bridge with an ohmmeter in diode test mode.
- For each diode, the value should be “open” (very high resistance) with the meter leads in one direction and 0.1 V to 1.0 V with the meter leads reversed.
  - A diode is shorted if the value is less than 0.1 V. Replace the bridge.
  - A diode is open if the value is greater than 1.0 V in both directions. Replace the bridge.

Note: In each case, common (black) should be on 3.

Note: Always replace output diodes as a pair.

### Test 4 – Inverter and PFC temperature sensor

Symptom: Fault code 0-40 appears in the operator screen.

Remove power and allow the system to reach room temperature (at least 60 minutes after use).

If the system has a temperature interlock, either fault code 0-40 or fault code 0-99 appears on the operator screen. Display the service screen and check the “F” field for the live (most recent) fault code. Fault code 0-40 appears on the operator screen, but you need to identify the specific 0-40 fault code variation:

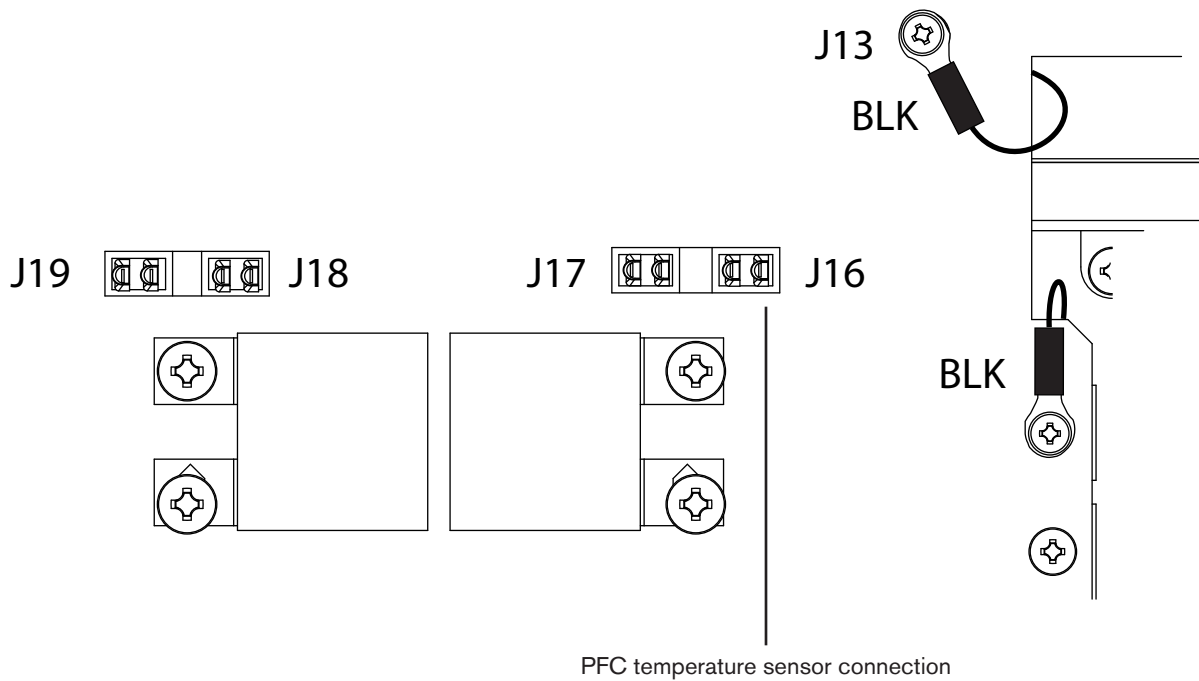
- 0-40-0 PFC module under temperature.
- 0-40-1 PFC module over temperature.
- 0-40-2 Inverter module under temperature.
- 0-40-3 Inverter module over temperature.

If fault code 0-99 appears on the operator screen, display the service screen and check the “F” field for:

- 2-10-0 Inverter module temperature sensor open.
- 2-10-1 Inverter module temperature sensor shorted.
- 3-11-0 PFC module temperature sensor open.
- 3-11-1 PFC module temperature sensor shorted.

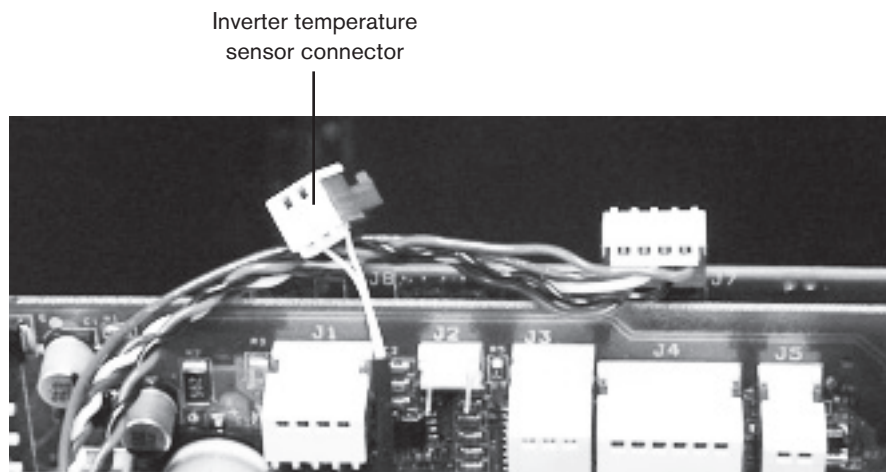
### For operational fault codes 0-40-0 and 0-40-1 or power board faults 3-11-0 and 3-11-1 (CSA only)

1. Remove PFC temperature sensor connector (J16) from power board.
2. Check the resistance between pins 1 and 2 on the plug. Resistance should be about 5.5 k $\Omega$ .
3. If the resistance is incorrect, replace the PFC IGBT, gate drive wires, and PFC temperature sensor wire.
4. If the value is correct, measure resistance between pins 1 and 2 on the power board with the temperature sensor disconnected. The resistance should be about 4.7 k $\Omega$ .
5. If the value is correct, replace DSP board.
6. If the value is incorrect, replace power board.



### For operational fault codes 0-40-2 and 0-40-3 or power board faults 2-10-0 and 2-10-1

1. Remove the inverter temperature sensor connector from the top-rear of the power board (J2 on CSA units or J4 on CE units).
2. Measure the resistance between pins 1 and 3 on the plug.
3. If the resistance is not within  $\pm 15\%$  of 10 k $\Omega$  replace the temperature sensor.
4. If the value is correct, remove the DSP board and measure the resistance between pins 1 and 3 on the power board with the temperature sensor disconnected. The resistance should be approximately 57.6 k $\Omega$ .
5. If the value is correct, replace the DSP board.
6. If the value is incorrect, replace the power board.



### Test 5 – Flyback circuit (DC minor voltages)

Symptom: Minor voltages are not present.

Note: Wear proper personal protective equipment (PPE) before testing powered equipment.

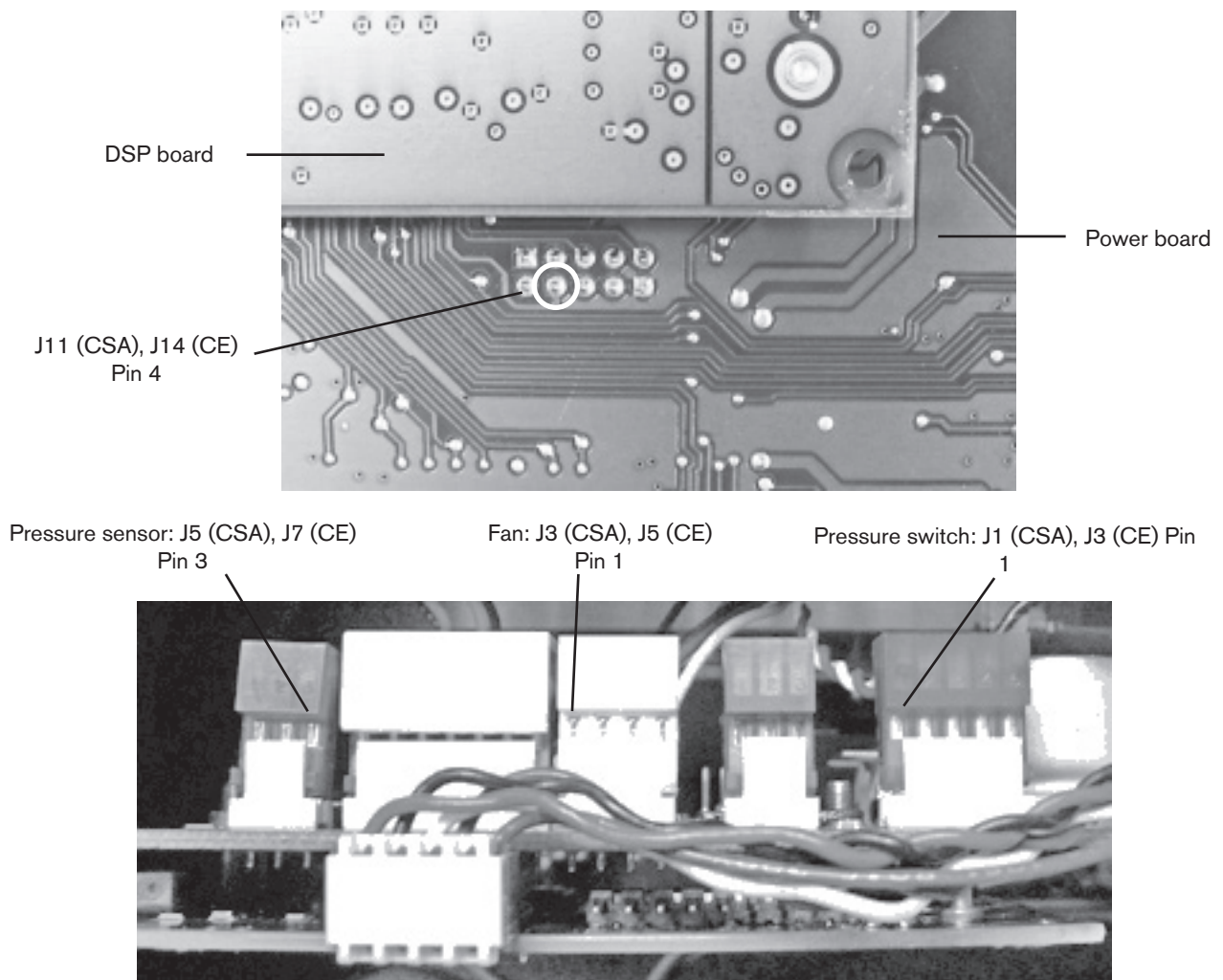
The flyback circuit is the source of the minor DC voltages in the power supply. It provides +3.3 VDC, +5 VDC, +24 VDC, and +48 VDC.

Check the voltages as described in the table. If a value is not within  $\pm 15\%$ , perform the appropriate test later in this section.

Note: A short-circuited fan can prevent you from getting correct voltage measurements in this test. Also, if nothing shows on the LCD screen after the plasma power supply is set to ON (I), this can be an indication of a short circuit in the fan. Remove the fan connector (J3 for CSA units or J5 for CE units) on the power board. Set the plasma power supply to ON (I) again. If the LCD screen comes on, replace the fan.



Volts DC	Component	Test points (use chassis for negative)	
		CSA units	CE units
+48	Fan	J3 – Pin 1	J5 – Pin 1
+24	Pressure switch	J1 – Pin 1	J3 – Pin 1
+5.0	Pressure sensor	J5 – Pin 3	J7 – Pin 3
+3.3	Power board	J11 – Pin 4	J14 – Pin 4



Remove the connector covers to access the pins on the top-rear of the power board.

If the +48 VDC value is incorrect:

- Remove the fan connector (J3 for CSA or J5 for CE) and repeat the test.
- If the value is now correct, replace the fan.
- If the value is still incorrect, do a check of the +24 VDC value.

If the +24 VDC value is incorrect:

- Remove the pressure switch connector (J1 for CSA or J3 for CE) and repeat the test.
- If the value is now correct, replace the pressure switch.
- If the value is still incorrect, connect the pressure switch connector, remove the solenoid valve connector (J4 for CSA and J6 for CE), and repeat the test.
- If the value is now correct, replace the solenoid valve.
- If the value is still incorrect, connect the solenoid valve and do a check of the +5 VDC value.

If the +5 VDC value is incorrect:

- Remove the pressure sensor connector (J5 for CSA or J7 for CE) and repeat the test.
- If the value is now correct, replace the pressure sensor.
- If the value is still incorrect, remove the DSP board and repeat the test.
- If the value is now correct, replace the DSP board.
- If the value is still incorrect, replace the power board.

If the +3.3 VDC value is incorrect:

- Remove the DSP board and repeat the test.
- If the value is now correct, connect the DSP board **with the ribbon cable disconnected**. If the value is now correct, replace the control board. If the value is still incorrect, replace the DSP board.
- If the value is still incorrect, replace the power board.

If all of the voltage measurements are correct but you continue to see the 3-42-0 fault code, replace the power PCB.

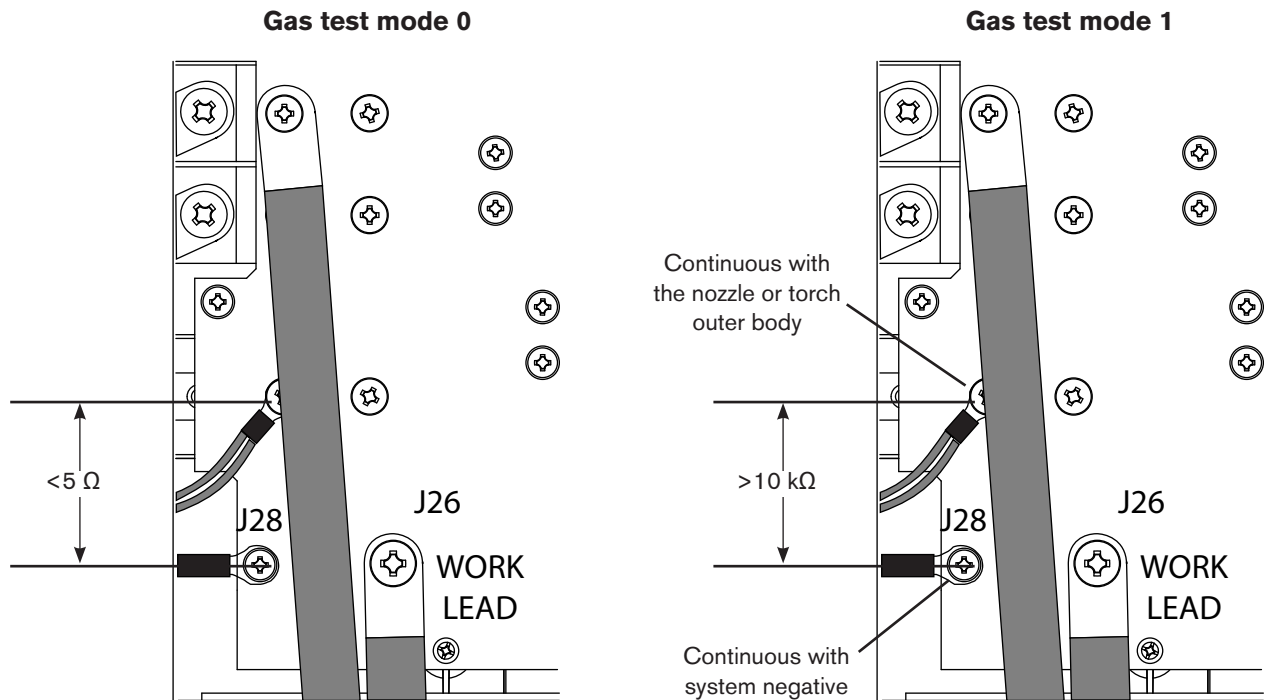
## Test 6 – Torch stuck open (TSO)

Symptom: No fault occurs at power-up but an 0-30 fault displays on the operator screen when attempting to fire the torch.

Confirm that all of the proper consumables are installed in the torch.

In an idle (no start signal) working system with the torch and consumables installed, there should be continuity between the dual black wires connected to the center post of the pilot arc IGBT and the red wire connecting to J28. With gas flowing through the torch (gas test mode 1) there should be very high resistance between those two points.

Note: To set the system to gas test mode, display the service screen (refer to page 5-21 *Displaying the service screen*), move the cursor to “G” (gas), and use the adjustment knob to toggle to “1” (gas test mode).



## TROUBLESHOOTING AND SYSTEM TESTS

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Before continuing, turn OFF the power.

If the resistance value is always less than 100  $\Omega$ , remove the torch and recheck the resistance. If the value is still less than 100  $\Omega$ :

- Use an IGBT tester to check for a shorted pilot arc IGBT.
- Replace the pilot arc IGBT if it is shorted.

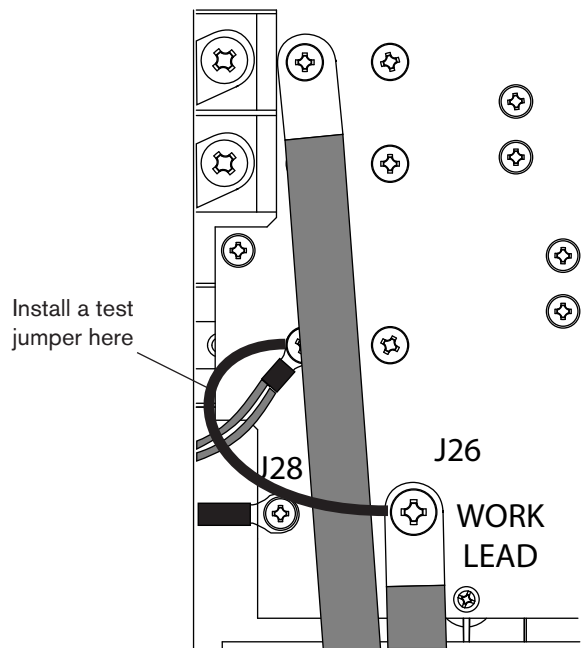
If the resistance is always greater than 100  $\Omega$ :

- Replace all consumables and recheck.
- If the resistance is correct ( $< 100 \Omega$ ) the old consumables are bad.
- If the resistance is still greater than 100  $\Omega$ , measure the resistance in the torch between the pilot arc wires (Pin 1 or 2) and negative arc power (the center connection).
- If the resistance is still too high, replace the torch and lead.

Note: The retaining cap should be snug but not over-tightened.  
All values are  $\pm 15\%$

Check the function of the pilot arc IGBT:

- Turn the machine off and disconnect power.
- Install a jumper wire from the work lead (J26 for CSA, J27 for CE) to the pilot arc IGBT (dual black wires).
- Reconnect power and turn on the machine.
- Attempt to fire the torch.
- If the torch fires, replace the pilot arc IGBT.



## Test 7 – Start signal

Symptom: There is no arc when the torch trigger is closed.

If the start icon is displayed and there is a fault code 0-51 at power up:

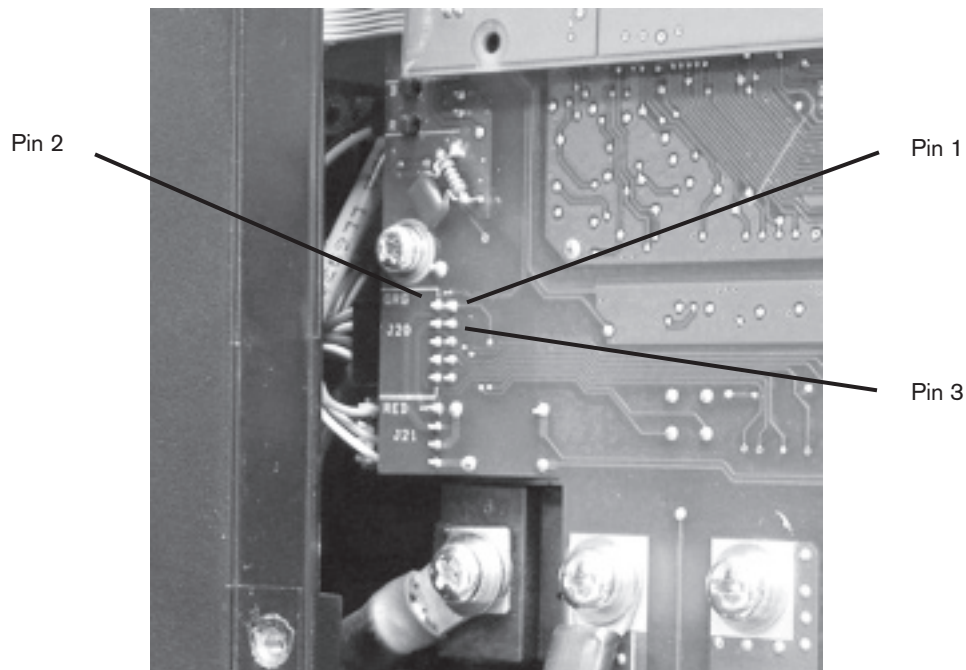
- Remove the torch from the system.
- Check the resistance between Pin 6 and Pin 7 In the lead plug, with the torch trigger open (not pulled).
- If there is very low resistance, inspect the lead set and trigger switch for shorts and replace or repair as necessary.

If the icon is not displayed at power up and does not appear when the torch trigger is closed:

- Remove the torch from the system.
- Close the trigger switch and check the resistance between Pin 6 and Pin 7.
- If there is very high resistance, inspect the lead and trigger switch for opens and replace or repair as necessary.

If there is no problem found with the torch wiring or trigger switch and there is still no arc or start icon:

- Turn the machine off and disconnect power.
- Remove the nozzle and electrode from the torch and re-install the retaining cap.
- Reconnect power and turn the machine on.
- Temporarily connect J20 Pin 2 to Pin 3. (CAUTION: Gas will flow to the torch)



- If gas does not flow and there is no start icon on the display:
  - Verify the DSP board is working by replacing it with a known good DSP board.
  - If the DSP board is not the problem, replace the power board.

### Test 8 – Torch cap switch

Symptom: Fault code 0-50 and the cap-sensor switch icon appear on the operator screen.

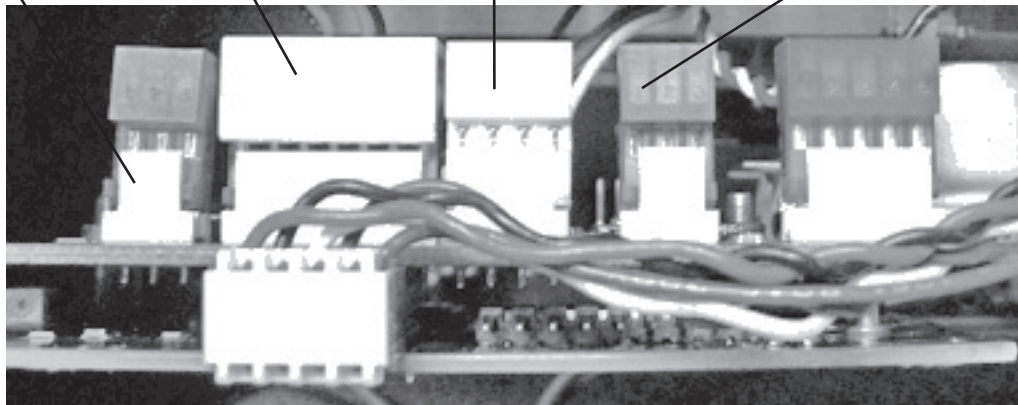
1. Confirm that the retaining cap is in place.
2. Remove the torch from the power supply and check the resistance between Pin 5 and Pin 7 in the torch lead plug.
  - a. If the resistance is very high, check for opens in the torch leads and cap sensor switch.
  - b. If there is no problem with the leads or switch, test the circuit boards.
    - Turn off the machine and disconnect power.
    - Put a jumper wire between J20 pins 1 and 2.
    - Reconnect power and turn on the machine.
    - If the cap-sensor switch icon is not displayed, verify the DSP board by replacing it with a known working board. If the DSP is not the problem replace the power board.

### **Test 9 – Electronic regulator**

Symptom: Air flows continuously through the torch.

1. Turn off the machine and disconnect power.
2. Disconnect the electronic regulator control cable (J4 for CSA, J6 for CE) from the power board.
  - If air continues to flow, replace the electronic regulator.
  - If the air stops flowing, verify the DSP board by replacing it with a known good one. If the DSP board is not the problem, replace the power board.

Pressure sensor J5 (CSA), J7 (CE)      Electronic regulator J4 (CSA), J6 (CE)      Fan J3 (CSA), J5 (CE)      Inverter temperature sensor J2 (CSA), J4 (CE)



### Test 10 – Pressure sensor

Symptom: The pressure sensor reading doesn't agree with known pressures.

Note: Wear proper personal protective equipment (PPE) before testing powered equipment.

1. Remove the white cover on the plug at J5 for CSA units or J7 for CE units.
2. Turn the machine on.
3. Measure power to the sensor between Pin 2 and Pin 3.

If not 5.0 ( $\pm 5\%$ ) perform the Flyback Circuit test above.

4. Display the service screen (refer to page 5-21 *Displaying the service screen*). Enable the gas test by moving the cursor to the "G" field and turning the adjustment knob to display "1" in the field. To turn off the gas test, turn the adjustment knob to display "0" in the field.

Note the flowing gas pressure in the "P" field to the right of the slash.

5. Measure VDC between Pin 2 (-) and Pin 1 (+)

The value should be 0.0463 times the pressure, for example (68 PSI \* .0463 VDC/PSI = 3.148 VDC).

If the voltage measurement is within  $\pm 10\%$  of the correct value and you have a pressure warning or fault:

- a. Test with a known working DSP board.
- b. If the measured voltage is correct, replace the DSP board.
- c. If the measured voltage is not correct, replace the pressure sensor.



## **Test 11 – Fan**

Symptom: The fan does not operate properly. Or, nothing shows on the LCD screen after the plasma power supply is set to ON (I). This can be an indication of a short-circuited fan.

Note: Wear proper PPE protection before testing powered equipment.

1. Remove the inverter temperature sensor plug from J2 in CSA units or J4 in CE units.
2. Place a jumper between Pin 1 and Pin 3 of the connector (J2/J4) on the power board.
3. Remove the white cover from the fan control cable at J3 for CSA units or J5 for CE units.
4. Turn the machine on.
5. With the fan control cable connected to J3 for CSA units and J5 for CE, measure the DC voltage between Pin 1 and Pin 4 in the plug.
  - a. If the voltage is 48 VDC ( $\pm 5\%$ ), replace the fan.
  - b. If the voltage is not correct:
    - Remove the fan control cable and re-measure the DC voltage on the power board connector between Pin 1 and Pin 4 of J3/J5.
    - If the voltage is 48 VDC, replace the fan. Otherwise, do "Test 5 – Flyback circuit (DC minor voltages)" on 5-46.
  - c. If the system passes the flyback circuit test:
    - If the voltage between Pin 1 and Pin 3 (J3 / J5) is 0 VDC, replace the DSP board.
    - If the voltage is greater than 0, replace the power board.

### Test 12 – AUX switch

Symptom: The display goes blank after "Hypertherm" appears. (CSA units only).

1. Turn the machine off and disconnect the power.
2. Disconnect the auxiliary switch cable from J1 on the power board.
3. Measure the resistance on the cable plug between Pin 4 and Pin 5.
4. If the power switch is closed (ON) there should be very low resistance.
5. If the power switch is open (OFF) there should be very high resistance.
6. If the resistance measurement doesn't agree, check the cable, plug, and switch for opens or shorts.

## Section 6

### COMPONENT REPLACEMENT

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## COMPONENT REPLACEMENT

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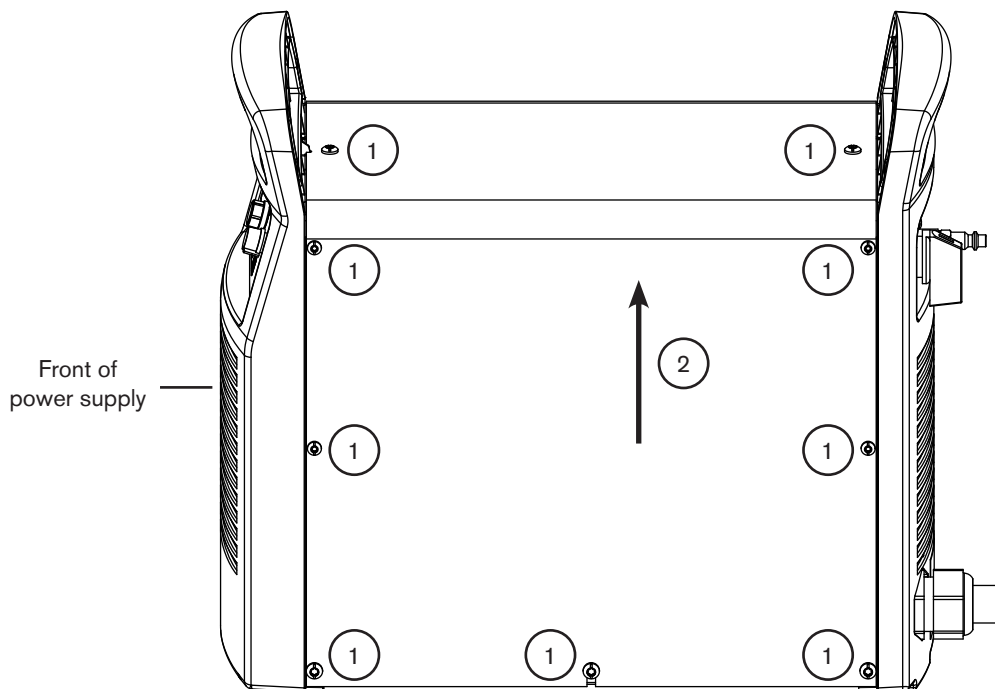
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## **Remove and replace the power supply cover and component barrier**

Replacing interior components requires that you remove and replace the power supply cover and component barrier. This section describes these procedures.

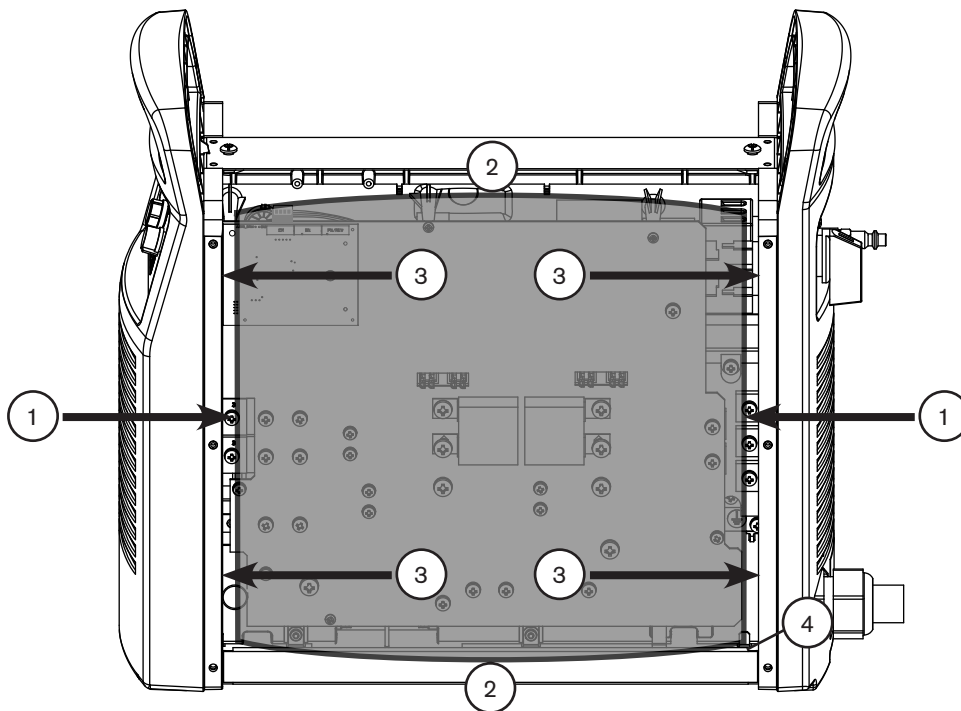
### **Remove the power supply cover and component barrier**

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the 16 screws (1) from the power supply cover.
3. Lift the cover (2) off the power supply.
4. Remove the component barrier from the power-board side of the power supply. The barrier is flexible and can be bent slightly for removal.



