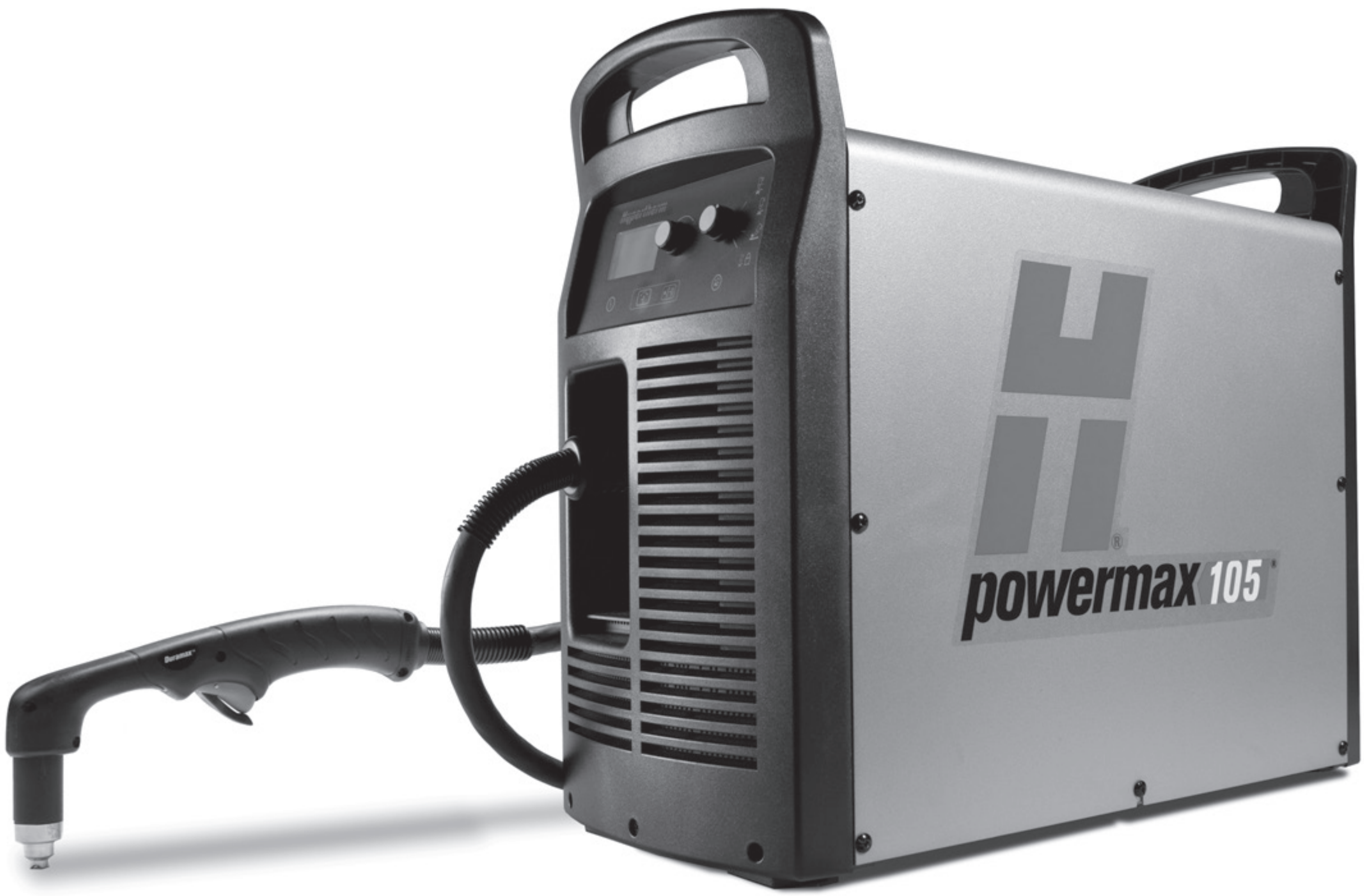
Hypertherm®

Powermax105®

Plasma Arc Cutting Systems



Service Manual

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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.

Powermax105

Service Manual

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ELECTROMAGNETIC COMPATIBILITY (EMC)

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 in crease 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.

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.

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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 Powermax105 is a highly portable, 105-amp, handheld and mechanized plasma cutting system appropriate for a wide range of applications. The Powermax system uses 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 Powermax105 can cut thicknesses up to 38 mm (1-1/2 inches) and pierce thicknesses up to 22 mm (7/8 inch). 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.

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

Powermax105 power supplies are shipped without a plug on the power cord. See the *Power Supply Setup* section for more information.

Note: Some configurations do not ship with a power cord. To maintain power supply certification, install an approved Powermax105 power cord:

- 230 – 400 V CE (kit 228886)
- 380 V CCC (kit 228962)

Powermax105 3-phase systems include the following models:

CSA	▪ The 200 – 600 V CSA model is a universal power supply that can automatically adjust to operate with AC voltages from 200 to 600 V.
CE	▪ The 400 V CE model is 400 V only. ▪ The 230 – 400 V CE model can automatically adjust from 230 to 400 V.
CE/CCC	The 230 – 400 V CE/CCC model can automatically adjust from 230 to 400 V.
CCC	▪ The 380 V CCC model is 380 V only.

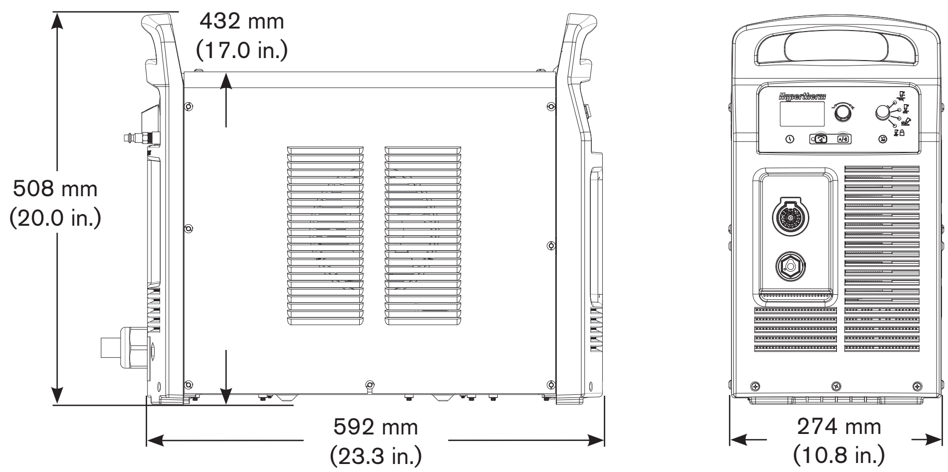
Where to find information

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 the *Power Supply Setup* section.
- Handheld and machine torch consumables, cut charts, and torch setup information — See the *Hand Torch Setup* or *Machine Torch Setup* section.
- Information about the controls and LEDs, steps for system operation, and hints for improving cut quality — See the *Basic System Operations*, *Hand Cutting*, and *Mechanized Cutting* sections.

The manual also contains sections on troubleshooting and ordering parts for your system.

Power supply dimensions



Component weights (105 A systems)

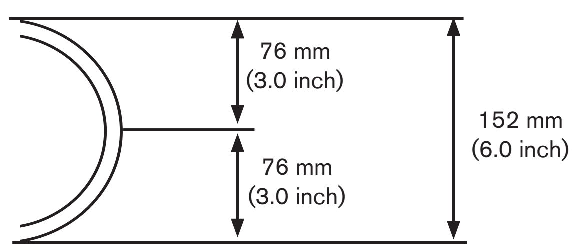
	200–600 V CSA	230–400 V CE	400 V CE	380 V CCC	380 V CCC/ 230–400 V CE
Power supply	40 kg (88 lbs)	39 kg (87 lbs)	35 kg (78 lbs)	With power cord 35 kg (78 lbs) No power cord 34 kg (74 lbs)	No power cord 36 kg (79 lbs)
With 7.6 m (25 ft) hand torch and 7.6 m (25 ft) work lead	45 kg (100 lbs)	45 kg (100 lbs)	41 kg (91 lbs)	With power cord 41 kg (91 lbs) No power cord 39 kg (87 lbs)	No power cord 42 kg (92 lbs)

Hand torch 7.6 m (25 ft)	3.3 kg (7.3 lbs)
Hand torch 15 m (50 ft)	5.9 kg (13.0 lbs)
Hand torch 23 m (75 ft)	8.4 kg (18.5 lbs)

Machine torch 4.6 m (15 ft)	2.4 kg (5.4 lbs)
Machine torch 7.6 m (25 ft)	3.4 kg (7.6 lbs)
Machine torch 11 m (35 ft)	4.5 kg (10.0 lbs)
Machine torch 15 m (50 ft)	6.2 kg (13.7 lbs)
Machine torch 23 m (75 ft)	8.7 kg (19.3 lbs)

Work lead 7.6 m (25 ft)	2.4 kg (5.3 lbs)
Work lead 15 m (50 ft)	4.4 kg (9.6 lbs)
Work lead 23 m (75 ft)	6.1 kg (13.4 lbs)

The recommended minimum bend radius for Powermax105 torch leads is 76 mm (3.0 inches).



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

Powermax105 power supply ratings

Rated open-circuit voltage (U_0)	200–600 V CSA 230–400 V CE 380 V CCC/230–400 V CE 400 V CE 380 V CCC	300 VDC 288 VDC 288 VDC 292 VDC 280 VDC
Output characteristic*	Drooping	
Rated output current (I_2)	30–105 A	
Rated output voltage (U_2)	160 VDC	
Duty cycle at 40° C (104° F)	200–600 V CSA	80% @ 105 A, 480–600 V, 3-PH 70% @ 105 A 240 V, 3-PH 54% @ 105 A 208 V, 3-PH 50% @ 105 A, 200 V, 3-PH 100% @ 94 A, 480–600 V, 3-PH 100% @ 88 A, 240 V, 3-PH 100% @ 77 A, 208 V, 3-PH 100% @ 74 A, 200 V, 3-PH
	230–400 V CE or 380 V CCC/230–400 V CE	 80% @ 105 A, 400 V, 3-PH 70% @ 105 A, 230 V, 3-PH 100% @ 94 A, 400 V, 3-PH 100% @ 88 A, 230 V, 3-PH
	400 V CE	80% @ 105 A, 400 V, 3-PH 100% @ 94 A, 400 V, 3-PH
	380 V CCC	80% @ 105 A, 380 V, 3-PH 100% @ 94 A, 380 V, 3-PH
Operating temperature	-10° to 40° C (14° to 104° F)	
Storage temperature	-25° to 55° C (-13° to 131° F)	
Power factor 200–600 V CSA, 3-PH 230–400 V CE, 3-PH 380 V CCC/230–400 V CE, 3-PH 400 V CE, 3-PH 380 V CCC, 3-PH	 0.94–0.77 0.94–0.92 0.94–0.92 0.94 0.94	
R_{sce} – Short Circuit Ratio (CE models only)	U_1 – Volts AC rms, 3-PH 230-400 V CE 400 V CE	R_{sce} 275 230

<table>
<tr><td colspan="2">EMC classification CISPR 11 (CE models only)†</td><td colspan="2">Class A</td></tr>
<tr><td rowspan="5">Input voltage (U_1)/ Input current (I_1) at rated output ($U_{2\,MAX}$, $I_{2\,MAX}$) (See the Power Supply Setup section for more information.)</td><td>200–600 V CSA</td><td colspan="2">200/208/240/480/600 V, 3-PH, 50/60 Hz
58/56/49/25/22 A</td></tr>
<tr><td>380 V CCC/
230–400 V CE**,***</td><td colspan="2">230-400 V, 3-PH, 50/60 Hz
50/29 A</td></tr>
<tr><td>230–400 V CE**,***</td><td colspan="2">230-400 V, 3-PH, 50/60 Hz
50/29 A</td></tr>
<tr><td>400 V CE***, ‡</td><td colspan="2">400 V, 3-PH, 50/60 Hz
28 A</td></tr>
<tr><td>380 V CCC</td><td colspan="2">380 V, 3-PH, 50/60 Hz
30 A</td></tr>
<tr><td>Gas type</td><td colspan="2">Air</td><td>Nitrogen</td></tr>
<tr><td>Gas quality</td><td colspan="2">Clean, dry, oil-free per
ISO 8573-1 Class 1.2.2</td><td>99.95% pure</td></tr>
<tr><td>Recommended gas inlet flow rate/ pressure</td><td colspan="3">Cutting: 220 slpm (460 scfh , 7.7 scfm) @ 5.9 bar (85 psi)
Maximum Removal gouging: 230 slpm (480 scfh, 8.0 scfm) @ 4.8 bar (70 psi)
Maximum Control gouging: 230 slpm (480 scfh, 8.0 scfm) @ 4.8 bar (70 psi)</td></tr>
</table>

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

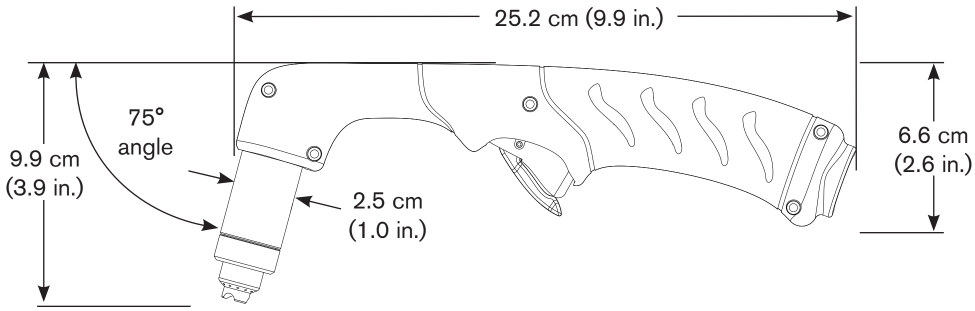
** Equipment complies with IEC 61000-3-12 provided that the short-circuit power S_{sc} is greater than or equal to 5528 KVA at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution 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 5528 KVA.

*** This product meets the technical requirements of IEC 61000-3-3 and is not subject to conditional connection.

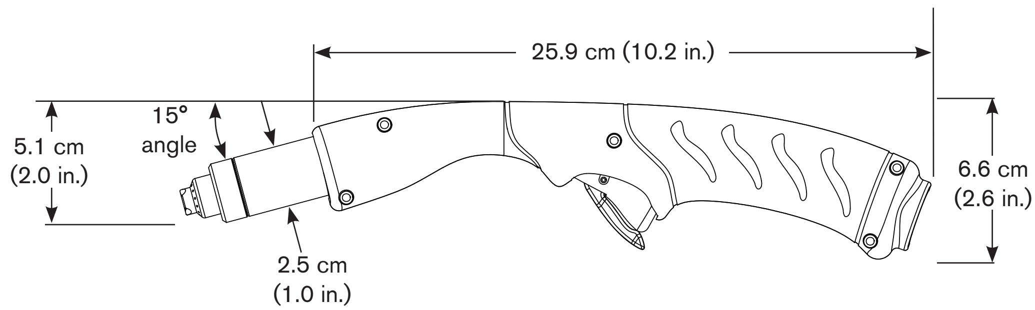
† WARNING: This Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There may be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated disturbances.

‡ Equipment complies with IEC 61000-3-12 provided that the short-circuit power S_{sc} is greater than or equal to 4462 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 4462 KVA.

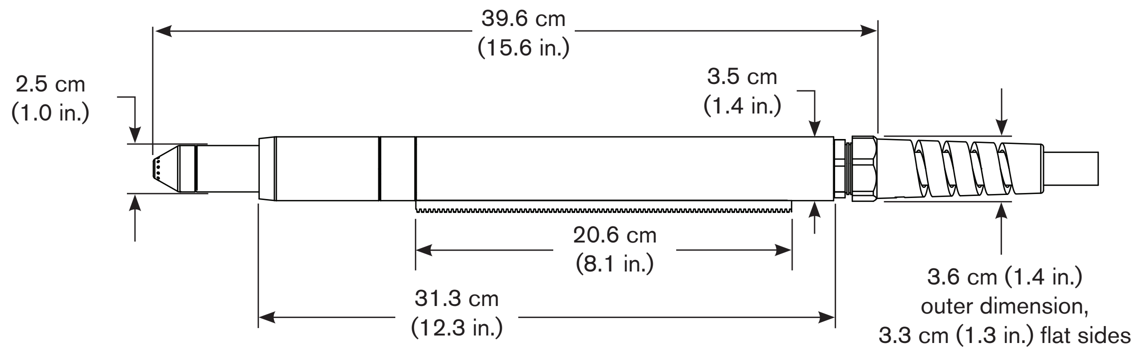
Duramax 75° hand torch dimensions



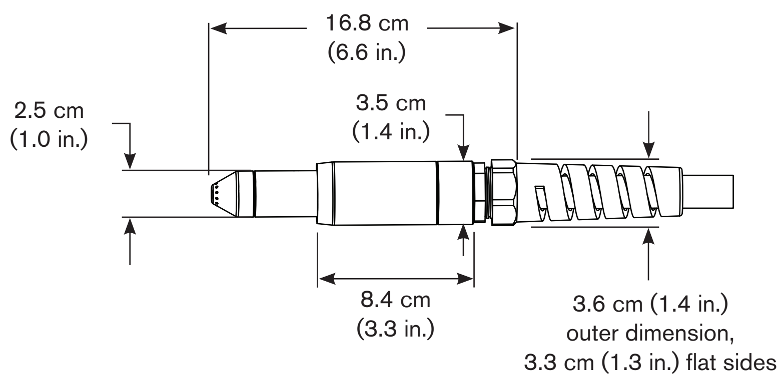
Duramax 15° hand torch dimensions



Duramax 180° full-length machine torch dimensions



Duramax 180° mini machine torch dimensions



Powermax105 cutting specifications

Handheld cut capacity (material thickness)	
Recommended cut capacity at 500 mm/min (20 ipm)*	32 mm (1-1/4 in.)
Recommended cut capacity at 250 mm/min (10 ipm)*	38 mm (1-1/2 in.)
Severance capacity at 125 mm/min (5 ipm)*	50 mm (2 in.)
Pierce capacity (material thickness)	
Pierce capacity for handheld cutting, or mechanized cutting with programmable torch height control	22 mm (7/8 in.)
Pierce capacity for mechanized cutting without programmable torch height control	20 mm (3/4 in.)
Maximum cut speed (mild steel)**	
6 mm (1/4 in.)	5600 mm/min (220 ipm)
12 mm (1/2 in.)	2400 mm/min (95 ipm)
20 mm (3/4 in.)	1300 mm/min (50 ipm)
25 mm (1 in.)	760 mm/min (30 ipm)
32 mm (1-1/4 in.)	510 mm/min (20 ipm)
Gouging capacity	
Maximum Removal metal removal rate on mild steel (65 A)	4.8 kg/hr (10.7 lbs/hr)
Maximum Control metal removal rate on mild steel (65 A)	3.4 kg/hr (7.5 lbs/hr)
Maximum Removal metal removal rate on mild steel (85 A)	8.8 kg/hr (19.5 lbs/hr)
Maximum Control metal removal rate on mild steel (85 A)	6.2 kg/hr (13.7 lbs/hr)
Maximum Removal metal removal rate on mild steel (105 A)	9.8 kg/hr (21.7 lbs/hr)
Maximum Control metal removal rate on mild steel (105 A)	6.9 kg/hr (15.2 lbs/hr)
Duramax series torch weights (refer to page 1-5 *Component weights (105 A systems)]* **)**	
Duty cycle and voltage information (refer to page *1-6 Powermax105 power supply ratings***)**	

* 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

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.

N30932

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.

И005 13

Serbian AAA mark

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

Noise levels

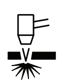
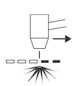
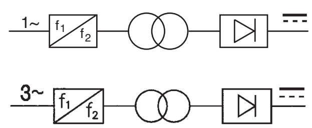
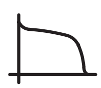
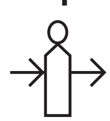
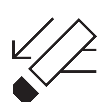
Acceptable noise levels as defined by national and local codes may be exceeded by this plasma system. Always wear proper ear protection when cutting or gouging. Any noise measurements taken are dependant on the specific environment in which the system is used. See also *Noise can damage hearing* in the *Safety and Compliance Manual* included with your system. Specific information by product can be found in the Hypertherm documents library at:

https://www.hypertherm.com/

Click Documents library, select a product from the Product Type drop-down menu, select “Regulatory” from the Category drop-down menu, and select “Acoustical Noise Data Sheets” from the Sub Category drop-down menu.

IEC symbols

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

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

Section 2

POWER SUPPLY SETUP

In this section:

Unpack the Powermax system....2-2
Claims....2-2
Contents....2-3
Position the power supply....2-4
Prepare the electrical power....2-4
Install a line-disconnect switch....2-5
Requirements for grounding....2-5
Power connection for the Powermax105....2-6
Three-phase power cord and plug installation....2-8
Extension cord recommendations....2-9
Extension cord specifications....2-9
Engine-driven generator recommendations....2-10
Prepare the gas supply....2-11
Additional gas filtration....2-11
Connect the gas supply....2-13

Unpack the Powermax system

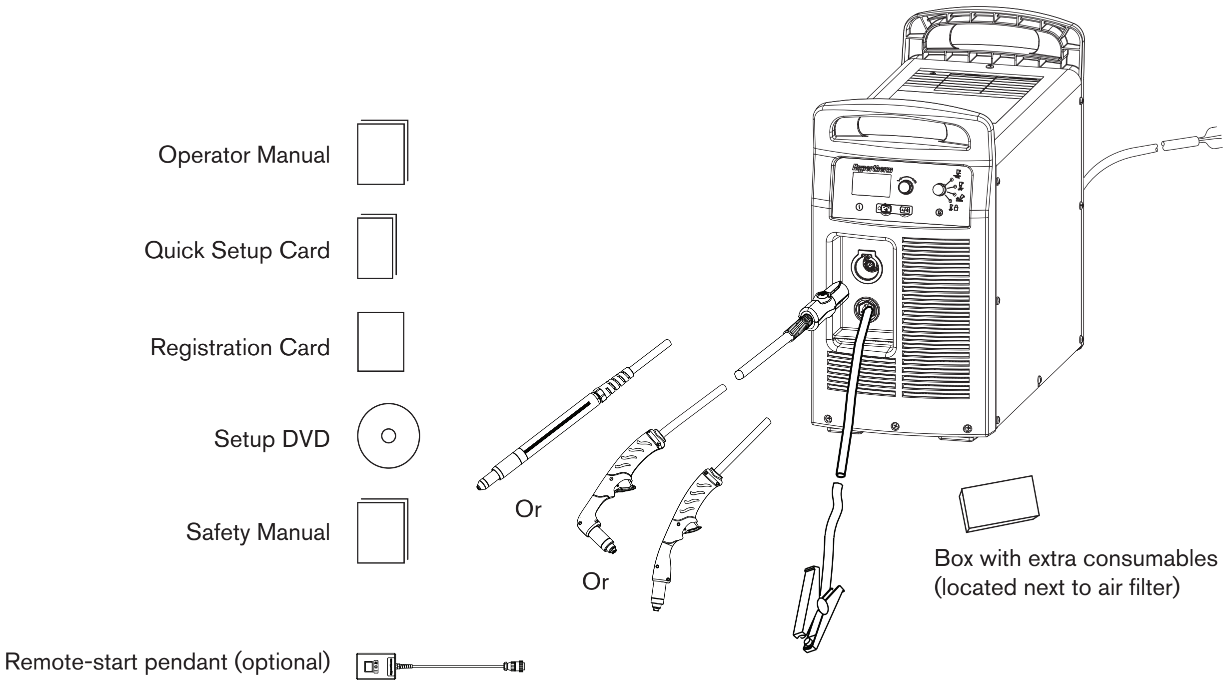
1. Verify that all items on your order have been received in good condition. Contact your distributor if any parts are damaged or missing.
2. Inspect the power supply for damage that may have occurred during shipping. If there is evidence of damage, refer to *Claims* below. All communications regarding 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

The following illustration shows typical system components. A vinyl cap is installed on torches that ship with new systems. Consumables are included in the consumables box.



Position the power supply

Locate the power supply near an appropriate power receptacle for your installation:

- 200–600 volts (3-phase, CSA certified)
- 230–400 volts (3-phase, CE certified)
- 380/230–400 volts (3-phase, CCC/CE certified) without power cord

  Note: To maintain CE certification, install power cord kit 228886.
- 400 volts (3-phase, CE certified)
- 380 volts (3-phase, CCC certified).

The power supply has a 3 m (10 ft) power cord (depending upon the model). Allow at least 0.25 m (10 inches) 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 on page 2-6. 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 page 2-6 *Power connection for the Powermax105* 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.
- 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 Powermax105

Powermax105 3-phase systems include the following models:

- The 200–600 V CSA model is a universal power supply that can automatically adjust to operate with AC voltages from 200 to 600 V.
- The 230–400 V CE model can automatically adjust from 230 to 400 V.
- The 380 V CCC/230–400 V CE model can automatically adjust from 230 to 400 V.

  Note: To maintain CE certification, install power cord kit 228886.
- The 400 V CE model is 400 V only.
- The 380 V CCC model is 380 V only.

The rated output is 30–105 A, 160 VDC.

200–600 V CSA					
Input voltage (V)	200	208	240	480	600
Input current (A) at rated output (16.8 kw)	58	56	49	25	22
Input current (A) at arc stretch	82	82	78	40	35
Fuse, slow-blow (A)	80	80	80	40	40

230–400 V CE		
Input voltage (V)	230	400
Input current (A) at rated output (16.8 kw)	50	29
Input current (A) at arc stretch	80	46
Fuse, slow-blow (A)	80	50

380 V CCC/230–400 V CE			
Input voltage (V)	230	400	380
Input current (A) at rated output (16.8 kw)	50	29	30
Input current (A) at arc stretch	80	46	42
Fuse, slow-blow (A)	80	50	50

400 V CE	
Input voltage (V)	400
Input current (A) at rated output (16.8 kw)	28
Input current (A) at arc stretch	44
Fuse, slow-blow (A)	50

380 V CCC	
Input voltage (V)	380
Input current (A) at rated output (16.8 kw)	30
Input current (A) at arc stretch	42
Fuse, slow-blow (A)	50

Three-phase power cord and plug installation

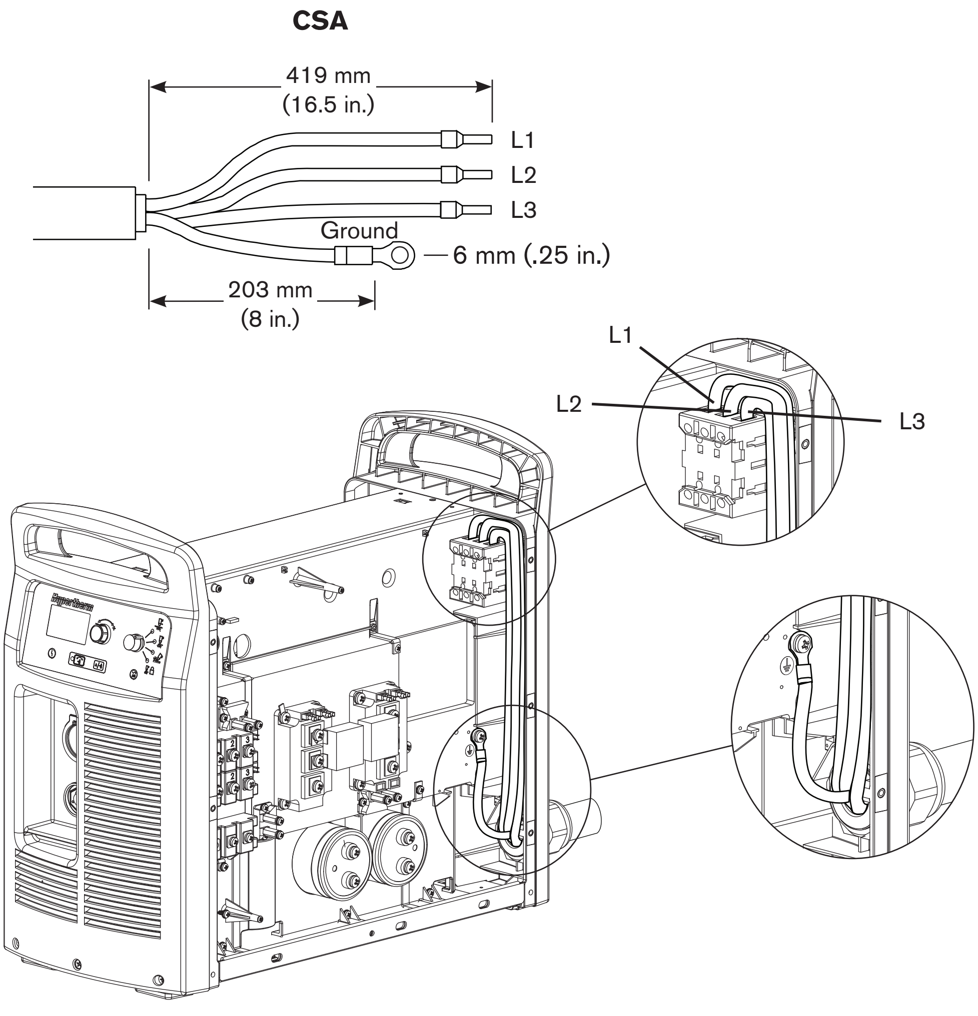
Powermax105 power supplies are shipped with the following power cords:

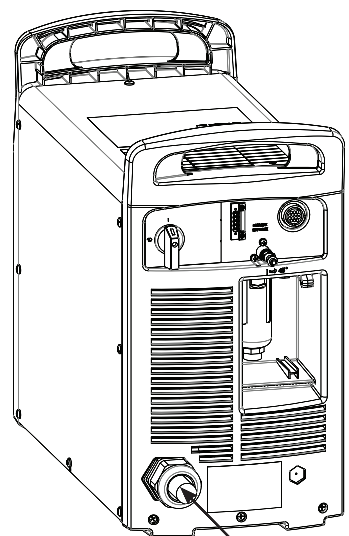
- CSA models: 6 AWG 4-wire power cord
- 230–400 V CE: 10 mm^2, 4-wire HAR power cord
- 380 V CCC/230–400 V CE ships without a power cord

  Note: To maintain CE certification, install power cord kit 228886.
- 400 V CE: 6 mm^2, 4-wire HAR power cord
- 380 V CCC: 6 mm^2, 4-wire CCC power cord (some models ship without a power cord)

To operate the Powermax105, use a plug that meets national and local electrical codes. The plug must be connected to the power cord by a licensed electrician.

Strip and prepare the power cord wires as shown below.





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		< 3 m (< 10 ft)	3–7.5 m (10–25 ft)	7.5–15 m (25–50 ft)	15–30 m (50–100 ft)	30–45 m (100–150 ft)
200–600 V CSA						
Input voltage (VAC)	**Phase**	**mm^2 (AWG)**	**mm^2 (AWG)**	**mm^2 (AWG)**	**mm^2 (AWG)**	**mm^2 (AWG)**
200–240	3	16 (6)	16 (6)	16 (6)	25 (4)	35 (2)
480–600	3	6 (10)	6 (10)	6 (10)	6 (10)	6 (10)
230–400 V CE						
Input voltage (VAC)	**Phase**	**mm^2**	**mm^2**	**mm^2**	**mm^2**	**mm^2**
230	3	16	16	16	25	25
400	3	10	10	10	10	10
380 V CCC/230–400 V CE						
Input voltage (VAC)	**Phase**	**mm^2**	**mm^2**	**mm^2**	**mm^2**	**mm^2**
230	3	16	16	16	25	25
400	3	10	10	10	10	10
380	3	10	10	10	10	10
400 V CE						
Input voltage (VAC)	**Phase**	**mm^2**	**mm^2**	**mm^2**	**mm^2**	**mm^2**
400	3	10	10	10	10	10
380 V CCC						
Input voltage (VAC)	**Phase**	**mm^2**	**mm^2**	**mm^2**	**mm^2**	**mm^2**
380	3	10	10	10	10	10

Engine-driven generator recommendations

Generators used with the Powermax105 should satisfy the following requirements:

200–600 V CSA

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

230–400 V CE

3-phase, 50/60 Hz, 230–400 VAC (400 VAC recommended for best performance)

380 V CCC/230–400 V CE

3-phase, 50/60 Hz, 230–400 VAC (400 VAC recommended for best performance)

400 V CE

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

380 V CCC

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

Engine drive rating	System output current	Performance (arc stretch)
30 kw	105 A	Full
22.5–25	105 A	Limited
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 60 to 70 seconds before turning ON again.

Prepare the gas supply

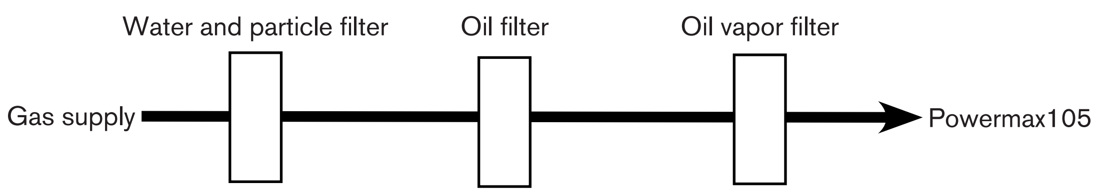
The air can be supplied by a compressor or from high-pressure cylinders. A high-pressure regulator must be used on either type of supply and must be capable of delivering gas to the air inlet on the power supply.

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^3 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^3.

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.



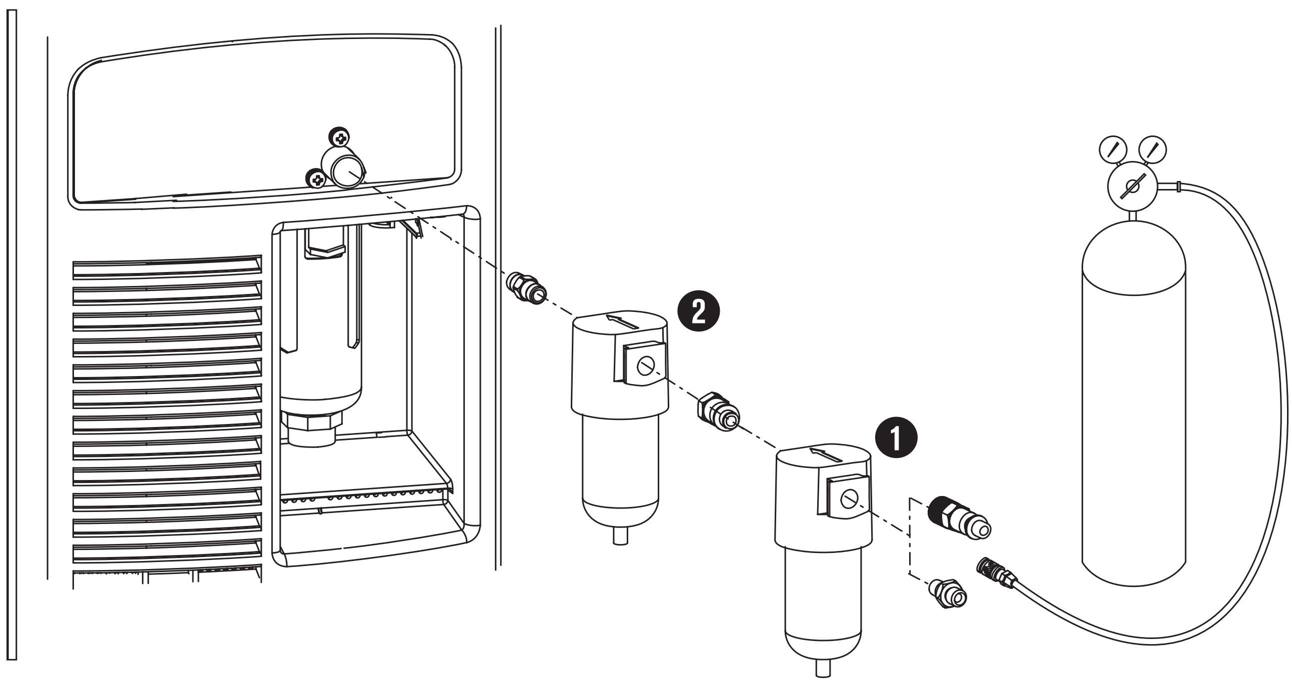
The filtering system should be installed between the gas supply and the power supply. Additional gas filtration may increase the required minimum inlet pressure.

Hypertherm offers these optional external filter kits:

1. The Eliminizer moisture removal air filter kit (128647) removes water and dirt from the gas supply. For more information, refer to Field Service Bulletin 804180.
2. 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.

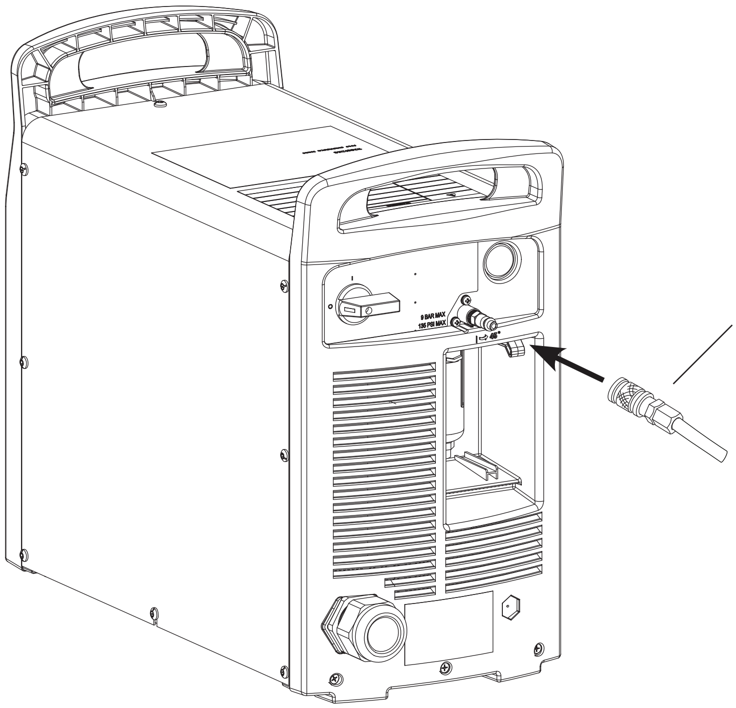
Note: For additional parts related to these filter kits, see page *11-21 Accessory parts.*

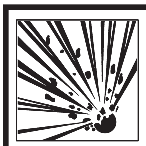
If you use both external filters, install them in the order shown to prevent damage to the gas line and equipment.



Connect the gas supply

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





WARNING

Do not allow the gas supply pressure to exceed 9.3 bar (135 psi). 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)	**15.2 m (50 ft)**	**22.9 m (75 ft)**
Cutting	5.2 bar (75 psi)	5.5 bar (80 psi)	5.9 bar (85 psi)
Maximum Removal gouging	4.1 bar (60 psi)	4.5 bar (65 psi)	4.8 bar (70 psi)
Maximum Control gouging	4.1 bar (60 psi)	4.5 bar (65 psi)	4.8 bar (70 psi)

Gas flow rates

Cutting	220 slpm (460 scfh, 7.7 scfm) at a minimum 5.9 bar (85 psi)
Maximum Removal gouging	230 slpm (480 scfh, 8.0 scfm) at a minimum 4.8 bar (70 psi)
Maximum Control gouging	230 slpm (480 scfh, 8.0 scfm) at a minimum 4.8 bar (70 psi)

Section 3

BASIC SYSTEM OPERATIONS

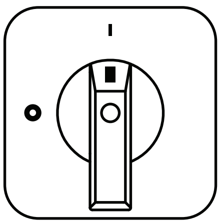
In this section:

Controls and indicators 3-2
Rear controls 3-2
Front controls and LEDs 3-2
Status screen 3-4
Operating the Powermax105 3-6
Connect the electrical power, gas supply, and torch lead 3-6
Attach the work lead to the power supply 3-7
Attach the work clamp to the workpiece 3-8
Turn ON the system 3-9
Set the operating mode switch 3-9
Check the indicators 3-10
Manually adjusting the gas pressure 3-10
Adjusting the current (amperage) 3-11
Electrode end-of-life detection feature 3-11
Understanding duty-cycle limitations 3-12

Controls and indicators

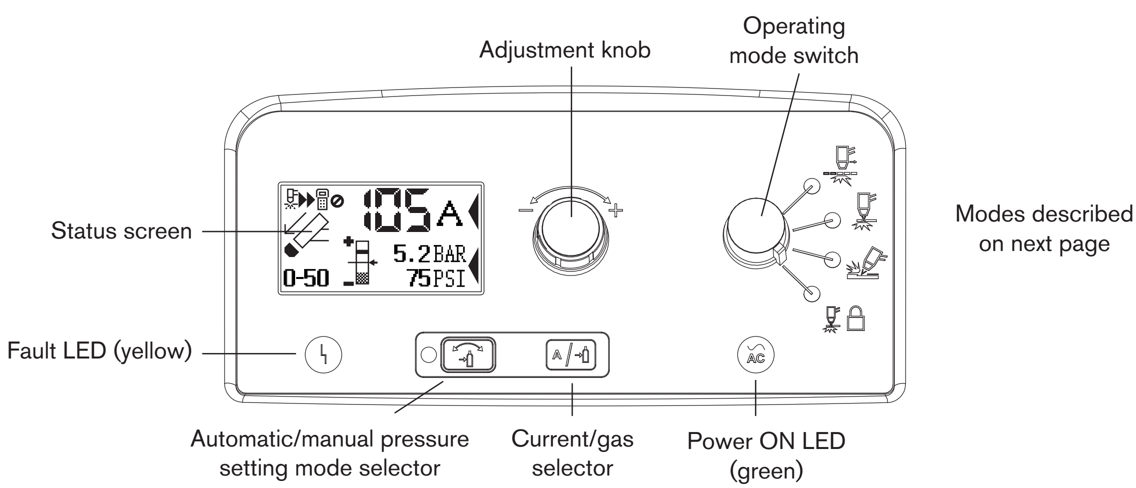
Powermax105 power supplies have the following: ON/OFF switch, adjustment knob, automatic/manual pressure setting mode selector, current/gas selector, operating mode switch, indicator LEDs, and a status screen. These controls and indicators are described on the following pages.

Rear controls



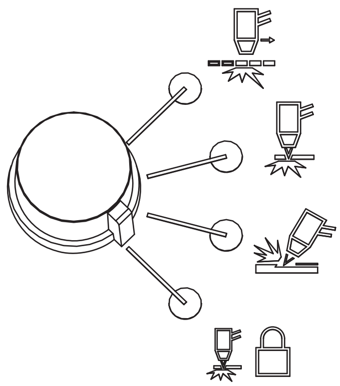
ON (I)/OFF (O) power switch
Activates the power supply and its control circuits.

Front controls and LEDs



Fault LED (yellow)
When illuminated, this LED indicates that there is a fault with the power supply.

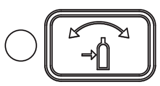
Power ON LED (green)
When illuminated, this LED indicates that the power switch has been set to I (ON) and that the safety interlocks are satisfied. When blinking, the power supply has a fault.



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. The torch goes out when the transfer is lost or the torch is retriggered.



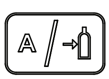
Automatic/manual pressure setting mode selector

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.

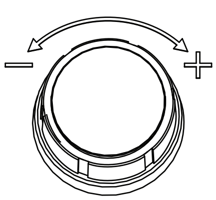
When you switch from manual mode to automatic mode, the power supply automatically sets the gas pressure and the amperage setting is unchanged. When you switch from automatic mode to manual mode, the power supply remembers the previous manual gas pressure setting and the amperage setting is unchanged.

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.

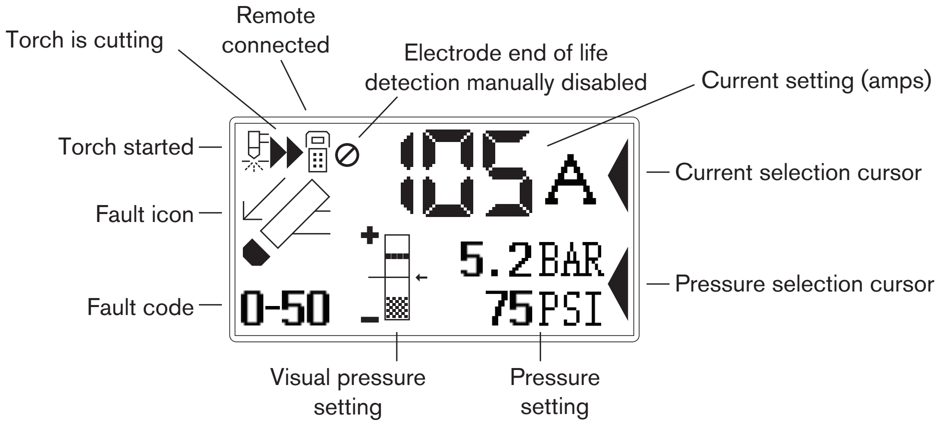


Adjustment knob

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.

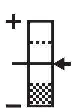
Status screen

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 page 3-10 *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.

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 or CNC is controlling the power supply using serial communications. All local controls are disabled.

Electrode end-of-life detection manually disabled
Indicates that the electrode end-of-life detection feature is manually 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. Fault code information is included later in this manual.

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.

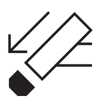
Fault icons

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 the troubleshooting information later in this manual.

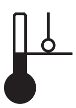
Warning
The system continues to run.

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

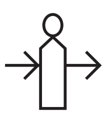
Error
The system requires service. Contact your distributor or Hypertherm Technical Service.



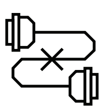
Torch cap sensor
Indicates that the consumables are loose, improperly installed, or missing. Turn OFF the power, properly install the consumables, and turn ON the system again to reset the power supply.



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 SCI communications between the control board and the DSP board.

Operating the Powermax105

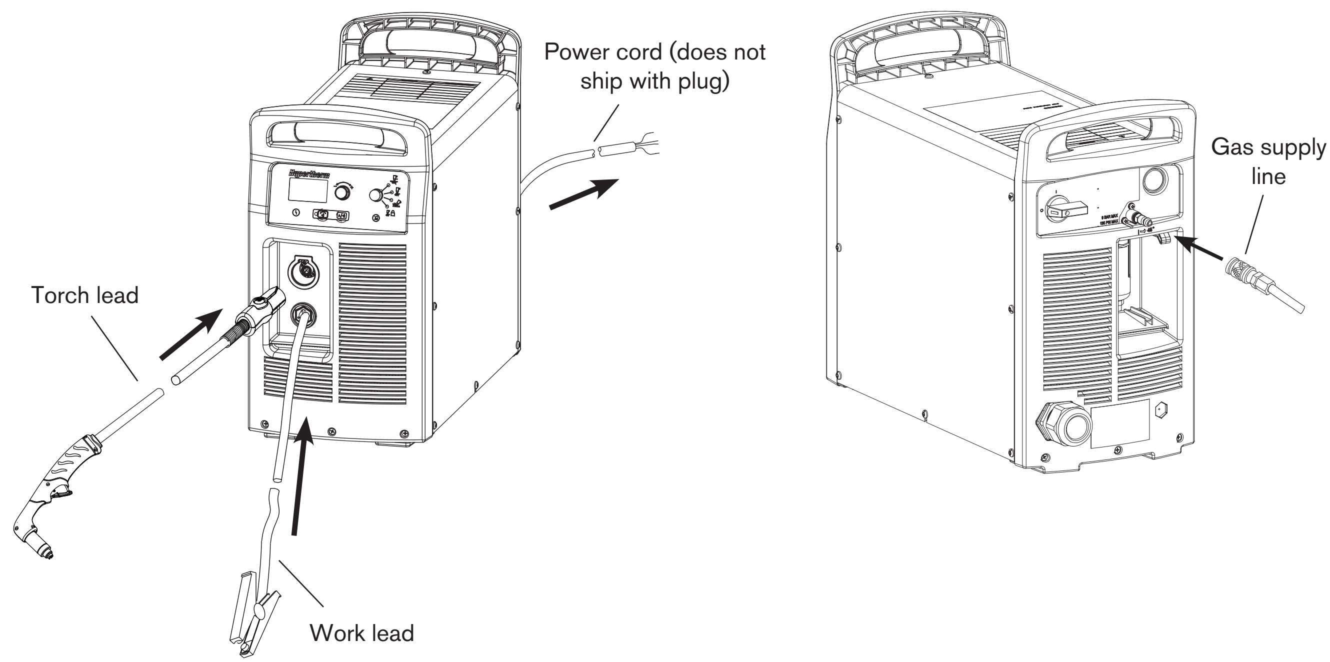
Follow the steps below to begin cutting or gouging with the Powermax system.

Note: This section provides basic operating instructions. Before operating your Powermax in a production environment, refer to the *Hand Torch Setup* section or the *Machine Torch Setup* section.

Connect the electrical power, gas supply, and torch lead

For information on connecting the proper plug to the power cord, refer to the *Power Supply Setup* section.

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 Powermax, see the *Power Supply Setup* section. 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.

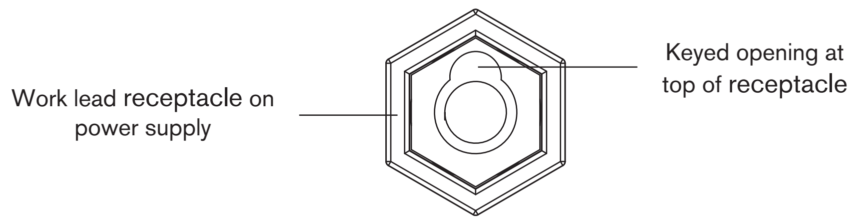


Attach the work lead to the power supply

> **Caution: Make sure you use a work lead that is appropriate for your power supply. Use a 105 A work lead with the Powermax105. 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.**

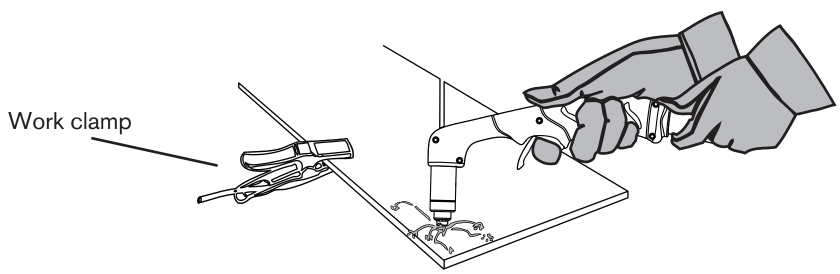
Attach the work clamp to the workpiece

The work clamp must be connected to the workpiece while you are cutting. If you are using the Powermax105 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 work lead makes proper contact with the workpiece.
- For the best cut quality, attach the work clamp as close as possible to the area being cut.

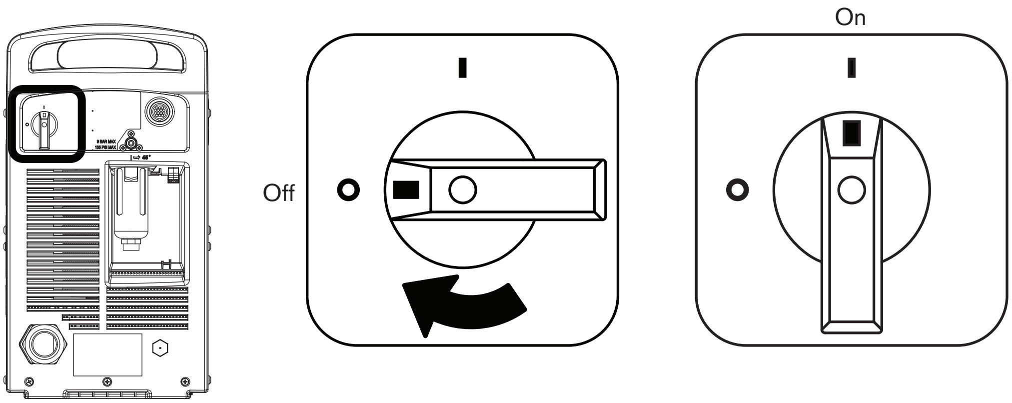
Caution: Do not attach the work clamp to the portion of the workpiece to be cut away.



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

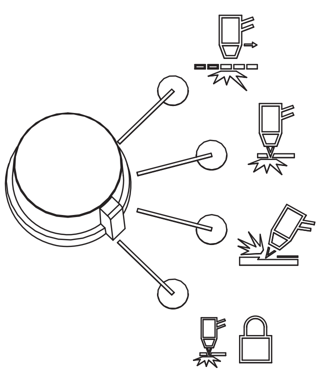
Set the ON/OFF switch to the ON (I) position.



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.



For cutting expanded metal, grates, metal containing holes, or any job that requires a continuous pilot arc. Using this mode to cut standard metal plate reduces consumable life.

For cutting or piercing metal. This is the standard setting for normal drag-cutting.

For gouging metal. (Note: Using this mode while cutting results in poor cut quality.)

Locks the torch in the ON (fire) position. With this option selected, press the trigger to fire the torch. You can then release the trigger while continuing to cut. Press the trigger again to stop the arc. The torch goes out when transfer is lost.

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. More troubleshooting information is included later in this manual.

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 on page 3-2 *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.

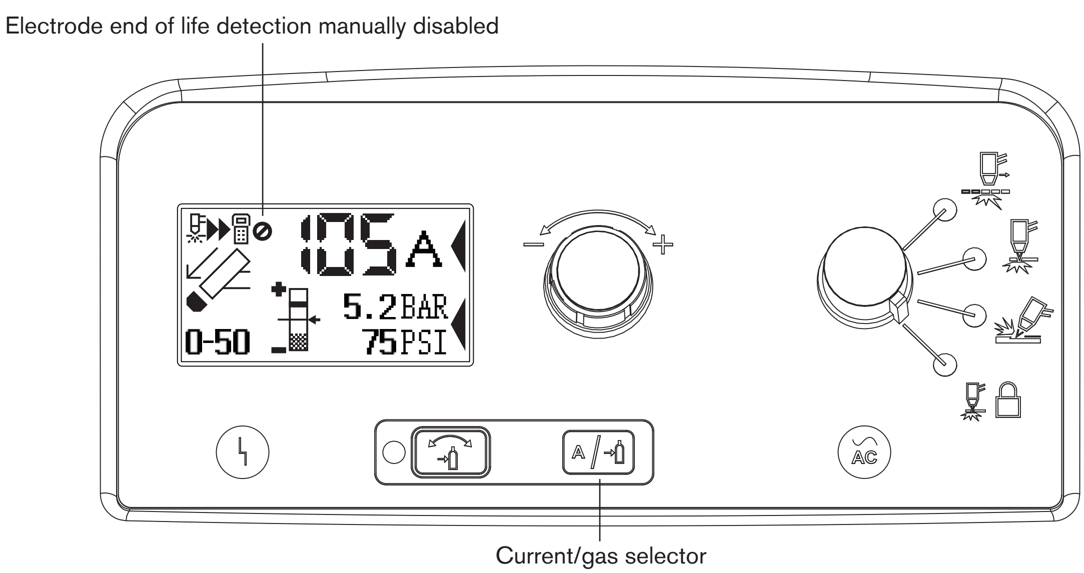
   Note: When you exit manual mode, the gas pressure resets to the factory-optimized value.

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.

Electrode end-of-life detection feature

The electrode end-of-life detection feature on the Powermax105 protects the torch and workpiece from damage by automatically stopping power to the torch when the electrode reaches its end of life. Fault code 0-32 also displays on the front panel status screen. If you have the current set below 55 A, this feature is automatically disabled without displaying the icon on the status screen.

To manually disable the feature, press the current/gas selector button (see figure below) five times on the control panel. The system must be in the auto mode and the selector presses must be less than one second apart. Re-enable the feature by repeating this procedure. An icon (see figure below) displays on the status screen when the feature is manually disabled.



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 40° C (104° F).

With a Powermax105:

- At 105 A (480-600 V CSA, 400 V CE, 380 V CCC), the arc can remain on for 8 minutes out of 10 minutes without causing the unit to overheat (80% duty cycle).
- At 94 A (480-600 V CSA, 400 V CE, 380 V CCC), the arc can remain on for 10 minutes out of 10 (100%).

See the *Specifications* section for a complete list of duty cycle specifications.

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.

Section 4

HAND TORCH SETUP

In this section:

Introduction 4-2
Consumable life..4-2
CopperPlus™ electrode for Duramax torches..4-2
Hand torch components 4-3
Choose the hand torch consumables..4-4
Hand torch consumables..4-5
Drag-cutting 105 A consumables..4-5
Drag-cutting 45 A, 65 A, 85 A consumables..4-5
Maximum Removal gouging consumables 4-5
Maximum Control gouging consumables 4-5
FineCut® consumables..4-6
HyAccess 65 A consumables..4-6
Install the hand torch consumables..4-7
Connecting the torch lead..4-8

Introduction

Duramax™ series hand torches are available for Powermax105 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 hand torch and choose the appropriate consumables for the job.

Consumable life

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

- The thickness of the metal being cut.
- The average length of the cut.
- 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 nozzle will wear out first when hand cutting. As general rule, a set of consumables lasts approximately 1 to 3 hours of actual “arc on” time for hand cutting.

You will find more information about proper cutting techniques in the *Hand Cutting* section.

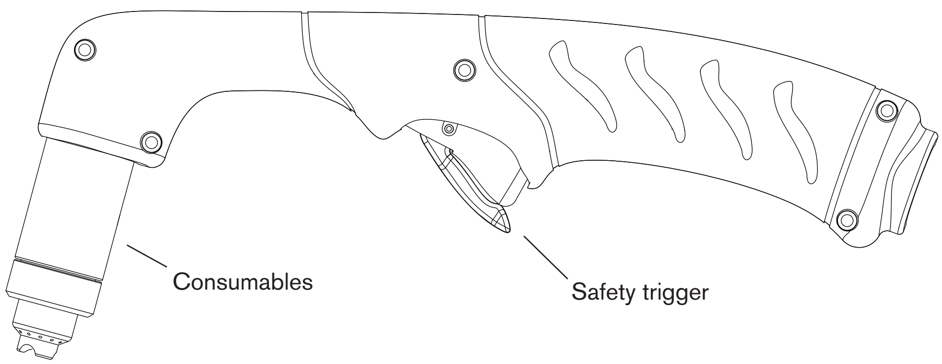
CopperPlus™ electrode for Duramax torches

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.

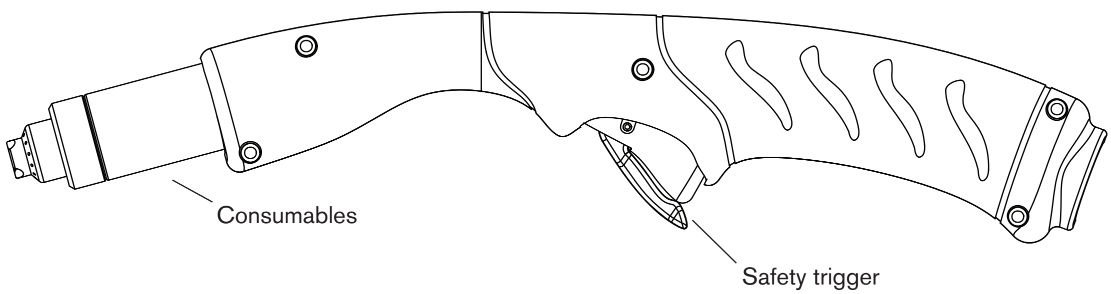
Hand torch components

Note: Torches ship without consumables installed.

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 in the next section. 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.

For the best cut quality on thin materials (approximately 4mm/10GA or less), you may prefer to use FineCut consumables, or use a 45 A nozzle and reduce the amperage to that setting.

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.

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.

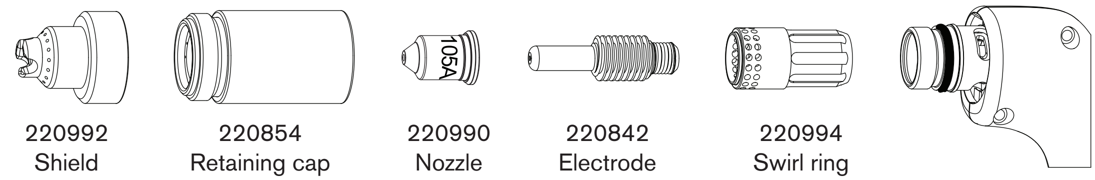
Two HyAccess nozzles are available:

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

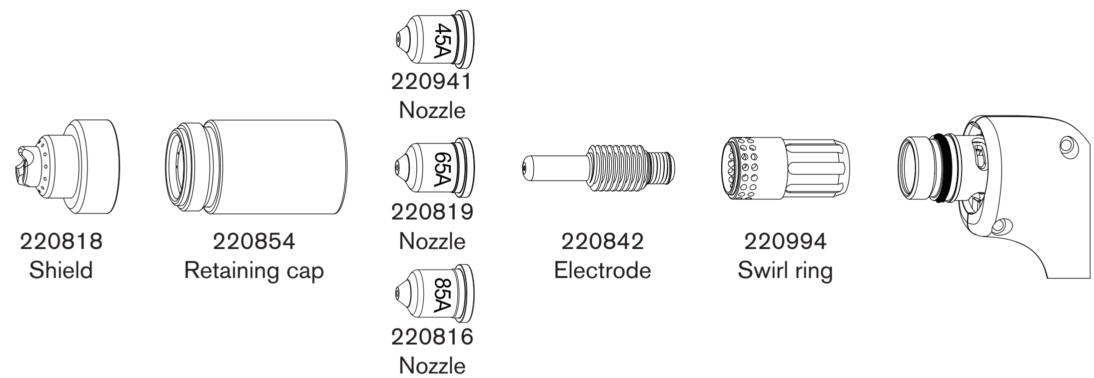
When the tip of either nozzle wears out, replace the entire nozzle.

Hand torch consumables

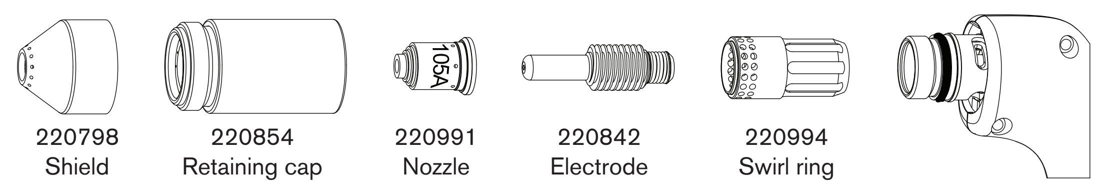
Drag-cutting 105 A consumables



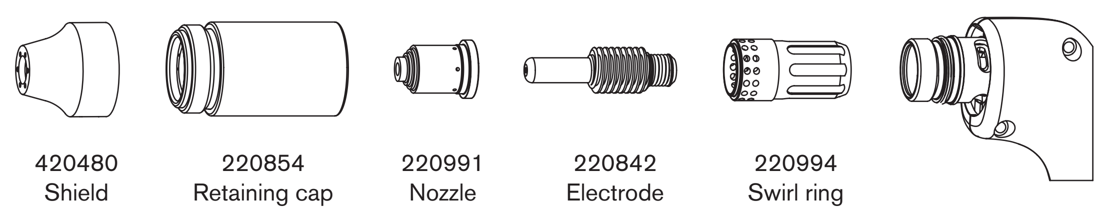
Drag-cutting 45 A, 65 A, 85 A consumables



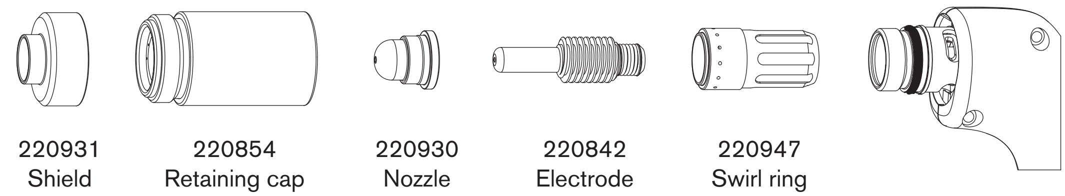
Maximum Removal gouging consumables



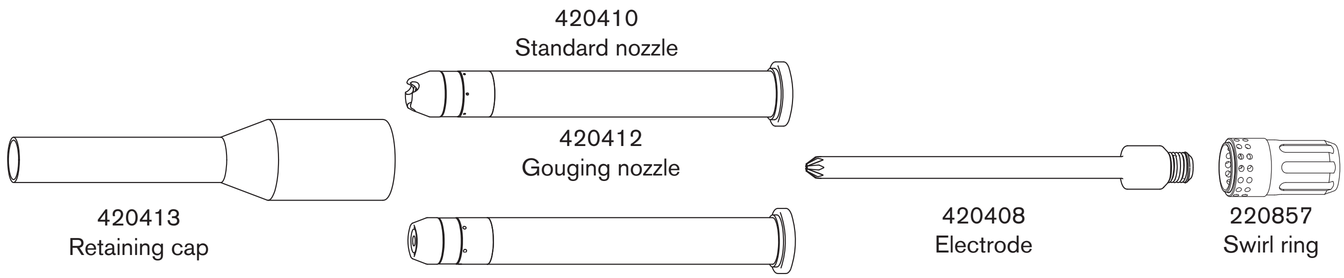
Maximum Control gouging consumables



FineCut® consumables



HyAccess 65 A consumables



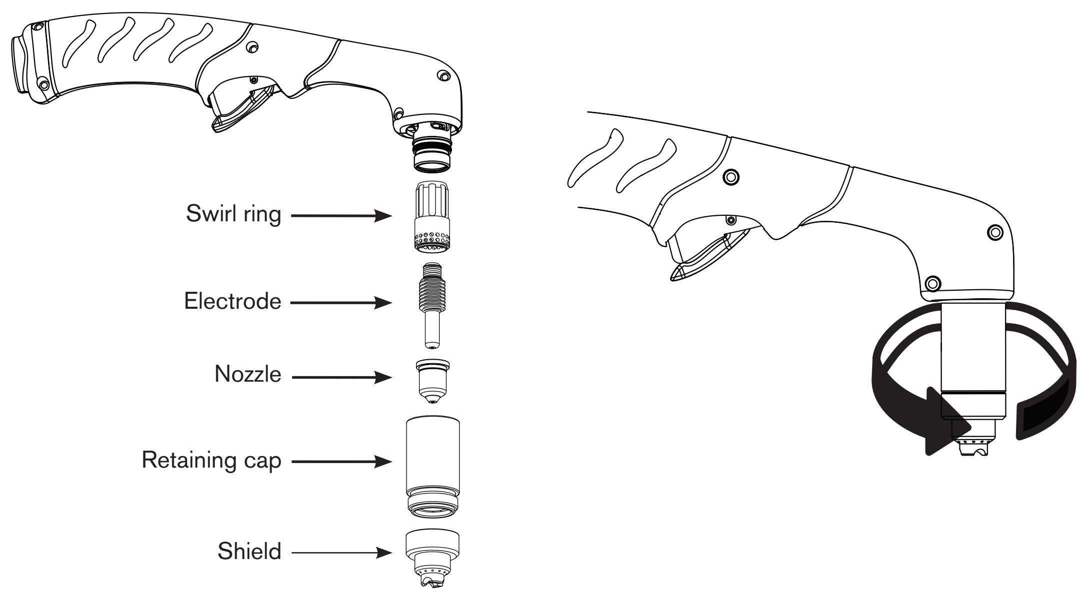
Install the hand torch consumables

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

The plasma arc comes on immediately when the torch trigger is activated.
Make sure the power is OFF before changing consumables.

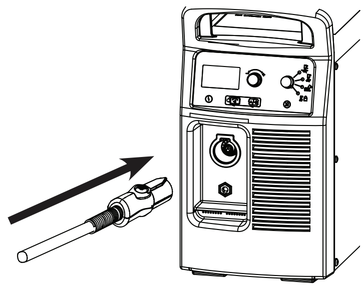
To operate the hand torch, a complete set of consumable parts must be installed: shield, retaining cap, nozzle, electrode, and swirl ring. Torches ship without consumables installed. Pull off the vinyl cap before installing your consumables.

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

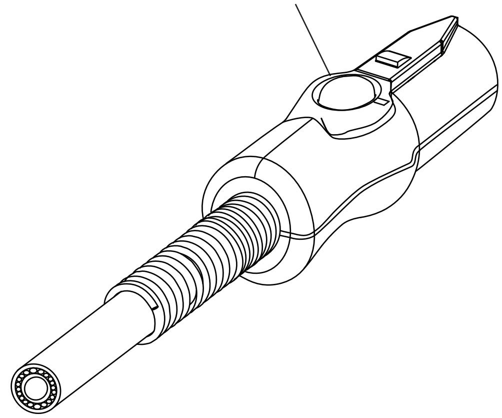


Connecting the torch lead

The Powermax105 is 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 the 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.



Section 5

HAND CUTTING

In this section:

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Operate the safety trigger....5-2
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Start a cut from the edge of the workpiece....5-4
Pierce a workpiece....5-5
Gouge a workpiece....5-6
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Varying the gouge profile....5-8
Common hand-cutting faults....5-8

Using the hand torch

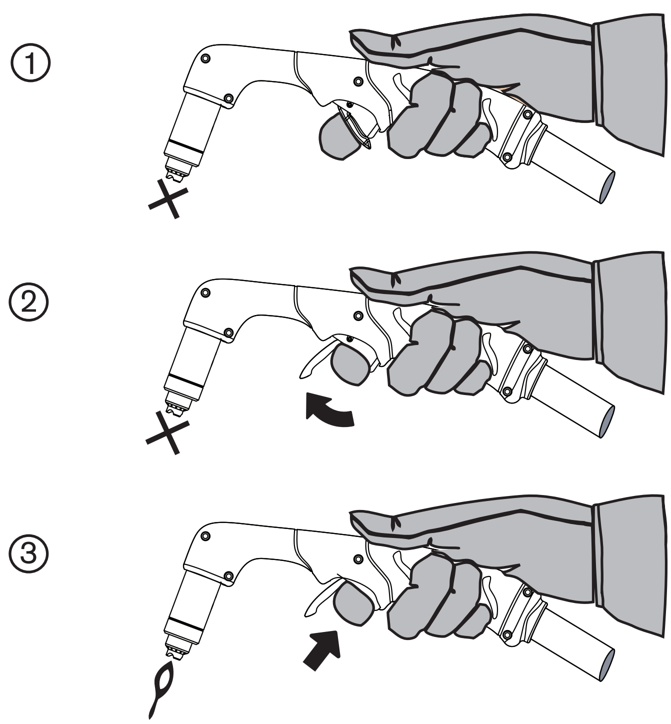
WARNING:
INSTANT-ON TORCHES
PLASMA ARC CAN CAUSE INJURY AND BURNS

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.**

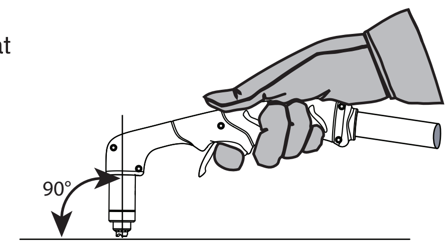
Operate the safety trigger

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

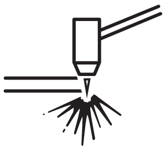
- Drag the torch tip lightly along the workpiece to maintain a steady cut.
- While cutting, make sure that sparks exit from the bottom of the workpiece. The sparks should lag slightly behind the torch as you cut (15–30° angle from vertical).
- If sparks spray up from the workpiece, move the torch more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



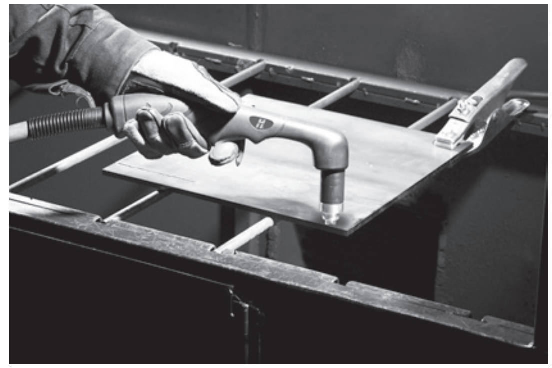
- If you fire the torch unnecessarily, you will shorten the life of the nozzle and electrode.

- 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.

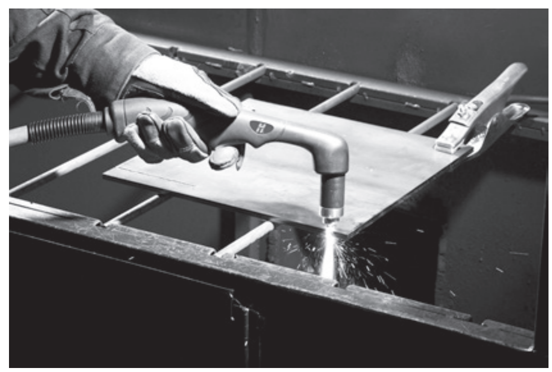
Start a cut from the edge of the workpiece



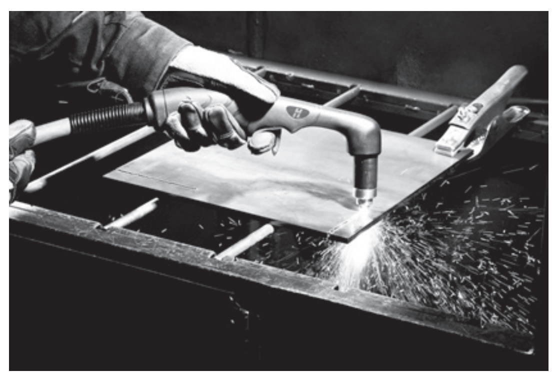
1. With the work clamp attached to the workpiece, hold the torch nozzle perpendicular (90°) to the edge of the workpiece.



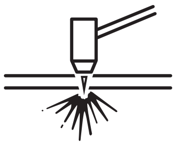
2. Press the torch's trigger to start the arc. Pause at the edge until the arc has cut completely through the workpiece.

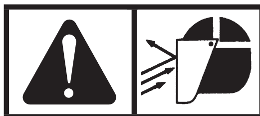


3. Drag the torch tip lightly across the workpiece to proceed with the cut. Maintain a steady, even pace.



Pierce a workpiece



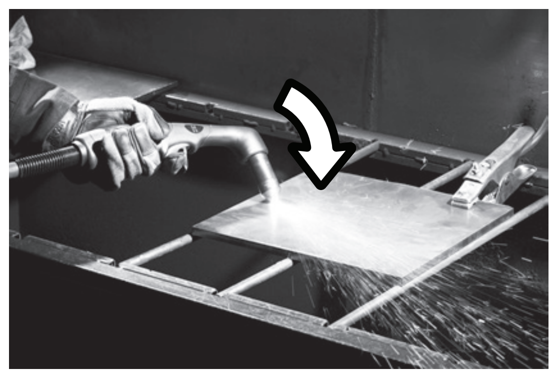


WARNING:

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° angle to the workpiece with the torch tip within 1.5 mm (1/16 inch) of the workpiece before firing the torch.

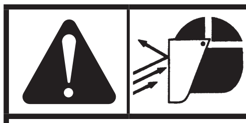
2. Fire the torch while still at an angle to the workpiece. Slowly rotate the torch to a perpendicular (90°) position.



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.

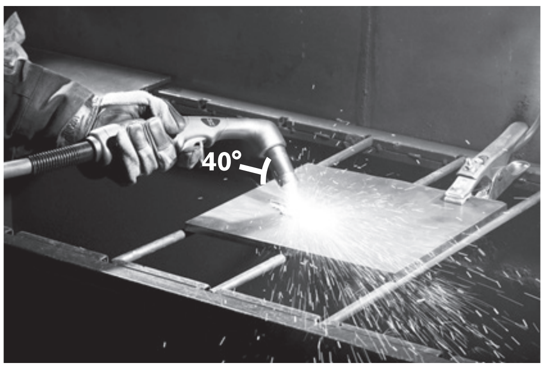
Gouge a workpiece



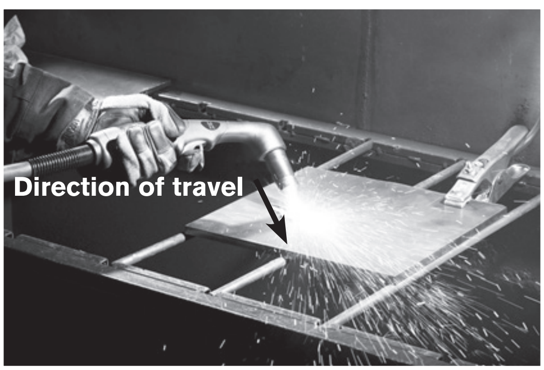
WARNING:

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 1.5 mm (1/16 inch) from the workpiece before firing the torch.