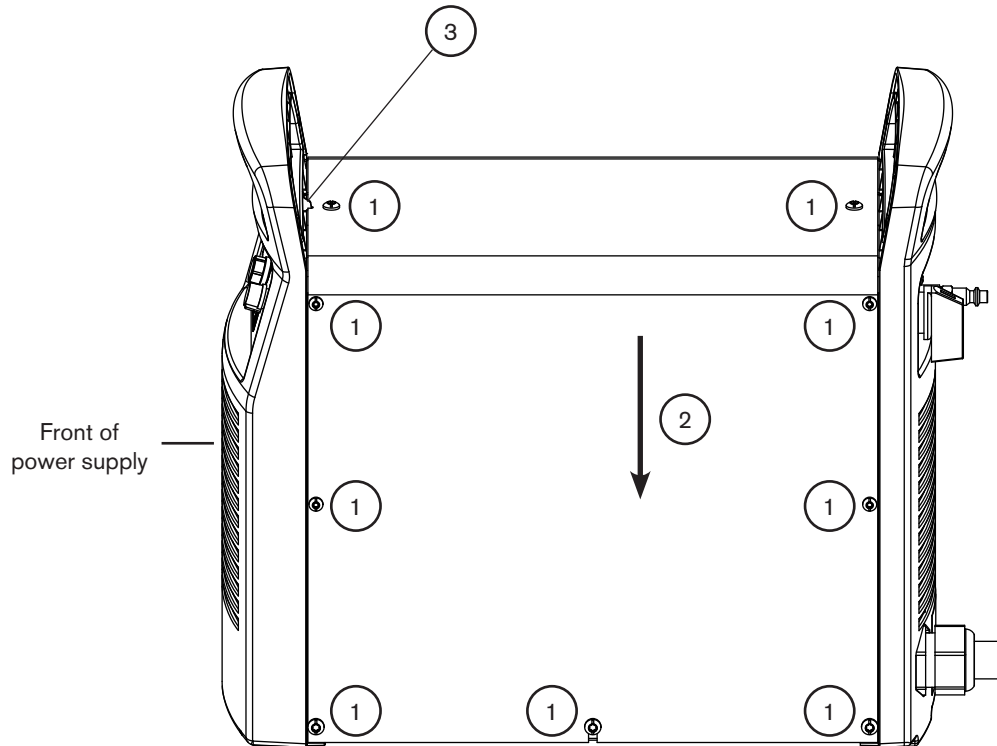
### Replace the component barrier

1. Remove the metal strap at the top of the power supply and pull the front panel out slightly to make it easier to install the component barrier.
2. Carefully push in the sides (1) of the component barrier so that the barrier bends out slightly at the top and bottom (2).
3. Slide the sides of the component barrier behind the power supply frame (3). Be careful not to damage wires or accidentally disconnect wires from the connectors.
4. Gently bend the top of the barrier at the perforation so that the top bends over the top of the power supply.
5. Slide the barrier down so that the bottom edge fits inside the power supply frame (4).
6. Reattach the metal strap at the top of the power supply to secure the front and rear panels. Be careful not to pinch any wires. Align the slot in the strap with the plastic tab in the front panel and push the strap straight down. The four pins in the strap snap into the front and rear panels.



### Replace the power supply cover

1. Place the cover (2) over the power supply with the slot in the cover (3) over the plastic tab in the front panel. The slot and tab ensure that the vent in the side of the cover is over the fan. Be careful not to pinch any wires.
2. Install the 16 screws (1) into the power supply cover. Tighten the screws to 15 in-lbs (17.3 kg cm).



### Replace the power cord

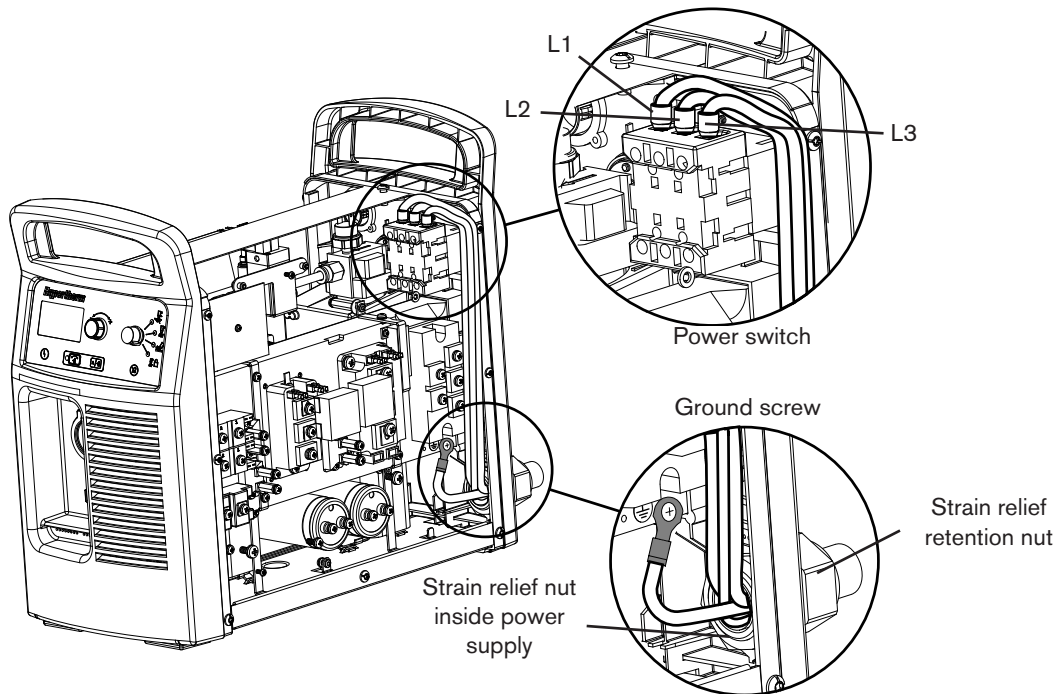
For wire sizes, see *Extension cord specifications* in Section 2, *Power Supply Setup*.

#### Replace the power cord (200 – 600 V 3-phase CSA, 380/400 V 3-phase CCC/CE)

This section describes the procedures for replacing the power cord on 3-phase power supplies.

##### Remove the existing 3-phase power cord

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. Loosen the set screws that secure the three power wires to the top of the power switch.





4. Pull the wires straight up to remove them from the power switch.
5. Remove the ground screw that secures the green ground wire to the heatsink.

Note: For CE models, the ground screw is located at the top of the heat sink.

6. On the outside of the power supply, unscrew the power cord's strain relief retention nut so that the wires move freely. Slide the nut back along the old power cord.
7. Pull the wires through the strain relief in the rear panel to remove the old power cord.

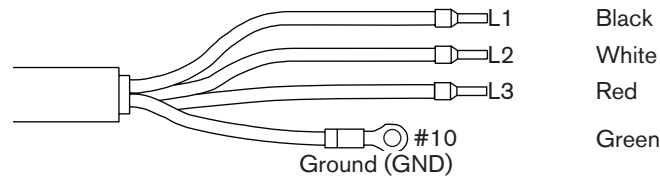
Note: A CE/CCC power cord must be pulled forward through the strain relief.

8. If you are replacing the old strain relief:
  - a. Use an adjustable wrench to unscrew the strain relief nut on the inside of the power supply.
  - b. Remove the old strain relief.

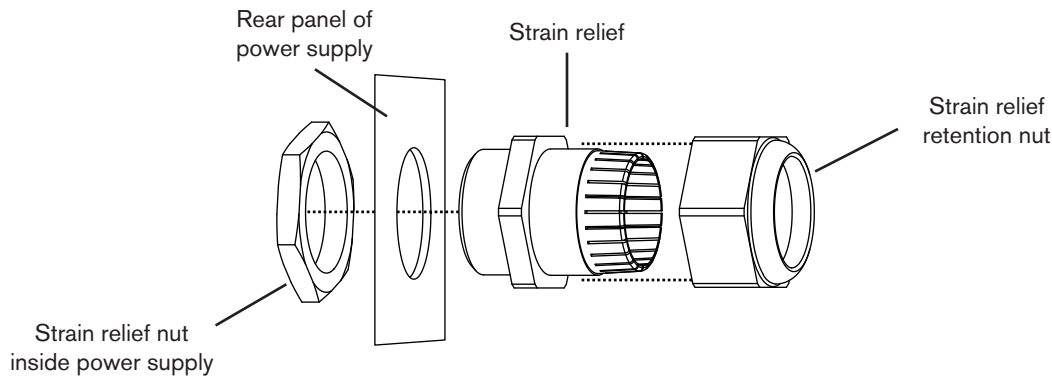
## COMPONENT REPLACEMENT

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### Install the new 3-phase power cord (CSA model)



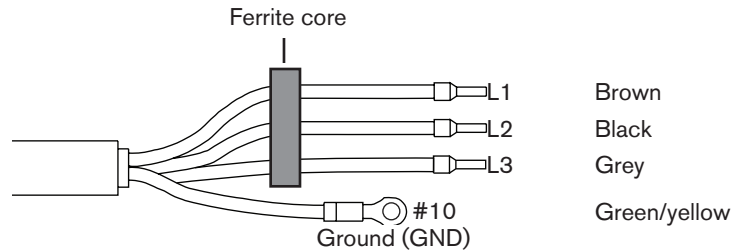
1. Slide the strain relief retention nut over the wires of the new power cord and slide it back along the cord.
2. If you are replacing the old strain relief:
  - a. Slide the new strain relief into the hole in the rear panel of the power supply.
  - b. Secure the strain relief on the inside of the power supply using the new strain relief nut. Hand tighten the nut and then over-tighten slightly more.



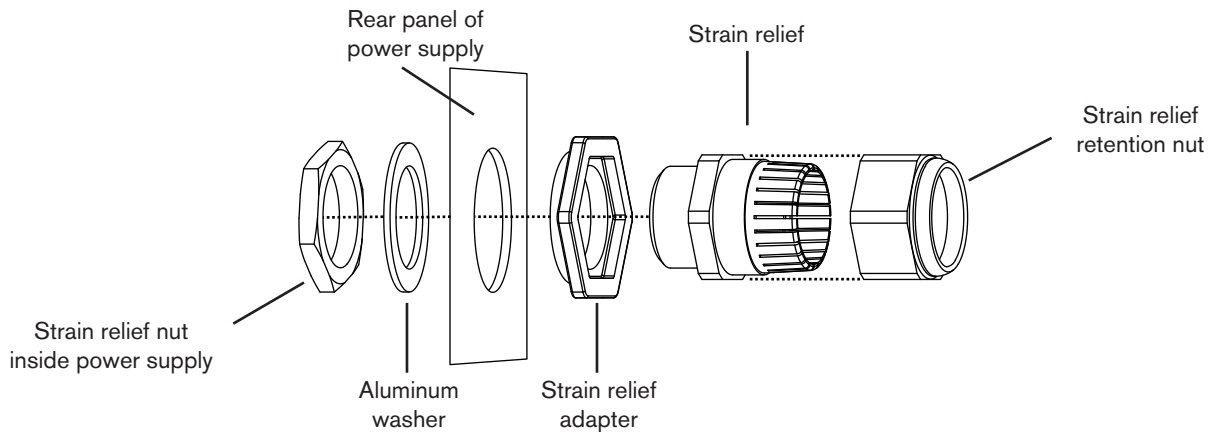
3. Route the new power cord wires through the strain relief in the rear panel.
4. Route the black, white, and red wires to the top of the power switch.
5. Insert the wire connectors into the top of the power switch and tighten the set screws to 10 in-lb (11.5 kg cm). Refer to the figure above for the correct color assignments. "L1", "L2", and "L3" are marked on the power switch above each set screw.
6. Secure the green ground wire to the heatsink using the screw and tighten to 20 in-lb (23.0 kg cm) with the star washer between the ring terminal and the heat sink.
7. Position the wires in the wire chase up the side of the end panel and out of the way of the power board. Once the wires are in place, tighten the strain relief retention nut onto the strain relief to secure the new power cord.

## Install the new 3-phase power cord (CE/CCC model)

In CE systems, the standard strain relief hole in the rear panel of the power supply is too big to accommodate the smaller CE power cord. Therefore, CE/CCC power cord kits contain an adapter that reduces the hole size. The kit also contains an aluminum washer to assist the strain relief nut in properly securing the strain relief inside the power supply. Refer to the figures below.



1. If you are replacing the old strain relief:
  - a. Slide the new strain relief through the strain relief adapter and into the hole in the rear panel of the power supply.
  - b. Place the aluminum washer over the strain relief inside the power supply.
  - c. Secure the strain relief on the inside of the power supply using the new strain relief nut. Hand tighten the nut and then over-tighten slightly more.



## COMPONENT REPLACEMENT

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2. Route the new power cord wires through the strain relief in the rear panel from inside the power supply. (The CE power cord includes a ferrite core. Therefore, you can not route the power cord through the strain relief from the outside of the power supply.)
3. Slide the strain relief retention nut over the wires of the new power cord and slide the nut forward toward the power supply.
4. Route the brown, black, and grey wires to the top of the power switch.
5. Insert the wire connectors into the top of the power switch and tighten the set screws to 10 in-lb (11.5 kg cm). Refer to the figure on the previous page for the correct color assignments. "L1", "L2", and "L3" are marked on the power switch above each set screw.
6. Secure the green/yellow ground wire to the heatsink using the screw and tighten to 20 in-lb (23.0 kg cm) with the star washer between the ring terminal and the heat sink.
7. Position the wires in the wire chase up the side of the end panel and out of the way of the power board. Once the wires are in place, tighten the strain relief retention nut onto the strain relief to secure the new power cord.

### **Install a plug on the power cord (CSA and CE/CCC)**

Use a plug that meets national and local electrical codes. The plug must be connected to the power cord by a licensed electrician.

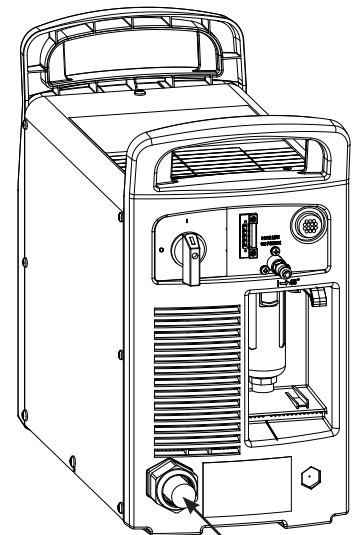
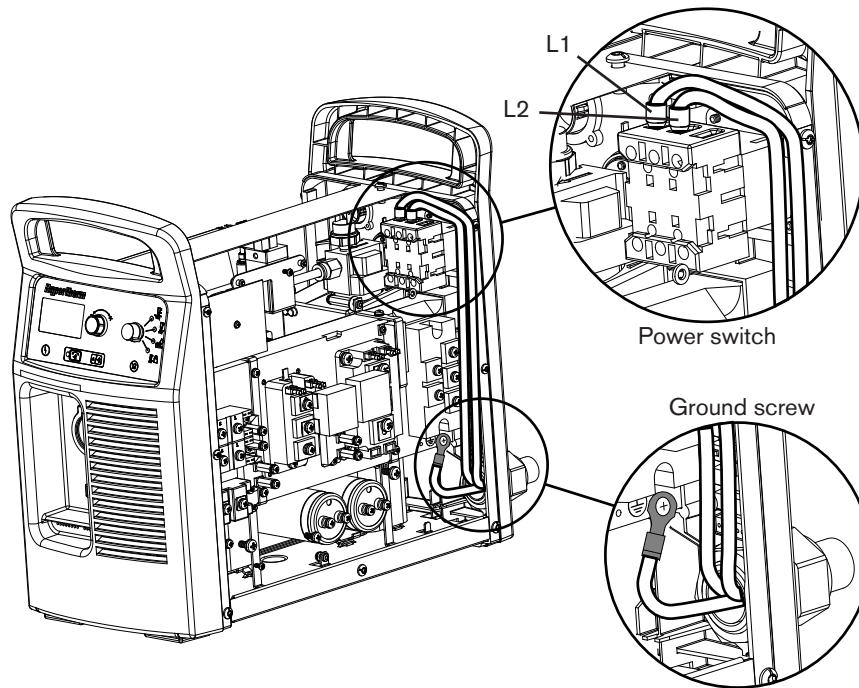
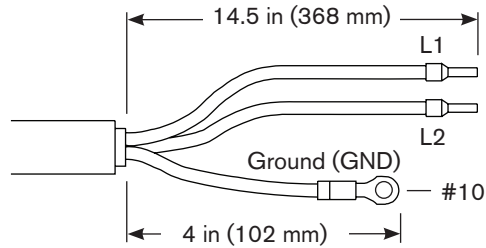
## Replace the power cord (200 – 480 V 1-phase CSA)

To operate your Powermax on 1-phase power, you will need to install an appropriate power cord.



**Caution:** When using the Powermax85 CSA model power supply (CE/CCC model is 3-phase only) with a 1-phase power source, replace the supplied power cord with a 6 AWG (16 mm<sup>2</sup>) 3-wire power cord. The power cord must be connected by a licensed electrician.

Strip and prepare the power cord wires as shown below.



Route lead through strain relief and tighten

## Install a plug on the power cord (CSA)

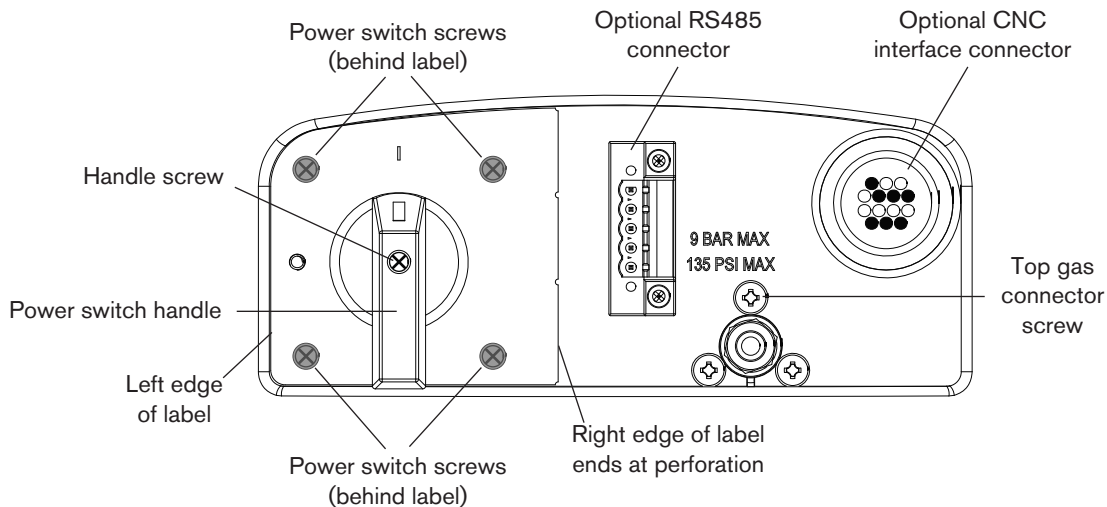
Use a plug that meets national and local electrical codes. The plug must be connected to the power cord by a licensed electrician.

### Replace the power switch

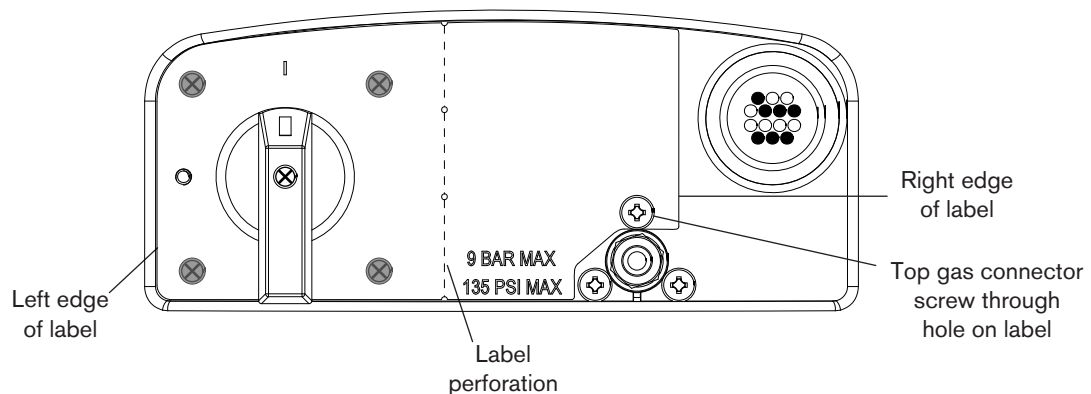
#### Loosen the old power switch

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. Remove the handle screw that secures the power switch handle to the post.
4. Pull the power switch handle straight off the post and set aside.
5. If the optional RS485 connector is *not* installed, the label extends to the right side of the gas connector. (Refer to the bottom figure below.) In this case, remove the top gas connector screw. Use a knife or blade screwdriver to pry up the edge of the label. Peel off the entire label to expose the four mounting screws that secure the power switch.
6. Remove the four power switch mounting screws. The power switch is disengaged from the rear panel and may be removed from inside the power supply.

**Left half of label used when RS485 connector is installed**

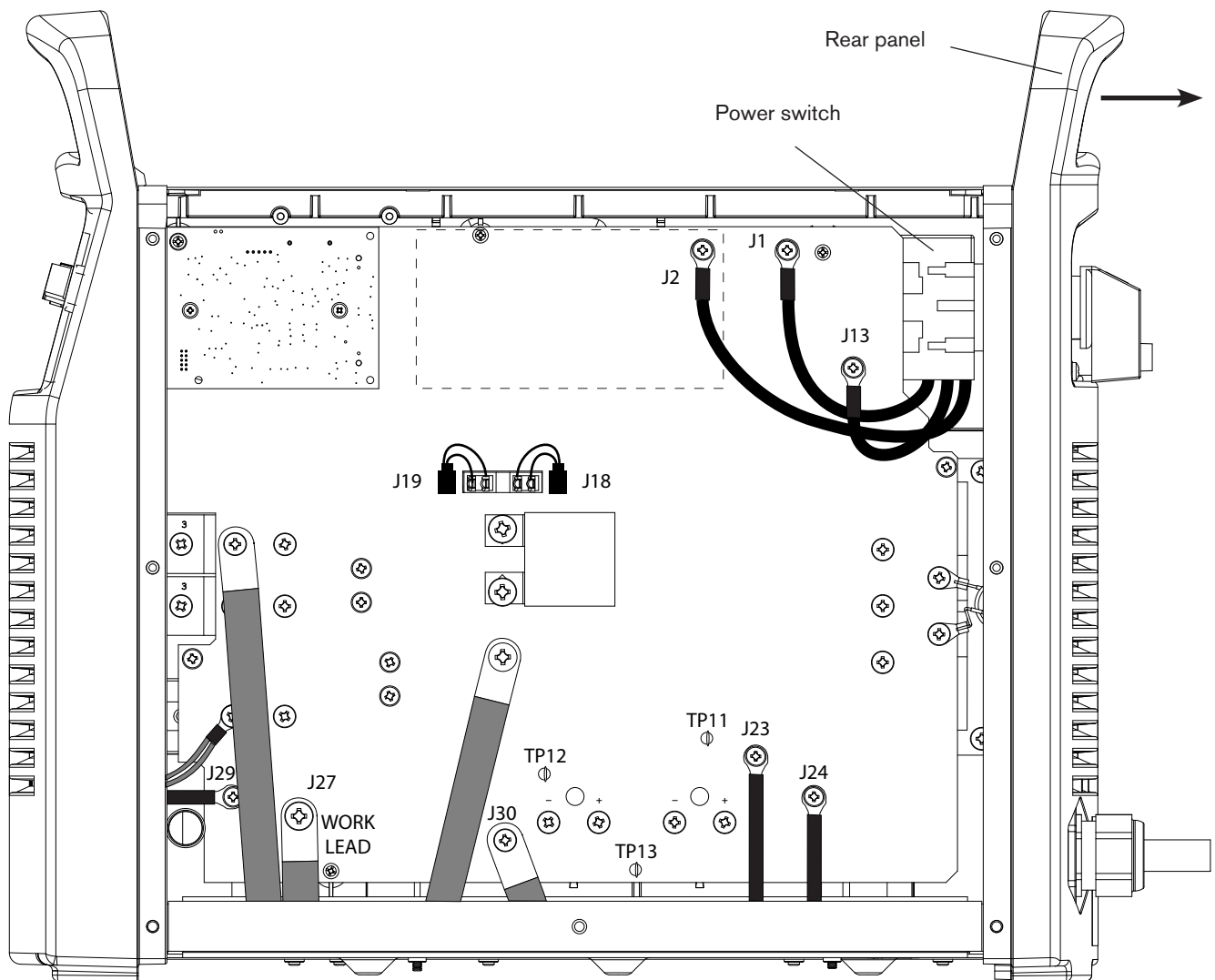


**Full label used when RS485 connector is not installed**



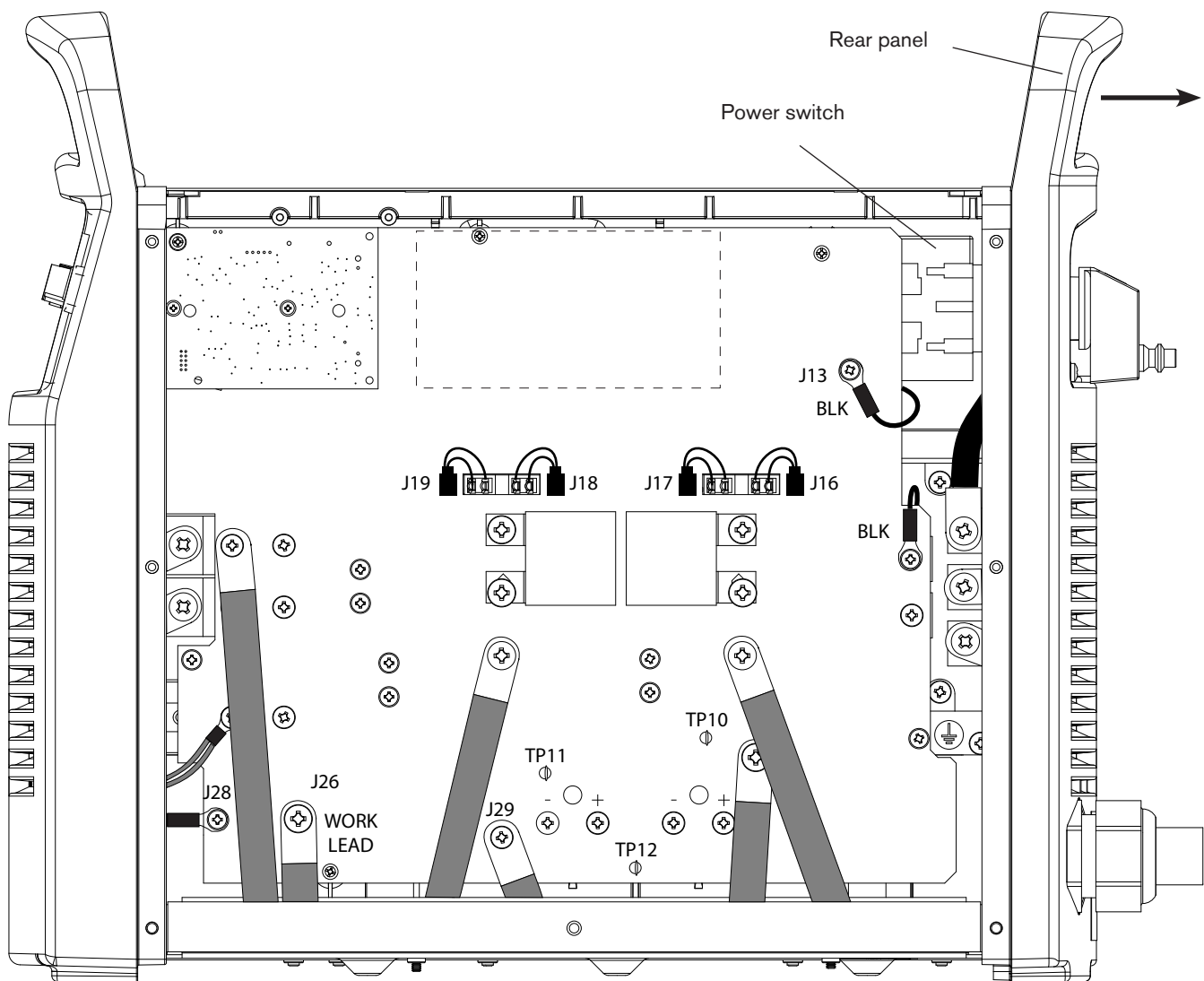
## Remove the old power switch (CE model)

1. On the fan side of the power supply, disconnect the gas supply tube from the air filter. Pull back the orange ring on the push-to-connect tube connector and pull the tube out of the connector. Disconnecting the tube allows the rear panel to move farther away from the power supply.
2. Carefully pull the top of the rear panel away from the power supply.
3. Slide the power switch out of the power supply. You will need to maneuver the power switch around the right edge of the power board. Be sure not to damage any components.
4. Remove the power wires from the top and bottom of the old power switch.
5. Discard the old power switch.



### Remove the old power switch (CSA model)

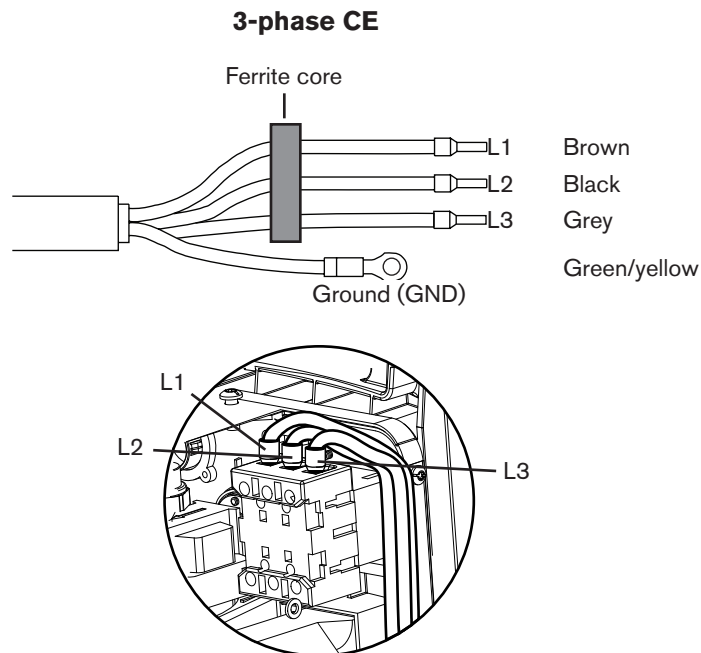
1. On the fan side of the power supply, disconnect the gas supply tube from the air filter. Pull back the orange ring on the push-to-connect tube connector and pull the tube out of the connector. Disconnecting the tube allows the rear panel to move farther away from the power supply.
2. Carefully pull the top of the rear panel away from the power supply.
3. Slide the power switch out of the power supply. You will need to maneuver the power switch around the right edge of the power board. Be sure not to damage any components.
4. Remove the power wires from the top and bottom of the old power switch.
5. Remove the wires from the auxiliary switch on top of the old power switch.
6. Discard the old power switch.





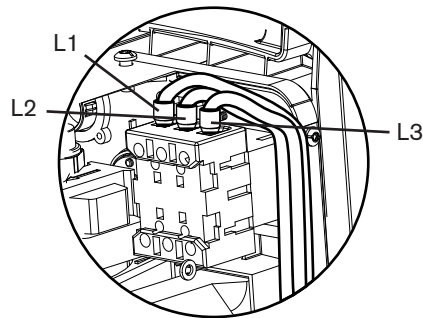
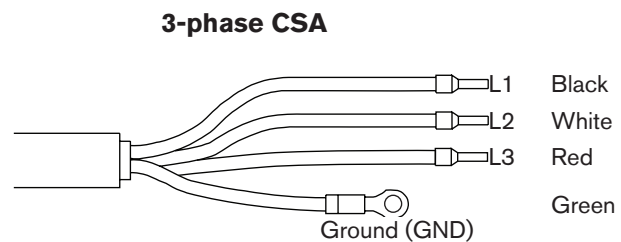
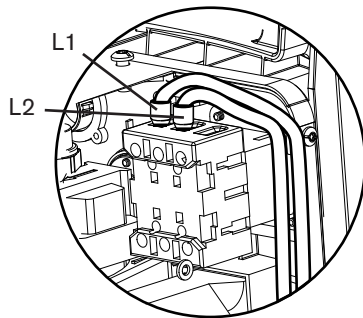
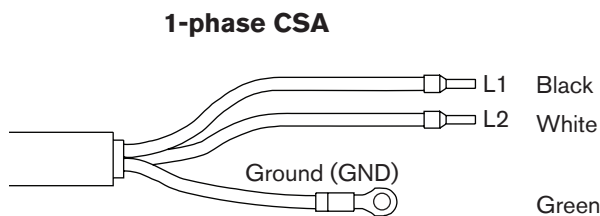
**Install the new power switch (CE model)**

1. Connect the power wires to the top of the new power switch. Connect the wires to the proper terminals in the same order as you removed them. Tighten the screws to 23 kg cm (20 in-lbs). Refer to the figures below.
2. Connect the power wires to the bottom of the new power switch. Connect the wires to the proper terminals in the same order as you removed them. Connect the short wire to T1, the medium wire to T2, and the long wire to T3. Tighten the screws to 23 kg cm (20 in-lbs).
3. Carefully pull the top of the rear panel away from the power supply.
4. Slide the power switch into the power supply. You will need to maneuver the power switch around the right edge of the power board. Be sure not to damage any components.
5. Push the power switch post through the hole in the rear panel.
6. On the fan side of the power supply, reconnect the gas supply tube to the air filter. Push the tube into the push-to-connect tube connector.
7. Carefully push the rear panel against the power supply.
8. Replace the metal end panel bracket located on top of the center panel. Align the slot in the bracket with the plastic tab on the front panel and push the pins into the holes on the end panels.



### Install the new power switch (CSA model)

1. Connect the wires to the auxiliary switch on top of the new power switch. Connect the red wire to the side marked 13 and the black wire to the side marked 14. Tighten the screws to 11.5 kg cm (10 in-lbs).
2. Connect the power wires to the top of the new power switch. Connect the wires to the proper terminals in the same order as you removed them. Tighten the screws to 20 in-lbs (23 kg cm). Refer to the figures below.
3. Connect the power wires to the bottom of the new power switch. Connect the wires to the proper terminals in the same order as you removed them. For 1-PH, connect the short wire to T1 and the long wire to T2. For 3-PH, connect the short wire to T1, the medium wire to T2, and the long wire to T3. Tighten the screws to 23 kg cm (20 in-lbs).
4. Carefully pull the top of the rear panel away from the power supply.
5. Slide the power switch into the power supply. You will need to maneuver the power switch around the right edge of the power board. Be sure not to damage any components.
6. Push the power switch post through the hole in the rear panel.
7. On the fan side of the power supply, reconnect the gas supply tube to the air filter. Push the tube into the push-to-connect tube connector.
8. Carefully push the rear panel against the power supply.
9. Replace the metal end panel bracket located on top of the center panel. Align the slot in the bracket with the plastic tab on the front panel and push the pins into the holes on the end panels.



**Attach the power switch and label (all models)**

1. Secure the new power switch to the rear panel using the four screws. Tighten the screws to 11.5 kg cm (10 in-lbs).
2. If the optional RS485 connector is *not* installed, the new label extends to the right side of the gas connector. In this case:
  - a. Peel the backing off the new label.
  - b. Carefully align the holes in the label with the corresponding holes in the rear panel.
  - c. Press the label into place.
  - d. Install the top gas connector screw through the hole in the label. Tighten the screw to 17.3 kg cm (15 in-lbs).
3. If the optional RS485 connector *is* installed:
  - a. Bend the new label at the perforation and tear the label in half. Discard the right half.
  - b. Peel the backing off the left half of the new label.
  - c. Carefully align the hole in the label with the corresponding hole in the rear panel.
  - d. Press the label into place.
4. Push the power switch handle straight onto the post.
5. Secure the switch handle to the post using the handle screw. Tighten the screw to 11.5 kg cm (10 in-lbs).
6. Replace the component barrier and power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
7. Reconnect the electrical power and the gas supply.

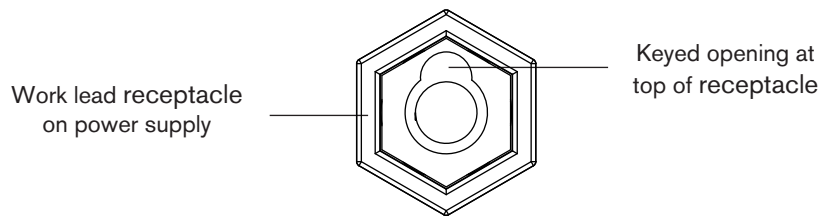
### Replace the work lead



**Caution:** Make sure you use a work lead that is appropriate for your power supply. Use a 65 A work lead with the Powermax65. Use an 85 A work lead with the Powermax85. The amperage is marked near the rubber boot of the work lead connector.

1. Turn OFF the power.
2. Remove the old work lead from the front of the power supply. Turn the work lead connector counterclockwise approximately 1/4 turn.
3. Pull the work lead connector out of the receptacle.
4. Insert the new work lead connector into the receptacle.

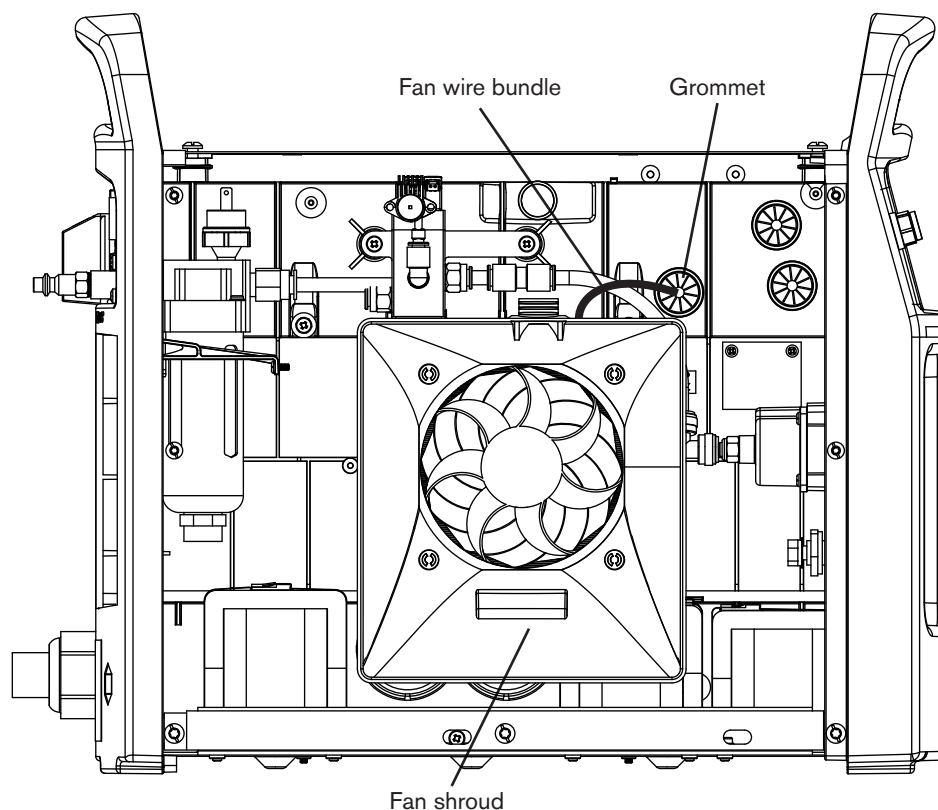
**Note:** The receptacle is keyed. Align the key on the work lead connector with the opening at the top of the receptacle on the power supply.



**Caution:** Ensure the work lead is fully seated in the receptacle to prevent overheating.

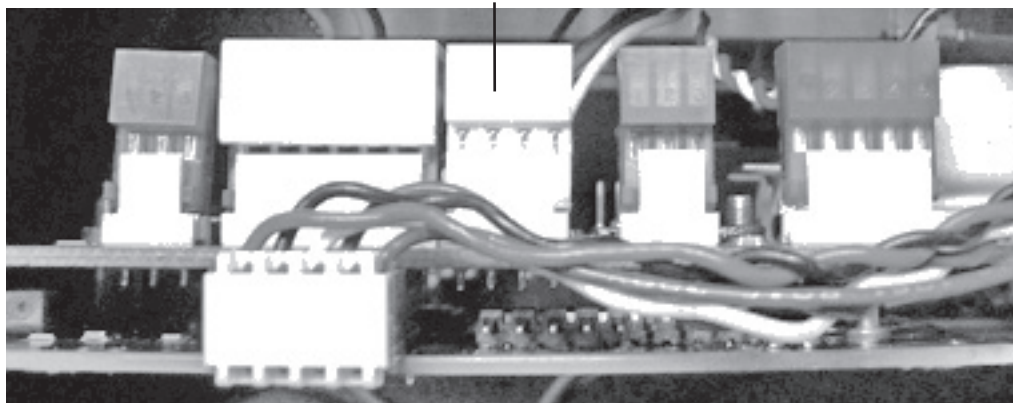
5. Push the work lead connector all the way into the receptacle on the power supply and turn clockwise, approximately 1/4 turn, until the connector is fully seated against the stop in order to achieve an optimal electrical connection.

## Replace the fan



1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover.
3. Remove the fan shroud by pulling it straight off the fan housing.
4. Detach the fan wire connector from J3 (CSA) or J5 (CE) on the top-rear of the power board.

Fan connector  
J3 (CSA), J5 (CE)



## COMPONENT REPLACEMENT

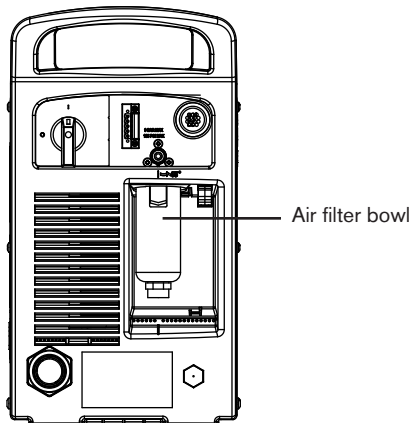
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5. Pull the fan wire through the grommet to the fan side of the power supply.
6. Insert a screwdriver through the holes in the fan casing to remove the retaining screw from each corner of the fan.
7. Slide the old fan out from the power supply.
8. Slide the new fan into place.
9. Replace the 4 retaining screws.
10. Route the fan wire through the grommet.
11. Attach the fan wire connector to J3 (CSA) or J5 (CE) on the top-rear of the power board.
12. Position the fan shroud onto the fan housing with the wider end at the bottom and snap it into place.
13. Replace the power supply cover.
14. Reconnect the electrical power and the gas supply.

## **Replace the air filter element and air filter bowl**

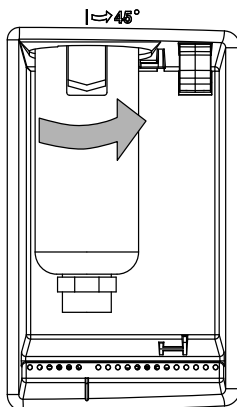
### **Remove the air filter bowl**

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Position the rear of the power supply so the removable air filter bowl is accessible.



Note: Remove the consumables case if it is next to the air filter bowl.

3. Hold the filter bowl with your right hand. Push down the thumb latch and rotate the filter bowl approximately 45 degrees to the right.



4. Pull the filter bowl straight down to remove.

### Identify the air filter assembly model

Because of a manufacturing change, your Powermax65/85 has one of the two air filter assemblies shown below. Both filter bowls use the same air filter element, but the procedures to replace the element are different for each bowl.

**Old air filter assembly  
(with metal guarded filter bowl)**



This air filter assembly is now obsolete and cannot be replaced. Order and install the plastic or nylon air filter assembly. Replacement white air filter elements and O-rings are still available for this air filter. See page 7-3.

- To replace the air filter element, see page 6-24.
- To install the filter bowl, see page 6-25.
- To replace the entire air filter assembly, see page 6-26.

**New air filter assembly  
(with plastic or nylon filter bowl)**

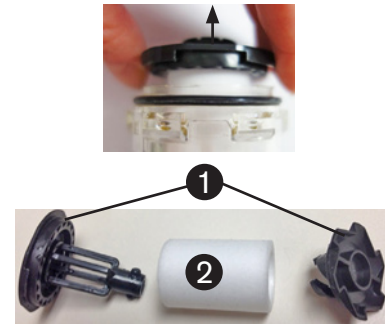


- To replace the air filter element, see page 6-23.
- To install the filter bowl, see page 6-25.
- To replace the entire air filter assembly (old or new model), see page 6-26.



## Install the air filter element for plastic or nylon bowl

1. Twist and pull up on the black air filter element retainer at the top of the filter bowl.
2. Carefully twist the black air filter element retainers ❶ until they come apart, and remove the dirty air filter element ❷.



3. Slide the new air filter element onto the retainer.
4. Twist the black air filter element retainers until they lock together against the new air filter element.

Note: If the black element retainers are damaged, order a new air filter assembly (kit 428351).

5. If you are not replacing the air filter bowl:
  - Clean the bowl of any oil, dirt, or other contaminants.
  - Install the thicker O-ring in kit 228695 onto the existing filter bowl.



Use the thicker O-ring.

O-ring



6. Put the air filter element in the filter bowl, so that the wider black part goes at the top.
7. Twist the black air filter element retainer until it fastens to the top of the filter bowl.



Note: To install the air filter bowl, go to page 6-25.

### Install the air filter element for metal guarded bowl

1. Locate the white air filter element and black retaining nut on the air filter assembly. Unscrew the black retaining nut that holds the filter element.
2. Replace the dirty air filter element with the new air filter element (shown below).



3. Install the black retaining nut to finger-tight only.

Note: If the black retaining nut is damaged, order a new air filter assembly (kit 428351).

4. If you are not replacing the air filter bowl:
  - Clean the bowl of any oil, dirt, or other contaminants.
  - Install the thinner of the two O-rings in kit 228695 onto the existing bowl.

Use the thinner  
O-ring.



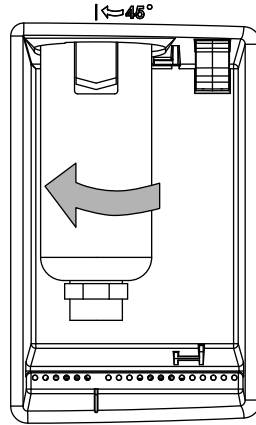
O-ring



Note: To install the air filter bowl, go to page 6-25.

**Install the air filter bowl (metal guarded, plastic, or nylon)**

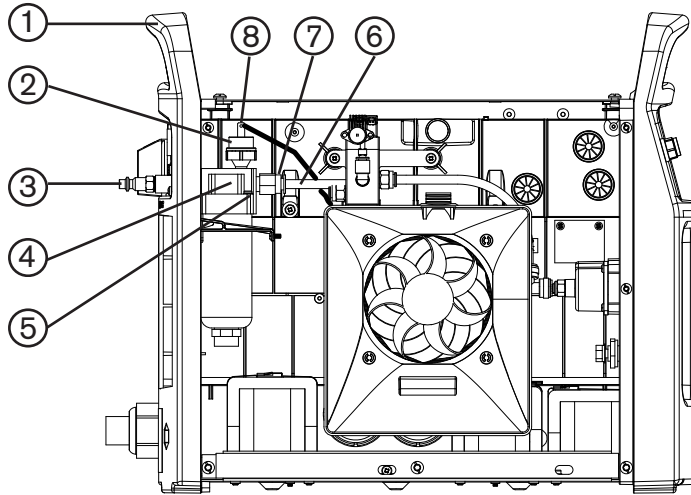
1. Vertically align the filter bowl and firmly push the filter bowl up to the top of the receptacle to seat the bowl.
2. Once the bowl is seated correctly, rotate the bowl 45 degrees to the left until you hear the thumb latch click into place.



3. Reconnect the gas supply hose to the gas fitting on the rear of the power supply and check for leaks.
4. Reconnect the electric power and turn ON the power switch.

### Replace the air filter assembly

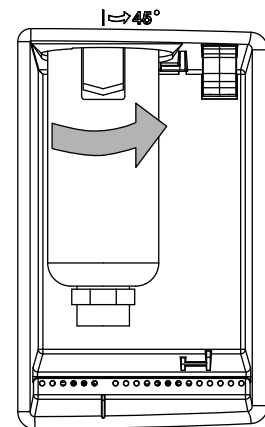
Note: Because of a manufacturing change, new air filter assemblies with plastic bowls replace old assemblies with filter bowls inside of metal guards. For details, refer to page 6-22.



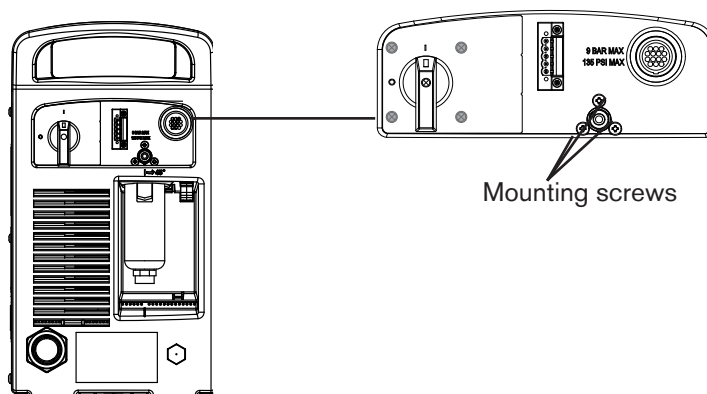
- |   |                    |   |                         |
|---|--------------------|---|-------------------------|
| ① | Rear panel         | ⑤ | Ground wire screw       |
| ② | Pressure switch    | ⑥ | Gas tube                |
| ③ | Gas fitting        | ⑦ | Push-to-connect fitting |
| ④ | Air filter housing | ⑧ | Wire terminals          |

### Remove the air filter assembly

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover.
3. Remove the end panel bracket.
4. Remove the air filter bowl from the air filter assembly.
  - a. Hold the filter bowl with your right hand. Push down the thumb latch and rotate the filter bowl approximately 45 degrees to the right.
  - b. Pull the filter bowl straight down.



5. Disconnect the 2 wire terminals from the top of the pressure switch.
6. Remove the screw that holds the ground wire(s) to the air filter housing. (See the figure at the top of page 6-26.)
7. Push in the plastic ring on the push-to-connect fitting. Carefully pull the top of the rear panel away from the power supply until the gas tube comes out of the push-to-connect fitting.
8. Remove the gas fitting from the rear panel.
9. Remove the 3 mounting screws around the gas fitting on the rear panel.



10. Remove the air filter assembly from the power supply.

### Install the air filter assembly

1. Remove the filter bowl from the new air filter assembly. See page 6-21 *Remove the air filter bowl*.
2. Position the new air filter assembly in the power supply.
3. Tighten the 3 mounting screws on the rear panel to 17.7 kg·cm (15 in·lb).
4. Apply thread sealant to the gas fitting threads and tighten the gas fitting into the bracket on the air filter.

Note: Too much thread sealant can contaminate the gas line.



#### CAUTION!

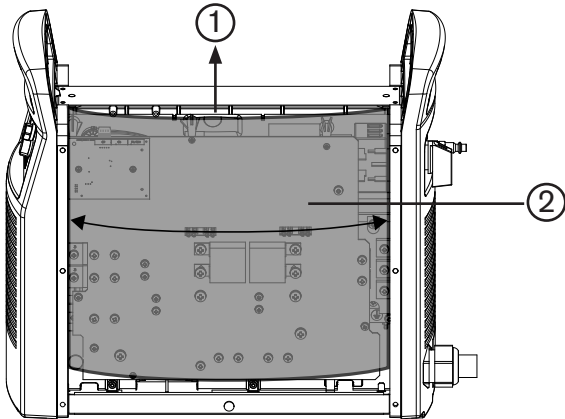
Never use PTFE tape on any joint preparation. Use only a liquid or paste thread sealant on male threads.

5. Align the end of the gas tube with the push-to-connect fitting, and gently push the rear panel toward the power supply until the gas tube is fully seated.
6. Use the ground wire screws to attach the ground wire to the air filter housing. Tighten the screws to 11.5 kg·cm (10 in·lb).
7. Connect the 2 wires to the top of the pressure switch. The wires are interchangeable.
8. Install the filter bowl onto the air filter assembly at the rear of the power supply. See page 6-25 *Install the air filter bowl (metal guarded, plastic, or nylon)*.
9. Install the end panel bracket.
10. Install the power supply cover.
11. Reconnect the power and gas supply.

## Replace the solenoid valve

### Remove the outer components

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover. See page 6-3.
3. Remove the end panel bracket ① located on top of the center panel.



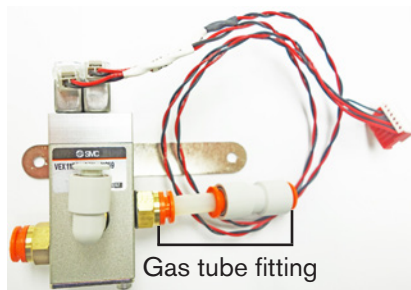
Note: Do not remove the component barrier ②. You may need to fold it back in a later step.

4. Hold the fan shroud with two hands and pull the shroud straight off the fan housing.

### Review solenoid valve models

Because of a manufacturing change, the solenoid valve that you are about to replace may look like either of the two models shown below. The replacement valve in kit 228687 is shown on the right.

#### Old solenoid valve with gas tube fitting



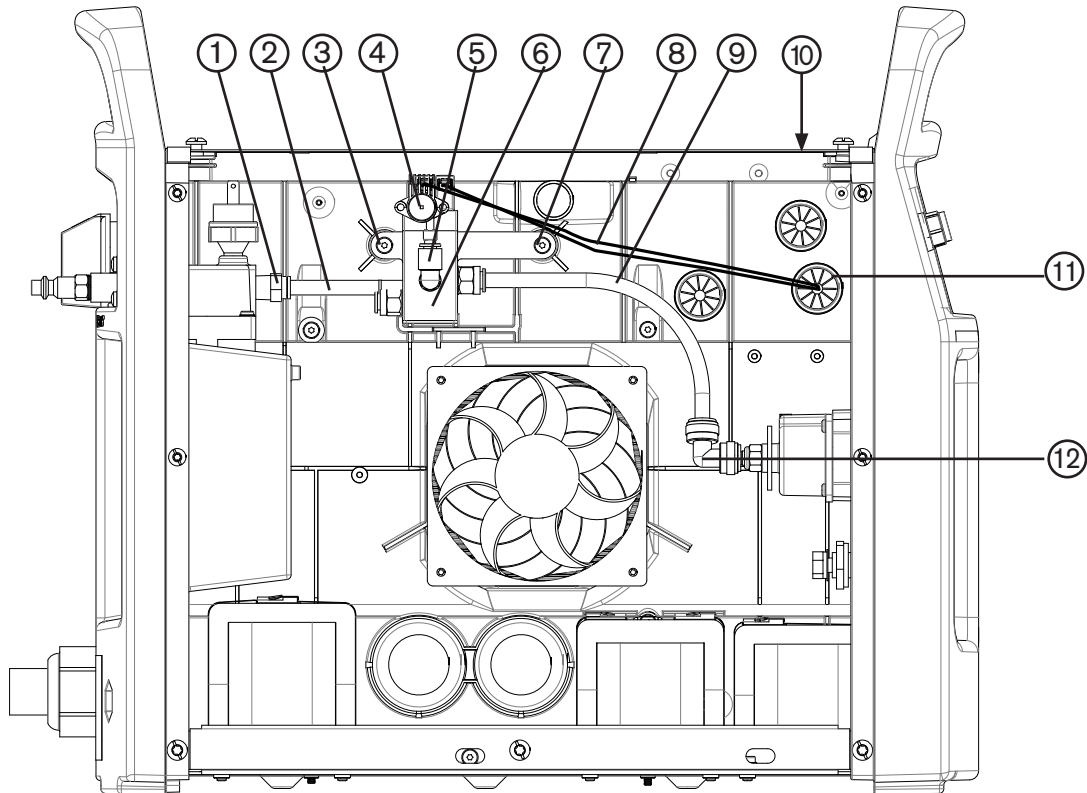
The old solenoid valve that shipped on Powermax65/85 systems before April 2015 included a gas tube fitting.

#### New solenoid valve without gas tube fitting



The new Powermax65/85 solenoid valve ships with longer gas tubing (not shown). The longer gas tubing eliminates the gas tube fitting and short tube that were included on the old model.

### Remove the old solenoid valve



1	Straight push-to-connect fitting	7	Mounting screw (right)
2	Short gas tube	8	Solenoid valve wires
3	Mounting screw (left)	9	Long gas tube
4	Pressure transducer	10	J4 connector (on power board not shown)
5	Pressure transducer fitting	11	Grommet
6	Solenoid valve	12	90° push-to-connect fitting for gas tube

1. Disconnect the J4 connector from the component side of the power board.

Note: If needed, fold back the top of the component barrier to access the J4 connector.

2. Pull the solenoid valve power wires and J4 connector through the grommet from the fan side of the power supply.
3. Push in the plastic ring on the pressure transducer fitting while pulling the pressure transducer out of the solenoid valve.
4. Push in the plastic ring on each end of the long gas tube fitting while you pull the long gas tube out of the solenoid valve and 90° push-to-connect fitting.
5. Remove the 2 mounting screws (left and right) from the solenoid valve.
6. Push in the plastic ring on the straight push-to-connect fitting while pulling the solenoid valve off the short gas tube (see figure above).
7. Remove the solenoid valve.



### **Install the new solenoid valve**

1. Align and push the new solenoid valve (shown on page 6-29) onto the short gas tube until fully seated.
2. Use the 2 supplied mounting screws to install the new solenoid valve onto the center panel. Tighten the screws to 23 kg·cm (20 in·lb).
3. Push the 19.69 cm (7.75 inch) long gas tube into the solenoid valve until fully seated. Push the other end of the long gas tube into the 90° push-to-connect fitting.



**CAUTION!** The kit includes two tubing lengths to accommodate different Powermax systems. For your Powermax65/85, be careful to use the shorter 19.69 cm (7.75 inch) tube.

4. Push the pressure transducer into the solenoid valve until fully seated.
5. Route the solenoid valve power wires and connector through the grommet shown on page 6-30.
6. Connect the solenoid valve power wires to J4 on the power board.
7. Position the top of the component barrier back into place.

### **Reinstall the outer components**

1. Install the shroud onto the fan housing and snap the shroud into place.
2. Reattach the metal end panel bracket on the top of the power supply. The 4 pins in the bracket snap into the front and rear panels. Be careful not to pinch any wires.

Note: Align the slot in the end panel bracket with the plastic tab in the front panel and push the bracket straight down.

3. Replace the power supply cover. See page 6-5.
4. Reconnect the electric power and the gas supply.

### Replace the power board

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove the power supply cover and component barrier*.
3. Remove the metal strap at the top of the power supply and pull the front panel out slightly to make it easier to access the power board.

### Remove the DSP board

1. Disconnect the DSP connector (1) from the top of the DSP board (3).

Note: This step is only required on systems that have an RS485 communication board installed. Systems without an RS485 communication board installed will not have a connector plugged into the top of the DSP board.

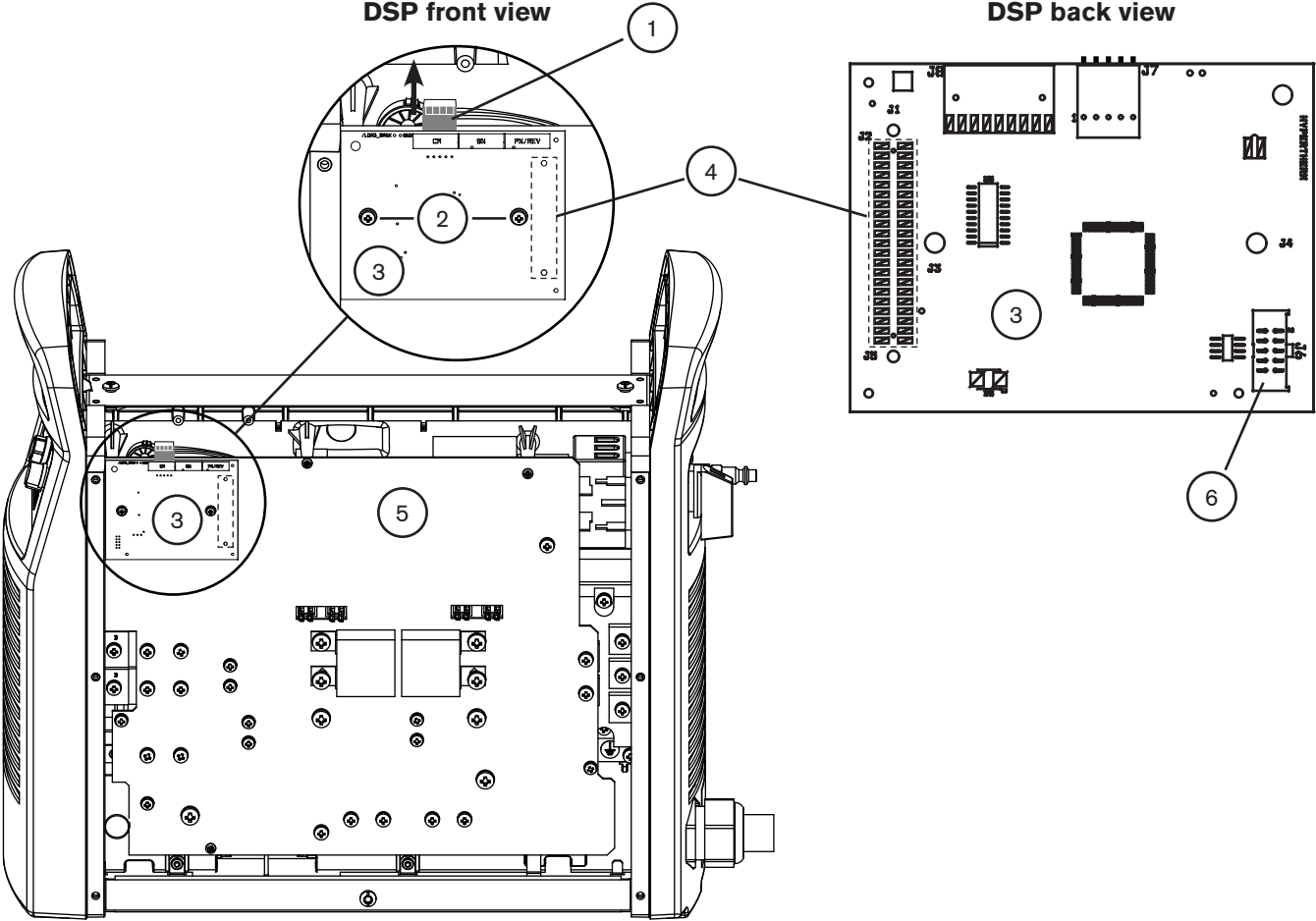
2. Remove the 2 screws (2) from the DSP board.  
Two rows of connector pins (4) are located on the back of the DSP board (3) as shown in the figures below. The dashed rectangle identifies the location of the pins on the back of the board.
3. Carefully pull the DSP board (3) straight out from the power board (5). Do not bend the pins.

Note: Instructions for removing the DSP board are the same for both CE and CSA models. The power board (5) shown below is a CSA model.

4. Disconnect the ribbon cable from the ribbon cable connector (6) on the back of the DSP board. Set the DSP board aside.

For CE systems, proceed to page 6-34 *Replace the power board (380/400V CE)*.

For CSA systems, proceed to page 6-37 *Replace the power board (200 – 600V CSA)*.



### Replace the power board (380/400V CE)

Refer to the figure on the next page when performing the following procedure.

#### Remove the old power board (380/400V CE)

1. Unplug the five wire connectors located at the J3, J4, J5, J6, and J7 headers on the heat sink side of the power board.
2. Disconnect the two gate drive wire connectors (J18, J19) from the power board.
3. Remove the 3uF capacitor and the two transformer wires below it by removing the three inverter IGBT screws and the screw at J30.
4. Disconnect the work lead wire by removing the screw at J27.
5. Disconnect the AC input wires and PFC inductor wires by removing the screws at J1, J2, J13, J23, and J24.
6. Remove the four snubber resistor screws and four capacitor screws.
7. Disconnect the MOV subassembly from the board by removing the two input bridge screws on the right.
8. Remove the remaining three input bridge screws.
9. Disconnect the output inductor wire by removing the upper left diode screw.
10. Remove the three remaining diode screws.
11. Disconnect the nozzle wire (black) by removing the pilot arc IGBT screw on the left.
12. Remove the remaining pilot arc IGBT screw.
13. Disconnect the electrode wire (red) by removing the screw at J29.
14. Remove the three heat sink mounting screws.

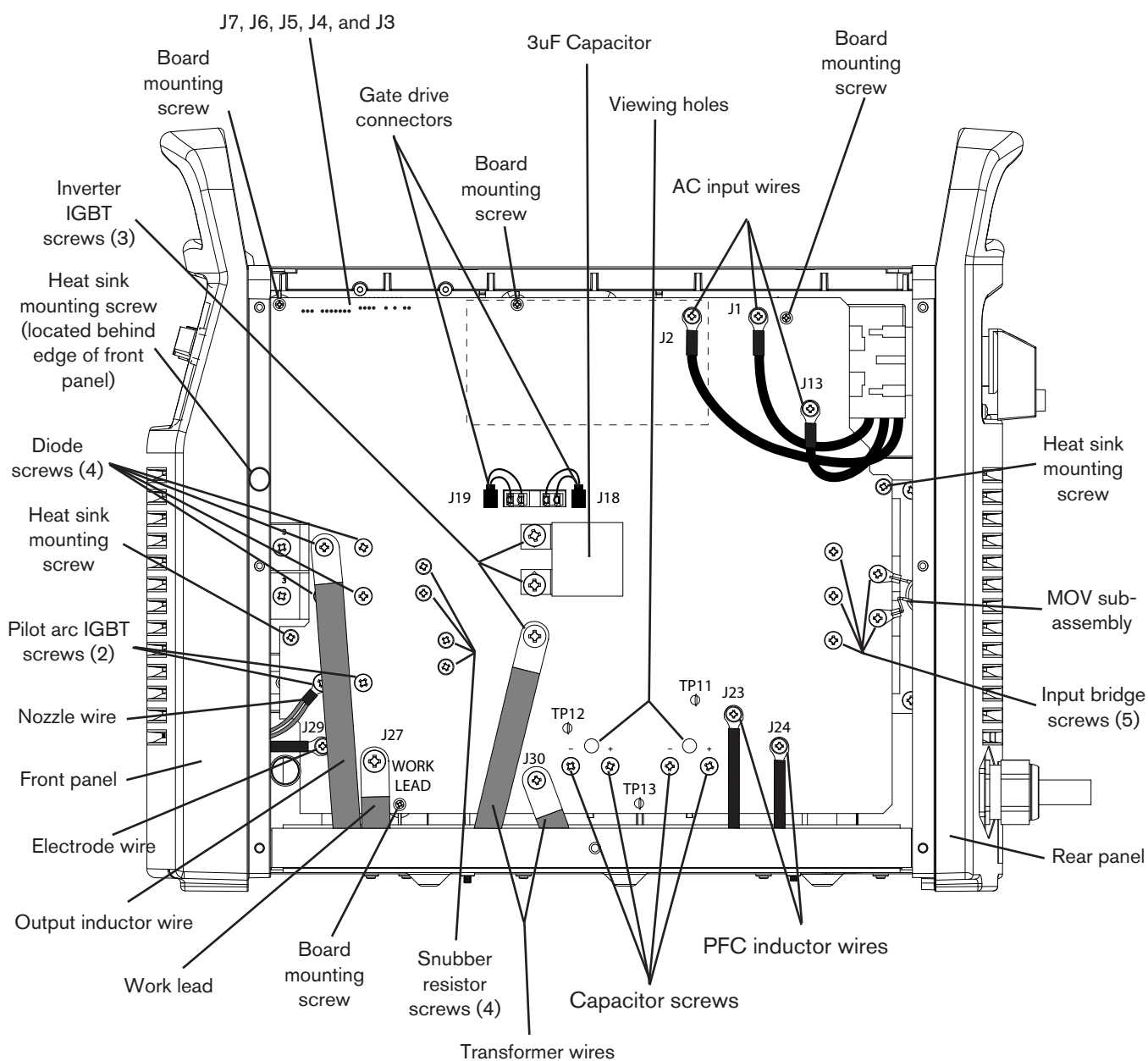
Note: It may be necessary to pull the top of the front panel slightly forward to remove the upper left heat sink mounting screw from the board.