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



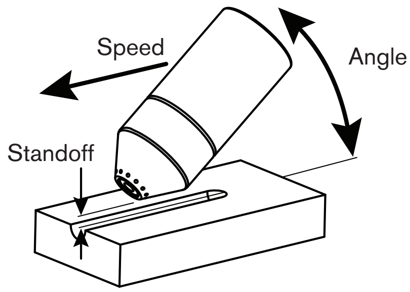
3. Pull the torch back and stretch the arc to 32 mm (1-1/4 inch). Push the plasma arc in the direction of the gouge you want to create. Increase standoff to create a shallower and wider gouge.

   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.

Gouge profile

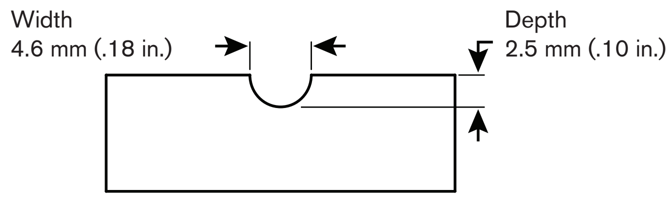
You can vary the gouge profile by varying the speed of the torch over the workpiece, varying the torch-to-work standoff distance, varying the angle of the torch to the workpiece, and varying the current output of the power supply.



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

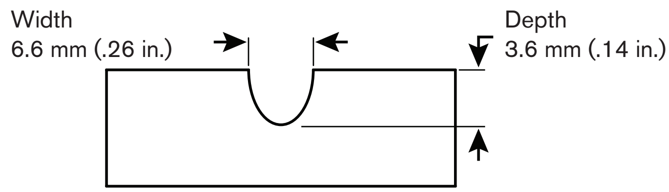
Typical Maximum Control Gouge Profile for 65 A

Metal removal rate on mild steel 3.4 kg/hr (7.5 lbs/hr)



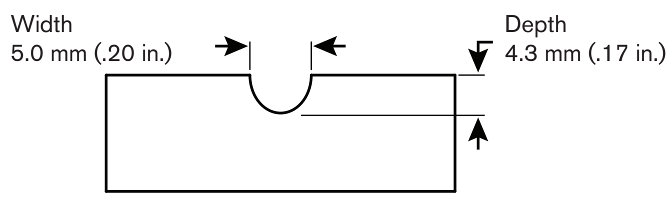
Typical Maximum Removal Gouge Profile for 65 A

Metal removal rate on mild steel 4.8 kg/hr (10.7 lbs/hr)



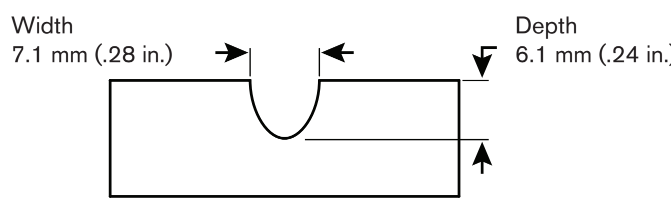
Typical Maximum Control Gouge Profile for 85 A

Metal removal rate on mild steel 6.2 kg/hr (13.7 lbs/hr)



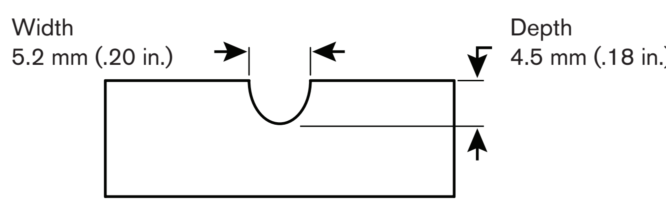
Typical Maximum Removal Gouge Profile for 85 A

Metal removal rate on mild steel 8.8 kg/hr (19.5 lbs/hr)



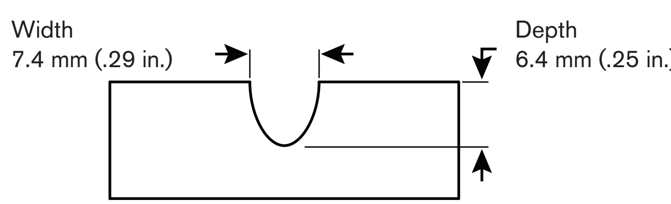
Typical Maximum Control Gouge Profile for 105 A

Metal removal rate on mild steel 6.9 kg/hr (15.2 lbs/hr)



Typical Maximum Removal Gouge Profile for 105 A

Metal removal rate on mild steel 9.8 kg/hr (21.7 lbs/hr)



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.

Section 6

MACHINE TORCH SETUP

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Introduction

Duramax™ series machine torches are available for Powermax105 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 machine torch and choose the appropriate consumables for the job.

Consumable life

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

- The thickness of the metal being cut.
- The average length of the cut.
- 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. As general rule, a set of consumables should last about 1 to 5 hours for mechanized cutting, depending upon the job.

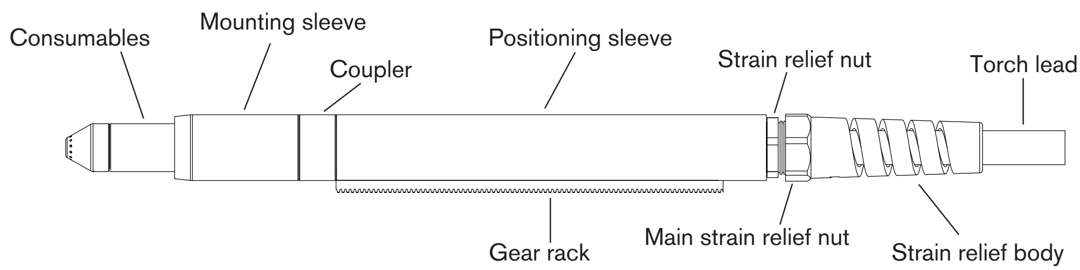
You will find more information about proper cutting techniques in the *Mechanized Cutting* section.

CopperPlus™ electrode for Duramax torches

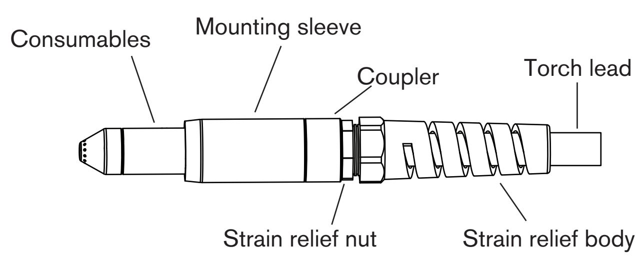
The CopperPlus electrode (part number 220777) delivers at least two times longer consumable life over standard consumables (Hypertherm consumables designed for the system). This electrode is designed exclusively for use with Duramax torches when cutting metal 12 mm (1/2 inch) and under, and is compatible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

Machine torch components

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 square to the plate.
- 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

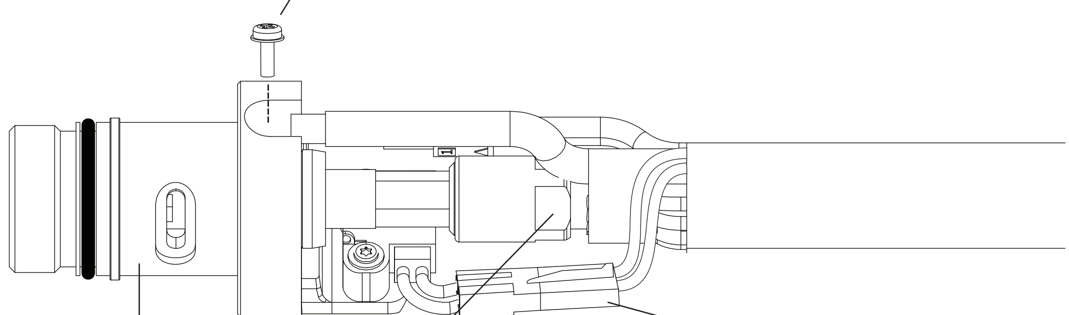
You can convert a full-length machine torch to a mini machine torch by removing the positioning sleeve.

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 on page 6-7 *Mount the torch*.

Refer to the figures on page 6-4 *Machine torch components* 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

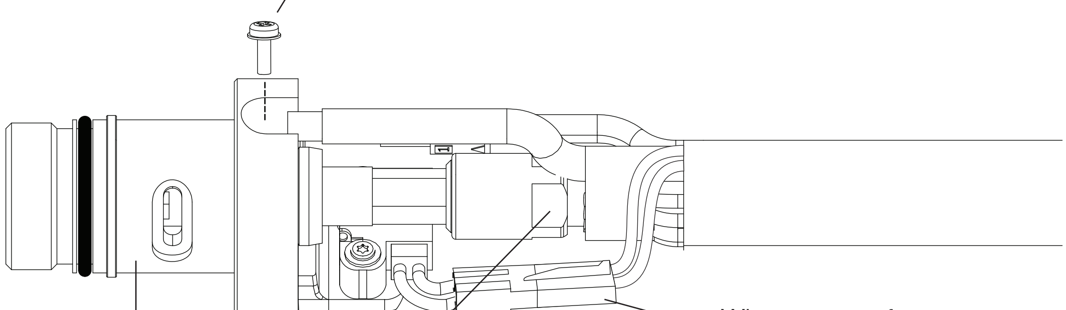
Depending on the type of cutting table you have, you may or may not need to disassemble the torch to route it through the track and mount it. If your cutting table's track is large enough for you to thread the torch through it without removing the torch body from the lead, do so and then attach the torch 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 on page 6-4 *Machine torch components* 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. If you are mounting a mini machine torch, set aside the positioning sleeve.
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. If you are mounting a mini machine torch, the strain relief nut attaches directly to the coupler in the next step.
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

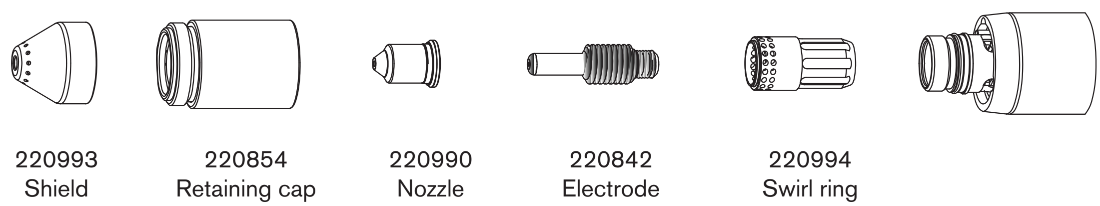
Powermax systems with the Duramax 180° full-length machine torch or Duramax 180° mini machine torch are shipped with a box of consumables. In addition, an ohmic-sensing retaining cap is available for use with shielded consumables.

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.

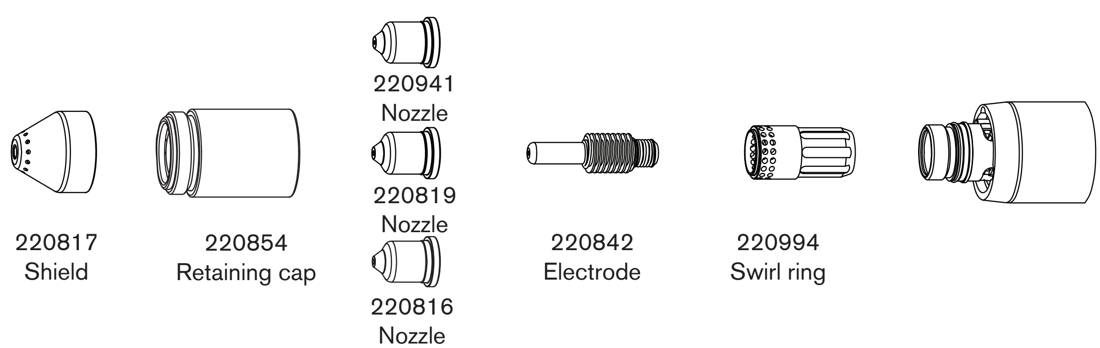
Both styles of machine torches use the same consumables.

Machine torch consumables

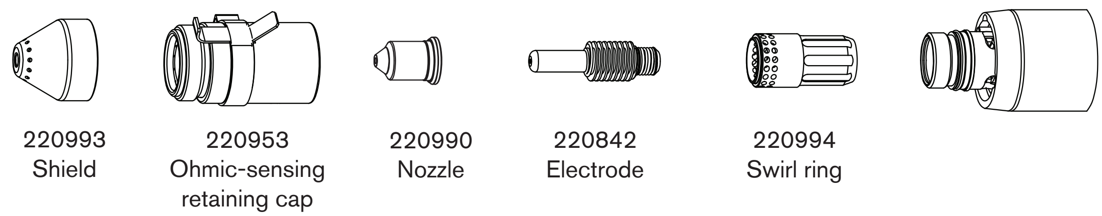
Mechanized shielded 105 A consumables



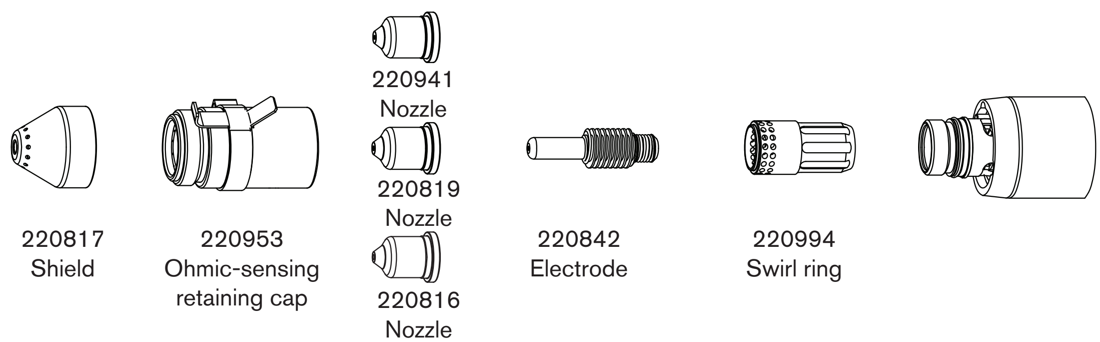
Mechanized shielded 45 A, 65 A, 85 A consumables



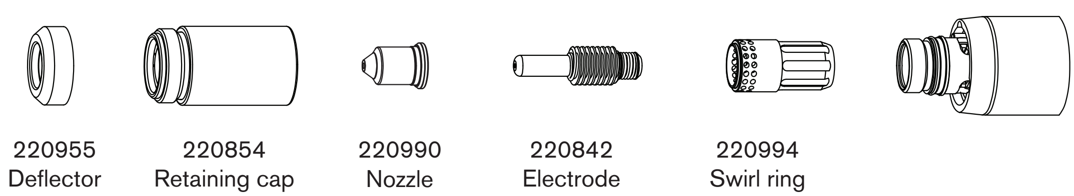
Mechanized shielded with ohmic 105 A consumables



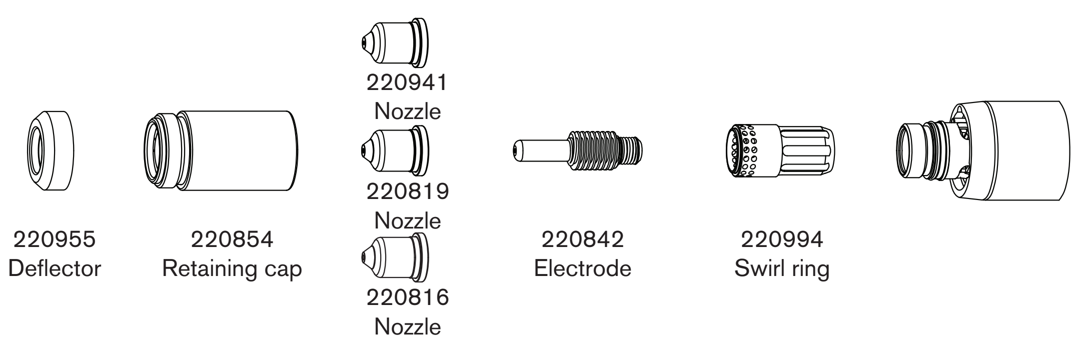
Mechanized shielded with ohmic 45 A, 65 A, 85 A consumables



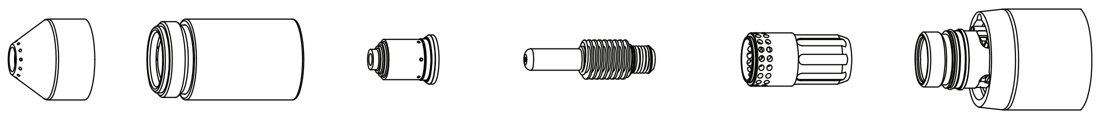
Mechanized unshielded 105 A consumables



Mechanized unshielded 45 A, 65 A, 85 A consumables

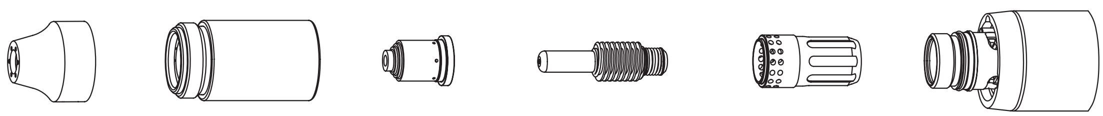


Maximum Removal gouging consumables



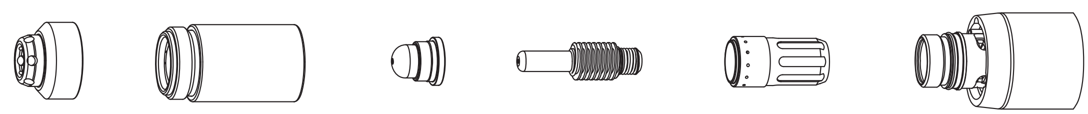
220798	220854	220991	220842	220994
Shield	Retaining cap	Nozzle	Electrode	Swirl ring

Maximum Control gouging consumables



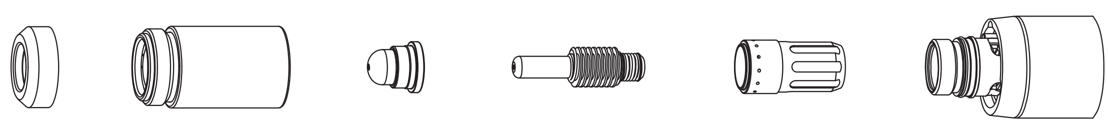
420480	220854	220991	220842	220994
Shield	Retaining cap	Nozzle	Electrode	Swirl ring

FineCut® shielded consumables



220948	220953	220930	220842	220947
Shield	Ohmic-sensing retaining cap	Nozzle	Electrode	Swirl ring

FineCut® unshielded consumables



220955	220854	220930	220842	220947
Deflector	Retaining cap	Nozzle	Electrode	Swirl ring

Install the machine torch consumables

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

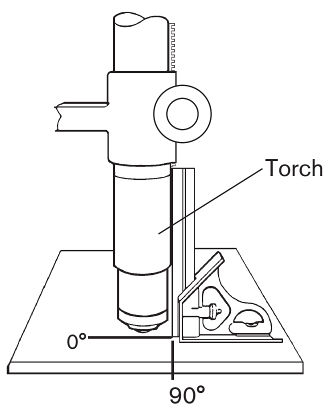
The plasma arc comes on immediately when the torch is activated. Make sure the power is OFF before changing the consumables.

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 the *Hand torch setup* section.

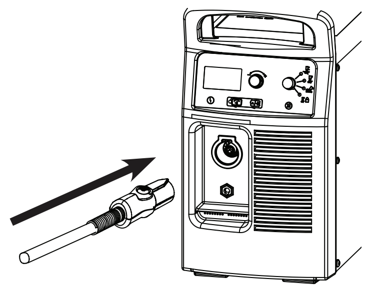
Aligning the torch

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°.

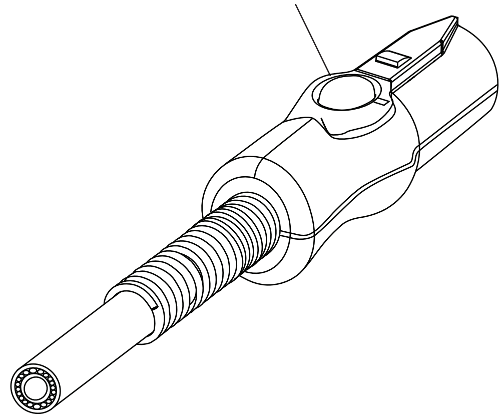


Connecting the torch lead

The Powermax105 is 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 the 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.

Each chart contains the following information:

- Amperage setting — Except for FineCut charts, the amperage setting at the top left side of the page applies to all the settings given on that page. In FineCut charts, the amperage setting for each thickness, either 45 or 40 (45, 40, or 30 for low speed), is included in the chart.
- 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) — 70% to 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.

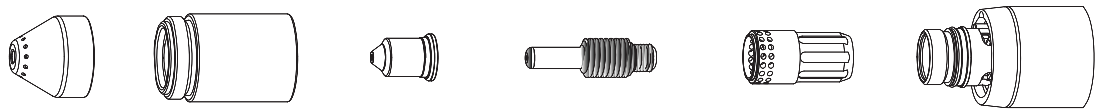
Estimated kerf-width compensation – Metric (mm)

Process	Thickness (mm)										
	0.5	1	2	3	6	8	10	12	16	20	25
	Mild Steel										
105 A Shielded					2.1	2.2	2.2	2.2	2.5	2.7	3.3
85 A Shielded				1.7	1.8	1.9	2.0	2.2	2.4	2.6	
65 A Shielded			1.6	1.6	1.8	1.9	2.0	2.2	2.3		
45 A Shielded	1.1	1.1	1.4	1.5	1.7						
FineCut	0.7	0.7	1.3	1.3							
Low Speed FineCut	0.6	0.8	0.7	1.3							
105 A Unshielded					2.1	2.2	2.2	2.2	2.5	2.7	3.3
85 A Unshielded			1.7	1.8	1.9	2.0	2.1	2.1	2.3		
65 A Unshielded			1.6	1.6	1.7	1.8	1.9	2.0			
45 A Unshielded	0.5	0.9	1.3	1.3							
Stainless Steel											
105 A Shielded					1.9	2.1	2.3	2.3	2.3	2.6	2.9
85 A Shielded				1.6	1.8	1.9	2.1	2.3	2.4	2.5	
65 A Shielded			1.4	1.5	1.8	1.9	2.0	2.2	2.4		
45 A Shielded	0.9	1.1	1.5	1.6	1.8						
FineCut	0.6	0.6	1.0	1.4							
Low Speed FineCut	0.7	0.6	1.3	1.4							
105 A Unshielded					2.0	2.2	2.4	2.5	2.7	2.7	3.1
85 A Unshielded			1.7	1.7	1.8	1.9	2.1	2.2	2.4		
65 A Unshielded			1.6	1.6	1.8	1.8	1.9	2.0			
45 A Unshielded	0.5	1.0	1.3	1.5	1.5						
Aluminum											
105 A Shielded					2.3	2.3	2.4	2.6	2.7	3.0	3.5
85 A Shielded				2.0	1.9	2.0	2.1	2.2	2.4	2.6	
65 A Shielded			1.9	1.9	1.9	2.0	2.1	2.3	2.5		
45 A Shielded		1.5	1.5	1.6	1.5						
105 A Unshielded					2.2	2.4	2.5	2.6	2.7	3.0	3.3
85 A Unshielded			1.9	1.9	1.9	2.0	2.0	2.1	2.2		
65 A Unshielded			1.8	1.8	1.8	1.8	1.9	2.0			
45 A Unshielded		1.6	1.5	1.4	1.5						

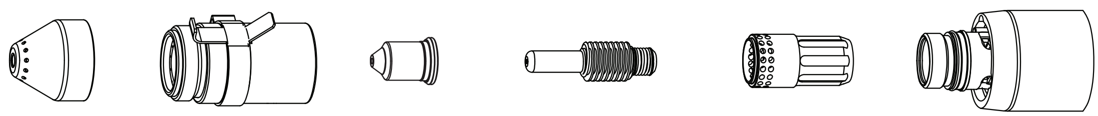
Estimated kerf-width compensation – English (inches)

Process	Thickness (inches)										
	22GA	18GA	14GA	10GA	3/16	1/4	3/8	1/2	5/8	3/4	1
	Mild Steel										
105 A Shielded						0.083	0.088	0.089	0.100	0.101	0.133
85 A Shielded				0.068	0.071	0.073	0.078	0.090	0.095	0.100	
65 A Shielded			0.062	0.065	0.068	0.070	0.076	0.088	0.090	0.091	
45 A Shielded	0.035	0.054	0.055	0.061	0.065	0.066					
FineCut	0.024	0.043	0.049	0.051							
Low Speed FineCut	0.025	0.031	0.027	0.051							
105 A Unshielded						0.083	0.097	0.098	0.107	0.111	0.125
85 A Unshielded				0.070	0.073	0.075	0.080	0.085	0.090		
65 A Unshielded			0.062	0.064	0.066	0.068	0.075	0.081			
45 A Unshielded	0.020	0.050	0.051	0.054	0.057	0.059					
Stainless Steel											
105 A Shielded						0.076	0.089	0.091	0.092	0.099	0.113
85 A Shielded				0.065	0.068	0.070	0.080	0.094	0.095	0.096	
65 A Shielded			0.056	0.062	0.068	0.073	0.076	0.090	0.093		
45 A Shielded	0.032	0.055	0.058	0.067	0.069	0.069					
FineCut	0.018	0.036	0.040	0.055							
Low Speed FineCut	0.025	0.023	0.021	0.055							
105 A Unshielded						0.080	0.095	0.101	0.106	0.104	0.122
85 A Unshielded			0.066	0.068	0.070	0.072	0.080	0.090	0.095		
65 A Unshielded			0.061	0.064	0.067	0.070	0.072	0.080			
45 A 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	1
105 A Shielded						0.091	0.092	0.102	0.107	0.111	0.138
85 A Shielded				0.080	0.078	0.075	0.080	0.090	0.095	0.100	
65 A Shielded			0.073	0.074	0.075	0.076	0.083	0.091	0.100		
45 A Shielded		0.059	0.061	0.065		0.060					
105 A Unshielded						0.089	0.098	0.102	0.106	0.117	0.132
85 A Unshielded				0.075	0.075	0.075	0.080	0.082	0.088		
65 A Unshielded			0.070	0.070	0.070	0.070	0.072	0.079			
45 A Unshielded		0.062	0.058	0.057		0.061					

105 A Shielded consumables



220993 Shield | 220854 Retaining cap | 220990 Nozzle | 220842 Electrode | 220994 Swirl ring



220993 Shield | 220953 Ohmic-sensing retaining cap | 220990 Nozzle | 220842 Electrode | 220994 Swirl ring

105 A Shielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	217 / 460
Cold	250 / 530

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
6	3.2	6.4	200	0.5	4140	144	5090	145
8				0.75	3140	145	3870	145
10					2260	145	2790	145
12					1690	145	2060	148
16				1.0	1060	149	1310	149
20					780	152	940	152
25		Edge Start			550	159	580	158
30					370	162	410	161
32					350	166	370	161
35					290	168	320	165
40					190	173	210	170

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/4	0.125	0.25	200	0.5	156	144	192	145
3/8				0.75	94	145	116	145
1/2					62	146	76	148
5/8				1.0	42	149	52	149
3/4					33	151	40	150
7/8				1.25	26	154	30	157
1		Edge Start			21	160	22	158
1-1/8					15	162	17	160
1-1/4					14	166	15	161
1-1/2					9	171	10	168

105 A Shielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	217 / 460
Cold	250 / 530

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
6	3.2	6.4	200	0.5	4870	139	6000	141
8					3460	141	4210	142
10					2240	144	2670	142
12				0.6	1490	148	1860	144
16				0.75	950	149	1080	149
20		8.0	250	1.25	660	154	810	152
25		Edge Start			440	158	530	156
30					340	164	360	160
32					300	166	320	163

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/4	0.125	0.25	200	0.5	185	139	224	141
3/8					94	143	112	142
1/2					55	148	68	145
5/8				0.75	38	149	43	149
3/4		0.31	250	1.25	28	153	34	151
7/8		Edge Start			22	156	27	153
1					17	158	20	156
1-1/8					14	162	16	159
1-1/4					12	166	13	163

105 A Shielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	217 / 460
Cold	250 / 530

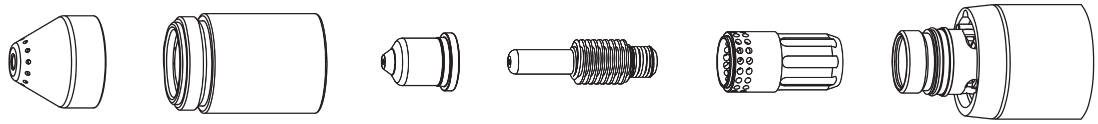
Metric

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
6	3.2	6.4	200	0.5	5980	145	7090	144
8				0.75	4170	149	5020	148
10					2640	152	3280	151
12				1.0	1910	156	2450	154
16					1290	157	1660	155
20				1.25	1020	163	1190	162
25		Edge Start			660	166	790	165
30					430	173	570	171
32					340	175	490	173

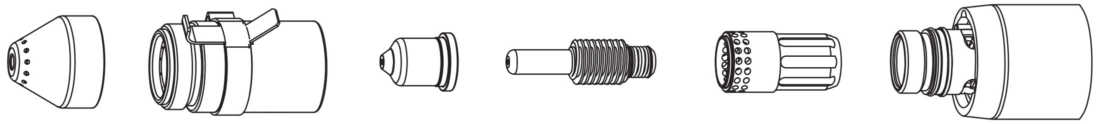
English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/4	0.125	0.25	200	0.5	223	146	265	145
3/8				0.75	110	151	136	150
1/2				1.0	71	156	91	154
5/8					51	157	66	155
3/4				1.25	43	162	50	161
7/8		Edge Start			34	164	40	163
1					25	166	30	165
1-1/8					20	171	25	169
1-1/4					15	175	20	173

85 A Shielded consumables



220817	220854	220816	220842	220994
Shield	Retaining cap	Nozzle	Electrode	Swirl ring



220817	220953	220816	220842	220994
Shield	Ohmic-sensing retaining cap	Nozzle	Electrode	Swirl ring

85 A Shielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	194 / 412
Cold	236 / 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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
10GA	0.06	0.15	250	0.2	250	122	336	121
3/16				0.2	185	123	220	123
1/4				0.5	130	123	160	126
3/8					70	126	86	127
1/2		0.18	300		45	131	56	131
5/8				1.0	35	134	37	133
3/4		0.24	400	1.5	24	136	29	135
7/8		Edge Start			19	139	22	138
1					13	142	17	141
1-1/8					9	145	13	143
1-1/4					7	148	10	146

85 A Shielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	194 / 412
Cold	236 / 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		1550	127	1900	126
12				0.7	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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
10GA	0.06	0.15	250	0.2	275	122	336	120
3/16					200	122	240	121
1/4				0.5	130	122	164	122
3/8					65	126	80	125
1/2		0.18	300		36	132	48	131
5/8				1.0	28	135	30	134
3/4		Edge Start			20	137	24	136
7/8					16	140	19	139
1					11	143	14	141

85 A Shielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	194 / 412
Cold	236 / 500

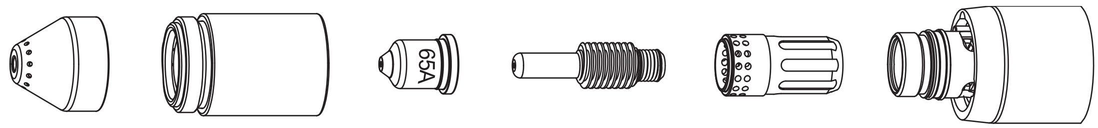
Metric

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				0.7	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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/8	0.06	0.15	250	0.2	300	122	360	121
1/4				0.5	130	127	172	127
3/8					80	132	104	131
1/2		0.18	300		50	135	68	133
5/8				1.0	38	139	48	137
3/4		Edge Start			25	142	37	140
7/8					20	144	29	142
1					14	146	20	144

65 A Shielded consumables



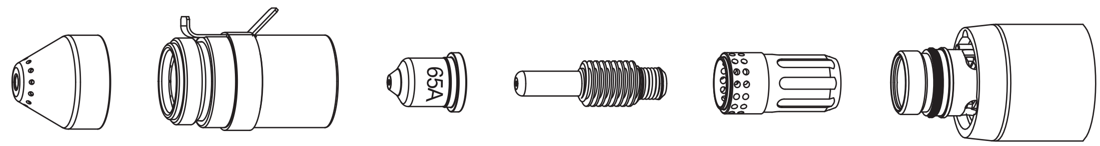
220817 Shield

220854 Retaining cap

220819 Nozzle

220842 Electrode

220994 Swirl ring



220817 Shield

220953 Ohmic-sensing retaining cap

220819 Nozzle

220842 Electrode

220994 Swirl ring

65 A Shielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	175 / 370
Cold	209 / 443

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	6050	124	7000	121
3				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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
16GA	0.06	0.15	250	0.1	260	123	294	121
10GA					190	125	224	123
3/16				0.2	140	126	168	125
1/4				0.5	90	127	116	127
3/8				0.7	45	130	62	129
1/2		0.18	300	1.2	30	135	40	132
5/8		0.24	400	2.0	23	138	26	136
3/4		Edge Start			15	141	19	141
7/8					12	143	14	143
1					8	145	10	145

65 A Shielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	175 / 370
Cold	209 / 443

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				1.2	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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
16GA	0.06	0.15	250	0.1	345	124	426	121
10GA					240	125	296	123
3/16				0.2	155	126	168	125
1/4				0.5	80	126	96	126
3/8				0.7	40	131	52	131
1/2		0.18	300	1.2	26	136	32	135
5/8		Edge Start			20	139	20	139
3/4					14	142	15	142

65 A Shielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	175 / 370
Cold	209 / 443

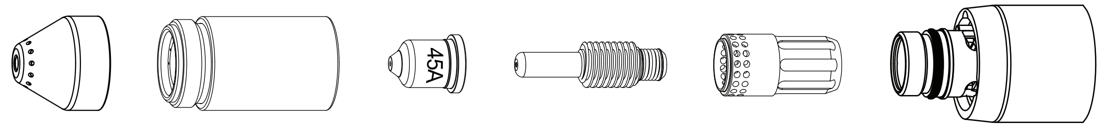
Metric

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

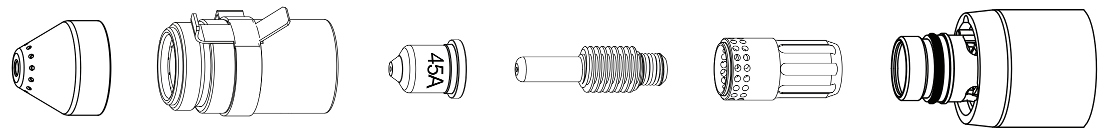
English

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

45 A Shielded consumables



220817 Shield	220854 Retaining cap	220941 Nozzle	220842 Electrode	220994 Swirl ring



220817 Shield	220953 Ohmic-sensing retaining cap	220941 Nozzle	220842 Electrode	220994 Swirl ring

45 A Shielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	177 / 376
Cold	201 / 427

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
inches	inches	inches	%	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				0.5	70	135	108	132
1/4				0.6	48	137	73	132

45 A Shielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	177 / 376
Cold	201 / 427

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
inches	inches	inches	%	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				0.5	52	135	58	135
1/4				0.6	30	141	35	140

45 A Shielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	177 / 376
Cold	201 / 427

Metric

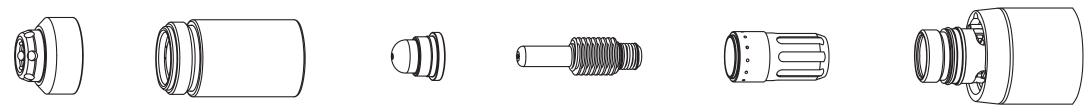
Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
mm	mm	mm	%	seconds	(mm/min)	Volts	(mm/min)	Volts
1	1.5	3.8	250	0.0	8250	136	11000	136
2				0.1	6600	136	9200	135
3				0.2	3100	139	6250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

English

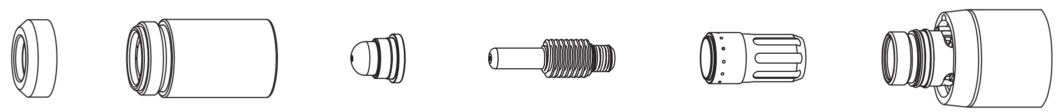
Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/32	0.06	0.15	250	0.0	325	136	450	136
1/16				0.1	325	136	400	136
3/32				0.2	200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

FineCut® consumables

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



220948 Shield	220953 Ohmic-sensing retaining cap	220930 Nozzle	220842 Electrode	220947 Swirl ring



220955 Deflector	220854 Retaining cap	220930 Nozzle	220842 Electrode	220947 Swirl ring

FineCut (Mild Steel)

Air flow rate – slpm/scfh	
Hot	181 / 384
Cold	191 / 404

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	40	1.5	2.25	150	0.0	8250	78
0.6						8250	78
0.8					0.1	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	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended	
						Cut Speed	Voltage
	A	inches	inches	%	seconds	ipm	Volts
26GA	40	0.06	0.09	150	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

FineCut (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	181 / 384
Cold	191 / 404

Metric

Material Thickness	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended Cut Speed	Recommended 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				0.15	8250	68
1.5					0.4	6150	70
2						4800	71
3					0.5	2550	80
4					0.6	1050	84

English

Material Thickness	Current	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Recommended Cut Speed	Recommended Voltage
	A	inches	inches	%	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	181 / 384
Cold	191 / 404

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	2.25	150	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	0.09	150	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 *	45					150	76
12GA					0.5	120	78
10GA						95	78

*Not a dross-free cut.

Low Speed FineCut (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	181 / 384
Cold	191 / 404

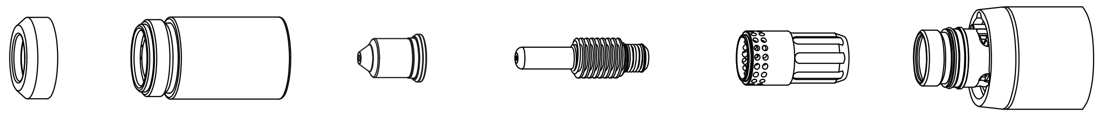
Metric

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

105 A Unshielded consumables



220955	220854	220990	220842	220994
Deflector	Retaining cap	Nozzle	Electrode	Swirl ring

105 A Unshielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	217 / 460
Cold	250 / 530

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
6	4.6	9.2	200	0.5	4040	148	4980	145
8					3160	149	3770	145
10					2350	150	2700	145
12					1700	153	2080	147
16				0.6	980	155	1200	152
20				1.0	742	155	940	154
25		Edge Start			500	159	580	159
30					300	161	370	160
32					260	169	270	167
35					320	164	350	163
40					160	176	190	172

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/4	0.18	0.36	200	0.5	153	148	188	145
3/8					91	150	112	145
1/2					62	153	76	148
5/8				0.6	39	155	48	152
3/4				1.0	31	155	40	153
7/8				1.25	25	156	30	158
1		Edge Start			19	160	22	159
1-1/8					14	161	17	160
1-1/4					13	164	14	163

105 A Unshielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	217 / 460
Cold	250 / 530

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
6	4.6	9.2	200	0.5	4970	145	6120	142
8					3420	147	4210	144
10					2090	149	2570	146
12					1410	151	1740	149
16				0.75	880	153	1080	151
20				1.0	660	156	800	155
25		Edge Start			420	159	500	159
30					330	162	370	161
32					300	163	320	162

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/4	0.18	0.36	200	0.5	185	145	228	142
3/8					88	149	108	145
1/2					52	151	64	149
5/8				0.75	35	153	43	151
3/4				1.0	28	155	34	154
7/8		Edge Start			22	157	26	157
1					16	159	19	159
1-1/8					14	161	16	161

105 A Unshielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	217 / 460
Cold	250 / 530

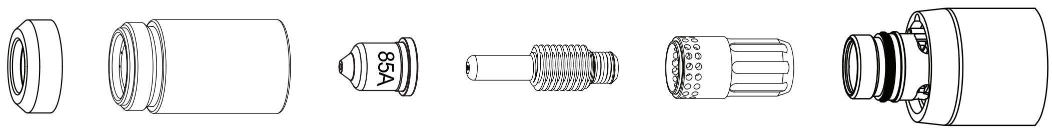
Metric

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
6	4.6	9.2	200	0.5	5840	148	7170	149
8				0.75	4110	152	5060	151
10					2670	154	3580	153
12				1.0	2090	155	2450	154
16					1330	160	1660	158
20				1.3	980	163	1190	162
25		Edge Start			660	167	770	167
30					500	170	590	169
32					450	171	520	170

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings	
					Cut Speed	Voltage	Cut Speed	Voltage
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/4	0.180	0.36	200	0.5	218	149	268	149
3/8				0.75	110	154	136	153
1/2				1.0	77	156	91	155
5/8					51	160	66	158
3/4				1.25	41	162	50	161
7/8		Edge Start			33	165	40	164
1					25	167	29	167
1-1/8					20	169	25	169

85 A Unshielded consumables



220955	220854	220816	220842	220994
Deflector	Retaining cap	Nozzle	Electrode	Swirl ring

85 A Unshielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	194 / 412
Cold	236 / 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	0.0	7150	117	10400	116
3				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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
14GA	0.08	0.20	250	0.1	280	117	416	116
10GA				0.2	230	118	328	117
3/16					175	119	220	118
1/4				0.5	125	120	160	119
3/8					65	122	86	122
1/2		0.24	300	0.6	42	127	56	125
5/8		Edge Start			33	131	37	128
3/4					23	136	27	131
7/8					18	140	21	134
1					12	144	15	138

85 A Unshielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	194 / 412
Cold	236 / 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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
14GA	0.08	0.20	250	0.1	340	117	452	116
10GA				0.2	250	118	352	118
3/16					180	119	249	119
1/4				0.5	120	120	160	121
3/8					60	122	77	123
1/2		0.24	300	0.6	35	131	46	129
5/8		Edge Start			26	134	29	133
3/4					17	137	24	136

85 A Unshielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	194 / 412
Cold	236 / 500

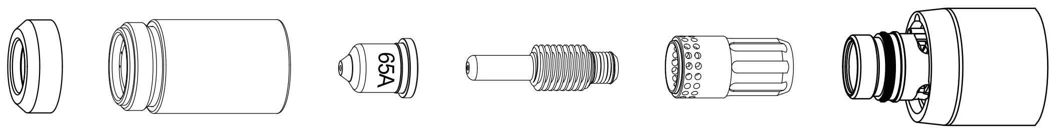
Metric

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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/8	0.08	0.20	250	0.2	280	120	368	119
3/16					200	123	271	120
1/4				0.5	110	126	172	122
3/8					75	127	88	126
1/2		0.24	300	0.6	45	135	62	131
5/8		Edge Start			34	139	45	134
3/4					22	143	32	137

65 A Unshielded consumables



220955 Deflector | 220854 Retaining cap | 220819 Nozzle | 220842 Electrode | 220994 Swirl ring

65 A Unshielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	175 / 370
Cold	209 / 443

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	6050	117	7340	117
3				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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
16GA	0.08	0.20	250	0.1	255	116	308	117
10GA					190	118	232	118
3/16				0.2	135	119	172	119
1/4				0.5	90	120	116	120
3/8		0.24	300	0.7	40	126	62	122
1/2		Edge Start			27	130	40	125
5/8					20	134	26	129
3/4					13	137	18	132

65 A Unshielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	175 / 370
Cold	209 / 443

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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
16GA	0.08	0.20	250	0.1	340	116	437	115
10GA					235	118	304	118
3/16				0.2	150	120	194	120
1/4				0.5	75	121	100	121
3/8		0.24	300	0.7	38	125	52	122
1/2		Edge Start			25	132	32	129
5/8					17	135	20	133

65 A Unshielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	175 / 370
Cold	209 / 443

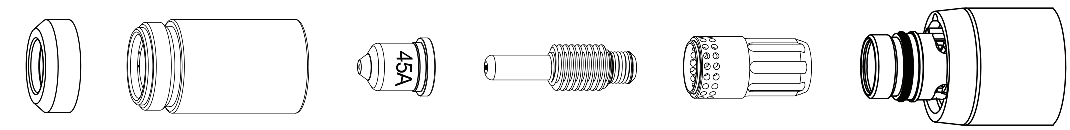
Metric

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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/16	0.08	0.20	250	0.1	325	122	476	122
1/8					250	124	360	123
3/16					175	125	245	124
1/4				0.5	100	127	128	126
3/8		0.24	300	0.7	45	132	68	128
1/2		Edge Start			32	136	44	134
5/8					24	138	28	136

45 A Unshielded consumables



220955 Deflector | 220854 Retaining cap | 220941 Nozzle | 220842 Electrode | 220994 Swirl ring

45 A Unshielded cutting (Mild Steel)

Air flow rate – slpm/scfh	
Hot	177 / 376
Cold	201 / 427

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
inches	inches	inches	%	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				0.5	85	122	108	124
1/4				0.6	48	127	73	124

45 A Unshielded cutting (Stainless Steel)

Air flow rate – slpm/scfh	
Hot	177 / 376
Cold	201 / 427

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
inches	inches	inches	%	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				0.5	42	131	88	123
1/4				0.6	25	130	48	124

45 A Unshielded cutting (Aluminum)

Air flow rate – slpm/scfh	
Hot	177 / 376
Cold	201 / 427

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
inches	inches	inches	%	seconds	ipm	Volts	ipm	Volts
1/32	0.06	0.15	250	0.0	325	126	450	121
1/16				0.1	200	126	400	122
3/32				0.2	150	127	328	124
1/8				0.4	100	130	224	125
1/4				0.5	36	136	72	127

Section 7

MECHANIZED CUTTING

In this section:

Connecting an optional remote-start pendant 7-2
Connecting an optional machine interface cable 7-3
    Machine interface pinout 7-4
    Setting the five-position voltage divider 7-6
Accessing raw arc voltage 7-7
Connecting an optional RS485 serial interface cable 7-7
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Using the machine torch 7-8
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Understand and optimize cut quality 7-8
    Cut or bevel angle 7-9
    Dross 7-9
Piercing a workpiece using the machine torch 7-10
Common machine-cutting faults 7-11

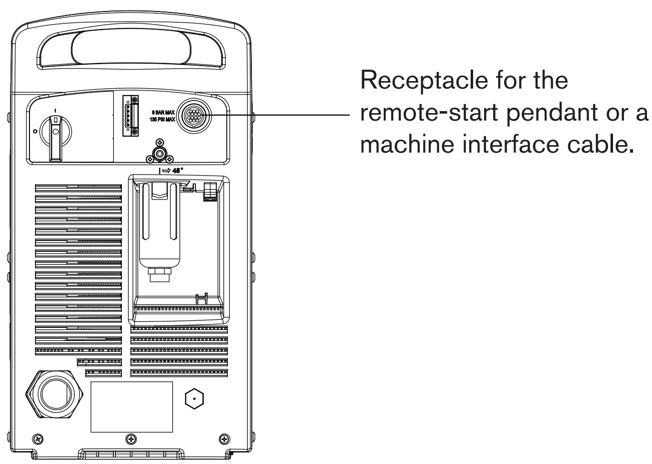
Connecting an optional remote-start pendant

Powermax105 configurations with a Duramax machine torch can include an optional remote-start pendant.

- Part number 128650: 7.6 m (25 feet)
- Part number 128651: 15.2 m (50 feet)
- Part number 128652: 22.9 m (75 feet)
- Part number 428755: 45 m (150 feet)

If your power supply has the optional machine interface receptacle on the rear of the power supply, remove the receptacle cover and plug the Hypertherm remote-start pendant into the receptacle.

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



Connecting an optional machine interface cable

The Powermax power supply may be equipped with a factory-installed (or user-installed) five-position voltage divider board. The built-in voltage divider provides a scaled down arc voltage of 20:1, 21.1:1, 30:1, 40:1, or 50:1 (maximum output of 15 V). An optional receptacle on the rear of the power supply (see the previous page) provides access to the scaled down arc voltage and signals for arc transfer and plasma start.

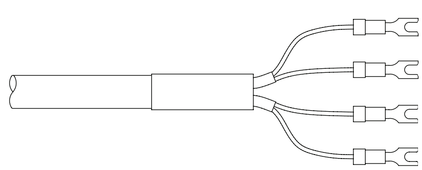
Note: The factory presets the voltage divider to 50:1. To change the voltage divider to a different setting, refer to page 7-6 *Setting the five-position voltage divider*.

Caution: The factory-installed internal voltage divider provides a maximum of 15 V under open circuit conditions. This is an impedance-protected functional extra low voltage (ELV) output to prevent shock, energy, and fire under normal conditions at the machine interface receptacle and under single fault conditions with the machine interface wiring. The voltage divider is not fault tolerant and ELV outputs do not comply with safety extra low voltage (SELV) requirements for direct connection to computer products.

Hypertherm offers several choices of machine interface cables for the Powermax105:

- 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 feet) or 228351 (15.2 m, 50 feet) for wires terminated with spade connectors.
  - Use part number 123896 (15.2 m, 50 feet) for a cable terminated with a D-sub connector. (Compatible with Hypertherm products, such as Edge® Ti and Sensor™ PHC.)
- To use signals for arc transfer and plasma start only, use either part number 023206 (7.6 m, 25 feet) or part number 023279 (15.2 m, 50 feet). These cables have spade connectors as shown below.

Refer to page 7-4 *Machine interface pinout* for receptacle pinout information.



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:

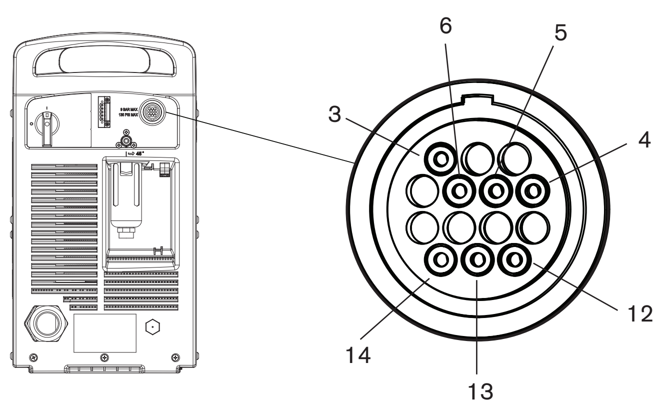
1. Turn OFF the power and disconnect the power cord.
2. Remove the machine interface receptacle's cover from the rear of the power supply.
3. Connect the Hypertherm machine interface cable to the power supply.
4. If you are using a cable with a D-sub connector on the other end, plug it into the appropriate 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 the torch height controller or CNC controller 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 on the next page. The table provides details about each signal type.

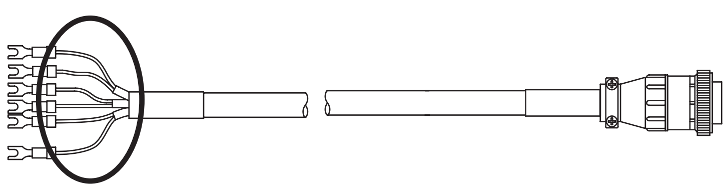
Machine interface pinout



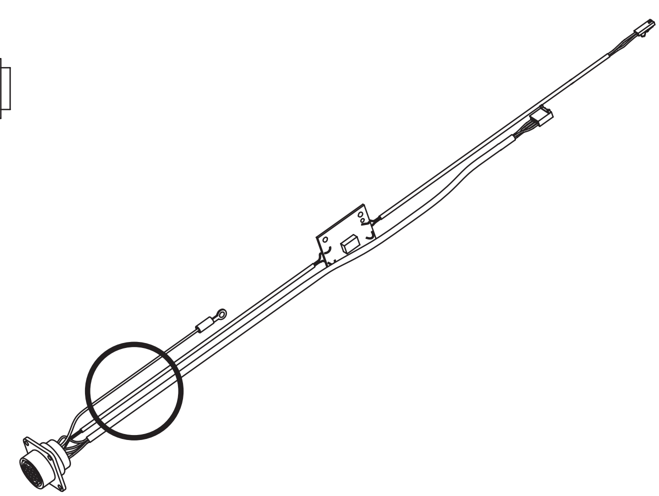
Refer to the following table when connecting the Powermax105 to a torch height controller or CNC controller with a machine interface cable.

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.	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 15 V).	5 (-)	Black (-)	Black (-)
			6 (+)	White (+)	Red (+)
Ground	Ground		13		Green/yellow

External cable wires



Internal cable wires

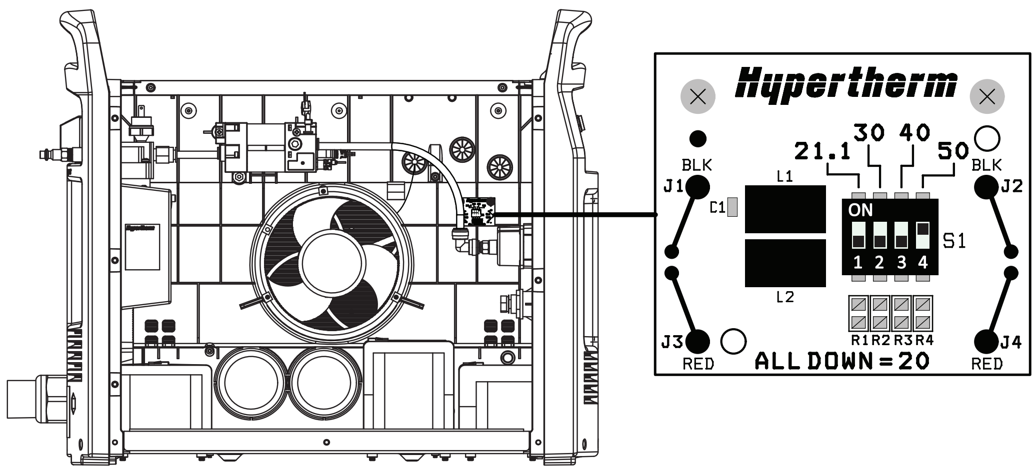


Setting the five-position voltage divider

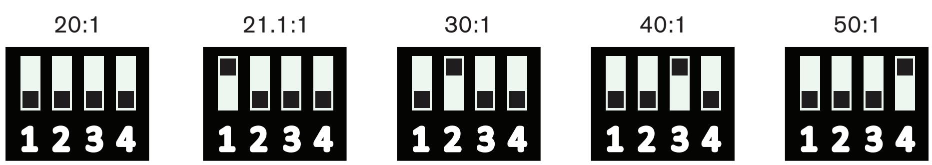
To change the factory preset voltage divider from 50:1 to a different setting:

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 and replace the power supply cover.



If the Hypertherm five-position voltage divider does not supply the required voltage for your application, contact your system integrator for assistance.

Accessing raw arc voltage

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

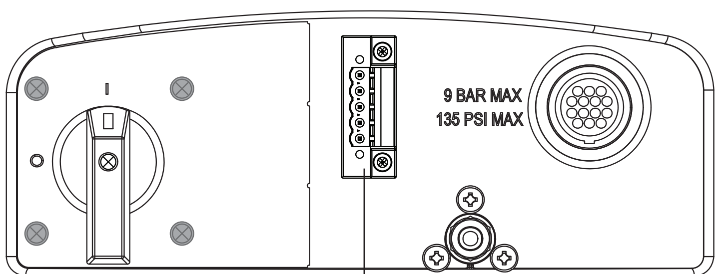
WARNING
SHOCK HAZARD, ENERGY HAZARD, AND FIRE HAZARD

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.

Connecting an optional RS485 serial interface cable

The RS485 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) RS485 serial interface connector on the rear panel. The receptacle on the rear of the power supply provides access to the RS485 board inside the power supply.



RS485 Connector

If your power supply is not equipped with the RS485 connector, order kit 228539, “Powermax65/85/105 RS485 board with cables”. Follow the installation instructions in Application Note 807220 or in the *Power Supply Component Replacement* section of the Service Manual. To download the Application Note, log into Xnet at 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 port 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)

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.

Setting up the torch and table

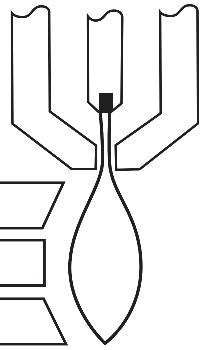
- Use a square to align the torch at right angles to the workpiece in two dimensions.
- The torch may travel more smoothly if you clean, check and "tune" the cutting table's rails and drive system. Unsteady machine motion can cause a regular, wavy pattern on the cut surface.
- Ensure that the torch does 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.



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

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.

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 page 7-8 Setting up the torch and table*), 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.

Piercing 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 may 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 Powermax105, the pierce height is generally 2.5 times the cutting height. Refer to the cut charts for specifics.

The pierce delay must be long enough 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 derives mild steel parameters using certified A-36 plate.

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 metal surface is not clean of rust or paint.
- 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 the *Machine Torch Setup* section.
- The cut speed is too high. See the cut charts in the *Machine Torch Setup* section.
- The metal being cut exceeds the maximum capacity for the selected amperage. See the *Specifications* section.

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

- The gas setting is incorrect.
- 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. See the cut charts in the *Machine Torch Setup* section.
- The current (amperage) is set too low. See the cut charts in the *Machine Torch Setup* section.

The cut angle is not square. Causes can be:

- The torch is not square to the work piece.
- The gas setting is incorrect.
- 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. See the cut charts in the *Machine Torch Setup* section.

The consumable life is shortened. Causes can be:

- The gas setting is incorrect.
- 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.
- The pierce time is incorrect.
- The air quality is poor (oil or water in the air).
- There might be a faulty pilot arc IGBT which can shorten nozzle life (refer to the troubleshooting sections in this manual, or call Technical Service).

Section 8

TROUBLESHOOTING AND SYSTEM TESTS

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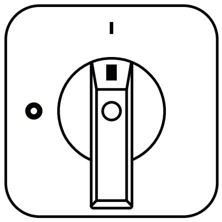
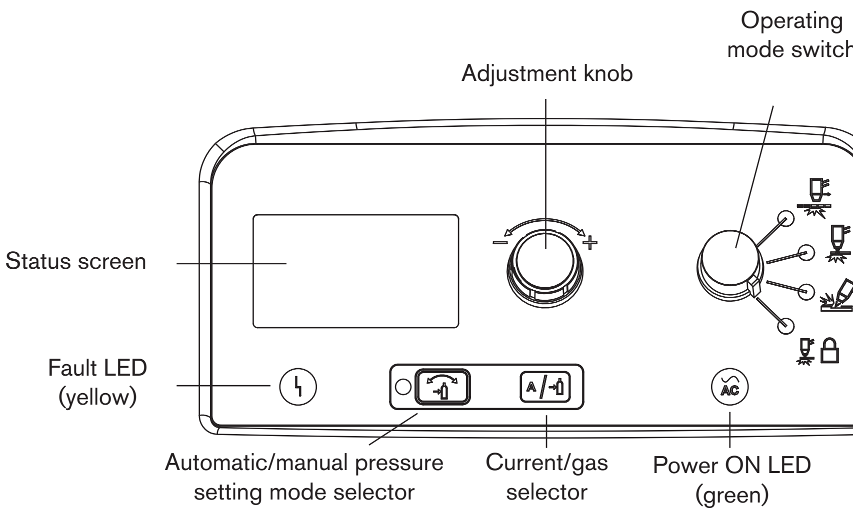
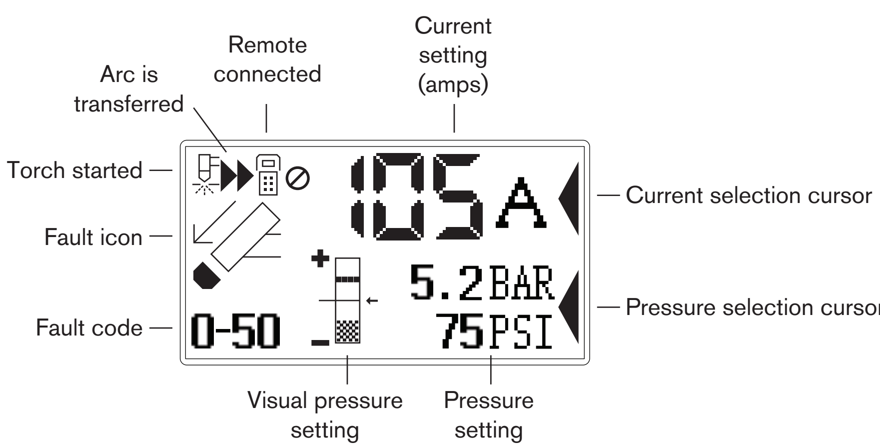
Controls and indicators

The Powermax105 controls and indicators are described in the *Basic System Operations* section. 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 the *Wiring Diagrams* section.

200-600 V CSA 3-phase power supply functional description

AC power enters the system through the power switch (S1) to the input diode bridge (D38). 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 (D36 and D37).

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: 30-105 amps. The system compares the set-point to the output current by monitoring the current sensors and adjusting the output of the inverter IGBT module (Q12).

230-400 V CE, 380 V CCC/230-400 V CE 3-phase power supply functional description

AC power enters the system through the power switch (S1) to the input diode bridge (D38). 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 PFC boost converter consists of an insulated gate bipolar transistor (IGBT Q11), PFC choke, and control circuit. It provides a nominal 760 VDC bus voltage.

The inverter consists of a dual IGBT package (Q12), 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 (D36 and D37).

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: 30-105 amps. The system compares the set-point to the output current by monitoring the current sensors and adjusting the output of the inverter IGBT module. (Q12).

400 V CE, 380 V CCC 3-phase power supply functional description

AC power enters the system through the power switch (S1) to the input diode bridge (D38). 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 (Q12), 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 (D36 and D37).

The output circuitry consists of 2 current sensors located on the power board, the pilot arc IGBT (Q3), 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: 30-105 amps. The system compares the set-point to the output current by monitoring the current sensors and adjusting the output of the inverter IGBT module. (Q12).

Sequence of operation

Power OFF

- Connect the gas supply to the air fitting on the power supply.
- Connect the work lead to the power supply and workpiece.
- Connect the torch to the power supply.
- Plug in the power supply and make sure incoming power is ON if using a line-disconnect box.
- Set the ON/OFF switch (S1) to ON (I).

- The green power ON LED illuminates, indicating the system is ready for operation.
- The fault LED should be off (see *Troubleshooting guide* and *Fault codes* in this section for more information).

- Set the mode switch to the desired mode for cutting or gouging.

- Set the amperage adjustment knob to the desired output current based on the thickness of the metal to be cut.

Note: The gas pressure automatically adjusts for optimal cutting based on the selected settings.

- Position the torch over the workpiece.
- Pull the plasma start trigger on the hand torch or press the remote start switch for the machine torch.

- The electronic regulator activates.
- The gas flow starts.
- The cutting arc starts.

- Drag the torch lightly across the workpiece to make a cut.
- The workpiece drops after the cut.
- Release the plasma start trigger on the hand torch or the remote start switch for the machine torch.

- The arc extinguishes.
- Gas continues to flow for 20 seconds.

- The electronic regulator deactivates.
- The gas flow stops.

- Set the power switch (S1) to OFF (O).

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

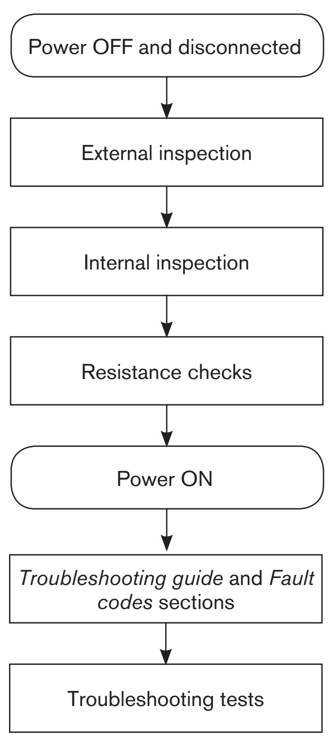
- Multimeter with a variety of test leads. Newer power boards contain test points with a diameter of 2.25 mm (0.09 inches) that accept miniature banana plugs (for example, Pamona® 2945 plugs). Earlier-style power boards contain larger test point openings that require the use of test hooks. See page 8-44.
- IGBT (insulated gate bipolar transistor) tester (part number 128883)

Troubleshooting procedures and sequence

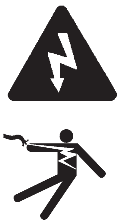
When performing the troubleshooting procedures:

- Read the *Safety and Compliance Manual* (80669C) for detailed safety information.
- Refer to the *Power Supply Component Replacement* section.
- Refer to the *Parts* section.
- Refer to the *Wiring Diagrams* section.

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.



DANGER



ELECTRIC SHOCK CAN KILL

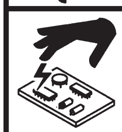
- **Turn off the power and remove the input power plug from its receptacle before removing the cover from the power supply. If the power supply is connected directly to a line disconnect box, switch the line disconnect to OFF (O). In the U.S., use a "lock-out / tag-out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.**
- **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.**
- **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.**

HOT PARTS CAN CAUSE SEVERE BURNS

- **Allow the power supply to cool before servicing.**

MOVING BLADES CAN CAUSE INJURY

- **Keep hands away from moving parts.**



STATIC ELECTRICITY CAN DAMAGE CIRCUIT BOARDS

- **Put on a grounded wrist strap before handling PC boards.**

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 screws from the power supply cover.
3. Lift the cover off the power supply.
4. Remove the component barrier from the power board side of the power supply. This 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.
5. 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 (**±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

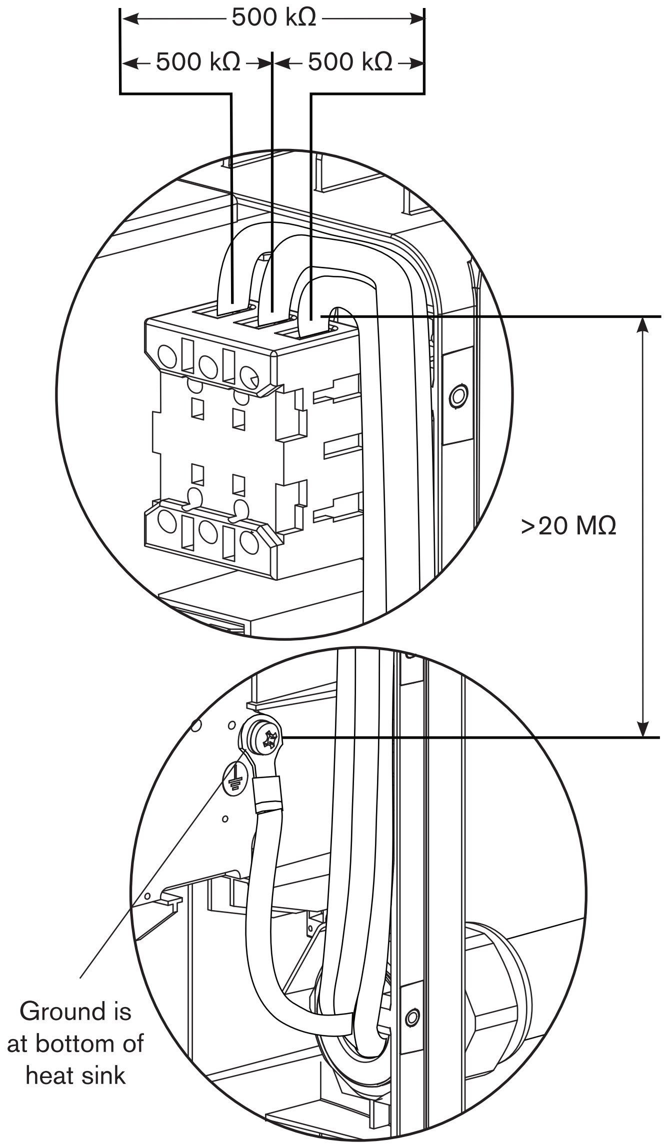
Refer to the figures and table on the following pages.

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 kΩ.
   - 230-400 V CE, 380 V CCC/230-400 V CE, 400 V CE, 380 V CCC: resistance across the input leads = 350 kΩ.
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 MΩ.

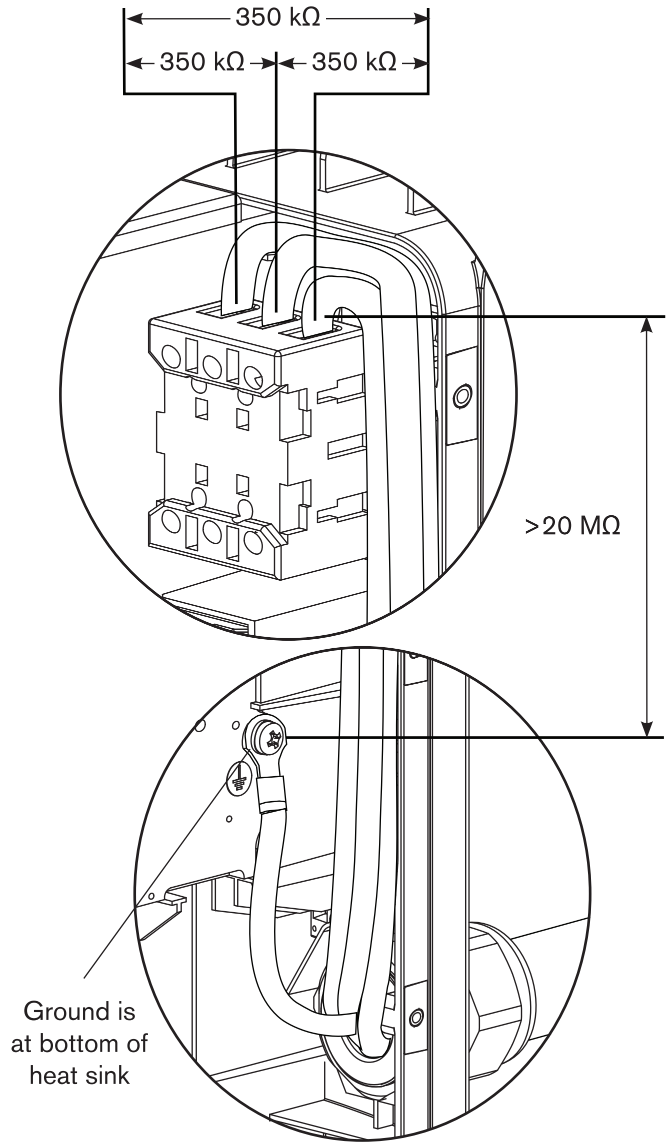
   Note: With the power disconnected and the ON/OFF switch (S1) set to OFF (O), all circuits should read as open.
   The electrical values shown are ±25%.

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

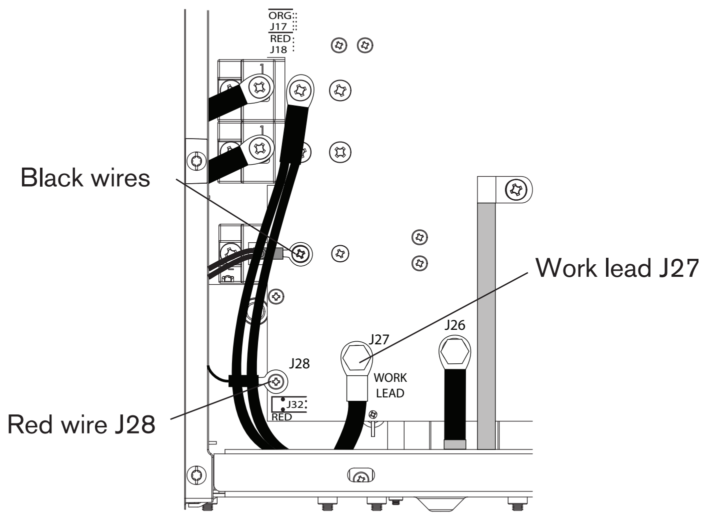
200-600 V CSA model



230-400 V CE, 380 V CCC/230-400 V CE, 400 V CE, 380 V CCC models



Measure resistance from	All models
Work lead (J27) to nozzle (black wire)	230 kΩ
Work lead (J27) to electrode (red wire)	9 kΩ
Electrode (red wire) to nozzle (black wire)	230 kΩ
Output to ground	> 20 MΩ

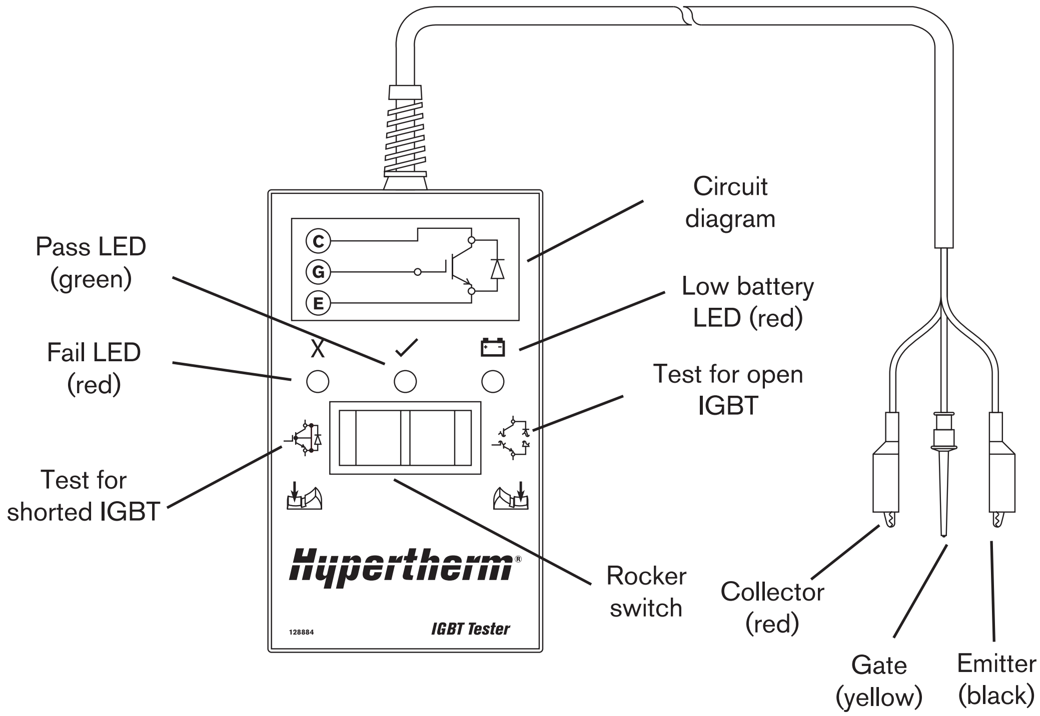


If no problems were found during the visual inspection or the initial resistance check, and the power supply still does not operate correctly, see the Troubleshooting guide.

Note: *Troubleshooting guide* later is this section 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 8-15 *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.