15. Remove the four board mounting screws.
16. Pull the right-hand edge of the power board forward, while pushing the gate drive wires through the opening in the board, until the components on the back side of the board clear the rear panel.

Note: Silkscreen printing above the opening in the board denotes the color and order of the gate drive wires. The printing is "BLK" (black), "RED" (red), "BLK" (black), "RED" (red) from left to right.

17. Slide the board to the right until the wire connectors on the left edge of the board are accessible, approximately 5.1 cm (2 inches).
18. Unplug the wire connectors from the J15 and J20 power board connectors.
19. If a CNC interface is installed on the power supply, unplug the wire connectors from the J21 and J33 power board connectors.
20. Remove the power board from the power supply and set aside.

380/400V CE Power Board



### Install the new power board (380/400V CE)

1. Position the left edge of the power board on a slight angle toward the front end panel, so the previously removed wire connectors will reach their intended locations.
2. If a CNC interface is installed on the power supply, plug the respective wire connectors into the J21 and J33 power board connectors.
3. Plug the respective wire connectors into the J3, J4, J5, J6, J7, J15, and J20 power board connectors.
4. Slide the power board into the mounting position while routing the gate drive wires through the opening in the board.

Note: Make certain all power board connection wires (11 wires with metal ring terminals) are positioned in front of the power board.

5. Install the four board mounting screws and tighten to 10 in-lbs (11.5 kg cm).
6. Install the three heat sink mounting screws and tighten to 15 in-lbs (17.3 kg cm).

Note: It may be necessary to pull the top of the front panel slightly forward to install the upper left heat sink mounting screw.

7. Connect the electrode wire (black) to J29 using a screwdriver to tighten the screw to 20 in-lbs (23.0 kg cm).
8. Install the two pilot arc IGBT screws, securing the nozzle wire (red) to the board with the left screw. Tighten both screws to 20 in-lbs (23.0 kg cm).

Note: All screw mounting holes which secure a wire to the power board, except for J29, have a yellow silkscreen outline on the board depicting the placement of the ring terminal.

9. Install the four diode screws, securing the output inductor wire to the board with the upper left screw. Tighten all four screws to 20 in-lbs (23.0 kg cm).
10. Install the five input bridge screws, securing the MOV sub assembly with the two screws on the right. Tighten all five screws to 20 in-lbs (23.0 kg cm).
11. Install the four snubber resistor screws using a screwdriver to tighten to 15 in-lbs (17.3 kg cm).
12. Verify that the gray dot on each capacitor is visible through the two viewing holes. Start the four capacitor screws by hand, then use a screwdriver to tighten to 20 in-lbs (23.0 kg cm).
13. Connect the AC input wires and PFC inductor wires at J1, J2, J13, J23, and J24 using a screwdriver. Tighten all five screws to 20 in-lbs (23.0 kg cm).
14. Connect the work lead at J27 and the shorter transformer wire at J30, and tighten the screws to 30 in-lbs (34.6 kg cm).
15. Secure the 3uF capacitor and the remaining transformer wire to the board using the three inverter IGBT screws. Tighten the screws to 30 in-lbs (34.6 kg cm).
16. Plug the gate drive wires into their respective power board connectors (J18, J19). Gently pull on each wire to ensure that they are fully seated.

Proceed to page 6-40 *Install the DSP board.*

## **Replace the power board (200 – 600V CSA)**

Refer to the figure on the next page when performing the following procedure.

### **Remove the old power board (200 – 600V CSA)**

1. Unplug the five wire connectors located at the J1, J2, J3, J4, and J5 headers on the heatsink side of the power board.
2. Disconnect the three gate drive wire connectors (J17, J18, and J19) from the power board.
3. Disconnect the PFC temperature sensor connector (J16) from the power board.
4. Remove the 3uF capacitor on the left and the longer transformer wire by removing the three inverter IGBT screws.
5. Disconnect the remaining transformer wire by removing the screw at J29.
6. Disconnect the work lead wire by removing the screw at J26.
7. Remove the 3uF capacitor on the right and the two PFC inductor wires below it by removing the three PFC IGBT screws and the screw securing the shorter PFC inductor wire.
8. Disconnect the snubber resistor wires by removing the screw at J13 and the two input bridge screws.
9. Remove the six snubber resistor screws and four capacitor screws.
10. Disconnect the output inductor wire by removing the upper left diode screw.
11. Remove the three remaining diode screws.
12. Disconnect the nozzle wire (black) by removing the pilot arc IGBT screw on the left.
13. Remove the remaining pilot arc IGBT screw.
14. Disconnect the electrode wire (red) by removing the screw at J28.
15. Remove the three heat sink mounting screws.

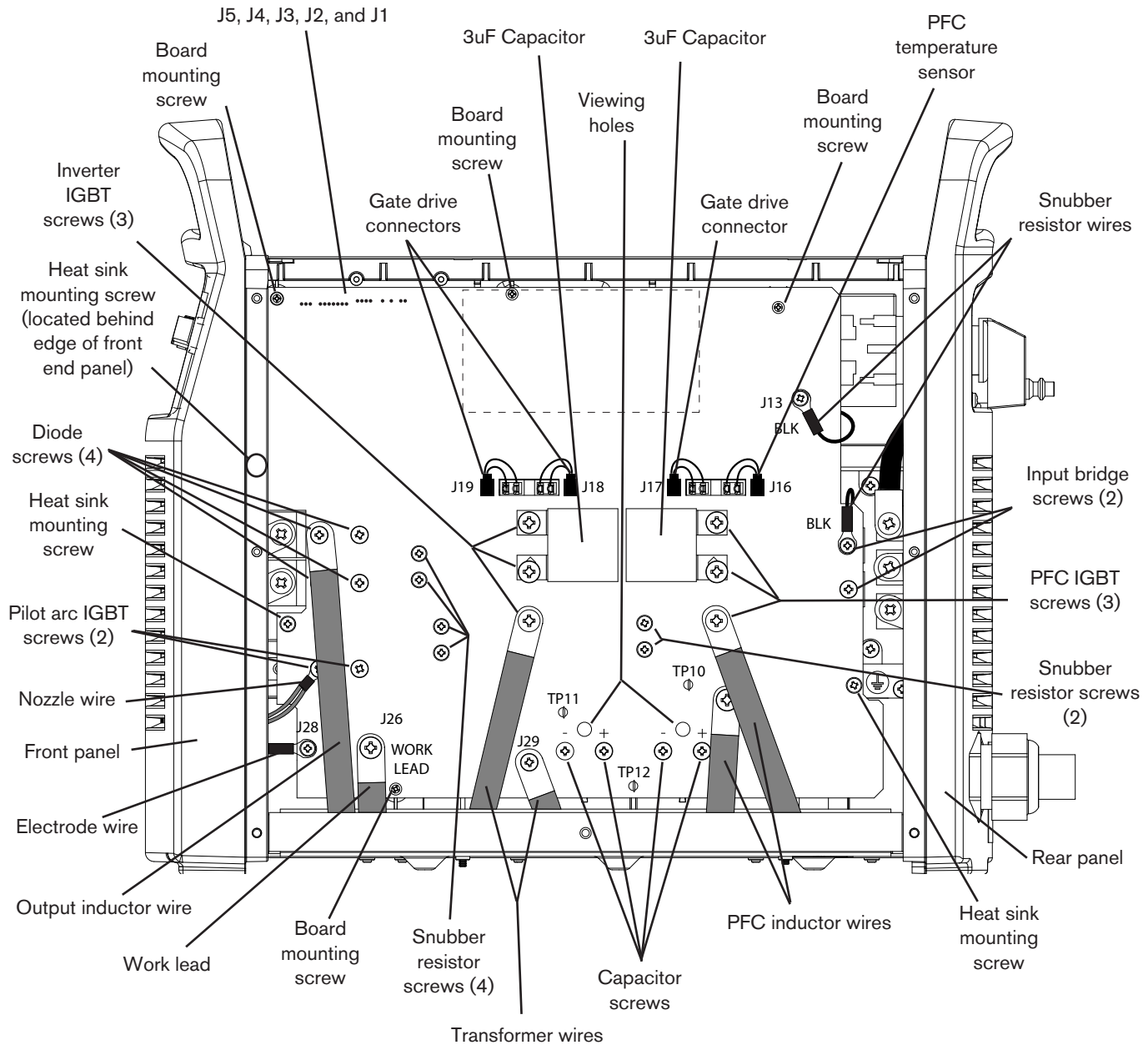
Note: It may be necessary to pull the top of the front panel slightly forward to remove the upper left heat sink mounting screw from the power board.

16. Remove the four board mounting screws.
17. Pull the right-hand edge of the power board forward, while pushing the gate drive wires through the two openings in the board, until the components on the back side of the board clear the rear panel.

Note: Silkscreen printing above the opening in the board denotes the color and order of the gate drive wires. The printing is "BLK" (black), "RED" (red), "BLK" (black), "RED" (red) from left to right.

18. Slide the board to the right until the wire connectors on the left edge of the board are accessible, approximately 2 inches (5.1 cm).
19. Unplug the wire connectors from the J12 and J20 power board connectors.
20. If a CNC interface is installed on the power supply, unplug the wire connectors from the J21 and J32 power board connectors.
21. Remove the power board from the power supply and set aside.

## 200 – 600V CSA Power Board





**Install the new power board (200-600V CSA)**

1. Position the left edge of the power board on a slight angle toward the front end panel, so the previously removed wire connectors will reach their intended locations.
2. If a CNC interface is installed on the power supply, plug the respective wire connectors into the J21 and J32 power board connectors.
3. Plug the respective wire connectors into the J1, J2, J3, J4, J5, J12, and J20 power board connectors.
4. Slide the power board into the mounting position while routing the gate drive wires through the two openings in the board.

Note: Make certain all power board connection wires (10 wires with metal ring terminals) are positioned in front of the power board.

5. Install the four board mounting screws by tightening to 10 in-lbs (11.5 kg cm).
6. Install the three heat sink mounting screws by tightening to 15 in-lbs (17.3 kg cm).

Note: It may be necessary to pull the top of the front panel slightly forward to install the upper left heat sink mounting screw.

7. Connect the electrode wire (red) to J28 by tightening the screw to 20 in-lbs (23.0 kg cm).
8. Install the two pilot arc IGBT screws, securing the nozzle wire (black) to the board with the left screw. Tighten both screws to 20 in-lbs (23.0 kg cm).

Note: All screw mounting holes which secure a wire to the power board, except for J28, have a yellow silkscreen outline on the board depicting the placement of the ring terminal.

9. Install the four diode screws, securing the output inductor wire to the board with the upper left screw. Tighten all four screws to 20 in-lbs (23.0 kg cm).
10. Install the six snubber resistor screws using a screwdriver to tighten to 15 in-lbs (17.3 kg cm).
11. Verify that the gray dot on each capacitor is visible through the two viewing holes. Start the four capacitor screws by hand, then use a screwdriver to tighten to 20 in-lbs (23.0 kg cm).
12. Connect the top snubber resistor wire to J13 using a screwdriver to tighten the screw to 20 in-lbs (23.0 kg cm).
13. Install the two input bridge screws, securing the remaining snubber resistor wire with the upper input bridge screw. Tighten both screws to 20 in-lbs (23.0 kg cm).
14. Connect the work lead at J26 and tighten the screws to 30 in-lbs (34.6 kg cm).

15. Secure the 3uF capacitor on the left and the longer transformer wire to the board using the three inverter IGBT screws. On a Powermax85, tighten the screws to 30 in-lbs (34.6 kg cm). On a Powermax65, tighten the screws to 20 in-lbs (23.0 kg cm).
16. Connect the remaining transformer wire at J29 by tightening the screw to 20 in-lbs (23.0 kg cm).
17. Secure the 3uF capacitor on the right and the longer PFC inductor wire with the three PFC IGBT screws. Tighten the screws to 30 in-lbs (34.6 kg cm).
18. Connect the remaining PFC inductor wire by tightening the screw to 30 in-lbs (34.6 kg-cm).
19. Plug the three gate drive wires into their respective power board connectors (J17, J18, and J19). Plug the PFC temperature sensor wire into the J16 power board connector. Gently pull on each wire to ensure that they are fully seated.

### Install the DSP board

Refer to the figure on the next page.

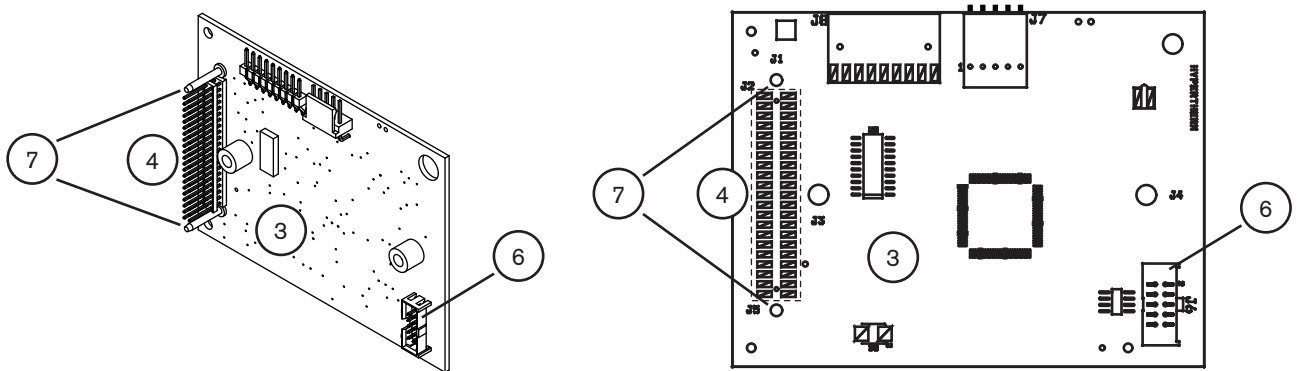
1. Connect the ribbon cable to the ribbon cable connector (6) on the back of the DSP board (3).
2. Align the two alignment pins (7) with the corresponding holes on the power board.
3. Carefully push the DSP board straight onto the power board. Do not bend the pins (4).
4. Secure the DSP board to the power board by tightening the two screws (2) to 10 in-lbs (11.5 kg cm).
5. If an RS485 communication board is installed on the power supply, connect the DSP connector (1) to the top of the DSP board.

**Caution:** Aligning the pins on the back of the DSP board with the corresponding holes on the power board is critical.

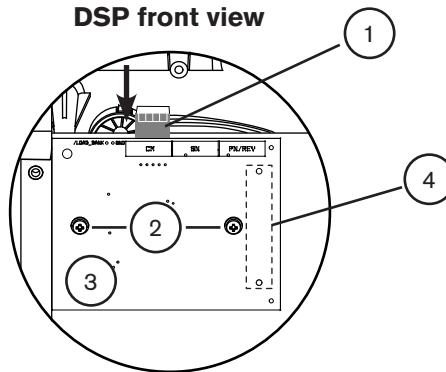


**Verify all pins are properly seated after carefully pushing the DSP board straight onto the power board.**

**DSP back view**



**DSP front view**



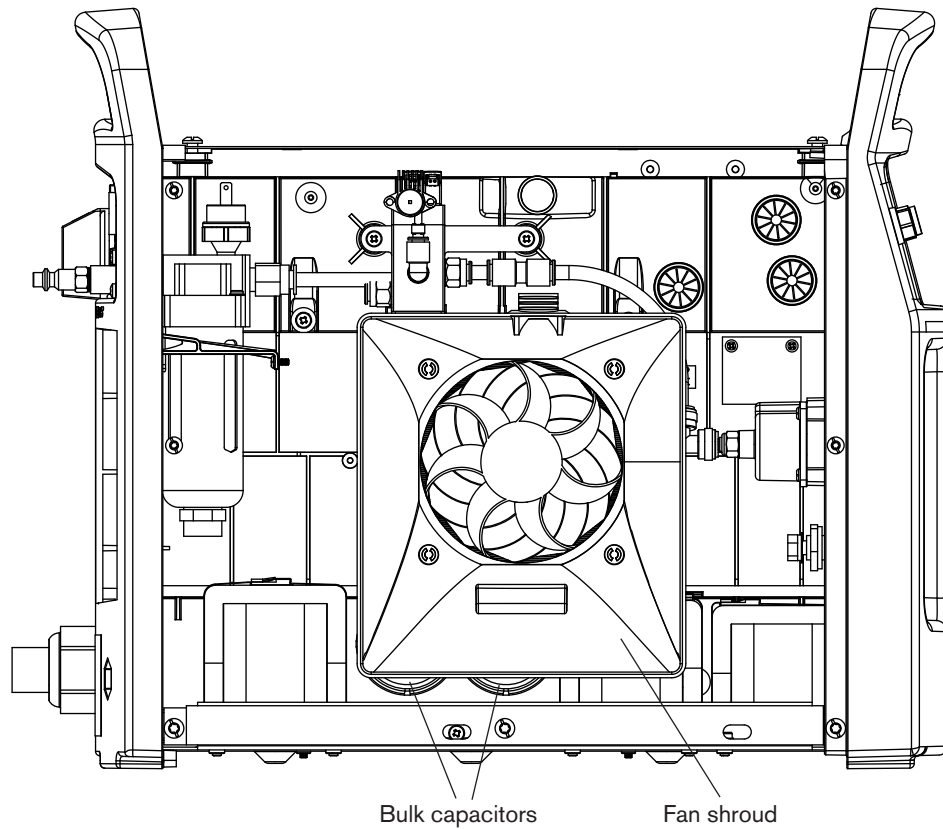
## Replace the component barrier and power supply cover.

1. Replace the component barrier. Refer to page 6-4 *Replace the component barrier*.
2. Replace the power supply cover. Refer to page 6-5 *Replace the power supply cover*.
3. Reconnect the electrical power and the gas supply.

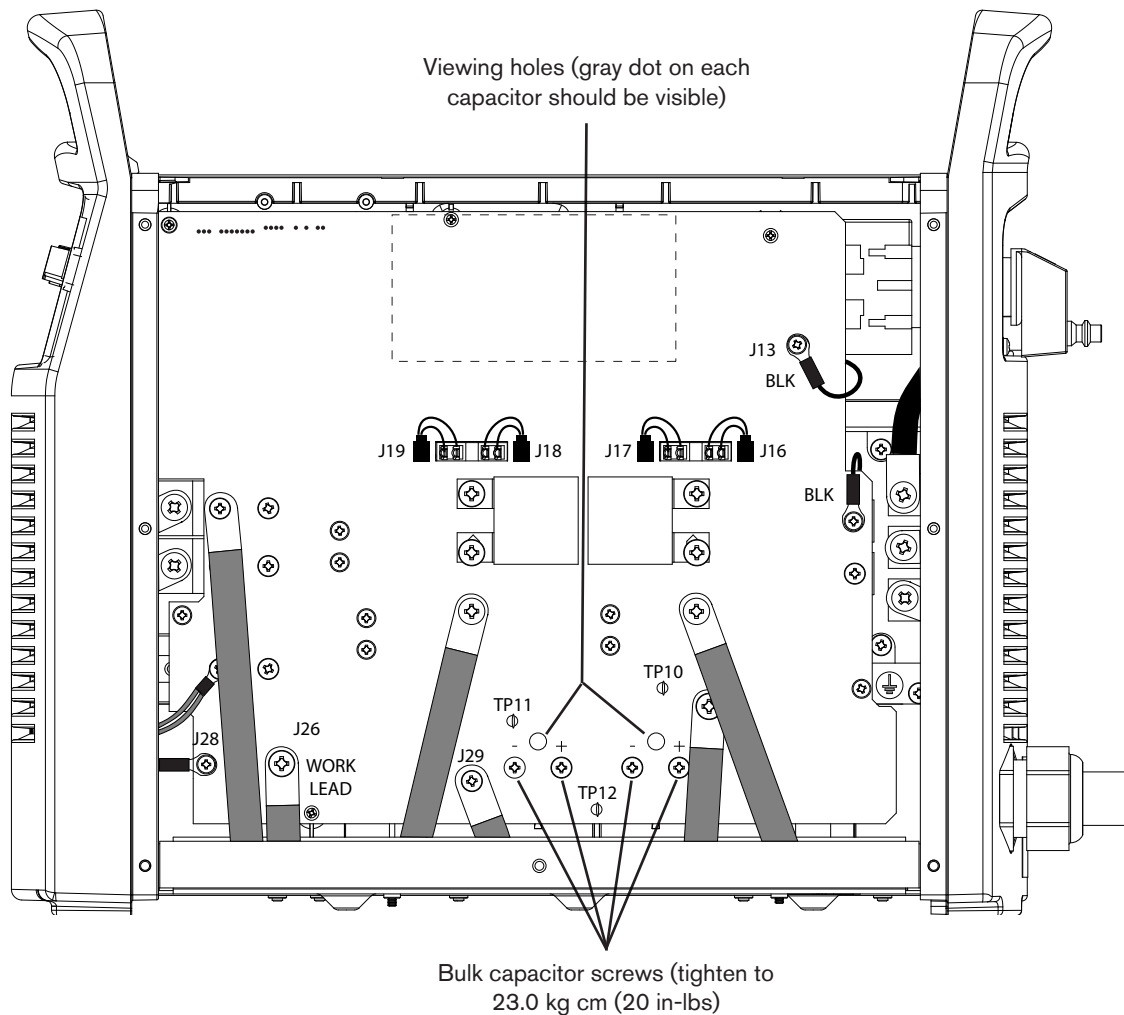
### Replace the bulk capacitors

#### Remove the old bulk capacitors

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. Remove the fan shroud by pulling it straight off the fan housing.



4. Position the power supply so you can access the power board.
5. Remove the four bulk capacitor mounting screws on the power board side of the power supply. Refer to the figure below.
6. Remove the old bulk capacitors, from the fan side of the power supply, by pulling them straight out. Discard the old capacitors.



### Install the new bulk capacitors

Note: The new bulk capacitors are installed in the same way regardless of power supply type. Make sure you install the correct bulk capacitors for your power supply.

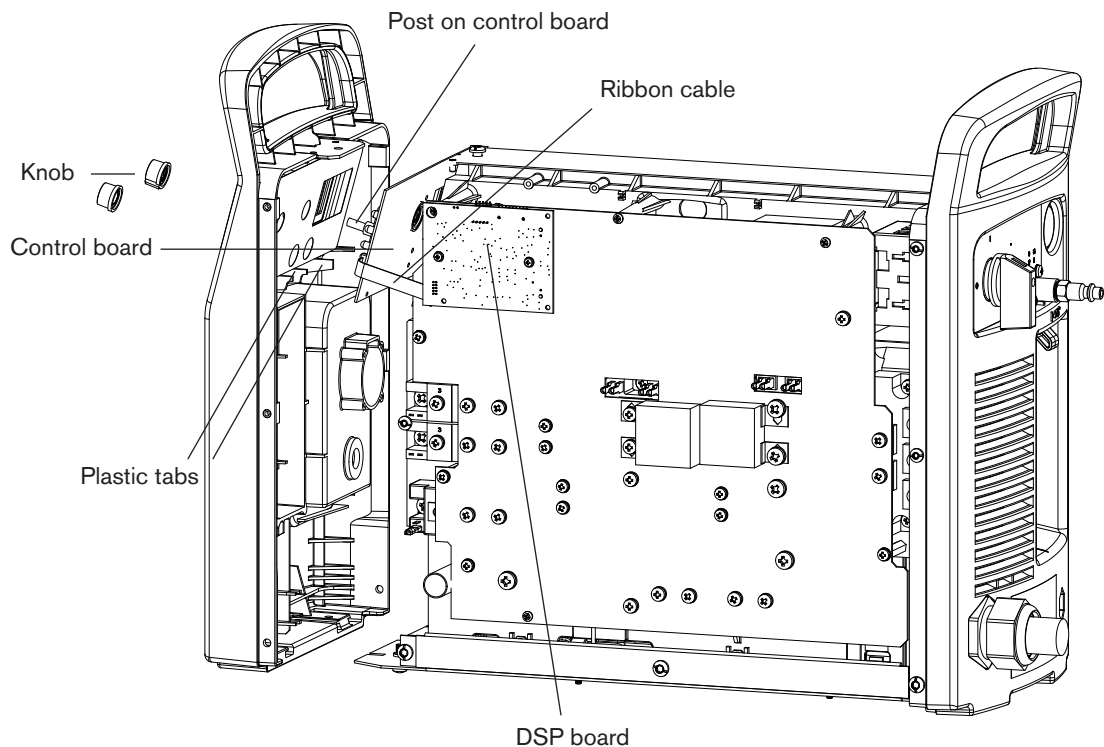
1. Insert the bulk capacitors into the receptacles, from the fan side of the power supply, with the gray dot on each capacitor positioned up.
2. Verify that the gray dot on each capacitor is visible through the viewing hole. (Refer to the figure on the previous page.) If necessary, rotate the capacitor until the gray dot is visible.
3. Start the four capacitor screws by hand, then tighten to 23.0 kg cm (20 in-lbs).
4. Snap the fan shroud into the four mounting holes on the fan.
5. Replace the component barrier and power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
6. Reconnect the electrical power and the gas supply.

## Replace the control board or ribbon cable

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. Remove the metal strap from the top of the power supply by lifting the strap straight up. The strap holds the two end panels together.
4. Remove the adjustment knob and operating mode switch knob from the front panel by pulling them straight off.
5. Carefully pull the top of the front panel away from the body of the power supply. The front panel is still attached to the bottom of the power supply and can only move a short distance.

Note: The figure below shows the front panel separated from the base for clarity. You can remove the two screws in the base and separate the front panel from the base if it is easier to access the components.

6. Remove the three screws that secure the control board to the front panel. Two screws are installed at the top of the control board, one at each end. The third screw is installed in the middle of the control board along the bottom edge.
7. Carefully slide the control board from behind the front panel toward the power board side of the power supply.
8. Disconnect the ribbon cable from the control board and set aside the control board. If you want to replace the ribbon cable, also disconnect the ribbon cable from the DSP board.



## COMPONENT REPLACEMENT

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9. If you have a new control board, connect the ribbon cable to the new control board. If you have a new ribbon cable, connect the new ribbon cable to the control board and to the DSP board.
10. Carefully slide the control board behind the front panel.
11. Tilt the bottom of the control board toward the front panel until the control board rests on the plastic tabs. Push the knob posts through the holes in the front panel.
12. Position the control board so that the mounting holes in the control board align with the mounting holes in the front panel.
13. Secure the control board to the front panel. Use a screwdriver to tighten the three screws to 5.7 kg cm (5 in-lbs).
14. Push the operating mode switch knob (with the white line) onto the mode switch post. Align the flat edge inside the knob with the flat side of the post.
15. Push the adjustment knob onto the remaining post.
16. Carefully push the top of the front panel against the power supply. Be sure not to pinch any wires between the front panel and the heat sink on the power supply.
17. Replace the metal strap on top of the power supply. Align the slot in the metal strap with the plastic tab in the front panel and push the strap straight down. The four pins in the strap snap into the front and rear panels.
18. Replace the power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
19. Reconnect the electrical power and the gas supply.



## **Replace the heat sink components**

This section describes the procedures for replacing heat sink components for the 65A CSA, 65A CE, 85A CSA, and 85A CE models. Refer to the figures following the instructions for your particular model.

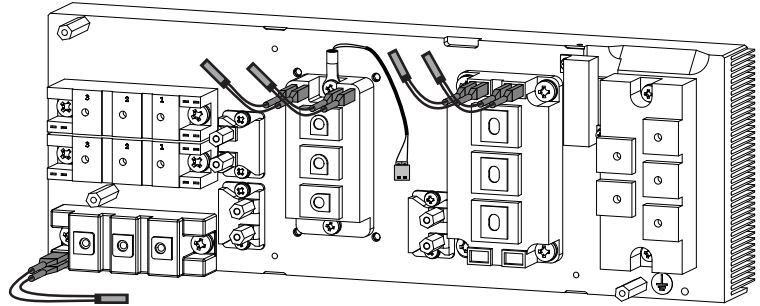
1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. Remove the power board to expose the heat sink. Refer to the instructions in the section beginning on page 6-32 *Replace the power board*.
4. Remove the old components from the heat sink.
5. Use isopropyl alcohol to remove the old thermal grease.
6. Install the new components to the heat sink as shown in the appropriate figure below.
7. Use thermal grease on all components. Apply a thin coat (3 mils or paper equivalent) to the component.
8. Gently tighten all screws and then tighten all screws to the required torque. Refer to the appropriate figure below for torque specifications.
9. Clean the excess grease from the heat sink.
10. Replace the power board.
11. Replace the component barrier and power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
12. Reconnect the electrical power and the gas supply.

## COMPONENT REPLACEMENT

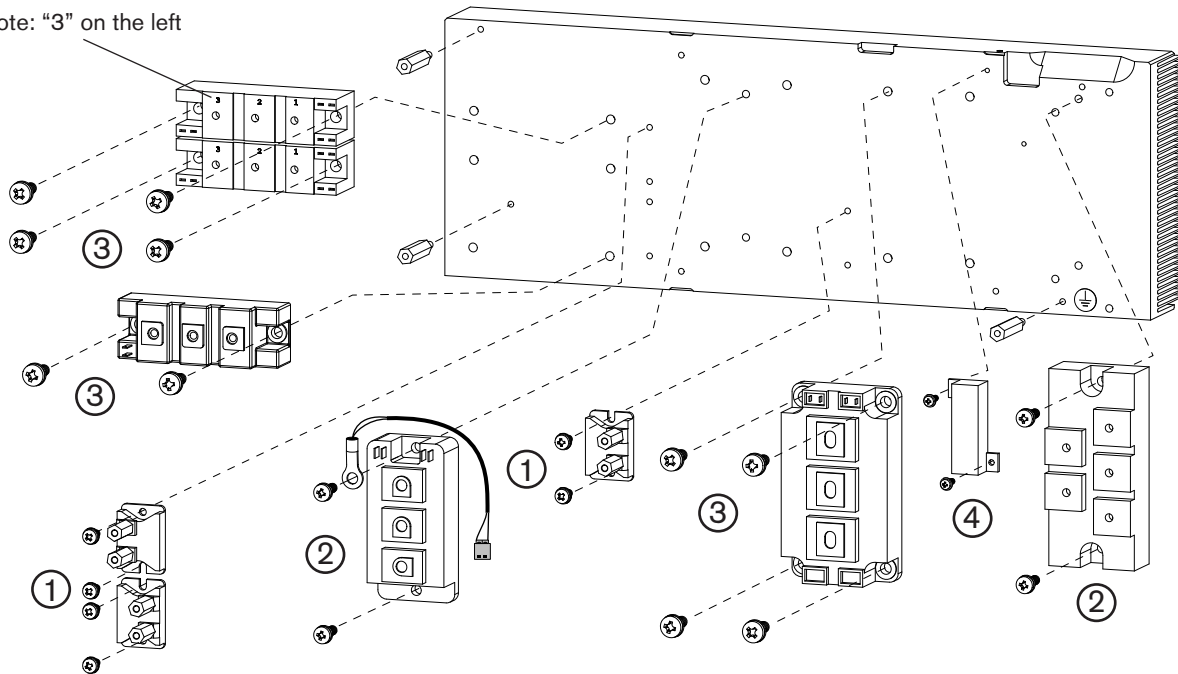
### 65A CSA

When securing a component to the heat sink, gently tighten all screws and then tighten all screws to the required torque.

- ① Torque to 15 in-lbs (17.3 kg cm).  
M4 X 10 2SEM
- ② Torque to 20 in-lbs (23 kg cm).  
M5 X 16 2SEM
- ③ Torque to 35 in-lbs (40 kg cm).  
M6 X 16-12.5 2SEM TRI CHR
- ④ Torque to 10 in-lbs (11.5 kg cm).  
M3 X 10 1SEM



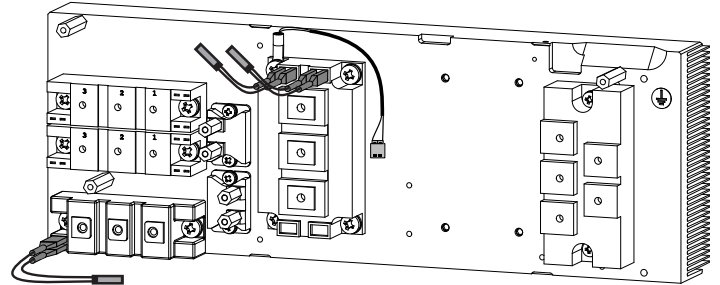
Note: "3" on the left



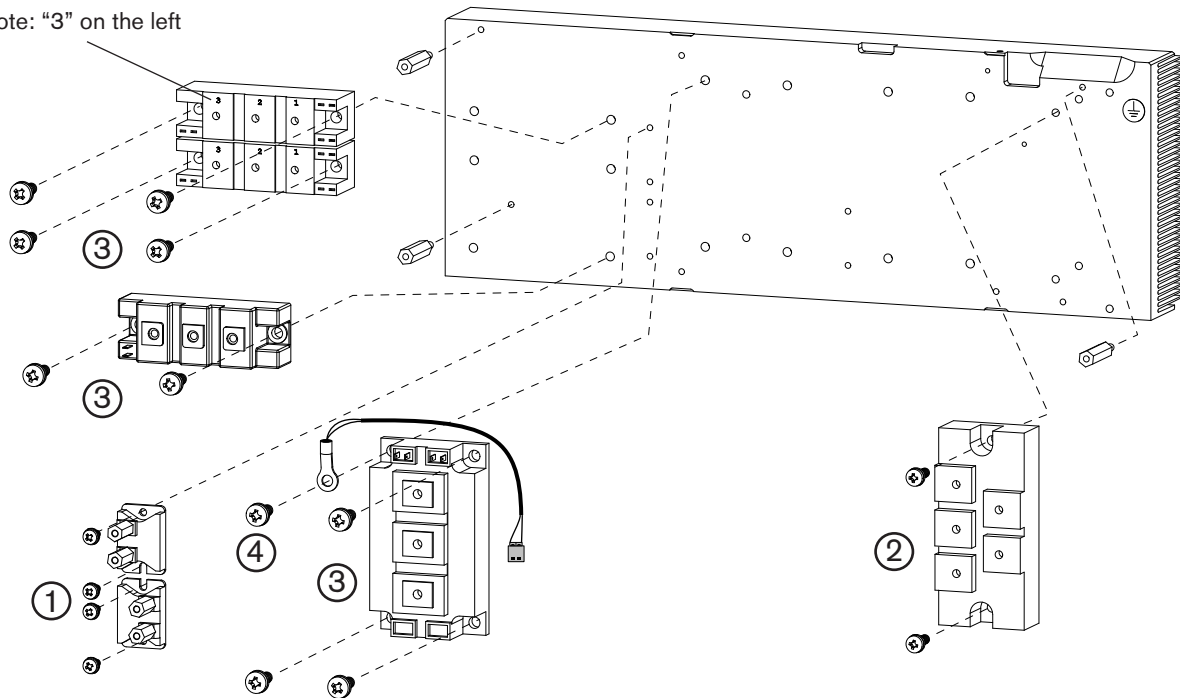
## 65A CE

When securing a component to the heat sink, gently tighten all screws and then tighten all screws to the required torque.

- ① Torque to 15 in-lbs (17.3 kg cm).  
M4 X 10 2SEM
- ② Torque to 20 in-lbs (23 kg cm).  
M5 X 16 2SEM
- ③ Torque to 35 in-lbs (40 kg cm).  
M6 X 16-12.5 2SEM TRI CHR
- ④ Torque to 35 in-lbs (40 kg cm).  
M6 X 18.5+/-0.5-12.5 2SEM PAN BLKZNC



Note: "3" on the left

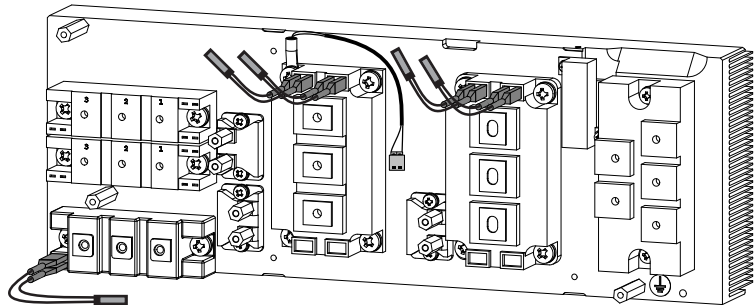


## COMPONENT REPLACEMENT

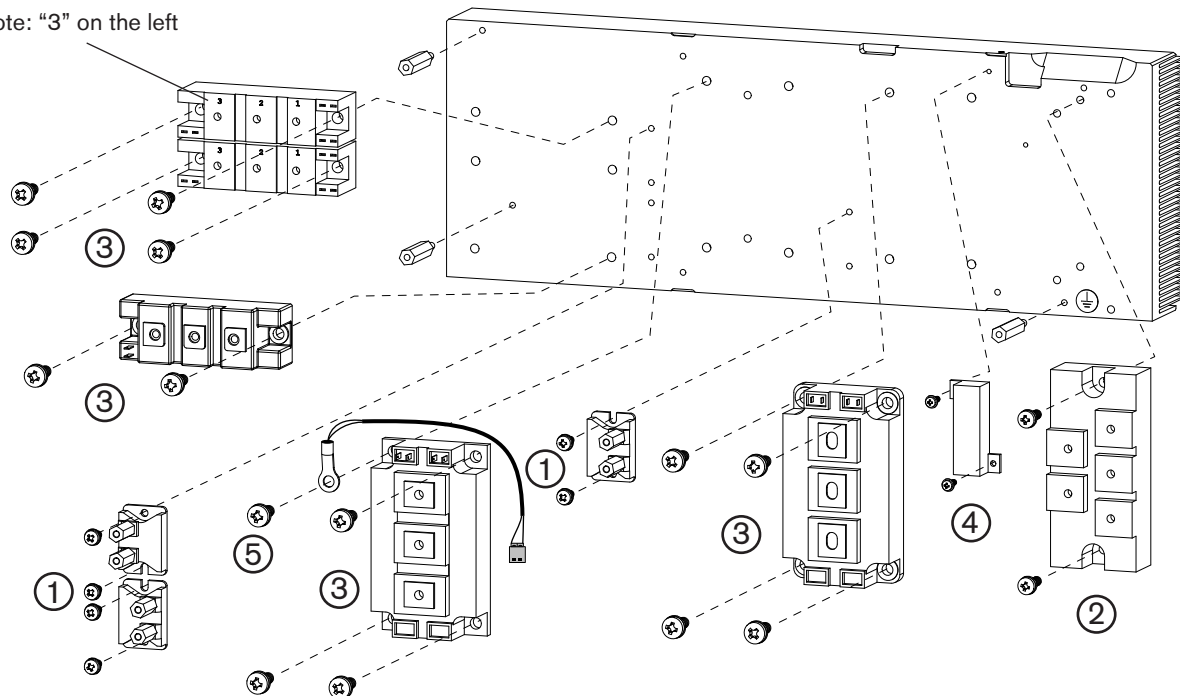
### 85A CSA

When securing a component to the heat sink, gently tighten all screws and then tighten all screws to the required torque.

- ① Torque to 15 in-lbs (17.3 kg cm).  
M4 X 10 2SEM
- ② Torque to 20 in-lbs (23 kg cm).  
M5 X 16 2SEM
- ③ Torque to 35 in-lbs (40 kg cm).  
M6 X 16-12.5 2SEM TRI CHR
- ④ Torque to 10 in-lbs (11.5 kg cm).  
M3 X 10 1SEM
- ⑤ Torque to 35 in-lbs (40 kg cm).  
M6 X 18.5+/-0.5-12.5 2SEM PAN BLKZNC



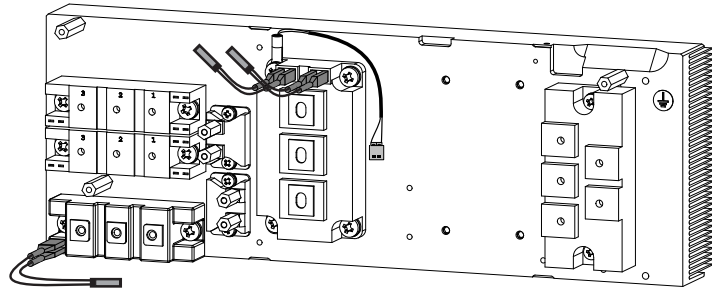
Note: "3" on the left



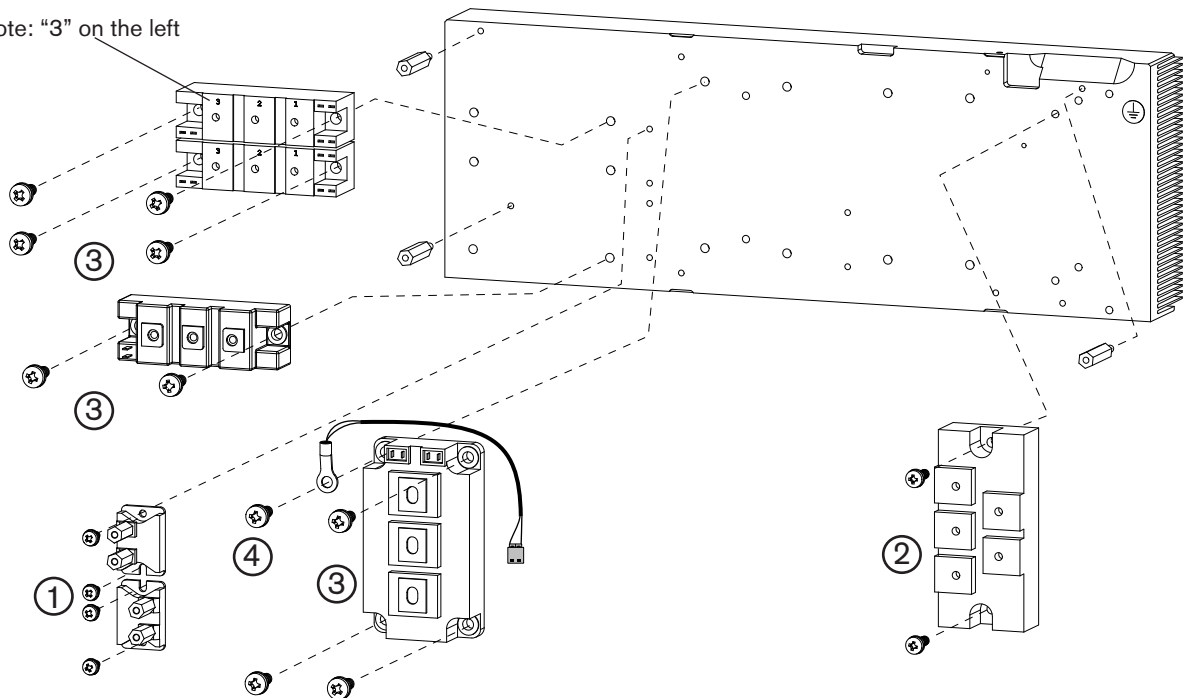
## 85A CE

When securing a component to the heat sink, gently tighten all screws and then tighten all screws to the required torque.

- ① Torque to 15 in-lbs (17.3 kg cm).  
M4 X 10 2SEM
- ② Torque to 20 in-lbs (23 kg cm).  
M5 X 16 2SEM
- ③ Torque to 35 in-lbs (40 kg cm).  
M6 X 16-12.5 2SEM TRI CHR M
- ④ Torque to 35 in-lbs (40 kg cm).  
M6 X 18.5+/-0.5-12.5 2SEM PAN BLKZNC



Note: "3" on the left

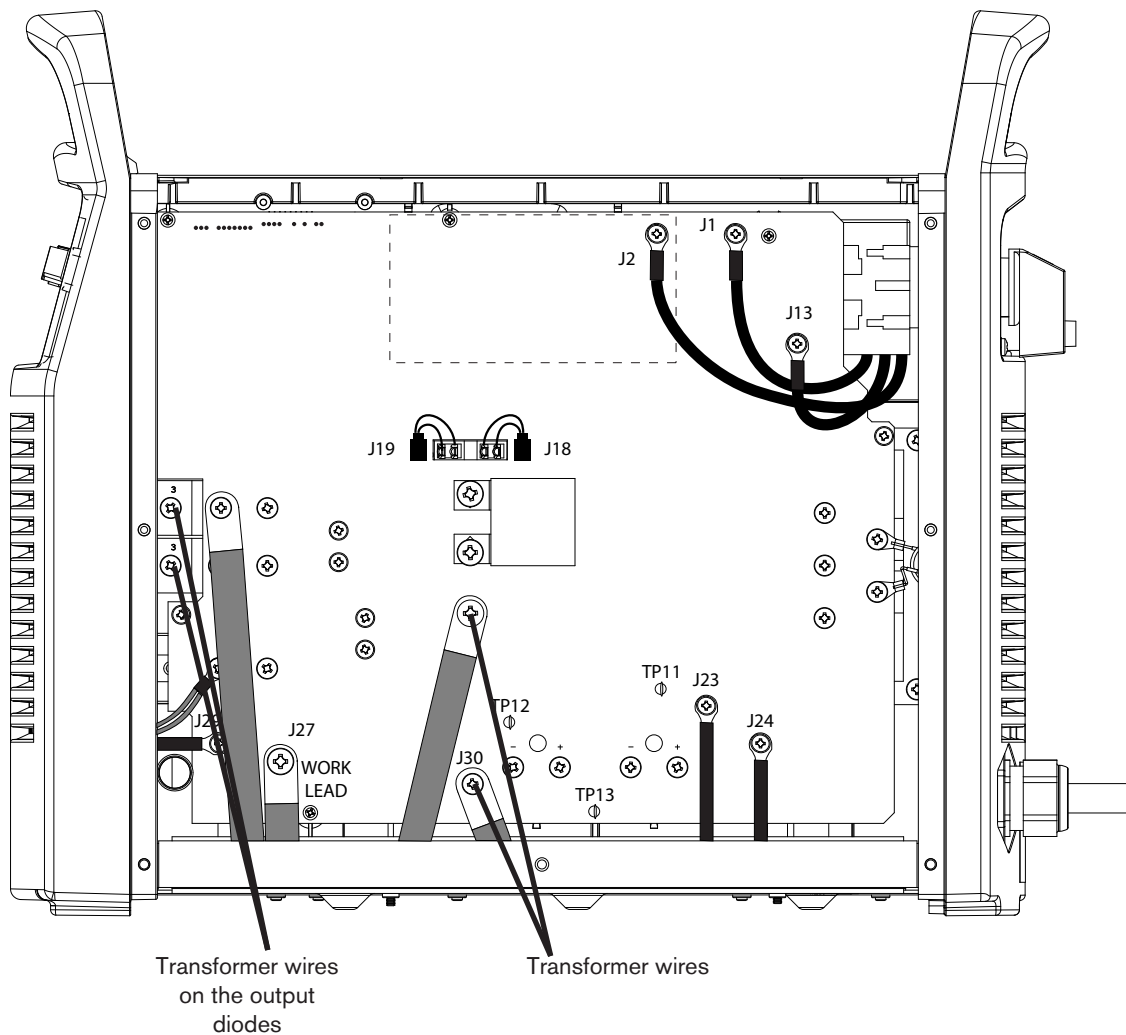


### Replace the transformer

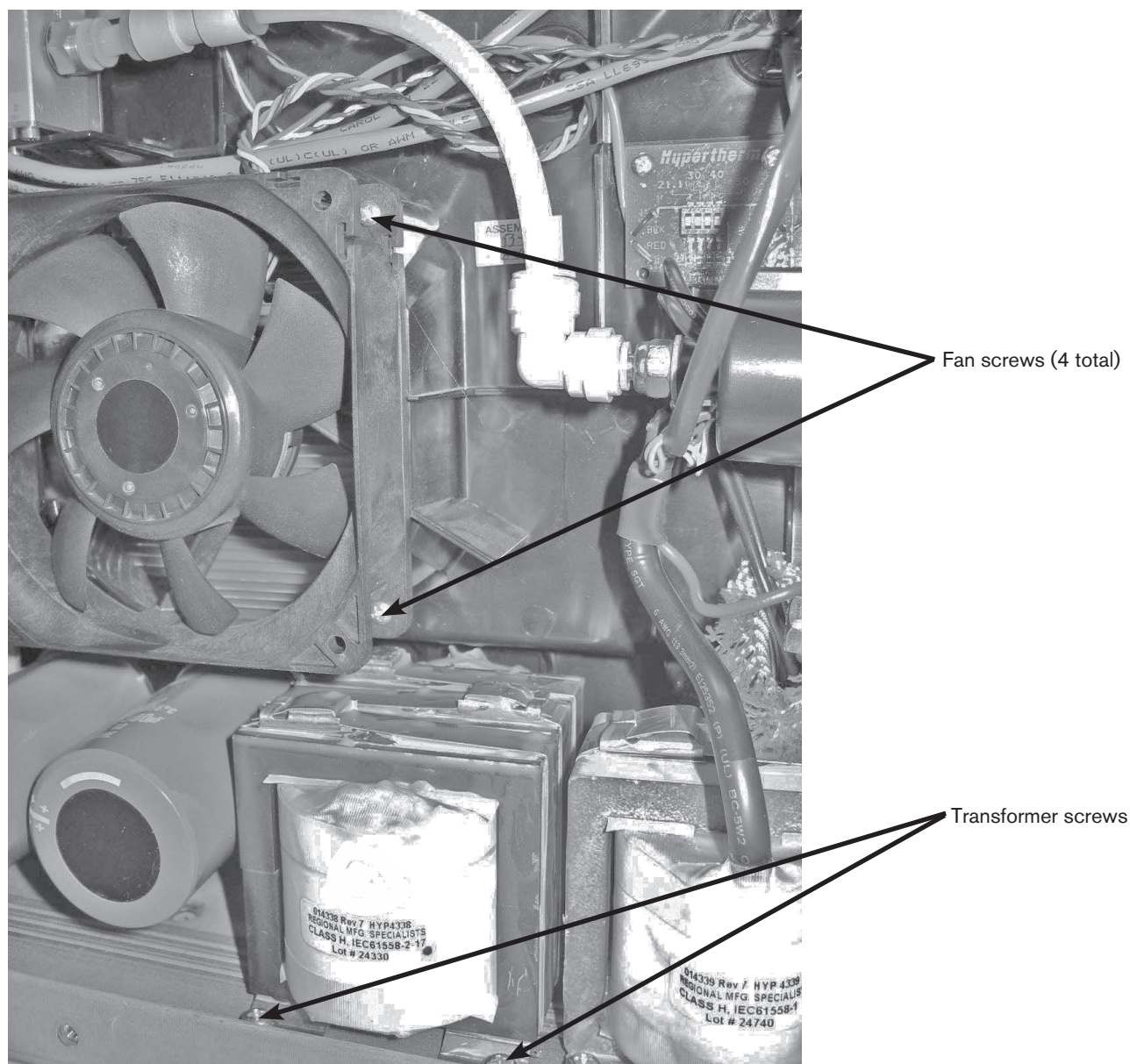
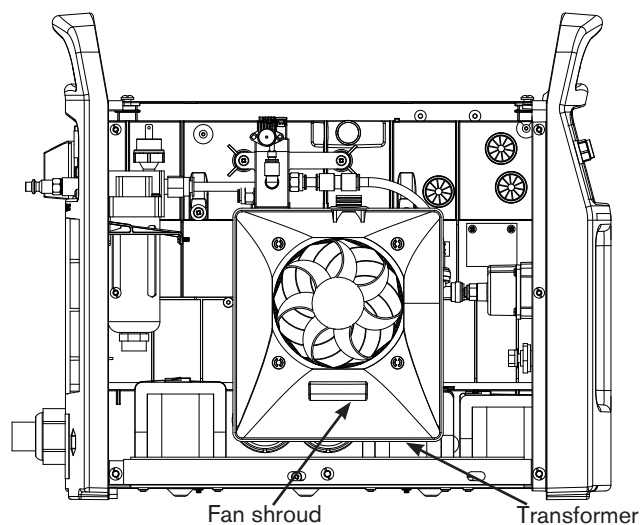
#### Remove the old transformer

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. On the power board side of power supply, remove the screws that secure the transformer wires to the power board.
4. Remove the screws that secure the transformer wires to the output bridge diodes.

Note: The illustration below shows a CE power supply. A CSA model appears slightly different.



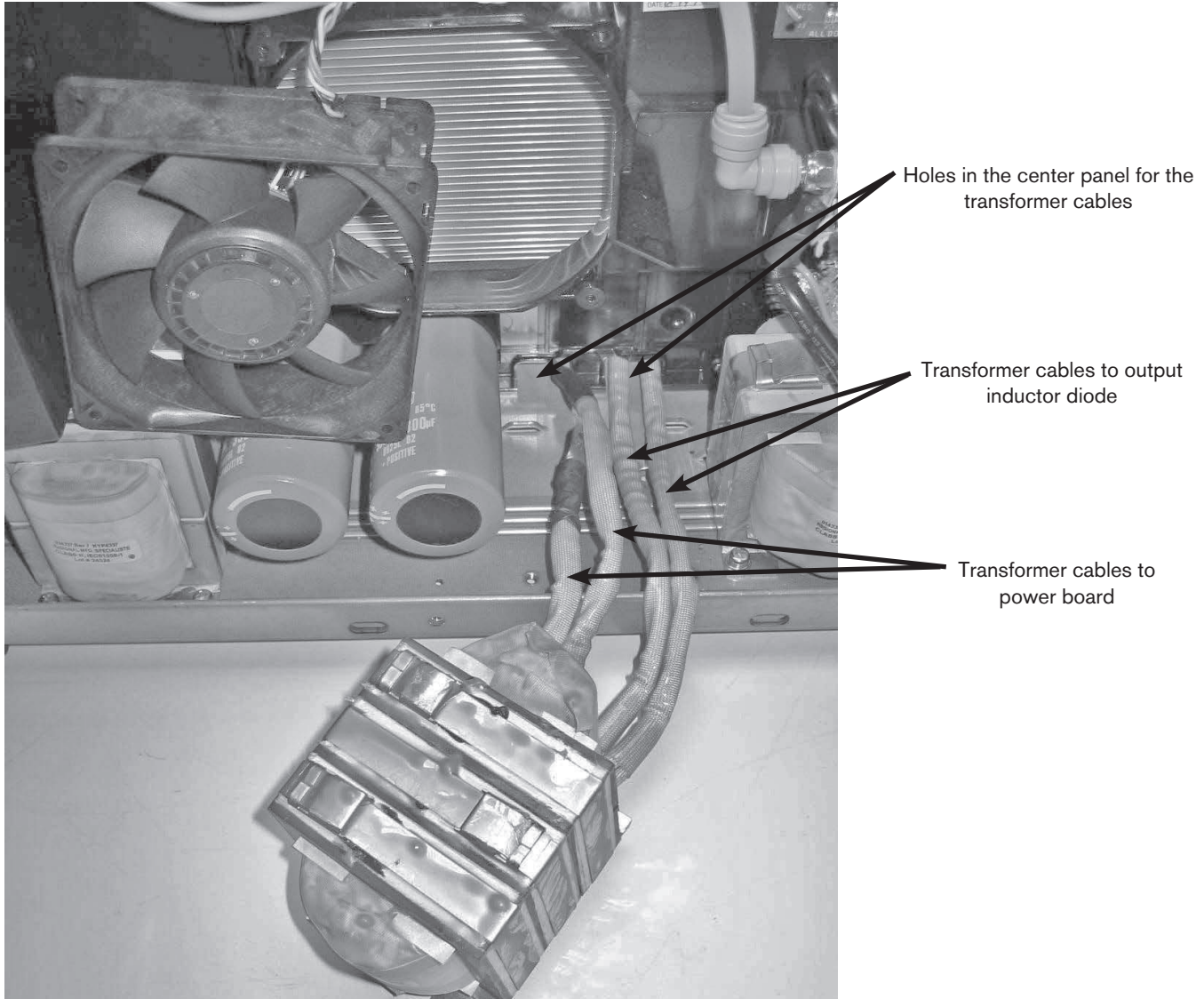
- On the fan side of the power supply, remove the fan shroud by gently pulling it straight off the fan housing.
- Remove the 4 screws that secure the fan assembly to the fan base.
- Remove the 2 screws that secure the transformer to the base of the power supply.
- Tip up the front of the transformer and lift it from the enclosure, while guiding the attached wires through the holes in the center panel.





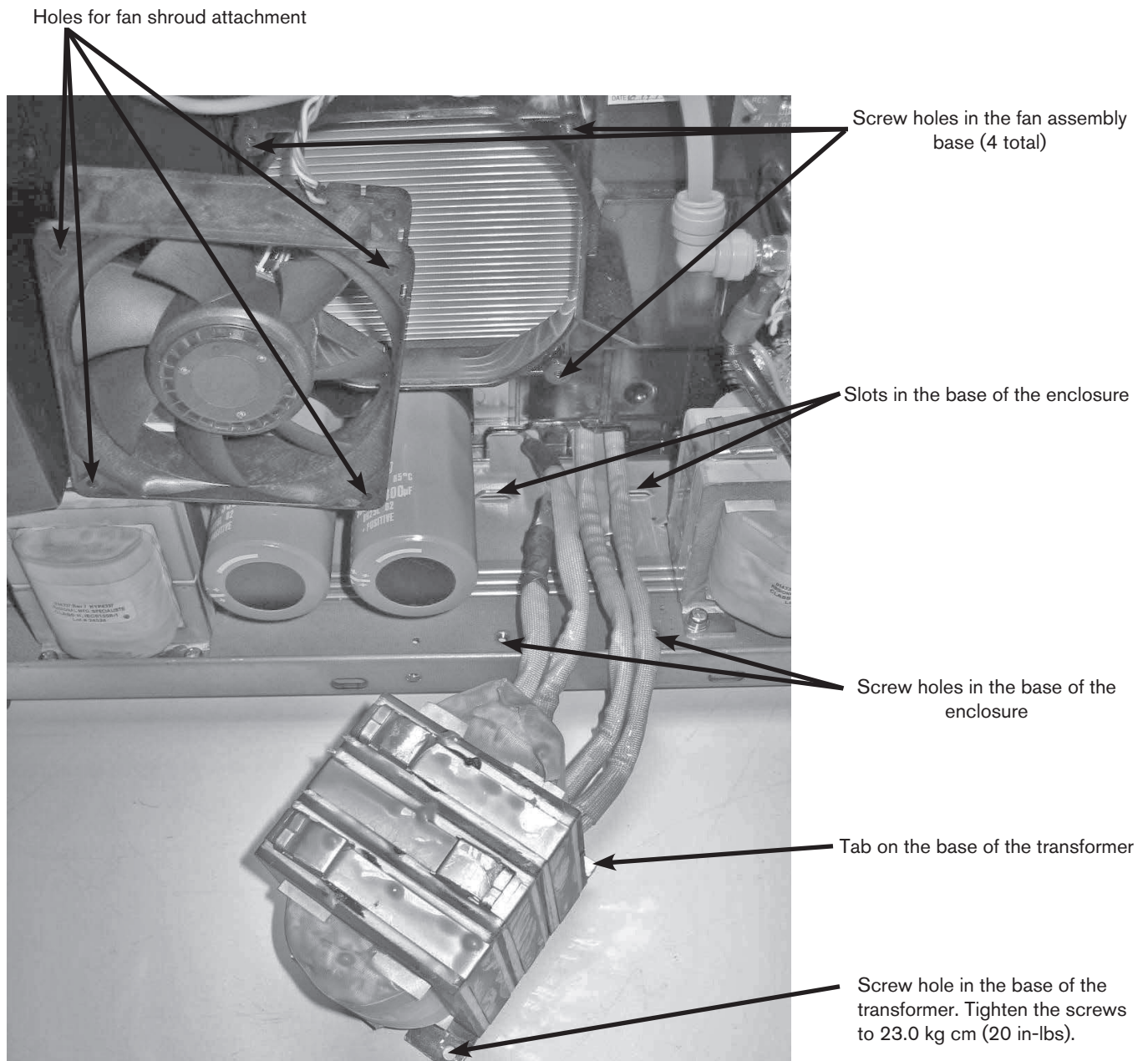
### Install the new transformer

1. Route the 4 transformer cables through the 2 holes at the base of the center panel, while sliding the transformer into place.
2. Verify that the tabs on the rear of the transformer slide into the mating slots of the power supply.





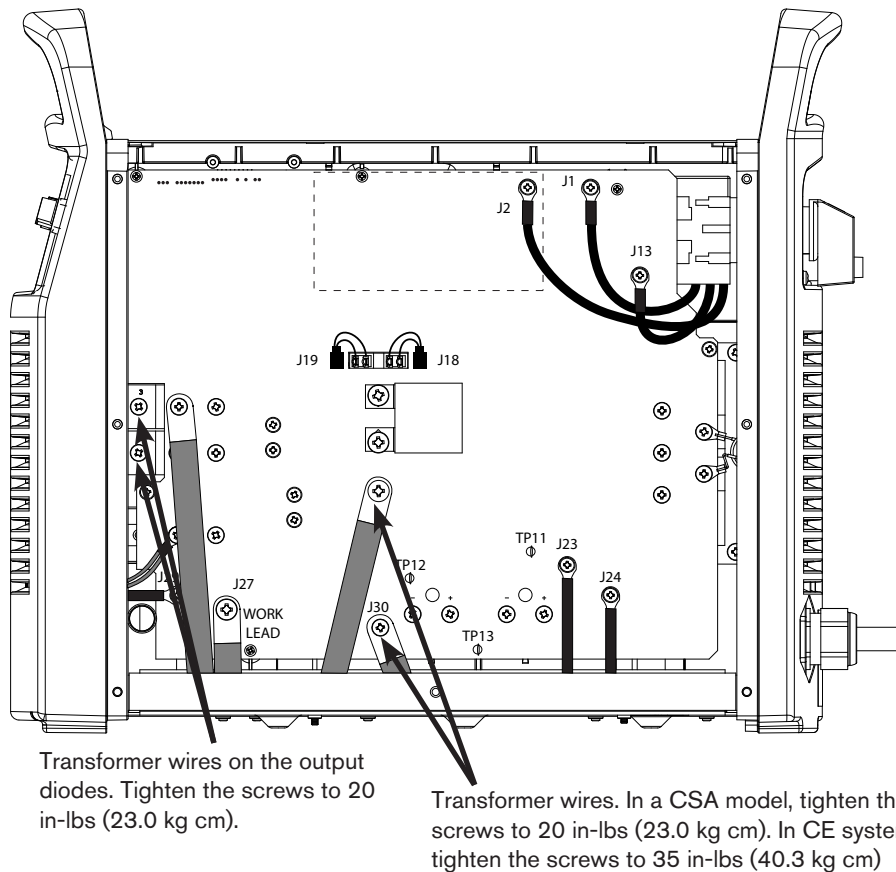
3. Line up the screw holes at the front of the transformer with the holes in the bottom of the enclosure.
4. Fasten the transformer to the enclosure using the 2 supplied mounting screws. Tighten the screws to 23.0 kg cm (20 in-lbs).
5. Align the screw holes in the fan assembly over the holes in the fan base and fasten the screws.
6. Replace the fan shroud over the fan assembly.



## COMPONENT REPLACEMENT

7. Fasten the 2 shorter transformer cables to the power board. In a CSA model, tighten the screws to 23.0 kg cm (20 in-lbs). In CE systems, tighten the screws to 40.3 kg cm (35 in-lbs).
8. Connect the 2 longest cables from the transformer to the output bridge diode and tighten the screws to 23.0 kg cm (20 in-lbs).
9. Replace the component barrier and power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
10. Reconnect the electrical power and the gas supply.

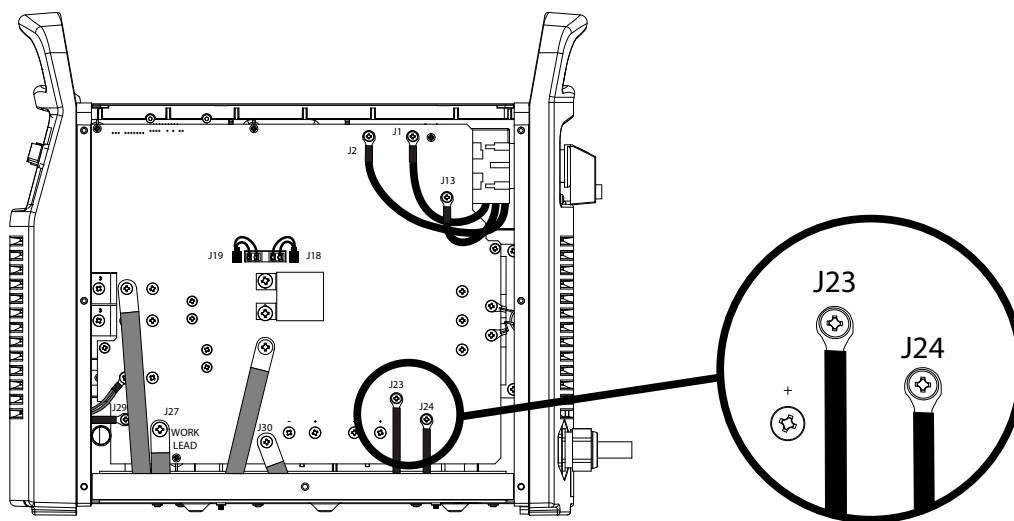
Note: The illustration below shows a CE power supply. A CSA model appears slightly different.