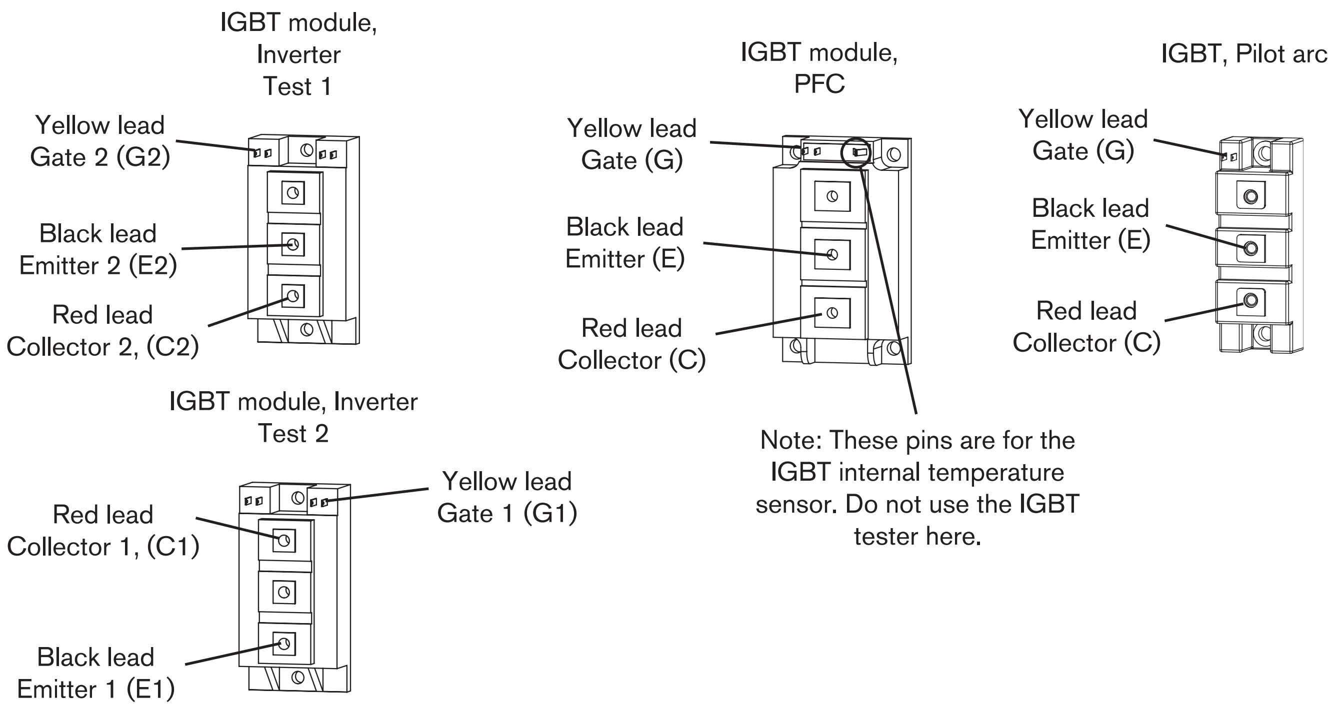
IGBT test preparation

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.



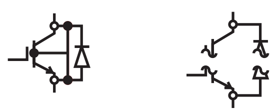
IGBT device test using the Hypertherm tester

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 Fail	LED Pass	LED Battery	This may mean	Corrective action
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

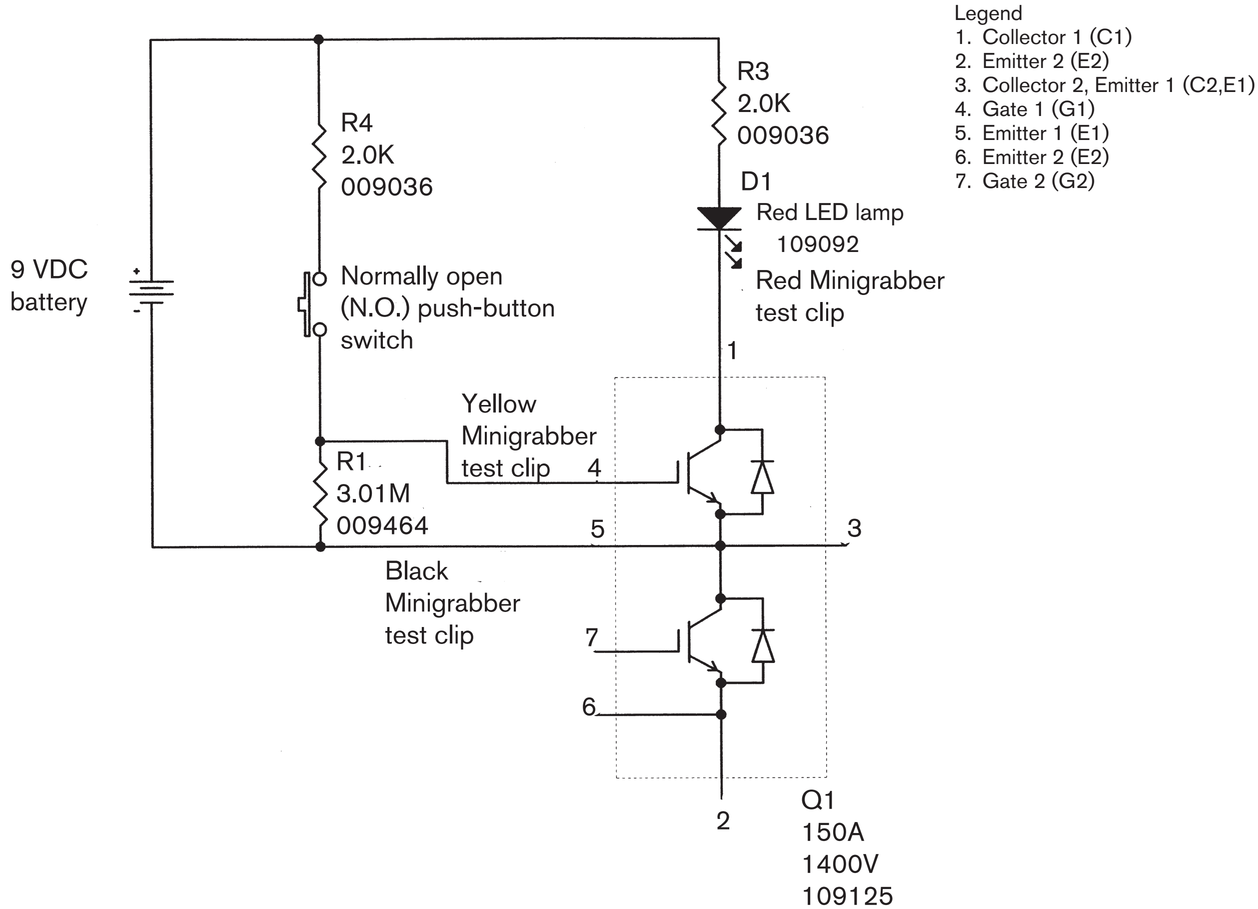
Troubleshoot the Hypertherm IGBT tester

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

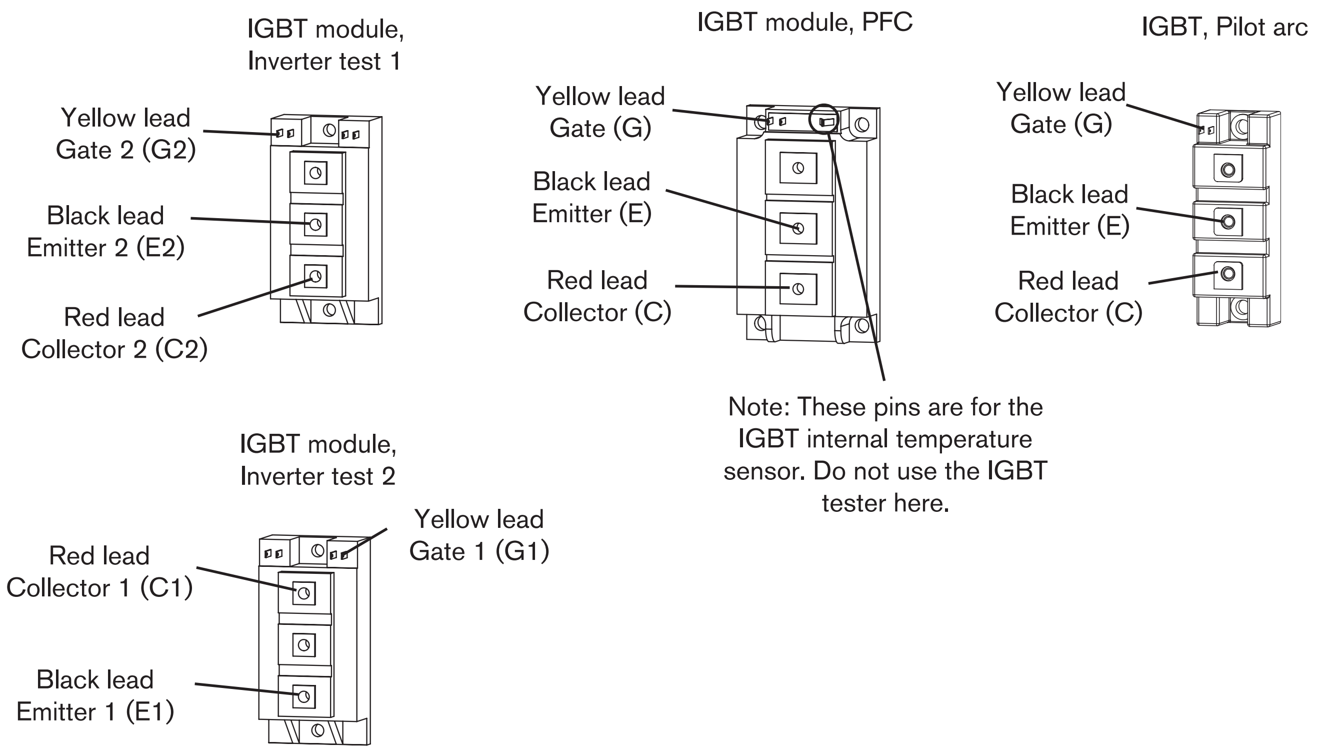


IGBT device test using a non-Hypertherm tester

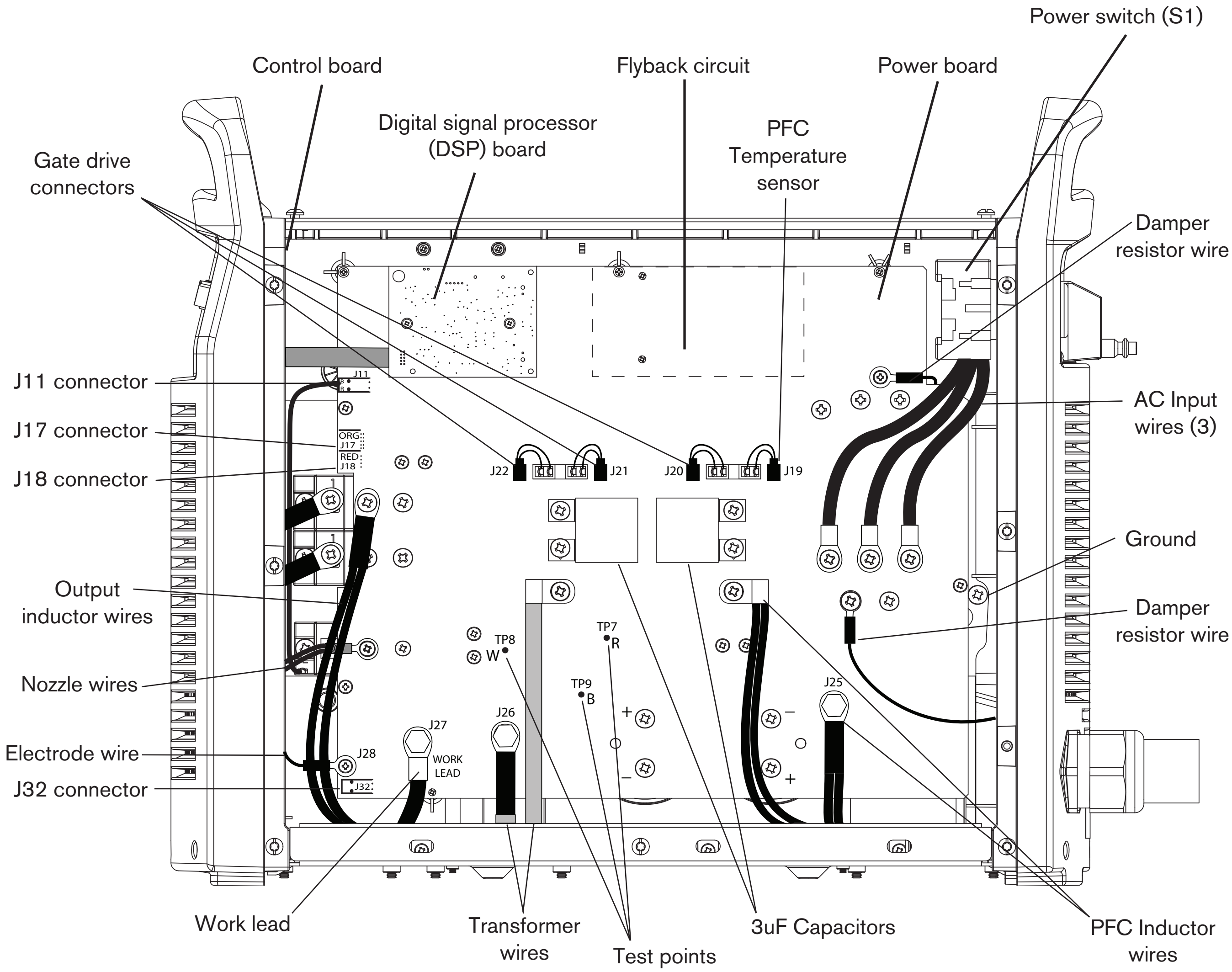
The device tester shown on page 8-15 *Schematic for building an IGBT tester* has one LED and one push-button switch that are used in combination to perform two tests.

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.

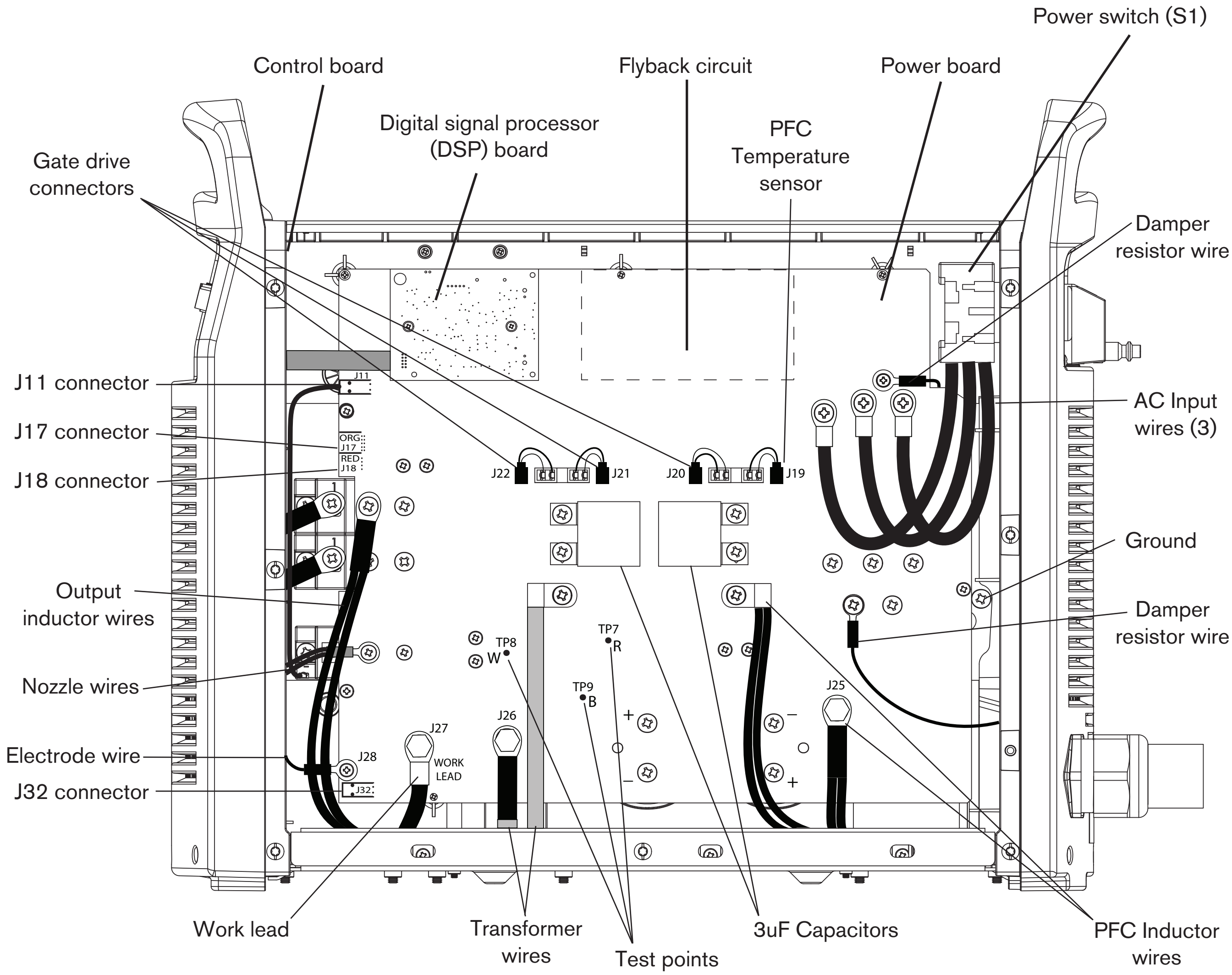
1. Inspect the IGBT for cracks or black marks. If damaged, replace the IGBT.
2. Verify that the 9 v battery reads greater than (>) 8.0 V.
3. Connect the test leads as shown below.
4. With the test leads connected and without pressing the pushbutton switch, the LED should not illuminate. If the LED is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



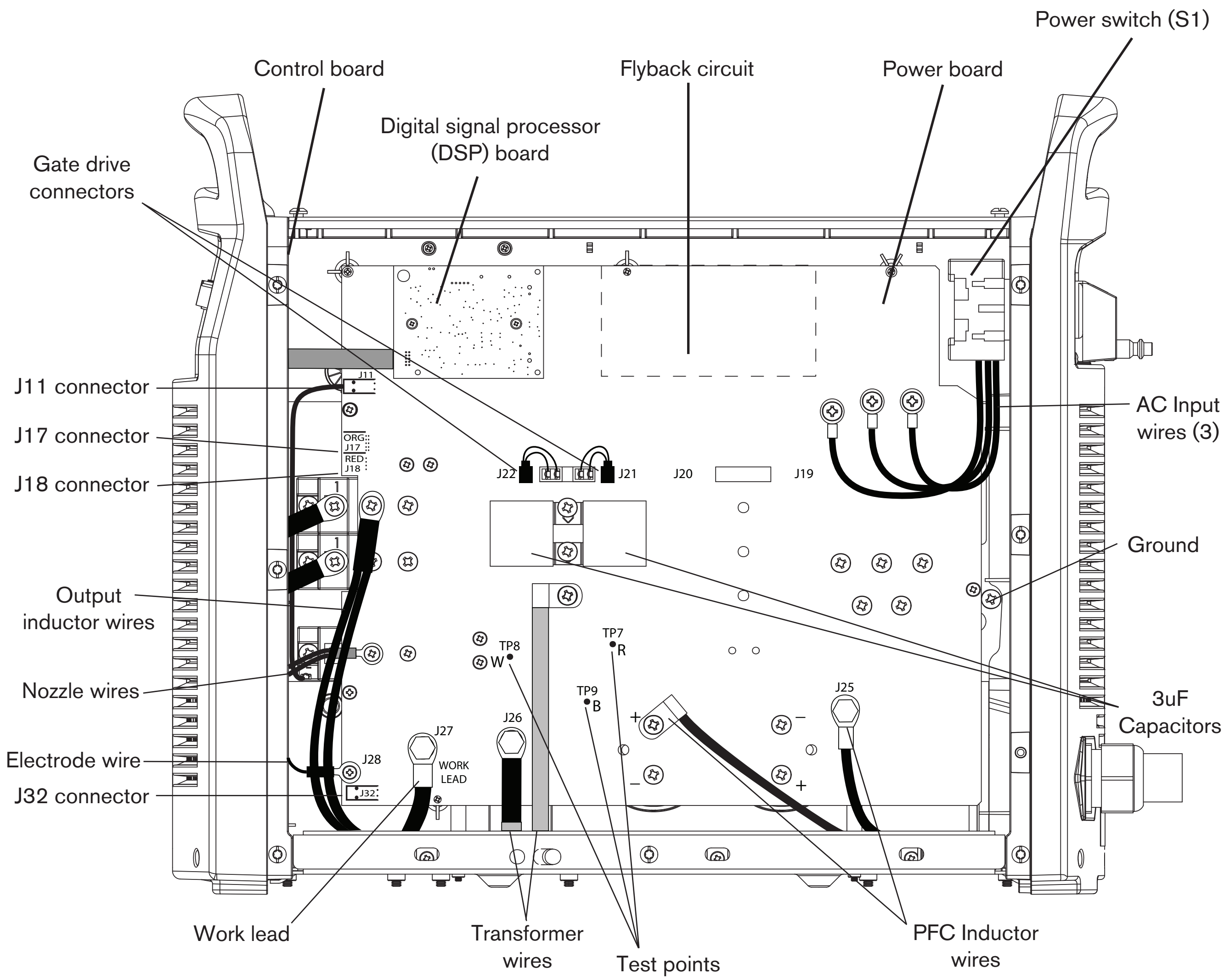
200-600 V CSA power supply overview



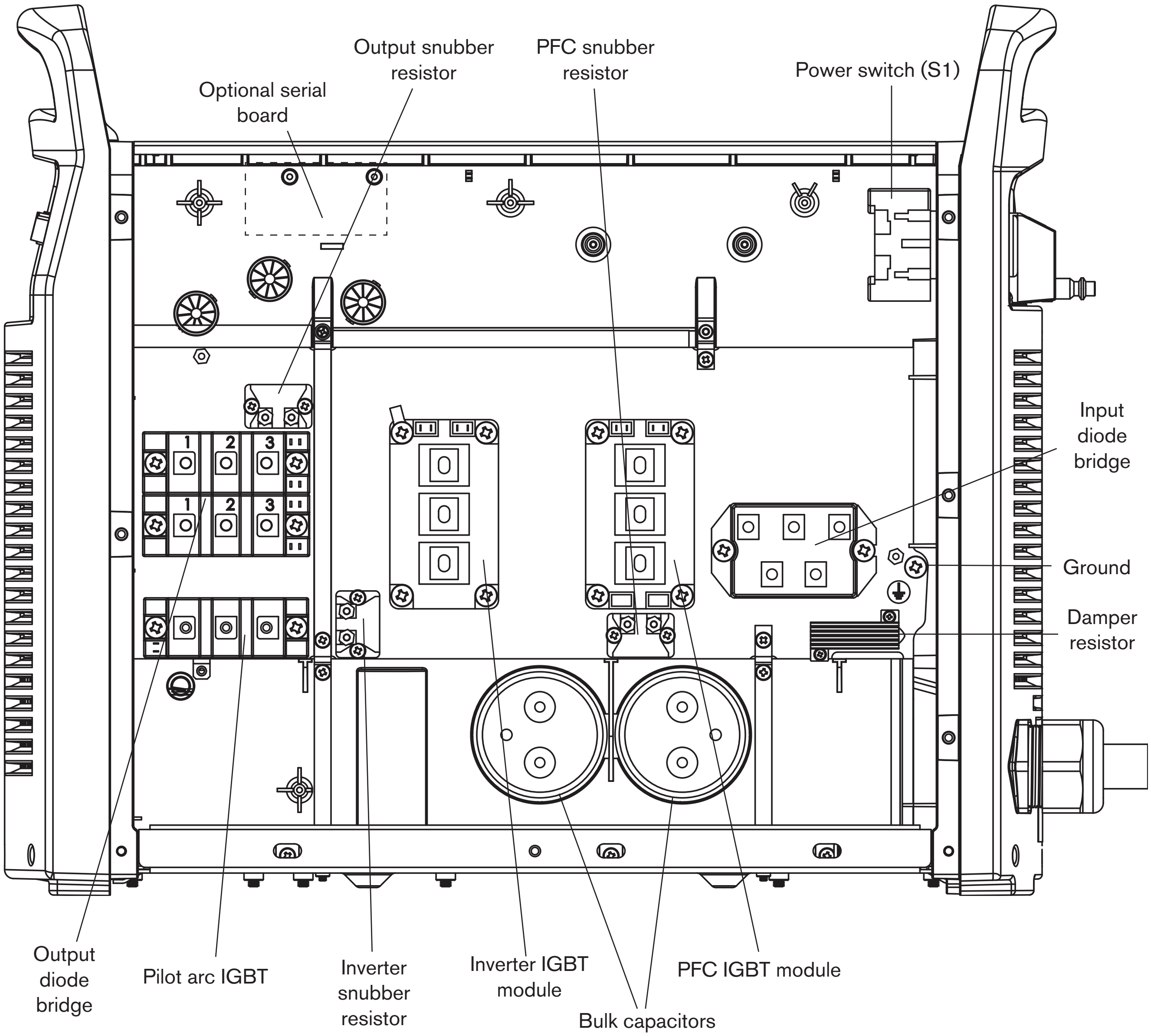
230-400 V CE, 380 V CCC/230-400 V CE power supply overview



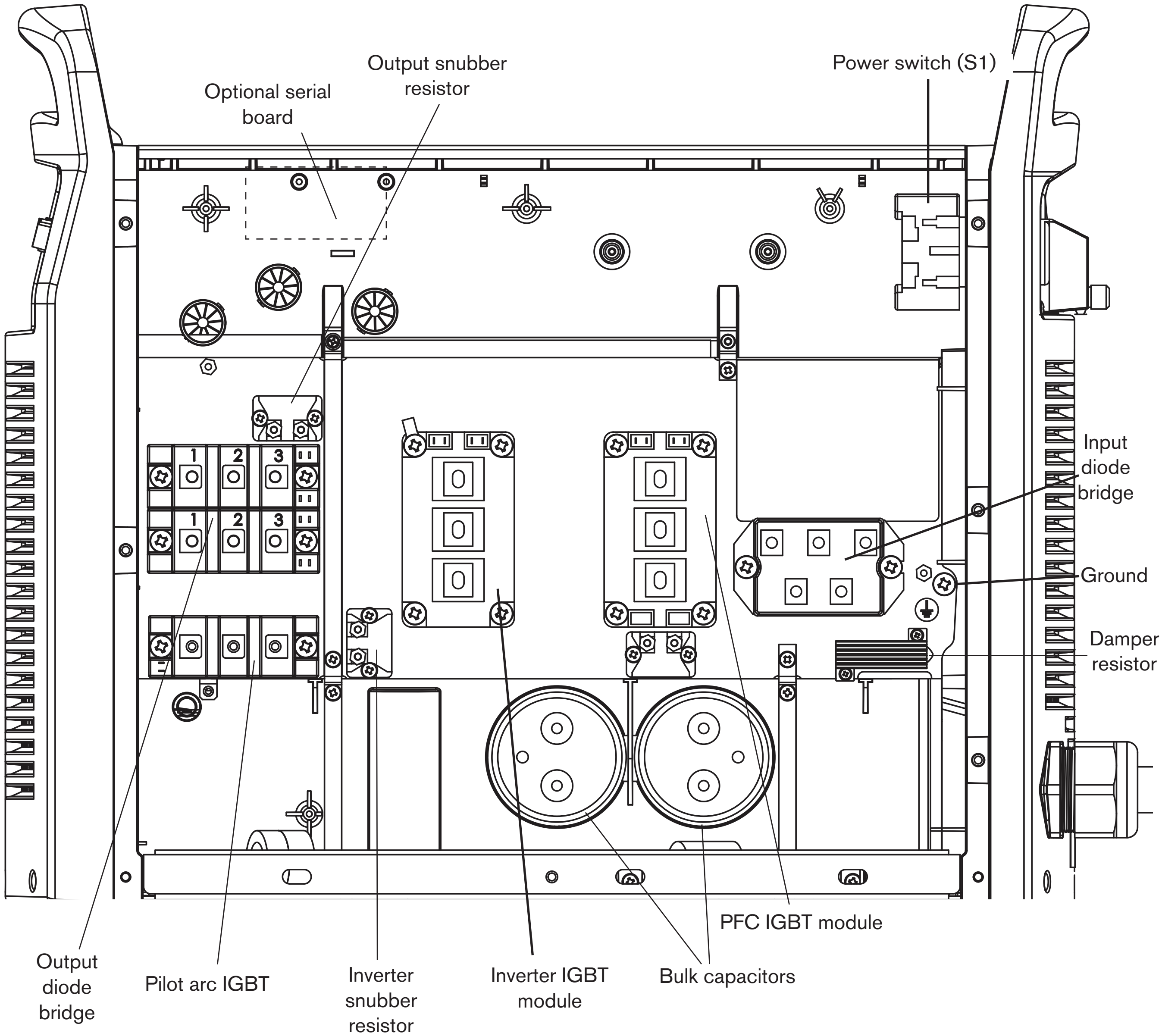
380 V CCC, 400 V CE power supply overview



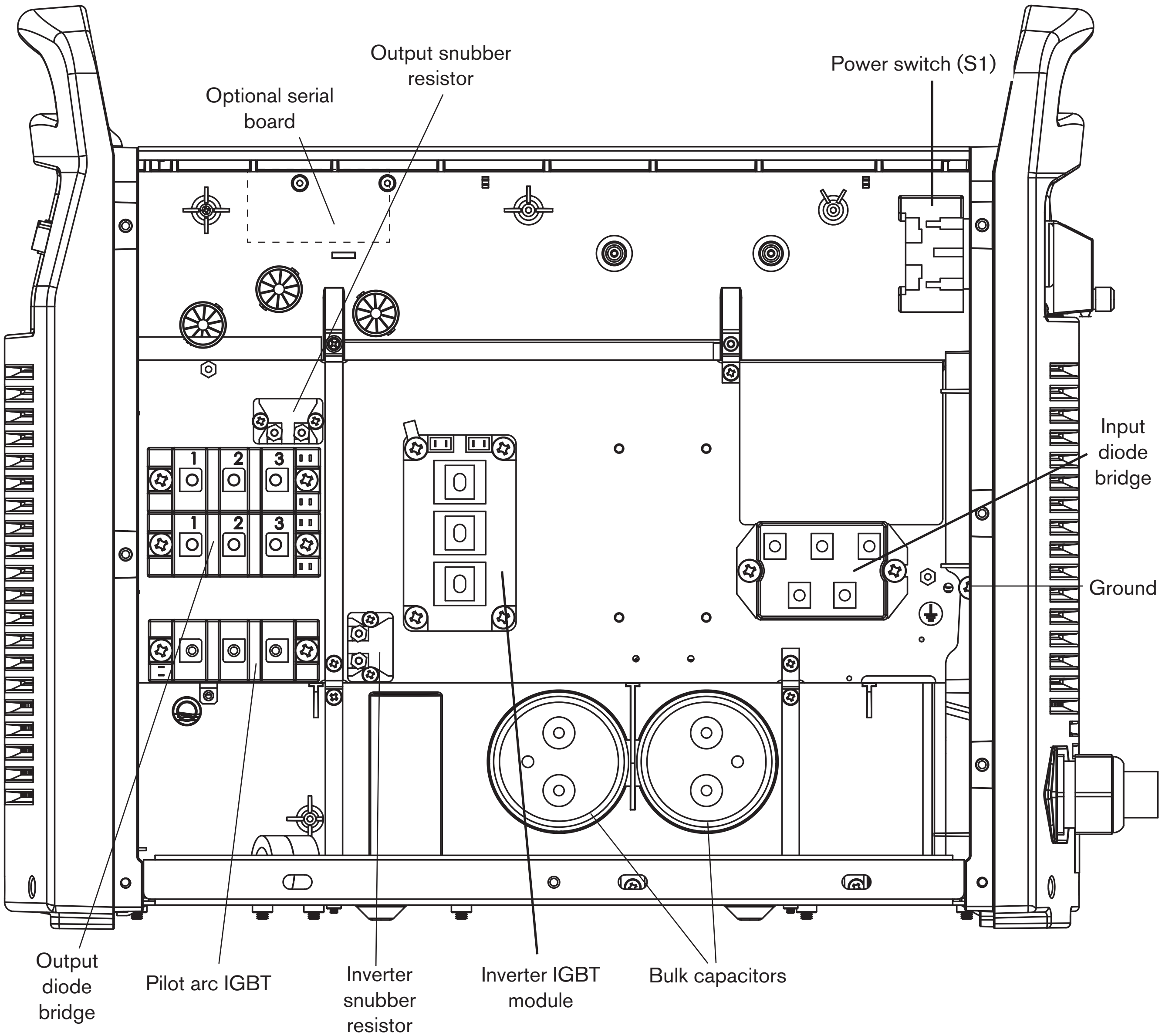
200-600 V CSA power supply overview (power board removed)



230-400 V CE, 380 V CCC/230-400 V CE power supply overview (power board removed)



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



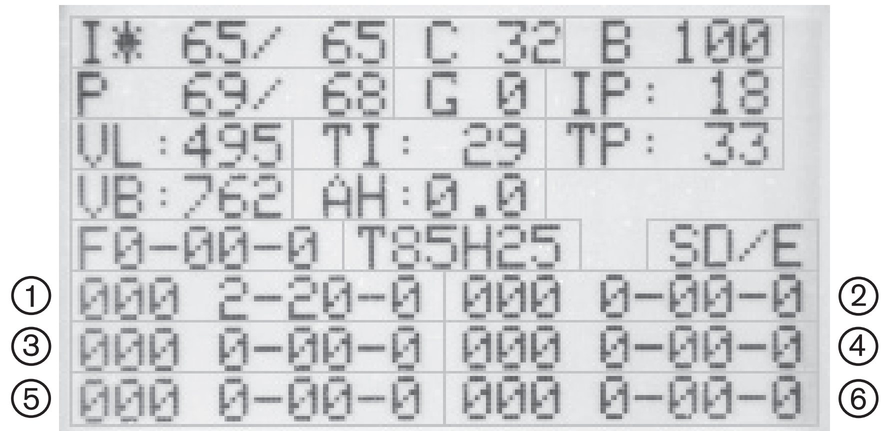
Fault codes

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.



Designator	Description
I	Current set/read
C	LCD contrast
B	LCD brightness (per cent)
P	Pressure set/read
G	Gas test enable (1)/disable (0)
IP	Boost circuit current (not present on 400 V CE)
VL	Incoming AC line voltage
TI	Inverter module temperature (°C)
TP	Boost module temperature (°C), not present on 400 V CE
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 once.
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 solutions show a test number. Refer to page 8-42 *System tests* to perform the indicated numbered test.

Note: 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.

0-00-0

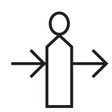
This fault code indicates normal operations.

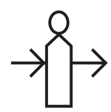
Fault code	Description	Power LED	Fault LED	Fault icon	Solutions
0-00-0	None	On	Off	-	No errors

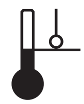
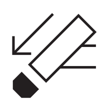
0-nn-n

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.

<table>
<tr><th>Fault code</th><th>Description</th><th>Power LED</th><th>Fault LED</th><th>Fault icon</th><th>Solutions</th></tr>
<tr><td>0-11-0</td><td>Remote controller cut mode invalid</td><td rowspan="3">On</td><td rowspan="3">Off</td><td rowspan="3"></td><td rowspan="3">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.
▪ Fix the controller.
▪ Check the interface cable.</td></tr>
<tr><td>0-11-1</td><td>Remote controller current invalid</td></tr>
<tr><td>0-11-2</td><td>Remote controller pressure invalid</td></tr>
<tr><td>0-12-1</td><td>Output gas pressure low</td><td rowspan="3">On</td><td rowspan="3">Off</td><td rowspan="3"></td><td>▪ Adjust the gas inlet pressure as needed.
▪ Check for kinked or blocked air lines.
▪ Perform Test 10.</td></tr>
<tr><td>0-12-2</td><td>Output gas pressure high</td><td rowspan="2">▪ The gas subsystem is not working properly. Check the valve.
▪ Perform Test 10.</td></tr>
<tr><td>0-12-3</td><td>Output gas pressure unstable</td></tr>
</table>

Fault code	Description	Power LED	Fault LED	Fault icon	Solutions
0-13-0	AC input unstable (line resonance): Alert	Blinks (3 Hz)	Off		▪ Perform a cold restart. ▪ If the fault does not clear, correct the power source. Change the character, generally the impedance, of the line.
0-19-9	Power board hardware protection. One or more major power board hardware faults (or electrical noise) detected: Alert. Fault 0-19-9 can occur three or more times before becoming a 0-99 fault. If fault code 0-19 appears upon power-up, wait one minute to see if fault code 0-99 appears. This could indicate a faulty auxiliary switch.	On	On		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. 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. ▪ Perform Test 12 if fault code 0-99 occurs after fault code 0-19 displays for one minute.
0-20-0	Low gas pressure The gas pressure has fallen below the minimum pressure for that process, mode, and lead length.	On	On		▪ Ensure the gas line is properly installed. ▪ Replace the air filter element if dirty. ▪ Replace the gas supply line if restricted. ▪ Ensure the inlet pressure is 5.9 to 9.3 bar (85 to 135 PSI). With proper air connected, measure the resistance between J5 pins 1 & 2. ▪ If short, replace the power board. ▪ If open, check the cable harness between J5 and the pressure switch. If the harness is good, replace the pressure switch (kit 228688). ▪ Perform Test 10.

Fault code	Description	Power LED	Fault LED	Fault icon	Solutions
0-21-0	Gas flow lost while cutting	On	On		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. ▪ Correct any gas supply restrictions and restart the power supply. ▪ Check the torch lead for leaks or kinking. ▪ Ensure air flows through the electronic regulator in gas test mode. Replace the regulator if necessary. ▪ Possible faulty DSP or power board.
0-22-0	No gas input	On	On		▪ Restore the gas supply. ▪ Restart the power supply. With proper air connected, measure the resistance between J5 pins 1 & 2. ▪ If short, replace the power board. ▪ If open, check the cable harness between J5 and the pressure switch. If the harness is good, replace the pressure switch (kit 228688). ▪ Perform Test 10.
0-30-0	Torch stuck open The nozzle and electrode are not touching after a start is received.	On	On		▪ 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. ▪ Inspect the torch for signs of wet or oily air. ▪ Inspect the torch for any signs of damage or pitting on the electrode contact surface. ▪ If the consumables appear to be installed correctly, the torch may be damaged. Test with a known working torch. ▪ Perform Test 6. ▪ If the problem persists, contact your Hypertherm distributor or authorized repair facility.
0-30-1	Torch stuck closed ▪ The nozzle and electrode will not separate after a start is received. ▪ The regulator may not be functioning properly.				

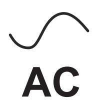
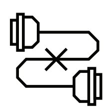
Fault code	Description	Power LED	Fault LED	Fault icon	Solutions
0-32-0	End of consumable life	On	On		▪ Replace the electrode and nozzle. ▪ Check the remaining consumables for wear and replace as needed.
0-40-0	PFC/Boost IGBT module under temperature	On	On		For an over-temperature fault: ▪ Leave the machine powered ON and confirm that the fan is operating. Ensure adequate air flow around the unit. ▪ Ensure the cover is placed with the air fins on the fan side of the power supply. ▪ If the duty cycle has been exceeded, let the unit cool and work within the duty cycle limits listed in the *Basic System Operations* section. For an under-temperature (<-30°C or <-22°F) fault: ▪ Move the unit to a warmer location. ▪ Perform Test 4.
0-40-1	PFC/Boost IGBT module over temperature				
0-40-2	Inverter IGBT module under temperature				
0-40-3	Inverter IGBT module over temperature				
0-50-0*	Retaining cap off	On	On		▪ Verify that proper consumables and retaining cap are installed. Replace damaged parts. Refer to the *Hand Torch Setup* or *Machine Torch Setup* section. ▪ Perform Test 8. ▪ If the consumables appear to be installed correctly, the torch may be damaged. Test with a known working torch. ▪ After correcting the problem, perform a cold restart.

*We recommend that you perform a continuity check on the FastConnect receptacle on the power supply per the table on page 8-29.

Torch-related faults — Check for continuity between the following points:

Torch FastConnect receptacle	J17 on the power board
5	1
7	2
6	3
8	4
9	5
10	6
11	7
12	8

Note: If there is no continuity between any two test points, replace the torch FastConnect receptacle.

Fault code	Description	Power LED	Fault LED	Fault icon	Solutions
0-51-0*	Start/trigger signal on at power up 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		If the power supply is turned on while the torch trigger is pressed, the system is disabled. ▪ Release the trigger and cycle the power to the machine. ▪ 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. ▪ Test with a known working torch.
0-52-0*	Torch not connected	On	On		▪ Plug a torch lead into the FastConnect receptacle on the front of the power supply and recycle the power switch.
0-60-0	Phase loss	On	On		Wear proper personal protection equipment when checking the voltage. ▪ Check for proper voltage (phase to phase and phase to ground) at the power source and at the machine.
0-60-1	Under voltage				▪ Increase the supply voltage.
0-60-2	Over Voltage				▪ Decrease the supply voltage.
0-61-0	AC input unstable: Shutdown	On	On		▪ Test the machine from another AC power source. ▪ Power down and correct the line resonance problem before continuing.
0-98-0	Internal communication failure The control board and the DSP are not communicating.	On	On		▪ Perform a cold restart. ▪ Confirm that the connecting ribbon cable is installed properly between the control board and the DSP board.
0-99-0	System hardware fault (service required) Indicates a major fault with the system.	On	On		▪ Display the service screen. ▪ A qualified service technician must service the system. Contact your distributor or authorized repair facility.

*We recommend that you perform a continuity check on the FastConnect receptacle on the power supply per the table on page 8-29.

1-nn-n

These fault codes can only be seen on the service screen.

Fault code	Description (*System test number)*	Power LED	Fault LED	Fault icon	Solutions
1-00-0	Digital signal processor fault				These are internal processor checks and are not likely to be caused by a hardware failure. ▪ Perform a cold restart. If that doesn't fix the problem, it is possible that the DSP or Power board have failed.
1-10-0	A/D converter fault				
1-20-0	I/O fault	On	On		

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	Power LED	Fault LED	Fault icon	Solutions
2-00-0	Analog to Digital (A/D) converter value out of range				▪ Perform a cold restart. If that doesn't fix the problem, it is possible that the DSP or Power board has failed.
2-01-0	Auxiliary switch disconnected				▪ Check the auxiliary switch cable. ▪ Perform Test 12.
2-10-0	Inverter module temp sensor open				▪ Check the associated wiring. ▪ Perform Test 4. If no problems are found, it is possible that the inverter heat sink temperature sensor assembly (228805) has failed.
2-10-1	Inverter module temp sensor shorted	On	On		
2-11-0	Pressure sensor open				▪ Check the associated wiring. ▪ Perform Test 10. ▪ If necessary, replace the pressure sensor (kit 228689)
2-11-1	Pressure sensor shorted				
2-20-0*	Torch ID The DSP does not recognize the torch.				▪ Confirm that the torch is seated properly in the connector. ▪ Inspect the connector for the proper pin-out.

*We recommend that you perform a continuity check on the FastConnect receptacle on the power supply per the table on page 8-29.

3-nn-n

These fault codes can only be seen on the service screen.

Fault code	Description	Power LED	Fault LED	Fault icon	Solutions
3-00-0	DC bus voltage DC bus voltage is out of range.	On	On		▪ Inspect the PFC Boost circuitry (CSA, 230-400 V CE) ▪ Test the PFC Boost IGBT module (CSA, 230-400 V CE) ▪ Measure the bus voltage from TP8 (-) to TP7 (+). If the voltage does not match the VB on the service screen, replace the DSP board.
3-10-0	Fan speed The fan speed is below the minimum speed.				▪ Clean the fan assembly. ▪ Perform Test 11.
3-10-1	Fan				▪ Check the associated wiring. ▪ Perform Test 11. ▪ If necessary, replace the fan assembly.
3-11-0	PFC module temp sensor open				▪ Check the associated wiring. ▪ Perform Test 4. ▪ If necessary, replace the PFC/Boost IGBT module.
3-11-1	PFC module temp sensor shorted				▪ Check the associated wiring. ▪ Perform Test 4. ▪ If necessary, replace the PFC/Boost IGBT module.
3-11-2	PFC module temp sensor circuit error				▪ Check the temperature circuit on the power board. If Test 4 is good, replace the power board.

<table>
<tr><th>Fault code</th><th>Description</th><th>Power LED</th><th>Fault LED</th><th>Fault icon</th><th>Solutions</th></tr>
<tr><td>3-20-0</td><td>Fill valve

Indicates that the Fill Valve is not connected.</td><td rowspan="4">On</td><td rowspan="4">On</td><td rowspan="4"></td><td>▪ Check the associated wiring.
▪ Perform Test 9.
▪ If necessary, replace the electronic regulator. (Kit 228687)</td></tr>
<tr><td>3-20-1</td><td>Dump valve

Indicates that the Dump Valve is not connected.</td><td>▪ Check the associated wiring.
▪ Perform Test 9.
▪ If necessary, replace the electronic regulator. (Kit 228687)</td></tr>
<tr><td>3-20-2</td><td>Valve ID</td><td>The DSP does not recognize the electronic regulator.
▪ Verify that the jumper at J6 is in the correct position. (See wiring diagram on 12-4 - 12-5.)</td></tr>
<tr><td>3-20-3</td><td>Electronic regulator is disconnected

The electronic regulator is not drawing current.</td><td>▪ Inspect the associated wiring, particularly the 7-pin connector at J6 on the power board.
▪ If necessary, replace the electronic regulator. (Kit 228687)</td></tr>
</table>

<table>
<tr><th>Fault code</th><th>Description</th><th>Power LED</th><th>Fault LED</th><th>Fault icon</th><th>Solutions</th></tr>
<tr><td>3-41-0</td><td>Drive fault</td><td rowspan="5">On</td><td rowspan="5">On</td><td rowspan="5"></td><td>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.</td></tr>
<tr><td>3-42-0</td><td>5 or 24 VDC fault</td><td>The 5 or 24 VDC supply from the flyback circuit is out of range.
Perform Test 5.</td></tr>
<tr><td>3-42-1</td><td>18 VDC fault</td><td>The 18 VDC supply from the flyback circuit is out of range.
▪ Replace the power board.
▪ Check the inverter IGBT module and replace if necessary.</td></tr>
<tr><td>3-43-0</td><td>Inverter capacitors unbalanced</td><td>Voltage across one or both inverter caps is more than 25% different than nominal.
CSA and 230-400 V CE 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.
▪ Replace the bulk capacitors.</td></tr>
<tr><td>3-44-1</td><td>PFC over current</td><td>High current in the PFC/Boost circuit.
▪ Test the PFC IGBT module.
▪ Replace it if faulty.
▪ If necessary, replace the power board.</td></tr>
</table>

<table>
<tr><th>Fault code</th><th>Description</th><th>Power LED</th><th>Fault LED</th><th>Fault icon</th><th>Solutions</th></tr>
<tr><td>3-51-1</td><td>Inverter saturation fault (the inverter is over current)</td><td rowspan="4">On</td><td rowspan="4">On</td><td rowspan="4"></td><td rowspan="2">Upper and lower inverter IGBTs are gating (being activated) in phase rather than 180° out of phase.
▪ Test the two inverter IGBTs in the module.
▪ Perform Test 3.
▪ Replace the module if either is faulty.
▪ If necessary, replace the power board.</td></tr>
<tr><td>3-52-0</td><td>Shoot through</td></tr>
<tr><td>3-60-0</td><td>Power board</td><td>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.</td></tr>
<tr><td>3-70-0</td><td>Internal serial communications fault</td><td>There is a fault with the communication between the DSP and Power board.
▪ Check the board connector.
▪ If necessary, replace either the DSP or Power board.</td></tr>
</table>

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 8-23 *Fault codes* before using this troubleshooting guide.

The following table provides an overview of the most common problems that can arise when using the Powermax and explains how to solve them. See page 8-42 *System tests* for detailed test procedures.

<table>
<tr><th>Problem</th><th>Meaning</th><th>Causes</th><th>Solution</th></tr>
<tr><td rowspan="5">The ON/OFF power switch is set to ON (I), but the power ON LED is not illuminated.</td><td rowspan="5">There is insufficient voltage to the control circuits or a short-circuited power component.</td><td>No voltage, improper voltage applied to the unit, a faulty power switch (S1), or a faulty input diode.</td><td>▪ Check to see that the system is plugged into an appropriately-sized circuit and that the circuit breaker has not been tripped.
▪ Verify that the power is ON at the main power panel or at the line-disconnect switch box.
▪ Verify that the line voltage is not too low (more than 15% below the rated voltage).
▪ Perform Test 1 to check the incoming voltage and the power switch.
▪ Perform Test 12 on CSA units.</td></tr>
<tr><td>Faulty power board, fan, or solenoid valve.</td><td>▪ Perform Test 5 to check the flyback circuit.</td></tr>
<tr><td>Faulty power board or IGBT.</td><td>▪ Perform Tests 1, 2, and 3 and replace any faulty components.</td></tr>
<tr><td>Faulty control board.</td><td>▪ Replace the control board.</td></tr>
<tr><td>Faulty DSP board.</td><td>▪ Replace the DSP board.</td></tr>
</table>

Problem	Meaning	Causes	Solution
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.	▪ The torch or torch lead may be damaged. ▪ The power board may be faulty. ▪ The control board may be faulty.	▪ Inspect the torch and torch lead for damage. ▪ 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.
Power ON LED blinks or goes out while cutting.	A power component is shorted.	▪ Faulty fan.	▪ Perform Test 11.
		▪ Faulty power board or IGBT.	▪ Perform Tests 1, 2, or 3.
		▪ Faulty DSP board.	
The arc does not transfer to the workpiece.			▪ Clean the area where the work clamp contacts the workpiece to ensure a good metal-to-metal connection. ▪ Inspect the work clamp for damage and repair as necessary. ▪ The pierce height distance may be too large. Move the torch closer to the workpiece and fire the torch again.
Gas flows from the torch at power-up when neither the torch trigger nor a remote start is activated.	The electronic regulator, power board, or control board is faulty.	▪ Faulty electronic regulator. ▪ Faulty power board. ▪ Faulty DSP board.	▪ 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 9.3 bar (135 psi). If necessary, reduce the pressure.

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.	▪ Overused or improperly installed consumables.	▪ Replace consumables.
	Damaged torch or lead assembly.	▪ Electrode is not moving properly in the torch or the torch lead is damaged.	▪ Perform Test 6.
	Insufficient or excessive gas flow.	▪ Gas pressure is too high or too low, or the gas supply is leaking or restricted.	▪ Ensure the inlet pressure is 5.9 to 9.3 bar (85 to 135 PSI). ▪ Repair air leaks or restrictions. ▪ Manually adjust the gas pressure on the power supply.
	Poor air quality.	▪ Air filter element is dirty. ▪ Moisture or contaminants in the gas supply line.	▪ Replace the air filter element. ▪ Add appropriate filtration and purge the lines with nitrogen to flush out oil and moisture.
	Insufficient input power.	Undersized electrical supply installation: ▪ Breaker or fuse. ▪ Supply wire. ▪ Extension cord.	▪ Verify that the external electrical power is installed according to the *Specifications* section.
	Faulty inverter IGBT module or power board.	▪ Faulty inverter IGBT module or power board.	▪ Use an IGBT tester to check the inverter IGBT module
	Capacitor voltage imbalance on the power board.	▪ Faulty resistors on the power board or faulty bulk capacitor(s).	▪ Perform Tests 1, 2, or 3. ▪ If the voltage across the capacitors is not balanced, replace the power board.

Problem	Meaning	Causes	Solution
Arc goes out while cutting or intermittently will not fire.	The arc lost contact with the workpiece.	▪ The work lead or work lead connection may be faulty. ▪ The material being cut may require the use of continuous pilot arc mode.	▪ If you are cutting expanded metal, grate, or any metal with holes, set the mode switch to continuous pilot arc mode. ▪ Check for loose connections at the work clamp and at the power supply. ▪ Reposition the work lead on the workpiece. ▪ Clean the cutting surface to ensure a better connection with the work lead.
	Faulty fan.	▪ The fan could be overloading the flyback circuit.	▪ Perform Tests 5 and 11.
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..	▪ The consumables need to be replaced	▪ Inspect the consumables and replace if necessary.
		▪ The work lead may be damaged or not properly connected to the work piece	▪ Inspect the work lead for damage. Reposition it and clean the work surface to ensure good contact.
		▪ The amperage adjustment knob may be set too low.	▪ Increase the amperage as needed.
		▪ The power board may be faulty.	▪ Perform Tests 1, 2, and 3 and replace any faulty components.
		The cutting mode switch is in the wrong position for the cutting operation.	▪ Ensure the cutting mode switch is in the correct position.
		▪ Faulty pilot arc IGBT.	▪ 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 kΩ, check the resistance across the pilot arc IGBT (two screws on 08). If the resistance is less than 5 kΩ, replace the pilot arc IGBT.

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.	▪ The mode switch may be set incorrectly	▪ Verify that the mode switch is set to continuous pilot arc.
		▪ The power board or the DSP board may be faulty.	▪ Perform Tests 1, 2, and 3 and replace the power board or DSP board if necessary.
The arc extinguishes, but re-ignites when the torch trigger is pressed again.	The consumables are worn or damaged, the air filter element is contaminated, or the input gas pressure is not at the proper level.	▪ The consumables need to be replaced.	▪ Replace the consumables as needed.
		▪ The air filter element needs to be replaced.	▪ Replace the air filter element if it is contaminated.
		▪ The gas pressure is too high or too low.	▪ Manually adjust the gas pressure as needed.
The arc sputters and hisses.	The gas filter element is contaminated, or the input gas line contains moisture.	▪ The air filter element needs to be replaced.	▪ Replace the air filter element if it is contaminated.
		▪ The input gas supply needs to be cleaned.	▪ Inspect the gas line for moisture. If necessary, install or repair the gas filtration to the power supply. See the *Power Supply Setup* section.

<table>
<tr><th>Problem</th><th>Meaning</th><th>Causes</th><th>Solution</th></tr>
<tr><td rowspan="5">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.</td><td rowspan="4">Inadequate ground.</td><td>▪ Poor work lead connection.</td><td>▪ Verify that the work lead is attached to the workpiece and the workpiece is free of rust, paint, or other coatings.</td></tr>
<tr><td>▪ Damaged work lead.</td><td>▪ Check the resistance across the work lead. If the resistance is greater than 3 Ω, repair or replace the work lead.</td></tr>
<tr><td>▪ Faulty pilot arc IGBT.</td><td>▪ Turn the power OFF, remove the consumables, and check the resistance between the plunger and the work piece. If the resistance is less than 5 kΩ, check the resistance across the pilot arc IGBT (two screws on 08). If the resistance is less than 5 kΩ, replace the pilot arc IGBT.</td></tr>
<tr><td>▪ Faulty DSP board.</td><td>▪ Replace the DSP board.</td></tr>
<tr><td>Low output from the power supply.</td><td>▪ Current is set too low.</td><td>▪ Increase the current as needed.</td></tr>
<tr><td rowspan="2">Nothing displays on the status screen, but the ON/OFF power switch is set to ON (I) and the power ON LED is illuminated.</td><td rowspan="2">There is insufficient voltage to the control circuits or a short-circuited component.</td><td>▪ No voltage or improper voltage applied to the unit, or a blown fuse.</td><td>▪ Check to see that the system is plugged into an appropriately-sized circuit and that the circuit breaker has not been tripped.
▪ Verify that the power is ON at the main power panel or at the line-disconnect switch box.
▪ Verify that the line voltage is not too low (more than 15% below the rated voltage).
▪ Verify that the fuses in the disconnect are not blown.</td></tr>
<tr><td>▪ The fan inside the power supply short-circuited.</td><td>▪ Turn the power OFF. Disconnect the fan from J1 on the power board. Turn the power back ON. If the status screen comes on, replace the fan.</td></tr>
</table>

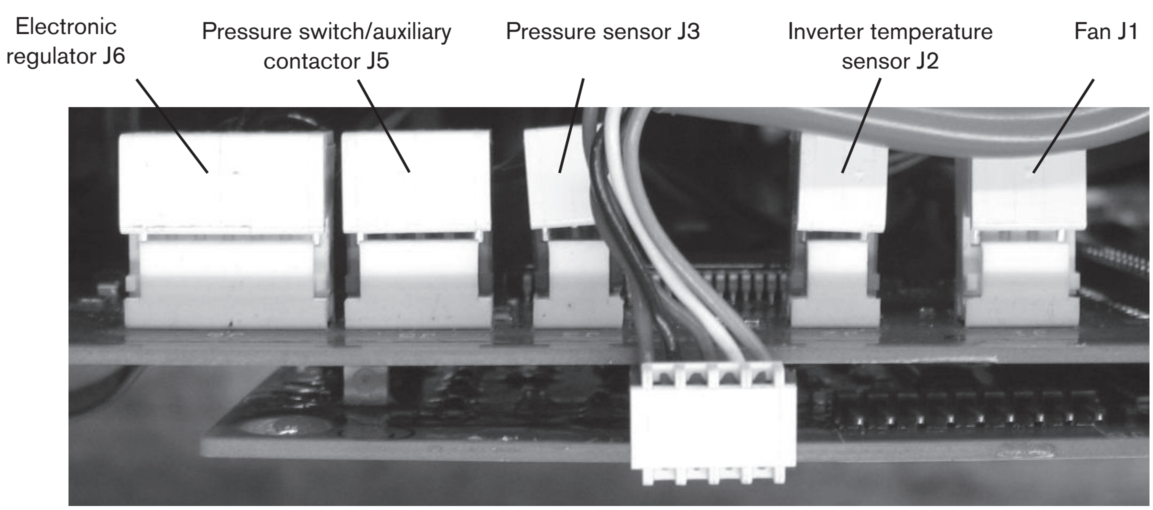
System tests

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/closed	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.



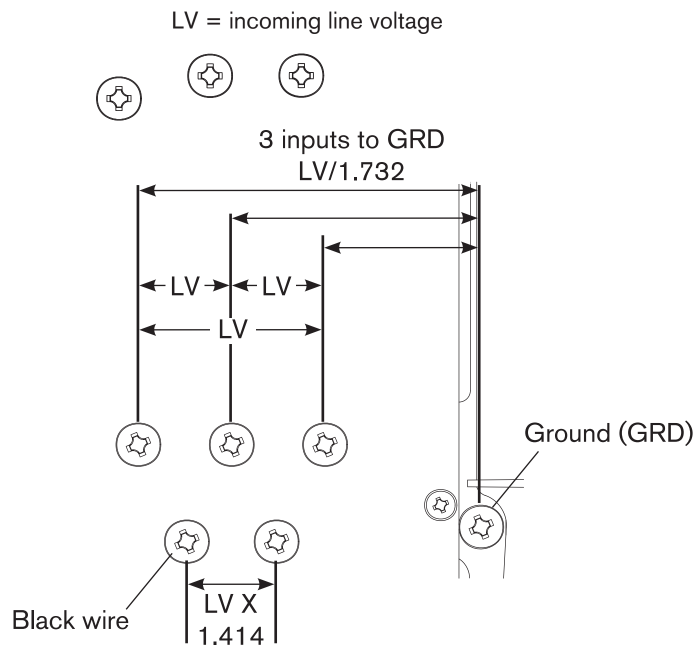
Test 1 – Voltage input

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

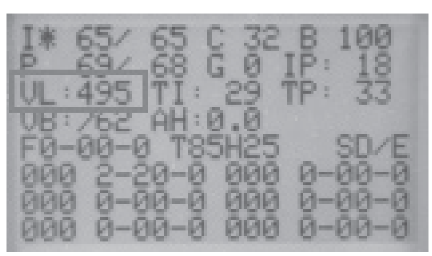
- Check the line voltage at the top of the power switch (S1) with the switch in the OFF position.
- Check the input voltage to the input diode bridge with the switch in the ON position.
  - The AC voltage between any 2 input wires should equal the line voltage.
- If there is proper voltage to the power switch and low voltage to the input diode bridge, 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 ±15%.

	Three phase
L1	Black (CSA) Brown (CE)
L2	White (CSA) Black (CE)
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 ±15% of AC line voltage.



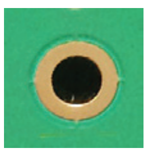
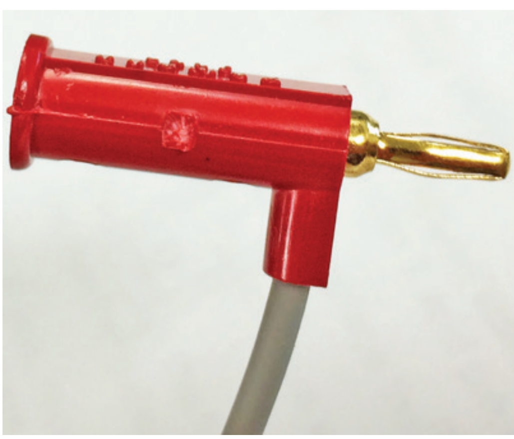
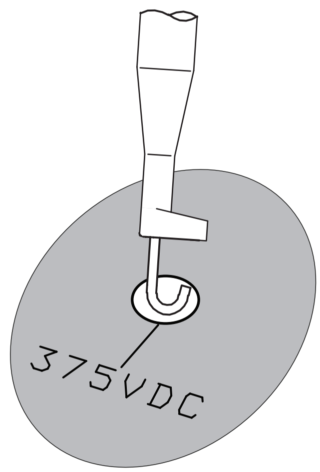
- If there is a fault and the "VL" value is correct:
  - Verify the DSP board by replacing it with a known good board.
  - If DSP board is not the problem, replace the power board and the PFC IGBT module (CSA and 230-400 V CE units only).

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 8-45.
  - 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 

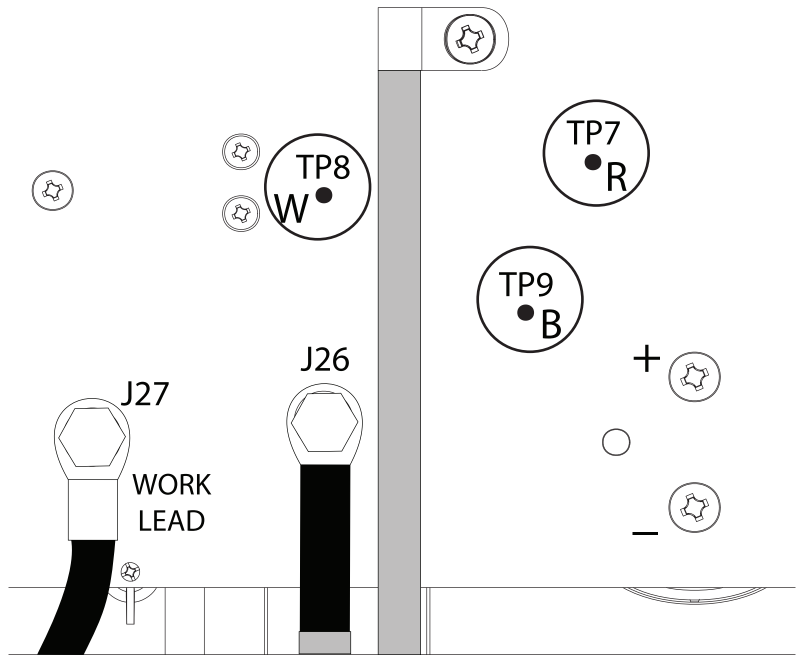
Note: If miniature banana plugs are not available, use small test clips that you can attach to the copper contacts in the test point openings on the power board.

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.

200-600 V CSA	
Test points	Value
TP 7 and 9	25 kΩ
TP 8 and 9	25 kΩ

230-400 V CE, 380 V CCC/230-400 V CE	
Test points	Value
TP 7 and 9	25 kΩ
TP 8 and 9	25 kΩ

380 V CCC, 400 V CE	
Test points	Value
TP 7 and 9	18 kΩ
TP 8 and 9	18 kΩ



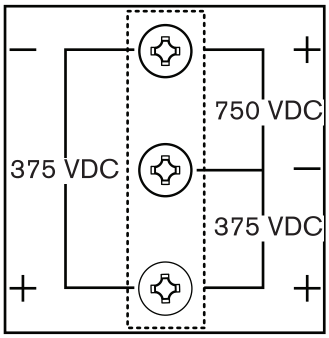
Voltage check

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

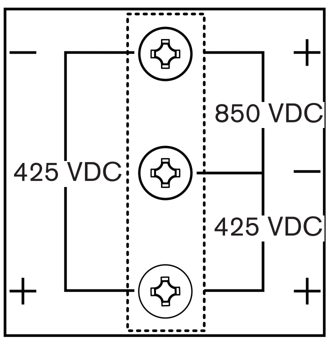
Note: Wear proper personal protective equipment (PPE) before testing powered equipment. All values are ±15%.

- Check the inverter IGBT module 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.

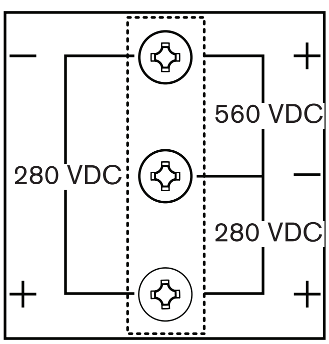
200-480 V CSA, 380 V CCC/230-400 V CE input



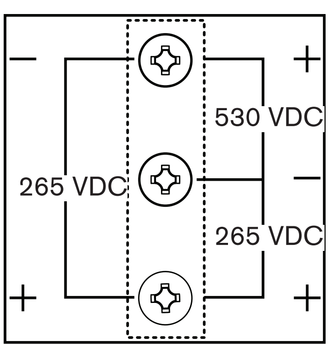
600 V CSA input

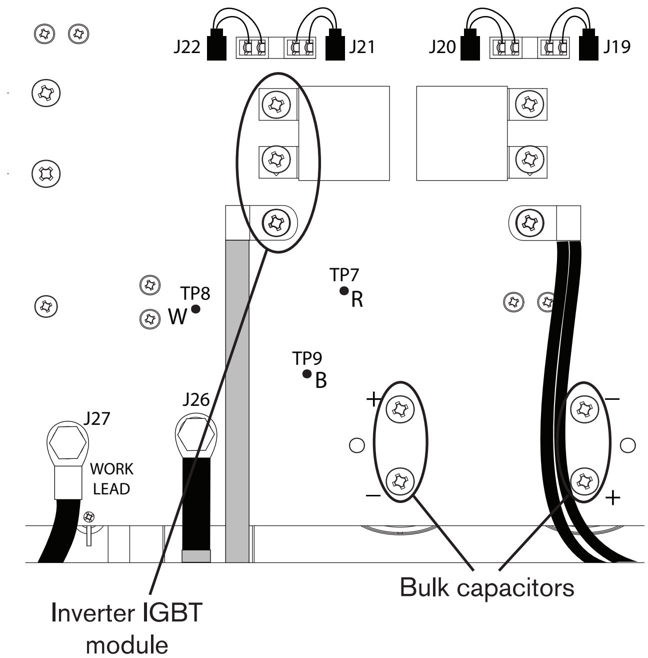


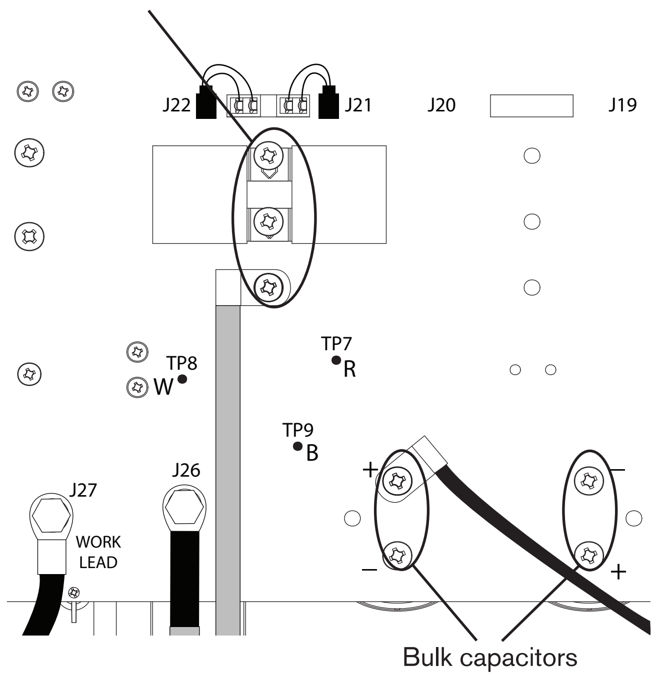
400 V CE input



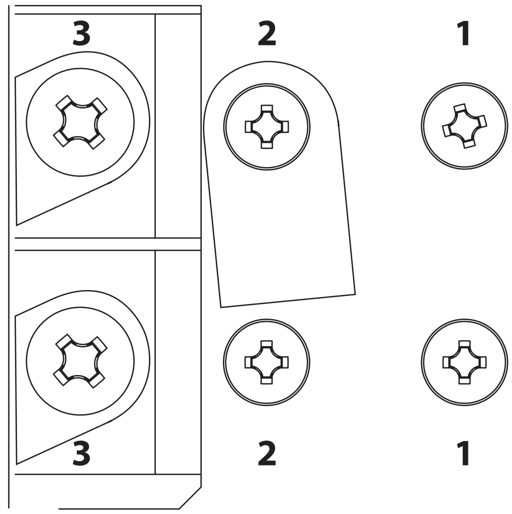
380 V CCC input

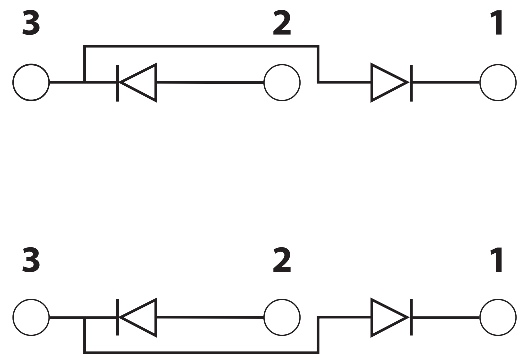






Test 3 – Output diodes





- Turn OFF the power switch and disconnect the power cord.
- 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 0.1V to 1.0V with the meter leads reversed.
  - A diode is shorted if the value is less than 0.1V. Replace both bridges.
  - A diode is open if the value is greater than 1.0V in both directions. Replace both bridges.

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:

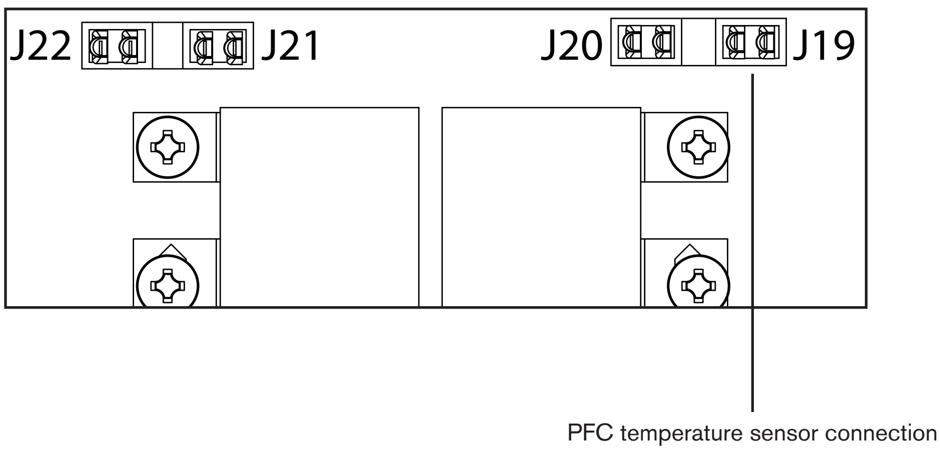
- 0-40-0 PFC module under temperature.
- 0-40-1 PFC module over temperature.
- 0-40-2 Inverter module under temperature.
- 0-40-3 Inverter module over temperature.

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, 230-400 V CE, 380 V CCC/230-400 CE models only)

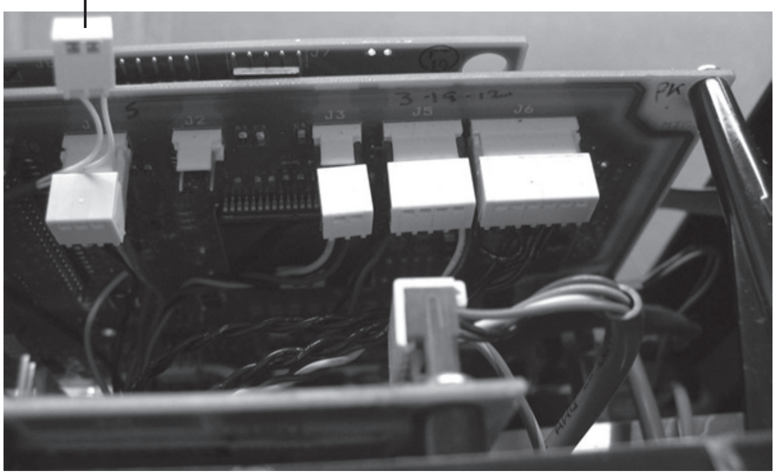
1. Remove PFC temperature sensor connector (J19) from power board.
2. Check the resistance between pins 1 and 2 on the plug. Resistance should be about 5 kΩ.
3. If the resistance is incorrect, replace the PFC IGBT module and gate drive cables.
4. If the value is correct, measure resistance between pins 1 and 2 on J19 on the power board with the temperature sensor disconnected. The resistance should be about 4.7 kΩ.
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).
2. Measure the resistance between pins 1 and 3 on the plug.
3. If the resistance is not within ±15% of 10 kΩ 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 kΩ.
5. If the value is correct, replace the DSP board.
6. If the value is incorrect, replace the power board.

Inverter temperature
sensor connector J2



Test 5 – Flyback circuit (DC minor voltages)

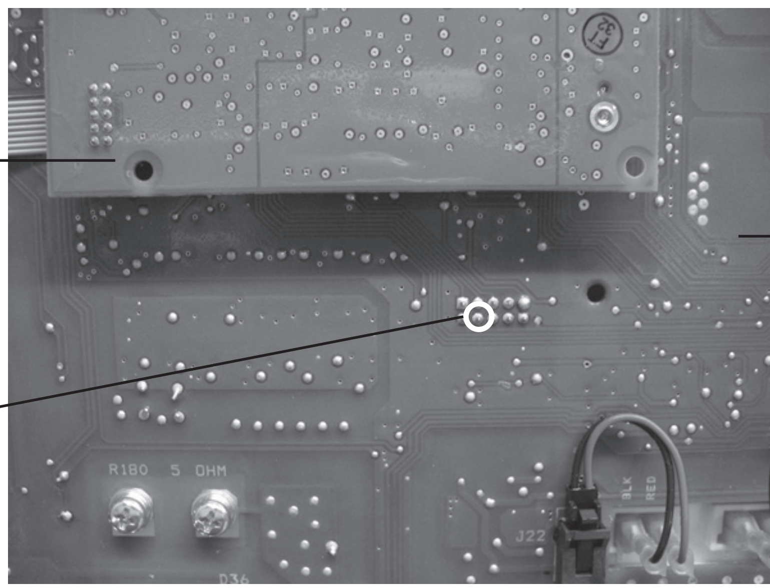
Symptom: Minor voltages are not present.

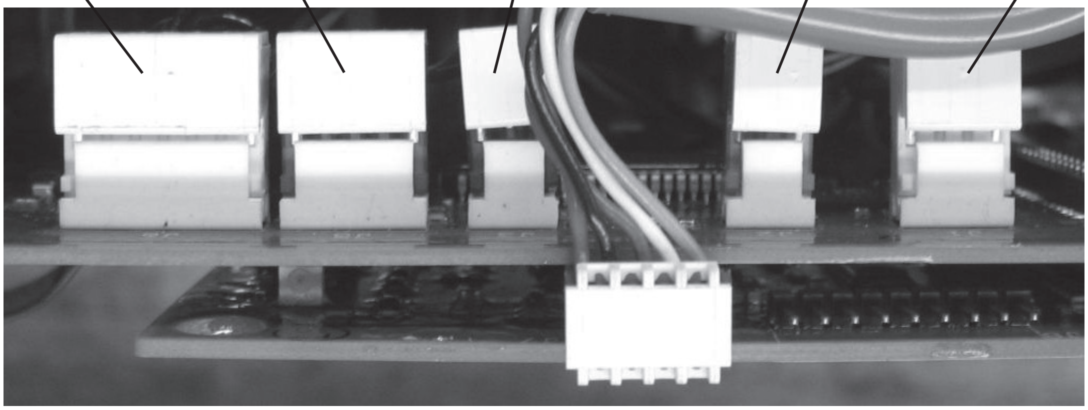
Note: Wear proper personal protective equipment (PPE) before testing powered equipment.