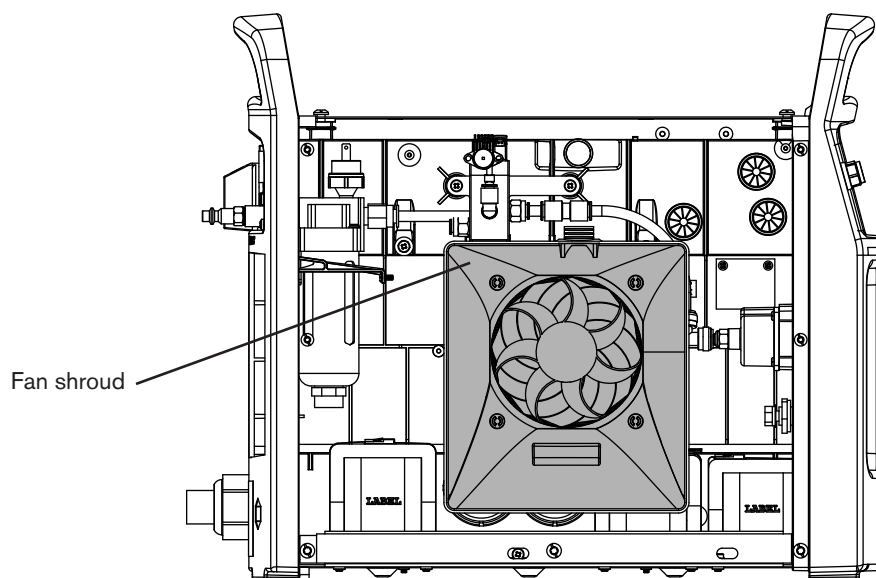
## Replace the PFC inductor

### Remove the old PFC inductor (CE model)

1. Turn OFF the power, disconnect the power cord, and disconnect the gas supply.
2. Remove the power supply cover and component barrier. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
3. Remove the two screws that secure the PFC inductor wires to J23 and J24 on the power board. Keep the screws for reuse.



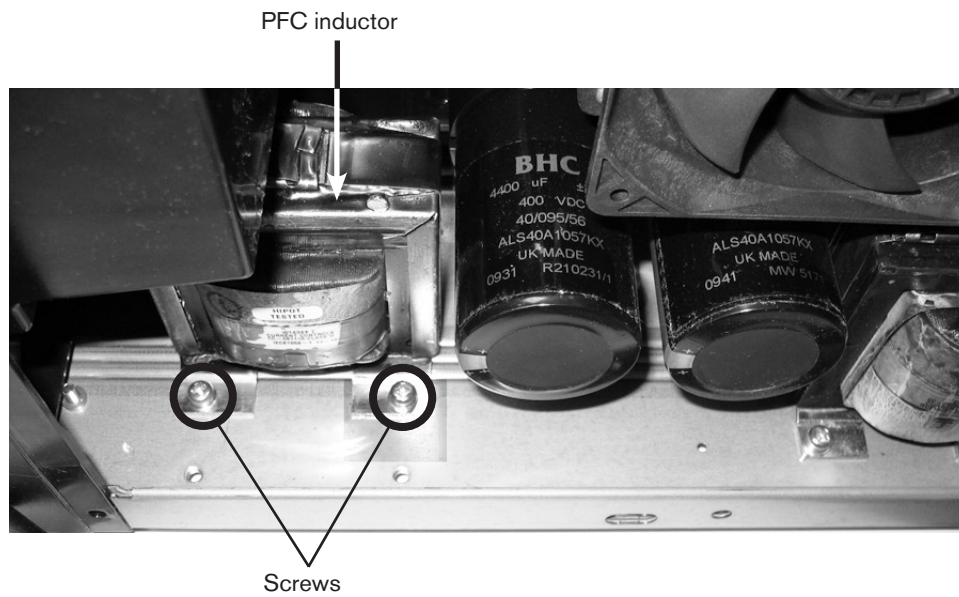
4. Remove the fan shroud by pulling it straight off the fan housing.



## COMPONENT REPLACEMENT

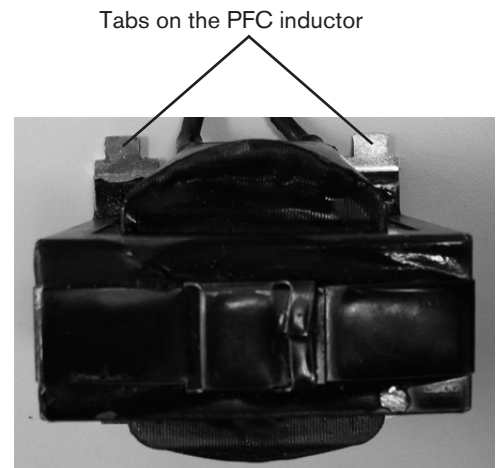
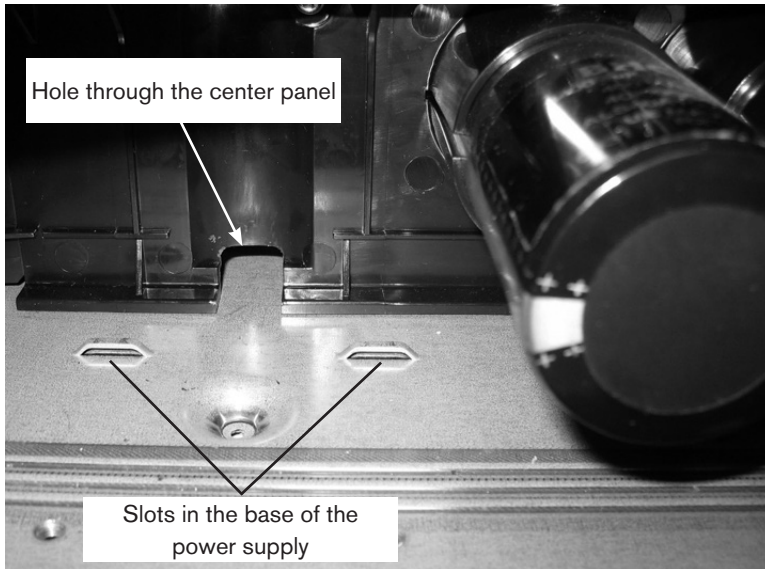
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5. Remove the two screws that secure the PFC inductor to the base of the power supply.
6. Remove the old PFC inductor.

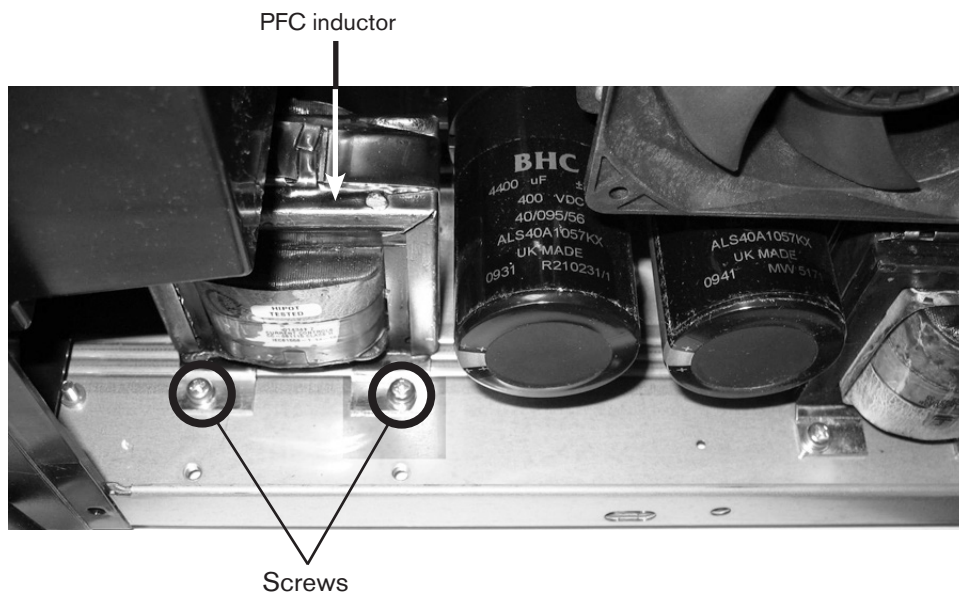


### Install the new PFC inductor (CE model)

1. Insert the wires from the new PFC inductor through the hole in the center panel and position the tabs on the base of the PFC inductor so that they slide into the slots in the base of the power supply.
2. Install the two screws (supplied in this kit) that secure the PFC inductor to the base of the power supply.



3. Secure the wire ends to J23 and J24 on the power board.

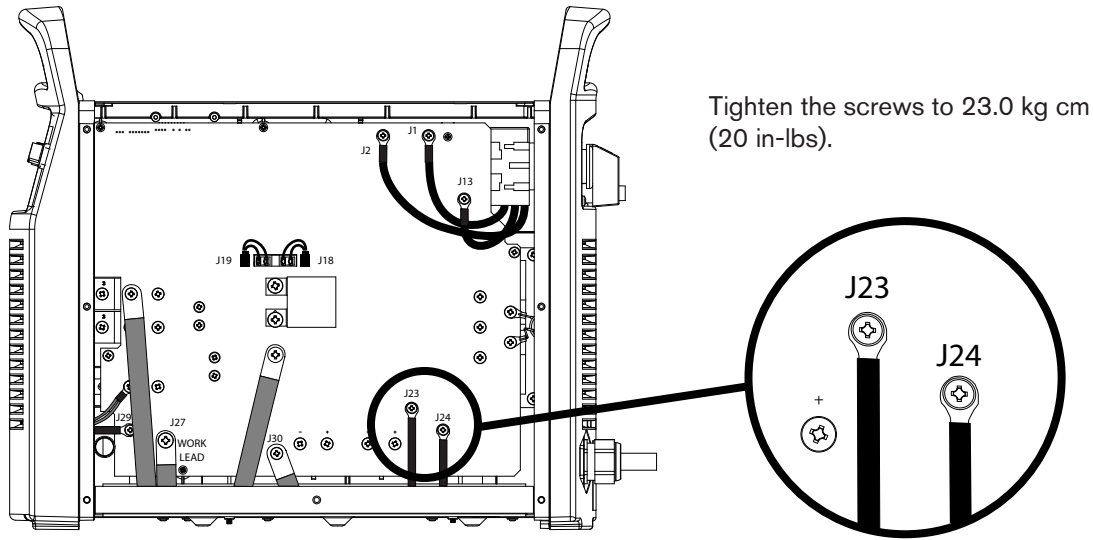


Tighten the screws to 23.0 kg cm  
(20 in-lbs).

## COMPONENT REPLACEMENT

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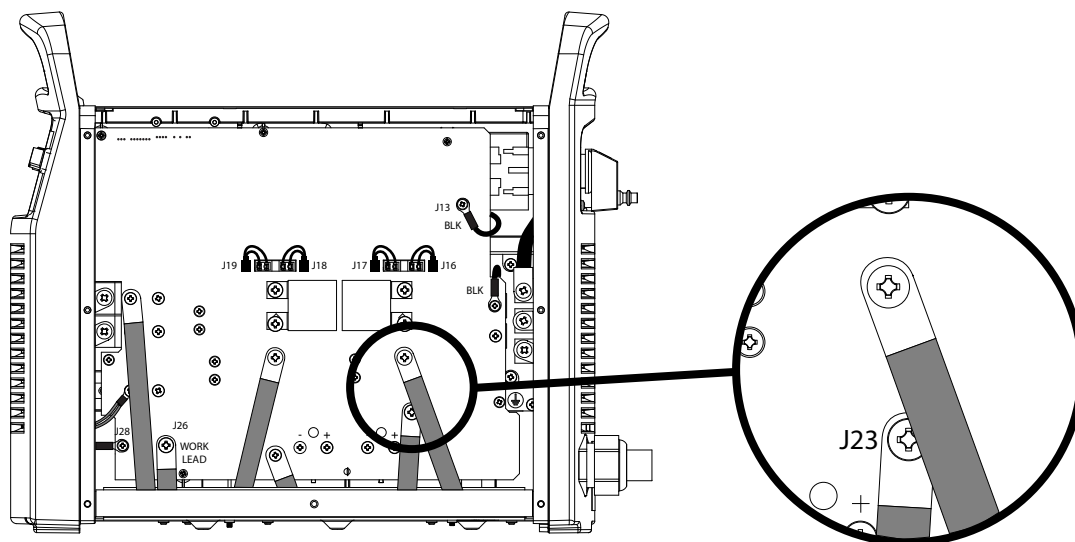
4. Replace the component barrier and power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.



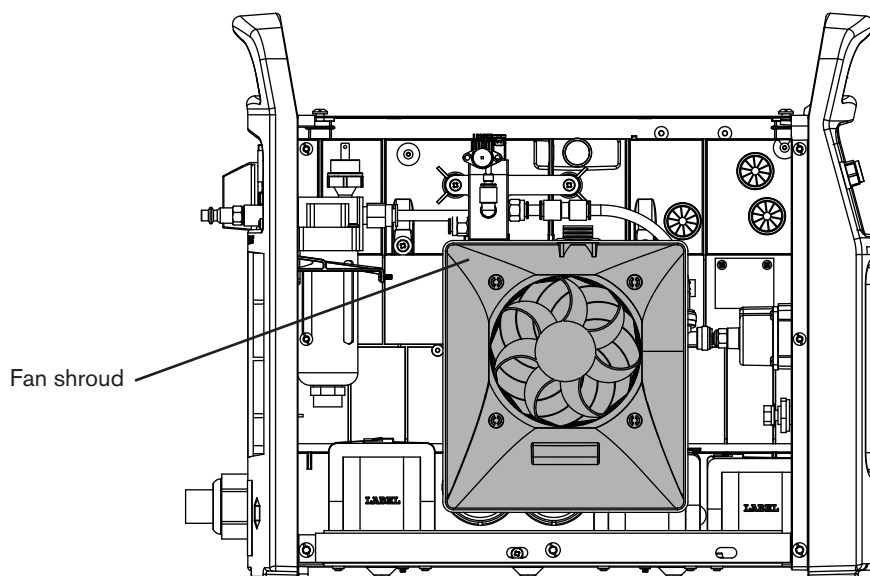
5. Reconnect the electrical power and the gas supply.

## Remove the old PFC inductor (CSA model)

1. Remove the two screws that secure the PFC inductor wires to the control board.



2. Remove the fan shroud by pulling it straight off the fan housing.

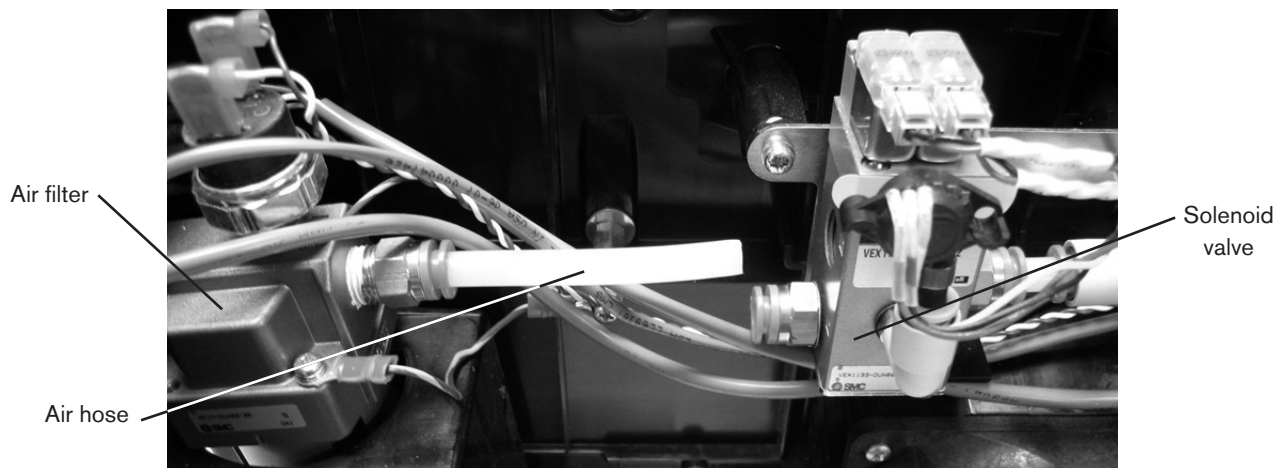




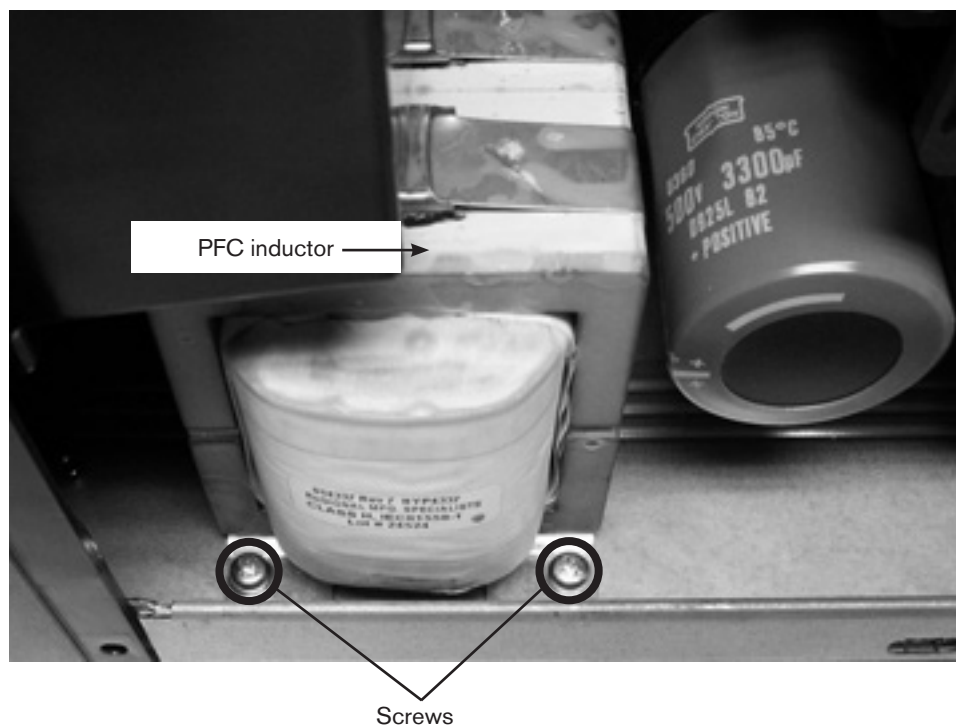
## COMPONENT REPLACEMENT

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3. Remove the two screws that secure the rear panel to the bottom of the power supply chassis.
4. Disconnect one end of the air hose between the air filter and the solenoid valve.



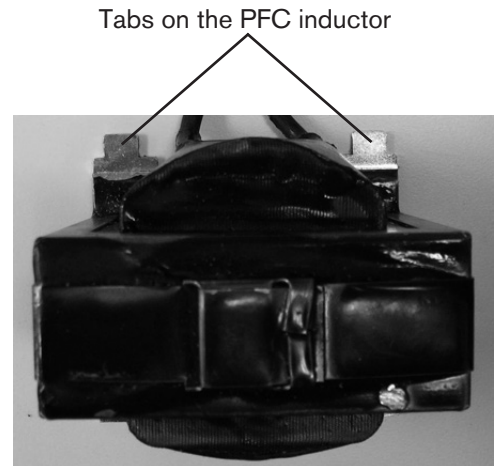
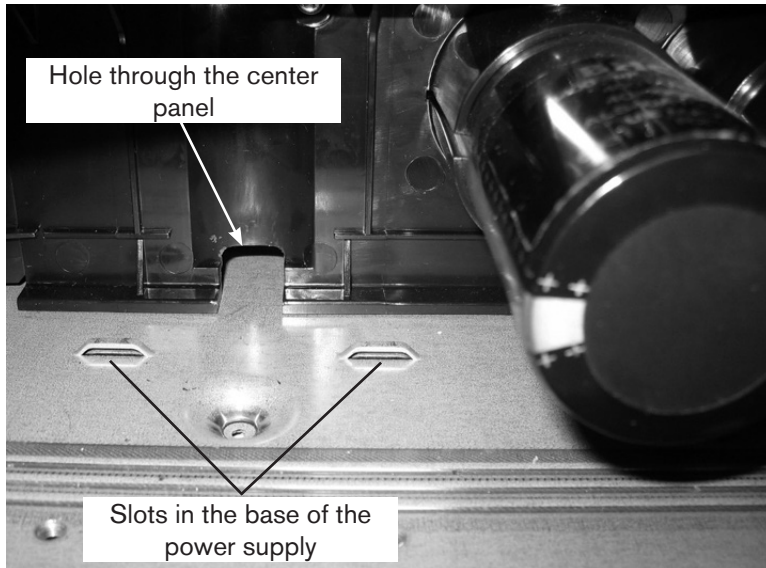
5. Remove the two screws that secure the PFC inductor to the base of the power supply.
6. Carefully pull the bottom of the rear panel away from the power supply chassis until the PFC inductor can be removed.





### Install the new PFC inductor (CSA model)

1. Insert the wires from the new PFC inductor through the hole in the center panel and position the tabs on the base of the PFC inductor so that they slide into the slots in the base of the power supply.
2. Install the two screws (supplied in this kit) that secure the PFC inductor to the base of the power supply.



3. Move the rear panel back into position, reattach the air hose, and secure the rear panel to the bottom of the power supply chassis with the screws that were removed earlier.

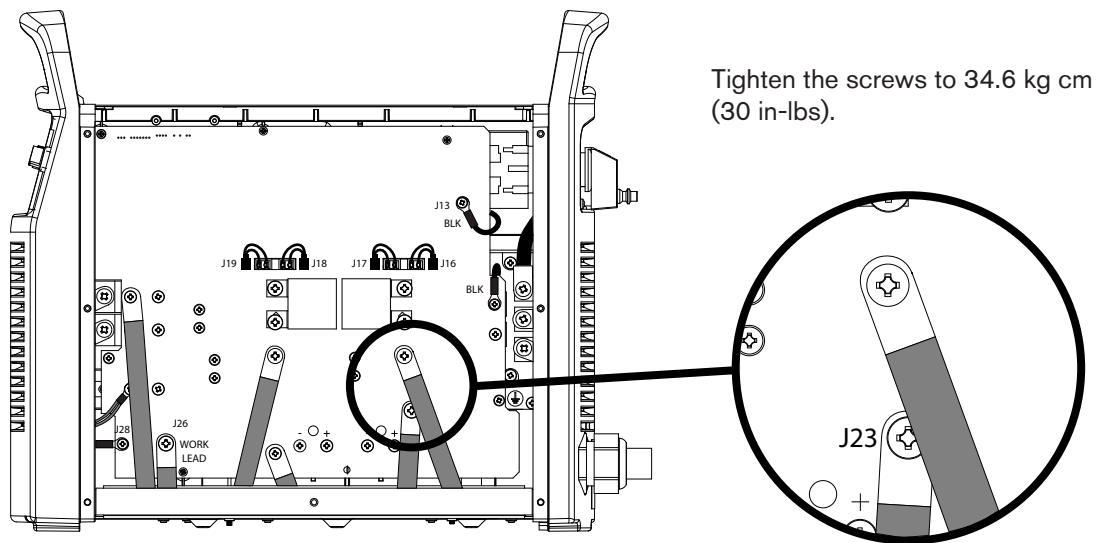


Tighten the screws to 23.0 kg cm (20 in-lbs).

## COMPONENT REPLACEMENT

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4. Install the two screws that secure the PFC inductor wires to the control board.
5. Replace the component barrier and power supply cover. Refer to page 6-3 *Remove and replace the power supply cover and component barrier*.
6. Reconnect the electrical power and the gas supply.



## Section 7

### PARTS

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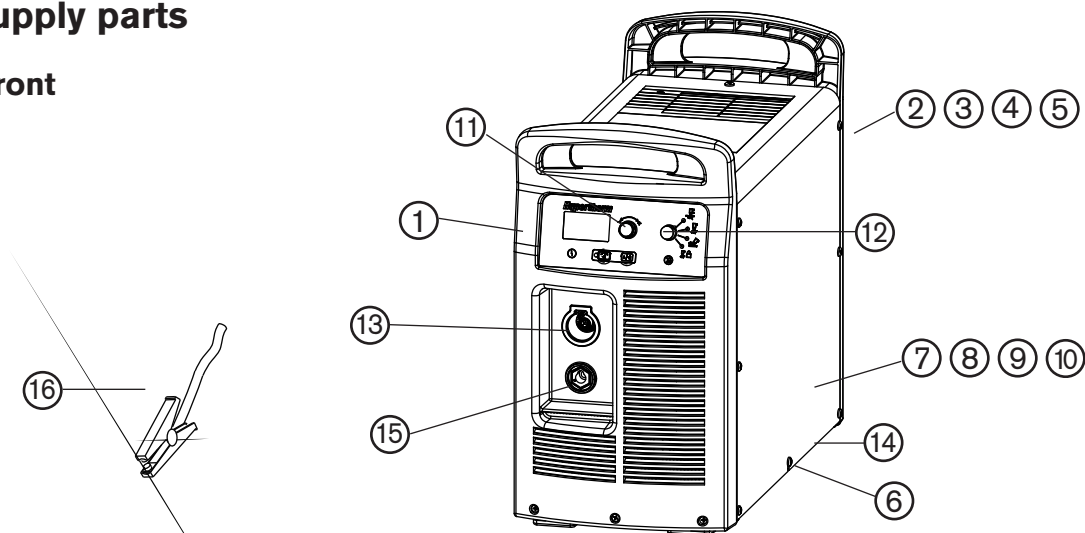
*In this section:*

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Note: If your Powermax65/85 has a CCC power cord, order CE-certified replacement parts for every part except the power cord.

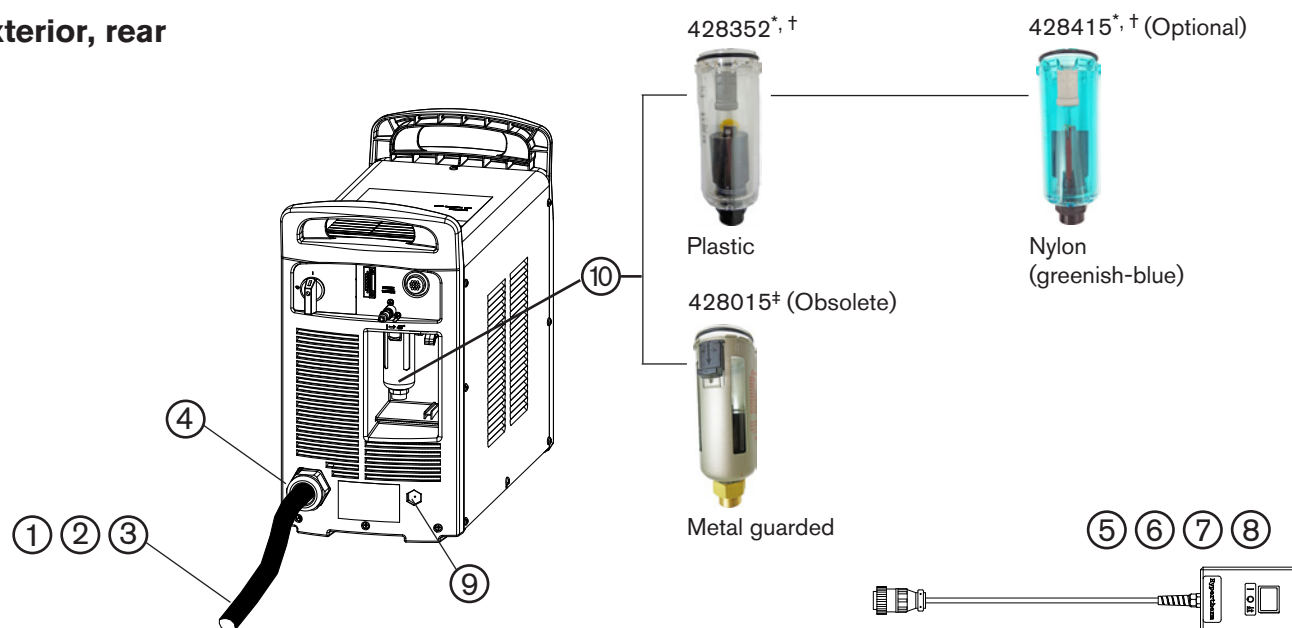
## Power supply parts

### Exterior, front



Item	Part number	Description
	228649	Kit: Powermax65 labels, CSA
	228650	Kit: Powermax65 labels, CE
	228651	Kit: Powermax85 labels, CE
	228652	Kit: Powermax85 labels, CSA
1	228643	Kit: Powermax65 and Powermax85 front panel
2	228645	Kit: Powermax65 CSA rear panel
3	228646	Kit: Powermax65 CE rear panel
4	228647	Kit: Powermax85 CSA rear panel
5	228653	Kit: Powermax85 CE rear panel
6	228642	Kit: Powermax65 and Powermax85 cover screws
7	228666	Kit: Powermax65 CSA power supply cover with labels
8	228674	Kit: Powermax65 CE power supply cover with labels
9	228676	Kit: Powermax85 CSA power supply cover with labels
10	228675	Kit: Powermax85 CE power supply cover with labels
11	108797	Adjustment knob
12	108732	Operating mode knob
13	228710	Kit: Powermax65 and Powermax85 FastConnect replacement (power supply half)
14	228640	Kit: Powermax65 and Powermax85 base
15	428070	Kit: Powermax65 and Powermax85 work lead receptacle (power supply side)
16		Work lead (see page 7-21 <i>Accessory parts</i> for a complete list of work leads with kit numbers)

## Exterior, rear



Item	Part number	Description
1	228691	Kit: Powermax65 and Powermax85 CSA power cord
2	228679	Kit: Powermax65 CE/CCC power cord
3	228678	Kit: Powermax85 CE/CCC power cord
4	228680	Kit: Powermax65 and Powermax85 power cord strain relief
5	128650	Remote start pendant for machine torch, 7.6 m (25 ft)
6	128651	Remote start pendant for machine torch, 15 m (50 ft)
7	128652	Remote start pendant for machine torch, 23 m (75 ft)
8	428755	Remote start pendant for machine torch, 45 m (150 ft)
9	228711	Kit: Powermax65 and Powermax85 Machine interface strain relief kit, raw arc voltage
	023206	Machine interface cable (start, stop, arc transfer signals), 7.6 m (25 ft), spade connectors
	023279	Machine interface cable (start, stop, arc transfer signals), 15 m (50 ft), spade connectors
	228350	Machine interface cable (start, stop, arc transfer signals) for divided arc voltage, 7.6 m (25 ft), spade connectors
	228351	Machine interface cable (start, stop, arc transfer signals) for divided arc voltage, 15 m (50 ft), spade connectors
	223048	Machine interface cable (start, stop, arc transfer signals) for divided arc voltage, 7.6 m (25 ft), D-sub connector with screws
	123896	Machine interface cable (start, stop, arc transfer signals) for divided arc voltage, 15 m (50 ft), D-sub connector with screws
	223733	External machine interface cable for PlasmaCAM® tables, 4.6 m (15 ft)
	223734	External machine interface cable for PlasmaCAM tables, 6.1 m (20 ft)
	127204	Powermax45, Powermax65, and Powermax85 Machine interface (CPC) receptacle cover
	228697	Kit: Powermax65 and Powermax85 Machine Interface Cable, internal cable with voltage divider board (CPC port upgrade)
	228539	Kit: RS485 board with internal cables (65/85)

Note: See additional parts and footnotes on the next page.