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 ±15%, perform the appropriate test later in this section.

Volts DC	Test points (use chassis for negative)
	All units
+48	J1 – Pin 1
+24	J5 – Pin 1
+5.0	J3 – Pin 3
+3.3	J15 – 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 (J1) and repeat the test.
- If the value is now correct, replace the fan.
- If the value is still incorrect, replace the power board.

If the +24 VDC value is incorrect:

- Remove the pressure switch connector (J5) and repeat the test.
- If the value is now correct, replace the pressure switch.
- If the value is still incorrect, replace the pressure switch connector, remove the solenoid valve connector (J6) and repeat the test. If the value is now correct, replace the solenoid valve. If the value is still incorrect, replace the power board.

If the +5 VDC value is incorrect:

- Remove the pressure sensor connector (J3) 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.
- If the value is still incorrect, replace the power board.

  Otherwise, the DSP board or control board may be bad. Do the following:

  - Re-install the DSP board with the ribbon cable disconnected. If the value is now correct, replace the control board. Otherwise, replace the DSP board.

Test 6 – Torch stuck open (TSO)/torch stuck closed (TSC)

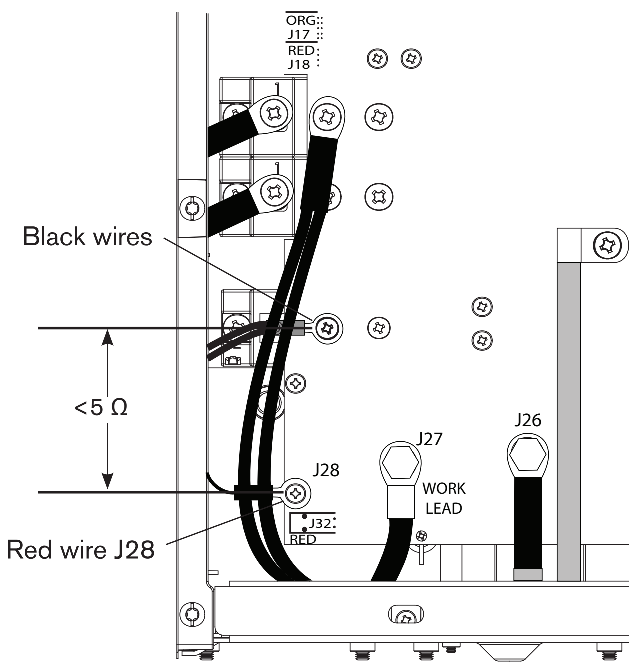
Symptom: No fault occurs at power-up but an 0-30 fault displays on the operator screen when attempting to fire the torch.

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

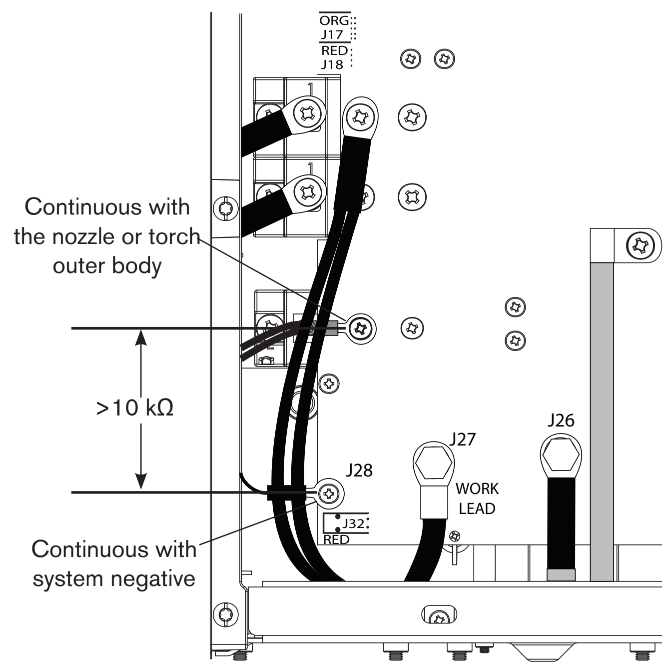
In an idle (no start signal) working system with the torch and consumables installed, there should be continuity between the dual black wires connected to the center post of the pilot arc IGBT and the red wire connecting to J28. With gas flowing through the torch (gas test mode 1) there should be very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

Note: To set the system to gas test mode, display the service screen (refer to page 8-23 *Displaying the service screen)*, move the cursor to “G” (gas), and use the adjustment knob to toggle to “1” (gas test mode). If air does not flow, the regulator might be faulty. Examine the fault log to see if any 3-20-n faults are logged.

Gas test mode 0



Gas test mode 1



Before continuing, turn OFF the power.

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

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

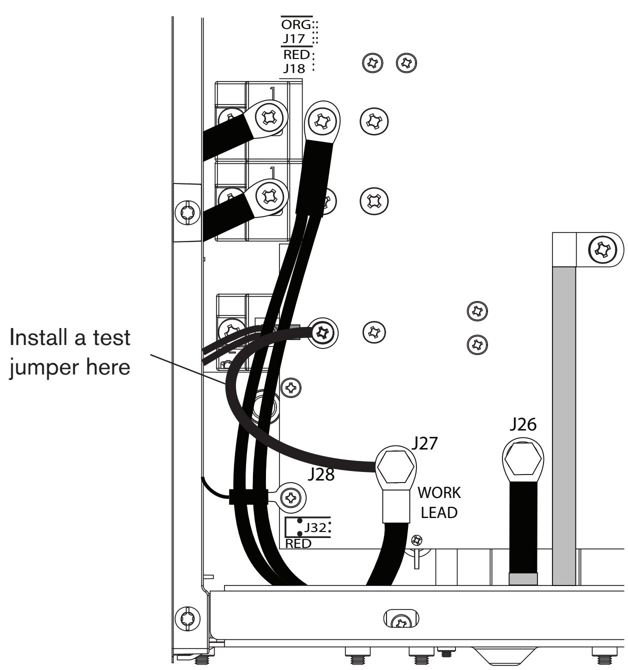
If the resistance is always greater than 100 Ω:

- Replace all consumables and recheck.
- If the resistance is correct (<100 Ω) the old consumables are bad.
- If the resistance is still greater than 100 Ω, 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 ±15%

Check the function of the pilot arc IGBT:

- Turn the machine off and disconnect power.
- Install a jumper wire (at least 8 AWG) from the work lead (J27) 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:

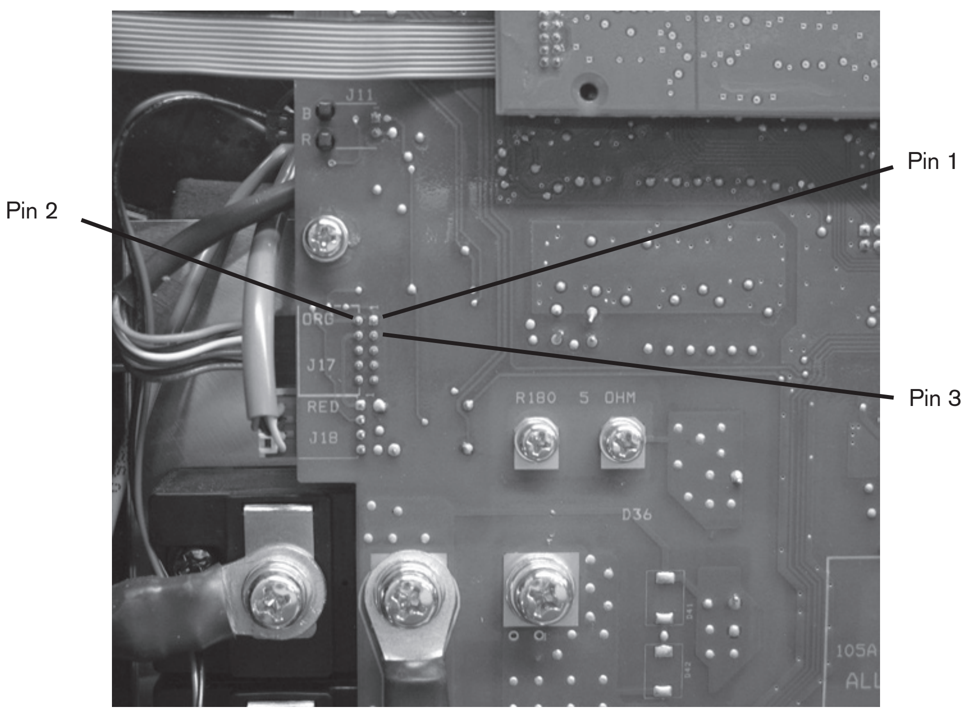
- Remove the torch from the system.
- Check the resistance between Pin 6 and Pin 7 In the lead plug, with the torch trigger open (not pulled).
- If there is very low resistance, inspect the lead set and trigger switch for shorts and replace or repair as necessary.

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 J17 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, perform the continuity check on page 8-29:
    - 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

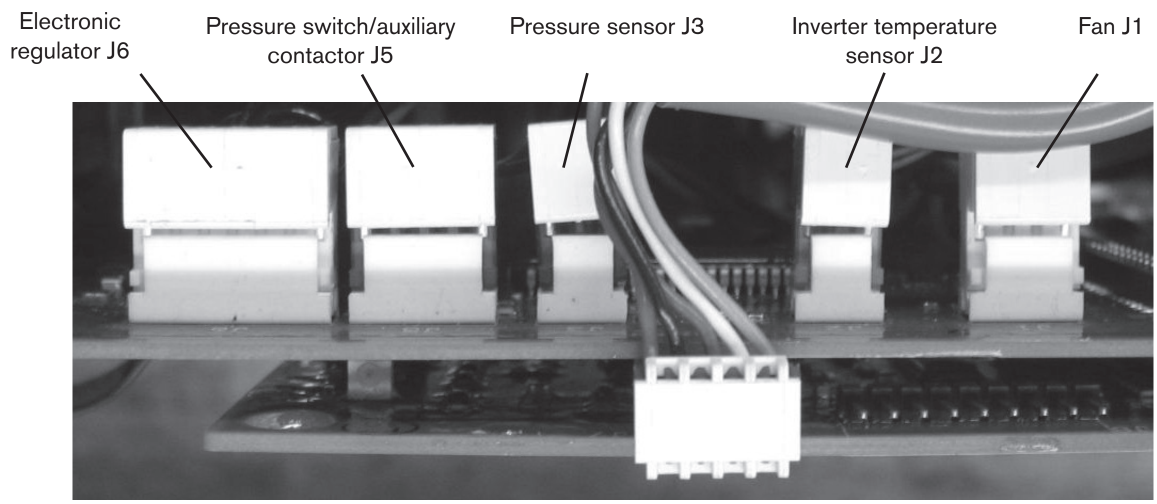
Symptom: Fault code 0-50 and the cap-sensor switch icon appear on the operator screen.

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 the resistance is approximately 0 Ω:
        - Reconnect the torch.
        - Measure for continuity between Pin 1 and Pin 2 at J17 on the power board.
        - If there is no continuity, inspect and perform a resistance test on the torch disconnect.
    c. 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 (J6) 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.



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 J3 on the power board.
2. Turn the machine ON.
3. Measure power to the sensor between Pin 2 and Pin 3.

   If not 5.0 (±5%) perform the Flyback Circuit test above.
4. From the service screen enable the gas test.

   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 ±10% of the correct value and you have a pressure alert 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.

Note: Wear proper PPE protection before testing powered equipment.

1. Remove the inverter temperature sensor plug from J2 on the power board.
2. Place a jumper between Pin 1 and Pin 3 of connector J2 on the power board.
3. Remove the white cover from the fan control cable at J1.
4. Turn the machine ON. (The fan should be running.)
5. With the fan control cable connected to J1, measure the DC voltage between Pin 1 and Pin 4 in the plug.
    a. If the voltage is 48 VDC (±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 J1.
        - If the voltage is 48 VDC, replace the fan. Otherwise, perform "Test 5 – Flyback circuit (DC minor voltages)" on page 8-51.
    c. If the system passes the flyback circuit test:
        - If the voltage between Pin 1 and Pin 3 (J1) is 0 VDC, replace the DSP board.
        - If the voltage is greater than 0, replace the power board.

Test 12 – AUX switch

Symptom: Upon power-up, fault code 0-19 displays. After 1 minute, fault code 0-99 displays. In service mode, the live fault code is 2-01-1.

1. Turn the machine off and disconnect the power.
2. Disconnect the auxiliary switch cable from J5 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 9

POWER SUPPLY COMPONENT REPLACEMENT

In this section:

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Replacing the work lead connector 9-3
Installing the optional filter kit 9-3
Replacing the power supply cover 9-3
Replacing the component barrier 9-3
Installing the machine interface cable with voltage divider board 9-4
Installing the machine interface cable 9-4
Installing the RS485 serial interface cable 9-4
Replacing the power cord 9-5
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Replacing the air filter element and air filter bowl

Kit # 228695, 428352/428415 (or 428015 for older systems)

☑	Step	Task	Page
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Replacing the work lead connector

Kit # 228891

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Installing the optional filter kit

Kit # 228890

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Replacing the power supply cover

Kit # 228905, 228906

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Replacing the component barrier

Kit # 228895

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Installing the machine interface cable with voltage divider board

Kit # 228884

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Installing the machine interface cable

Kit # 228350, 228351

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Installing the RS485 serial interface cable

Kit # 228539

☑	Step	Task	Page
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☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Install the RS485 serial interface cable	9-32
☐	6.	Install the end panel bracket	9-95
☐	7.	Install the component barrier	9-96
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Replacing the power cord

Kit # 228885, 228886, 228887, 228962

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☐	5.	Disconnect the gas tube	9-36
☐	6.	Remove the power cord	9-37
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☐	9.	Install the end panel bracket	9-95
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Replacing the strain relief connector

Kit # 228913, 228914, 228915

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☐	12.	Install the component barrier	9-96
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Replacing the power switch

Kit # 228879, 228880

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
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☐	4.	Remove the end panel bracket	9-26
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Replacing the control board

Kit # 228657

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Replace the control board	9-43
☐	6.	Install the end panel bracket	9-95
☐	7.	Install the component barrier	9-96
☐	8.	Install the power supply cover	9-97

Replacing the DSP board

Kit # 228909

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Install the DSP board	9-58
☐	6.	Install the component barrier	9-96
☐	7.	Install the power supply cover	9-97

Replacing the power board

Kit # 228876, 228877, 228878

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Install the power board	9-57
☐	7.	Install the DSP board	9-58
☐	8.	Install the component barrier	9-96
☐	9.	Install the power supply cover	9-97

Replacing the input diode bridge

Kit # 128746

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the input diode bridge	9-49
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the output diode bridge

Kit # 228902

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the output diode bridge	9-49
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the pilot arc IGBT

Kit # 228944

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the pilot arc IGBT	9-50
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the inverter IGBT module

Kit # 228702

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the inverter IGBT module	9-50
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the PFC IGBT module

Kit # 228699

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the PFC IGBT module	9-51
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the snubber resistor

Kit # 228897, 228898, 228693

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the snubber resistor	9-52
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the damper resistor

Kit # 228894

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the damper resistor	9-52
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the thermal sensor

Kit # 228805

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the DSP board	9-44
☐	5.	Remove the power board	9-45
☐	6.	Replace the thermal sensor	9-53
☐	7.	Install the power board	9-57
☐	8.	Install the DSP board	9-58
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the fan shroud

Kit # 228910

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the fan shroud	9-59
☐	4.	Install the fan shroud	9-59
☐	5.	Install the power supply cover	9-97

Replacing the fan

Kit # 228881

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Remove the fan shroud	9-59
☐	6.	Replace the fan	9-60
☐	7.	Install the fan shroud	9-59
☐	8.	Install the end panel bracket	9-95
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the pressure transducer

Kit # 228689

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Replace the pressure transducer	9-61
☐	6.	Install the end panel bracket	9-95
☐	7.	Install the component barrier	9-96
☐	8.	Install the power supply cover	9-97

Replacing the pressure switch

Kit # 228688

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the end panel bracket	9-26
☐	4.	Replace the pressure switch	9-62
☐	5.	Install the end panel bracket	9-95
☐	6.	Install the power supply cover	9-97

Replacing the air filter assembly

Kit # 428351

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the end panel bracket	9-26
☐	4.	Replace the air filter assembly	9-63
☐	5.	Install the end panel bracket	9-95
☐	6.	Install the power supply cover	9-97

Replacing the solenoid valve

Kit # 228687

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Remove the fan shroud	9-59
☐	6.	Replace the solenoid valve	9-65
☐	7.	Install the fan shroud	9-59
☐	8.	Install the end panel bracket	9-95
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the gas tubing

Kit # 228865

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the end panel bracket	9-26
☐	4.	Remove the fan shroud	9-59
☐	5.	Replace the gas tubing	9-68
☐	6.	Install the fan shroud	9-59
☐	7.	Install the end panel bracket	9-95
☐	8.	Install the power supply cover	9-97

Replacing the bulk capacitors

Kit # 228888, 228889

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the fan shroud	9-59
☐	5.	Replace the bulk capacitors	9-69
☐	6.	Install the fan shroud	9-59
☐	7.	Install the component barrier	9-96
☐	8.	Install the power supply cover	9-97

Replacing the torch quick disconnect receptacle

Kit # 228883

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Remove the fan shroud	9-59
☐	6.	Replace the torch quick disconnect receptacle	9-70
☐	7.	Install the fan shroud	9-59
☐	8.	Install the end panel bracket	9-95
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the work lead receptacle

Kit # 228912

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the fan shroud	9-59
☐	4.	Replace the work lead receptacle	9-74
☐	5.	Install the fan shroud	9-59
☐	6.	Install the power supply cover	9-97

Replacing the output inductor

Kit # 228875

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Remove the fan shroud	9-59
☐	6.	Replace the output inductor	9-75
☐	7.	Install the fan shroud	9-59
☐	8.	Install the end panel bracket	9-95
☐	9.	Install the component barrier	9-96
☐	10.	Install the power supply cover	9-97

Replacing the transformer

Kit # 228871, 228872

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the fan shroud	9-59
☐	5.	Replace the transformer	9-79
☐	6.	Install the fan shroud	9-59
☐	7.	Install the component barrier	9-96
☐	8.	Install the power supply cover	9-97

Replacing the PFC inductor

Kit # 228873, 228874

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the fan shroud	9-59
☐	5.	Replace the PFC inductor	9-82
☐	6.	Install the fan shroud	9-59
☐	7.	Install the component barrier	9-96
☐	8.	Install the power supply cover	9-97

Replacing the front end panel

Kit # 228866

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Replace the front end panel	9-85
☐	6.	Install the end panel bracket	9-95
☐	7.	Install the component barrier	9-96
☐	8.	Install the power supply cover	9-97

Replacing the rear end panel

Kit # 228867, 228868, 228869

☑	Step	Task	Page
☐	1.	Disconnect the electric power and gas supply	9-16
☐	2.	Remove the power supply cover	9-25
☐	3.	Remove the component barrier	9-25
☐	4.	Remove the end panel bracket	9-26
☐	5.	Remove the fan shroud	9-59
☐	6.	Disconnect the gas tube	9-36
☐	7.	Remove the power cord	9-37
☐	8.	Remove the strain relief connector	9-39
☐	9.	Replace the rear end panel	9-89
☐	10.	Install the strain relief connector	9-92
☐	11.	Install the power cord	9-93
☐	12.	Connect the gas tube	9-36
☐	13.	Install the fan shroud	9-59
☐	14.	Install the end panel bracket	9-95
☐	15.	Install the component barrier	9-96
☐	16.	Install the power supply cover	9-97

Installing the machine interface cable for raw arc voltage

Kit # 228711

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

Disconnect the electric power and gas supply

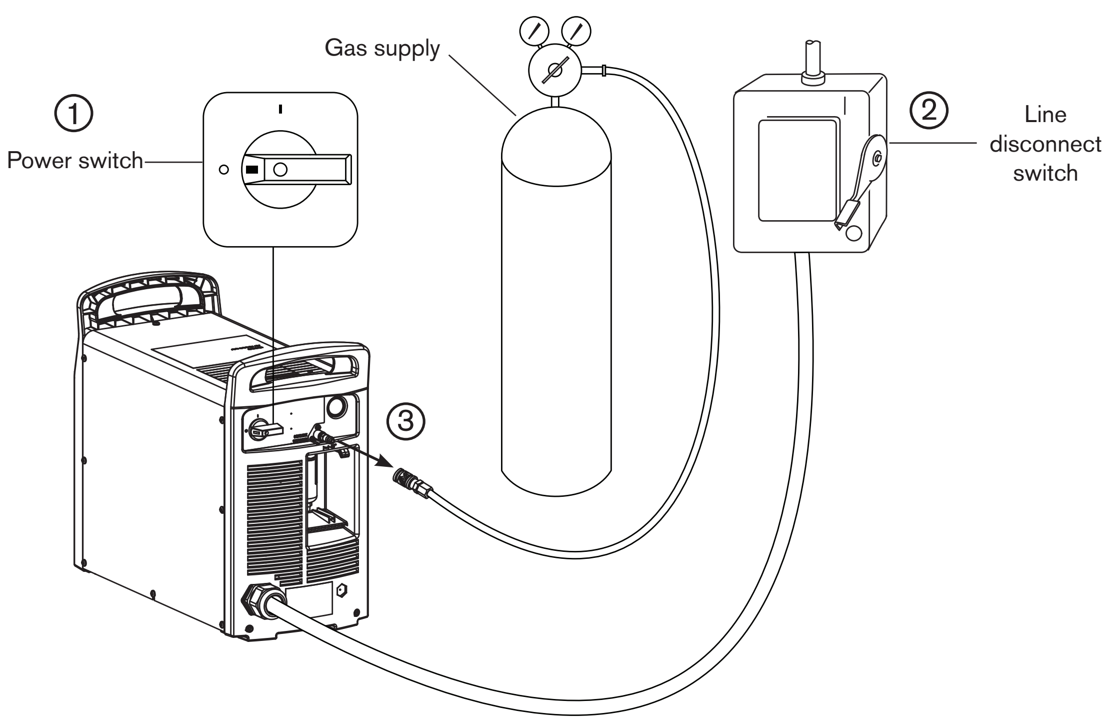
WARNING
ELECTRIC SHOCK CAN KILL

Disconnect electrical power before performing any maintenance or repairs. See the *Safety and Compliance Manual* included with your system for more safety precautions.

Caution: Static electricity can damage circuit boards.

- **Use proper precautions when handling printed circuit boards.**
  - **Store PC boards in anti-static containers.**
  - **Wear a grounded wrist strap when handling PC boards.**

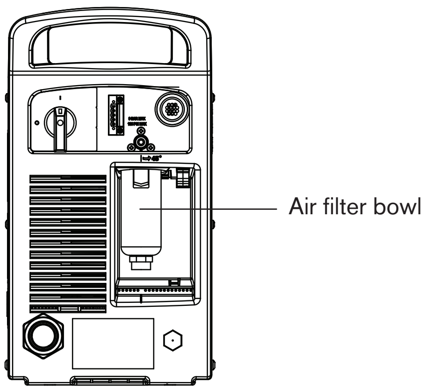
1. Turn the plasma power supply switch to OFF (O).
2. Turn the line disconnect switch to OFF (O).
3. Disconnect the gas supply hose from the plasma power supply.



Replace the air filter element and air filter bowl

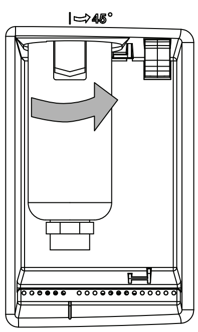
Remove the air filter bowl

1. 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.

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



3. Pull the air filter bowl straight down to remove.

Identify the air filter assembly model

Because of a manufacturing change, your Powermax105 may have one of the two air filter assemblies shown below. Filter bowl replacement kits are not interchangeable. (See page 11-3 *Exterior rear.*) 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)

If you have the old air filter assembly with the metal guarded filter bowl, go to:

- Page 9-20 to replace the air filter element.
- Page 9-21 to install the filter bowl.
- Page 9-63 to replace the entire air filter assembly.

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

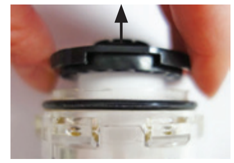
If you have the new air filter assembly with the plastic or nylon* filter bowl, go to:

- Page 9-19 to replace the air filter element.
- Page 9-21 to install the filter bowl.
- Page 9-63 to replace the entire air filter assembly.

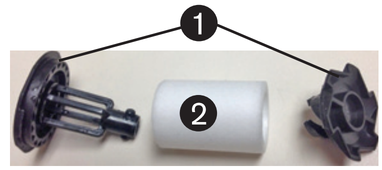
* The optional nylon filter bowl is greenish-blue. See page 11-3 *Exterior rear.*

Install the air filter element (for plastic or nylon bowl)

1. Twist and pull up on the black element retainer at the top of the filter bowl.



2. Carefully twist the black element retainers ❶ until they come apart and you can remove the dirty air filter element ❷ from them.

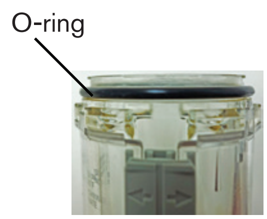


3. Slide the new element onto the retainer.

4. Twist the 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 air filter bowl.



6. Put the air filter element in the filter bowl, so that the wider black part goes at the top.

7. Twist the top plastic part of the filter element until it fastens to the top of the filter bowl.

   Note: To install the air filter bowl, go to page 9-21.

Install the air filter element (for metal guarded bowl)

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

3. Install the original plastic retaining nut to finger-tight only.

   Note: If the black retaining nut is damaged, order a new air filter assembly (kit 428351, or 228685 if still available from the factory).

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 filter bowl.

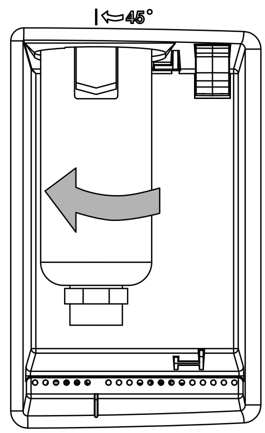
Use the thinner O-ring.

O-ring

Note: To install the air filter bowl, go to page 9-21.

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

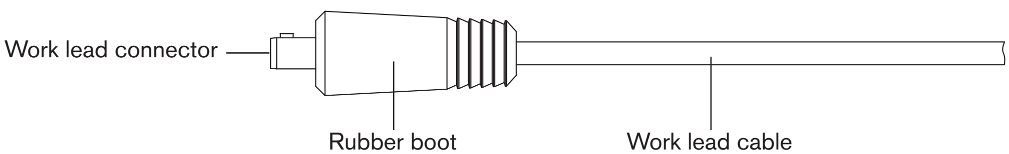
1. Vertically align the filter bowl and firmly push the filter bowl up to the top of the receptacle to seat the bowl.
2. Once the bowl is seated correctly, rotate the bowl 45 degrees to the left until you hear the thumb latch click into place.



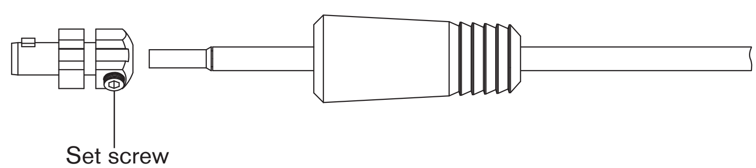
3. Reconnect the gas supply hose to the gas fitting on the rear of the power supply and check for leaks.
4. Reconnect the electric power and turn ON the power switch.

Replace the work lead connector

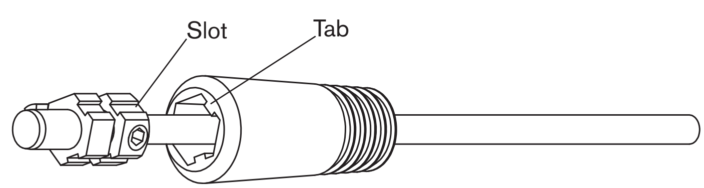
1. Using a razor blade or sharp knife, slice the rubber boot from one end to the other, being careful not to cut into the work lead cable.
2. Remove the rubber boot from the work lead connector.



3. Loosen the work lead connector set screw and pull the work lead cable out of the connector.
4. Slide the new rubber boot over the work lead cable.

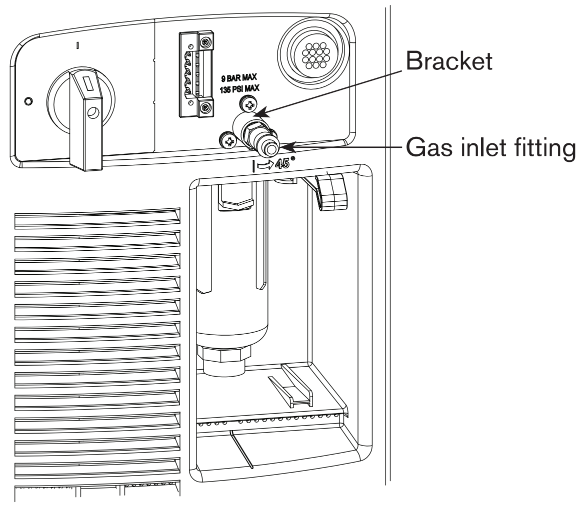


5. Insert the end of the work lead cable into the new work lead connector.
6. Tighten the set screw to 115.2 kg cm (100 in.-lbs).
7. Align the tabs in the rubber boot with the mating slots in the work lead connector.
8. Slide the rubber boot over the work lead connector until it is fully seated.



Install the optional filter kit

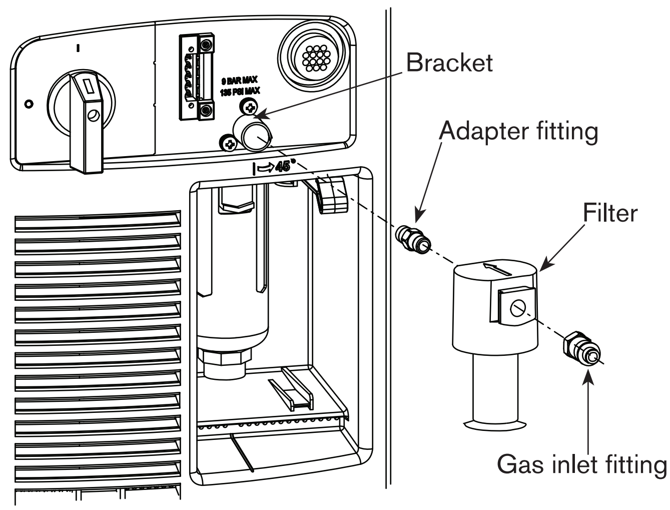
1. Remove the gas inlet fitting from the bracket.



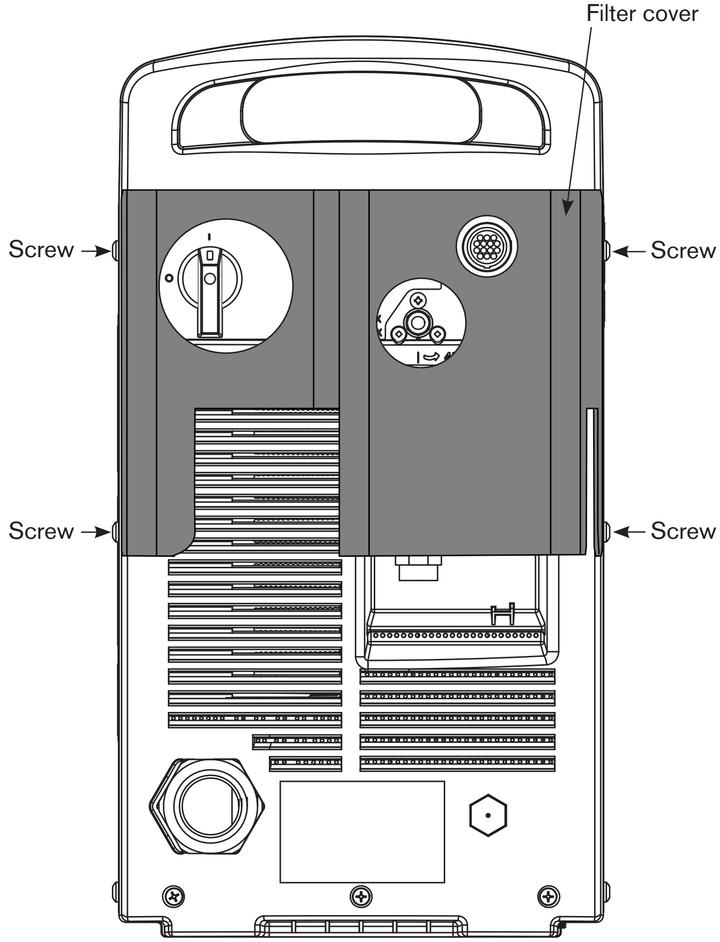
2. Apply thread sealant to the adapter fitting and tighten it into the bracket.

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

3. Thread the new filter onto the adapter fitting, using thread sealant, with the arrow pointing toward the power supply.
4. Tighten the gas inlet fitting into the filter using thread sealant.

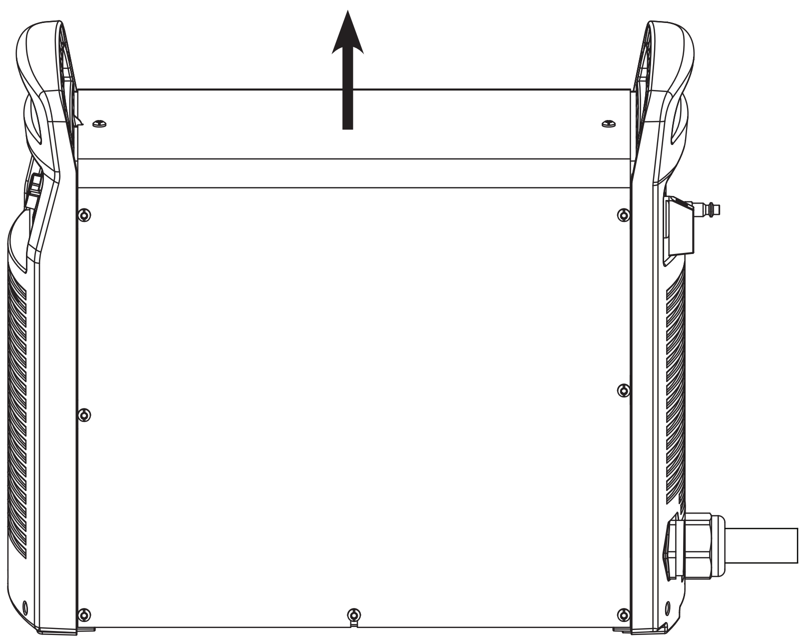


5. Remove the upper two T20 screws from each side of the power supply.
6. Place the filter cover over the filter on the rear of the power supply, aligning the screw holes with the holes in the power supply cover.
7. Install the four T20 screws, provided in the kit, through the filter cover and power supply cover. Tighten the screws to 17.3 kg cm (15 in.-lbs).



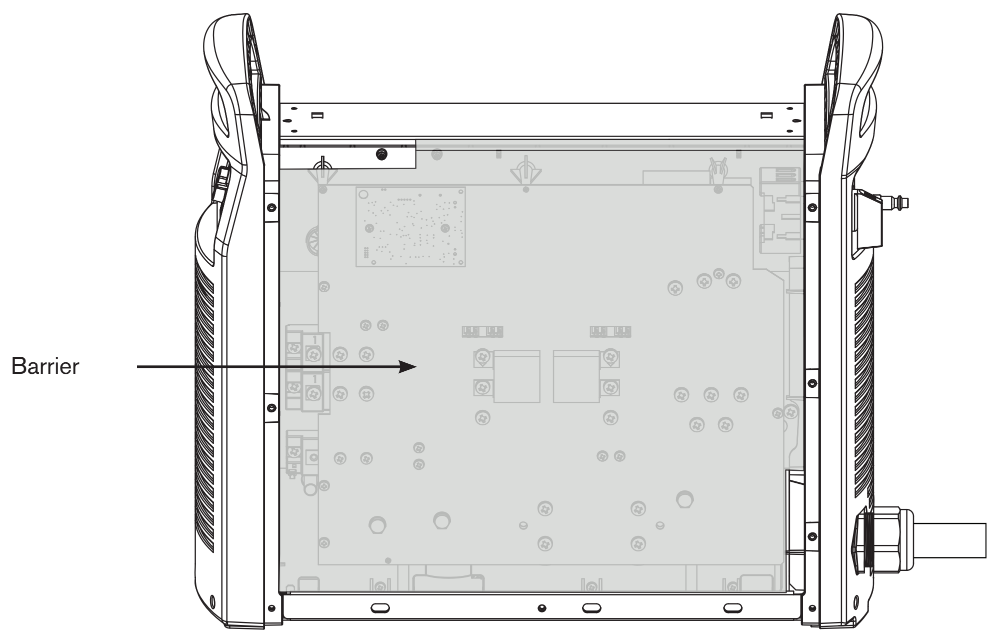
Remove the power supply cover

1. Remove the 16 T20 screws from the sides and top of the power supply cover.
2. Lift the cover off the power supply.



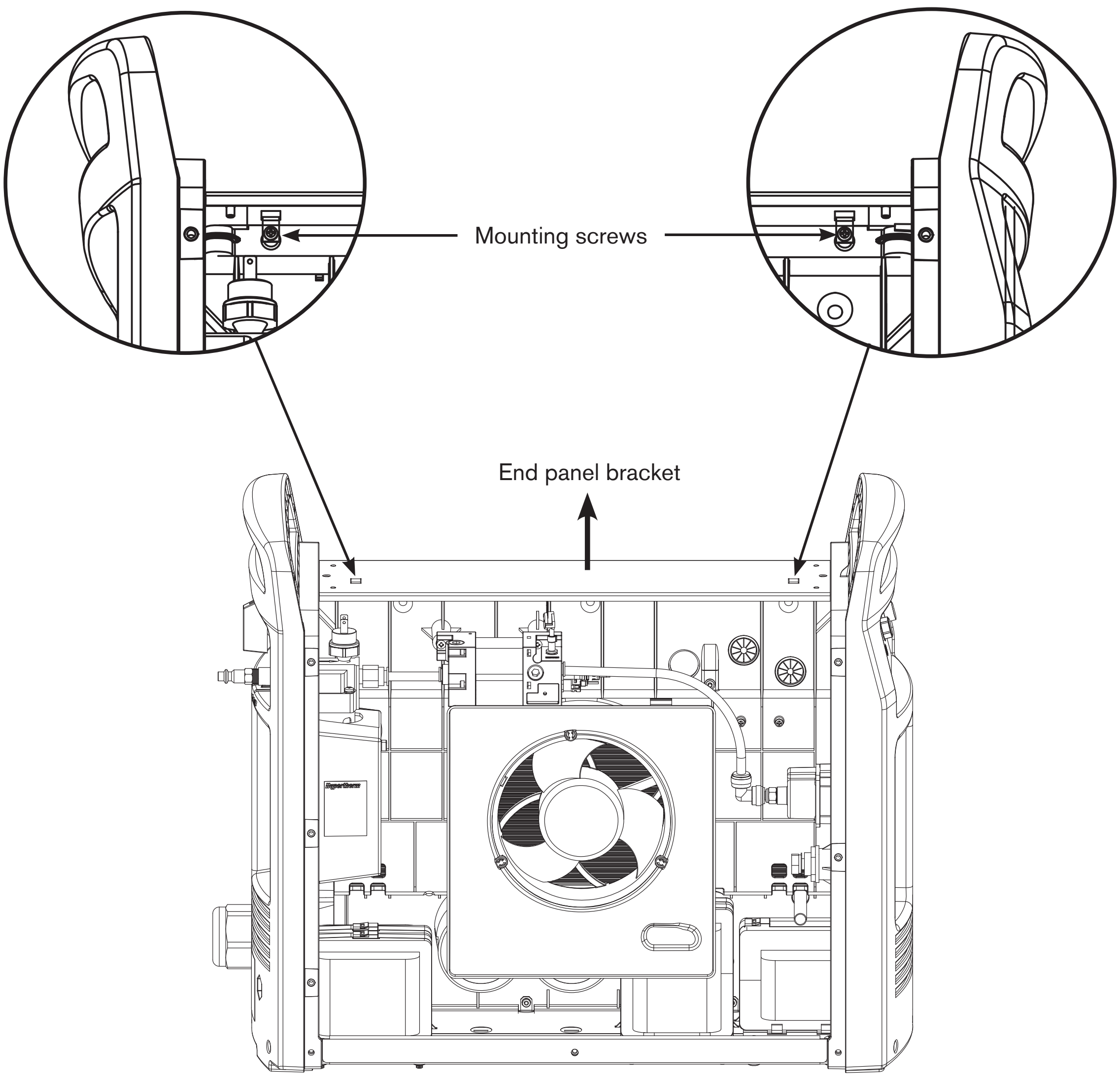
Remove the component barrier

1. Remove the component barrier from the power board side of the power supply. This barrier is flexible and can be bent slightly for removal.



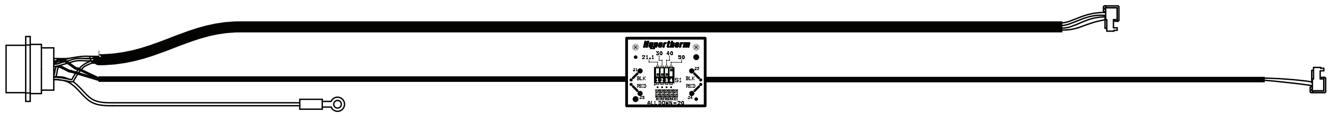
Remove the end panel bracket

1. Remove the two mounting screws from the end panel bracket. The screws are located under each end of the end panel bracket.
2. Lift the end panel bracket straight up from the power supply.

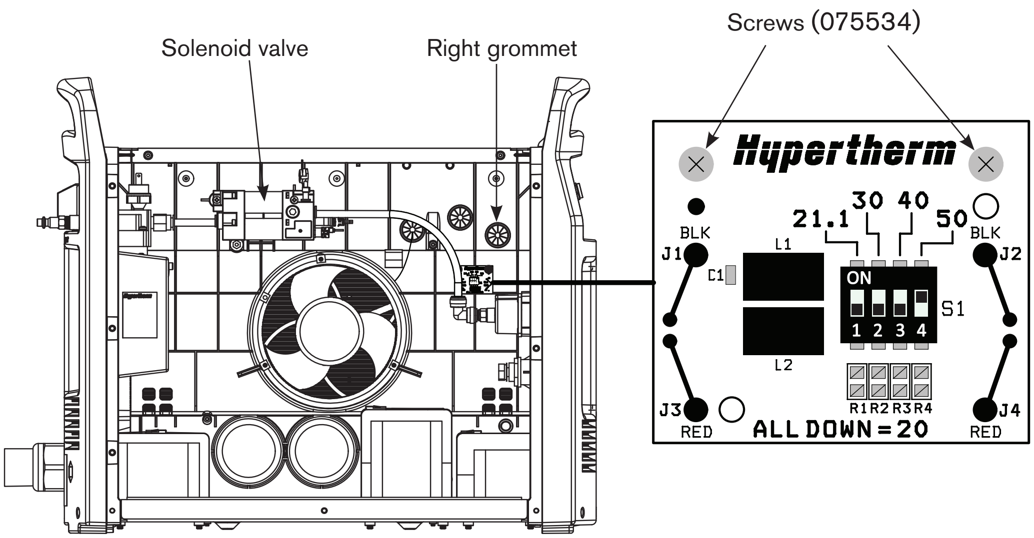


Install the machine interface cable with voltage divider board

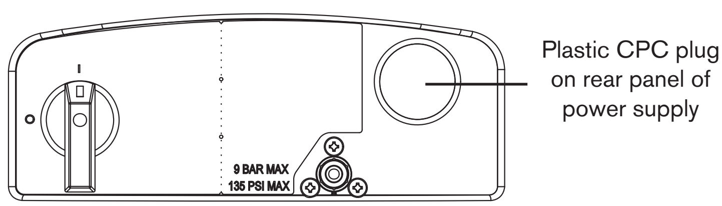
Voltage divider board with CPC port and cables



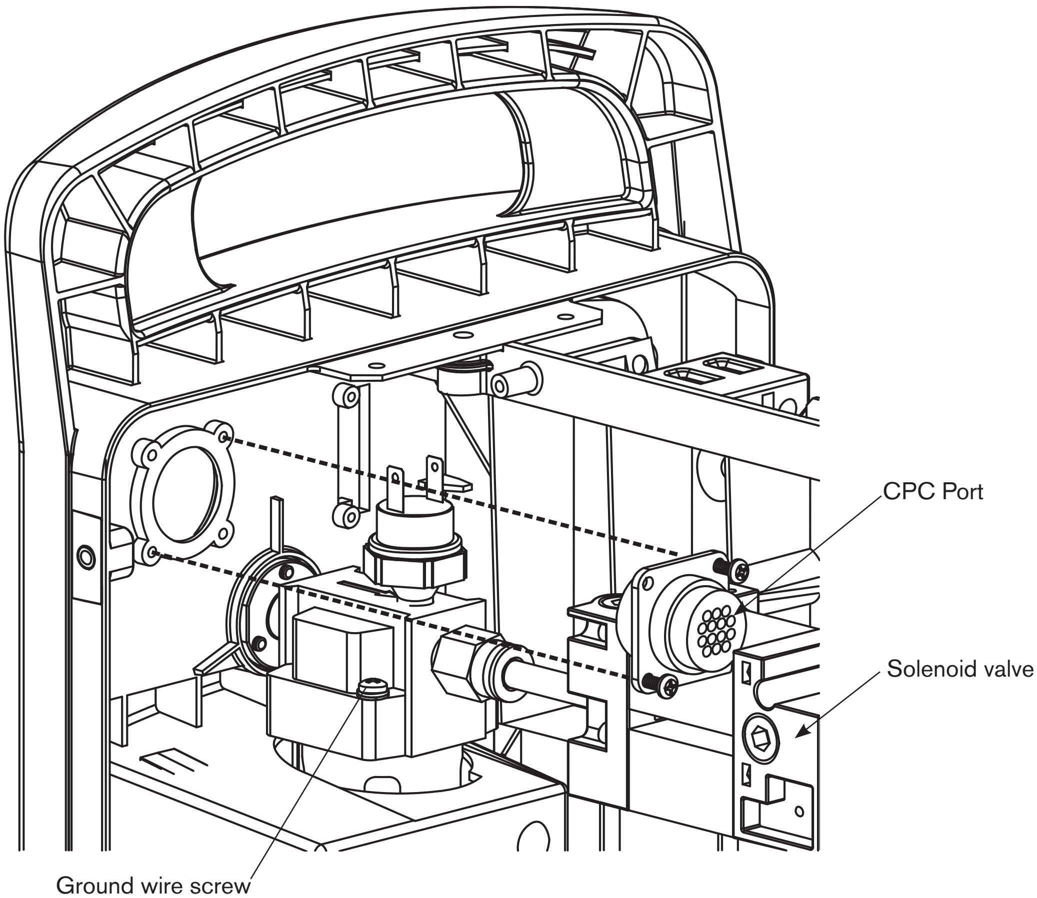
1. Secure the voltage divider board to the right of the power supply fan by tightening two of the supplied screws to 11.5 kg cm (10 in.-lbs).



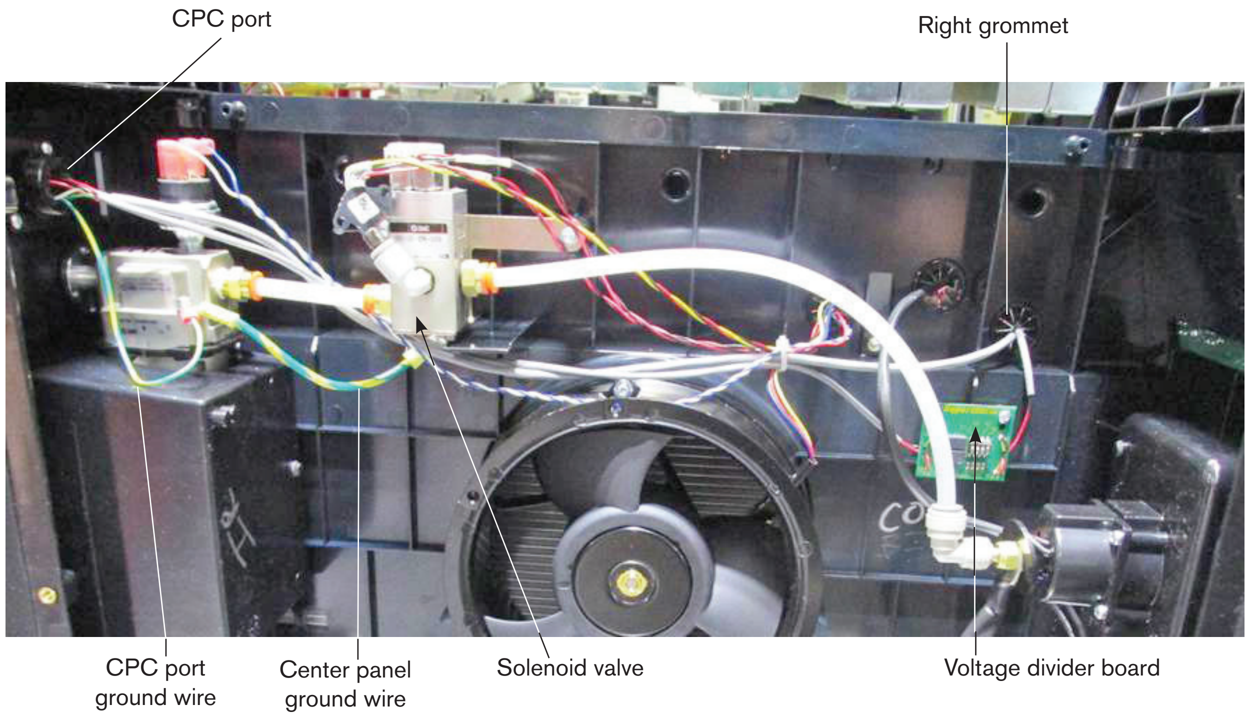
2. Remove the round plastic plug that covers the CPC opening in the rear panel.

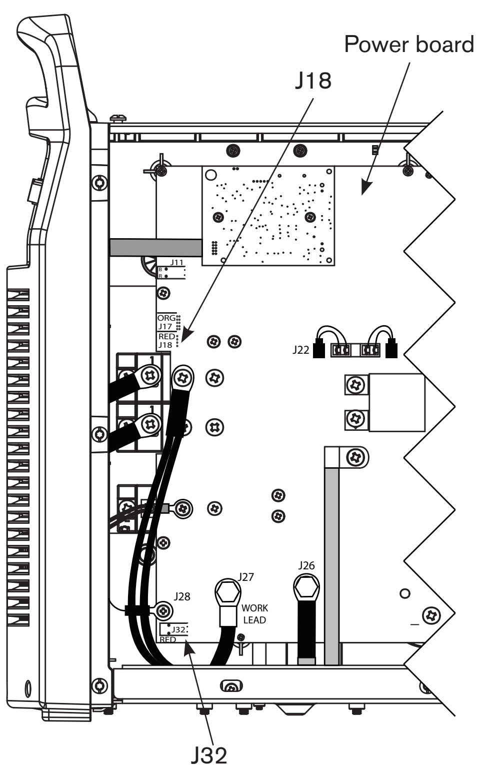


3. Route the CPC port and attached cables below* the solenoid valve and over to the CPC port opening on the rear panel of the power supply.
   *Note: The RS-485 cable and two gray cables on older Powermax105 systems are routed above the solenoid valve.



4. Insert the CPC port into the CPC port opening from inside the power supply. Be sure to position the port with the green/yellow ground wire at the bottom of the port.
5. Secure the CPC port by tightening two of the supplied screws to 11.5 kg cm (10 in.-lbs). Two screws are sufficient when inserted in opposite corners of the CPC port.





6. Secure the green/yellow ground wire (from the CPC port) to the gas filter housing, using the same screw that secures the large ground wire from the center panel. Tighten the ground wire screw to 17.3 kg cm (15 in.-lbs).
7. Route the large cable (from the CPC port) through the right grommet and down the left side of the power board to the J18 connector.
8. Push the cable connector onto the power board connector. Be sure to align the red wire in the cable connector with “RED” that is printed on the power board.
9. Route the small cable (from the right side of the voltage divider board) through the right grommet and down the left side of the power board to the J32 connector.
10. Push the cable connector onto the power board connector. Be sure to align the red wire in the cable connector with “RED” that is printed on the power board.

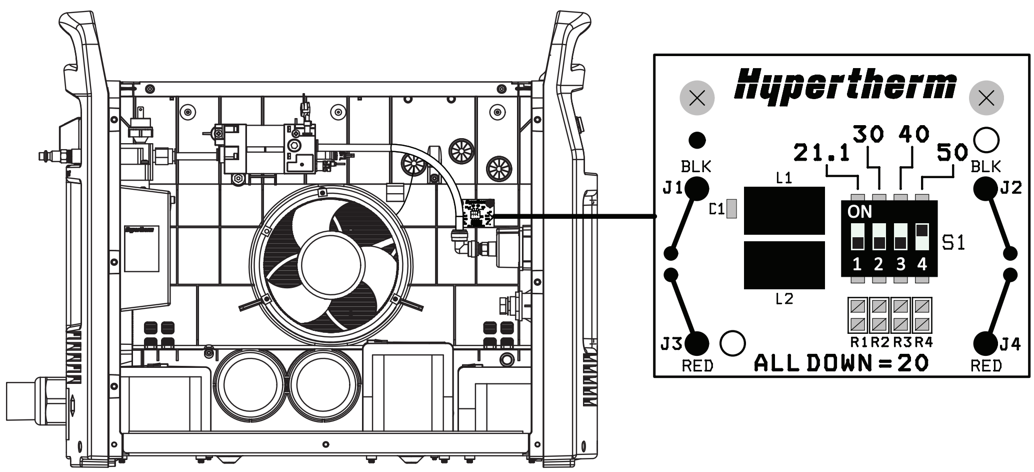
Set the voltage divider board

CAUTION: The factory-installed internal voltage divider provides a maximum of 15 V under open circuit conditions. This is an impedance-protected functional extra low voltage (ELV) output to prevent shock, energy, and fire under normal conditions at the machine interface receptacle and under single fault conditions with the machine interface wiring. The voltage divider is not fault tolerant and ELV outputs do not comply with safety extra low voltage (SELV) requirements for direct connection to computer products.

The factory presets the voltage divider to 50:1. To change the voltage divider to a different setting:

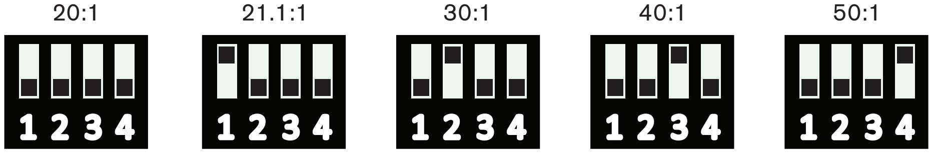
1. Locate the voltage divider DIP switches on the left side of the power supply.

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



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

20:1 21.1:1 30:1 40:1 50:1



Connect the machine interface cable

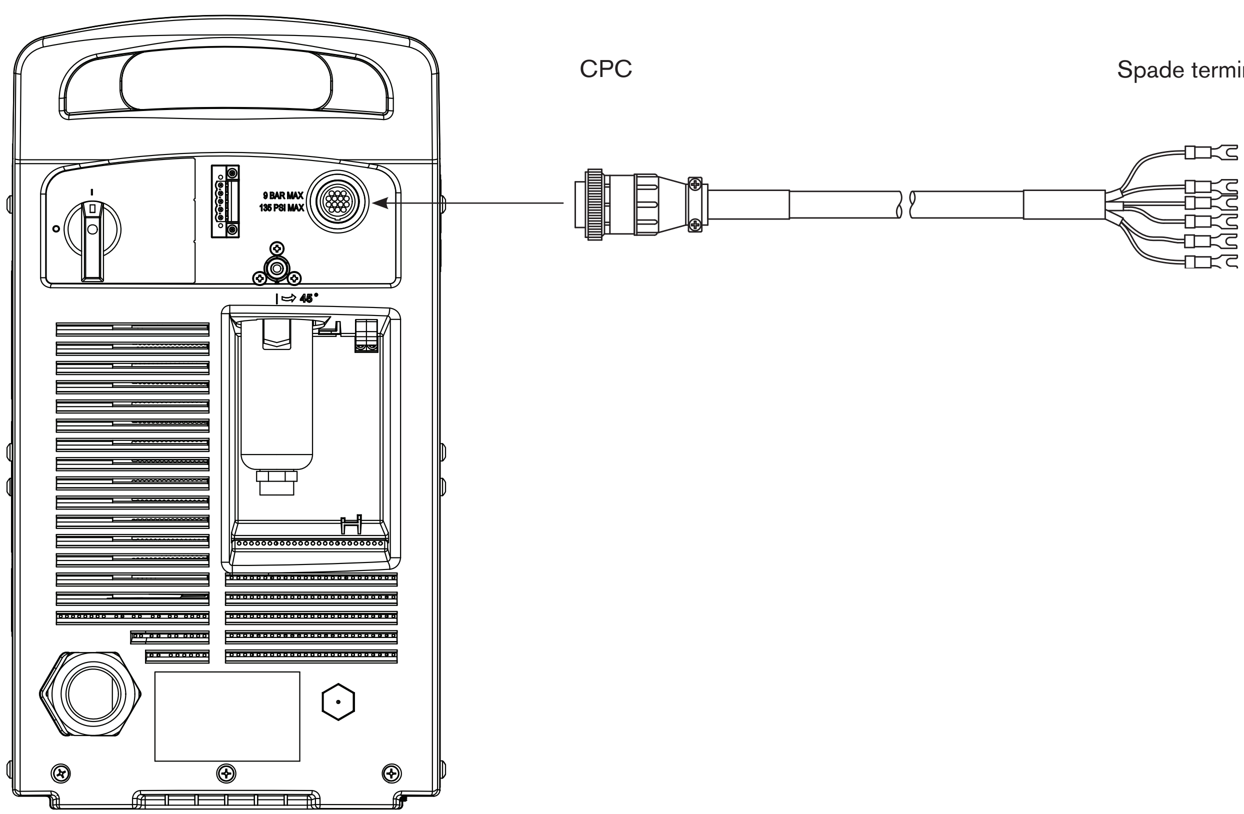
1. Remove the machine interface receptacle's cover from the rear of the power supply.

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

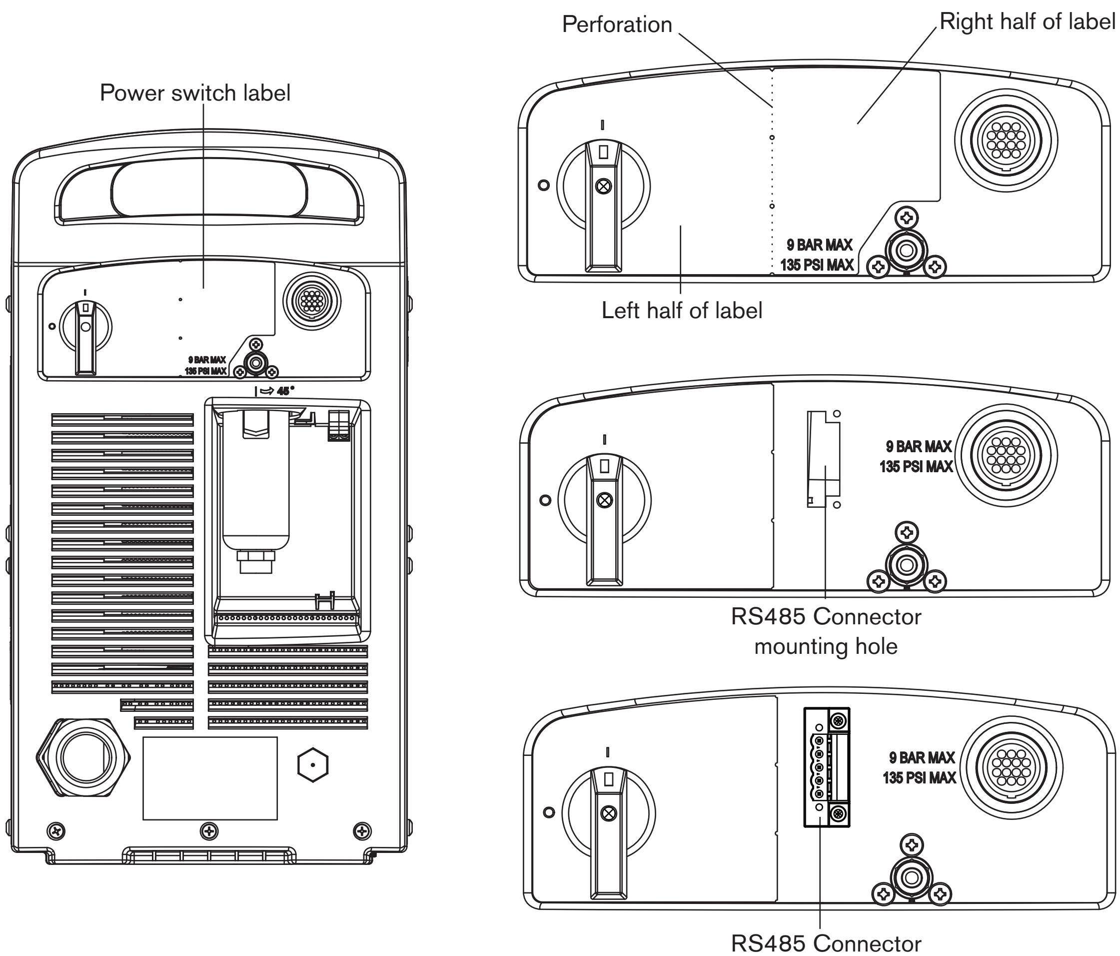
2. Connect the machine interface cable CPC to the power supply.
3. Terminate the machine interface cable spade terminals inside the electrical enclosure of listed and certified torch height controllers or CNC controllers to prevent unauthorized access to the connections after installation. Verify that 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.

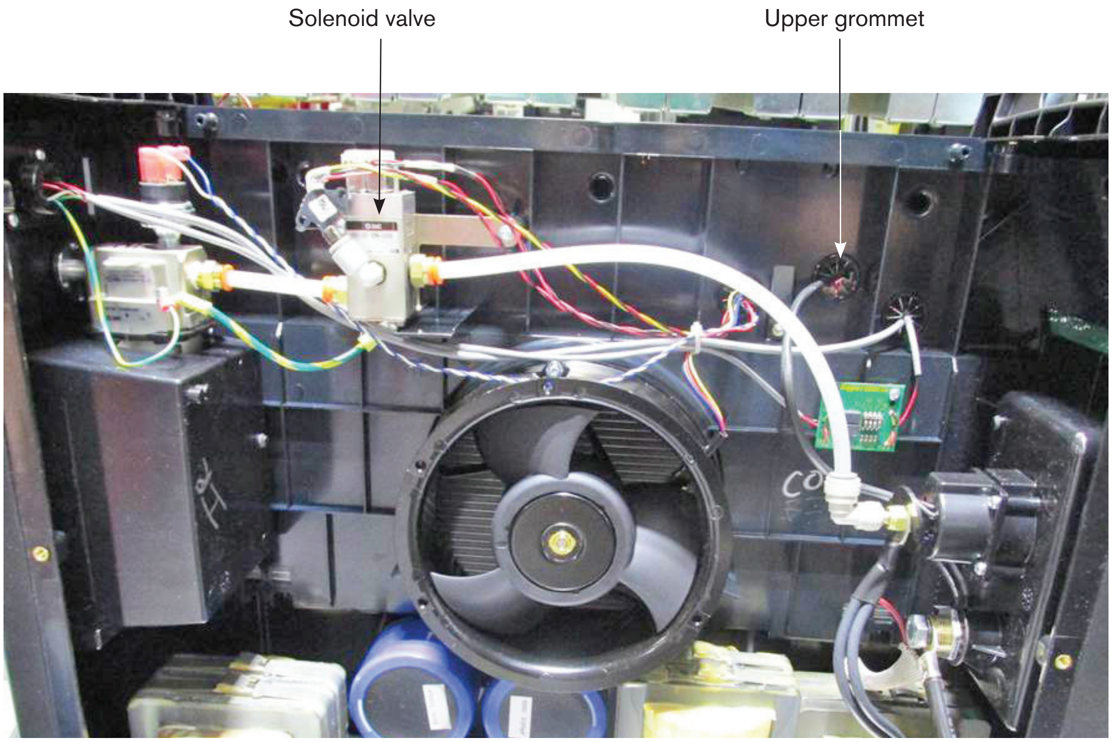
   See the "Mechanized Cutting" section for more information on each type of signal available through the machine interface cable.



Install the RS485 serial interface cable



1. Pry up the right edge of the power switch label using a knife or blade screwdriver.
2. Peel the right half of the label back to the perforation.
3. Apply pressure to the left half of the label while tearing the right half away. Discard the right half of the label.
4. Route the long cable, small connector first, through the RS485 mounting hole in the rear end panel.
5. Fasten the RS485 connector in the mounting hole of the rear panel, with the red wire on top, by tightening the two supplied #4 pan head screws to 11.5 kg cm (10 in.-lbs).

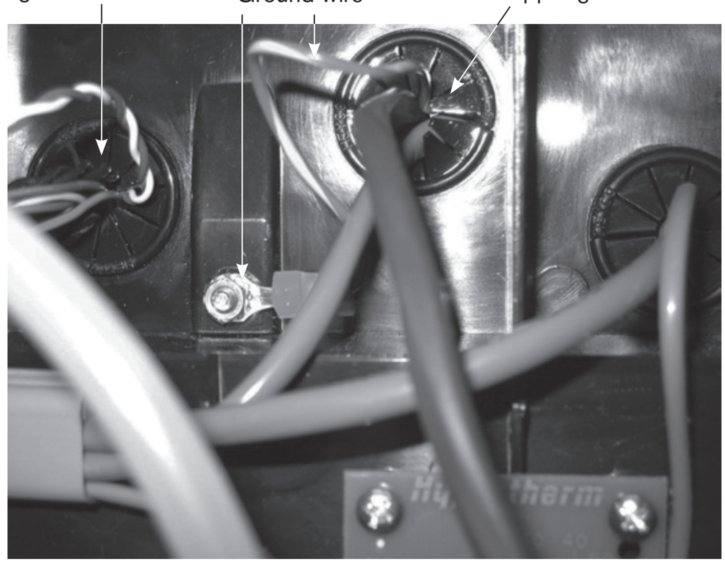


6. Route the long RS485 cable, along with the two existing gray cables, below* the solenoid valve.

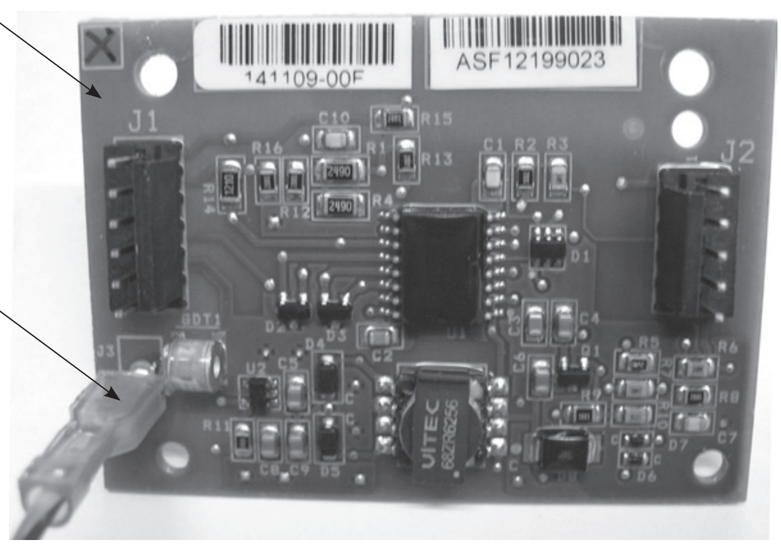
   *Note: The RS485 cable and two gray cables on older Powermax105 systems are routed above the solenoid valve.

7. Push the small connector, from the long RS485 cable, through the upper grommet in the center panel.
8. Attach the ground wire (green with yellow stripe) ring connector to the threaded post located between the upper and left grommet. Tighten the supplied nut to the threaded post to 17.3 kg cm (15 in.-lbs).

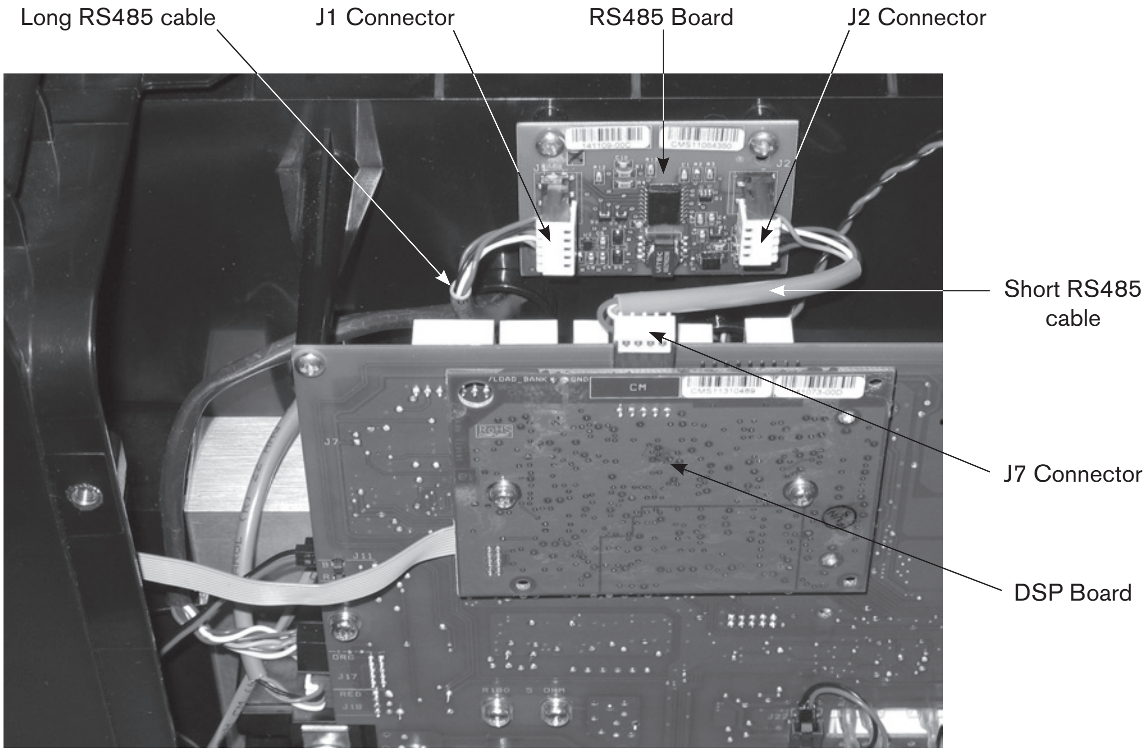
9. Firmly push the ground wire connector through the upper grommet.
10. Secure the RS485 board to the plastic mounting posts, located on the center panel directly behind the DSP board, by tightening the two supplied #6 pan head screws to 11.5 kg cm (10 in.-lbs). Refer to the figure on the next page.



11. Attach the ground wire connector to the bottom left connector on the RS485 board.
12. Push the connector, from the long RS485 cable, onto the J1 connector of the RS485 board.

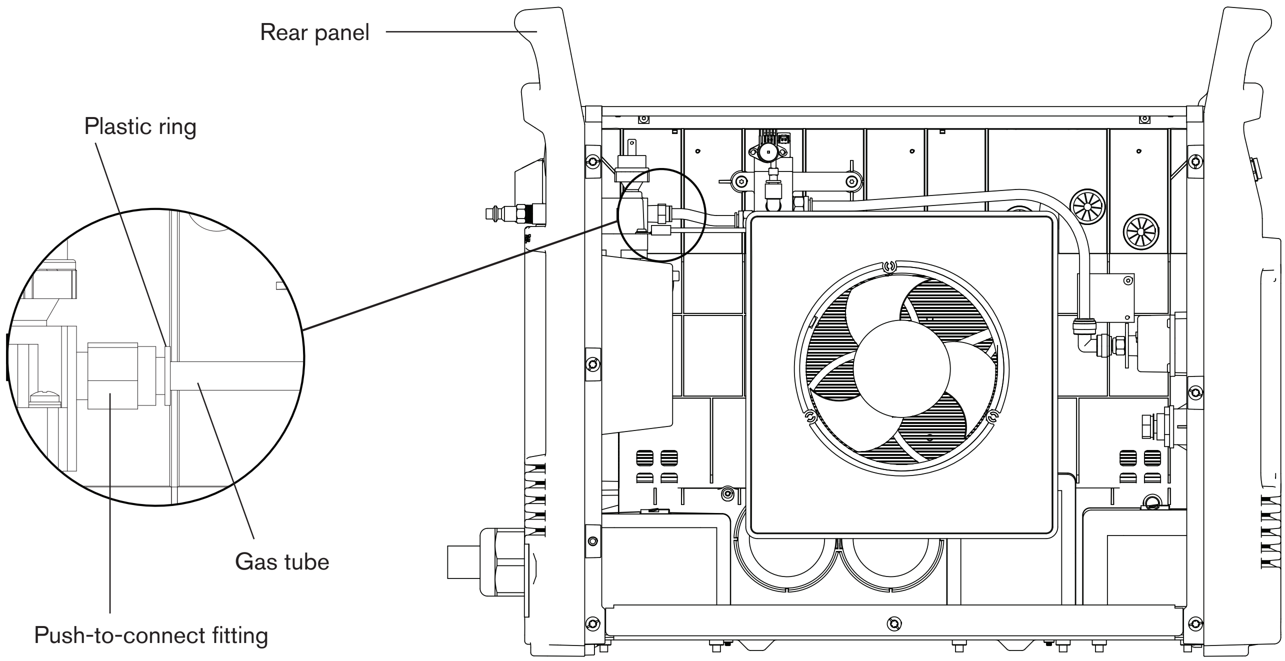


13. Install the short RS485 cable by pushing the connector, with the smaller white dust cover, onto the J7 connector of the DSP board. Push the other connector onto the J2 connector of the RS485 board.



Disconnect the gas tube

1. Push in the plastic ring on the push-to-connect fitting.
2. Gently pull the top of the rear end panel away from the power supply until the gas tube pulls out of the push-to-connect fitting.

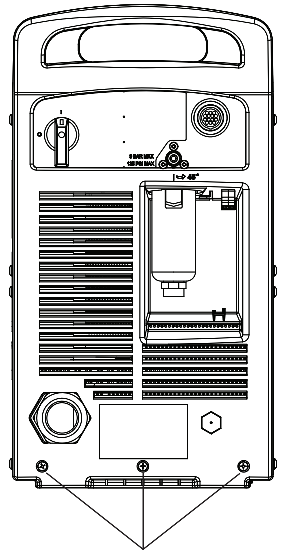


Connect the gas tube

1. Align the end of the gas tube with the push-to-connect fitting.
2. Gently push the top of the rear end panel toward the power supply until the gas tube is fully seated in the push-to-connect fitting.

Remove the power cord

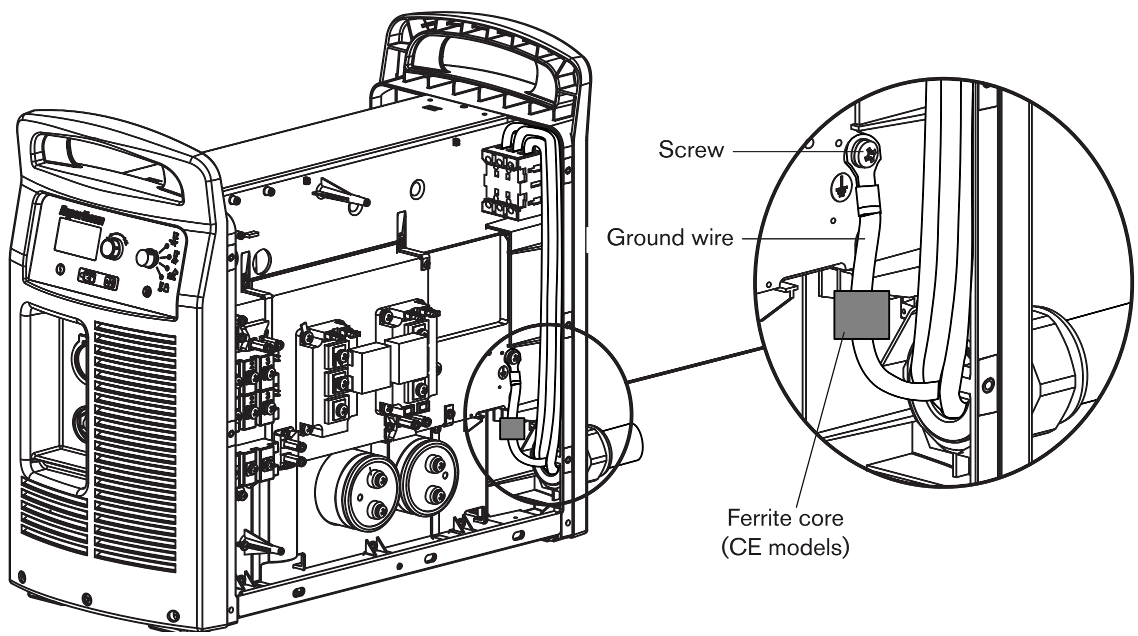
1. Remove the three mounting screws from the bottom of the rear end panel.



2. Remove the screw securing the ground wire to the heat sink.

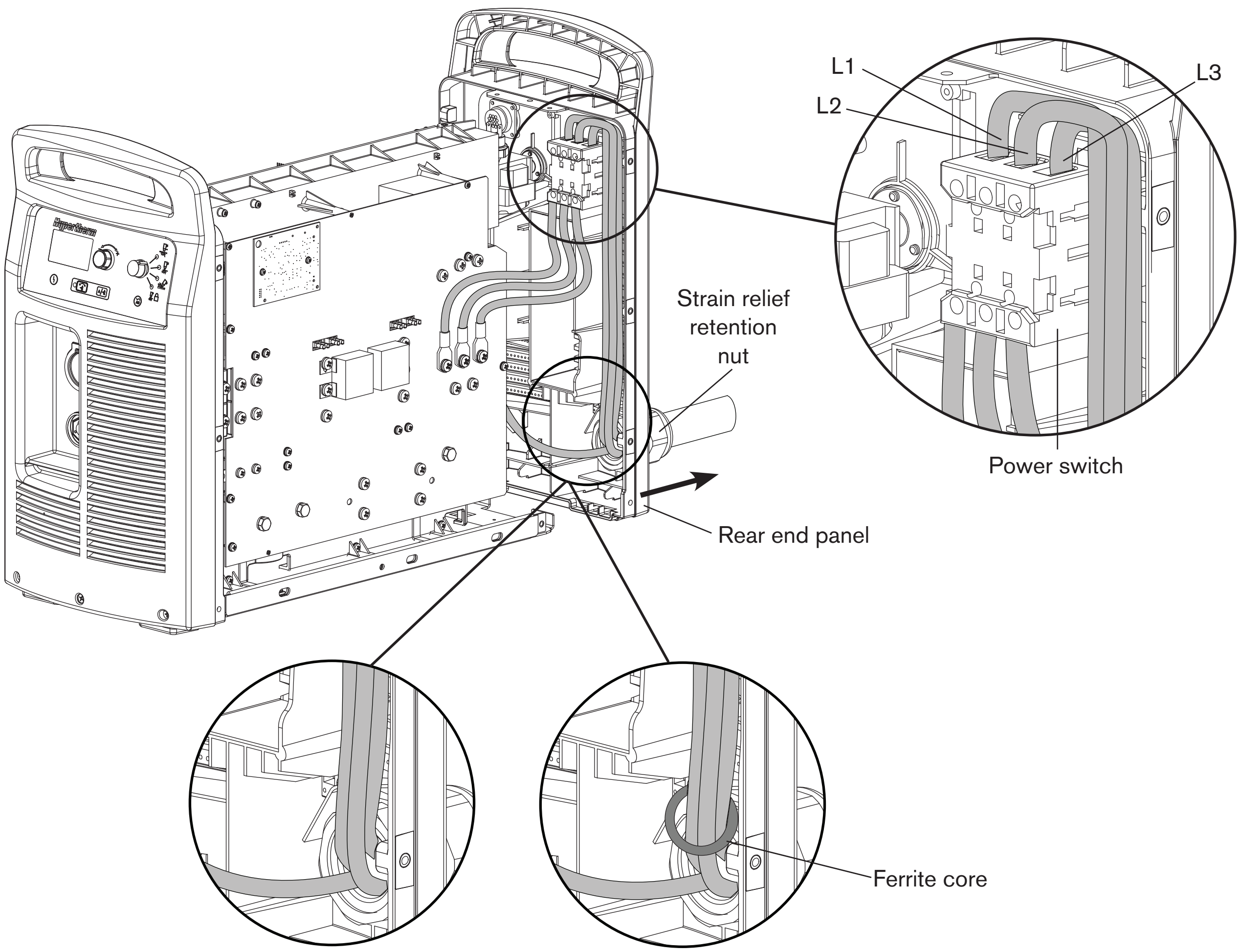
   Note: CE models have a ferrite core installed over the ground wire. CSA and CCC models do not have a ferrite core on the ground wire.

   The power board is removed to show the ground wire connection on the heat sink.



3. Slide the rear end panel approximately 4.0 cm (1.5 inches) away from the power supply.
4. Verify that power to the system has been turned OFF and loosen the set screws that secure the three power wires (L1, L2, L3) to the top of the power switch.
5. Pull the wires straight up to remove them from the power switch.
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 power cord.
7. Pull the wires through the strain relief to remove the power cord.

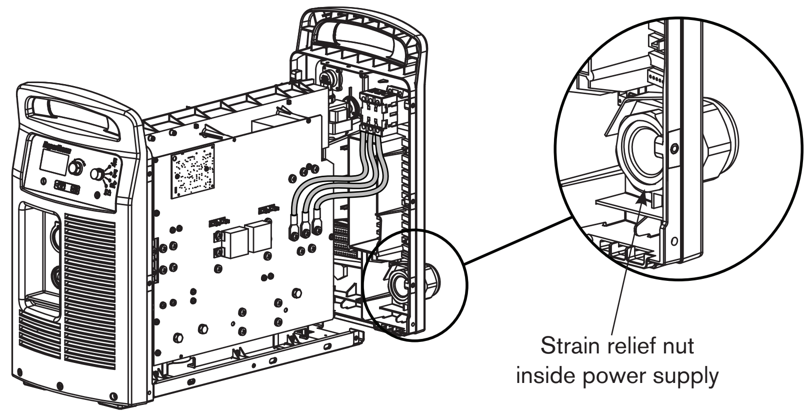
   Note: CE power cords must be pulled forward through the strain relief, from inside the rear end panel, because of the ferrite core installed on the three power wires.



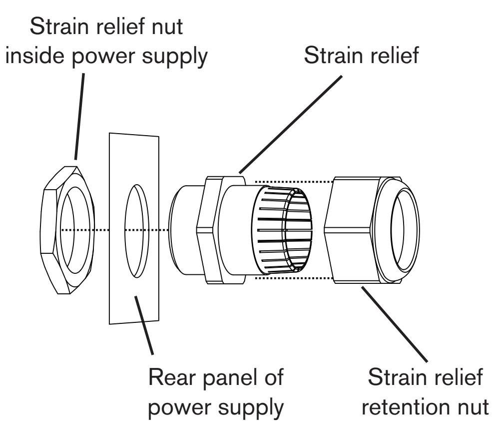
CSA and CCC Power cord **CE Power cord**

Remove the strain relief connector

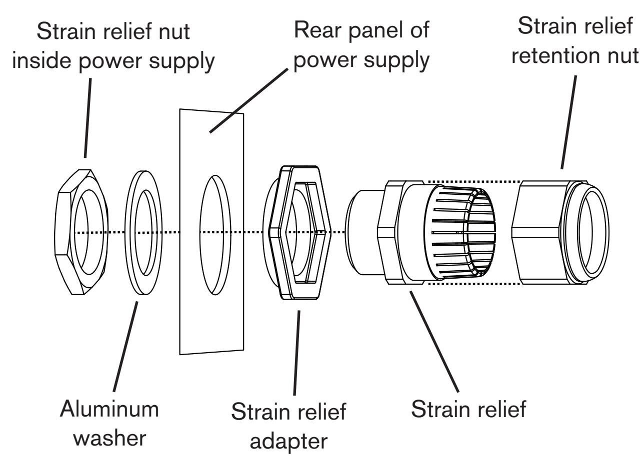
1. Loosen and remove the strain relief nut on the inside of the power supply.
2. Remove the remaining parts of the strain relief connector from the power supply.



**200-600 V CSA, 230-400 V CE,
and 380 V CCC/230- 400 V CE
Strain relief**

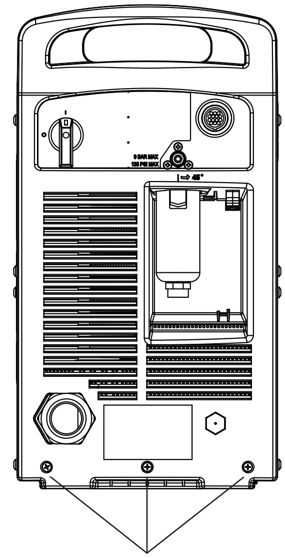


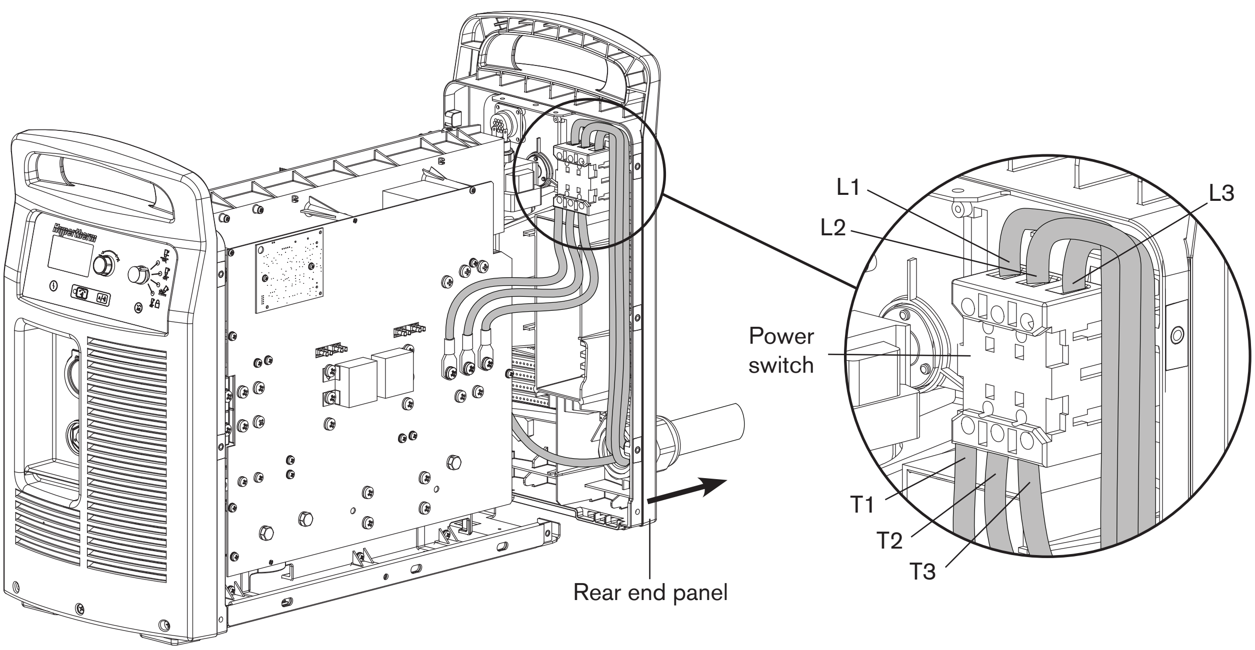
**380 V CCC and 400 V CE
Strain relief**



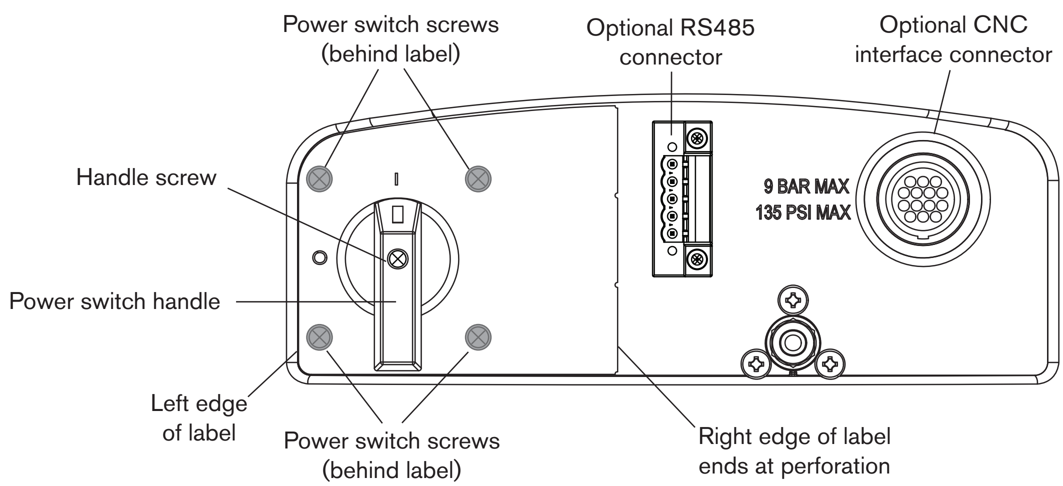
Replace the power switch

1. Remove the three mounting screws from the bottom of the rear end panel.
2. Slide the rear end panel approximately 4.0 cm (1.5 inches) away from the power supply.
3. Verify that power to the system has been turned OFF and loosen the set screws that secure the three power wires (L1-L2-L3) to the top of the power switch.
4. Pull the wires straight up to remove them from the power switch.
5. Loosen the set screws that secure the two wires (red, black) to the auxiliary switch located on top of the power switch behind the L1-L2-L3 wires.
6. Pull the wires straight up to remove them from the auxiliary switch.
7. Loosen the set screws that secure the three power wires (T1-T2-T3) to the bottom of the power switch.
8. Pull the wires straight down to remove them from the power switch.

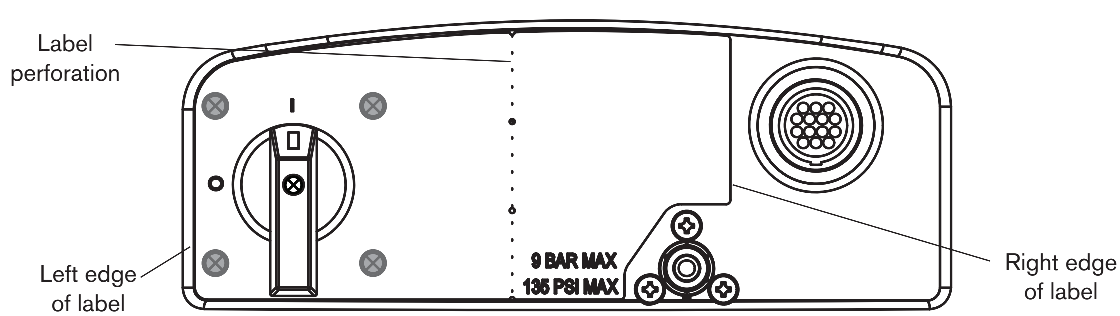




9. Remove the handle screw that secures the power switch handle to the post.
10. Pull the power switch handle straight off the post and set aside the handle and screw.
11. Pry up the edge of the power switch label using a knife or blade screwdriver. If the optional RS485 connector is *not* installed, the label extends to the right side of the inlet gas fitting.
12. Peel off the entire label to expose the four mounting screws that secure the power switch to the rear end panel.
13. Disengage the power switch from the rear end panel by removing the four mounting screws.
14. Secure the new power switch to the rear end panel by tightening the four supplied mounting screws to 11.5 kg cm (10 in.-lbs).
15. If the RS485 connector is installed, bend and tear the new label at the perforation.
16. Peel the backing off the label and affix to the rear end panel, being careful to align the hole in the label with the corresponding hole in the rear end panel.
17. Push the new power switch handle straight onto the post and tighten the handle screw to 11.5 kg cm (10 in.-lbs).

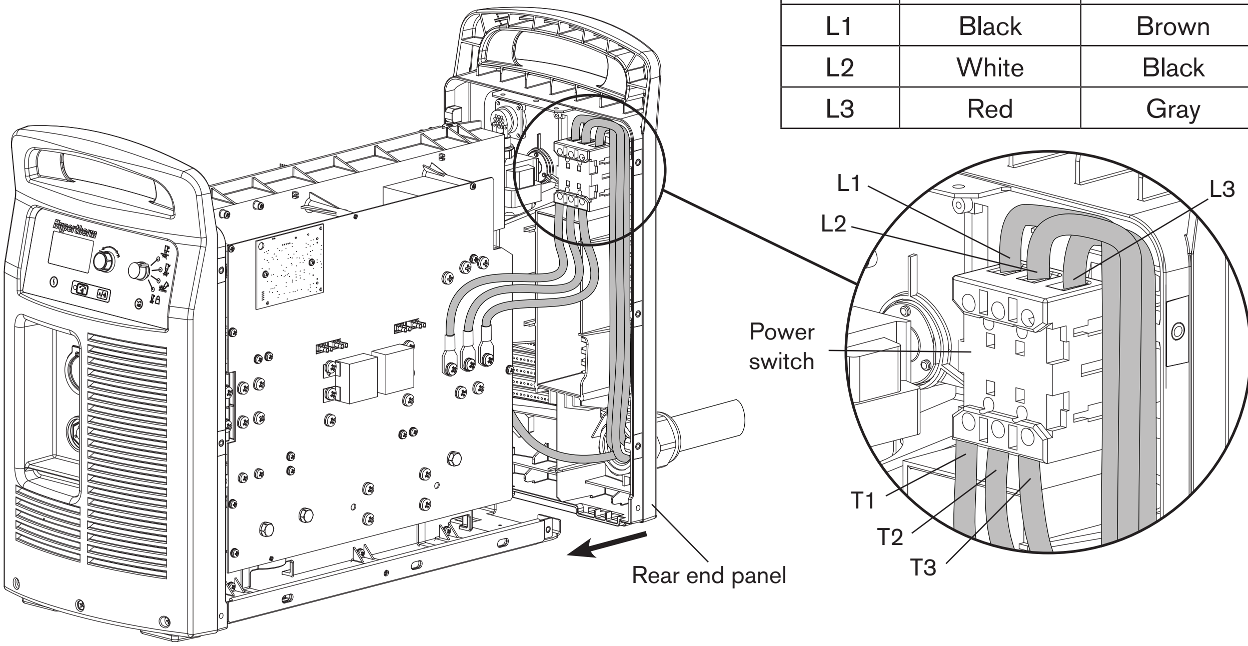


Left half of label used when RS485 connector is installed

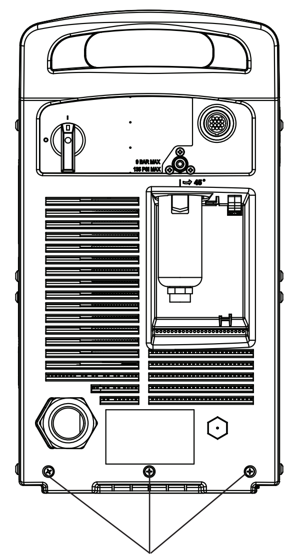


Full label used when RS485 connector is *not* installed

Power cord connections		
Wire	**CSA**	**CE or CCC**
L1	Black	Brown
L2	White	Black
L3	Red	Gray

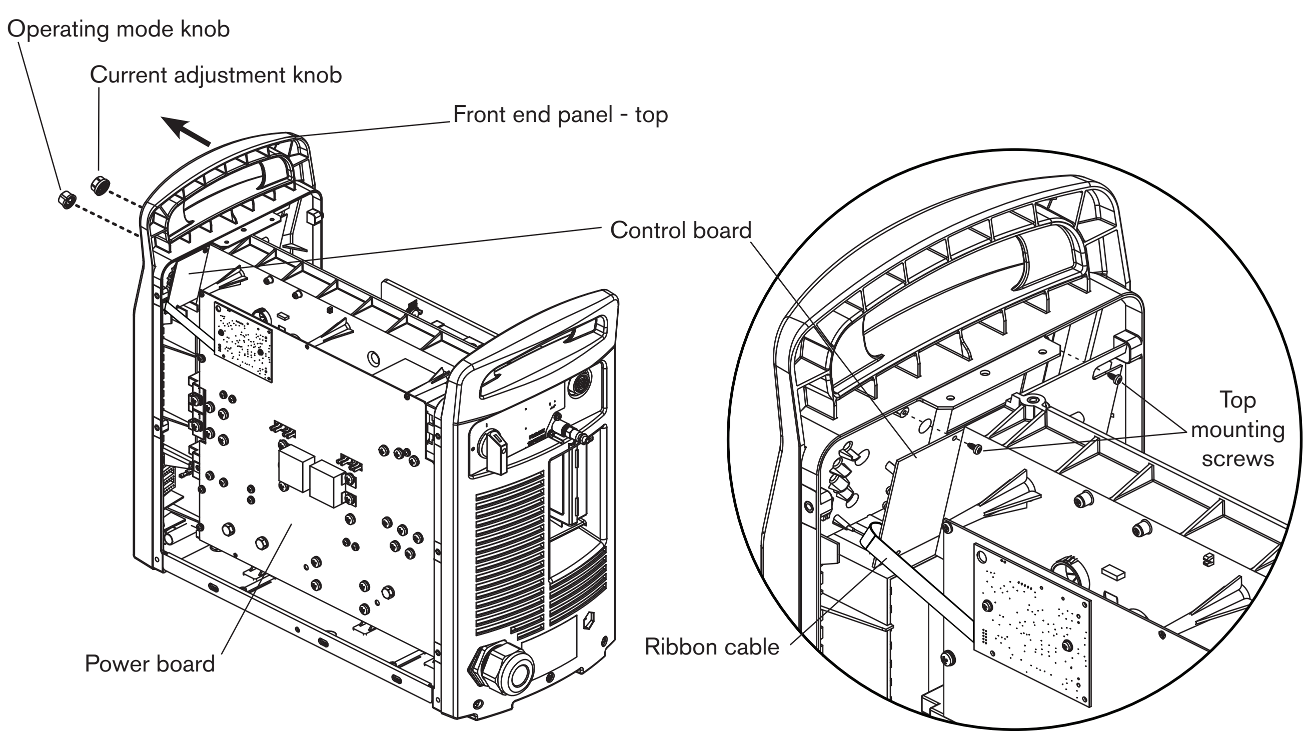


18. Insert the red and black wires in the top of the auxiliary switch and tighten the set screws to 11.5 kg cm (10 in.-lbs). The red wire connects to the "13" terminal and the black wire connects to the "14" terminal.
19. Insert the three power wires in the bottom of the power switch, in the same order as they were removed, and tighten the T1-T2-T3 set screws to 23 kg cm (20 in.-lbs).
20. Insert the three power wires in the top of the power switch, in the same order as they were removed, and tighten the L1-L2-L3 set screws to 23 kg cm (20 in.-lbs).
21. Slide the rear end panel against the power supply chassis.
22. Tighten the three mounting screws in the bottom of the rear end panel to 23 kg cm (20 in.-lbs).



Replace the control board

1. Remove the current adjustment knob and operating mode switch knob from the front panel by pulling them straight off their respective posts.
2. Carefully pull the top of the front end panel away from the power supply. The front panel is still attached to the bottom of the power supply and can only move a short distance.
3. 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 (not shown) is installed in the middle of the control board along the bottom edge.
4. Carefully slide the control board from behind the front end panel toward the power board side of the power supply.
5. Disconnect the ribbon cable from the control board and set aside the control board.
6. Plug the ribbon cable into the J6 connector on the new control board.
7. Carefully pull the top of the front end panel away from the power supply and slide the control board into place.
8. Secure the control board to the front end panel by tightening the three supplied mounting screws to 5.7 kg cm (5 in.-lbs).
9. Align the inside flat edge of the new operating mode switch knob (with the white line) with the flat side of the control board post and push the knob straight onto the post.
10. Align the inside flat edge of the new current adjustment knob with the flat side of the control board post and push the knob straight onto the post.



Remove the DSP board

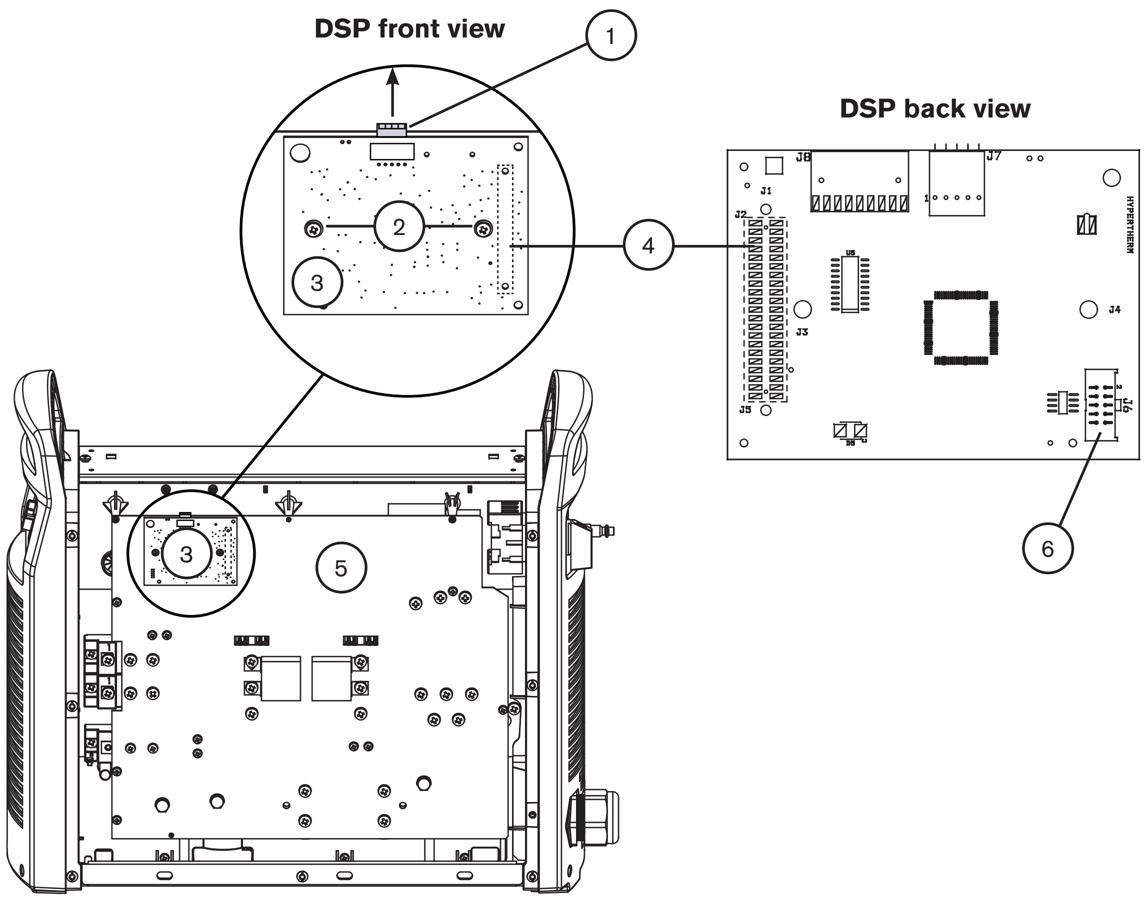
1. Disconnect the DSP connector (1) from the top of the DSP board (3).

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



Remove the power board

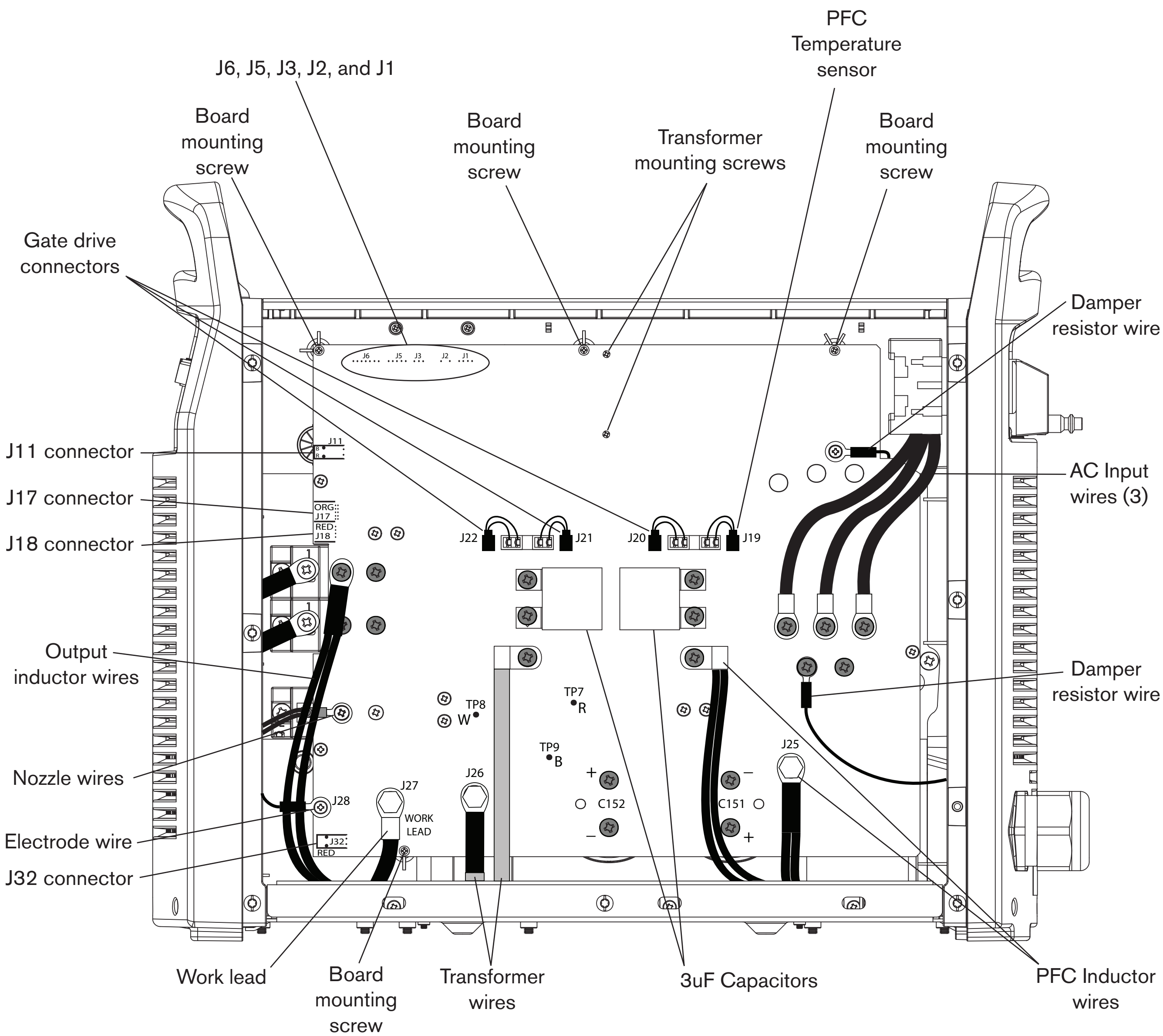
Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA power board on page 9-46
- 230-400 V CE, 380 V CCC/230-400 V CE power board on page 9-47
- 380 V CCC/400 V CE power board on page 9-48

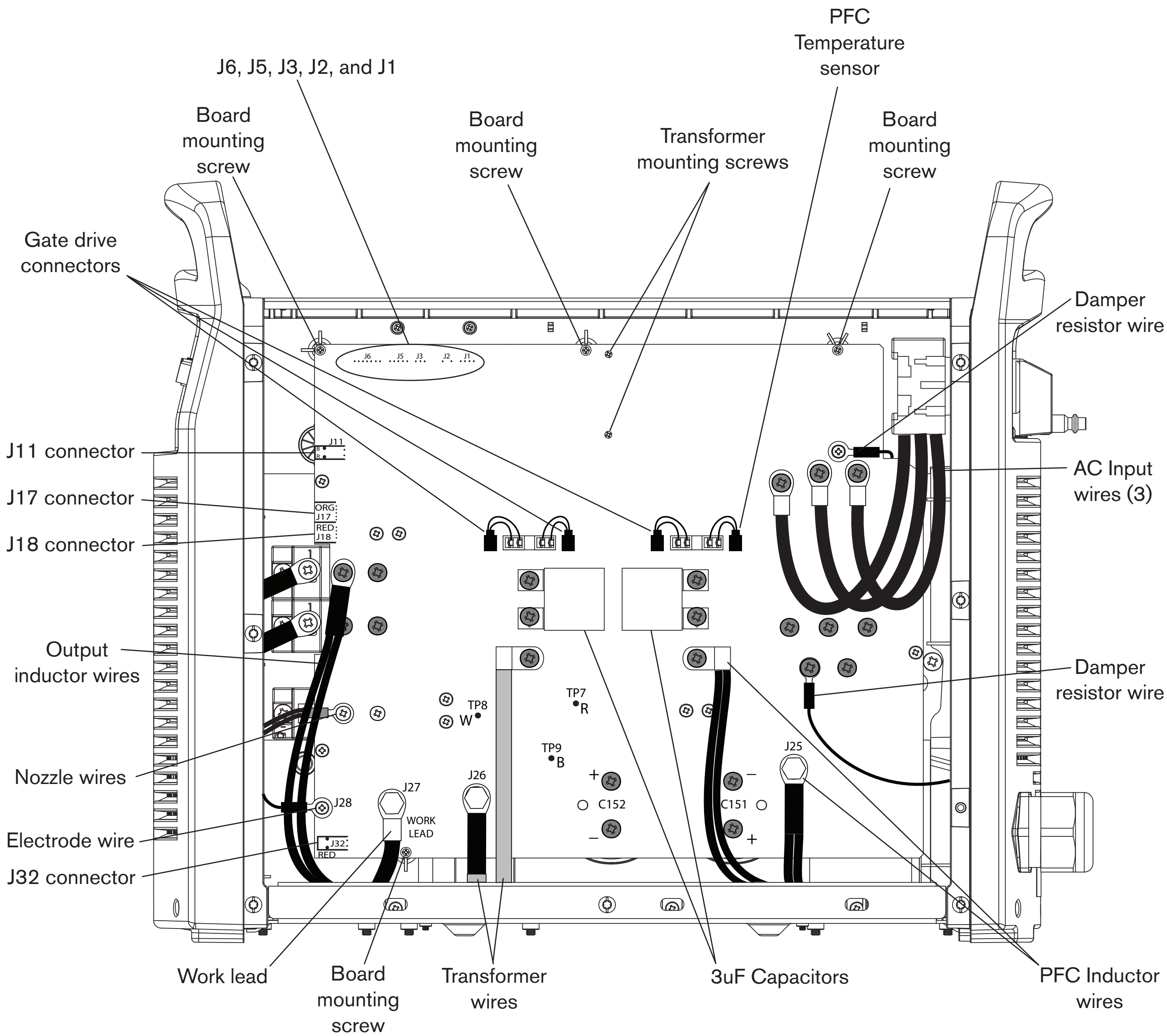
1. Unplug the five wire connectors located at the J1, J2, J3, J5, and J6 headers on the back side of the power board.
2. Disconnect the gate drive wire connectors from the power board.
3. Disconnect the PFC temperature sensor connector (all models except 380 V CCC and 400 V CE) from the power board.
4. Remove the two 3uF capacitors from the power board.
5. Remove all the screws and bolts securing wires to the power board.
6. Remove all the remaining screws from the power board except the four board mounting screws and the two transformer mounting screws.
7. Remove the four board mounting screws. Do not remove the two transformer mounting screws.
8. Pull the right-hand edge of the power board forward, while pushing the gate drive wires and PFC temperature sensor wires through the openings in the board.

   Note: Silkscreen printing above the openings 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.
9. Unplug the J11 and J17 wire connectors from the left side of the power board.
10. If a CNC interface receptacle is installed on the rear of the power supply, unplug the J18 and J32 wire connectors from the left side of the power board.
11. Remove the power board from the power supply and set aside.

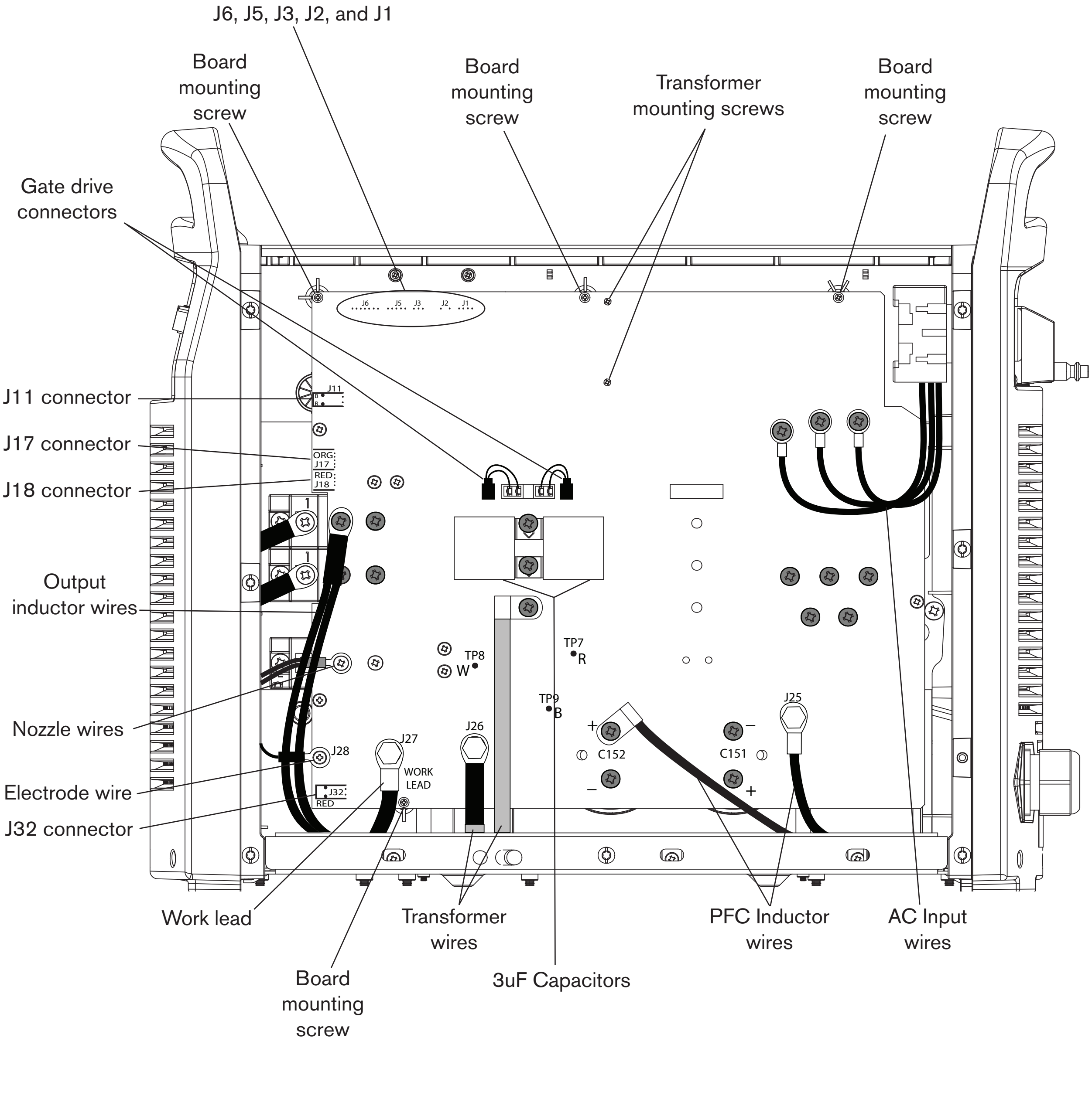
200-600 V CSA Power Board



230-400 V CE, 380 V CCC/230-400 V CE Power Board



380 V CCC/400 V CE Power Board



Replace the input diode bridge

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55
- 380 V CCC/400 V CE heat sink components on page 9-56

1. Remove the two mounting screws from the input diode bridge.
2. Remove the input diode bridge from the heat sink.
3. Clean the area where the input diode bridge was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
4. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the input diode bridge mounting surface.
5. Orient the input diode bridge correctly and mount it to the heat sink by gently tightening the two supplied screws.
6. Alternately step torque the two mounting screws to the proper torque value as shown in the applicable figure.

Replace the output diode bridge

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55
- 380 V CCC/400 V CE heat sink components on page 9-56

1. Remove the four mounting screws from the output diode bridge.
2. Remove the output diode bridge from the heat sink.
3. Clean the area where the output diode bridge was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
4. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the output diode bridge mounting surface.
5. Orient the output diode bridge correctly and mount it to the heat sink by gently tightening the four supplied screws.
6. Alternately step torque the four mounting screws to the proper torque value as shown in the applicable figure.

Replace the pilot arc IGBT

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55
- 380 V CCC/400 V CE heat sink components on page 9-56

1. Remove the two mounting screws from the pilot arc IGBT.
2. Remove the pilot arc IGBT from the heat sink.
3. Clean the area where the pilot arc IGBT was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
4. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the pilot arc IGBT mounting surface.
5. Orient the pilot arc IGBT correctly and mount it to the heat sink by gently tightening the two supplied screws.
6. Alternately step torque the two mounting screws to the proper torque value as shown in the applicable figure.
7. Connect the supplied cable to the pilot arc IGBT terminals. The black wire connects to the top terminal (labelled "E2" or "7") and the red wire connects to the bottom terminal (labelled "G2" or "6").

Replace the inverter IGBT module

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55
- 380 V CCC/400 V CE heat sink components on page 9-56

1. Remove the four mounting screws from the inverter IGBT module.
2. Remove the thermal sensor and set it aside.
3. Remove the inverter IGBT module from the heat sink.
4. Clean the area where the inverter IGBT module was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
5. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the inverter IGBT module mounting surface.

6. Orient the inverter IGBT module correctly and mount it to the heat sink by gently tightening the four supplied screws, using the longer screw to capture the ring terminal of the thermal sensor between the screw head and the upper left mounting hole of the inverter IGBT module.
7. Alternately step torque the four mounting screws to the proper torque value as shown in the applicable figure.
8. Connect the supplied cables to the inverter IGBT module terminals. Attach the black wire from one cable to the "6" terminal and the red wire to the "7" terminal. Attach the black wire from the remaining cable to the "5" terminal and the red wire to the "4" terminal.

Replace the PFC IGBT module

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55

1. Remove the four mounting screws from the PFC IGBT module.
2. Remove the PFC IGBT module from the heat sink.
3. Clean the area where the PFC IGBT module was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
4. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the PFC IGBT module mounting surface.
5. Orient the PFC IGBT module correctly and mount it to the heat sink by gently tightening the four supplied screws.
6. Alternately step torque the four mounting screws to the proper torque value as shown in the applicable figure.
7. Connect the supplied cables to the PFC IGBT module terminals. Attach the black wire from one cable to the "G2" terminal and the red wire to the "E2" terminal. Attach the black wire from the remaining cable to the "E1" terminal and the red wire to the "G1" terminal.

Replace the snubber resistor

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55
- 380 V CCC/400 V CE heat sink components on page 9-56

1. Remove the two mounting screws from the appropriate snubber resistor.
2. Remove the snubber resistor from the heat sink.
3. Clean the area where the snubber resistor was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
4. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the snubber resistor mounting surface.
5. Orient the snubber resistor correctly and mount it to the heat sink by gently tightening the two supplied screws.
6. Alternately step torque the two mounting screws to the proper torque value as shown in the applicable figure.
7. Tighten the two supplied standoffs, in the threaded holes of the snubber resistor, to 11.5 kg cm (10 in.-lbs).

Replace the damper resistor

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55

1. Remove the two mounting screws from the damper resistor.
2. Remove the damper resistor from the heat sink.
3. Clean the area where the damper resistor was mounted, using isopropyl alcohol to remove the old thermal grease from the heat sink.
4. Apply a thin coat (3 mils, approximately the thickness of a sheet of paper) of thermal grease evenly to the damper resistor mounting surface.
5. Orient the damper resistor correctly and mount it to the heat sink by gently tightening the two supplied screws.
6. Alternately step torque the two mounting screws to the proper torque value as shown in the applicable figure.

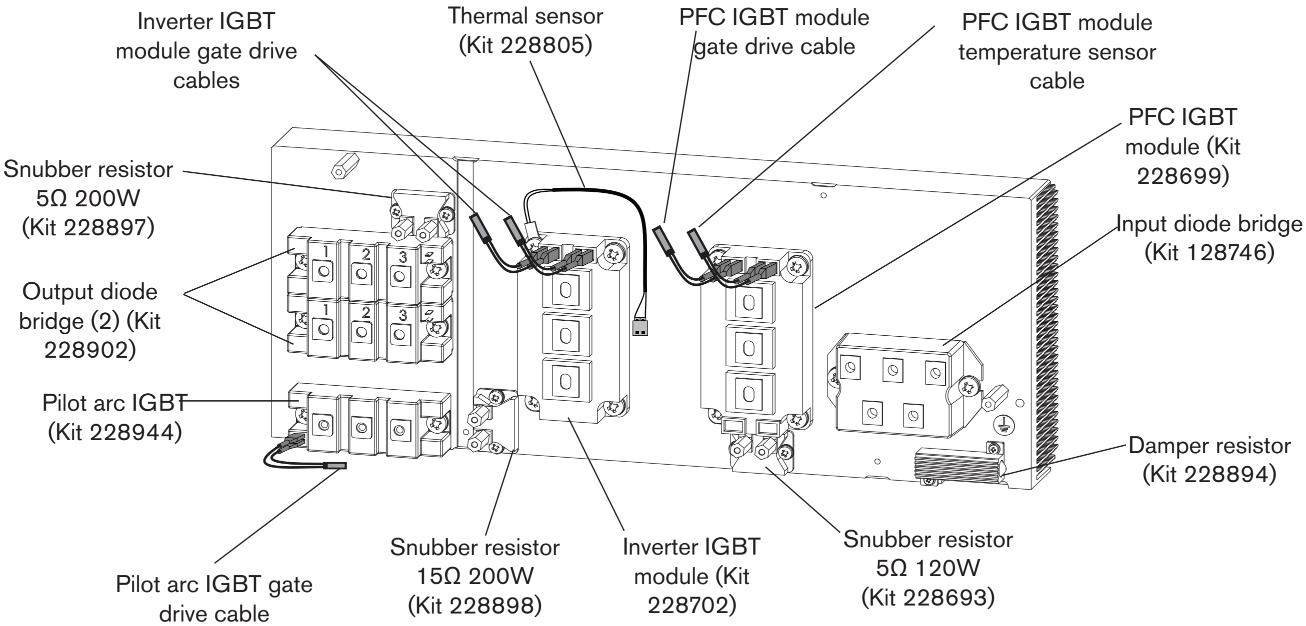
Replace the thermal sensor

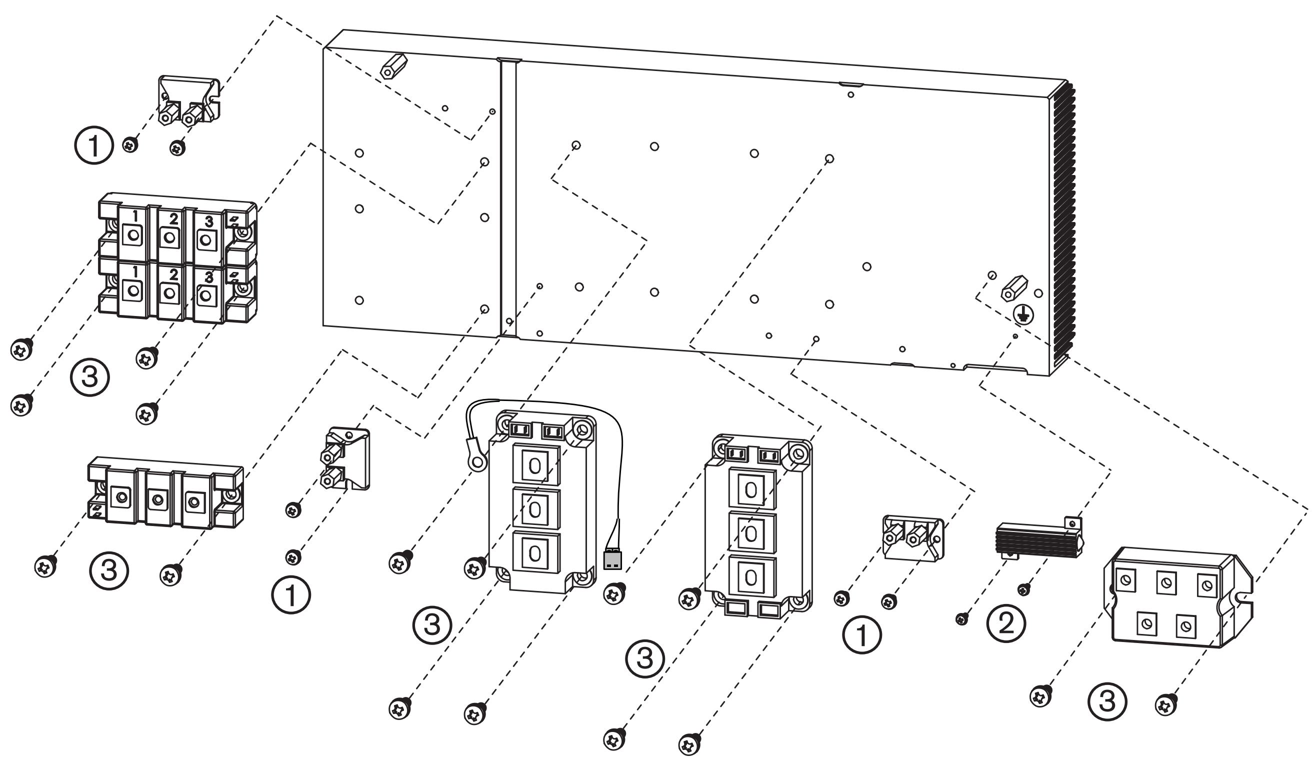
Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA heat sink components on page 9-54
- 230-400 V CE, 380 V CCC/230-400 V CE heat sink components on page 9-55
- 380 V CCC/400 V CE heat sink components on page 9-56

1. Remove the upper left mounting screw from the inverter IGBT module.
2. Remove the thermal sensor.
3. Align the ring terminal of the new thermal sensor with the upper left hole in the inverter IGBT module.
4. Step torque the supplied mounting screw to the proper value as shown in the applicable figure.

200-600 V CSA heat sink components



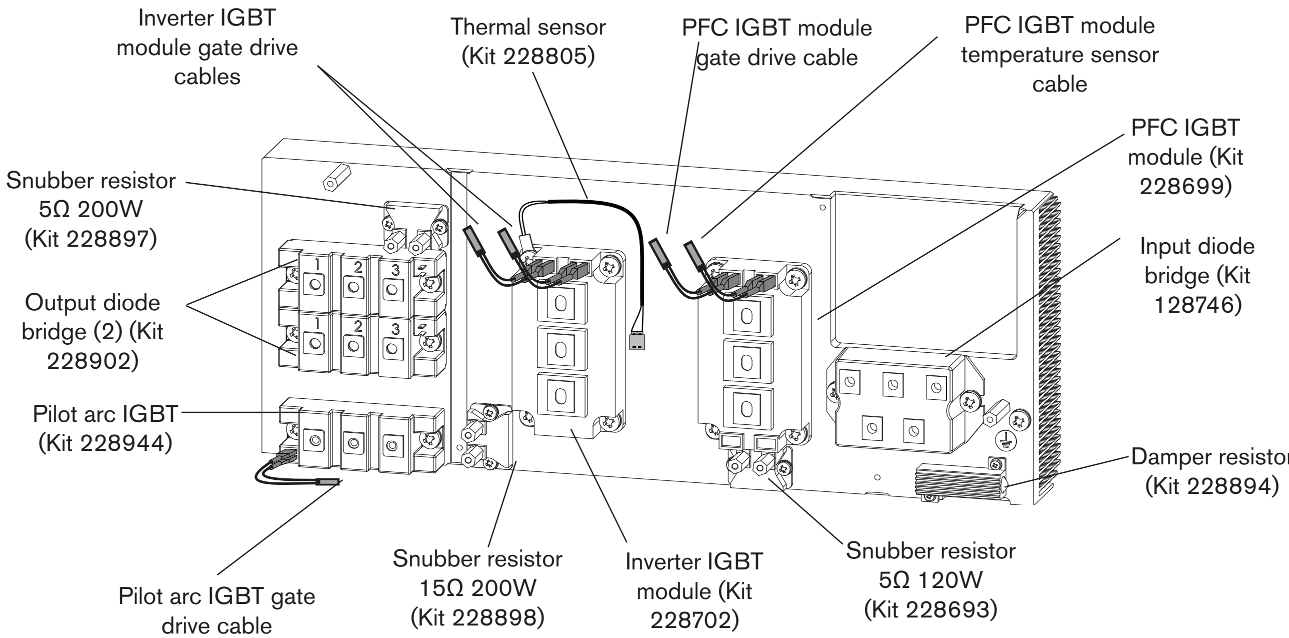


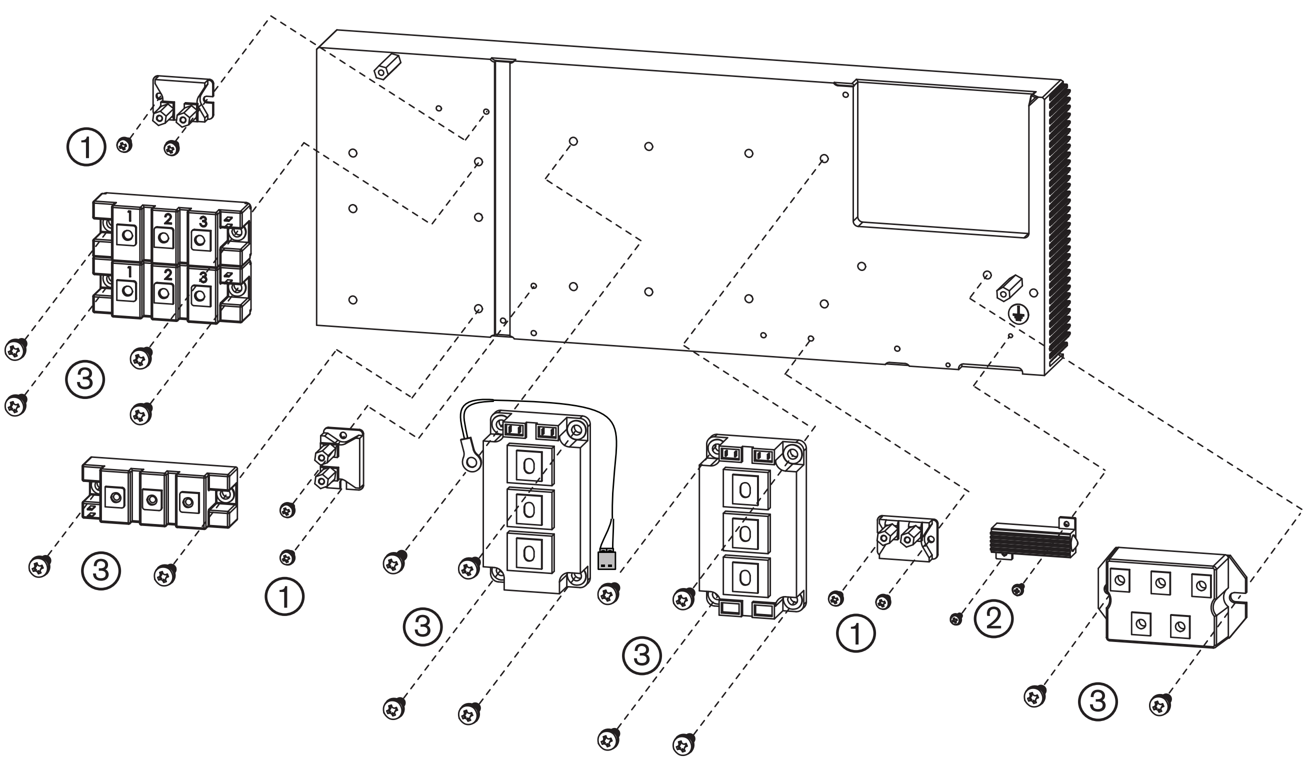
1 Torque to 17.3 kg cm (15 in.-lbs). M4 X 10 2SEM

2 Torque to 11.5 kg cm (10 in.-lbs). M3 X 10 1SEM

3 Torque to 40 kg cm (35 in.-lbs). M6 X 16-12.5 2SEM TRI CHRM

230-400 V CE, 380 V CCC/230-400 V CE heat sink components



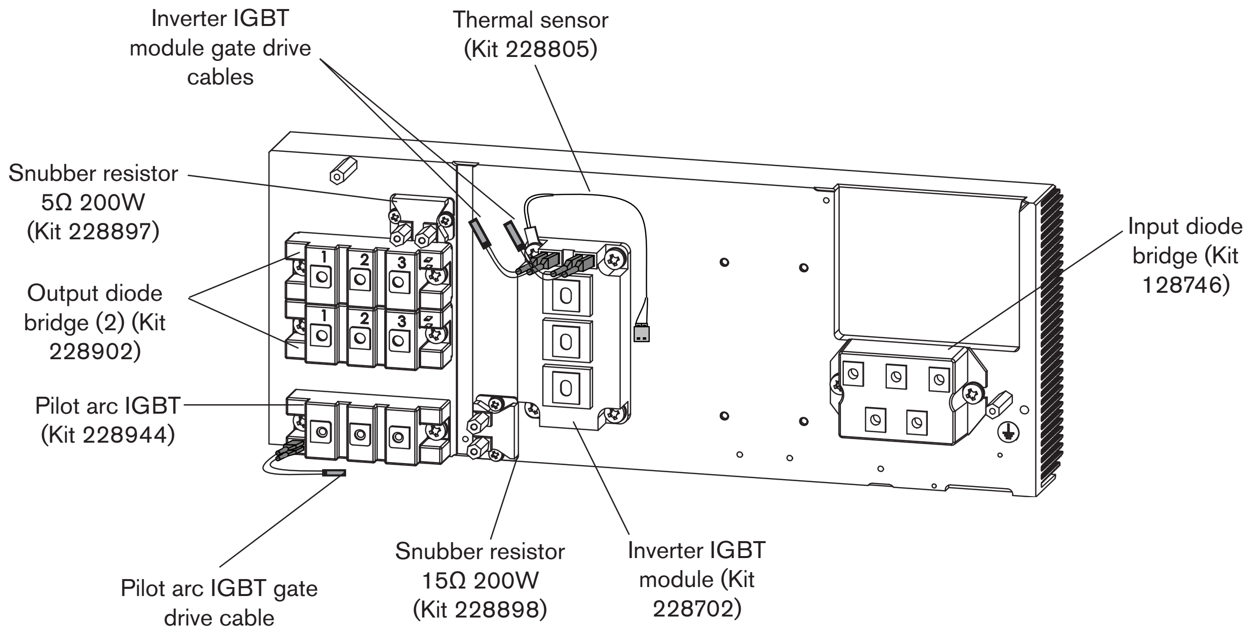


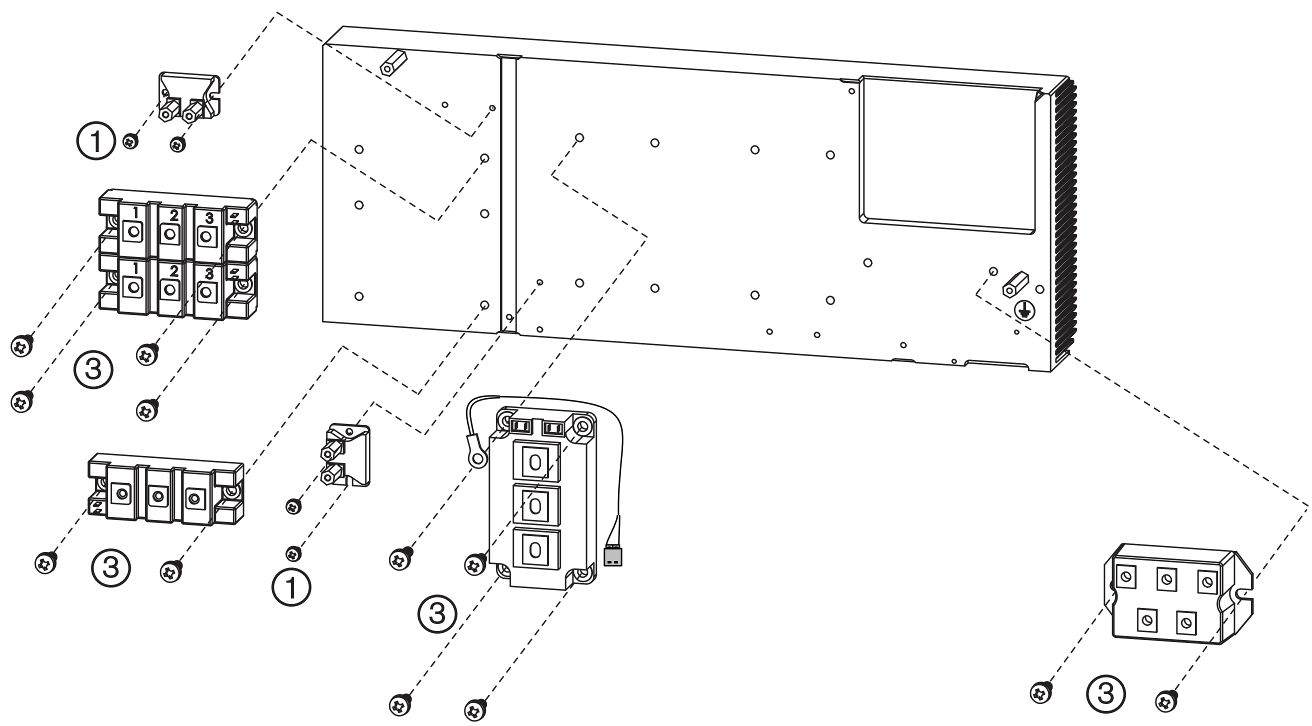
1. Torque to 17.3 kg cm (15 in.-lbs).
   M4 X 10 2SEM

2. Torque to 11.5 kg cm (10 in.-lbs).
   M3 X 10 1SEM

3. Torque to 40 kg cm (35 in.-lbs).
   M6 X 16-12.5 2SEM TRI CHRM

380 V CCC/400 V CE heat sink components





1 Torque to 17.3 kg cm (15 in.-lbs).
M4 X 10 2SEM

2 Torque to 11.5 kg cm (10 in.-lbs).
M3 X 10 1SEM

3 Torque to 40 kg cm (35 in.-lbs).
M6 X 16-12.5 2SEM TRI CHRM

Install the power board

Complete the instructions below while referring to the applicable figure:

- 200-600 V CSA power board on page 9-46
- 230-400 V CE, 380 V CCC/230-400 V CE power board on page 9-47
- 380 V CCC/400 V CE power board on page 9-48

1. Place the power board in the mounting position while routing the gate drive wires and PFC temperature sensor wires (all models except 380 V CCC and 400 V CE) through the respective openings in the board.

   Note: Verify that all the wires that were disconnected while removing the power board are now positioned in front of the power board.

2. Tighten the four board mounting screws to 17.3 kg cm (15 in.-lbs).
3. Plug the gate drive wires into the respective connectors on the power board.

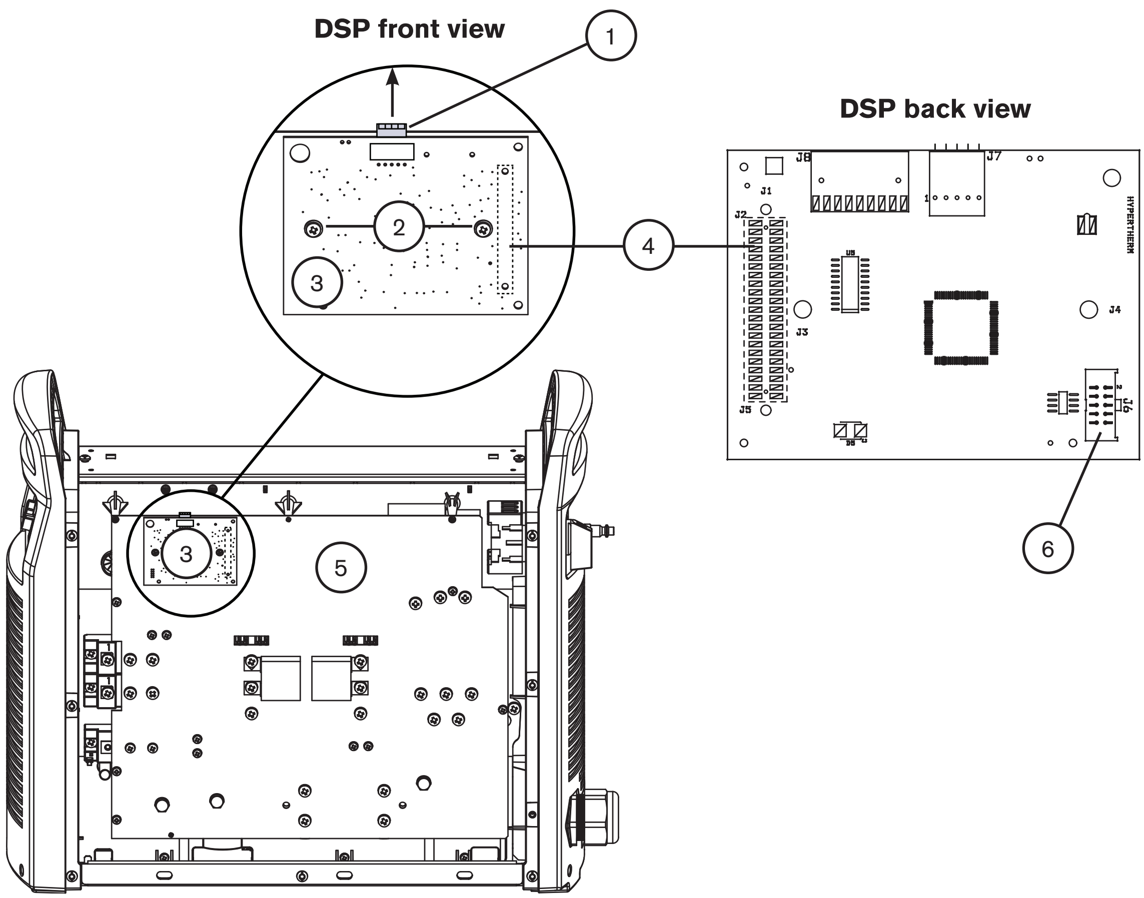
   Note: Silkscreen printing above the openings in the board denotes the color and order of the gate drive wires. The printing is “BLK” (black), “RED” (red), “BLK” (black), “RED” (red) from left to right.

4. Plug the PFC temperature sensor connector (all models except 380 V CCC and 400 V CE) into the connector on the power board.
5. Plug the respective wire connectors into the J1, J2, J3, J5, and J6 headers on the back of the power board.
6. Plug the J11 and J17 wire connectors into the respective connectors on the left side of the power board.
7. If a CNC interface receptacle is installed on the rear of the power supply, plug the J18 and J32 wire connectors into the respective connectors on the left side of the power board.
8. Secure the respective wires to the power board at J25, J26, and J27 by tightening the bolts to 63.4 kg cm (55 in.-lbs).
9. Install and tighten the gray colored screws to 40.3 kg cm (35 in.-lbs), making sure to secure the previously removed wires and capacitors to the power board.
10. Install and tighten the remaining screws to 23 kg cm (20 in.-lbs), making sure to secure the previously removed wires to the power board.

Install the DSP board

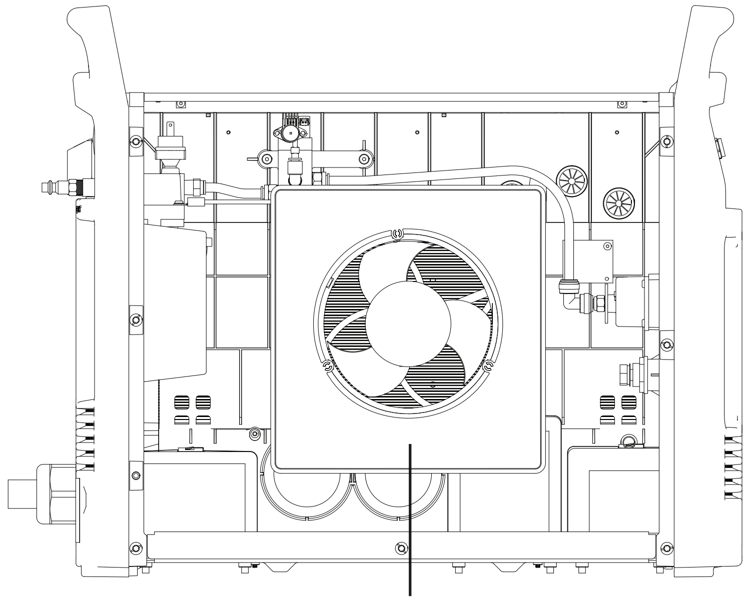
1. Connect the ribbon cable from the control board to the connector (6) on the back of the DSP board.
2. Carefully align the two rows of connector pins (4), located on the back of the DSP board (3), with the mating holes in the power board (5).
3. Gently push the DSP board connector pins into the power board until fully seated. Be careful not to bend the pins.
4. Connect the DSP connector (1) to the top of the DSP board (3).

   Note: This step is only required on systems that have an RS485 communication board installed.
5. Tighten the two mounting screws (2) to 8.1 kg cm (7 in.-lbs).



Remove the fan shroud

1. Grasp the fan shroud with two hands.
2. Pull the fan shroud straight off the fan housing.

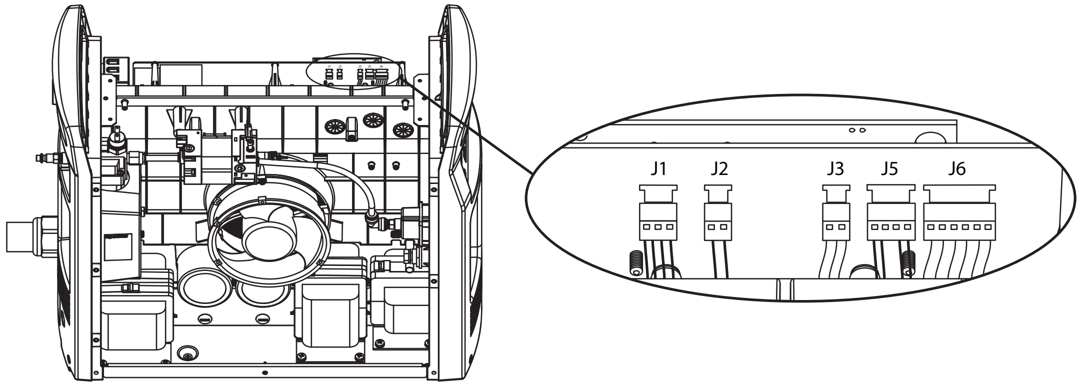


Install the fan shroud

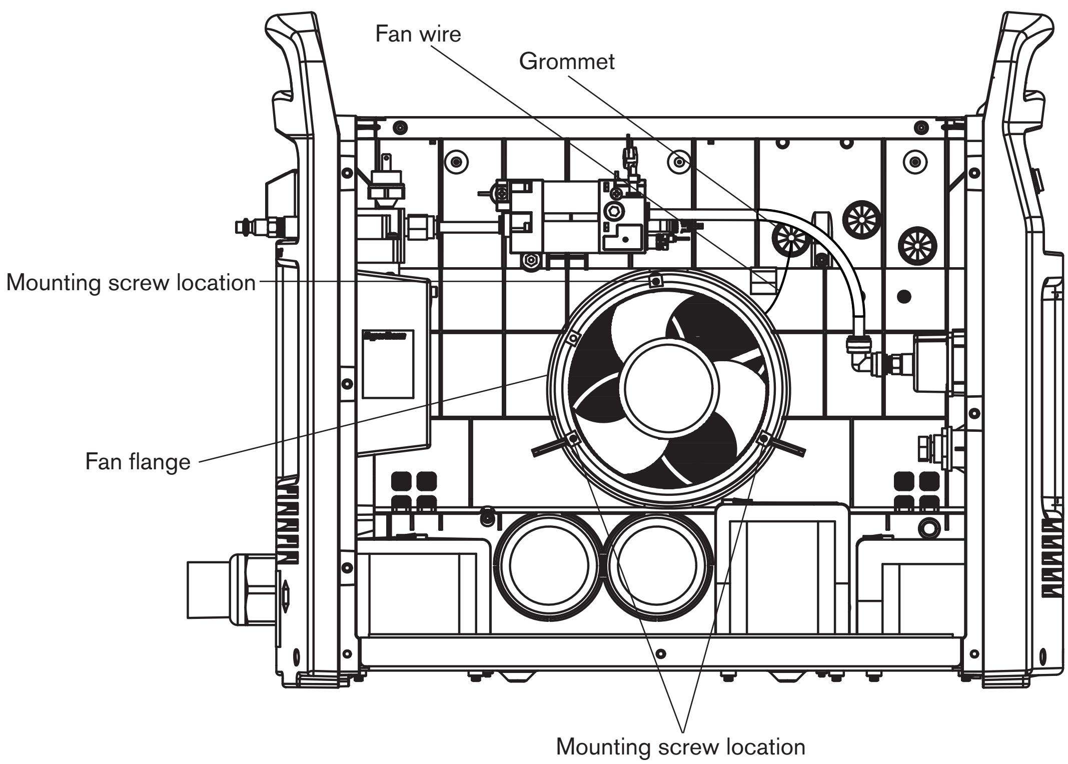
1. Align the three plastic posts on the back side of the fan shroud with the corresponding holes in the fan housing.
2. Push the fan shroud straight onto the fan housing.