## PARTS

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Item	Part number	Description
10	428352*, **, †	Kit: Powermax65/85/105/125 plastic air filter bowl (includes O-ring)
	428415*, **, †	Kit: Powermax65/85/105/125 (Optional) nylon air filter bowl (includes O-ring)
	428015‡	Kit: Powermax65/85/105/125 metal guarded air filter bowl (includes O-ring)(OBSOLETE)
	228695	Kit: Powermax65/85/105/125 white air filter element and O-rings (compatible with all bowl types, including metal guarded bowl)

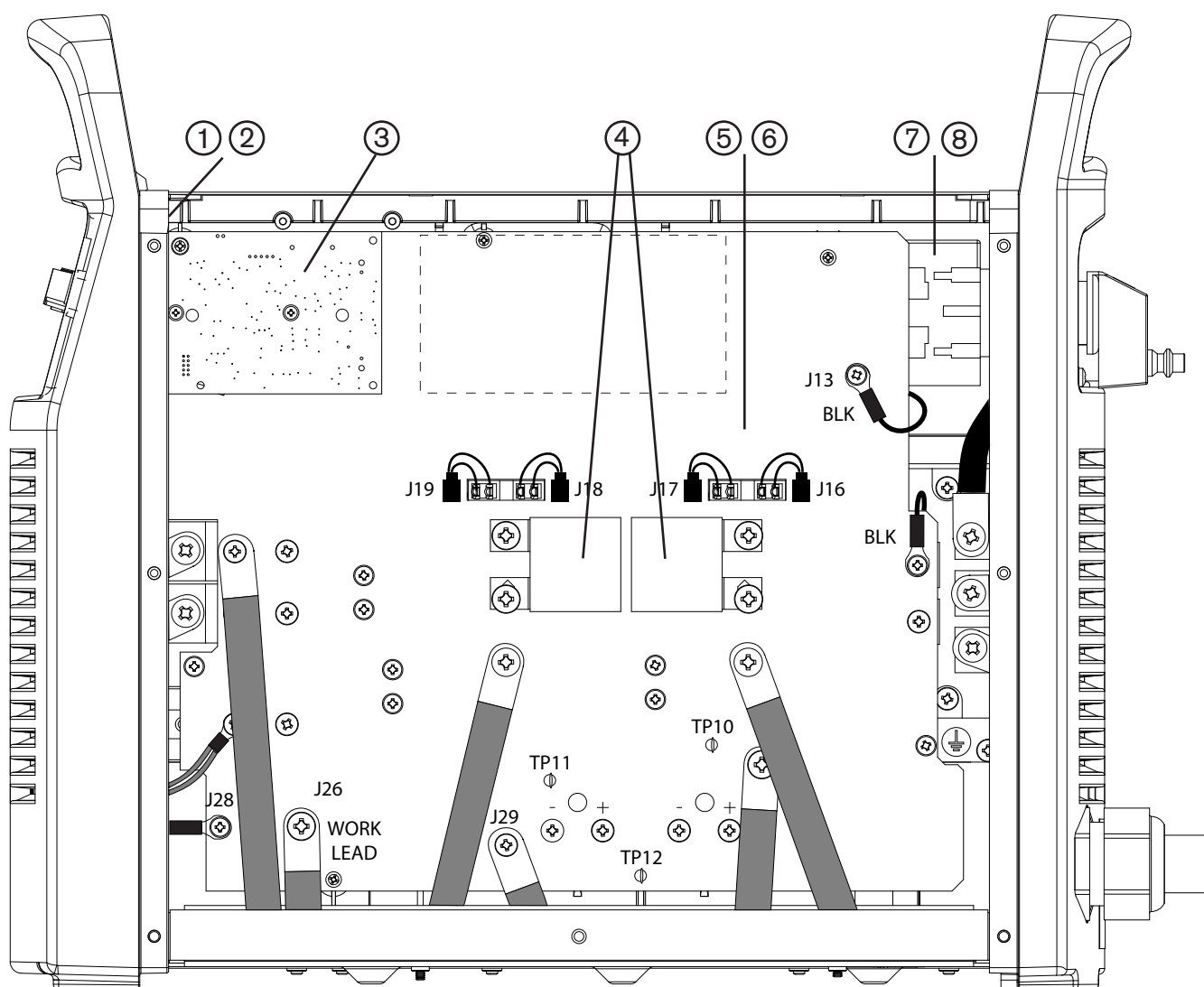
\* Filter bowl kit 428352 and 428415 only fit on air filter assembly kit 428351. See page 7-7.

\*\* If the black filter element retainers are damaged, order air filter assembly kit 428351. See page 7-7.

† The plastic air filter bowl (kit 428352) that comes with the Powermax65/85 is compatible with most air systems, but the airline should be maintained clean. Organic solvents, chemicals, cutting oil, synthetic oil, alkali, and thread lock solutions may cause harmful effects to the plastic air filter bowl. An optional nylon bowl (kit 428415) is available for sites that have difficulty preventing harsh chemicals from entering the air system.

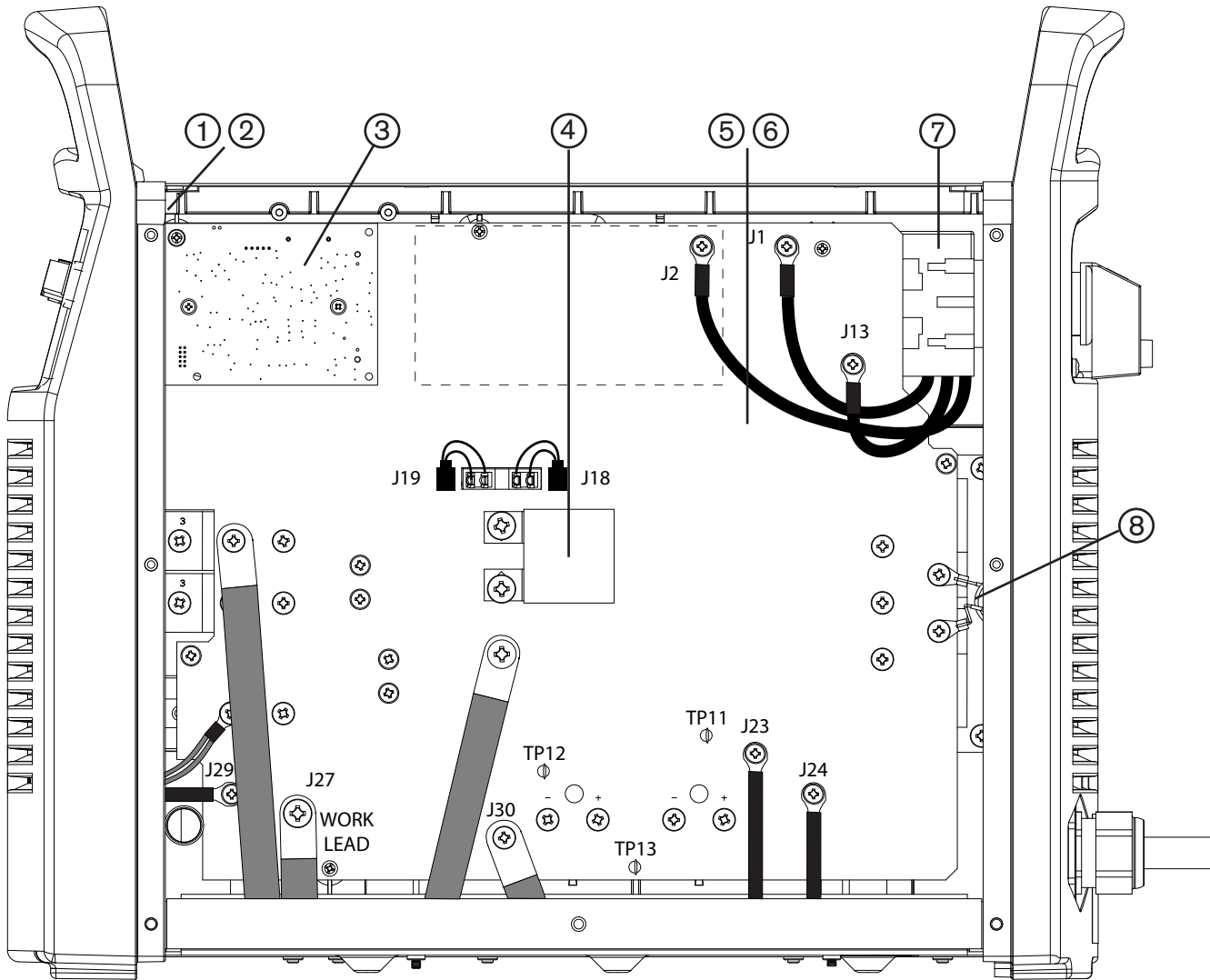
‡ Filter bowl kit 428015 is now obsolete and cannot be ordered. Order and install the full air filter assembly kit 428351 (see page 7-7).

# Interior, power board side (200 – 600V CSA)



Item	Part number	Description
1	228657	Kit: Powermax65 control board
2	228658	Kit: Powermax85 control board
3	228909	Kit: Powermax65 and Powermax85 DSP board
4	428066	Kit: Powermax65 and Powermax85 Power board capacitor, 3uF, 850 VDC
5	228659	Kit: Powermax65 Power board CSA
6	228662	Kit: Powermax85 Power board CSA
7	228644	Kit: Powermax65 CSA Power Switch
8	228655	Kit: Powermax85 CSA Power Switch
	228690	Kit: Powermax65 CSA wire group
	228700	Kit: Powermax85 CSA wire group
	228705	Kit: Powermax65 and Powermax85 component barrier
	428068	Kit: Powermax65 and Powermax85 ribbon cable (connects control board to DSP board)

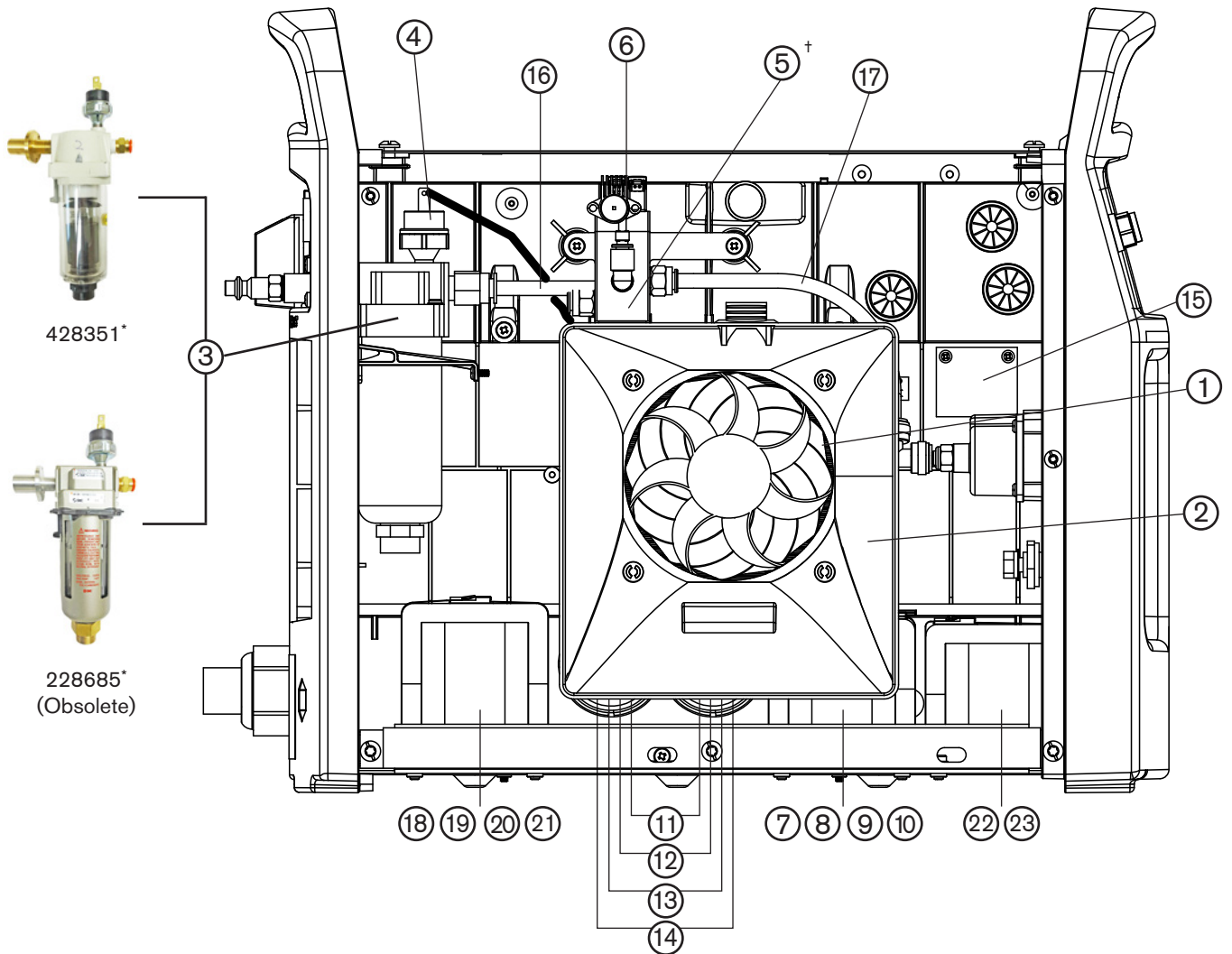
## Interior, power board side (380/400V CE)



Item	Part number	Description
1	228657	Kit: Powermax65 control board
2	228658	Kit: Powermax85 control board
3	228909	Kit: Powermax65 and Powermax85 DSP board
4	428066	Kit: Powermax65 and Powermax85 Power board capacitor, 3uF, 850 VDC
5	228708	Kit: Powermax65 Power board CE
6	228672	Kit: Powermax85 Power board CE
7	228671	Kit: Powermax65 and Powermax85 CE Power Switch
8	428412	Kit: Powermax65/85 Metal Oxide Varistor assembly
	228698	Kit: Powermax65 CE wire group
	228677	Kit: Powermax85 CE wire group
	228705	Kit: Powermax65 and Powermax85 component barrier
	428068	Kit: Powermax65 and Powermax85 ribbon cable (connects control board to DSP board)



Interior, fan side



## PARTS

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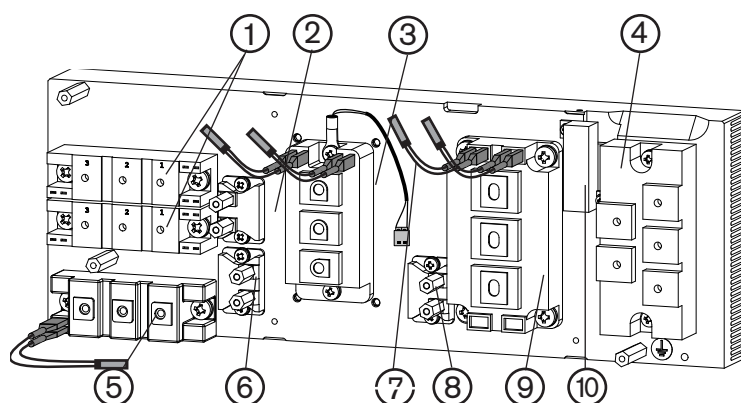
Item	Part number	Description
1	228686	Kit: Powermax65/85 fan subassembly
2	228694	Kit: Fan shroud
3	428351*	Kit: Powermax65/85/105/125 air filter assembly with connector, pressure switch, bracket, and tubing (also includes plastic air filter bowl, white air filter element, black filter element retainers, and O-ring)
	228685 *	Kit: Powermax65/85/105/125 air filter assembly (OBSOLETE)
4	228688	Kit: Powermax65 and Powermax85 pressure switch
5	228687†	Kit: Powermax65 and Powermax85 regulator (solenoid valve assembly)
6	228689	Kit: Powermax65 and Powermax85 pressure transducer
7	228663	Kit: Powermax65 transformer CSA
8	228669	Kit: Powermax65 transformer CE
9	228667	Kit: Powermax85 transformer CSA
10	228654	Kit: Powermax85 transformer CE
11	228683	Kit: Powermax65 CSA bulk capacitor (2 in kit)
12	228684	Kit: Powermax65 CE bulk capacitor (2 in kit)
13	228681	Kit: Powermax85 CSA bulk capacitor (2 in kit)
14	228682	Kit: Powermax85 CE bulk capacitor (2 in kit)
15	228697	Kit: Powermax65 and Powermax85 machine interface cable with voltage divider board
16	228641	Kit: Powermax65 and Powermax85 tubing: part number 104487 (short tube in kit)
17	228641	Kit: Powermax65 and Powermax85 tubing: part number 104488 (long tube in kit)
18	228661	Kit: Powermax65 PFC inductor CSA
19	228670	Kit: Powermax65 PFC inductor CE
20	228668	Kit: Powermax85 PFC inductor CSA
21	228664	Kit: Powermax85 PFC inductor CE
22	228648	Kit: Powermax65 output inductor
23	228665	Kit: Powermax85 output inductor

\* Air filter assembly kit 228685 is now obsolete and cannot be ordered. Order and install air filter assembly kit 428351 (shown on page 7-7). Replacement white air filter elements and O-rings are still available (see pages 7-3 through 7-4).

† Because of a manufacturing change, new solenoid valves do not have the additional gas tubing that was included on older models. See page 6-29 for details.

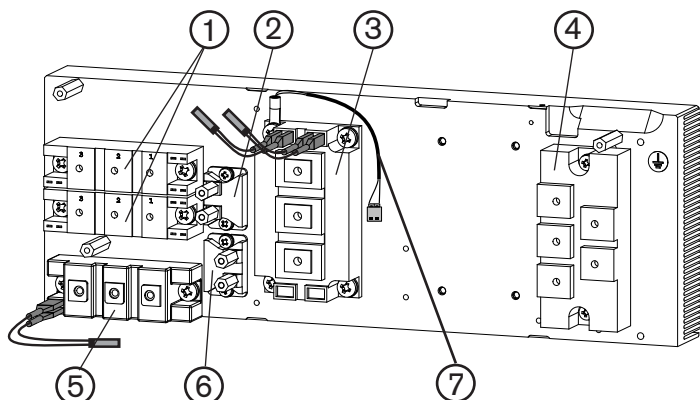
## Heat sink assembly

### 65A CSA



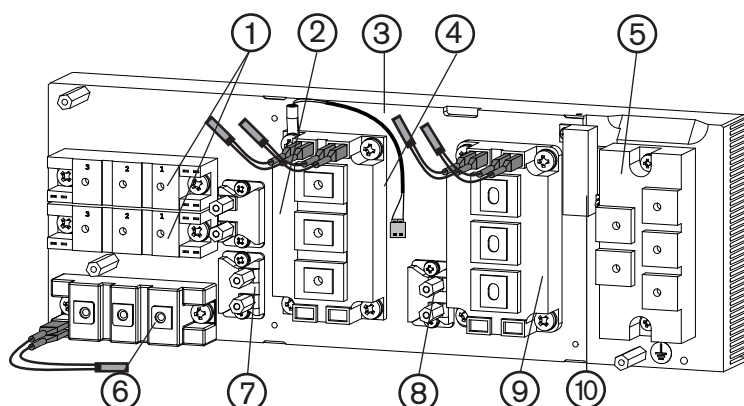
Item	Part number	Description
1	228803	Kit: Powermax65 output diode bridge
2	228693	Kit: Powermax65 and Powermax85 5 Ω snubber resistor with thermal grease
3	228704	Kit: Powermax65 inverter IGBT with thermal grease
4	228742	Kit: Powermax65 CSA/CE, Powermax85 CE input diode bridge with thermal grease
5	228692	Kit: Powermax65 pilot arc IGBT with thermal grease
6	228706	Kit: Powermax65 and Powermax85 15 Ω snubber resistor with thermal grease
7	228805	Kit: Powermax65/85/105/125 thermal switch replacement
8	228693	Kit: Powermax65 and Powermax85 5 Ω snubber resistor with thermal grease
9	228707	Kit: Powermax65 PFC IGBT with thermal grease
10	228740	Kit: Powermax65 and Powermax85 damper resistor with thermal grease
	127128	Thermal grease, T-grease 2500™, 10cc

### 65A CE



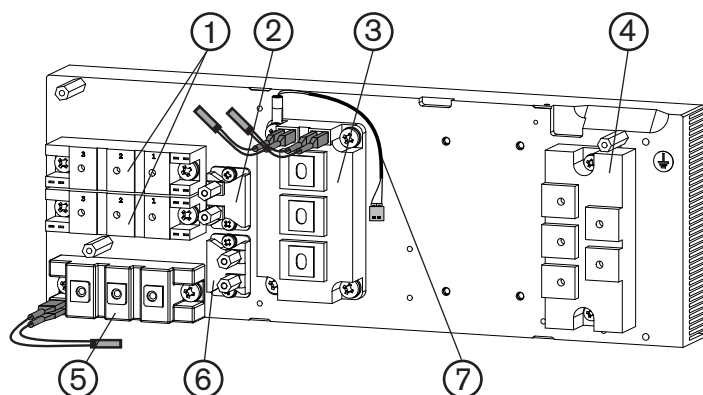
Item	Part number	Description
1	228803	Kit: Powermax65 output diode bridge
2	228693	Kit: Powermax65 and Powermax85 5 $\Omega$ snubber resistor
3	228703	Kit: Powermax85 CSA, Powermax65 CE inverter IGBT
4	228742	Kit: Powermax65 CSA/CE, Powermax85 CE input diode bridge
5	228692	Kit: Powermax65 pilot arc IGBT
6	228706	Kit: Powermax65 and Powermax85 15 $\Omega$ snubber resistor
7	228805	Kit: Powermax65/85/105/125 thermal switch replacement
	127128	Thermal grease, T-grease 2500, 10cc

## 85A CSA



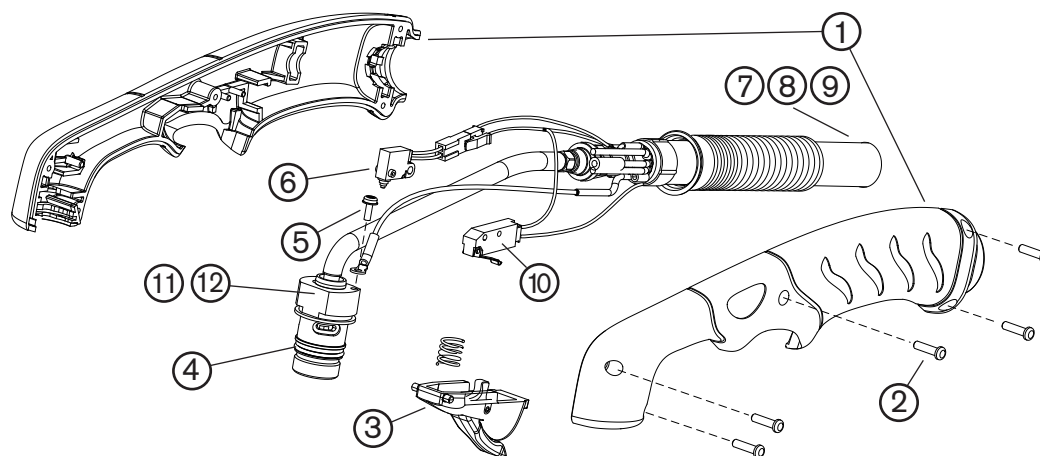
Item	Part number	Description
1	228804	Kit: Powermax85 output diode bridge
2	228693	Kit: Powermax65 and Powermax85 5 $\Omega$ snubber resistor
3	228805	Kit: Powermax65/85/105/125 thermal switch replacement
4	228703	Kit: Powermax85 CSA, Powermax65 CE inverter IGBT
5	228741	Kit: Powermax85 CSA input diode bridge
6	228701	Kit: Powermax85 pilot arc IGBT
7	228706	Kit: Powermax65 and Powermax85 15 $\Omega$ snubber resistor
8	228693	Kit: Powermax65 and Powermax85 5 $\Omega$ snubber resistor
9	228699	Kit: Powermax85 PFC IGBT
10	228740	Kit: Powermax65 and Powermax85 damper resistor
	127128	Thermal grease, T-grease 2500, 10cc

### 85A CE



Item	Part number	Description
1	228804	Kit: Powermax85 output diode bridge
2	228693	Kit: Powermax65 and Powermax85 5 Ω snubber resistor
3	228702	Kit: Powermax85 CE inverter IGBT
4	228742	Kit: Powermax85 CSA/CE, Powermax85 CE input diode bridge
5	228701	Kit: Powermax85 pilot arc IGBT
6	228706	Kit: Powermax65 and Powermax85 15 Ω snubber resistor
	127128	Thermal grease, T-grease 2500, 10cc
7	228805	Kit: Powermax65/85/105/125 thermal switch replacement

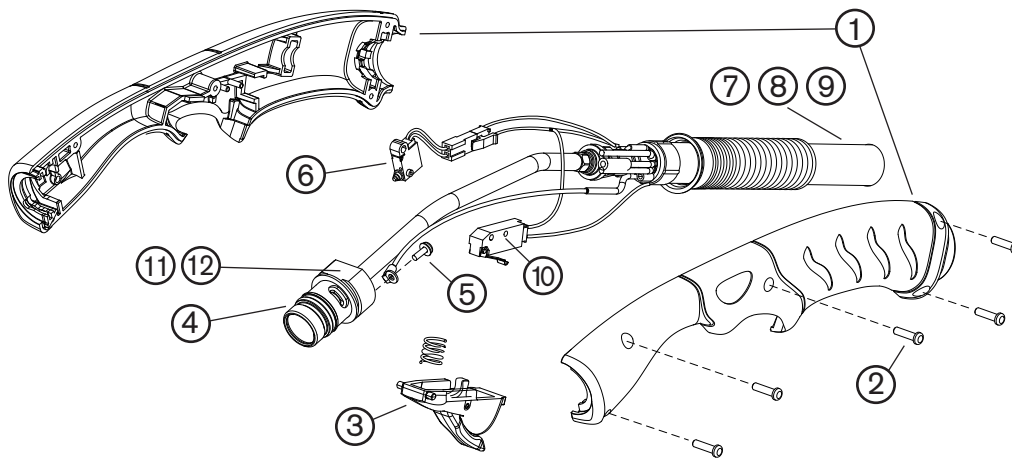
## Duramax 75° hand torch replacement parts



The entire hand torch and lead assembly can be replaced, or individual component parts can be replaced. Part numbers starting with 059 indicate complete torch and lead assemblies.

Item	Part number	Description
	059473	Powermax65/85/105 75° hand torch assembly with 7.6 m (25 ft) lead
	059474	Powermax65/85/105 75° hand torch assembly with 15 m (50 ft) lead
	059475	Powermax65/85/105 75° hand torch assembly with 23 m (75 ft) lead
1	228954	Kit: Duramax 75°/HRT torch handle replacement
2	075714	Handle screws, #4 x 1/2 pan head, S/B
3	228721	Kit: Duramax 75°/15° hand torch safety trigger with spring replacement
4	058519	O-ring: VITON .673 X .063
5	075504	Pilot terminal screw: MSCR:4-40 X 5/16 SW CN SEM PAN S/Z
6	228719	Kit: Duramax 75° hand torch cap-sensor switch replacement
7	228959	Kit: Duramax hand torch lead replacement, 7.6 m (25 ft)
8	228960	Kit: Duramax hand torch lead replacement, 15 m (50 ft)
9	228961	Kit: Duramax hand torch lead replacement, 23 m (75 ft)
10	128642	Kit: Trigger start switch replacement
11	228714	Kit: Duramax 75° hand torch main body replacement (torches built before May 2012)
12	228958	Kit: Duramax 75° hand torch main body replacement (torches built after May 2012)
	228314	Kit: Powermax45/65/85/105 torch quick disconnect repair (latch & spring)

## Duramax 15° hand torch replacement parts



The entire hand torch and lead assembly can be replaced, or individual component parts can be replaced. Part numbers starting with 059 indicate complete torch and lead assemblies.

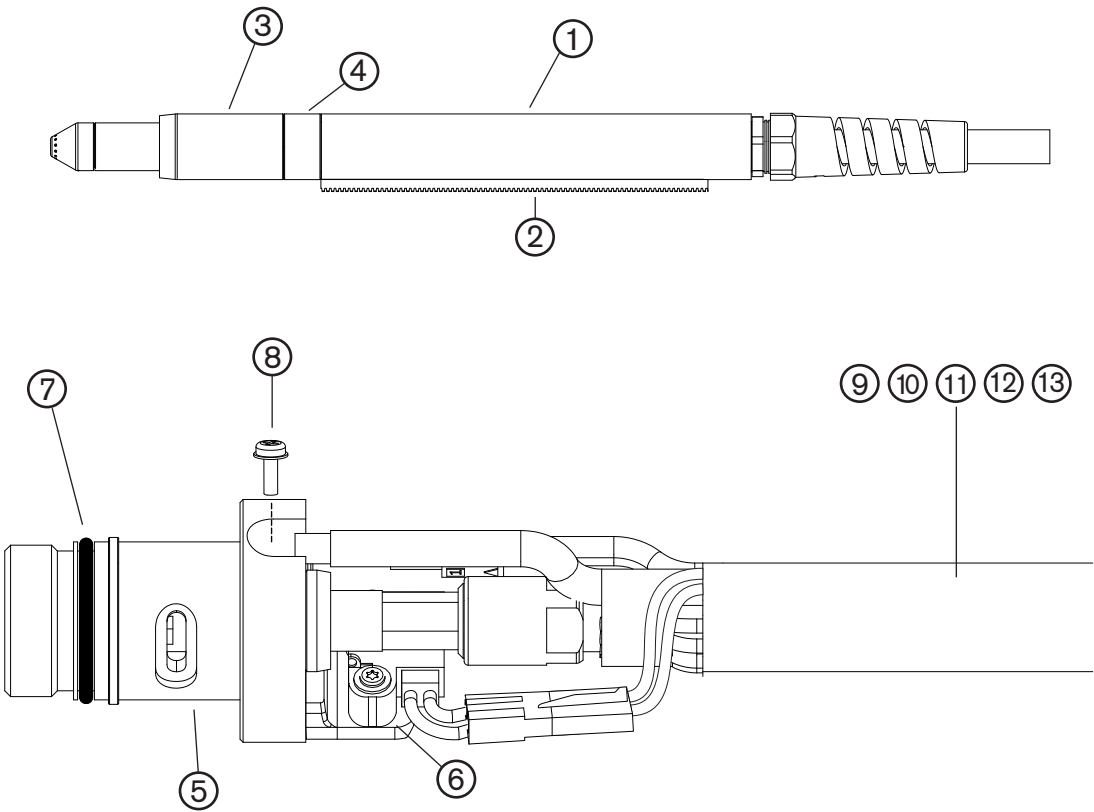
Item	Part number	Description
	059470	Powermax65/85/105 15° hand torch assembly with 7.6 m (25 ft) lead
	059471	Powermax65/85/105 15° hand torch assembly with 15 m (50 ft) lead
	059472	Powermax65/85/105 15° hand torch assembly with 23 m (75 ft) lead
1	228955	Kit: Duramax 15°/HRTs torch handle replacement
2	075714	Handle screws, #4 x 1/2 pan head, S/B
3	228721	Kit: Duramax 75°/15° hand torch safety trigger with spring replacement
4	058519	O-ring: VITON .673 X .063
5	075504	Pilot terminal screw: MSCR:4-40 X 5/16 SW CN SEM PAN S/Z
6	228109	Kit: Powermax30/45/65/85/105 15° hand torch/T30v/T45v/HRTs cap-sensor switch replacement
7	228959	Kit: Duramax hand torch lead replacement, 7.6 m (25 ft)
8	228960	Kit: Duramax hand torch lead replacement, 15 m (50 ft)
9	228961	Kit: Duramax hand torch lead replacement, 23 m (75 ft)
10	128642	Kit: Trigger start switch replacement
11	228715	Kit: Duramax 15° hand torch main body replacement (torches built before May 2012)
12	228957	Kit: Duramax 15° hand torch main body replacement (torches built after May 2012)
	228314	Kit: Powermax45/65/85/105 torch quick disconnect repair (latch & spring)



## Hand torch consumables

Part number	Description
<b>Drag cutting</b>	
220818	Shield
220854	Retaining cap
220941	Nozzle 45 A
220819	Nozzle 65 A
220816	Nozzle 85 A
220842	Electrode
220857	Swirl ring
<b>Gouging</b>	
220798	Maximum Removal gouging shield 45/65/85 A
420480	Maximum Control gouging shield 45/65/85 A
220854	Retaining cap
220797	Nozzle 65/85 A
220842	Electrode
220857	Swirl ring
<b>FineCut</b>	
220931	Deflector
220854	Retaining cap
220930	Nozzle
220842	Electrode
220947	Swirl ring
<b>CopperPlus</b>	
220777	CopperPlus electrode
<b>HyAccess</b>	
428414	Kit: Duramax HyAccess 65 A starter kit (includes 2 HyAccess electrodes and 1 of every other consumable listed below)
420413	Duramax HyAccess retaining cap
420410	Duramax HyAccess standard nozzle 65 A
420412	Duramax HyAccess gouging nozzle 65 A
420408	Duramax HyAccess electrode 65 A
220857	Swirl ring 65 A (standard Powermax65 swirl ring)

**Duramax 180° full-length machine torch replacement parts**

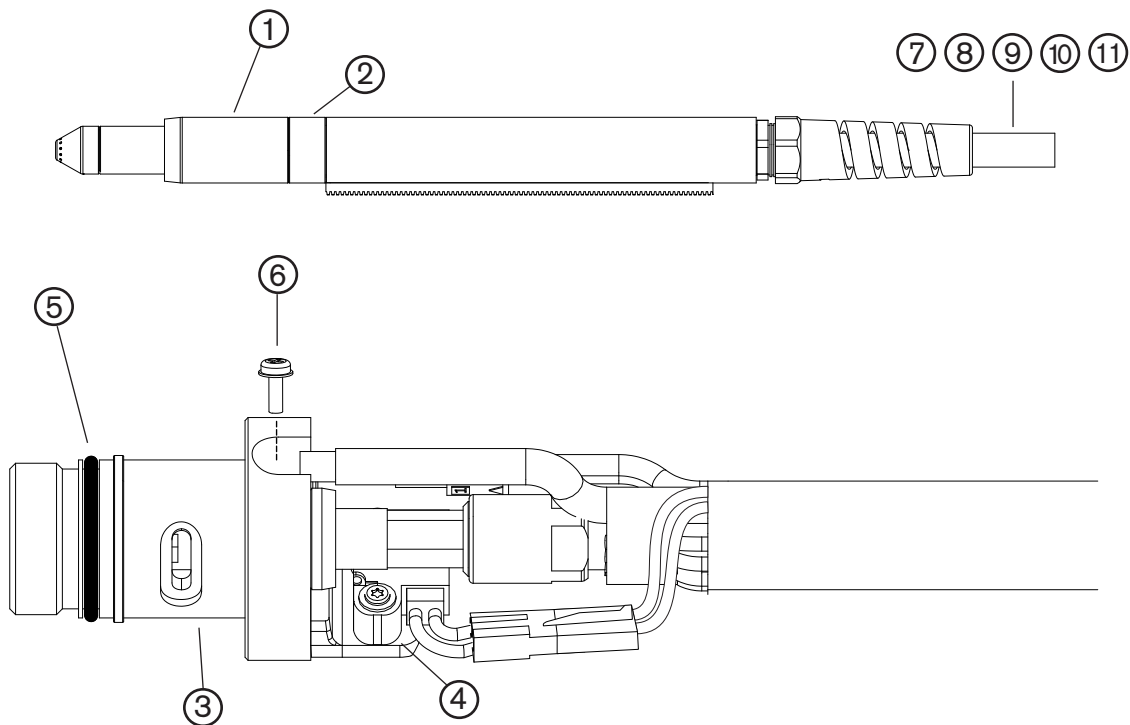


The entire machine torch and lead assembly can be replaced, or individual component parts can be replaced. Part numbers starting with 059 indicate complete torch and lead assemblies.