Replace the fan

1. Unplug the J1 connector from the back side of the power board.

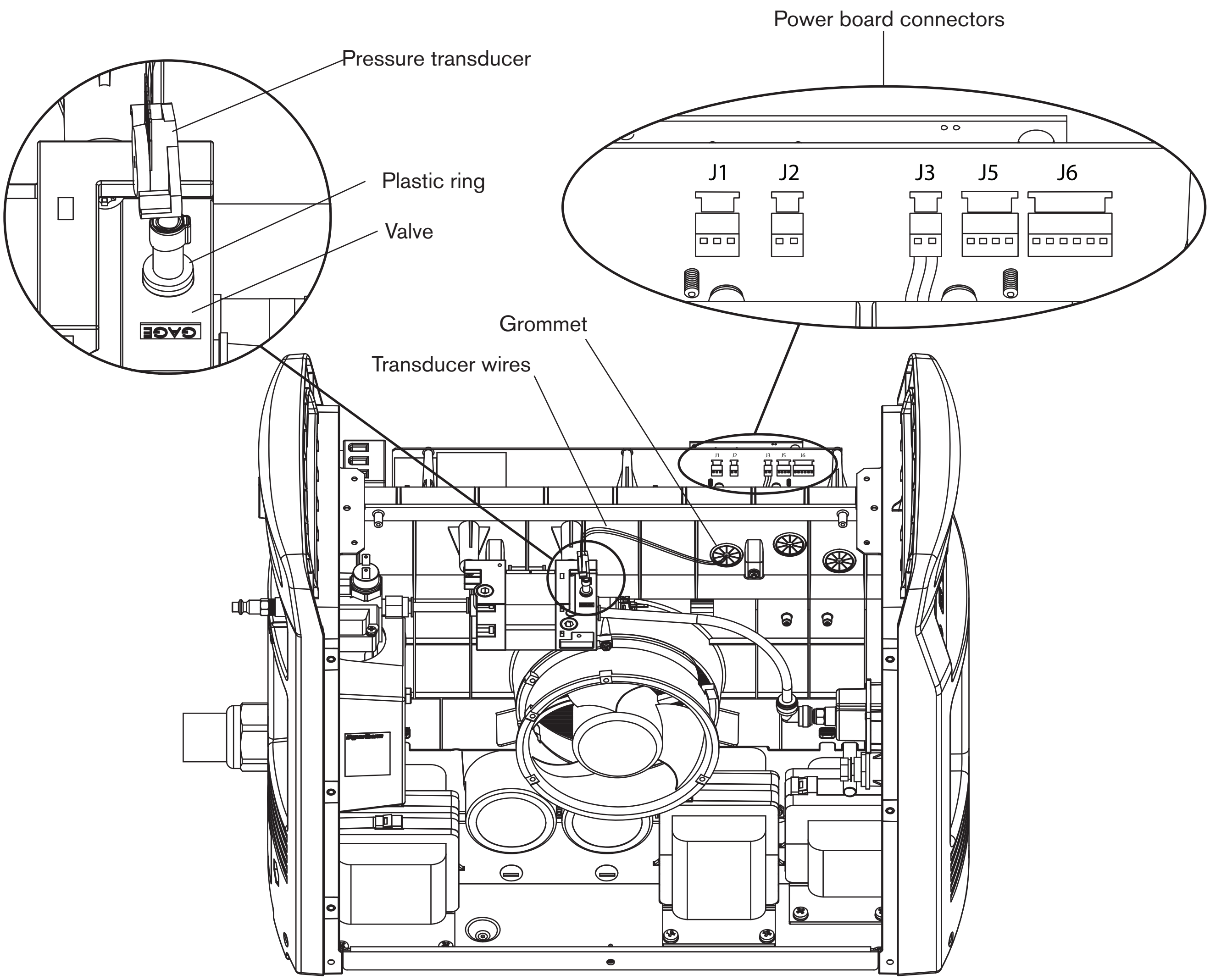


2. Pull the fan wire and connector through the grommet from the fan side of the power supply.
3. Remove the three mounting screws located behind the fan flange.
4. Remove the fan from the power supply.
5. Orient the new fan and tighten the three supplied mounting screws to 23 kg cm (20 in.-lbs).
6. Route the fan wire through the grommet.
7. Plug the fan wire connector into the J1 header of the power board.



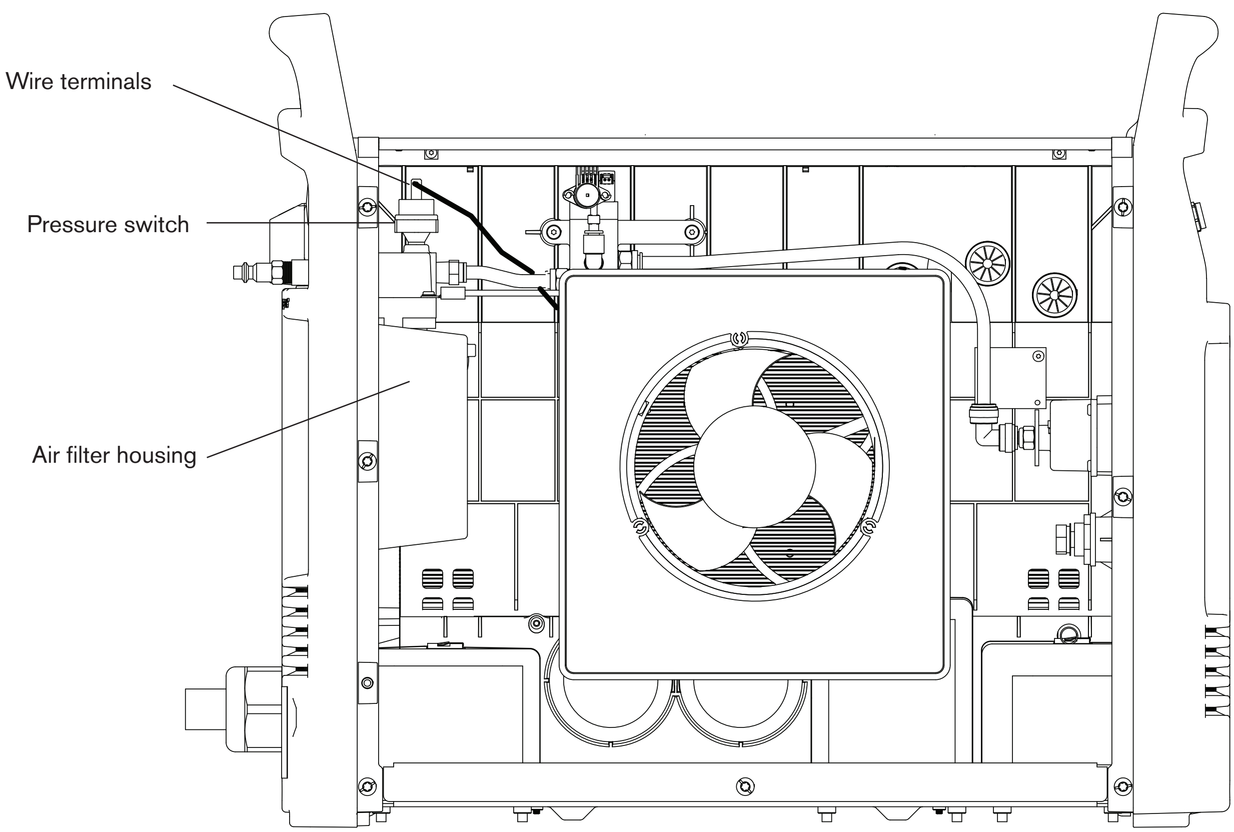
Replace the pressure transducer

1. Unplug the J3 connector from the back side of the power board.
2. Pull the pressure transducer wires and connector through the grommet from the fan side of the power supply.
3. Remove the pressure transducer from the solenoid valve by pressing the plastic ring against the valve, while pulling up on the pressure transducer.
4. Insert the new pressure transducer into the valve and push down until fully seated.
5. Route the pressure transducer connector and wires through the grommet.
6. Plug the pressure transducer connector into the J3 header of the power board.

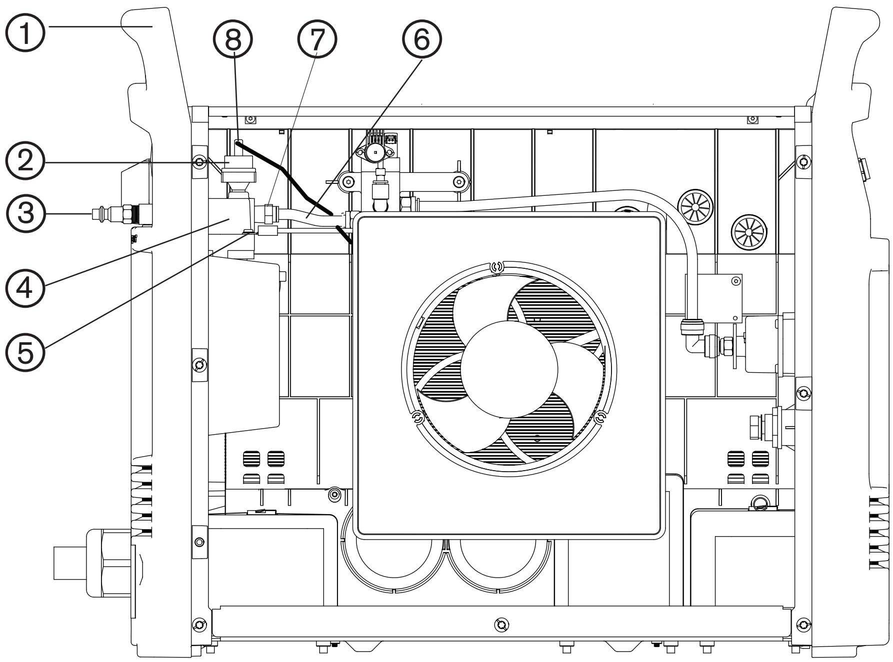


Replace the pressure switch

1. Unplug the wire terminals from the top of the pressure switch.
2. Loosen the pressure switch with a wrench.
3. Remove the pressure switch from the air filter housing.
4. Apply thread sealant to the threads of the new pressure switch.
5. Tighten the new pressure switch into the air filter housing.
6. Connect the wire terminals to the pressure switch.
7. Remove the gas fitting from the rear end panel.



Replace the air filter assembly



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

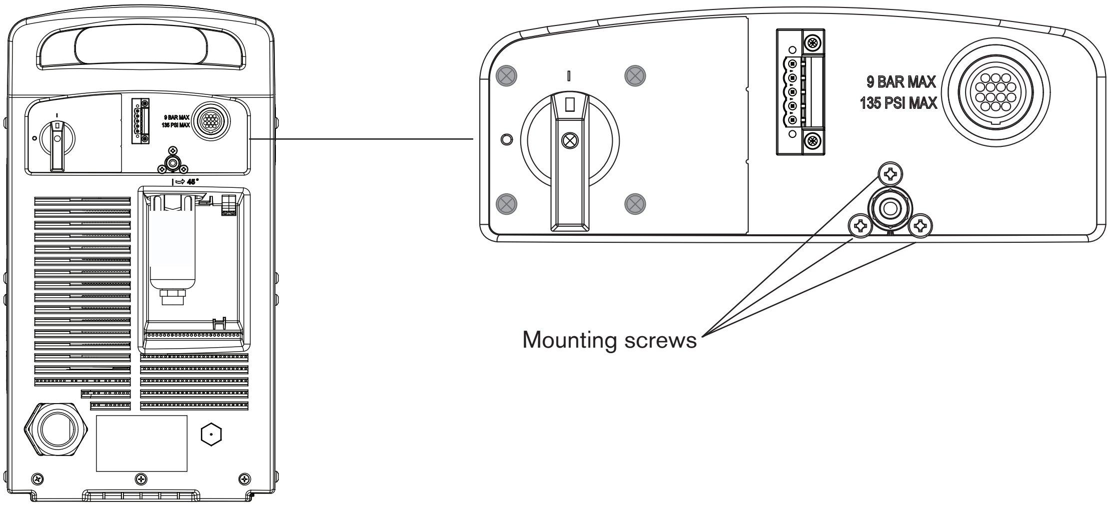
Remove the air filter assembly

1. Remove the air filter bowl and filter element from the air filter assembly. Refer to page *9-17 Remove the air filter bowl.*
2. Disconnect the 2 wire terminals from the top of the pressure switch.
3. Remove the screw that holds the ground wire(s) to the air filter housing.

   Note: There will be 2 ground wires if the optional CPC port is installed in the rear panel.
4. Push in the plastic ring on the push-to-connect fitting. Carefully pull the top of the rear end panel away from the power supply until the gas tube pulls out of the push-to-connect fitting.
5. Remove the gas fitting from the rear panel.
6. Remove the 3 mounting screws around the gas fitting on the rear panel. (See figure on page 9-64.)
7. Remove the air filter assembly from the power supply.

Install the air filter assembly

1. Remove the filter bowl and filter element from the new air filter assembly. See page 9-17 *Remove the air filter bowl*.
2. Position the new air filter assembly in the power supply.
3. Tighten the 3 mounting screws in the rear panel to 23 kg·cm (20 in·lb).



4. Apply thread sealant to the gas fitting threads and tighten the gas fitting into the bracket on the air filter.

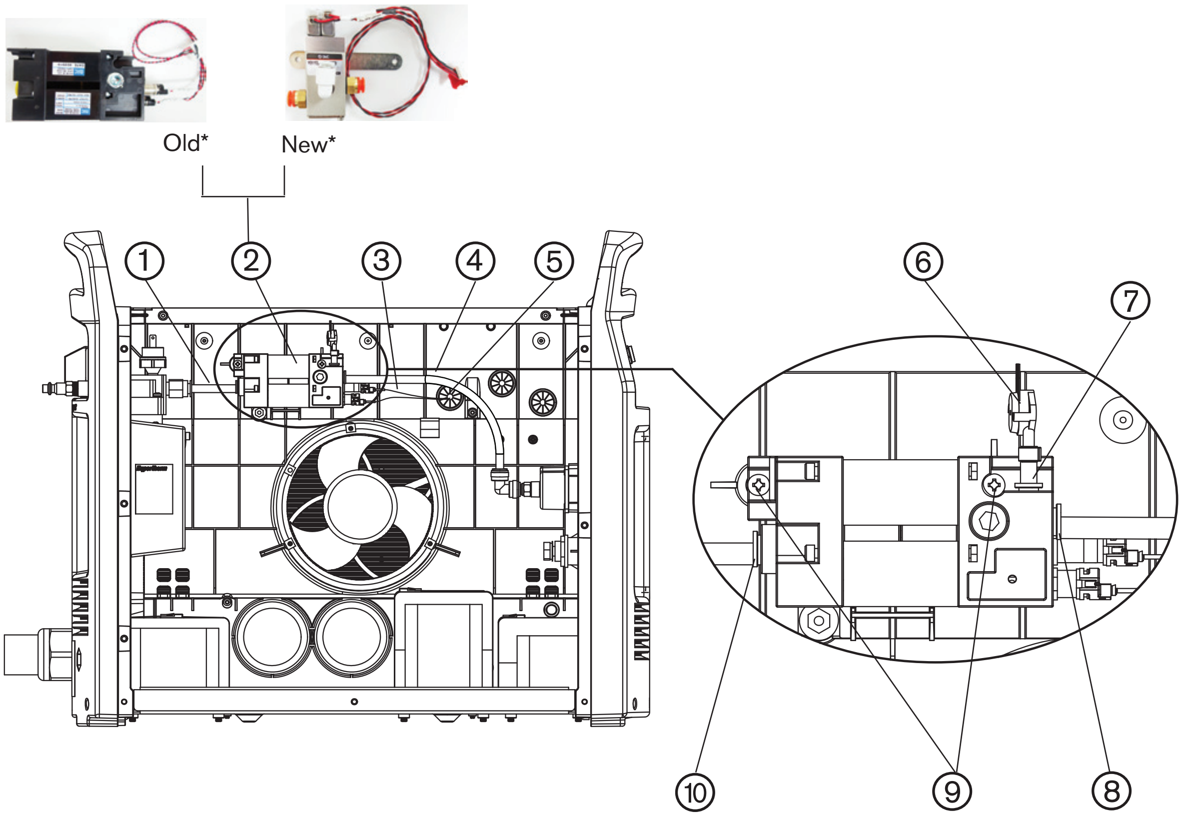
   Note: Too much thread sealant can contaminate the gas line.

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 end 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 with the filter element assembly onto the filter assembly at the rear of the power supply. See page 9-19.
9. Install the end panel bracket.
10. Install the power supply cover. See page 9-95.
11. Reconnect the power and gas supply. See page 9-97.

Replace the solenoid valve



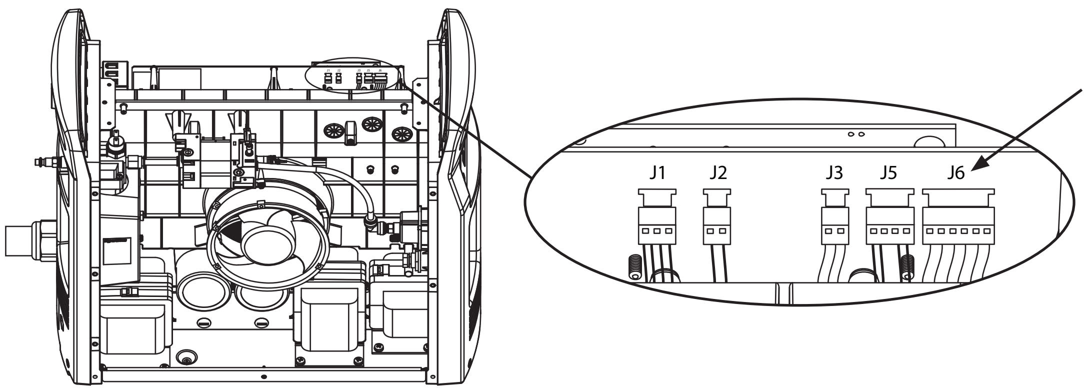
1	Short gas tube	**6**	Pressure transducer
2	Solenoid valve*	**7**	Pressure transducer fitting
3	Solenoid valve power wires	**8**	Long gas tube fitting
4	Long gas tube	**9**	Mounting screws
5	Left grommet	**10**	Short gas tube fitting

*Note: Because of a manufacturing change, solenoid valve kit 228687 replaces solenoid valve kit 228882, as also shown on page 11-8. See page 9-66 for instructions on how to remove both solenoid valve models.

Remove the old solenoid valve

1. Disconnect the J6 connector from the back side of the power board.

   Note: If needed, fold back the top of the component barrier to access the J6 connector.



2. Pull the solenoid valve power wires and J6 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 the long gas tube fitting while you pull the long gas tubing out of the solenoid valve and 90° push-to-connect fitting.
5. Remove the 2 mounting screws from the solenoid valve.
6. Push in the plastic ring on the short gas tube fitting while pulling the solenoid valve off the short gas tube.
7. Remove the solenoid valve.

Install the new solenoid valve

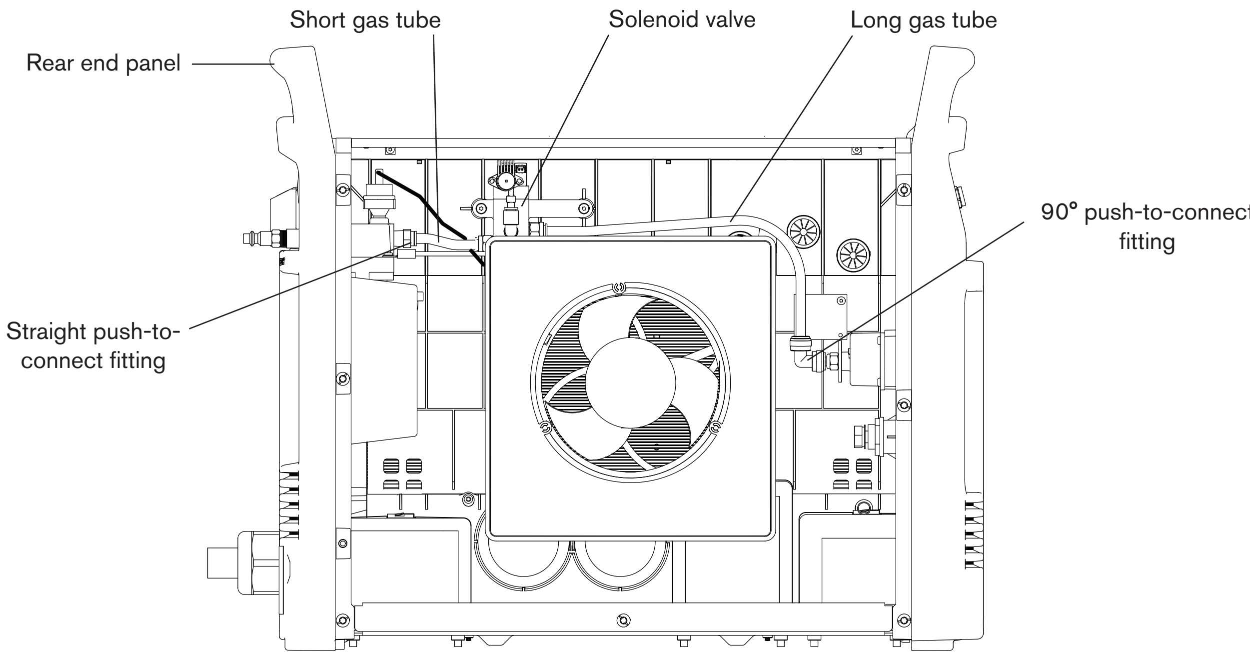
8. Align and push the new solenoid valve onto the short gas tube (see page 9-65) until fully seated.
9. Use the 2 supplied mounting screws to install the new solenoid valve onto the center panel. Tighten the screws to 23 kg·cm (20 in·lb).
10. Push the 30.48 cm (12 inch) long gas tube into the solenoid valve until fully seated. Push the other end of the long gas tube into the 90° fitting until fully seated.

CAUTION!

The kit includes 2 tubing lengths to accommodate different Powermax systems. For your Powermax105/125, be careful to use the longer 30.48 cm (12 inch) tube.

11. Push the pressure transducer into the solenoid valve until fully seated.
12. Route the solenoid valve power wires and connector through the left grommet (see page 9-65).
13. Connect the solenoid valve power wires to J6 on the power board.
14. Position the top of the component barrier into place.
15. Reinstall the outer components. See page 9-12 for instructions.

Replace the gas tubing

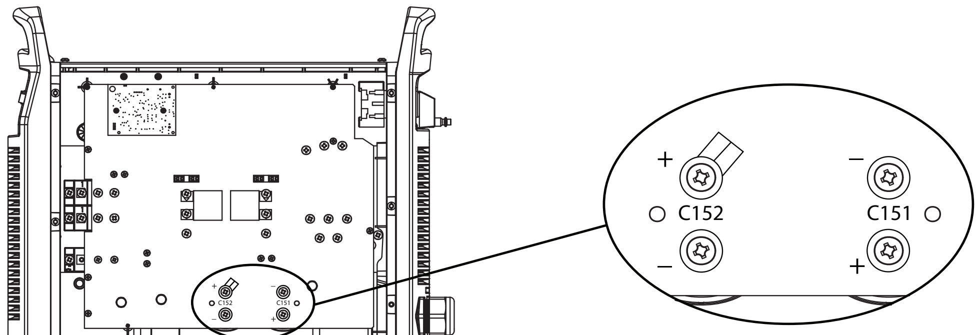


1. Push in the plastic ring on the straight push-to-connect fitting while gently pulling the top of the rear end panel away from the power supply, until the end of the short gas tube pulls out of the straight push-to-connect fitting.
2. Push in the plastic ring on the solenoid valve fitting and pull the short gas tube out of the fitting.
3. Push one end of the new short gas tube into the solenoid valve fitting until fully seated.
4. Align the other end of the short gas tube with the straight push-to-connect fitting and gently push the top of the rear end panel toward the power supply, until the short gas tube is fully seated in the straight push-to-connect fitting.
5. Push in the plastic ring on top of the 90° push-to-connect fitting and pull the long gas tube out of the fitting.
6. Push in the plastic ring on the solenoid valve fitting and remove the long gas tube by pulling it out of the fitting.
7. Push one end of the new long gas tube into the solenoid valve fitting until fully seated.
8. Push the other end of the new long gas tube into the 90° push-to-connect fitting until fully seated.

Replace the bulk capacitors

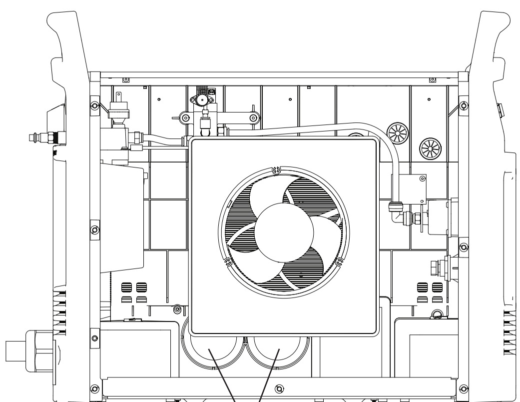
1. Remove the four bulk capacitor mounting screws from the power board.

   Note: If the power supply is a 380 V CCC or 400 V CE model, the C152 top mounting screw will also secure an inductor wire to the power board.



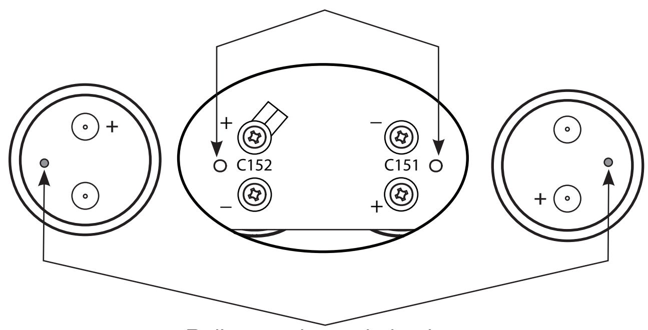
Mounting screws (4)

2. Remove the bulk capacitors, from the fan side of the power supply, by pulling them straight out.



Bulk capacitors

Power board viewing holes

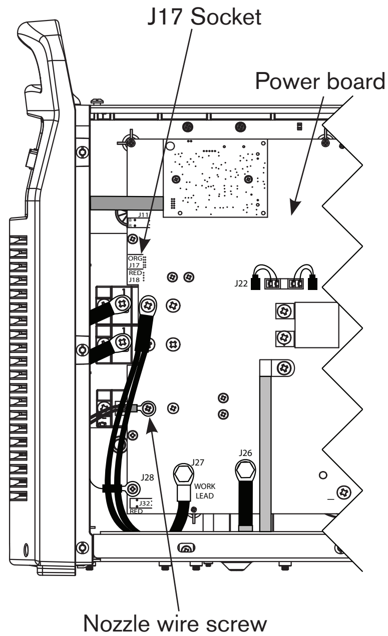


Bulk capacitor polarity dots

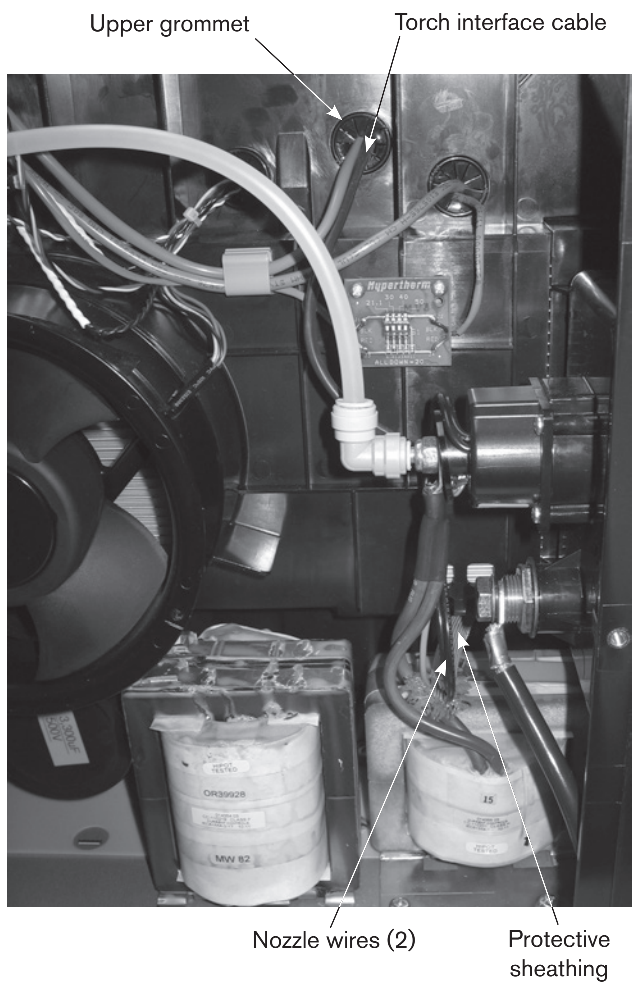
3. Insert the new bulk capacitors, from the fan side of the power supply, noting the orientation of the polarity dot in regard to the viewing hole in the power board.
4. Rotate each capacitor, from the fan side, until the polarity dot aligns with the viewing hole on the front side of the power board.
5. Start the four supplied mounting screws by hand, then tighten to 40.3 kg cm (35 in.-lbs).

   Note: If the power supply is a 380 V CCC or 400 V CE model, secure the inductor wire with the top C152 mounting screw.

Replace the torch quick disconnect receptacle



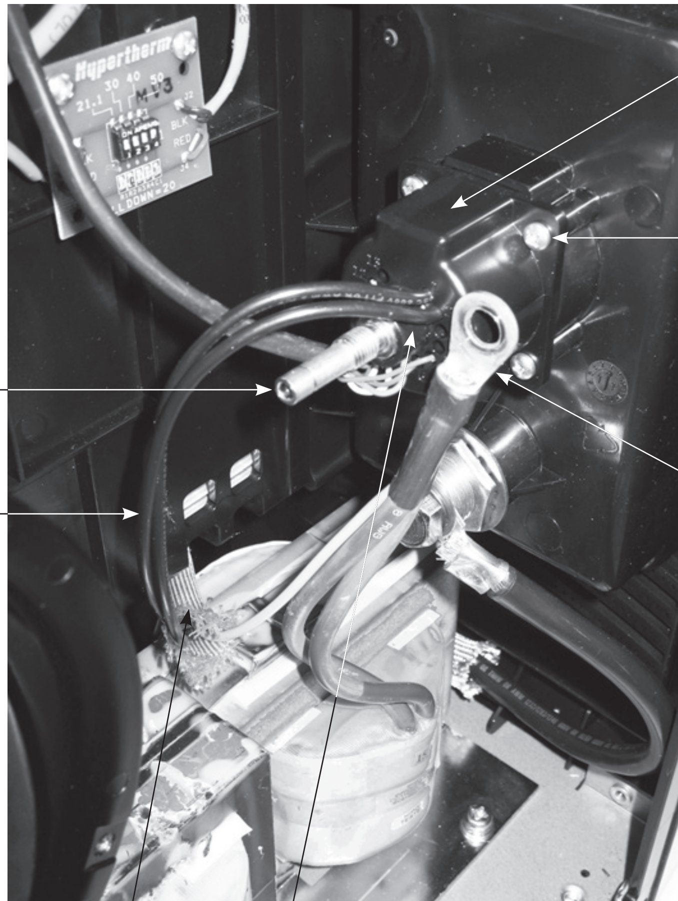
1. Unplug the wire connector from the J17 power board socket.
2. Disconnect the nozzle wires by removing the screw that secures the ring terminal to the power board.



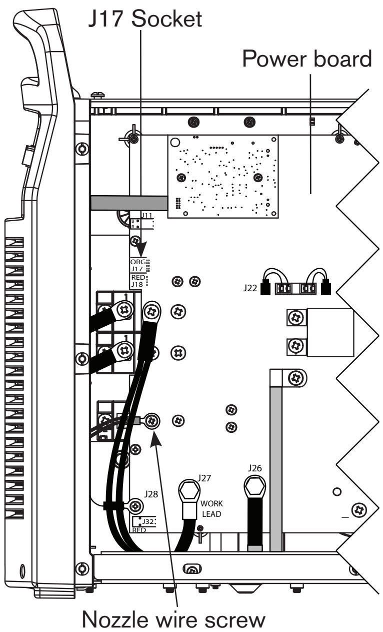
3. Pull the torch interface cable, from the fan side, through the upper grommet.
4. Pull the nozzle wires, from the fan side, through the protective sheathing that passes through the center panel.

5. Disconnect the 90° push-to-connect fitting by pushing in the plastic ring (closest to the brass nut) and pulling the fitting away from the nut.
6. Disconnect the electrode wire and two output inductor wires by removing the brass nut that secures the ring terminal to the quick disconnect receptacle.

   Note: The electrode wire and two output inductor wires are captured in the same wire connector.
7. Remove the plastic washer.

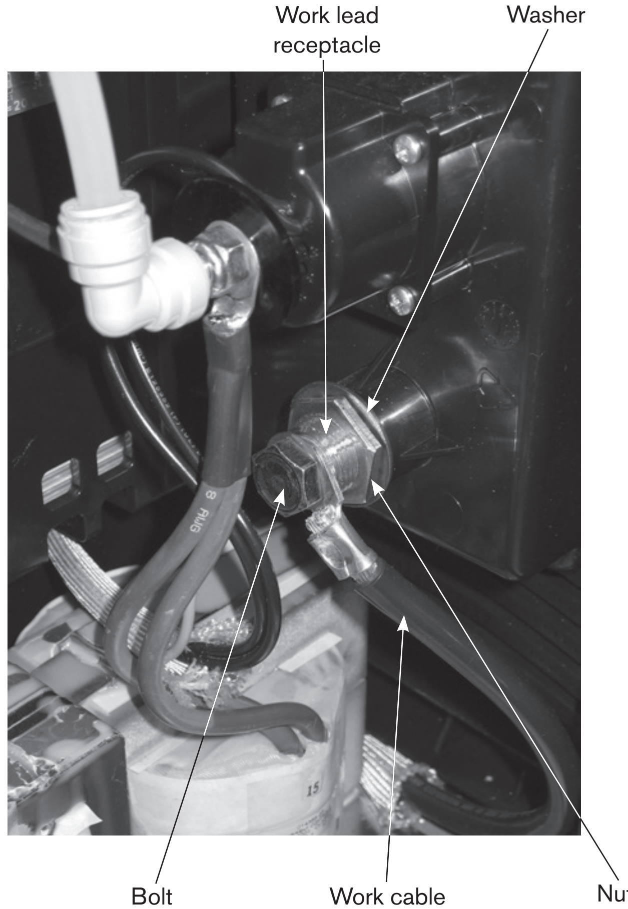


8. Remove the brass fitting by pushing it out through the front of the quick disconnect receptacle housing.
9. Remove the quick disconnect receptacle by removing the four mounting screws that secure the quick disconnect receptacle to the front end panel.
10. Secure the new quick disconnect receptacle to the front end panel by tightening the four supplied mounting screws to 23 kg cm (20 in.-lbs).
11. Insert the small end of the new brass fitting, from the front of the power supply, into the center hole of the quick disconnect receptacle until fully seated.
12. Install the plastic washer over the brass fitting and the plastic hub on the rear of the quick disconnect receptacle.
13. Place the ring terminal over the brass fitting and tighten the new brass nut onto the brass fitting. Tighten the nut to 46.1 kg cm (40 in.-lbs).
14. Push the 90° push-to-connect fitting onto the brass fitting until fully seated.
15. Route the nozzle wires through the protective sheathing in the center panel.
16. Route the torch interface cable through the upper grommet.

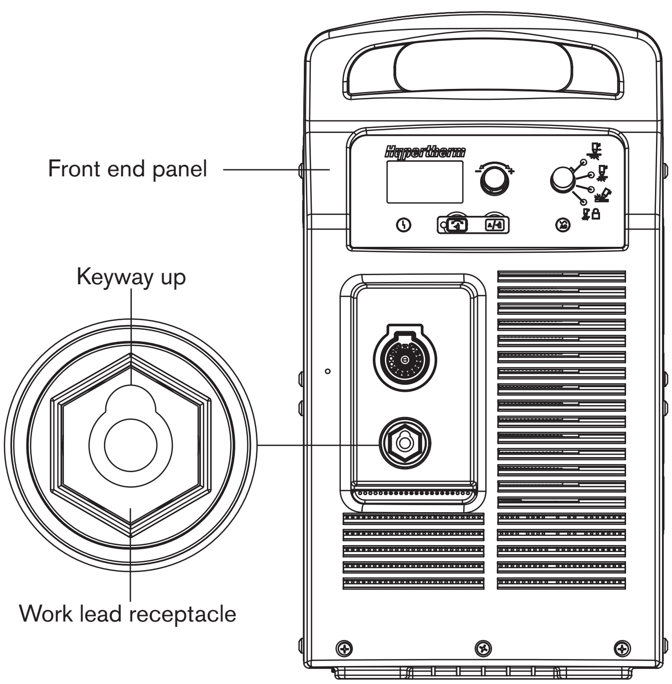


17. Secure the nozzle wires ring terminal to the power board by tightening the screw to 23 kg cm (20 in.-lbs).
18. Plug the torch interface cable connector into the J17 socket on the power board. Be sure to align the orange wire in the connector with the "ORG" that is printed on the power board.

Replace the work lead receptacle



1. Remove the bolt securing the work cable to the work lead receptacle.
2. Remove the nut and washer securing the work lead receptacle to the front end panel.
3. Push the work lead receptacle out through the front end panel.

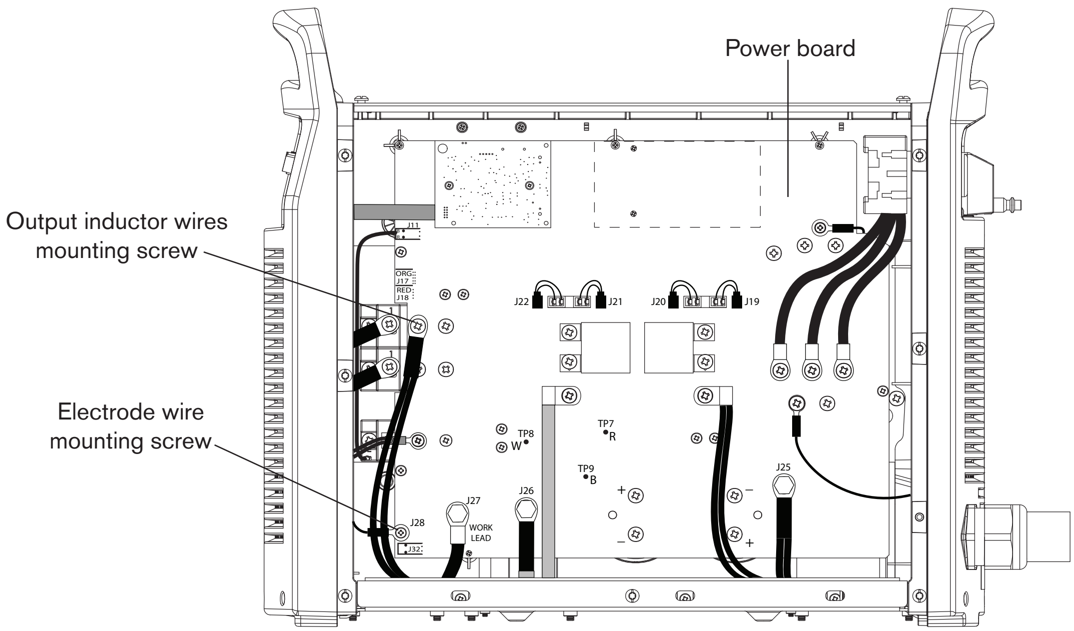


4. Push the threaded end of the new work lead receptacle into the opening in the front end panel, with the keyway facing up, until fully seated.
5. Place the washer over the work lead receptacle inside the power supply.
6. Tighten the nut onto the work lead receptacle.
7. Secure the work cable to the work lead receptacle by tightening the bolt.

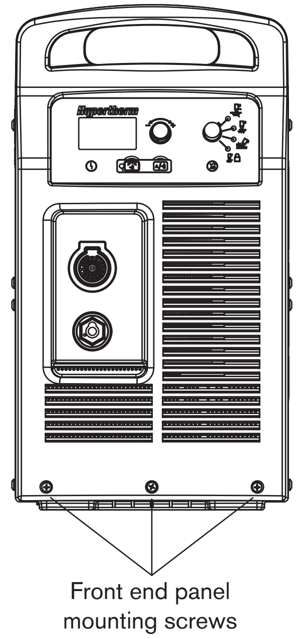
Replace the output inductor

1. Remove the screw at J28 that secures the electrode wire to the power board.
2. Remove the screw securing the output inductor wires to the power board.

   Note: The power board shown below is a 200-600 V CSA model. The connections for the output inductor wires and the electrode wire are the same for all models.

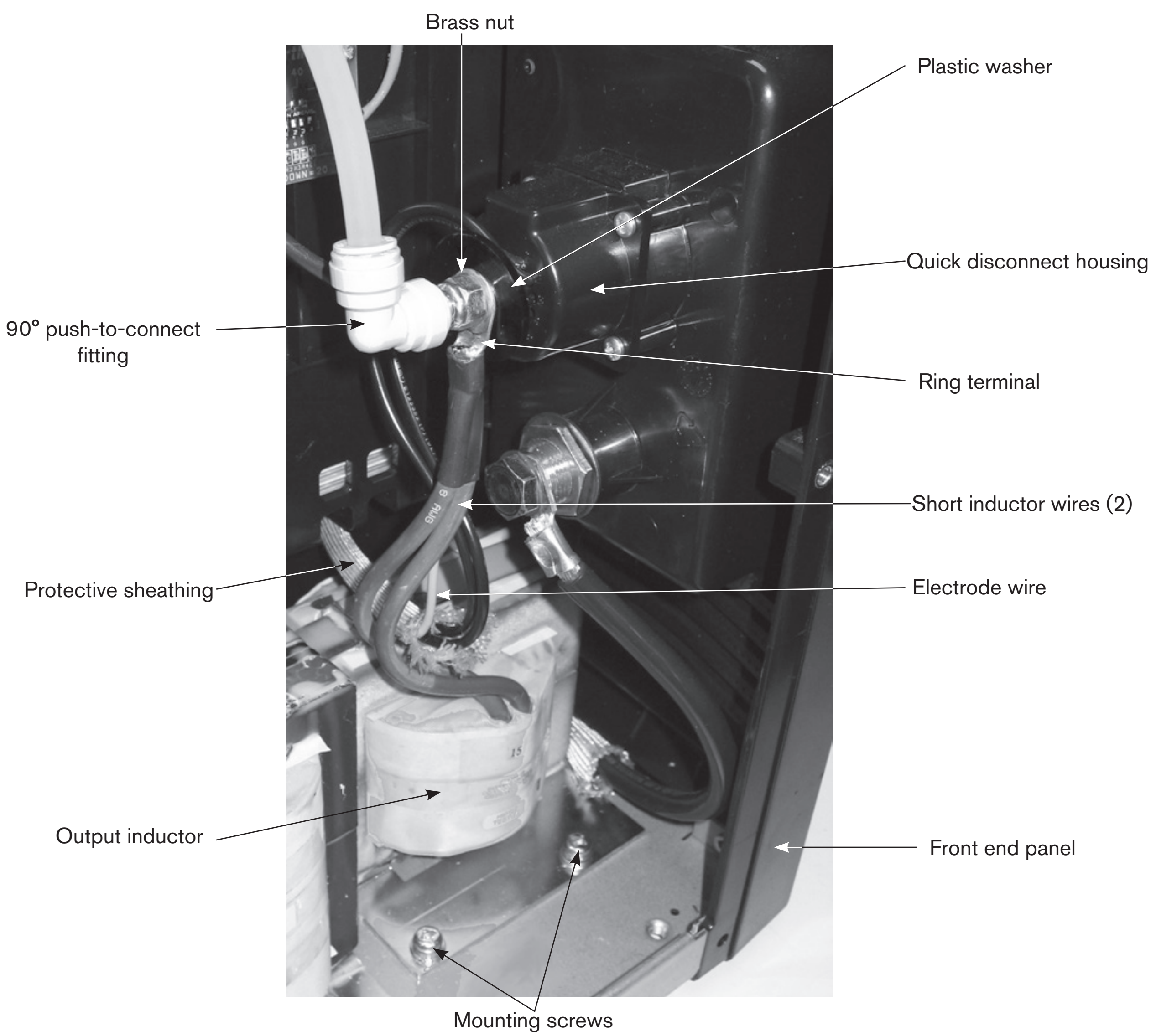


3. Remove the three mounting screws from the bottom of the front end panel.

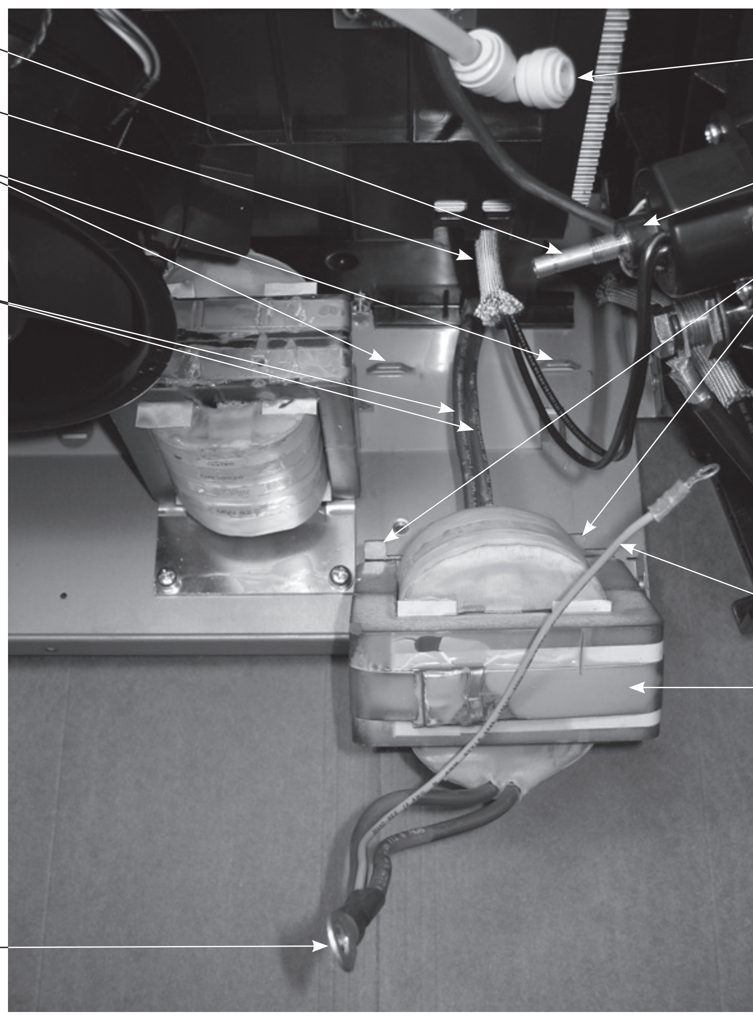


4. Disconnect the 90° push-to-connect fitting by pushing in the plastic ring (closest to the brass nut) and pulling the fitting away from the nut.
5. Disconnect the electrode wire and short inductor wires by removing the brass nut that secures the ring terminal to the quick disconnect housing.

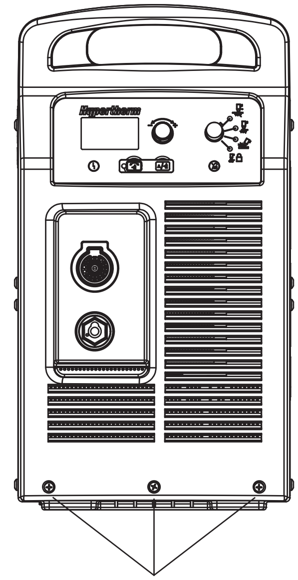
   Note: The electrode wire and short inductor wires are captured in the same wire connector.
6. Pull the electrode wire through the protective sheathing that passes through the center panel.
7. Carefully slide the front end panel a short distance away from the base of the power supply.
8. Remove the two mounting screws in the base of the output inductor.



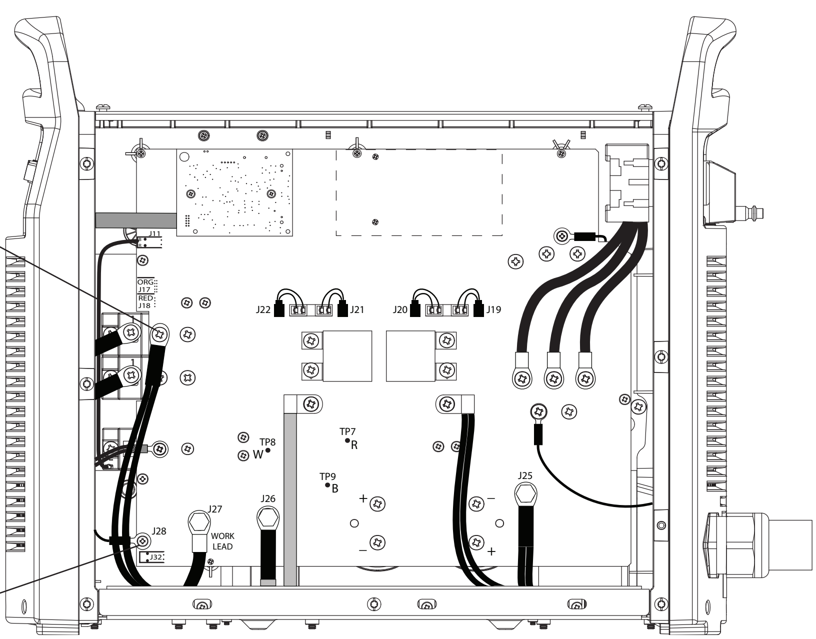
9. Lift the output inductor out of the power supply while guiding the long inductor wires through the opening in the bottom of the center panel.
10. Place the new output inductor in the power supply while guiding the long inductor wires through the opening in the bottom of the center panel.
11. Insert the tabs on the front of the output inductor in the slots in the base of the power supply.
12. Push the electrode wire through the protective sheathing that passes through the center panel.
13. Tighten the two supplied mounting screws in the base of the output inductor to 69.1 kg cm (60 in.-lbs).
14. Verify that the plastic washer is installed over the plastic hub on the rear of the quick disconnect receptacle.
15. Place the ring terminal over the brass fitting and tighten the nut onto the brass fitting. Tighten the nut to 46.1 kg cm (40 in.-lbs).
16. Push the 90° push-to-connect fitting onto the brass fitting until full seated.



17. Carefully slide the front end panel against the power supply base.
18. Tighten the three mounting screws in the bottom of the front end panel to 23 kg cm (20 in.-lbs).



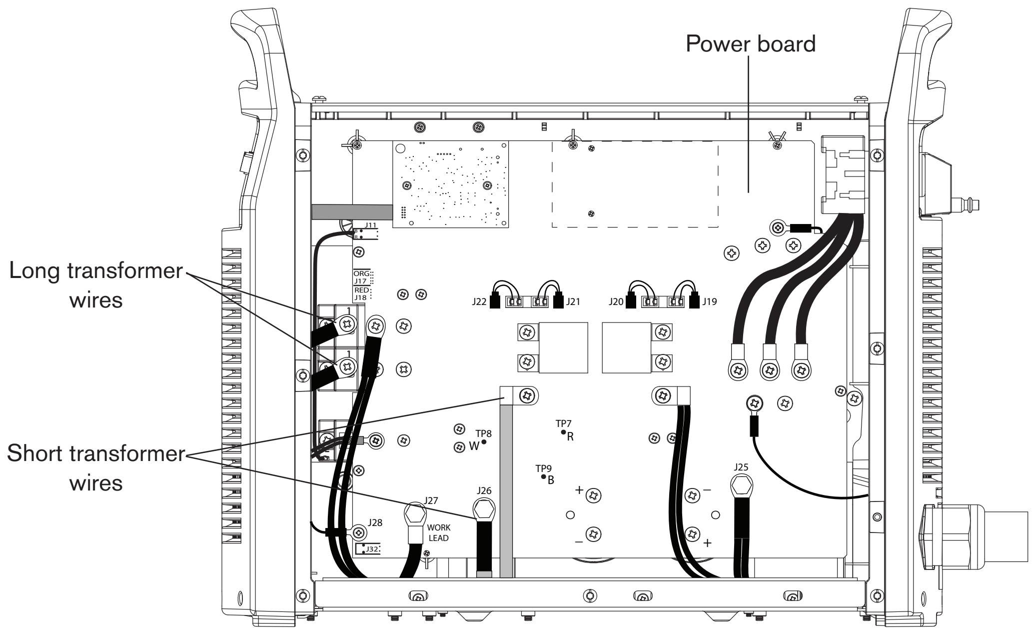
19. Secure the electrode wire to the power board at J28 by tightening the screw to 23 kg cm (20 in.-lbs).
20. Secure the output inductor wires to the power board by tightening the screw to 40.3 kg cm (35 in.-lbs).



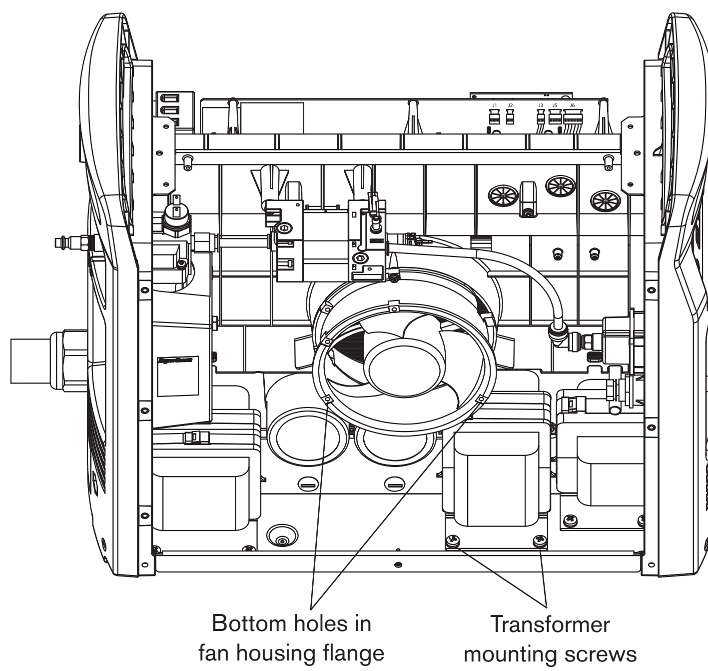
Replace the transformer

1. Remove the two screws securing the long transformer wires to the output diode bridge.
2. Remove the screw and bolt securing the short transformer wires to the power board.

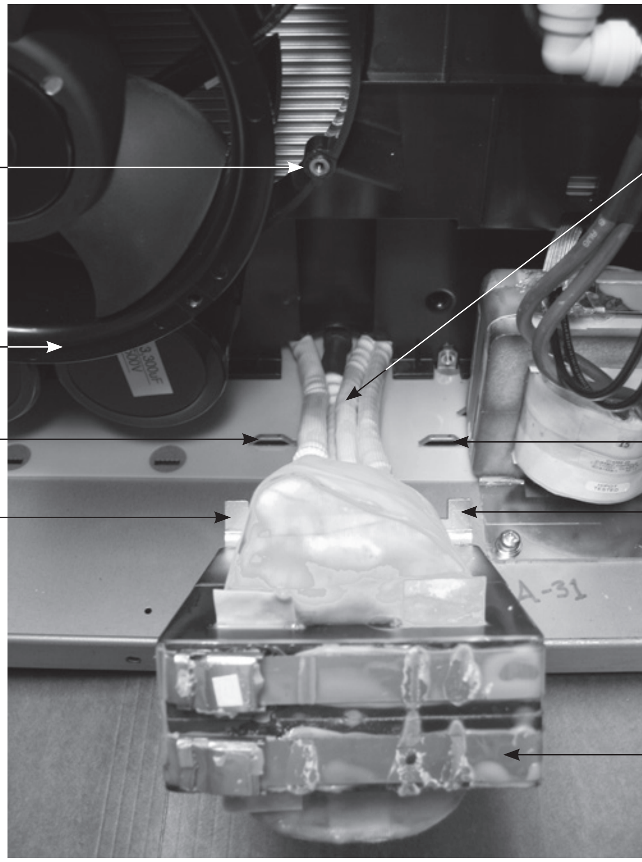
   Note: The power board shown below is a 200-600 V CSA model. The connections for the transformer wires are the same for all models.

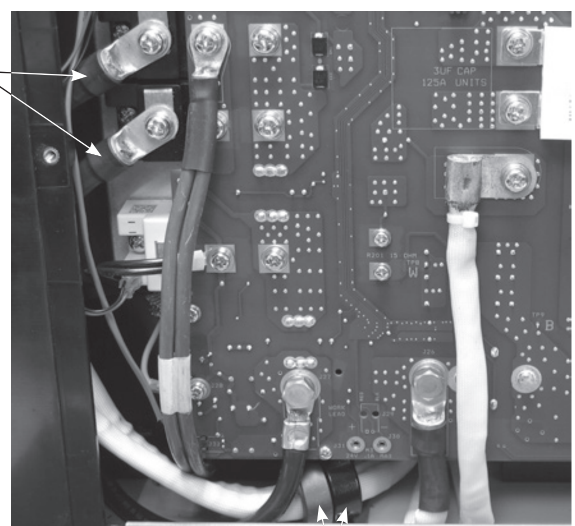


3. Remove the two mounting screws from the base of the transformer.
4. Remove the bottom two fan mounting screws. The screws are located directly behind the bottom holes in the fan housing flange.



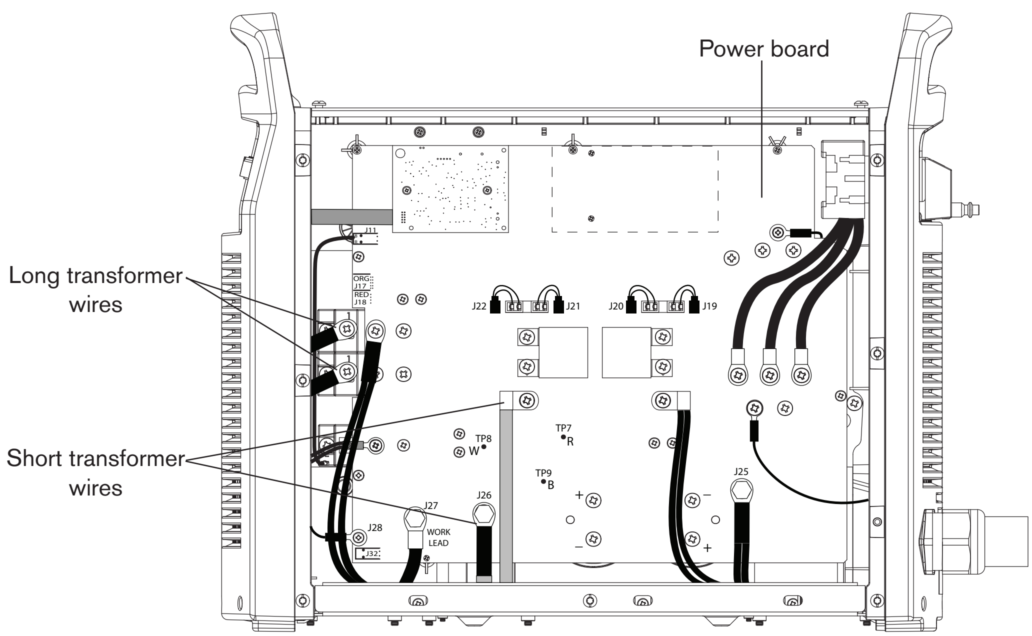
5. Push the bottom of the fan to the left, so that it will not interfere with the removal of the transformer.
6. Lift the transformer out of the power supply, while carefully guiding the transformer wires through the opening in the bottom of the center panel.





Note: CE and CCC models have two ferrite cores installed over the long transformer wires, on the power board side, that must be removed while removing the transformer from the power supply.

7. Place the new transformer in the power supply, while guiding the transformer wires through the opening in the bottom of the center panel.
8. Slide the tabs on the front of the transformer into the slots in the base of the power supply.
9. Tighten the two supplied mounting screws in the base of the transformer to 69.1 kg cm (60 in.-lbs).
10. Align the two bottom fan holes with the corresponding holes in the center panel.
11. Tighten the two fan mounting screws to 23 kg cm (20 in.-lbs).
12. If the power supply is a CE or CCC model, install the two ferrite cores over the long transformer wires, on the power board side.
13. Secure the long transformer wires to the output diode bridge by tightening the screws to 40.3 kg cm (35 in.-lbs).
14. Secure the short transformer wires to the power board using the screw and bolt removed in an earlier step. Tighten the screw to 40.3 kg cm (35 in.-lbs) and the bolt at J26 to 63.4 kg cm (55 in.-lbs).



Replace the PFC inductor

1. Refer to the applicable figure that follows and remove the screw and bolt securing the PFC inductor wires to the power board.

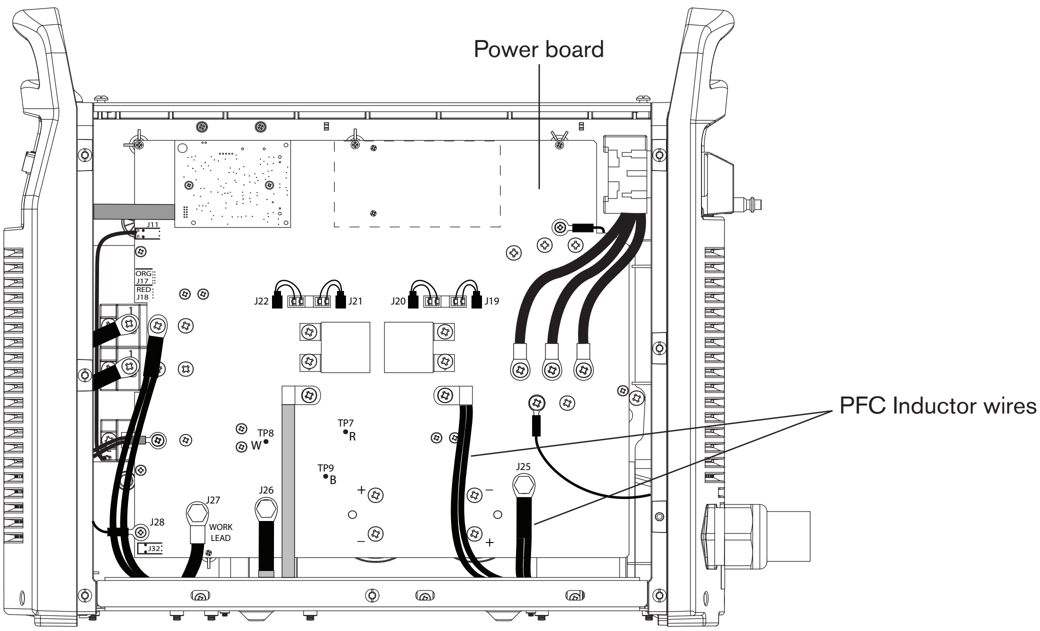


Figure 1 - 200-600 V CSA model

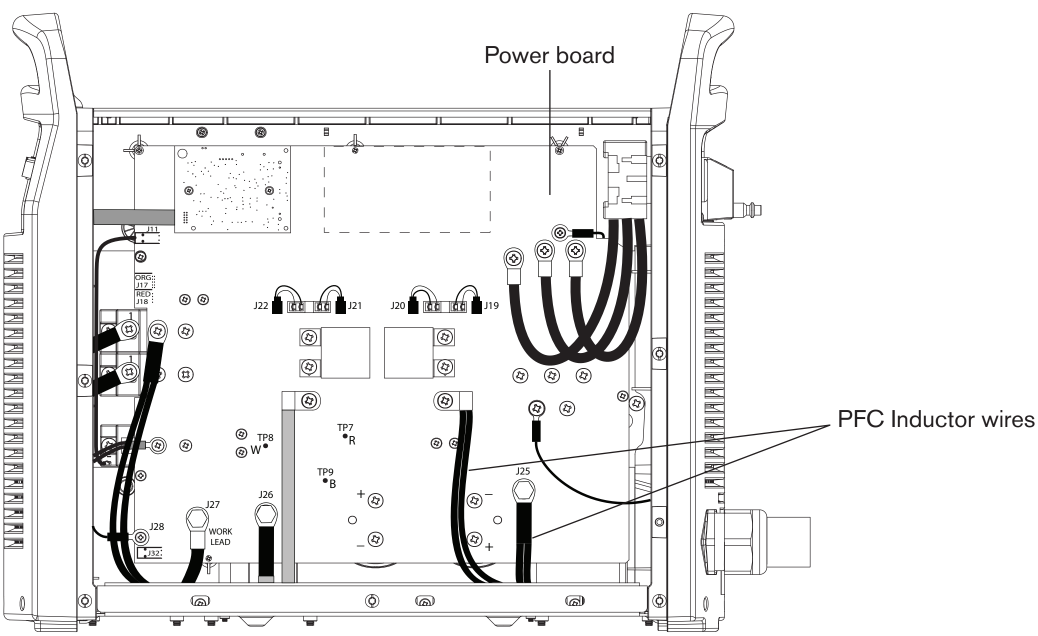


Figure 2 - 230-400 V CE, 380 V CCC/230-400 V CE models

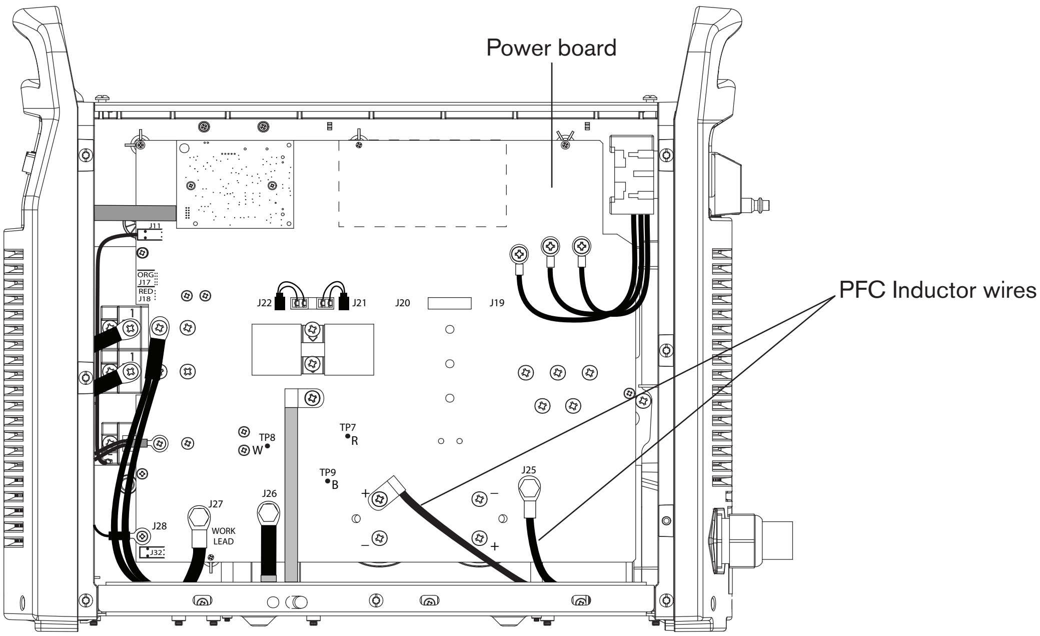
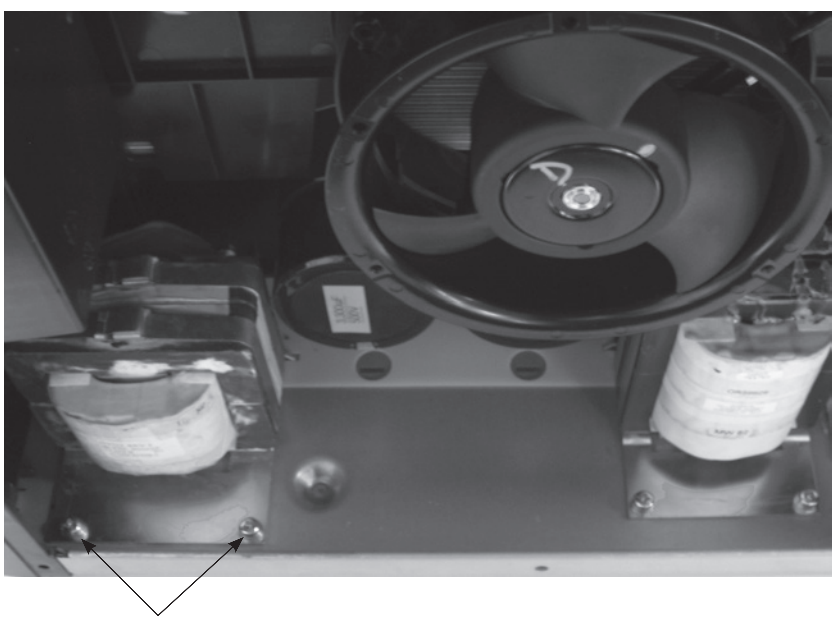


Figure 3 - 380 V CCC and 400 V CE models

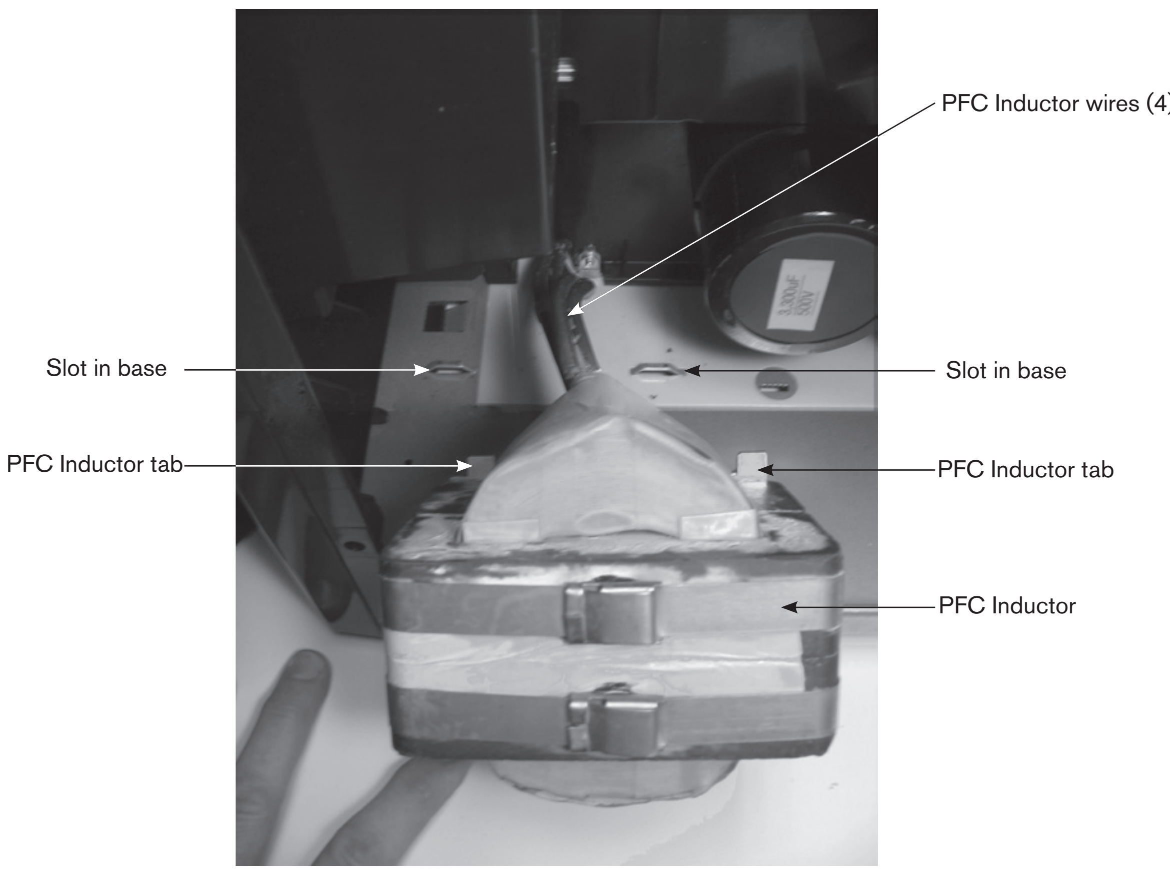
2. Remove the two mounting screws from the base of the PFC inductor.



3. Lift the PFC inductor out of the power supply, while carefully guiding the PFC inductor wires through the opening in the bottom of the center panel.

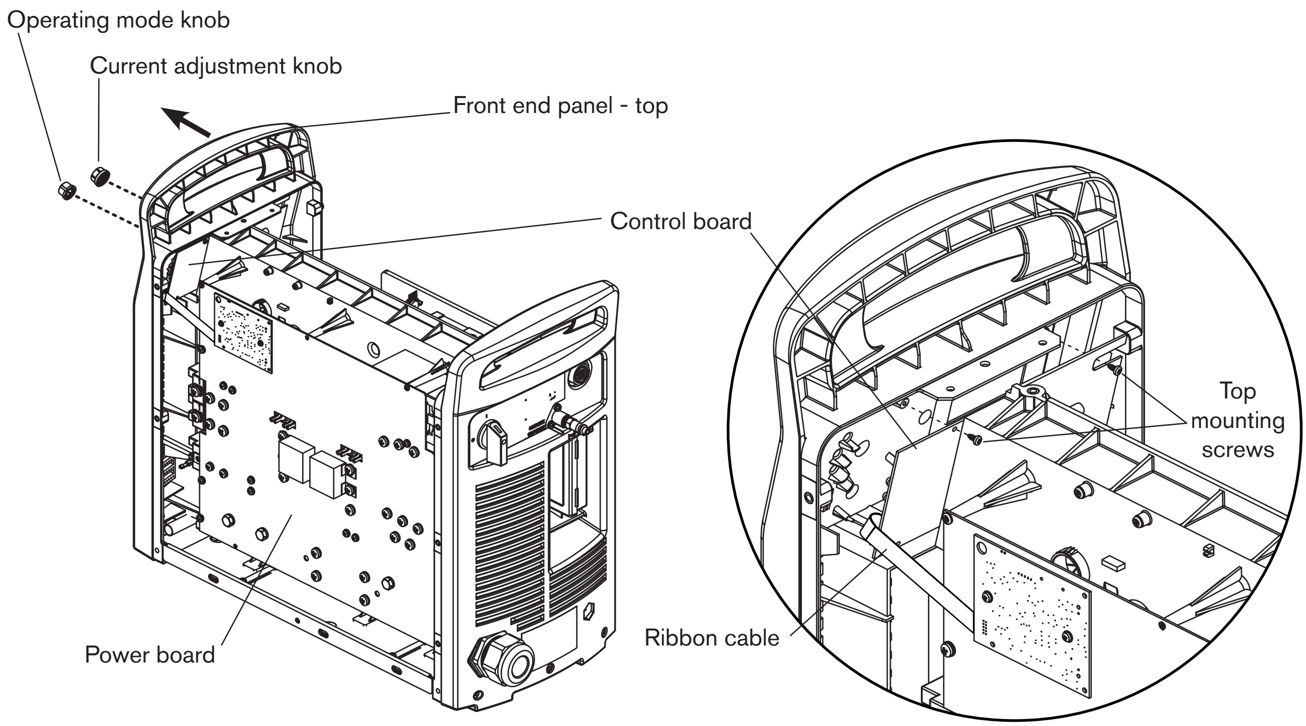
   Note: 230-400 V CE and 380 V CCC/230-400 V CE models have a ferrite core installed over the longer PFC inductor wires, on the power board side, that must be removed while removing the PFC inductor from the power supply.

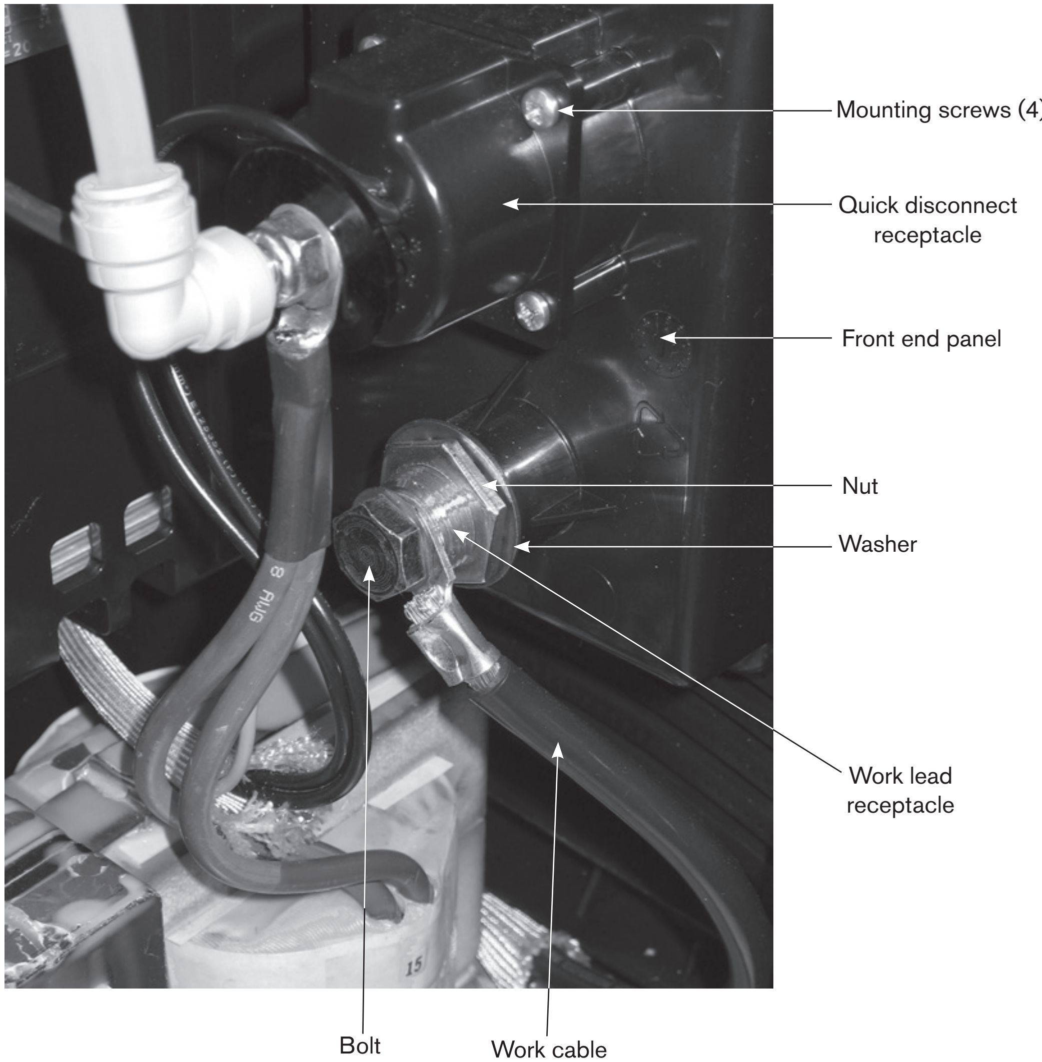
4. Place the new PFC inductor in the power supply, while guiding the PFC inductor wires through the opening in the bottom of the center panel.
5. Slide the tabs on the front of the PFC inductor into the slots in the base of the power supply.
6. Tighten the two supplied mounting screws in the base of the PFC inductor to 69.1 kg cm (60 in.-lbs).
7. If the power supply is a 230-400 V CE or 380 V CCC/230-400 V CE model, install the ferrite core over the longer PFC inductor wires on the power board side of the power supply.
8. Secure the PFC inductor wires to the power board using the screw and bolt removed in an earlier step, while referring to the applicable figure on the previous two pages. Tighten the screw to 40.3 kg cm (35 in.-lbs) and the bolt at J25 to 63.4 kg cm (55 in.-lbs).



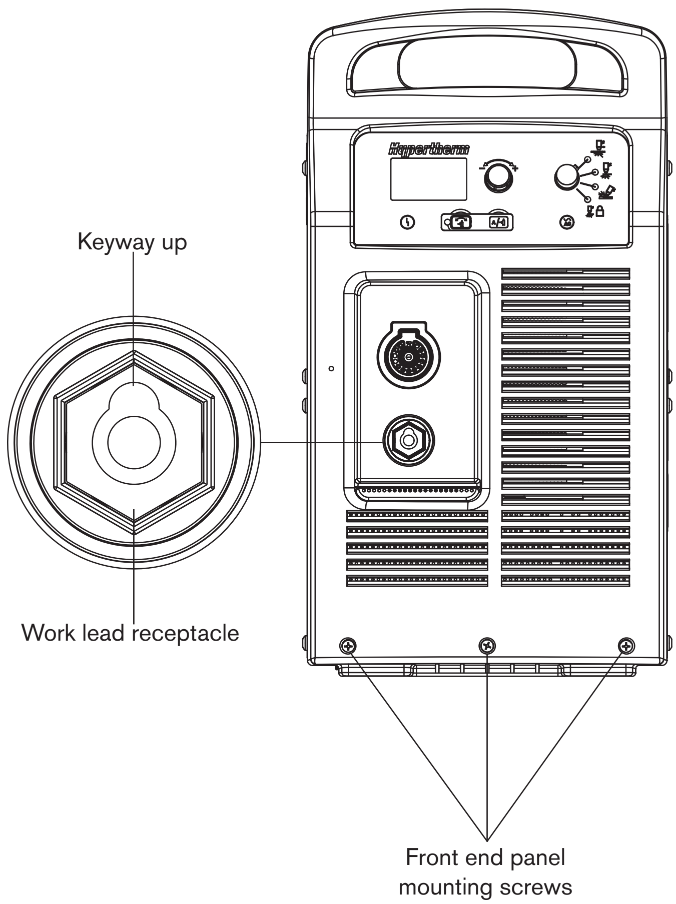
Replace the front end panel

1. Remove the current adjustment knob and operating mode switch knob from the front end panel by pulling them straight off their respective post.
2. Carefully pull the top of the front end panel away from the power supply. The front panel is still attached to the bottom of the power supply and can only move a short distance.
3. 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 (not shown) is installed in the middle of the control board along the bottom edge.
4. Carefully slide the control board from behind the front end panel toward the power board side of the power supply.
5. Disconnect the ribbon cable from the control board and set aside the control board.

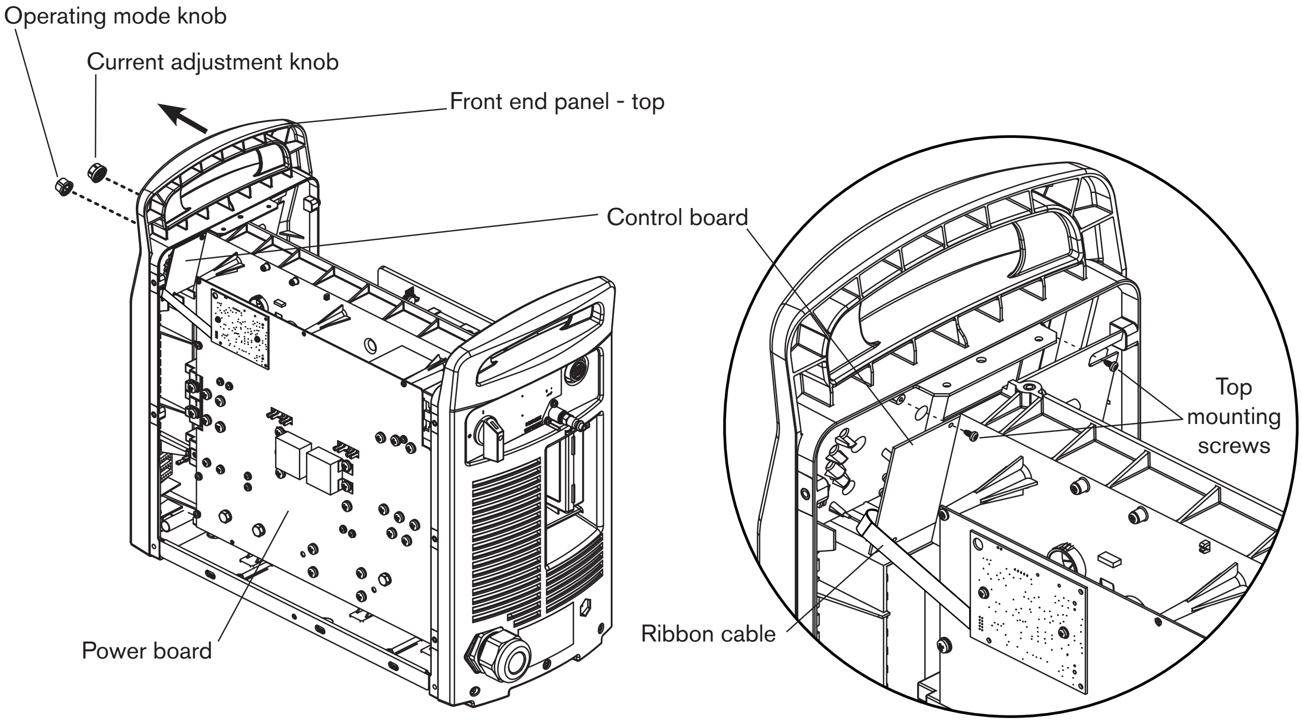




6. Disconnect the quick disconnect receptacle from the front end panel by removing the four mounting screws.
7. Remove the bolt securing the work cable to the work lead receptacle.
8. Remove the nut and washer securing work lead receptacle to the front end panel.
9. Push the work lead receptacle out through the front end panel.



10. Remove the three front end panel mounting screws.
11. Remove the front end panel from the power supply.
12. Align the new front end panel with the power supply and tighten the three supplied mounting screws to 23 kg cm (20 in.-lbs).
13. Insert the threaded end of the work lead receptacle in the front end panel, making sure that the keyway is facing up.
14. Place the washer over the work lead receptacle and tighten the nut onto the work lead receptacle.
15. Secure the work cable to the work lead receptacle by tightening the bolt.
16. Secure the quick disconnect to the front end panel by tightening the four mounting screws to 23 kg cm (20 in.-lbs).



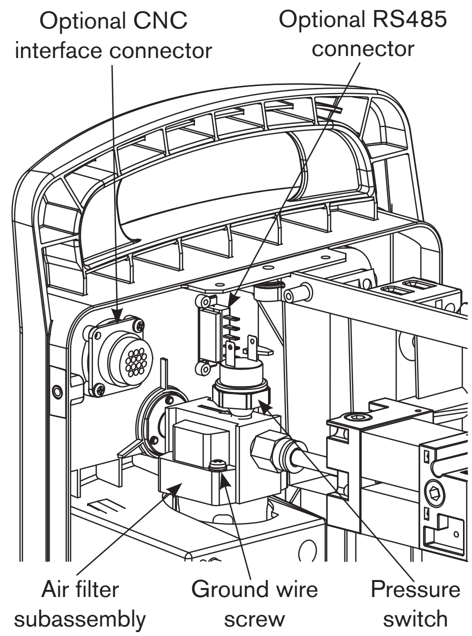
17. Plug the ribbon cable into the J6 connector on the control board.
18. Carefully pull the top of the front end panel away from the power supply and slide the control board into place.
19. Tighten the three board mounting screws to 8.1 kg cm (7 in.-lbs).
20. Align the inside flat edge of the operating mode switch knob (with the white line) with the flat side of the control board post and push the knob straight onto the post.
21. Align the inside flat edge of the current adjustment knob with the flat side of the control board post and push the knob straight onto the post.

Replace the rear end panel

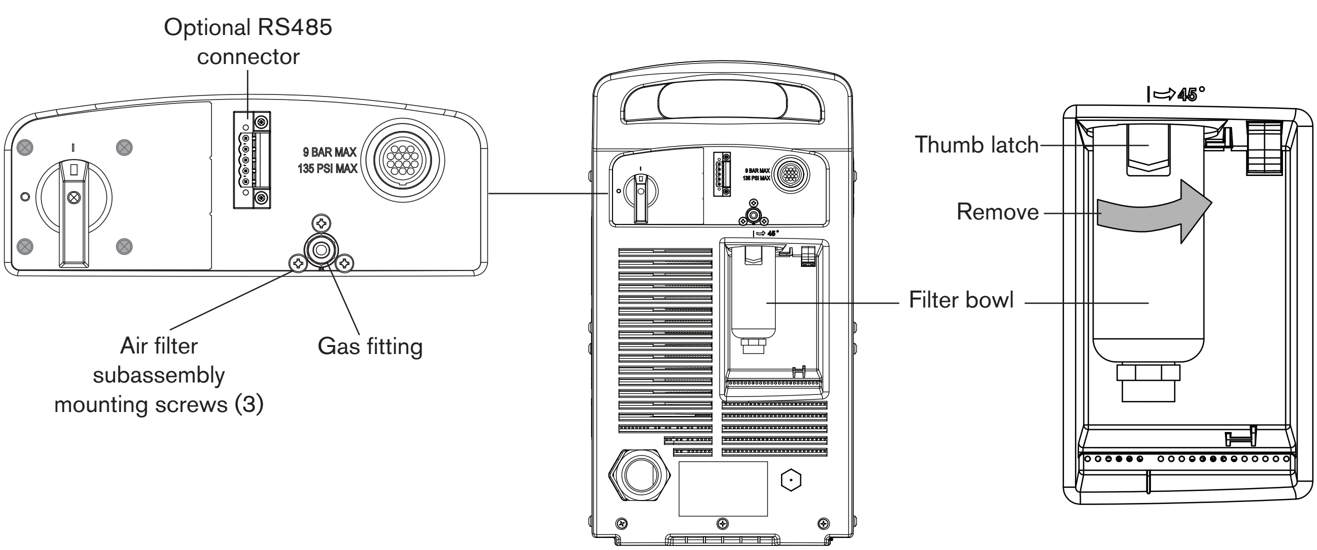
1. Remove the screw securing the ground wire(s) to the air filter housing.

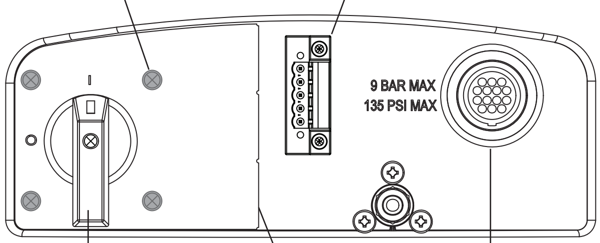
   Note: There will be two ground wires if the optional CNC interface connector is installed in the rear panel.

2. Unplug the two wire connectors from the terminals on top of the pressure switch.
3. If the optional CNC interface is installed, remove the two mounting screws securing it to the rear end panel.
4. Remove the air filter bowl. See page 9-17 for details.
5. Remove the gas fitting from the rear panel.
6. Remove the three air filter assembly mounting screws.
7. Lift the air filter assembly out of the power supply.
8. If the optional RS485 connector is installed, remove it by unplugging the five wires from the connector terminals inside the power supply and removing the two mounting screws from the rear end panel.

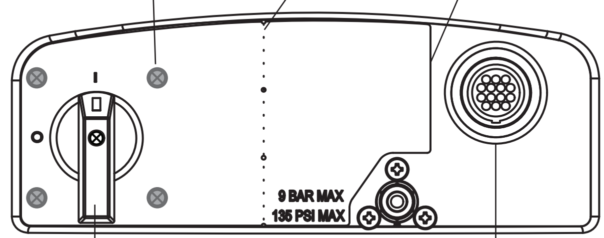


9. Remove the handle screw that secures the power switch handle to the post.
10. Pull the power switch handle straight off the post.
11. Pry up the right edge of the power switch label. If the optional RS485 connector is *not* installed, the label extends to the right side of the inlet gas fitting.



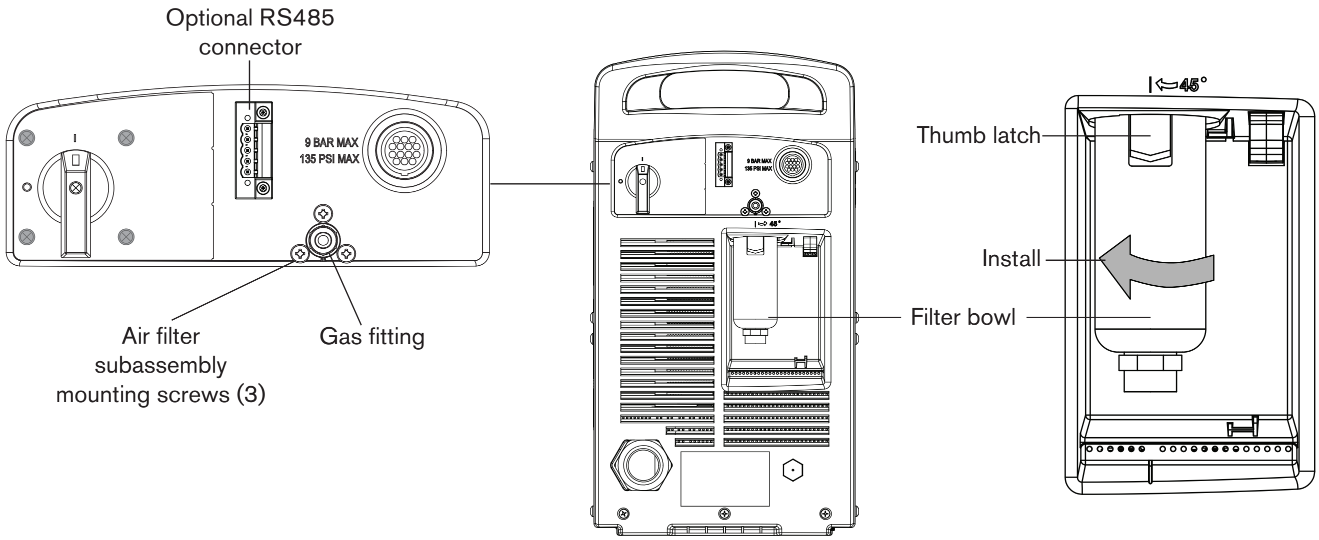


RS485 connector installed



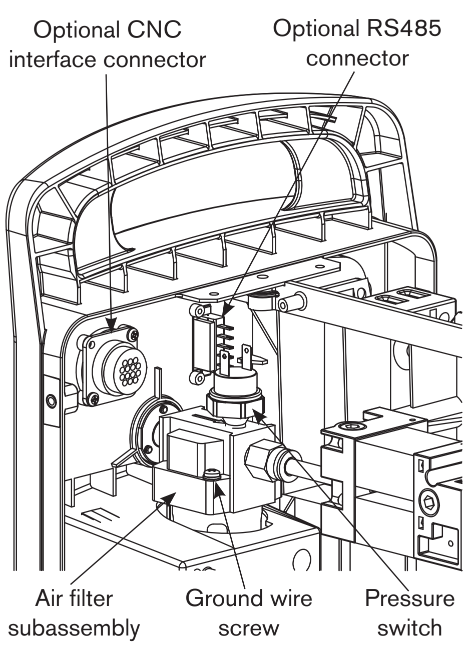
RS485 connector not installed

12. Peel off the entire label to expose the four mounting screws that secure the power switch to the rear end panel.
13. Disengage the power switch from the rear end panel by removing the four mounting screws.
14. Remove the rear end panel.
15. Align the mounting holes in the new rear end panel with the corresponding holes in the power switch.
16. Secure the power switch to the rear end panel by tightening the four mounting screws to 17.3 kg cm (15 in.-lbs).
17. If the RS485 connector is installed, bend and tear the new label at the perforation.
18. Peel the backing off the new label and affix to the rear end panel, being careful to align the hole in the label with the corresponding hole in the rear end panel.
19. Push the power switch handle straight onto the post and tighten the handle screw to 11.5 kg cm (10 in.-lbs).
20. If removed in an earlier step, secure the RS485 connector to the rear end panel by tightening the two mounting screws to 11.5 kg cm (10 in.-lbs).
21. Install the air filter assembly. See page 9-64 for details.
22. Install the filter element and filter bowl onto the air filter assembly. See page 9-18 *Identify the air filter assembly model* for details.



23. If disconnected in an earlier step, connect the wires to the RS485 connector terminals, starting from the top, in the following order: red - black - brown - white - green.
24. Connect the two wires to the pressure switch wire terminals.
25. If removed in an earlier step, secure the CNC interface connector to the rear end panel by tightening the two mounting screws to 11.5 kg cm (10 in.-lbs).
26. Secure the ground wire(s) to the air filter housing by tightening the ground wire screw to 11.5 kg cm (10 in.-lbs).

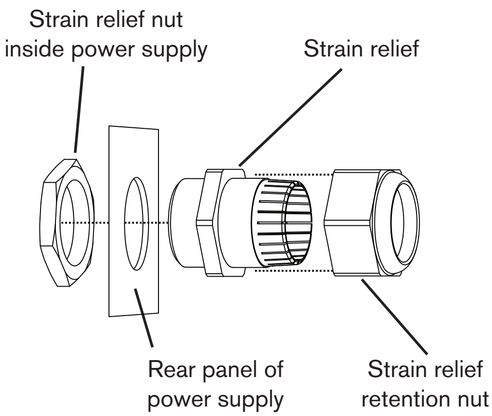
    Note: There will be two ground wires if the optional CNC interface connector is installed in the rear panel.



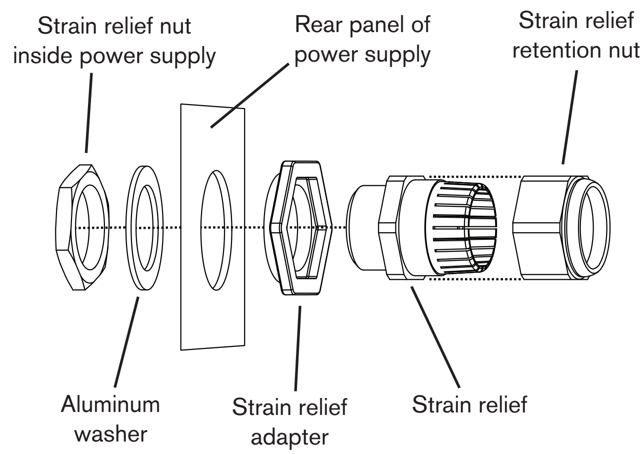
Install the strain relief connector

1. Install the strain relief connector parts referring to the applicable figure below.

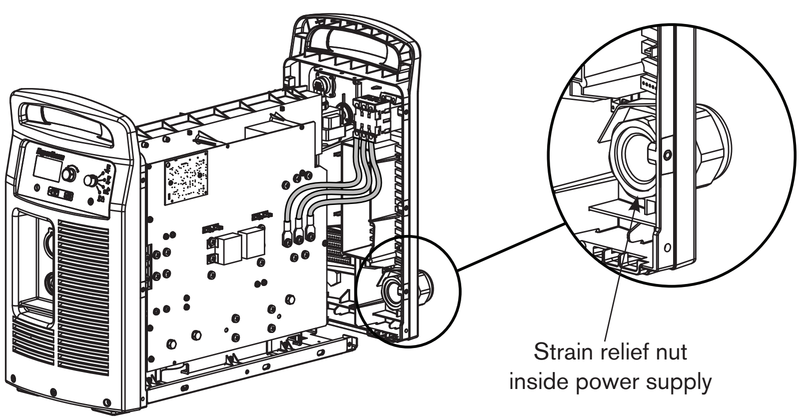
200-600 V CSA, 230-400 V CE, 380 V CCC/230- 400 V CE Strain relief



380 V CCC and 400 V CE Strain relief



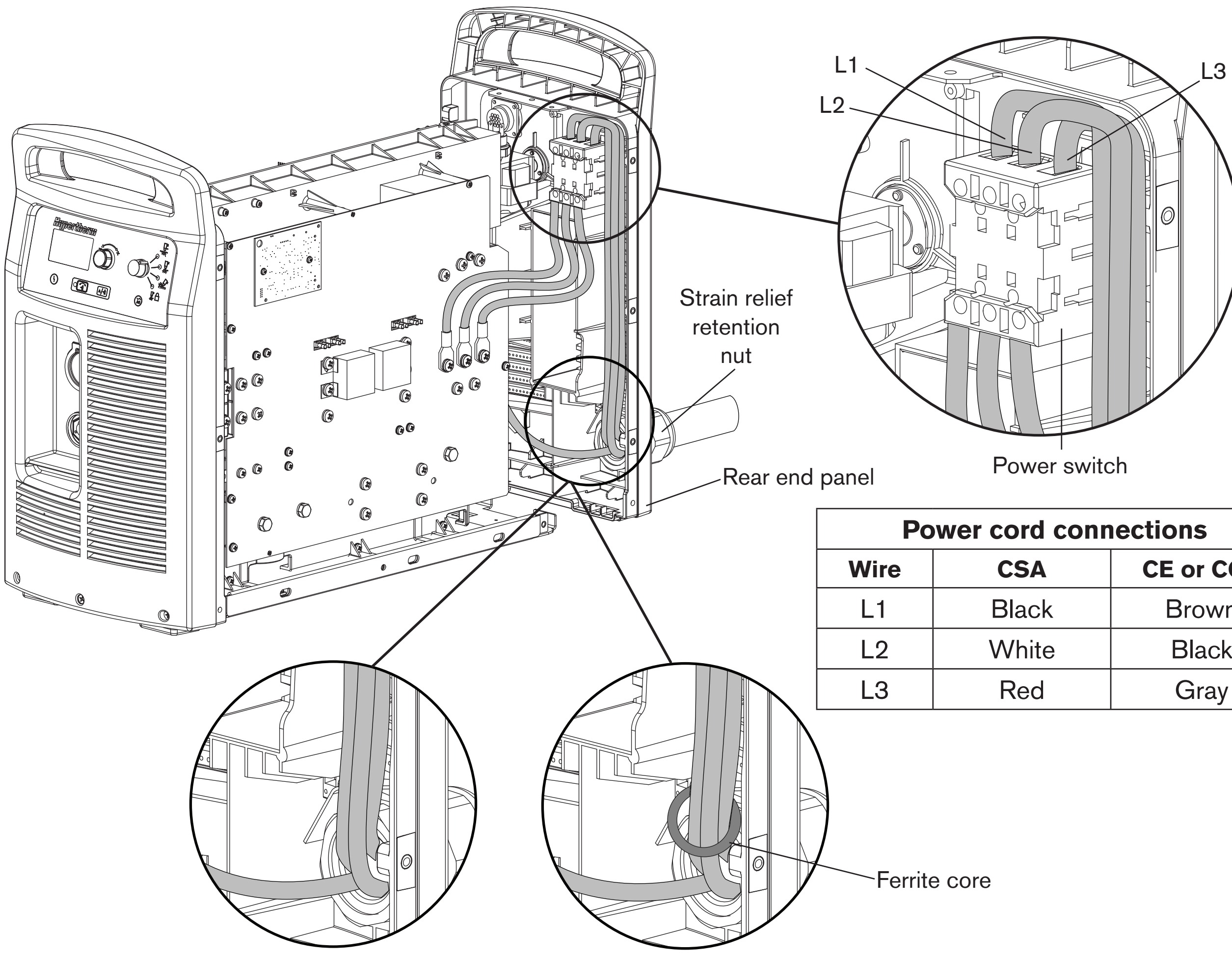
2. Tighten the strain relief nut to secure the strain relief connector to the power supply.



Install the power cord

1. Loosen the strain relief retention nut on the strain relief connector.
2. Slide the power cord through the strain relief connector.

   Note: CE power cords must be pushed through the strain relief connector from inside the rear end panel, because of the ferrite core installed on the three power wires.
3. Route the three power wires up the chase inside the rear end panel to the top of the power switch.
4. Insert the three wires in the top of the power switch, in the same order as they were removed, and tighten the three set screws to 23 kg cm (20 in.-lbs).
5. Tighten the strain relief retention nut.
6. Slide the rear end panel against the power supply chassis.

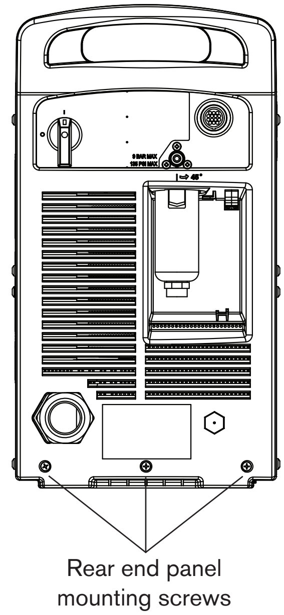


CSA and CCC Power cord

CE Power cord

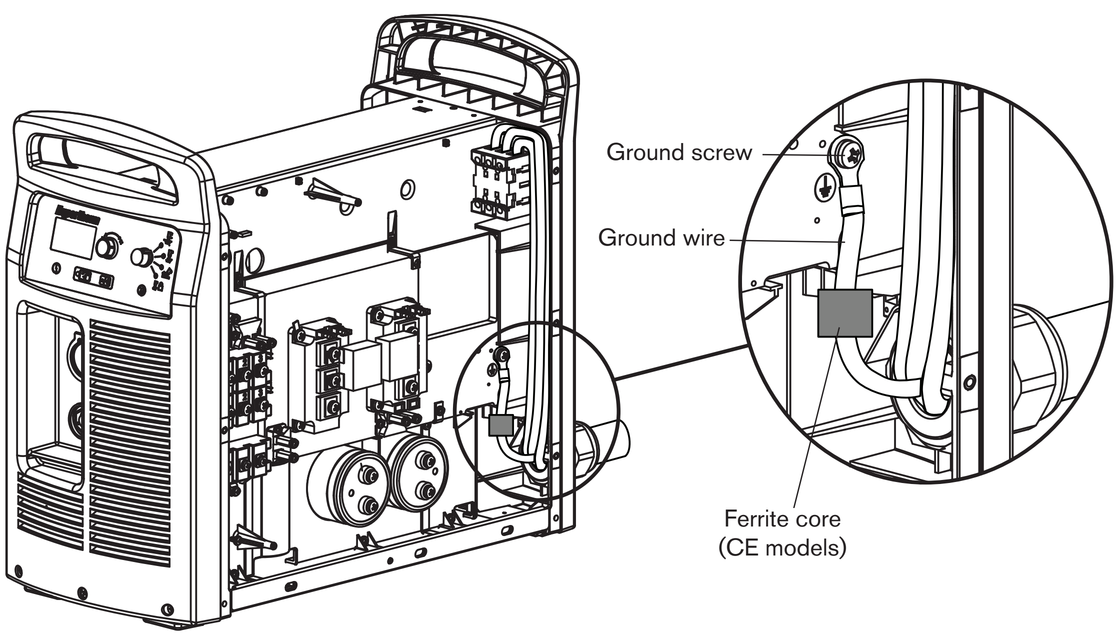
Power cord connections		
Wire	**CSA**	**CE or CCC**
L1	Black	Brown
L2	White	Black
L3	Red	Gray

7. Tighten the three supplied mounting screws in the bottom of the rear end panel to 23 kg cm (20 in.-lbs).



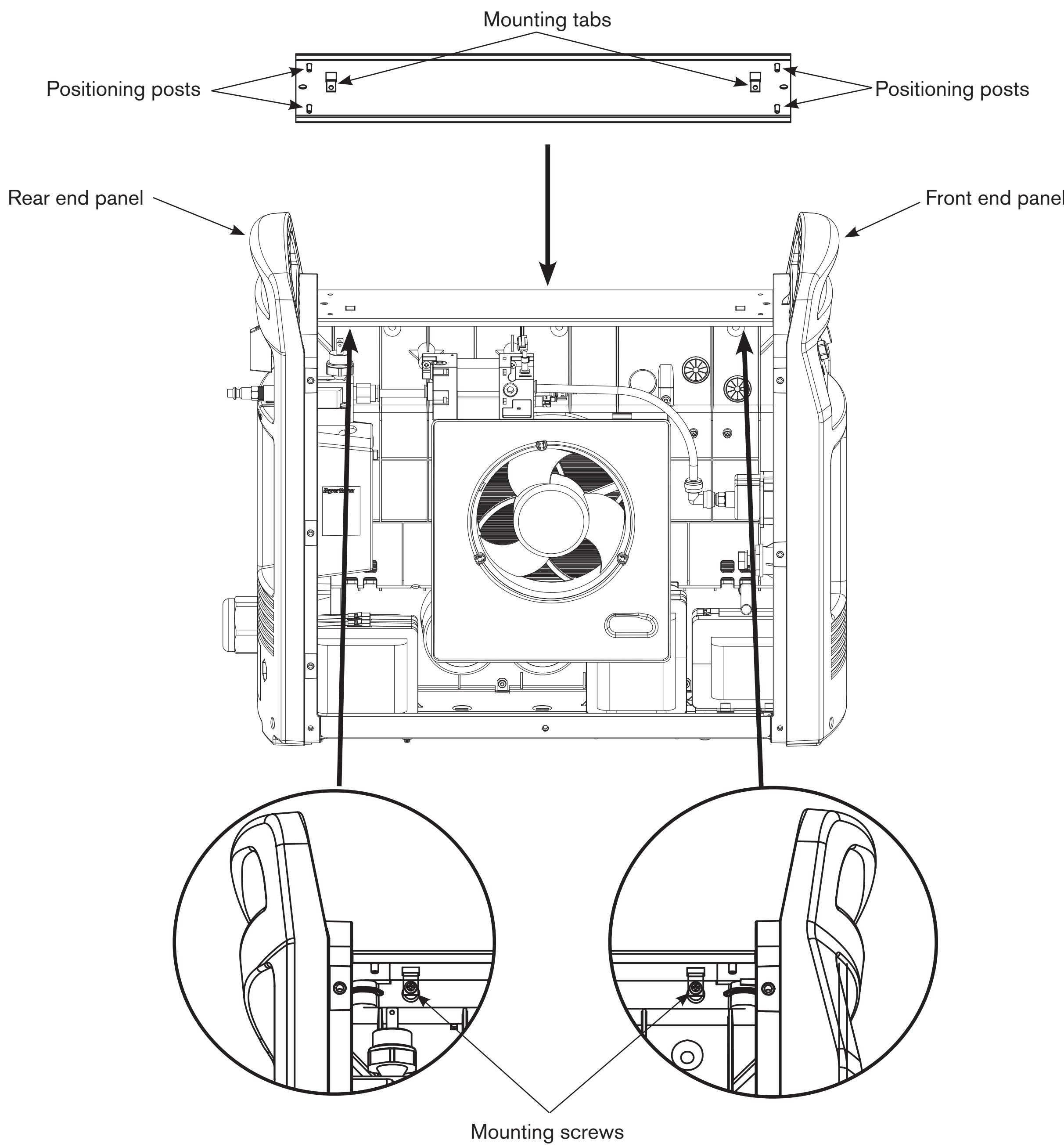
8. Secure the ground wire to the heat sink by tightening the ground screw to 23 kg cm (20 in.-lbs).

   Note: The power board is removed to show the ground wire connection on the heat sink.



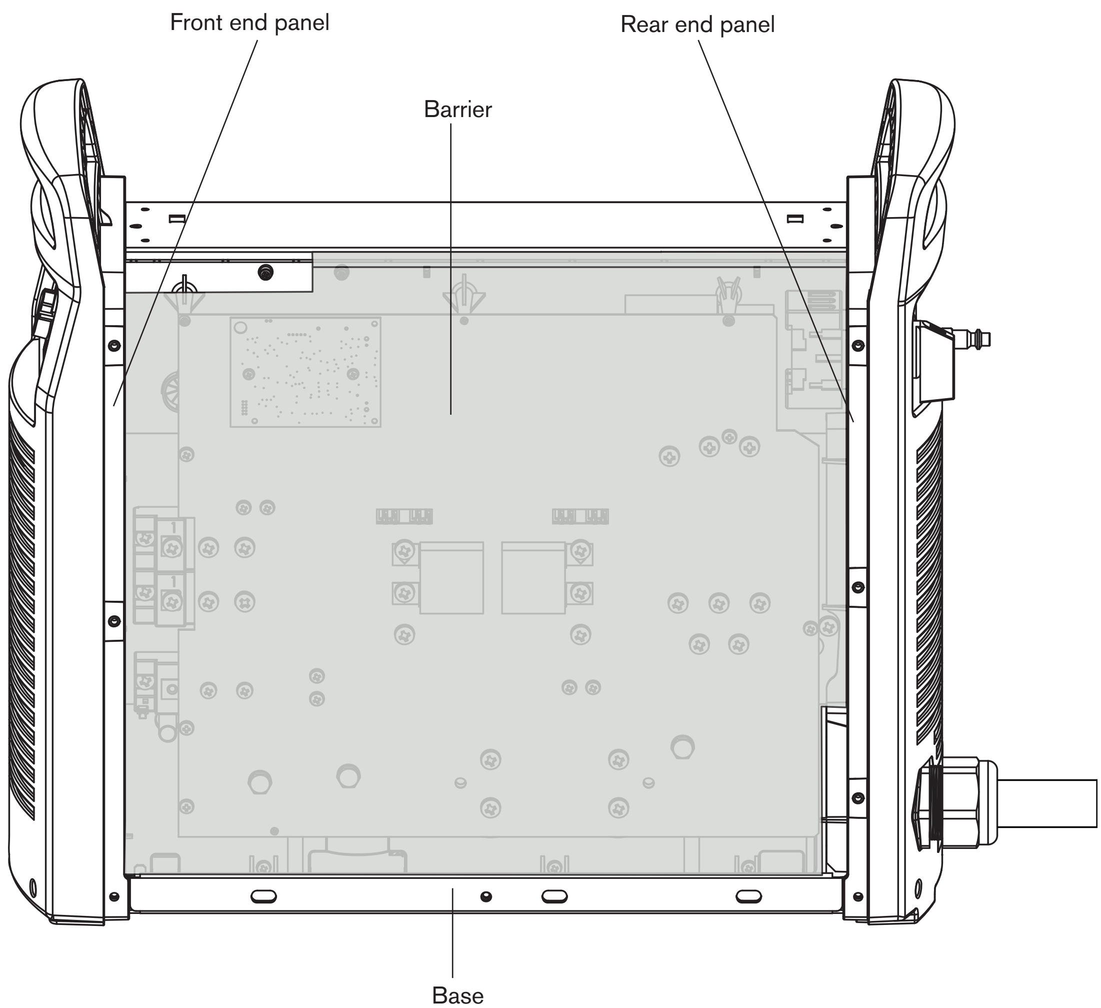
Install the end panel bracket

1. Align the end panel bracket positioning posts with the holes in the top of the front and rear end panels. Make sure the end panel bracket mounting tabs are positioned on the fan side of the power supply.
2. Push the end panel bracket straight down onto the power supply.
3. Tighten the two end panel bracket mounting screws to 11.5 kg cm (10 in.-lbs).



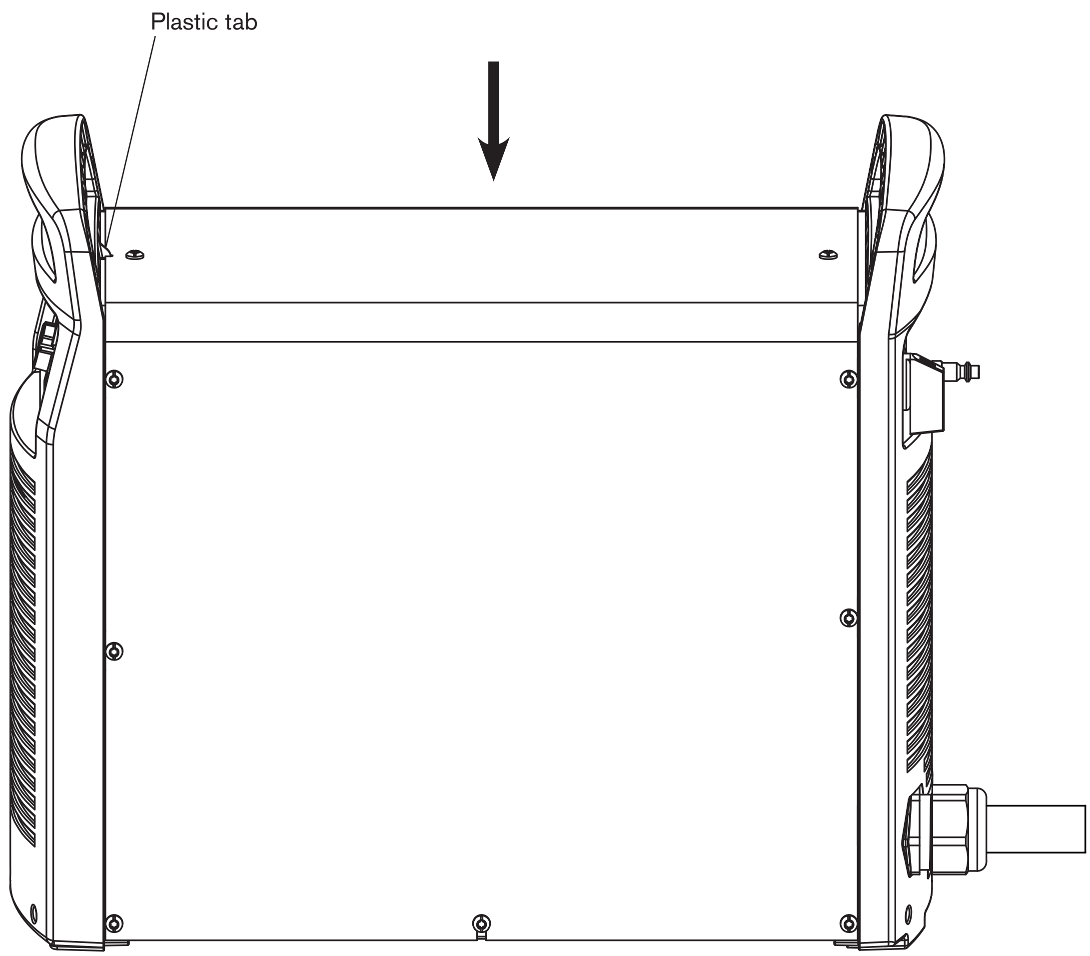
Install the component barrier

1. Slide the side and bottom edges of the component barrier behind the end panel edges and the base.
2. Bend the top of this barrier at the perforation and place over the top of the power board.



Install the power supply cover

1. Place the cover over the power supply, aligning the slot in the top of the cover with the plastic tab in the front end panel. The slot and tab ensure that the vent in the side of the cover is over the fan.
2. Tighten the 16 screws in the sides and top of the cover to 17.3 kg cm (15 in.-lbs).



Section 10

TORCH COMPONENT REPLACEMENT

In this section:

Hand torch: Replacing the start switch 10-2
Hand torch: Replacing the cap-sensor switch 10-2
Hand torch: Replacing the handles 10-2
Hand torch: Replacing the trigger 10-3
Hand torch: Replacing the torch body 10-3
Hand torch: Replacing the torch lead 10-3
Hand torch: Replacing the quick disconnect housing 10-4
Machine torch: Replacing the mounting sleeve 10-4
Machine torch: Replacing the cap-sensor switch 10-4
Machine torch: Replacing the torch body 10-4
Machine torch: Replacing the coupler 10-5
Machine torch: Replacing the gear rack 10-5
Machine torch: Replacing the positioning sleeve 10-5
Machine torch: Replacing the torch lead 10-6
Machine torch: Replacing the quick disconnect housing 10-6

Hand torch: Replacing the start switch

Kit # 128642

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Remove the left handle	10-8
☐	3.	Remove the trigger and spring	10-9
☐	4.	Replace the start switch	10-10
☐	5.	Install the trigger and spring	10-9
☐	6.	Install the left handle	10-8

Hand torch: Replacing the cap-sensor switch

Kit # 228719, 228109

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Remove the left handle	10-8
☐	3.	Remove the trigger and spring	10-9
☐	4.	Remove the start switch	10-10
☐	5.	Remove the right handle	10-11
☐	6.	Replace the cap-sensor switch	10-11
☐	7.	Install the right handle	10-14
☐	8.	Install the trigger and spring	10-9
☐	9.	Install the left handle	10-8

Hand torch: Replacing the handles

Kit # 228954, 228955

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Remove the left handle	10-8
☐	3.	Remove the trigger and spring	10-9
☐	4.	Remove the start switch	10-10
☐	5.	Remove the right handle	10-11
☐	6.	Install the right handle	10-14
☐	7.	Install the trigger and spring	10-9
☐	8.	Install the left handle	10-8

Hand torch: Replacing the trigger

Kit # 228721

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Remove the left handle	10-8
☐	3.	Remove the trigger and spring	10-9
☐	4.	Install the trigger and spring	10-9
☐	5.	Install the left handle	10-8

Hand torch: Replacing the torch body

Kit # 228958, 228957

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Remove the left handle	10-8
☐	3.	Remove the trigger and spring	10-9
☐	4.	Remove the start switch	10-10
☐	5.	Remove the right handle	10-11
☐	6.	Replace the torch body	10-12
☐	7.	Install the right handle	10-14
☐	8.	Install the trigger and spring	10-9
☐	9.	Install the left handle	10-8

Hand torch: Replacing the torch lead

Kit # 228959, 228960, 228961

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Remove the left handle	10-8
☐	3.	Remove the trigger and spring	10-9
☐	4.	Remove the start switch	10-10
☐	5.	Remove the right handle	10-11
☐	6.	Replace the torch lead	10-13
☐	7.	Install the right handle	10-14
☐	8.	Install the trigger and spring	10-9
☐	9.	Install the left handle	10-8

Hand torch: Replacing the quick disconnect housing

Kit # 228314

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Disassemble the quick disconnect housing	10-20
☐	3.	Reassemble the quick disconnect housing	10-20

Machine torch: Replacing the mounting sleeve

Kit # 228735

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Remove the mounting sleeve	10-16
☐	4.	Install the mounting sleeve	10-19
☐	5.	Connect the torch components	10-19

Machine torch: Replacing the cap-sensor switch

Kit # 228720

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Remove the mounting sleeve	10-16
☐	4.	Remove the cap-sensor switch	10-16
☐	5.	Install the cap-sensor switch	10-19
☐	6.	Install the mounting sleeve	10-19
☐	7.	Connect the torch components	10-19

Machine torch: Replacing the torch body

Kit # 228716

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Remove the mounting sleeve	10-16
☐	4.	Remove the cap-sensor switch	10-16
☐	5.	Remove the torch body	10-16
☐	6.	Install the torch body	10-19
☐	7.	Install the cap-sensor switch	10-19
☐	8.	Install the mounting sleeve	10-19
☐	9.	Connect the torch components	10-19

Machine torch: Replacing the coupler

Kit # 228736

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Remove the mounting sleeve	10-16
☐	4.	Remove the torch body	10-16
☐	5.	Replace the coupler	10-18
☐	6.	Install the torch body	10-19
☐	7.	Install the mounting sleeve	10-19
☐	8.	Connect the torch components	10-19

Machine torch: Replacing the gear rack

Kit # 228738

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Replace the gear rack	10-18
☐	4.	Connect the torch components	10-19

Machine torch: Replacing the positioning sleeve

Kit # 228737

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Remove the mounting sleeve	10-16
☐	4.	Remove the torch body	10-16
☐	5.	Replace the positioning sleeve	10-18
☐	6.	Install the torch body	10-19
☐	7.	Install the mounting sleeve	10-19
☐	8.	Connect the torch components	10-19

Machine torch: Replacing the torch lead

Kit # 228730, 228731, 228732, 228733, 228734

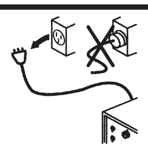
☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Separate the torch components	10-16
☐	3.	Remove the mounting sleeve	10-16
☐	4.	Remove the torch body	10-16
☐	5.	Replace the torch lead	10-18
☐	6.	Install the torch body	10-19
☐	7.	Install the mounting sleeve	10-19
☐	8.	Connect the torch components	10-19

Machine torch: Replacing the quick disconnect housing

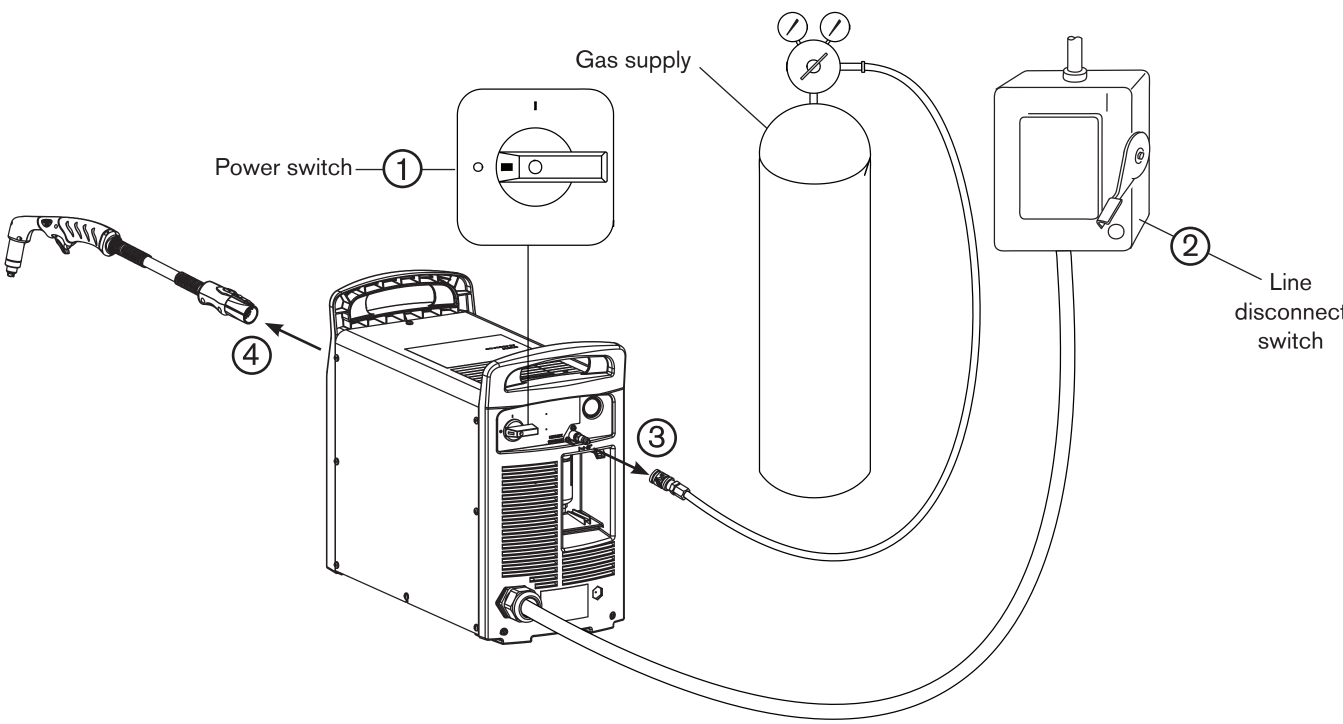
Kit # 228314

☑	Step	Task	Page
☐	1.	Disconnect the power, gas supply, and torch	10-7
☐	2.	Disassemble the quick disconnect housing	10-20
☐	3.	Reassemble the quick disconnect housing	10-20

Disconnect the power, gas supply, and torch

		**WARNING** **ELECTRIC SHOCK CAN KILL**
	**Disconnect electrical power before performing any maintenance or repairs. See the *Safety and Compliance Manual* included with your system for more safety precautions.**	

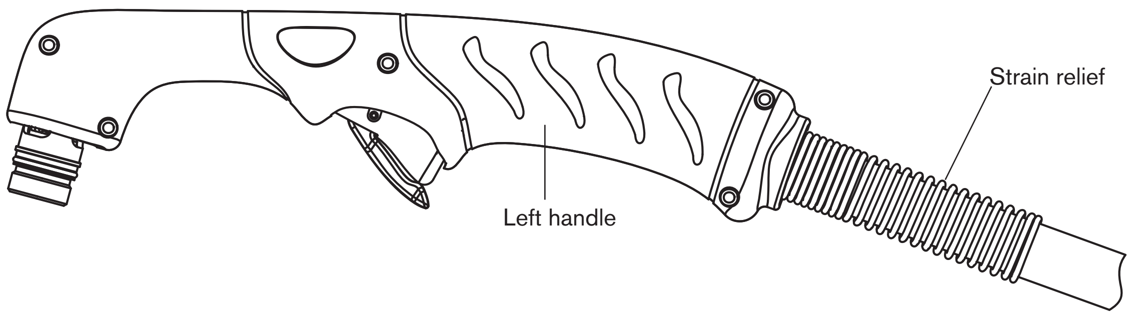
1. Turn the plasma power supply switch to OFF (O).
2. Turn the line disconnect switch to OFF (O).
3. Disconnect the gas supply hose from the plasma power supply.
4. Disconnect the torch from the plasma power supply.



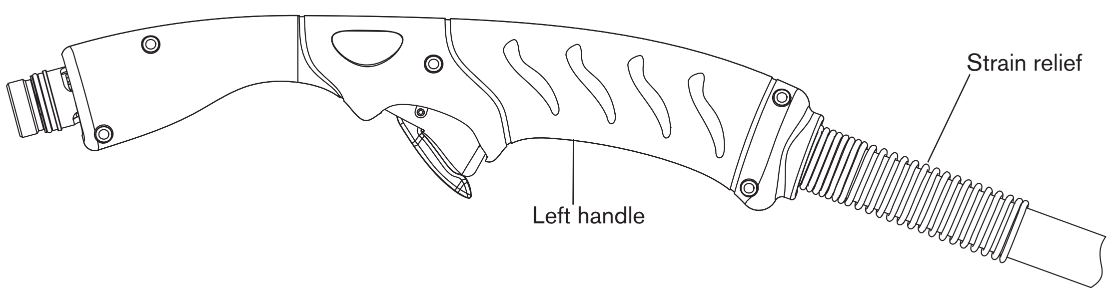
Remove the left handle

1. Remove the consumables from the torch.
2. Place the torch on a flat surface with the left handle facing up.
3. Remove the five handle screws from the left handle.
4. Carefully lift the left handle away from the torch.

   Note: You should wear eye protection as the trigger spring can launch out of the handle.



Duramax 75° hand torch



Duramax 15° hand torch

Install the left handle

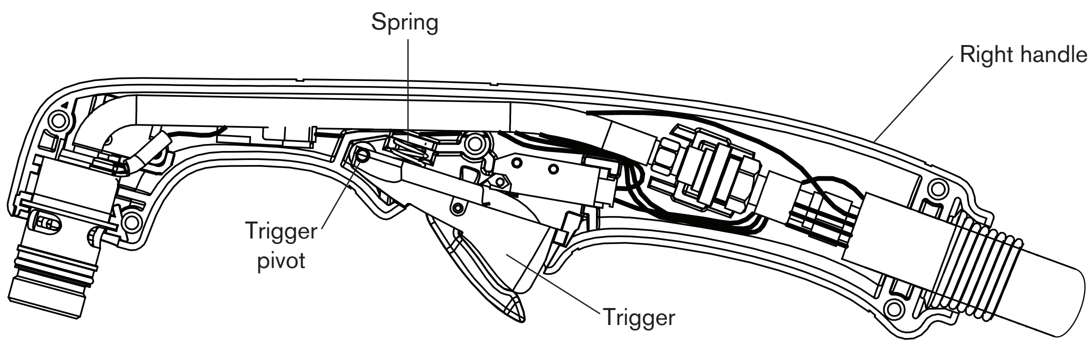
1. Align the left half of the handle with the right half.

   Note: If replacing the handles, apply the “H” label to the left side of the torch handle.

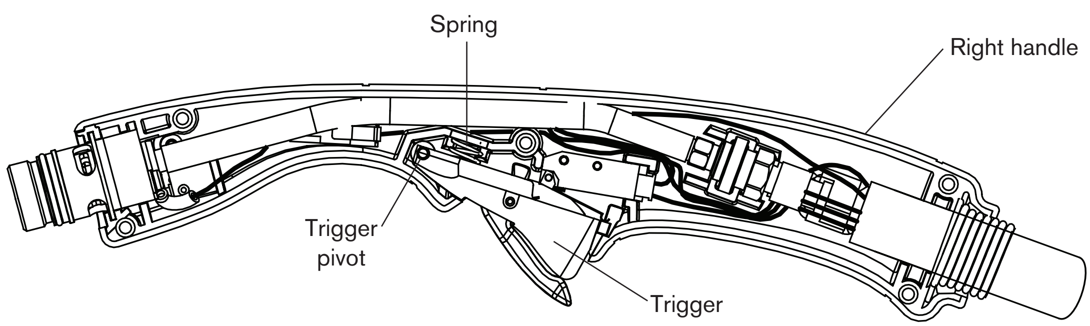
2. Verify that both trigger pivots are located in the trigger pivot holes (one pivot hole in each half of the handle). Make certain the wires are not pinched by the handles and that the strain relief is held in place by the handles.
3. Tighten the five handle screws to 14.98 kg cm (13.0 in.-lbs).
4. Install the consumables.

Remove the trigger and spring

1. Compress the spring into the trigger.
2. Carefully lift the spring and trigger out of the right handle and set aside.



Duramax 75° hand torch



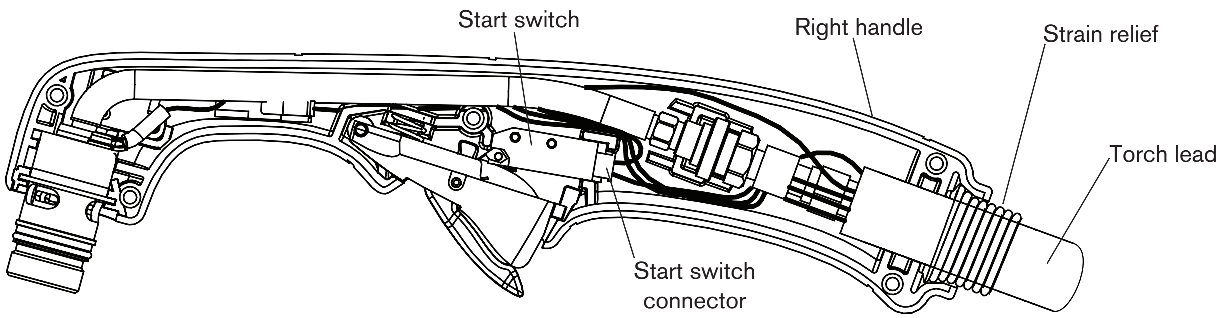
Duramax 15° hand torch

Install the trigger and spring

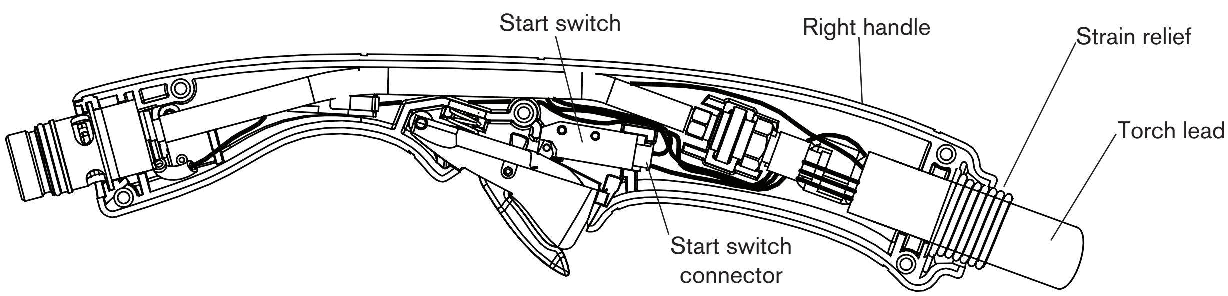
1. Compress the spring into the trigger.
2. Carefully insert the spring and trigger into the right handle, aligning the trigger pivot with the trigger pivot hole in the right handle.

Remove the start switch

1. Pry the start switch up using a flat blade screwdriver.
2. Disconnect the start switch by pressing the tab on the connector and pulling the start switch away from the connector.
3. Lift the start switch off the two mounting posts in the right handle.



Duramax 75° hand torch



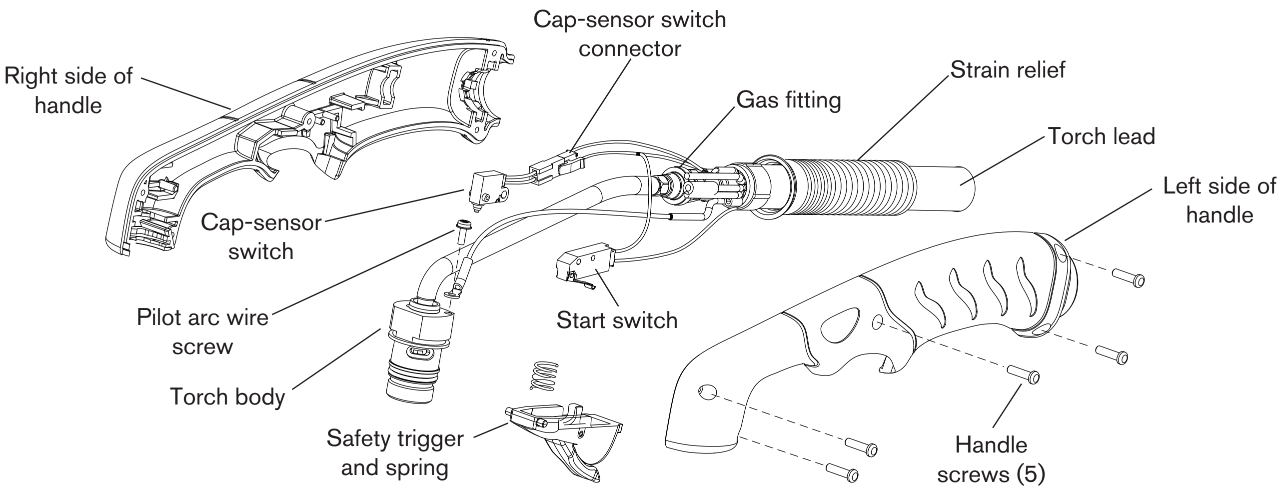
Duramax 15° hand torch

Replace the start switch

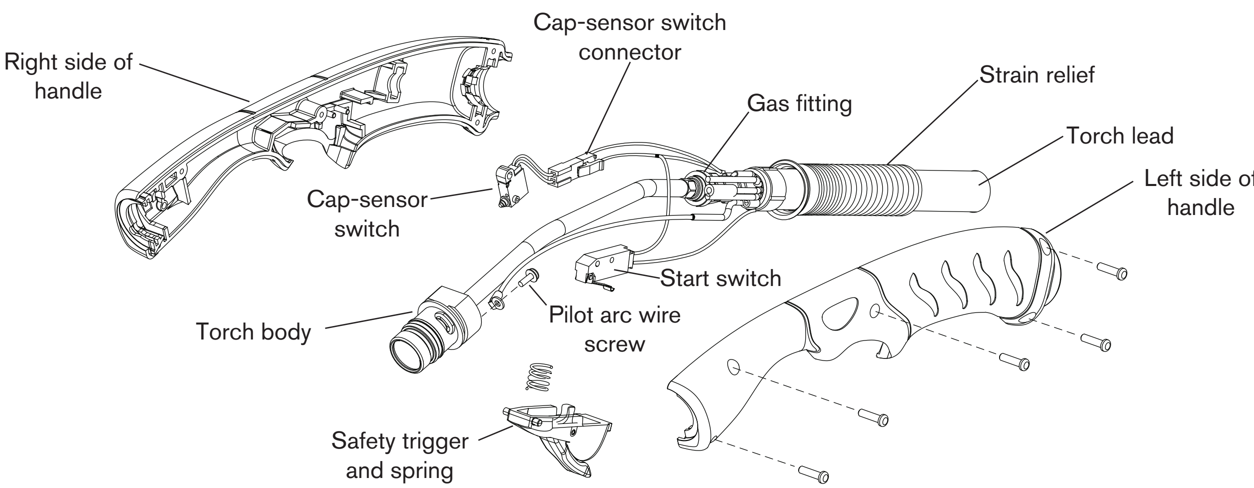
1. Pry the start switch up using a flat blade screwdriver.
2. Lift the start switch off the two mounting posts in the right handle.
3. Plug the start switch connector into the new start switch.
4. Press the start switch onto the two mounting posts in the right handle.

Remove the right handle

1. Press the right handle away from the torch body to remove it. The torch body fits snugly in the right handle.
2. Pull the cap-sensor switch off the mounting post in the right handle.



Duramax 75° hand torch



Duramax 15° hand torch

Replace the cap-sensor switch

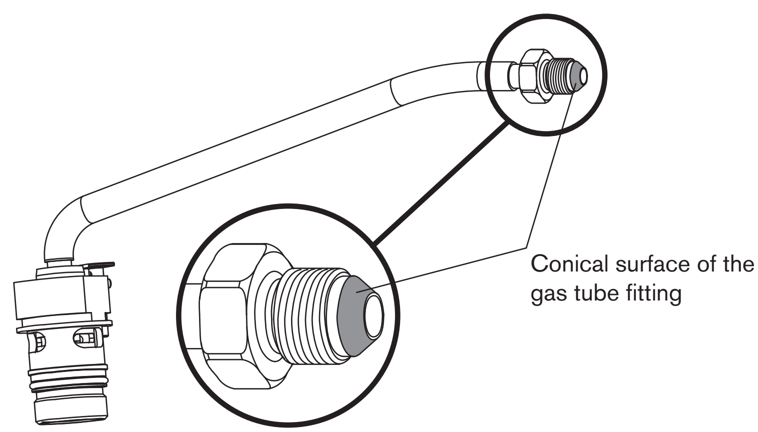
1. Press the tab on the cap-sensor switch connector and pull the cap-sensor switch away from the connector.
2. Plug the connector into the new cap-sensor switch.

Replace the torch body

Refer to the appropriate figure on the previous page and complete the following instructions.

1. Remove the screw that secures the torch's pilot arc wire to the torch body.
2. Use two wrenches to loosen the gas fitting that secures the torch body to the torch lead.
3. Apply threadlocker (Part # 330103) to the threads of the gas tube fitting on the torch body. Be very careful not to get any threadlocker on the conical surface of the gas tube fitting to avoid damage to the torch. See the figure below.

Caution: **Do not get any threadlocker on the conical surface of the gas tube fitting to avoid causing damage to the torch. If any threadlocker does get on this surface, clean it off immediately.**



4. Thread the torch body into the torch lead until snug.
5. Use two wrenches to tighten the gas fitting that secures the torch body to the torch lead to 69.1 kg cm (60 in.-lbs).
6. Tighten the screw that secures the torch's pilot arc wire to the torch body to 5.76 kg cm (5.0 in.-lbs).

   Note: To prevent the pilot arc wire from being pinched between the handles, angle the pilot arc wire terminal so it is below the torch body gas tube.

Replace the torch lead

Refer to the appropriate figure on the previous page and complete the following instructions.

1. Remove the screw that secures the torch's pilot arc wire to the torch body.
2. Use two wrenches to loosen the gas fitting that secures the torch body to the torch lead.
3. Disconnect the start switch by pressing the tab on the connector and pulling the start switch away from the connector.
4. Disconnect the cap-sensor switch by pressing the tab on the connector and pulling the cap-sensor switch away from the connector.
5. Apply the threadlocker (330103), included in the kit, to the threads of the gas tube fitting on the torch body. Be very careful not to get any threadlocker on the conical surface of the gas tube fitting to avoid damage to the torch. See the figure on the previous page for details.
6. Thread the torch body into the new torch lead until snug.
7. Use two wrenches to tighten the gas fitting that secures the torch body to the torch lead to 69.1 kg cm (60 in.-lbs).
8. Tighten the screw that secures the torch's pilot arc wire to the torch body to 5.76 kg cm (5.0 in.-lbs).

   Note: To prevent the pilot arc wire from being pinched between the handles, angle the pilot arc wire terminal so it is below the torch body gas tube.

9. Connect the start switch by pressing the connector into the back of the start switch.
10. Connect the cap-sensor switch by pushing the socket into the mating plug of the connector.

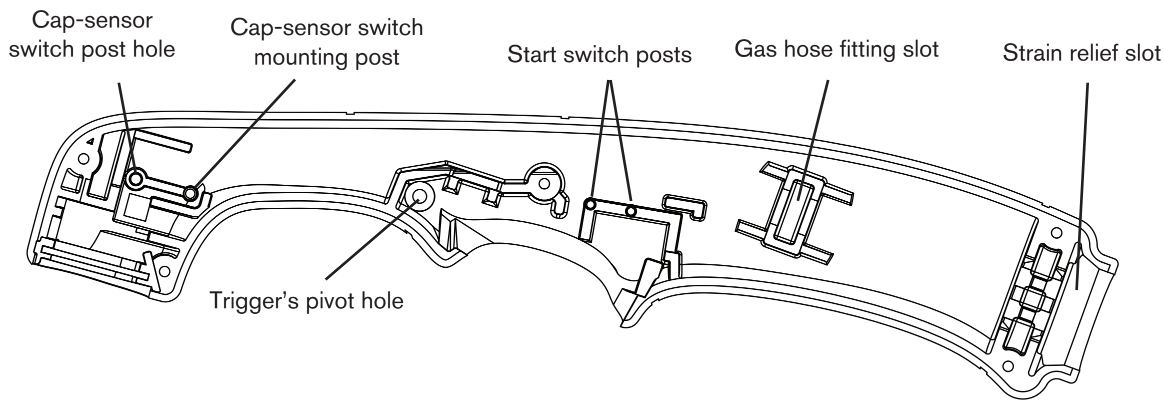
Install the right handle

Refer to the appropriate figures that follow and complete the following instructions.

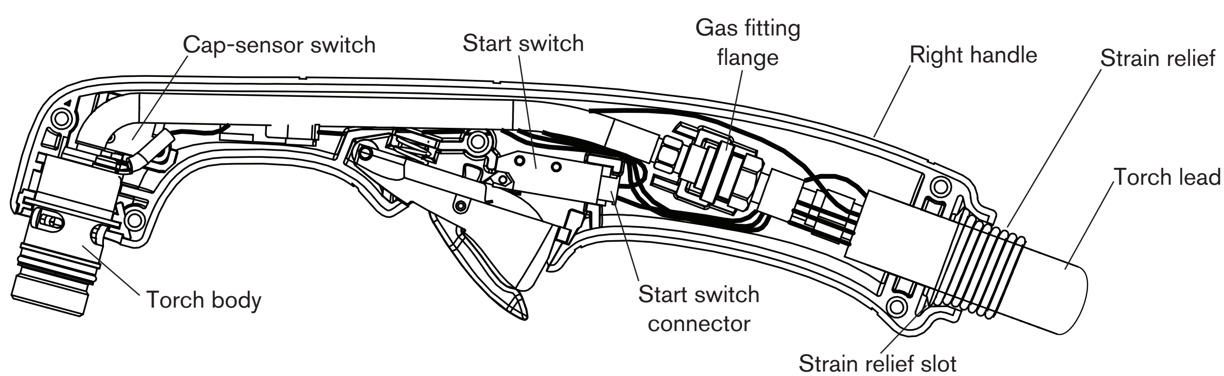
1. Lay the right side of the handle on a flat surface.

   Note: If replacing the handles, apply the “H” label to the right side of the torch handle.

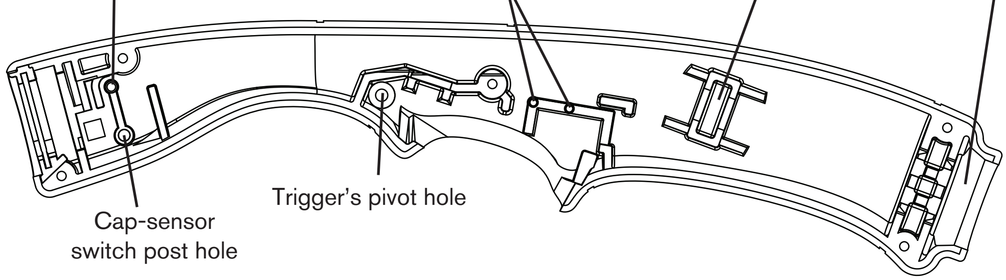
2. Position the pilot arc wire, cap-sensor wires, and cap-sensor wire connector in the handle.
3. Press the cap-sensor switch onto the mounting post in the handle while pressing the cap-sensor post into the post hole in the handle.
4. Gently press the torch body into the torch handle with the gas hose fitting’s flange aligned with the slot in the handle. Be careful not to damage the cap-sensor switch, cap-sensor wires or pilot arc wire in the handle. Make sure that the strain relief rests in the slot near the rear of the handle.
5. Position the start switch wires beside the gas fitting flange in the handle and gently press the start switch onto the two mounting posts in the handle.



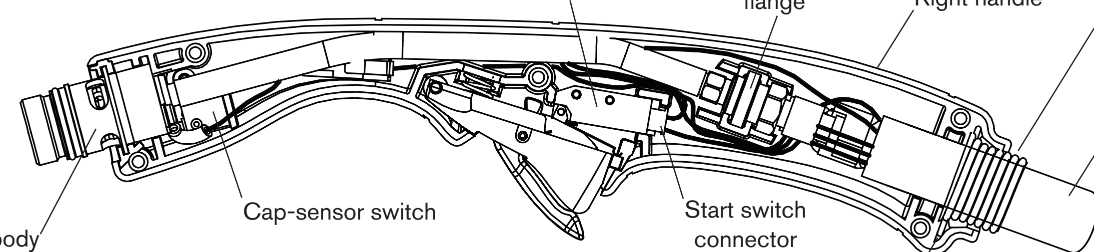
Duramax 75° hand torch handle



Duramax 75° hand torch



Duramax 15° hand torch handle



Duramax 15° hand torch

Separate the torch components

Refer to the appropriate figure(s) on the following page and complete the following instructions.

1. Unscrew the strain relief body from the strain relief nut and slide the strain relief body back along the torch lead.
2. Unscrew the strain relief nut from the positioning sleeve (Duramax 180° full-length machine torch) or coupler (Duramax 180° mini machine torch) and slide the nut back along the torch lead.
3. Unscrew the positioning sleeve (Duramax 180° full-length machine torch) from the coupler.
4. Unscrew the coupler from the mounting sleeve.

Remove the mounting sleeve

Refer to the appropriate figure(s) on the following page and complete the following instructions.

1. Remove the consumables from the torch.
2. Remove the three screws from the end of the mounting sleeve.
3. Slide the mounting sleeve off the front of the torch body.

Remove the cap-sensor switch

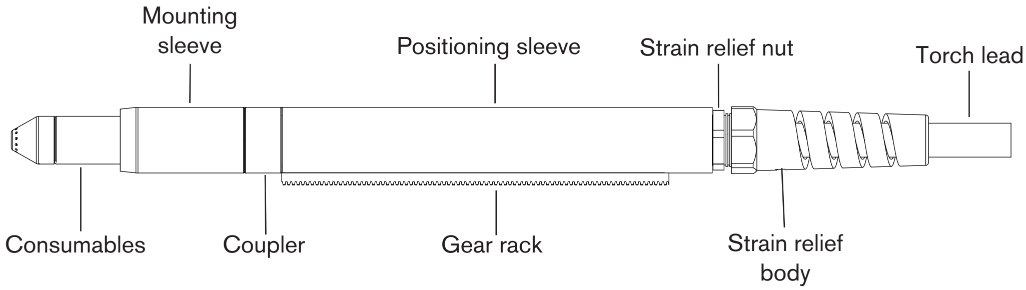
Refer to the appropriate figure(s) on the following page and complete the following instructions.

1. Unplug the cap-sensor switch connector.
2. Remove the cap-sensor switch mounting screw.

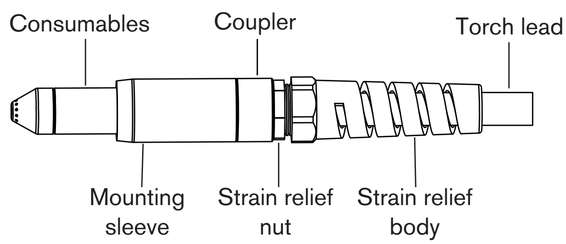
Remove the torch body

Refer to the appropriate figure(s) on the following page and complete the following instructions.

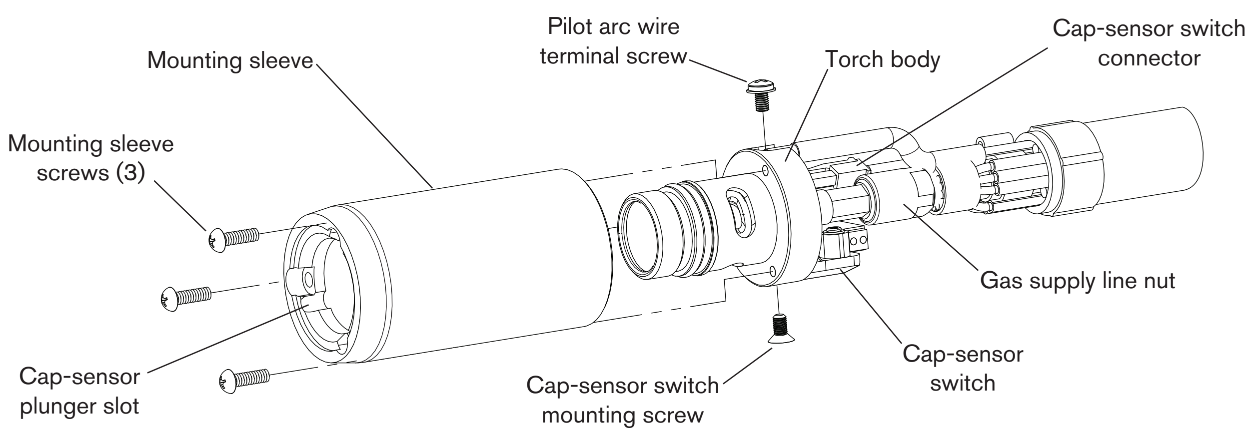
1. Remove the pilot arc wire terminal screw.
2. Use a 1/4-inch and 3/8-inch wrench together (or two adjustable wrenches) to loosen the nut that secures the gas supply line to the torch body.