<b>Item</b>	<b>Part number</b>	<b>Description</b>
	059476	Powermax65/85/105 180° full-length machine torch assembly with 4.6 m (15 ft) lead
	059477	Powermax65/85/105 180° full-length machine torch assembly with 7.6 m (25 ft) lead
	059478	Powermax65/85/105 180° full-length machine torch assembly with 10.7 m (35 ft) lead
	059479	Powermax65/85/105 180° full-length machine torch assembly with 15 m (50 ft) lead
	059480	Powermax65/85/105 180° full-length machine torch assembly with 23 m (75 ft) lead
1	228737	Kit: Powermax65/85/105 180° full-length machine torch/MRT positioning sleeve
2	228738	Kit: Powermax65/85/105 180° full-length machine torch/MRT removable gear rack replacement
3	228735	Kit: Powermax65/85/105 180° full-length/mini machine torch/MRT front mounting sleeve
4	228736	Kit: Powermax65/85/105 180° full-length/mini machine torch/MRT adapter ring (coupler)
5	228716	Kit: Powermax65/85/105 180° full-length/mini machine torch main body replacement
6	228720	Kit: Duramax/MRT 180° machine and robotic torch cap-sensor switch replacement
7	058519	O-ring: VITON .673 X .063
8	075504	Pilot terminal screw: MSCR:4-40 X 5/16 SW CN SEM PAN S/Z
9	228730	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 4.6 m (15 ft)
10	228731	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 7.6 m (25 ft)
11	228732	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 10.7 m (35 ft)
12	228733	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 15 m (50 ft)
13	228734	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 23 m (75 ft)
	228314	Kit: Powermax45/65/85/105 torch quick disconnect repair (latch & spring)

### Duramax 180° mini machine torch replacement parts

Note: This illustration shows the Duramax 180° machine torch. The Duramax 180° mini machine torches do not have a positioning sleeve and gear rack.



The entire machine torch and lead assembly can be replaced, or individual component parts can be replaced. Part numbers starting with 059 indicate complete torch and lead assemblies.

<b>Item</b>	<b>Part number</b>	<b>Description</b>
	059481	Powermax65/85/105 180° mini machine torch assembly with 4.6 m (15 ft) lead
	059482	Powermax65/85/105 180° mini machine torch assembly with 7.6 m (25 ft) lead
	059483	Powermax65/85/105 180° mini machine torch assembly with 10.7 m (35 ft) lead
	059484	Powermax65/85/105 180° mini machine torch assembly with 15 m (50 ft) lead
1	228735	Kit: Powermax65/85/105 180° full-length/mini machine torch/MRT front mounting sleeve
2	228736	Kit: Powermax65/85/105 180° full-length/mini machine torch/MRT adapter ring (coupler)
3	228716	Kit: Powermax65/85/105 180° full-length/mini machine torch main body replacement
4	228720	Kit: Duramax/MRT 180° machine and robotic torch cap-sensor switch replacement
5	058519	O-ring: VITON .673 X .063
6	075504	Pilot terminal screw: MSCR:4-40 X 5/16 SW CN SEM PAN S/Z
7	228730	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 4.6 m (15 ft)
8	228731	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 7.6 m (25 ft)
9	228732	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 10.7 m (35 ft)
10	228733	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 15 m (50 ft)
11	228734	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 23 m (75 ft)
	228314	Kit: Powermax45/65/85/105 torch quick disconnect repair (latch & spring)

**Machine torch consumables**

<b>Part number</b>	<b>Description</b>
<b>Shielded</b>	
220817	Shield
220854	Retaining cap
220953	Ohmic retaining cap
220941	Nozzle 45 A
220819	Nozzle 65 A
220816	Nozzle 85 A
220842	Electrode
220857	Swirl ring
<b>Unshielded</b>	
220955	Deflector
220854	Retaining cap
220941	Nozzle 45 A
220819	Nozzle 65 A
220816	Nozzle 85 A
220842	Electrode
220857	Swirl ring
<b>Gouging</b>	
220798	Maximum Removal gouging shield 45/65/85 A
420480	Maximum Control gouging shield 45/65/85 A
220854	Retaining cap
220797	Nozzle 65/85 A
220842	Electrode
220857	Swirl ring
<b>FineCut*</b>	
220955	Deflector
220948	Shield
220854	Retaining cap
220953	Ohmic retaining cap
220930	Nozzle
220842	Electrode
220947	FineCut swirl ring

\* The deflector (220955) is used only with the standard retaining cap (220854). The shield (220948) is used only with the ohmic retaining cap (220953).

## Accessory parts

<b>Part number</b>	<b>Description</b>
024877	Leather torch sheathing, black leather with logos, 7.6 m (25 ft)
127102	Basic plasma (circles and lines) cutting guide
027668	Deluxe plasma (circles and lines) cutting guide
017059	Bevel cutting guide
127301	Powermax65 and Powermax85 dust cover
128647	Kit: Eliminer air filter (for moisture removal)
011092	Replacement filter element for Eliminer air filter
228570	Kit: Eliminer air filter with protective metal cover
228624	Kit: Eliminer filter protective metal cover
428719	Kit: Oil removal coalescing filter
428720	Kit: Replacement filter element for oil removal coalescing filter
428718	Kit: Mounting bracket for Eliminer air filter or oil removal coalescing filter
223125	Kit: 65 A Work lead with hand clamp, 7.6 m (25 ft)
223126	Kit: 65 A Work lead with hand clamp, 15 m (50 ft)
223127	Kit: 65 A Work lead with hand clamp, 23 m (75 ft)
223194	Kit: 65 A Work lead with C-style clamp, 7.6 m (25 ft)
223195	Kit: 65 A Work lead with C-style clamp, 15 m (50 ft)
223196	Kit: 65 A Work lead with C-style clamp, 23 m (75 ft)
223200	Kit: 65 A Work lead with ring terminal, 7.6 m (25 ft)
223201	Kit: 65 A Work lead with ring terminal, 15 m (50 ft)
223202	Kit: 65 A Work lead with ring terminal, 23 m (75 ft)
223035	Kit: 85 A Work lead with hand clamp, 7.6 m (25 ft)
223034	Kit: 85 A Work lead with hand clamp, 15 m (50 ft)
223033	Kit: 85 A Work lead with hand clamp, 23 m (75 ft)
223203	Kit: 85 A Work lead with C-style clamp, 7.6 m (25 ft)
223204	Kit: 85 A Work lead with C-style clamp, 15 m (50 ft)
223205	Kit: 85 A Work lead with C-style clamp, 23 m (75 ft)
223209	Kit: 85 A Work lead with ring terminal, 7.6 m (25 ft)
223210	Kit: 85 A Work lead with ring terminal, 15 m (50 ft)
223211	Kit: 85 A Work lead with ring terminal, 23 m (75 ft)
229370	Kit: Powermax65 and Powermax85 Wheel kit assembly

### Powermax65 and Powermax85 labels

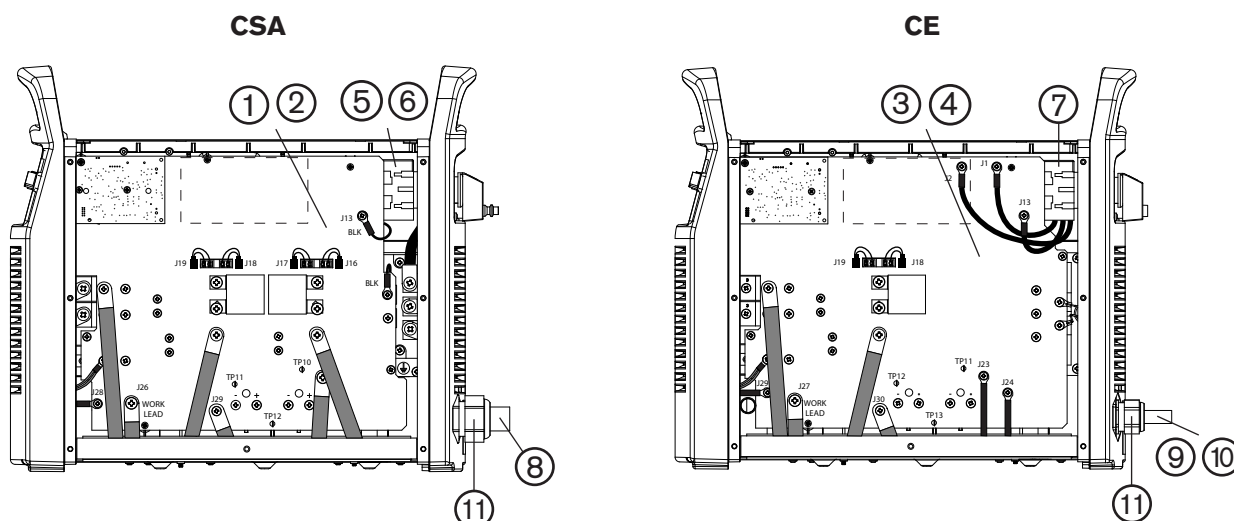
Item	Part number	Description
	228649	Kit: Powermax65 labels, CSA
	228650	Kit: Powermax65 labels, CE
	228651	Kit: Powermax85 labels, CE
	228652	Kit: Powermax85 labels, CSA

The label kits include the consumable label, appropriate safety labels, display panel label, power switch label, and side decals.



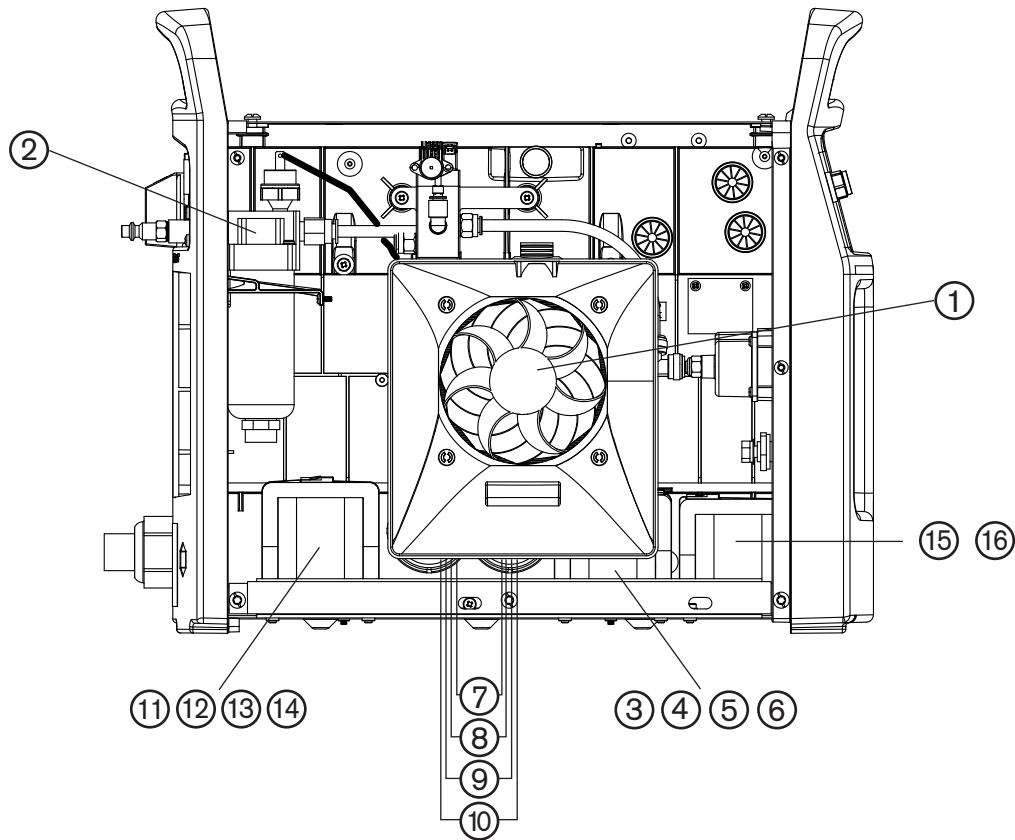
## Safety-critical parts

Genuine Hypertherm parts are the factory-recommended parts for your Hypertherm system. Any damage caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty. In addition, the parts listed below are considered safety-critical parts that must be replaced only with Hypertherm parts to maintain the warranty and all system certifications, including CE, CSA, GOST, and CCC certification.



Item	Part number	Description
1	228659	Kit: Powermax65 Power board CSA and subcomponents
2	228662	Kit: Powermax85 Power board CSA and subcomponents
3	228708	Kit: Powermax65 Power board CE and subcomponents
4	228672	Kit: Powermax85 Power board CE and subcomponents
5	228644	Kit: Powermax65 CSA power switch
6	228655	Kit: Powermax85 CSA power switch
7	228671	Kit: Powermax65 and Powermax85 CE power switch
8	228691	Kit: Powermax65 and Powermax85 CSA power cord
9	228679	Kit: Powermax65 CE/CCC power cord
10	228678	Kit: Powermax85 CE/CCC power cord
11	228680	Kit: Powermax65 and Powermax85 power cord strain relief

CSA, CE



Item	Part number	Description
1	228686	Kit: Powermax65 and Powermax85 fan subassembly
2	428351	Kit: Powermax65/85/105/125 air filter assembly (includes filter bowl, air filter element, and O-ring)
3	228663	Kit: Powermax65 transformer CSA
4	228669	Kit: Powermax65 transformer CE
5	228667	Kit: Powermax85 transformer CSA
6	228654	Kit: Powermax85 transformer CE
7	228683	Kit: Powermax65 CSA bulk capacitor (2 in kit)
8	228684	Kit: Powermax65 CE bulk capacitor (2 in kit)
9	228681	Kit: Powermax85 CSA bulk capacitor (2 in kit)
10	228682	Kit: Powermax85 CE bulk capacitor (2 in kit)
11	228661	Kit: Powermax65 PFC inductor CSA
12	228670	Kit: Powermax65 PFC inductor CE
13	228668	Kit: Powermax85 PFC inductor CSA
14	228664	Kit: Powermax85 PFC inductor CE
15	228648	Kit: Powermax65 output inductor
16	228665	Kit: Powermax85 output inductor

## Recommended spare parts

<b>Part number</b>	<b>Description</b>
108797	Adjustment knob
108732	Operating mode knob
223125	Kit: 65 A Work lead with hand clamp, 7.6 m (25 ft)
223035	Kit: 85 A Work lead with hand clamp, 7.6 m (25 ft)
228643	Kit: Powermax65 and Powermax85 front panel
228645	Kit: Powermax65 CSA rear panel
228646	Kit: Powermax65 CE rear panel
228647	Kit: Powermax85 CSA rear panel
228653	Kit: Powermax85 CE rear panel
228640	Kit: Powermax65 and Powermax85 base
228657	Kit: Powermax65 control board
228658	Kit: Powermax85 control board
228659	Kit: Powermax65 power board CSA
228662	Kit: Powermax85 power board CSA
228708	Kit: Powermax65 power board CE
228672	Kit: Powermax85 power board CE
228644	Kit: Powermax65 CSA Power Switch
228655	Kit: Powermax85 CSA Power Switch
228671	Kit: Powermax65 and Powermax85 CE Power Switch
228663	Kit: Powermax65 transformer CSA
228669	Kit: Powermax65 transformer CE
228667	Kit: Powermax85 transformer CSA
228654	Kit: Powermax85 transformer CE
228683	Kit: Powermax65 CSA bulk capacitor (2 in kit)
228684	Kit: Powermax65 CE bulk capacitor (2 in kit)
228681	Kit: Powermax85 CSA bulk capacitor (2 in kit)
228682	Kit: Powermax85 CE bulk capacitor (2 in kit)
228661	Kit: Powermax65 PFC inductor CSA
228670	Kit: Powermax65 PFC inductor CE
228668	Kit: Powermax85 PFC inductor CSA
228664	Kit: Powermax85 PFC inductor CE

<b>Part number</b>	<b>Description</b>
228648	Kit: Powermax65 output inductor
228665	Kit: Powermax85 output inductor
228688	Kit: Powermax65 and Powermax85 pressure switch
228687	Kit: Powermax65 and Powermax85 regulator (solenoid valve)
228686	Kit: Powermax65 and Powermax85 fan subassembly
428351	Kit: Powermax65/85/105/125 air filter assembly (includes filter bowl, air filter element, and O-ring)
058519	O-ring: VITON .673 X .063
228954	Kit: Duramax 75°/HRT torch handle replacement
228955	Kit: Duramax 15°/HRTs torch handle replacement
075714	Handle screws, #4 x 1/2 pan head, S/B
228721	Kit: Duramax 75°/15° hand torch safety trigger with spring replacement
228719	Kit: Duramax 75° hand torch cap-sensor switch replacement
228109	Kit: Powermax30/45/65/85/105 15° hand torch/T30v/T45v/HRTs cap-sensor switch replacement
059473	Powermax65/85/105 75° hand torch assembly with 7.6 m (25 ft) lead
059474	Powermax65/85/105 75° hand torch assembly with 15 m (50 ft) lead
059470	Powermax65/85/105 15° hand torch assembly with 7.6 m (25 ft) lead
059471	Powermax65/85/105 15° hand torch assembly with 15 m (50 ft) lead
228959	Kit: Duramax hand torch lead replacement, 7.6 m (25 ft)
228960	Kit: Duramax hand torch lead replacement, 15 m (50 ft)
059477	Powermax65/85/105 180° full-length machine torch assembly with 7.6 m (25 ft) lead
059478	Powermax65/85/105 180° full-length machine torch assembly with 10.7 m (35 ft) lead
059479	Powermax65/85/105 180° full-length machine torch assembly with 15 m (50 ft) lead
059482	Powermax65/85/105 180° mini machine torch assembly with 7.6 m (25 ft) lead
059483	Powermax65/85/105 180° mini machine torch assembly with 10.7 m (35 ft) lead
059484	Powermax65/85/105 180° mini machine torch assembly with 15 m (50 ft) lead

<b>Part number</b>	<b>Description</b>
228737	Kit: Powermax65/85/105 180° full-length machine torch/MRT positioning sleeve
228738	Kit: Powermax65/85/105 180° full-length machine torch/MRT removable gear rack replacement
228735	Kit: Powermax65/85/105 180° full-length/mini machine torch/MRT front mounting sleeve
228736	Kit: Powermax65/85/105 180° full-length/mini machine torch/MRT adapter ring (coupler)
228720	Kit: Duramax/MRT 180° machine and robotic torch cap-sensor switch replacement
228731	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 7.6 m (25 ft)
228732	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 10.7 m (35 ft)
228733	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 15 m (50 ft)



WIRING DIAGRAMS

*In this section:*

Powermax generic timing chart .....8-3

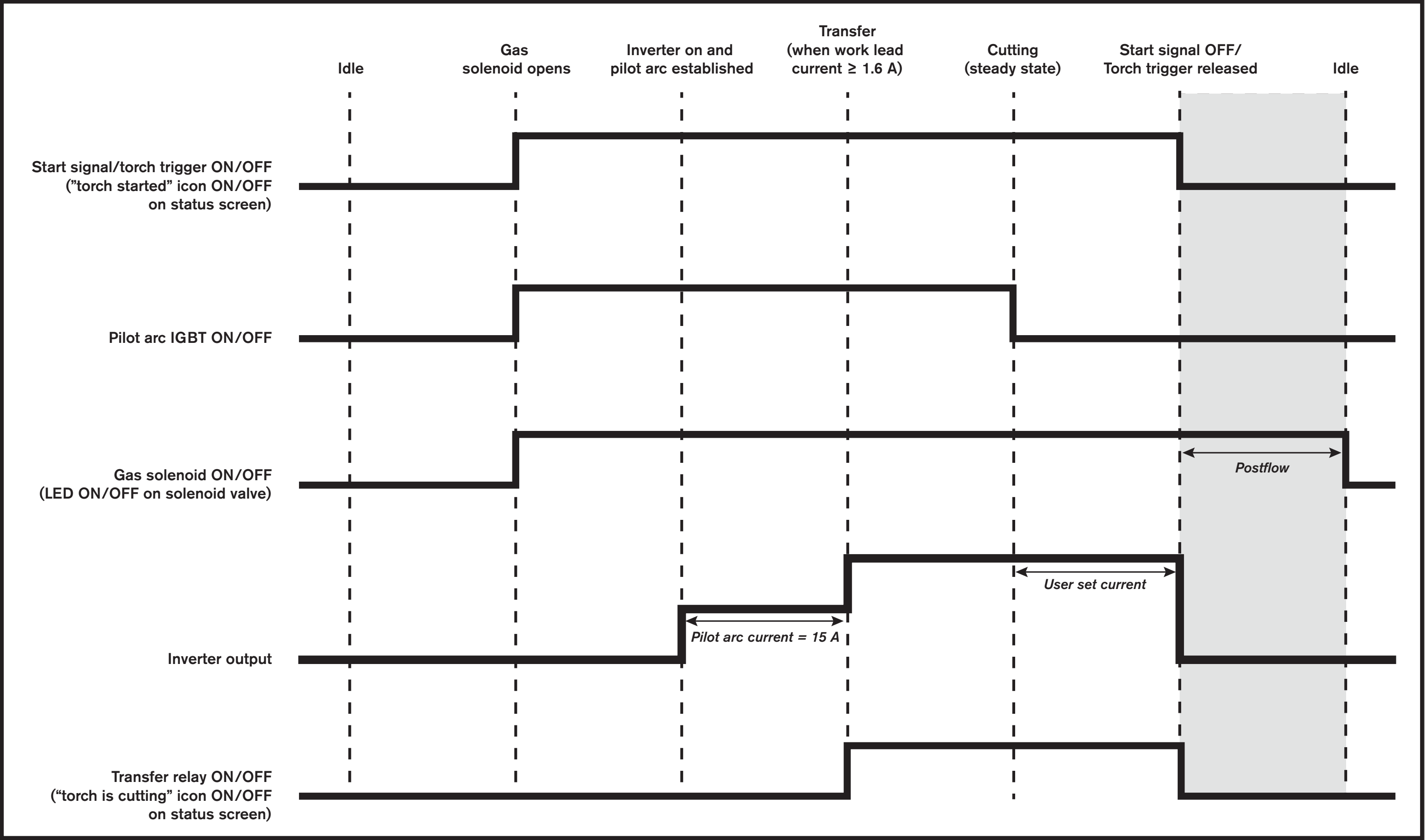
Electrical schematic diagram (CSA) .....8-4

Electrical schematic diagram (CE) .....8-5



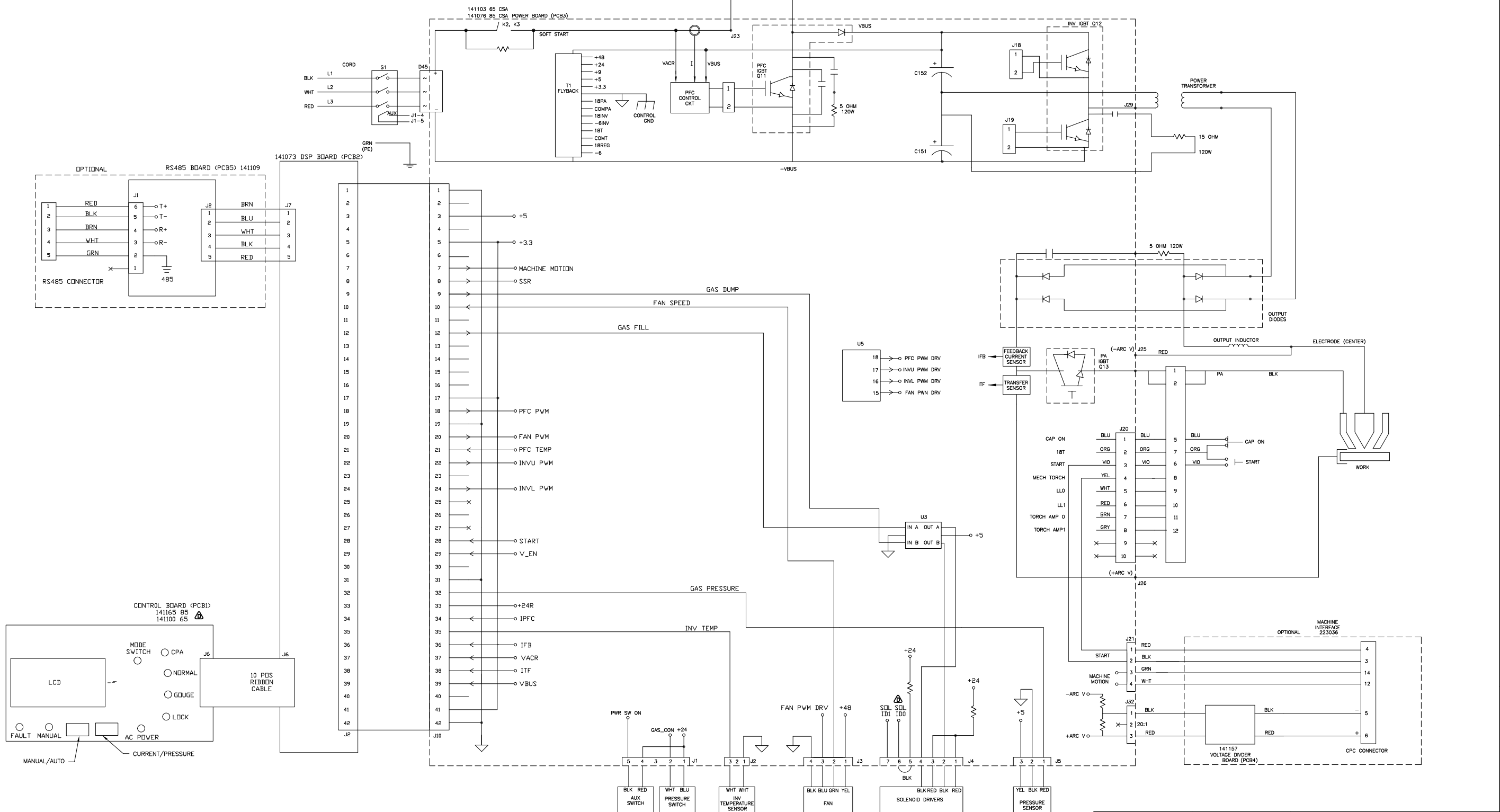


Powermax generic timing chart



Electrical schematic diagram (CSA)

REVISIONS					
REV	ECN	DATE	APPROVED	DATE	QL
D	21645	11-29-12	CSM	11-30-12	QL



MATERIAL		Hypertherm	
THIS DRAWING AND ALL INFORMATION CONTAINED THEREON IS CONSIDERED PROPRIETARY AND MAY NOT BE USED FOR MANUFACTURING OR FABRICATION PURPOSES WITHOUT PERMISSION FROM HYPER THERMAL, INC.		Box-5010 Hanover, NH 03755-5010 603/843-3441	
TOLERANCES ARE: 2 PL. DECIMAL ±.01 3 PL. DECIMAL ±.005 FRACTIONS ±1/64 ANGULAR ±.2° PART MUST BE FREE OF BURRS AND SHARP EDGES. BREAK SHARP EDGES IF NECESSARY WITH CHAMFER OR RADIUS .015 MAX.		DESCRIPTION ELEC SCHEM:65/85A CSA SYS	
ITEM NO. 013370		SCALE NTS	
DATE 05-03-10		APPROVED BY DMB	
DRAWN BY CSM		DATE 05-04-10	
SHEET 1 OF 1		DATE 05-04-10	

Electrical schematic diagram (CE)

REVISIONS					
REV	ECN	DATE	DRAWN	DATE	APPROVED
D	21645	11-29-12	CSM	11-30-12	QL

D

D

C

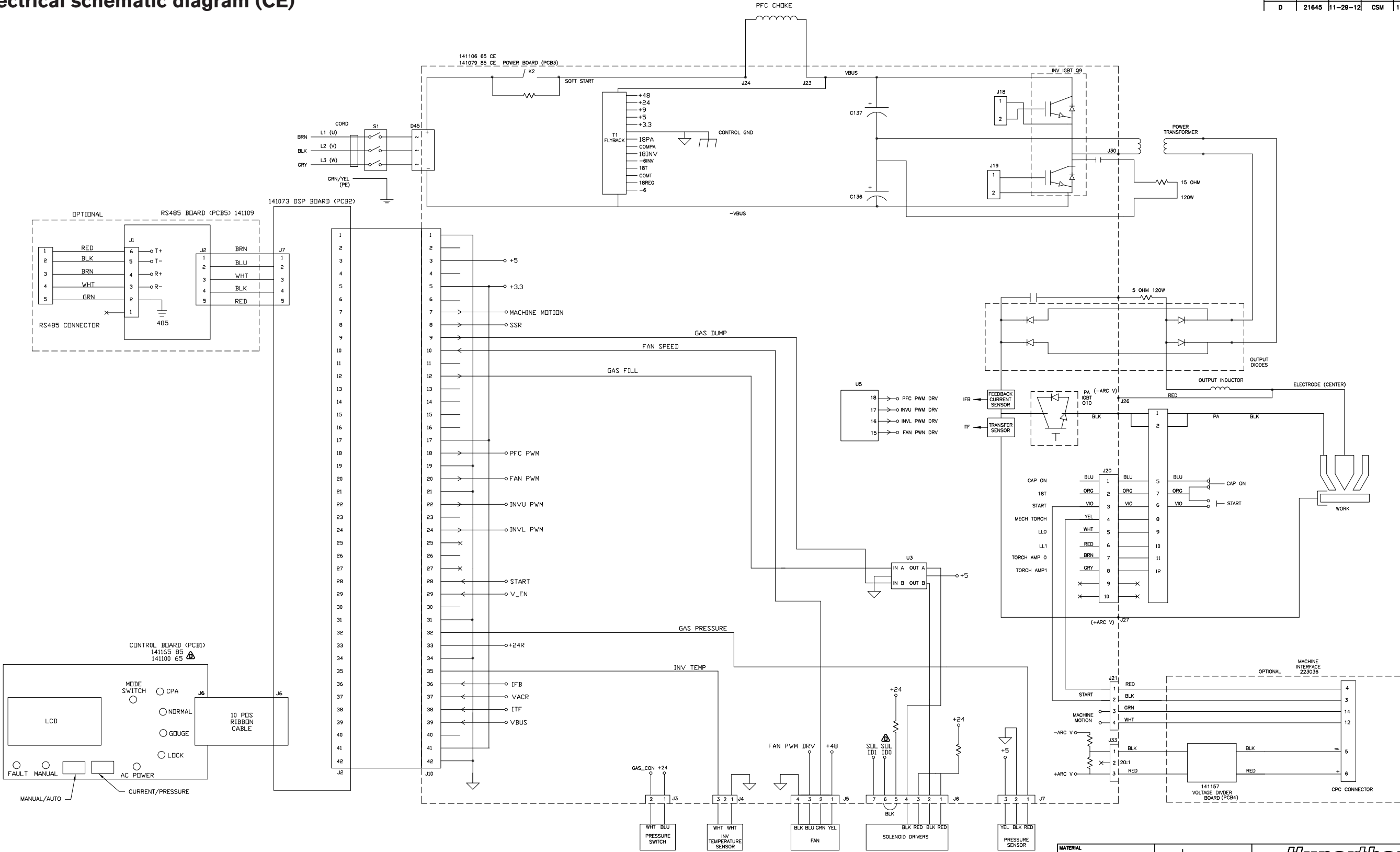
C

B

B

A

A



MATERIAL		Hypertherm	
THIS DRAWING AND ALL INFORMATION CONTAINED THEREON IS CONSIDERED PROPRIETARY AND MAY NOT BE USED FOR MANUFACTURING OR FABRICATION PURPOSES WITHOUT PERMISSION FROM HYPERTHERM, INC.		Box-5010 Hanover, NH 03755-5010 603/843-3441	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ARE: 2 PL. DECIMAL 0.01 3 PL. DECIMAL 0.005 FRACTIONS 1/64 ANGULAR .5° OF BURRS AND SHARP EDGES. BREAK SHARP EDGES IF NECESSARY WITH CHAMFER OR RADIUS .015 MAX.		DESCRIPTION ELEC SCHEM:65/85A CE SYS	
ITEM NO. 013371		FILE NAME 013371D	
DATE 05-03-10		SCALE NTS	
DRAWN BY CSM		APPROVED BY DMB	
DATE 05-04-10		SHEET 1 OF 1	