Duramax 180° full-length machine torch



Duramax 180° mini machine torch



Machine torch connections

Replace the coupler

Refer to the appropriate figure(s) on the previous page and complete the following instructions.

1. Slide the coupler off the end of the torch lead.
2. Slide the new coupler over the end of the torch lead.

Replace the gear rack

Refer to the appropriate figure(s) on the previous page and complete the following instructions.

1. Slide the gear rack out of the groove in the positioning sleeve.
2. Slide the new gear rack into the groove in the positioning sleeve.

Replace the positioning sleeve

Refer to the appropriate figure(s) on the previous page and complete the following instructions.

1. Slide the coupler off the end of the torch lead.
2. Slide the positioning sleeve (Duramax 180° full-length machine torch) off the end of the torch lead.
3. Slide the gear rack out of the groove in the positioning sleeve.
4. Slide the gear rack into the groove in the new positioning sleeve.
5. Slide the new positioning sleeve (Duramax 180° full-length machine torch) over the end of the torch lead.
6. Slide the coupler over the end of the torch lead.

Replace the torch lead

Refer to the appropriate figure(s) on the previous page and complete the following instructions.

1. Slide the coupler off the end of the torch lead.
2. Slide the positioning sleeve (Duramax 180° full-length machine torch) off the end of the torch lead.
3. Unscrew the strain relief body from the strain relief nut on the new torch lead.
4. Slide the positioning sleeve (Duramax 180° full-length machine torch) over the end of the new torch lead.
5. Slide the coupler over the end of the new torch lead.

Install the torch body

Refer to the appropriate figure(s) on page 10-17 and complete the following instructions.

1. Use a 1/4-inch and 3/8-inch wrench together (or two adjustable wrenches) to tighten the nut that secures the gas supply line to the torch body.
2. Connect the cap-sensor switch connector.
3. Secure the pilot arc wire to the torch body by tightening the screw to 5.76 kg cm (5.0 in.-lbs).

Install the cap-sensor switch

Refer to the appropriate figure(s) on page 10-17 and complete the following instructions.

1. Secure the cap-sensor switch to the torch body by tightening the mounting screw to 9.22 kg cm (8.0 in.-lbs).
2. Connect the cap-sensor switch connector.

Install the mounting sleeve

Refer to the appropriate figure(s) on page 10-17 and complete the following instructions.

1. Slide the mounting sleeve over the front of the torch body, aligning the slot in the mounting sleeve with the cap-sensor plunger.
2. Tighten the three mounting screws to 11.52 kg cm (10.0 in.-lbs).
3. Install the consumables.

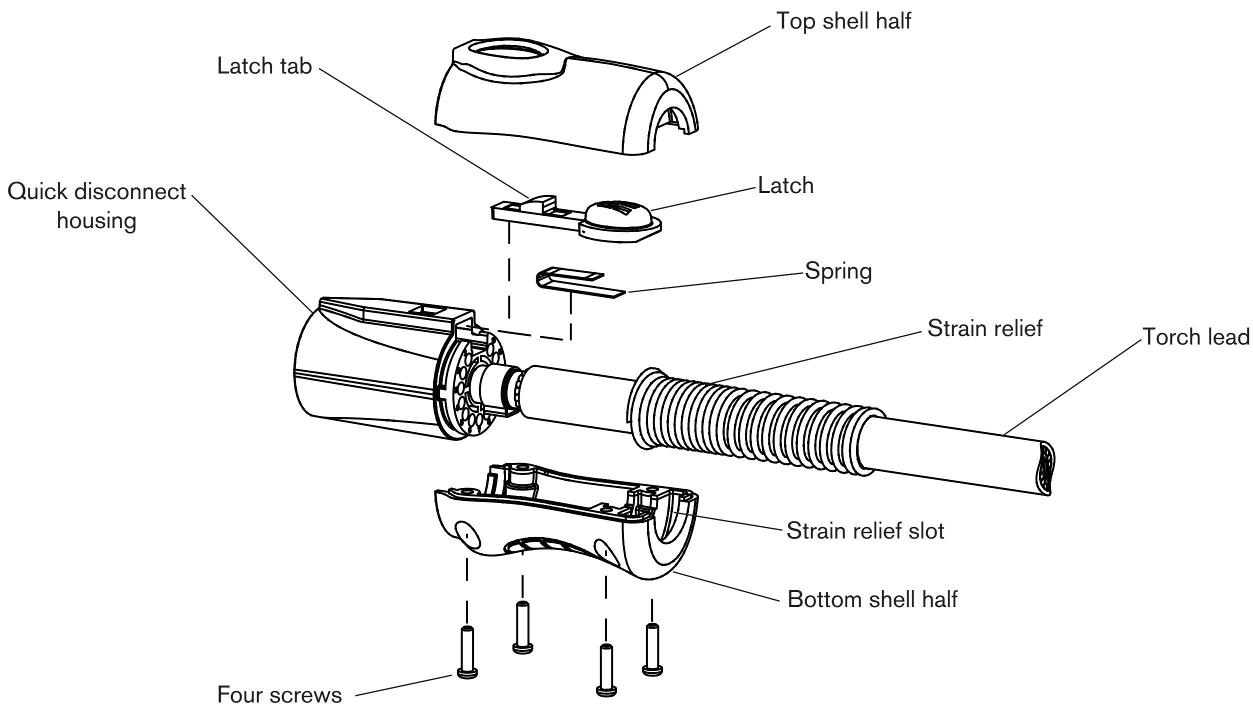
Connect the torch components

Refer to the appropriate figure(s) on page 10-17 and complete the following instructions.

1. Thread the coupler (Duramax 180° mini machine torch) or the coupler and positioning sleeve (Duramax 180° full-length machine torch) into the mounting sleeve until hand tight.
2. Thread the strain relief nut into the coupler (Duramax 180° mini machine torch) or the positioning sleeve (Duramax 180° full-length machine torch) until hand tight.
3. Thread the strain relief body onto the strain relief nut until hand tight.

Disassemble the quick disconnect housing

1. Remove the four screws from the bottom half of the shell.
2. Remove the two shell halves.
3. Remove the latch by using a flat-blade screwdriver to press down firmly on the latch tab while pushing the tab down and out toward the lead.
4. Pull the spring out of the quick disconnect housing.



Reassemble the quick disconnect housing

1. Place the new latch into the quick disconnect housing.
2. Hold up the end of the latch and insert the new spring under the latch.
3. Use a flat-blade screwdriver to push the spring into the recess until it clicks into place.
4. Install the new shell halves onto the torch lead, making sure the strain relief fits in the slot of the shell and the wires are not pinched or do not interfere with the latch.
5. Tighten the four screws.

Section 11

PARTS

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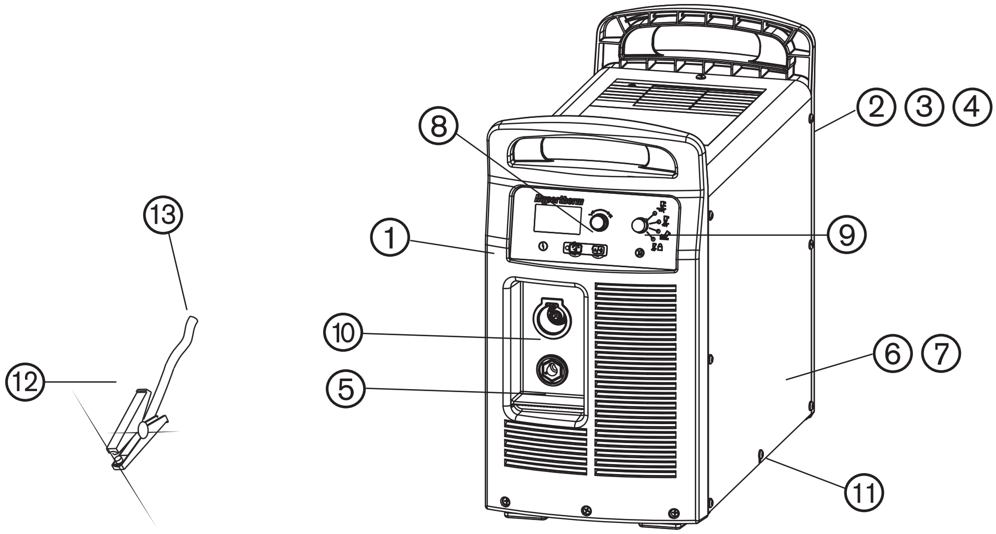
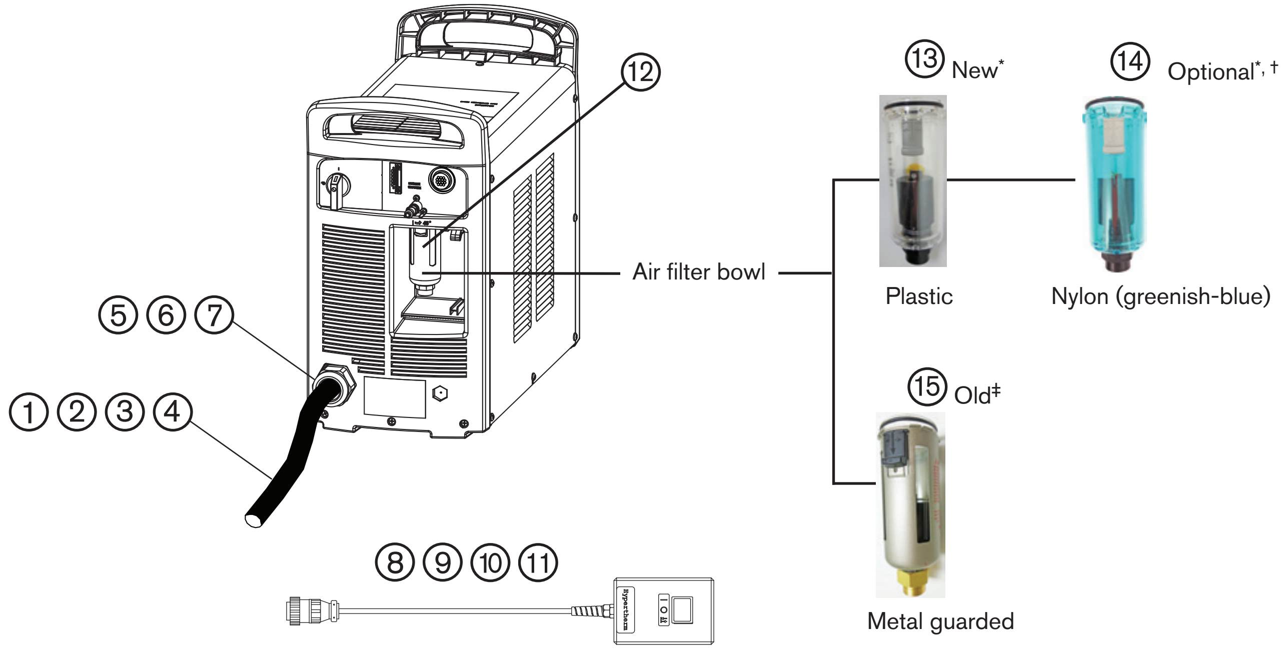
Power supply parts

Exterior front



Item	Part number	Description
	228903	Kit: Powermax105 labels, CSA
	228904	Kit: Powermax105 labels, CE
1	228866	Kit: Powermax105 front panel
2	228867	Kit: Powermax105 200-600 V CSA rear panel
3	228868	Kit: Powermax105 230-400 V CE rear panel
4	228869	Kit: Powermax105 400 V CE/380 V CCC rear panel
5	228912	Kit: Powermax105 work lead receptacle (power supply side)
6	228905	Kit: Powermax105 CSA power supply cover with labels
7	228906	Kit: Powermax105 CE/CCC power supply cover with labels
8	108797	Adjustment knob
9	108732	Operating mode knob
10	228883	Kit: Powermax105 torch quick disconnect replacement (power supply half)
11	075769	Cover screws
12		Work lead (see page 11-21 *Accessory parts* for a complete list of work leads)
13	228891	Kit: Powermax105 work lead connector (lead side)

Exterior rear



Item	Part number	Description
1	228885	Kit: Powermax105 power cord 200-600 V CSA
2	228886	Kit: Powermax105 power cord 230-400 V CE
3	228887	Kit: Powermax105 power cord 400 V CE
4	228962	Kit: Powermax105 power cord 380 V CCC
5	228913	Kit: Powermax105 power cord strain relief 230-400 V CE
6	228914	Kit: Powermax105 power cord strain relief 400 V CE/380 V CCC
7	228915	Kit: Powermax105 power cord strain relief CSA
8	128650	Remote start pendant for machine torch, 7.6 m (25 ft)
9	128651	Remote start pendant for machine torch, 15 m (50 ft)
10	128652	Remote start pendant for machine torch, 23 m (75 ft)
11	428755	Remote start pendant for machine torch, 45 m (150 ft)
	228539	Kit: Powermax65/85/105 RS485 board with cables
	127204	Cover for Powermax45/65/85/105 machine interface (CPC) receptacle
12	228695	Kit: Powermax65/85/105/125 air filter element (inside filter bowl) and O-ring
13	428352*	Kit: Powermax65/85/105/125 plastic air filter bowl (includes O-ring)
14	428415*,†	Kit: Powermax65/85/105/125 nylon air filter bowl (includes O-ring) (optional)
15	428015‡	Kit: Powermax65/85/105/125 metal guarded air filter bowl (includes O-ring)

Note: See next page for footnotes and machine interface cables.

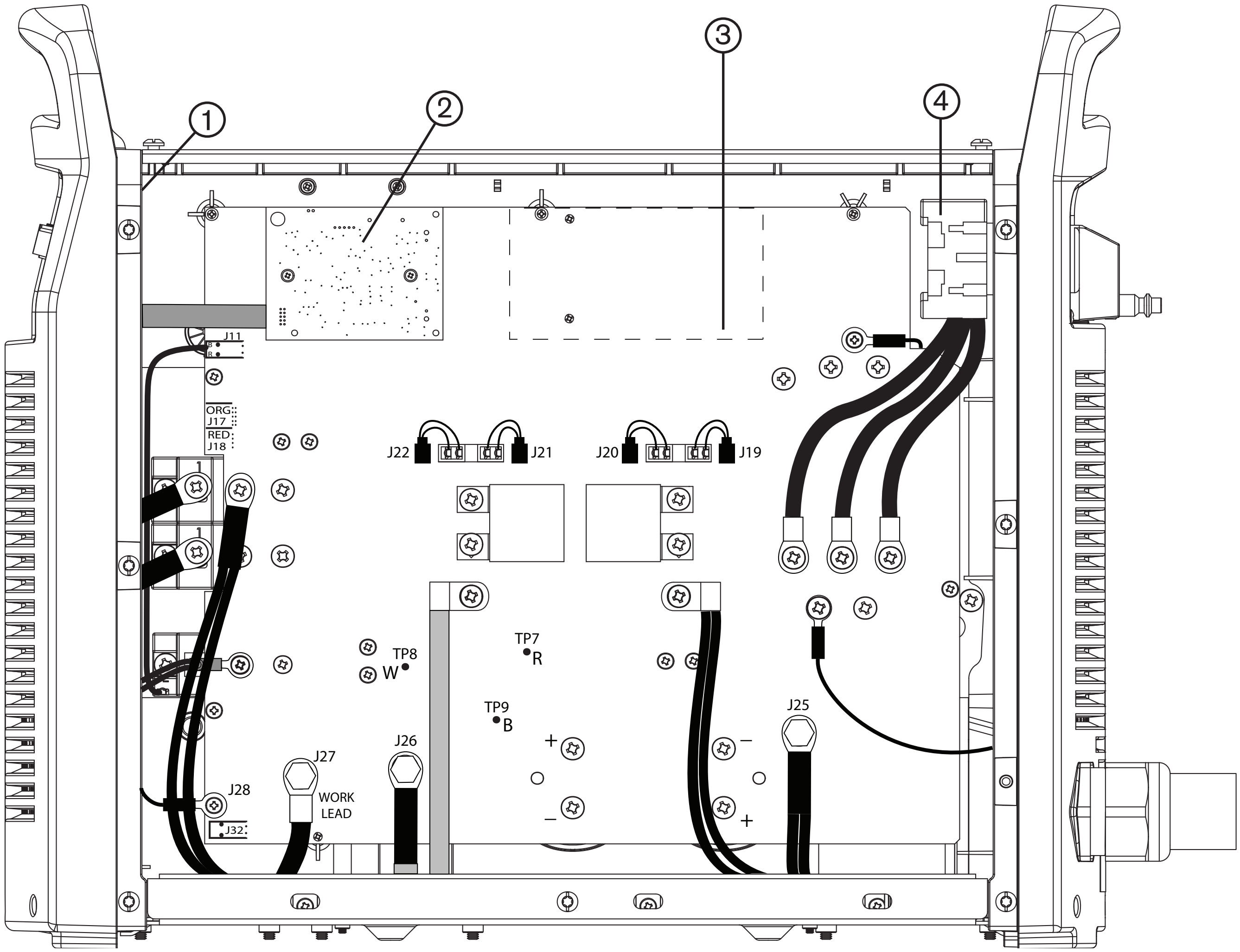
Item	Part number	Description
	023206	Machine interface cable (start, stop, arc transfer signals), 7.6 m (25 ft), spade connectors
	023279	Machine interface cable (start, stop, arc transfer signals), 15 m (50 ft), spade connectors
	228350	Machine interface cable (start, stop, arc transfer signals) for 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)
	228884	Kit: Powermax105 machine interface cable, internal cable with voltage divider board (CPC port upgrade)

* Filter bowl kit 428352 and 428415 only fit on air filter assembly kit 428351. See page 11-8.

† The plastic air filter bowl (kit 428352) that comes with the Powermax105 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.

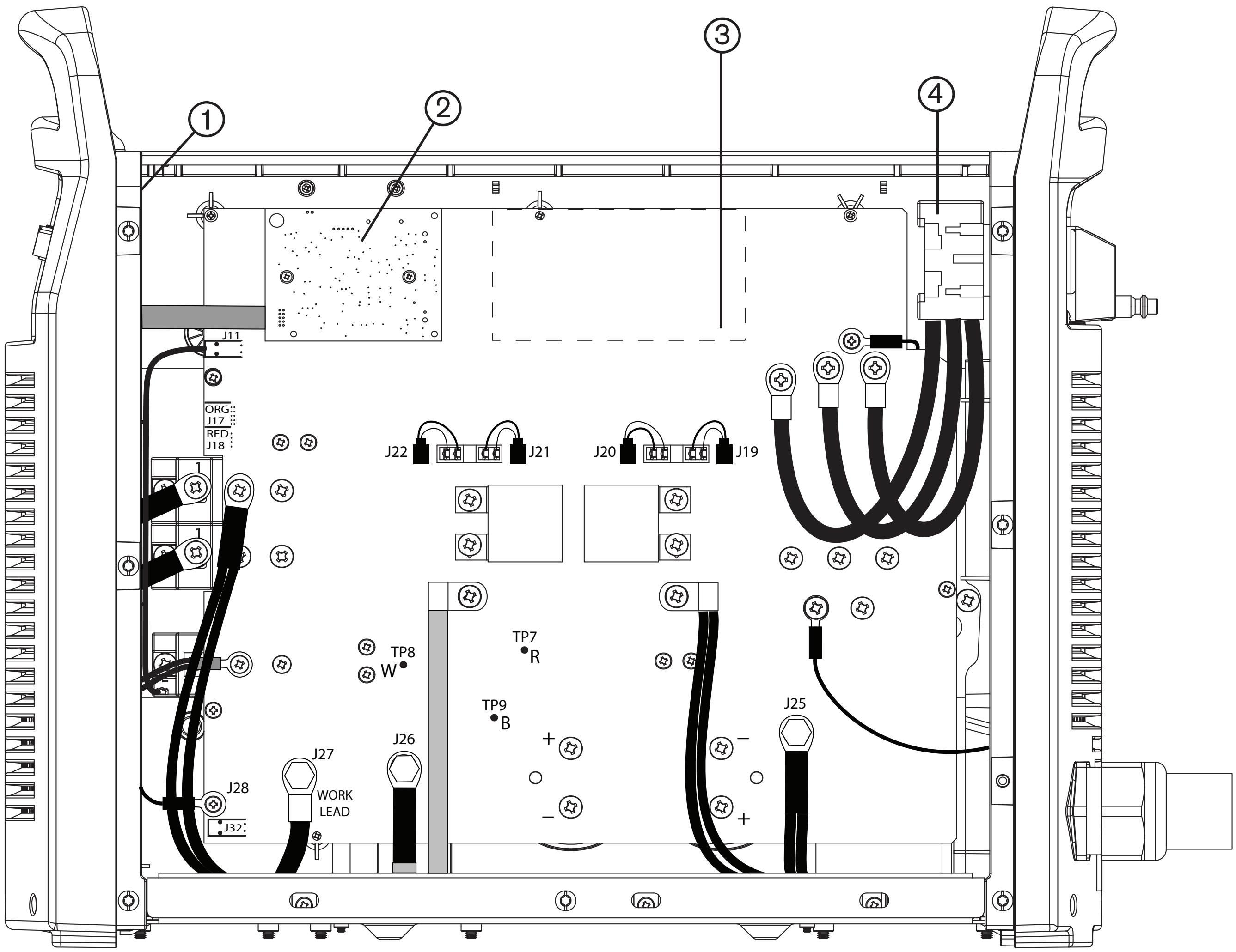
‡ The filter bowl kits are not interchangeable. Filter bowl kit 428015 only fits on old air filter assembly kit 228685 (shown on page 11-8). Order kit 428015 if you currently have a metal guarded filter bowl, as shown on page 11-3.

Interior, power board side (200-600 V CSA)



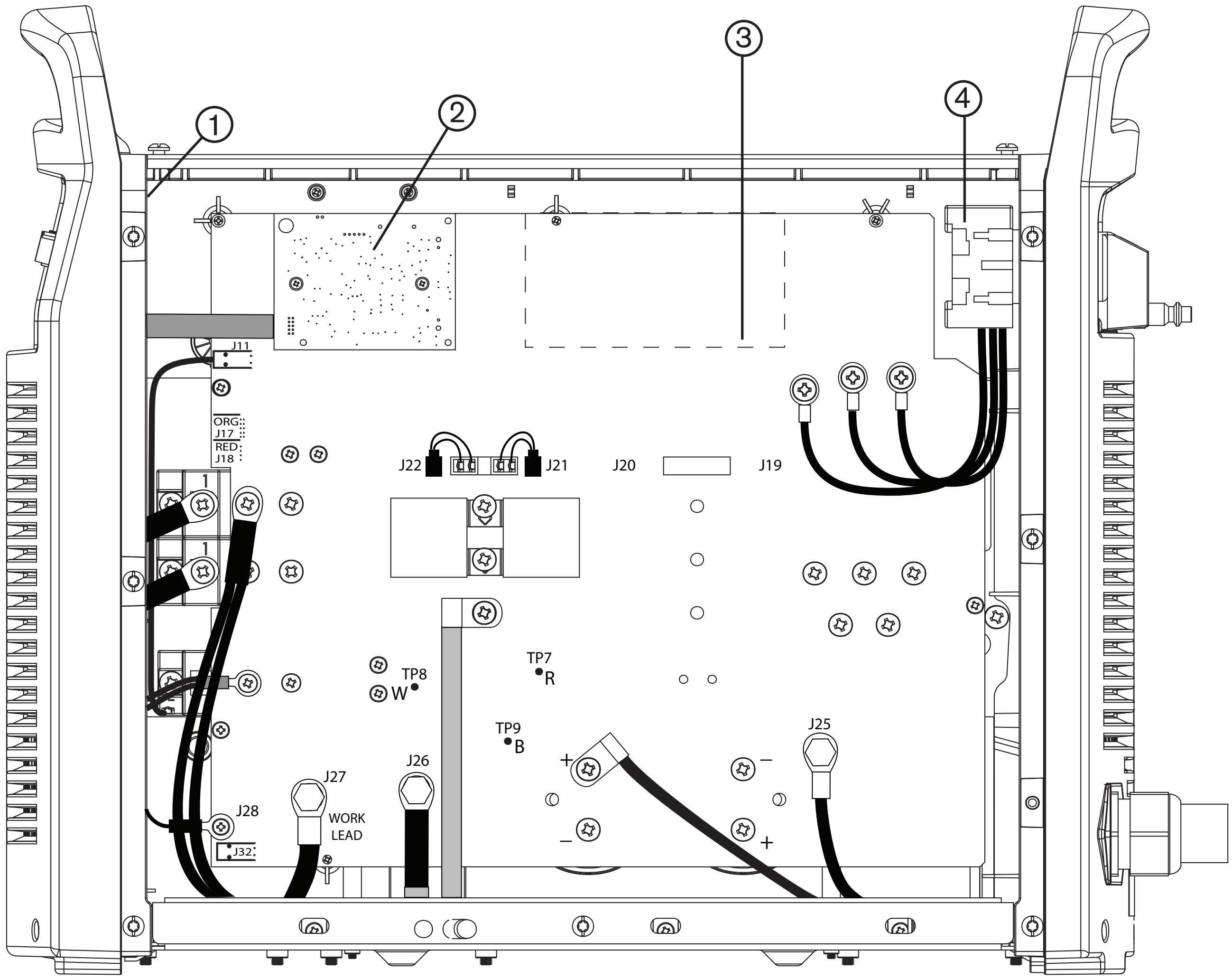
Item	Part number	Description
1	228657	Kit: Powermax65/105 control board
2	228909	Kit: Powermax105 DSP board
3	228876	Kit: Powermax105 power board 200-600 V CSA
4	228879	Kit: Powermax105 power switch 200-600 V CSA/230-400 V CE
	228895	Kit: Powermax105 insulation

Interior, power board side (230-400 V CE)



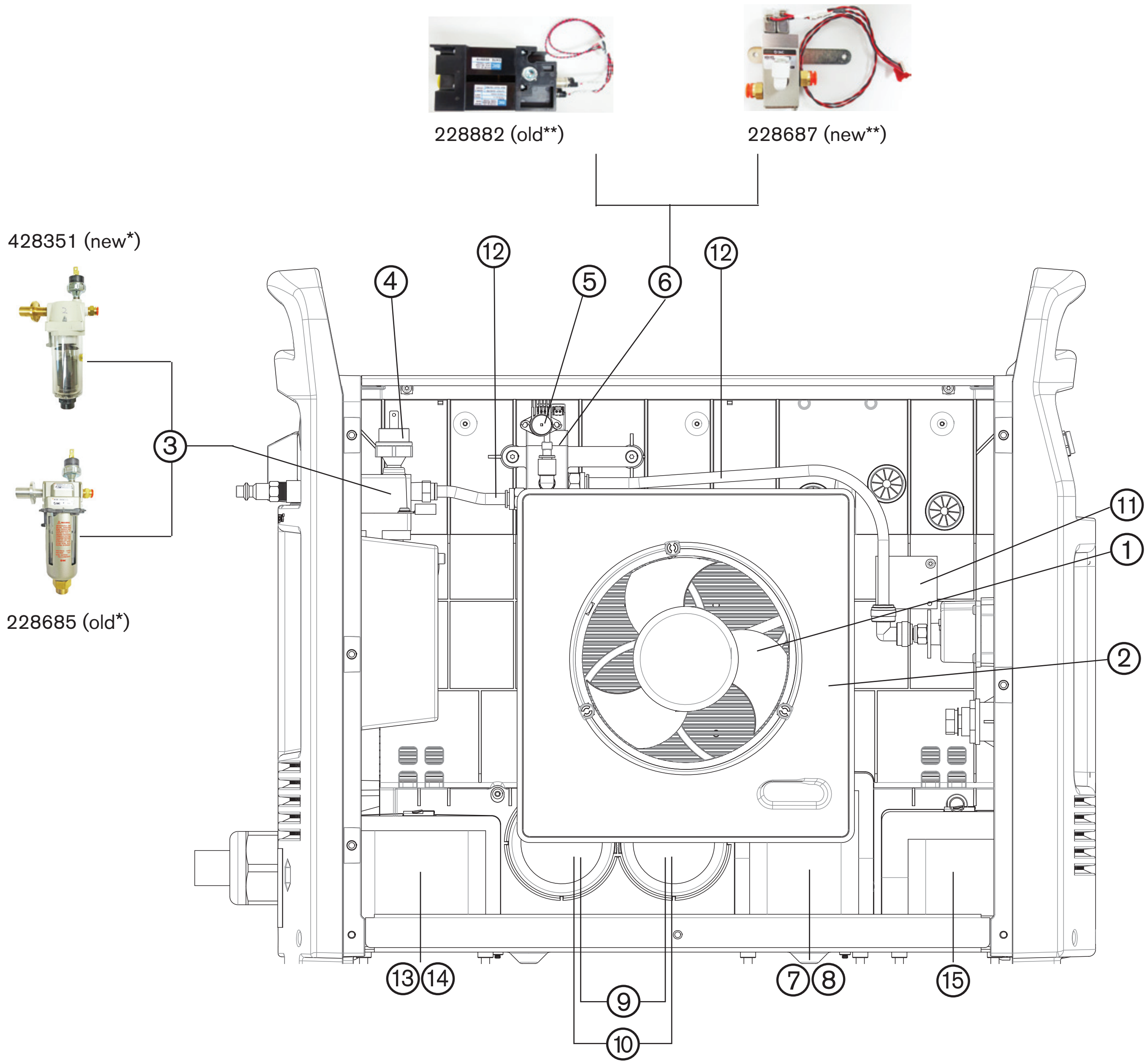
Item	Part number	Description
1	228657	Kit: Powermax65/105 control board
2	228909	Kit: Powermax105 DSP board
3	228877	Kit: Powermax105 power board 230-400 V CE
4	228879	Kit: Powermax105 power switch 200-600 V CSA/230-400 V CE
	228895	Kit: Powermax105 insulation

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



Item	Part number	Description
1	228657	Kit: Powermax65/105 control board
2	228909	Kit: Powermax105 DSP board
3	228878	Kit: Powermax105 power board 400 V CE/380 V CCC
4	228880	Kit: Powermax105 power switch 400 V CE/380 V CCC
	228895	Kit: Powermax105 insulation

Interior, fan side



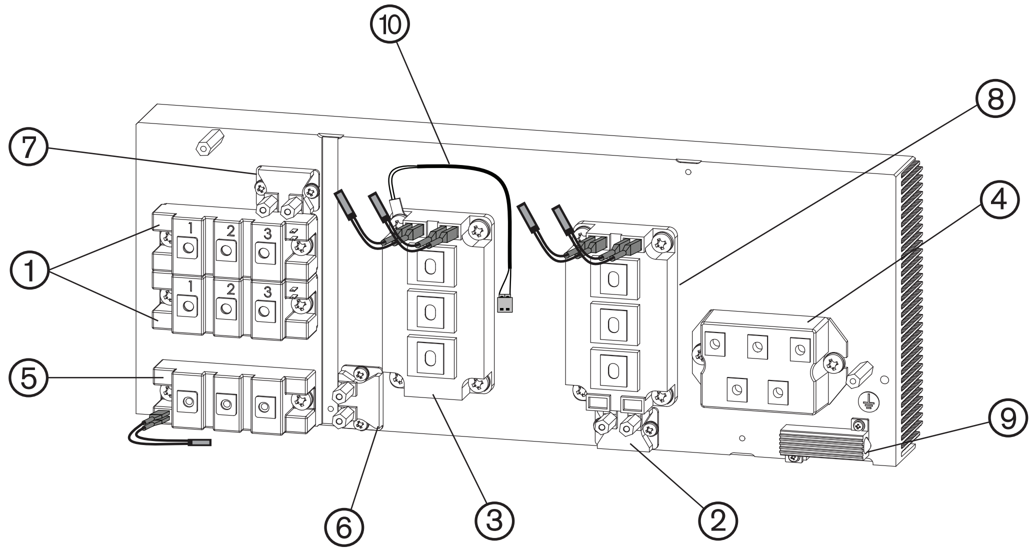
Item	Part number	Description
1	228881	Kit: Powermax105 fan subassembly
2	228910	Kit: Powermax105 fan shroud
3	428351*	Kit: Powermax65/85/105/125 new air filter assembly (includes plastic filter bowl, air filter element, and O-ring)
3	228685*	Kit: Powermax65/85/105/125 old air filter assembly (includes metal guarded filter bowl, air filter element, and O-ring)
4	228688	Kit: Powermax65/85/105 pressure switch
5	228689	Kit: Powermax65/85/105 pressure transducer
6	228687**	Kit: Powermax105 regulator/solenoid valve (includes tubing and screws)
7	228871	Kit: Powermax105 transformer 200-600 V CSA/230-400 CE (multivoltage)
8	228872	Kit: Powermax105 transformer 400 V CE/380 V CCC
9	228888	Kit: Powermax105 bulk capacitor 200-600 V CSA/230-400 CE (2 per kit)
10	228889	Kit: Powermax105 CE bulk capacitor 400 V CE/380 V CCC (2 per kit)
11	228884	Kit: Powermax105 machine interface cable, internal cable with voltage divider board (CPC port upgrade)
12	228865	Kit: Powermax105 gas tubing (short tube inside kit)
	228865	Kit: Powermax105 gas tubing (long tube inside kit)
13	228873	Kit: Powermax105 PFC inductor 200-600 V CSA/230-400 CE (multivoltage)
14	228874	Kit: Powermax105 PFC inductor 400 V CE/380 V CCC
15	228875	Kit: Powermax105 output inductor

* Because of a manufacturing change, the new air filter assembly in kit 428351 (see page 11-8) replaces the old air filter assembly in kit 228685. Although kit 228685 is no longer available to order, you can still order its individual filter bowl and filter element. For air filter element, air filter bowl, and O-ring part numbers, see page 11-3. See Field Service Bulletin 806970 for additional details.

** Because of a manufacturing change, solenoid valve kit 228687 replaces solenoid valve kit 228882.

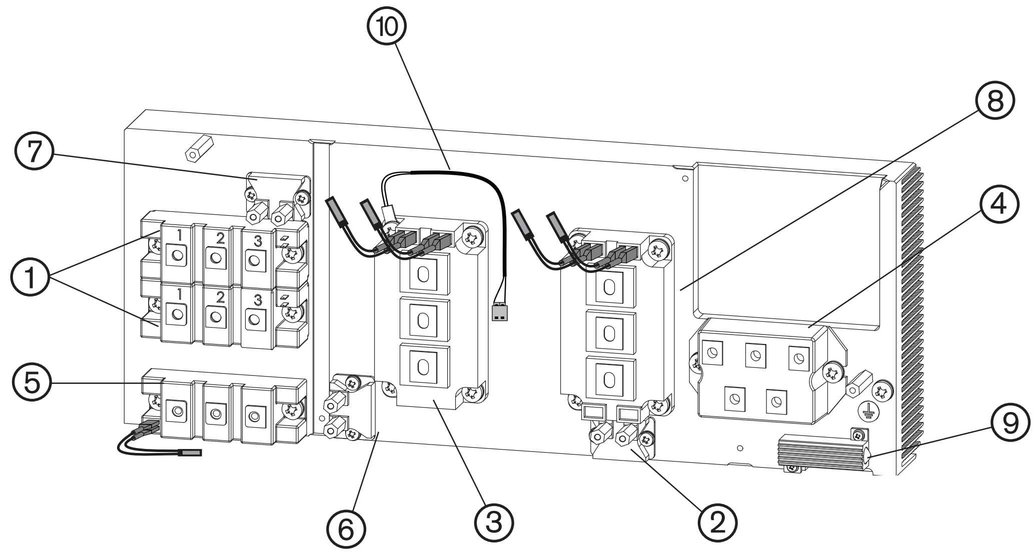
Heat sink assembly

200-600 V CSA heat sink components



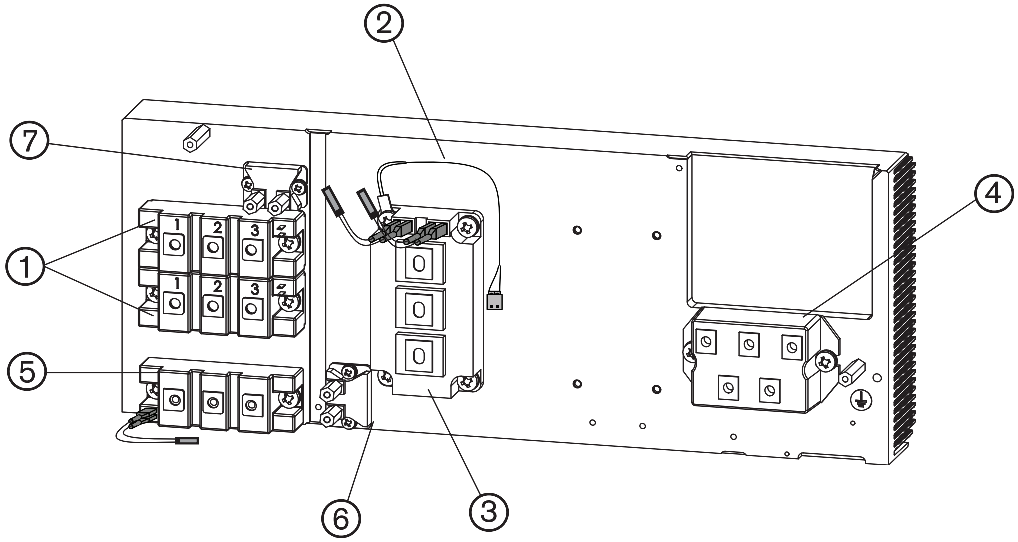
Item	Part number	Description
1	228902	Kit: Powermax105 output diode bridge (2) with thermal grease
2	228693	Kit: Powermax65/85/105 5 Ω 120W snubber resistor with thermal grease
3	228702	Kit: Powermax85 CE/Powermax105 inverter IGBT module with thermal grease
4	128746	Kit: Powermax1650/105 input diode bridge with thermal grease
5	228944	Kit: Powermax105 pilot arc PA IGBT with thermal grease
6	228898	Kit: Powermax105 15 Ω 200W snubber resistor with thermal grease
7	228897	Kit: Powermax105 5 Ω 200W snubber resistor with thermal grease
8	228699	Kit: Powermax85 200-600 V CSA/230-400 CE PFC IGBT module with thermal grease
9	228894	Kit: Powermax105 damper resistor 200-600 V CSA/230-400 CE
10	228805	Kit: Powermax65/85/105 thermal sensor
	128836	Thermal grease, Tgrease 1/8 ounce

230-400 V CE heat sink components



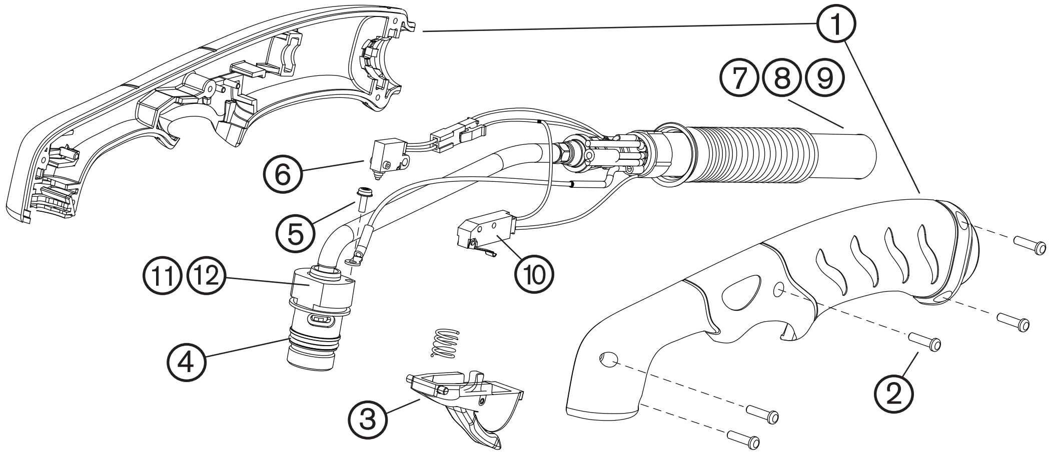
Item	Part number	Description
1	228902	Kit: Powermax105 output diode bridge (2) with thermal grease
2	228693	Kit: Powermax65/85/105 5 Ω 120W snubber resistor with thermal grease
3	228702	Kit: Powermax85 CE/Powermax105 inverter IGBT module with thermal grease
4	128746	Kit: Powermax1650/105 input diode bridge with thermal grease
5	228944	Kit: Powermax105 pilot arc PA IGBT with thermal grease
6	228898	Kit: Powermax105 15 Ω 200W snubber resistor with thermal grease
7	228897	Kit: Powermax105 5 Ω 200W snubber resistor with thermal grease
8	228699	Kit: Powermax85 200-600 V CSA/230-400 CE PFC IGBT module with thermal grease
9	228894	Kit: Powermax105 damper resistor 200-600 V CSA/230-400 CE
10	228805	Kit: Powermax65/85/105 thermal sensor
	128836	Thermal grease, Tgrease 1/8 ounce

400 V CE/ 380 V CCC heat sink components



Item	Part number	Description
1	228902	Kit: Powermax105 output diode bridge (2) with thermal grease
2	228805	Kit: Powermax65/85/105 thermal sensor
3	228702	Kit: Powermax85 CE/Powermax105 inverter IGBT module with thermal grease
4	128746	Kit: Powermax1650/105 input diode bridge with thermal grease
5	228944	Kit: Powermax105 pilot arc PA IGBT with thermal grease
6	228898	Kit: Powermax105 15 Ω 200W snubber resistor with thermal grease
7	228897	Kit: Powermax105 5 Ω 200W snubber resistor with thermal grease
	128836	Thermal grease, Tgrease 1/8 ounce

Duramax 75° hand torch replacement parts

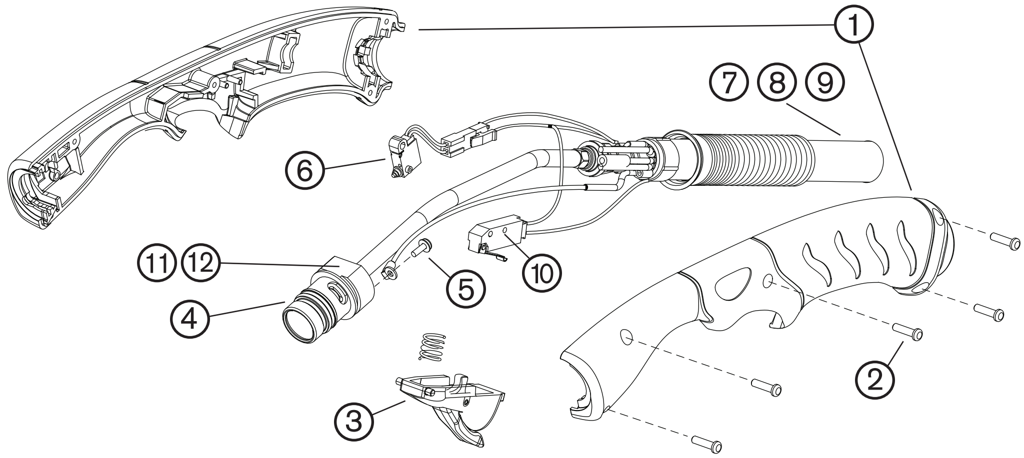


The entire hand torch and lead assembly can be replaced, or individual component parts can be replaced. Part numbers starting with 059 indicate complete torch and lead assemblies.

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 slotted 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)

* The torch assembly does not include consumables. See page 11-15 for a list of part numbers for consumables.

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.

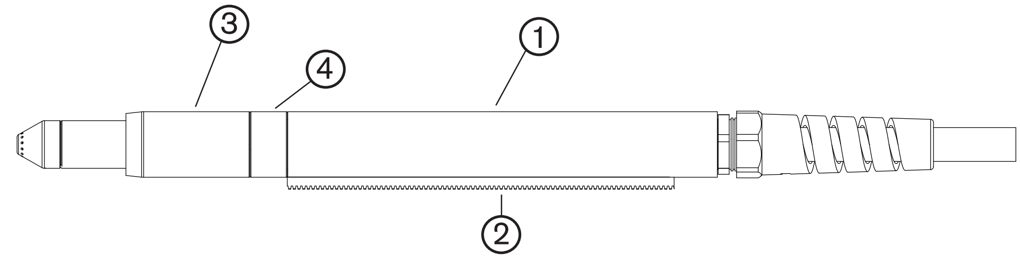
Item	Part number	Description
	059470*	Powermax65/85/105 15° hand torch assembly with 7.6 m (25 ft) lead
	059471*	Powermax65/85/105 15° hand torch assembly with 15 m (50 ft) lead
	059472*	Powermax65/85/105 15° hand torch assembly with 23 m (75 ft) lead
1	228955	Kit: Duramax 15°/HRTs torch handle replacement
2	075714	Handle screws, #4 x 1/2 slotted 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)

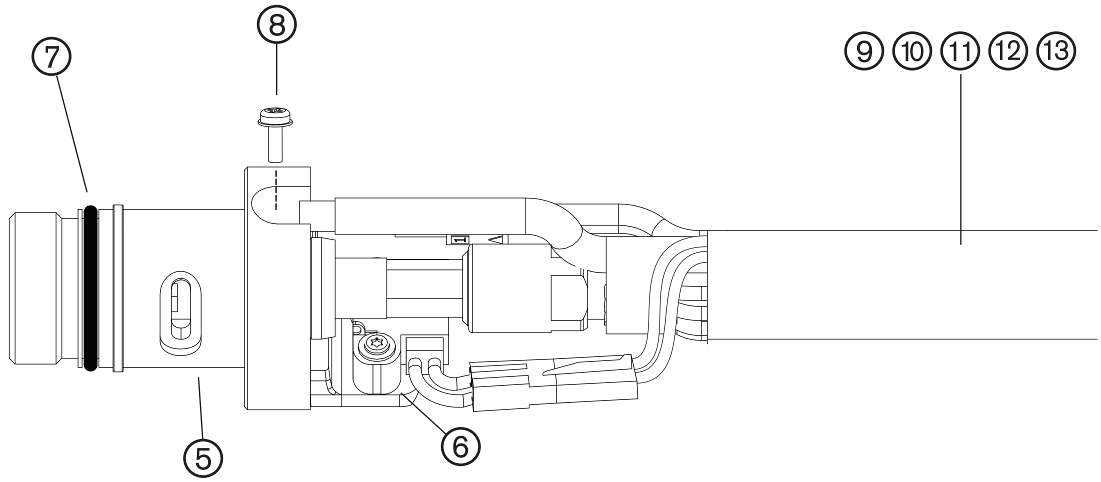
* The torch assembly does not include consumables. See page 11-15 for a list of part numbers for consumables.

Hand torch consumables

Part number	Description
Drag cutting	
220818	Shield 45/65/85 A
220992	Shield 105 A
220854	Retaining cap
220941	Nozzle 45 A
220819	Nozzle 65 A
220816	Nozzle 85 A
220990	Nozzle 105 A
220842	Electrode
220994	Swirl ring
Gouging	
220798	Maximum Removal gouging shield 45/65/85/105 A
420480	Maximum Control gouging shield 45/65/85/105 A
220854	Retaining cap
220991	Nozzle 105 A
220842	Electrode
220994	Swirl ring
FineCut	
220931	Deflector
220854	Retaining cap
220930	Nozzle
220842	Electrode
220947	Swirl ring
CopperPlus	
220777	CopperPlus electrode
HyAccess	
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 65 A)

Duramax 180° full-length machine torch replacement parts



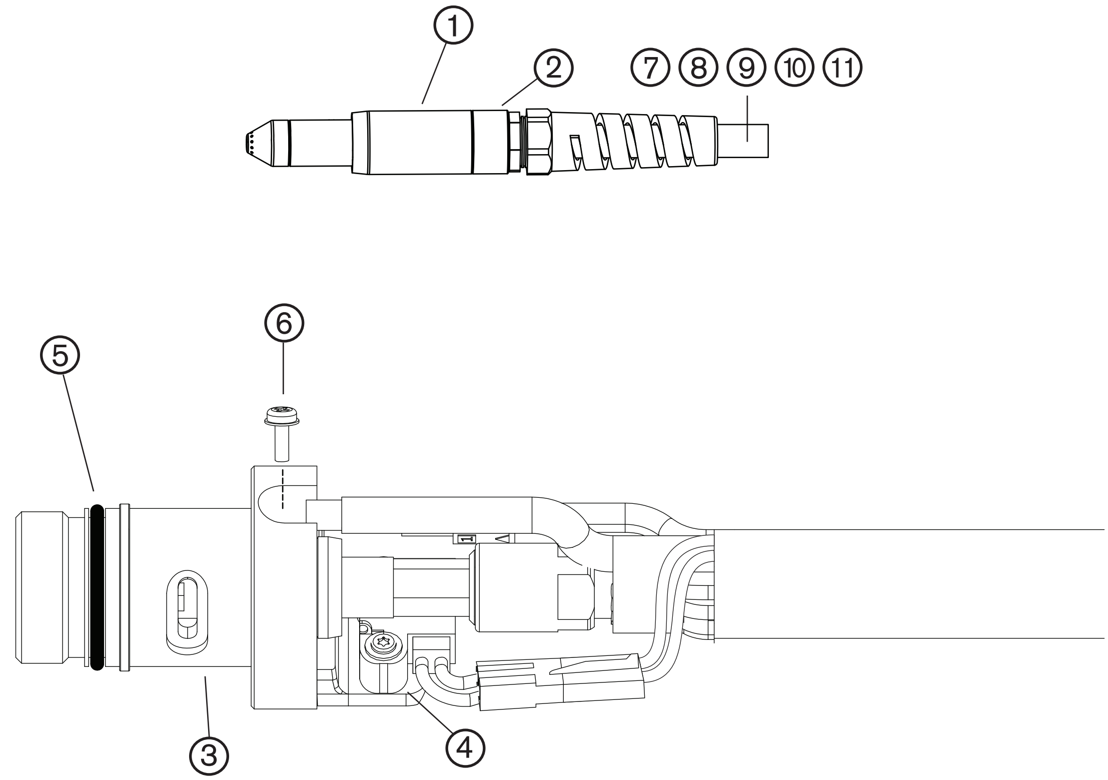


The entire machine torch and lead assembly can be replaced, or individual component parts can be replaced. Part numbers starting with 059 indicate complete torch and lead assemblies.

Item	Part number	Description
	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)

* The torch assembly does not include consumables. See page 11-20 for a list of consumable part numbers.

Duramax 180° mini 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.

Item	Part number	Description
	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)

* The torch assembly does not include consumables. See page 11-20 for a list of consumable part numbers.

Machine torch consumables

Part number	Description
Shielded	
220817	Shield 45/65/85 A
220993	Shield 105 A
220854	Retaining cap
220953	Ohmic retaining cap
220941	Nozzle 45 A
220819	Nozzle 65 A
220816	Nozzle 85 A
220990	Nozzle 105 A
220842	Electrode
220994	Swirl ring
Unshielded	
220955	Deflector
220854	Retaining cap
220941	Nozzle 45 A
220819	Nozzle 65 A
220816	Nozzle 85 A
220990	Nozzle 105 A
220842	Electrode
220994	Swirl ring
Gouging	
220798	Maximum Removal gouging shield 45/65/85/105 A
420480	Maximum Control gouging shield 45/65/85/105 A
220854	Retaining cap
220991	Nozzle 105A
220842	Electrode
220994	Swirl ring
FineCut*	
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) can be used with the standard retaining cap (220854) or the ohmic retaining cap (220953).

Accessory parts

Part number	Description
024877	Black leather torch sheathing with Hypertherm logo, 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
127360	Powermax105 dust cover
228695	Kit: Powermax65/85/105 air filter element (with O-ring)
128647	Kit: Eliminizer air filter (for moisture removal)
011092	Replacement filter element for Eliminizer air filter
228890	Kit: Eliminizer air filter with protective metal cover for the Powermax105
101215	Kit: Eliminizer air filter protective metal cover for the Powermax105 (cover only)
428719	Kit: Oil removal coalescing filter
428720	Kit: Replacement filter element for oil removal coalescing filter
428718	Kit: Mounting bracket for Eliminizer air filter or oil removal coalescing filter
223254	Kit: 105 A work lead with hand clamp, 7.6 m (25 ft)
223255	Kit: 105 A work lead with hand clamp, 15 m (50 ft)
223256	Kit: 105 A work lead with hand clamp, 23 m (75 ft)
223287	Kit: 105 A work lead with C-style clamp, 7.6 m (25 ft)
223288	Kit: 105 A work lead with C-style clamp, 15 m (50 ft)
223289	Kit: 105 A work lead with C-style clamp, 23 m (75 ft)
223284	Kit: 105 A work lead with ring terminal, 7.6 m (25 ft)
223285	Kit: 105 A work lead with ring terminal, 15 m (50 ft)
223286	Kit: 105 A work lead with ring terminal, 23 m (75 ft)
008337	Work clamp: 300 A
229467	Kit: Powermax105 wheel kit assembly

Powermax105 labels

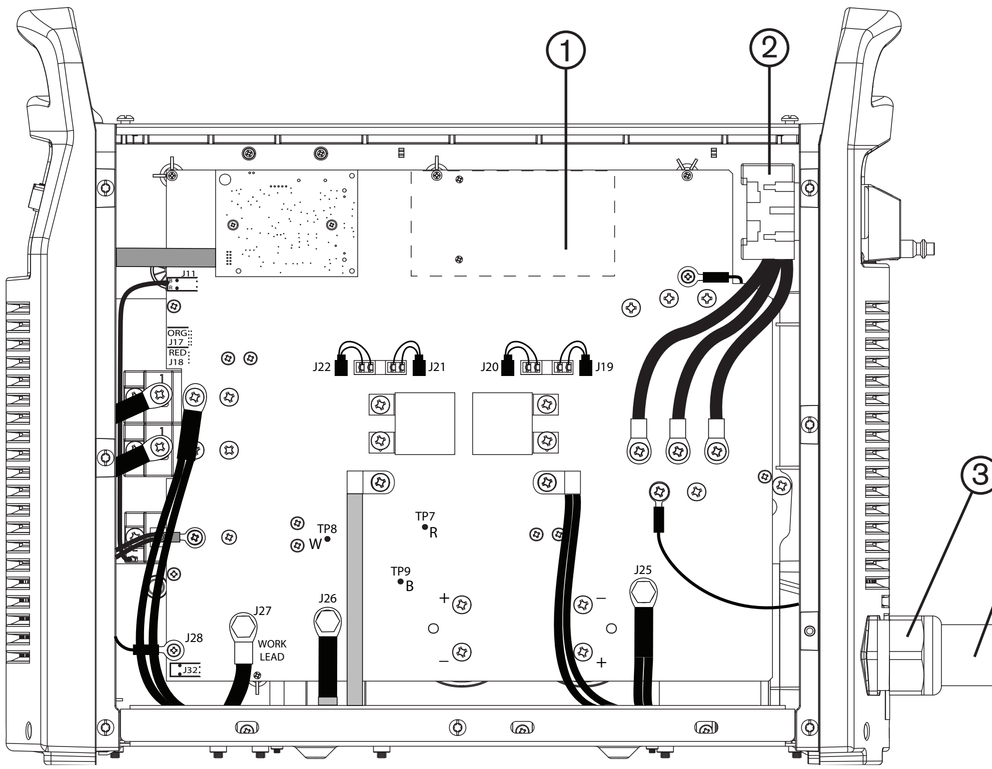
Part number	Description
228903	Kit: Powermax105 labels, CSA
228904	Kit: Powermax105 labels, CE

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

Safety-critical parts

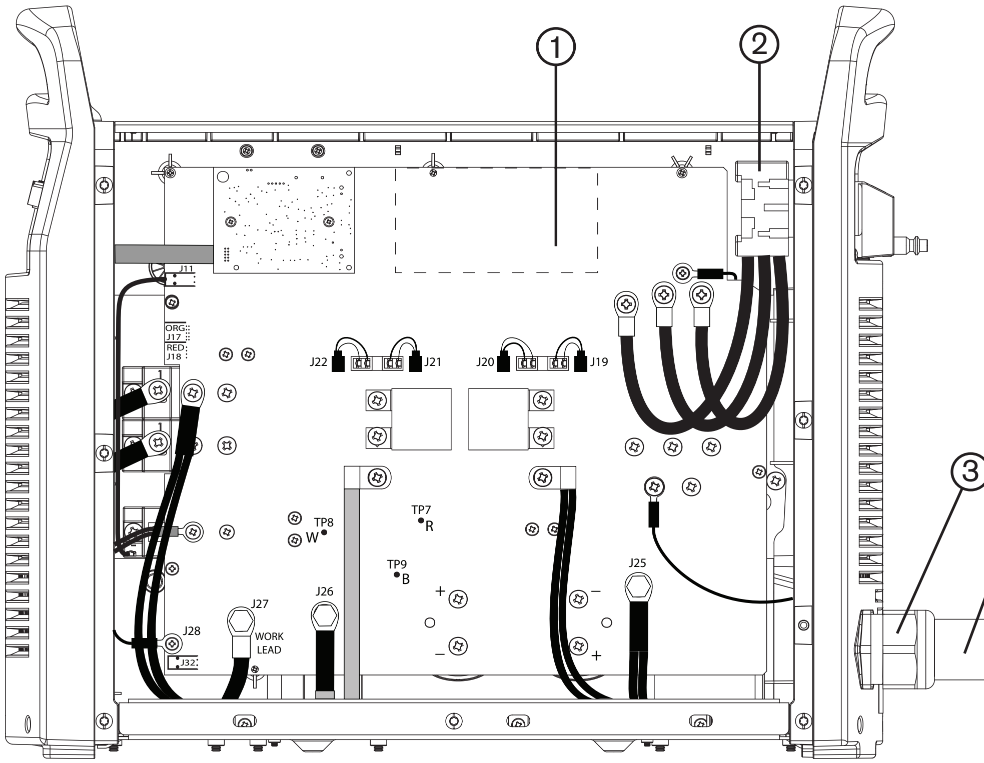
Genuine Hypertherm parts are the factory-recommended parts for your Hypertherm system. The parts listed below are considered safety-critical parts that must be replaced only with Hypertherm parts to maintain the warranty and all system certifications, including CE, CSA, GOST, and CCC certification.

200-600 V CSA



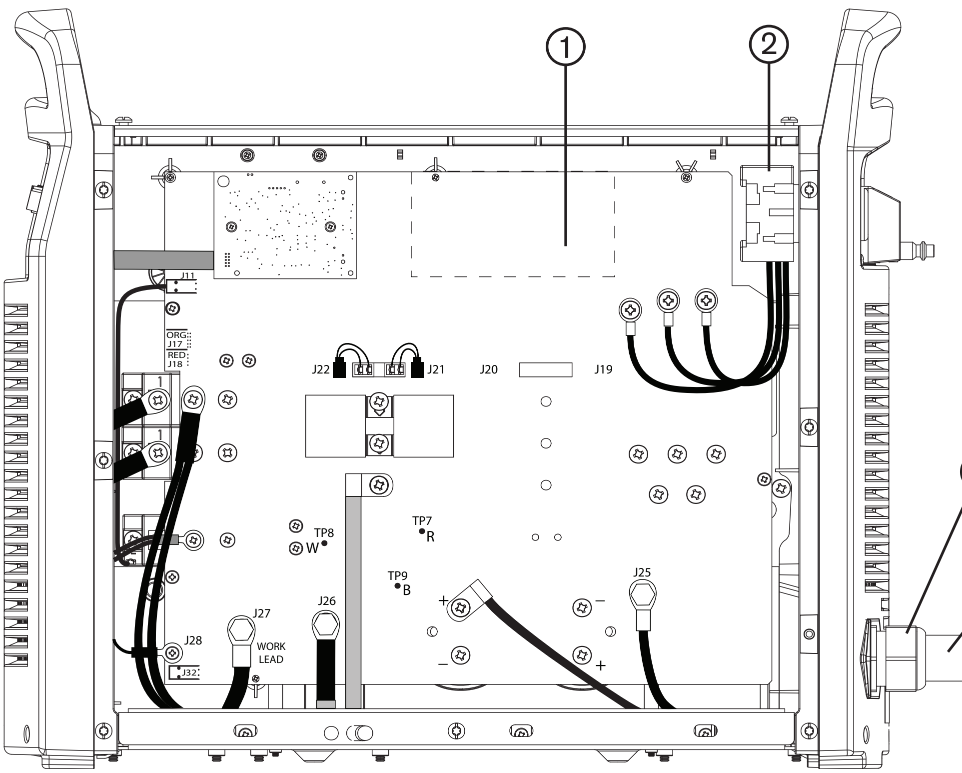
Item	Part number	Description
1	228876	Kit: Powermax105 power board 200-600 V CSA
2	228879	Kit: Powermax105 power switch 200-600 V CSA/230-400 V CE
3	228915	Kit: Powermax105 power cord strain relief CSA
4	228885	Kit: Powermax105 power cord 200-600 V CSA

230-400 V CE



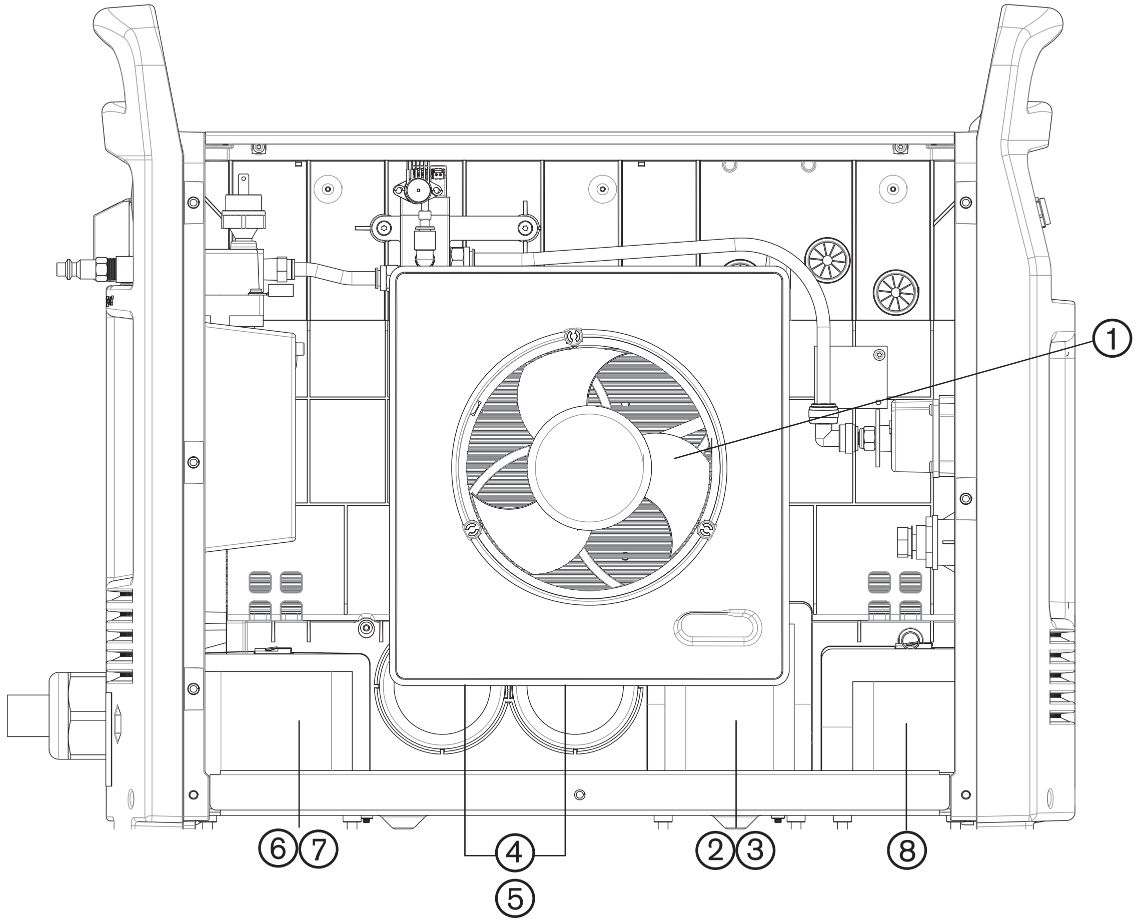
Item	Part number	Description
1	228877	Kit: Powermax105 power board 230-400 V CE
2	228879	Kit: Powermax105 power switch 200-600 V CSA/230-400 V CE
3	228913	Kit: Powermax105 power cord strain relief 230-400 V CE
4	228886	Kit: Powermax105 power cord 230-400 V CE

400 V CE/380 V CCC



Item	Part number	Description
1	228878	Kit: Powermax105 power board 400 V CE/380 V CCC
2	228880	Kit: Powermax105 power switch 400 V CE/380 V CCC
3	228914	Kit: Powermax105 power cord strain relief 400 V CE/380 V CCC
4	228887	Kit: Powermax105 power cord 400 V CE
5	228962	Kit: Powermax105 power cord 380 V CCC

Power supply fan side



Item	Part number	Description
1	228881	Kit: Powermax105 fan subassembly
2	228871	Kit: Powermax105 transformer 200-600 V CSA/230-400 CE (multivoltage)
3	228872	Kit: Powermax105 transformer 400 V CE/380 V CCC
4	228888	Kit: Powermax105 bulk capacitor 200-600 V CSA/230-400 CE (2 per kit)
5	228889	Kit: Powermax105 CE bulk capacitor 400 V CE/380 V CCC (2 per kit)
6	228873	Kit: Powermax105 PFC inductor 200-600 V CSA/230-400 CE (multivoltage)
7	228874	Kit: Powermax105 PFC inductor 400 V CE/380 V CCC
8	228875	Kit: Powermax105 output inductor

Recommended spare parts

Part number	Description
108797	Adjustment knob
108732	Operating mode knob
223254	Kit: 105 A work lead with hand clamp, 7.6 m (25 ft)
228866	Kit: Powermax105 front panel
228657	Kit: Powermax65/105 control board
228876	Kit: Powermax105 power board 200-600 V CSA
228877	Kit: Powermax105 power board 230-400 V CE
228878	Kit: Powermax105 power board 400 V CE/380 V CCC
228879	Kit: Powermax105 power switch 200-600 V CSA/230-400 CE
228880	Kit: Powermax105 power switch 400 V CE/380 V CCC
228871	Kit: Powermax105 transformer 200-600 V CSA/230-400 CE (multivoltage)
228872	Kit: Powermax105 transformer 400 V CE/380 V CCC
228888	Kit: Powermax105 bulk capacitor 200-600 V CSA/230-400 CE (2 per kit)
228889	Kit: Powermax105 CE bulk capacitor 400 V CE/380 V CCC (2 per kit)
228873	Kit: Powermax105 PFC inductor 200-600 V CSA/230-400 CE (multivoltage)
228874	Kit: Powermax105 PFC inductor 400 V CE/380 V CCC
228875	Kit: Powermax105 output inductor
228688	Kit: Powermax65/85/105 pressure switch
228687	Kit: Powermax105 regulator/solenoid valve
228881	Kit: Powermax105 fan subassembly
428351	Kit: Powermax65/85/105/125 air filter assembly (with air filter element, O-ring, and filter bowl)
228695	Kit: Powermax65/85/105/125 air filter element (with 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 slotted 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

Part number	Description
228959	Kit: Duramax hand torch lead replacement, 7.6 m (25 ft)
228960	Kit: Duramax hand torch lead replacement, 15 m (50 ft)
228961	Kit: Duramax hand torch lead replacement, 23 m (75 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
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: Powermax65/85/105 180° full-length/mini machine torch/MRT cap-sensor switch replacement
228730	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 4.6 m (15 ft)
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)
228734	Kit: Powermax65/85/105 180° full-length/mini machine torch lead replacement, 23 m (75 ft)

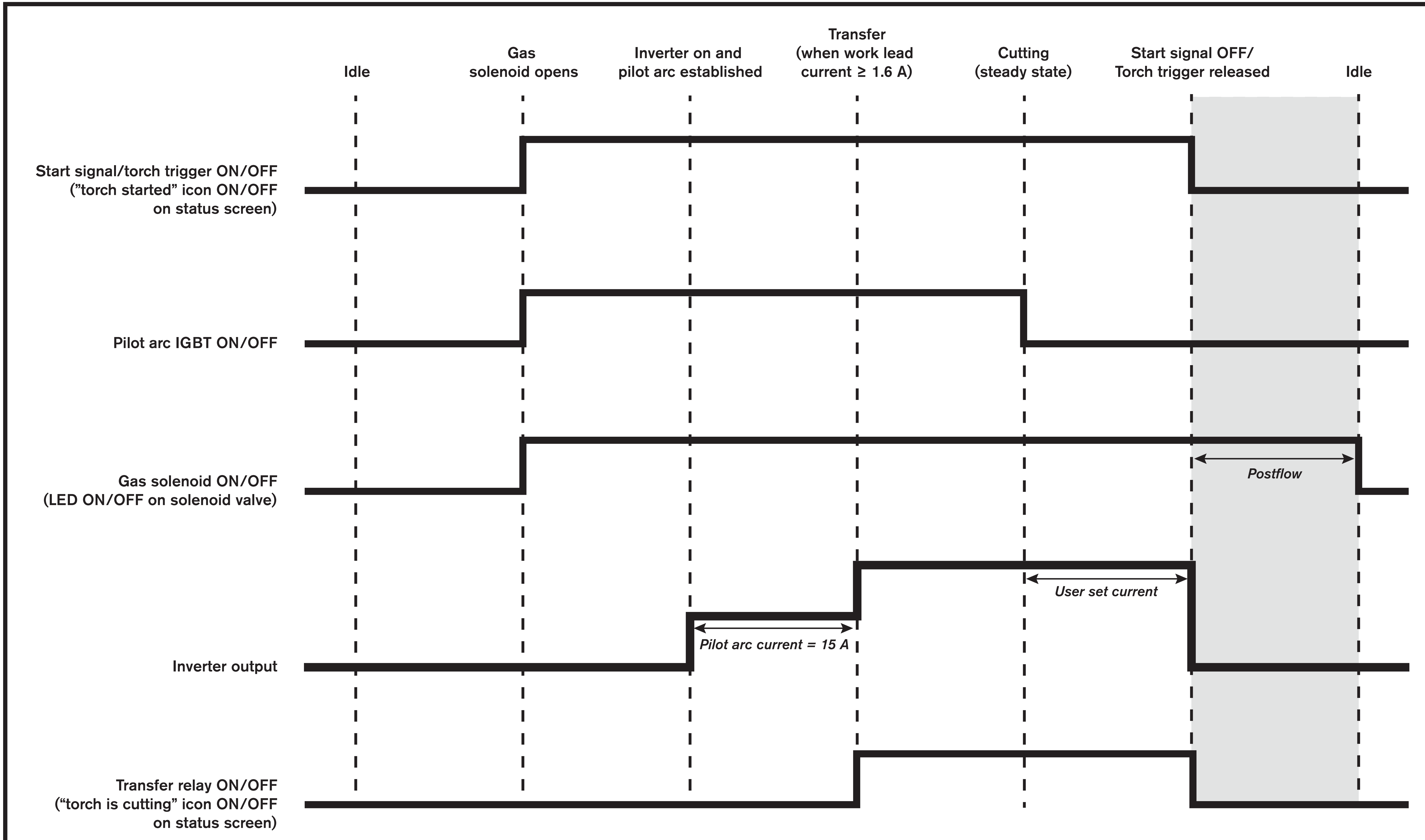
Section 12

WIRING DIAGRAMS

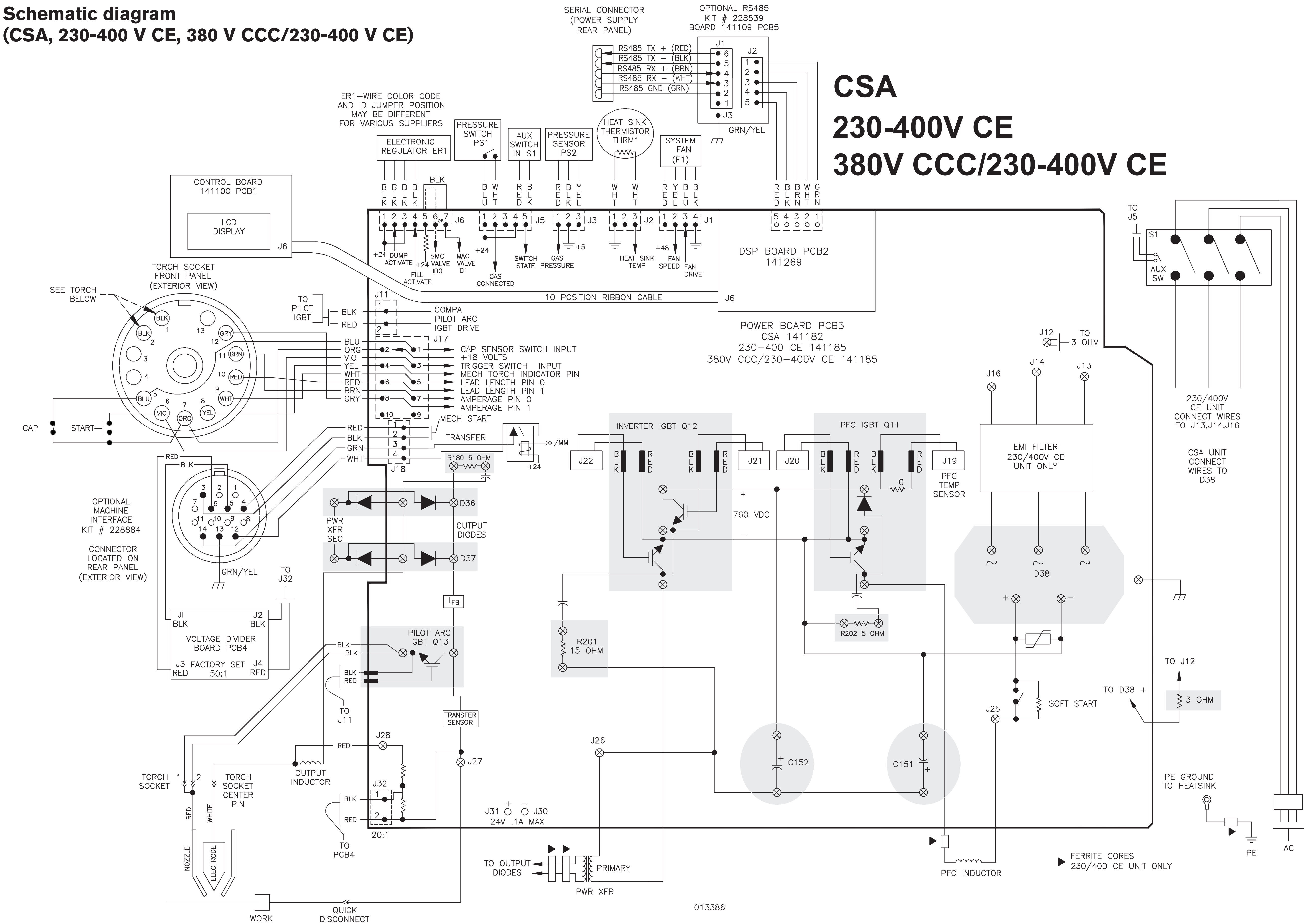
In this section:

Powermax Generic Timing Chart 12-3
Schematic diagram (CSA, 230-400 V CE, 380 V CCC/230-400 V CE) 12-4
Schematic diagram (380 V CCC, 400 V CE) 12-5

Powermax Generic Timing Chart



Schematic diagram
(CSA, 230-400 V CE, 380 V CCC/230-400 V CE)



Schematic diagram (380 V CCC, 400 V CE)