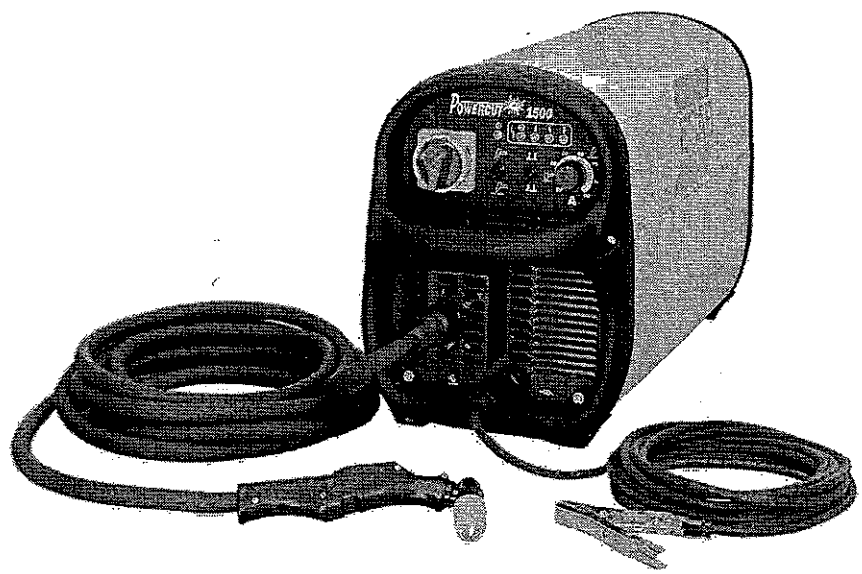
POWERCUT-1500



SERVICE INFORMATION

General Comments

The PowerCut 1500 is an inverter based air plasma cutter for metals up to 38mm (1½ ") thick. It utilises the PT-32EH plasma torch and is rated at 90A at 60% duty.

The PowerCut utilises HF and Pilot Current circuitry to initiate the arc. The torch fitted is a PT-32EH, this incorporates an air valve, which in combination with flow and pressure switches in the power source, provides "parts in place" protection - removing the shroud from the torch closes the air valve in the back of the torch head. Whilst no air can flow, no OCV can be present.

The PowerCut uses IGBT technology (Insulated Gate Bipolar Transistor), two IGBT's are used in this unit, each IGBT comprising two transistors.

The main control PCB provides current control, control of the air, HF and Pilot Current circuitry and other functions. The Control PCB1 utilises a PIC (Programmable Integrated Circuit) which provides all the logic functional controls.

CIRCUIT DESCRIPTION

Fan Motor Operation

Switching the machine ON puts the power light on and also gas preflow, however the fan motor is off at this time. Closing the Torch Switch causes the PIC circuit to energise optor (Q4) switching on the fan motor, the fan will continue to run for approx. 5 minutes after cutting stops.

Mains Input Circuitry

The mains supply input (3 phase 415V) is supplied to the primary rectifier bridge BR1 via the input on/off switch and an EMC filter.

The mains supply also feeds the control transformer T6 via a 2A fuse (F1), the fan motor being supplied via a 230Vac auto-winding on this transformer via an opto coupled device (Q4) controlled by PCB1.

Primary Circuits

Main bridge BR1 rectifies the incoming supply providing around 580Vdc. In addition the bridge incorporates a thyristor in its positive output leg which is gated by signals from the main control PCB1 via in-rush PCB4. Resistors on this PCB4 bypasses the thyristor initially soft charging the dc capacitors. When the torch switch is operated the dc thyristor is gated, effectively bypassing the resistors on PCB4, making available full power from the bridge and supply.

The IGBT 's are arranged in bridge configuration feeding the main transformer, the individual transistors being gated alternately in pairs, effectively supplying ac power to the primary of the main transformers T2 & T4. Hall effect devices T5 & T7 monitor the pilot and mains current send signals to the main PCB1.

Correctly timed gate signals are fed from the main PCB1 (via driver PCB7). **Note:** always replace this driver PCB when replacing a failed IGBT module.

Main Secondary

The secondary of the main transformers is full wave rectified by diode modules D7 & D8 and power is fed to the torch electrode (-ve) via smoothing inductor L2 and HF coupling transformer T8. A Hall Effect device (T5) in the workside (+ve) feeds current signals back to the main PCB1. An HF bypass and "Easy Start" network (resistors and capacitors) is incorporated on PCB6 across the machine output.

The HF consists of high voltage transformer (T8) the primary of this being fed by high frequency PCB2, this controlled via the main PCB1. The secondary of this transformer injecting HF into the torch (-ve) side of the system.

Electronic Control

Auxiliary ac supplies for the main PCB1 are generated by transformer T6. **Note:** there are 6 separate auxiliaries which include 575Vac for the HF generator.

The front panel of the machine carries the Display PCB3, this consists of all the fault indicator LED's. The current control , trigger lock and air-check switches, it is connected directly to PCB1 via edge connector 'J'. For the connections see Measurements/Voltages section below.

The main PCB1 drives the gas solenoid valve SOL1 with 24Vac. This via connections J4-3 & J4-4 on this PCB1 and connections J1-5 & J1-4 on in-rush PCB4. **Note:** when the front panel air check switch is operated air will flow continuously and cutting is not possible, this inputs directly to the PCB1 and the PIC circuit. A flow switch (FS1) and pressure switch (PS1) confirms air is flowing and inputs to PCB1 together with signals from the check/run switch. The unit is fitted with a trigger lock/unlock switch (in the display PCB). When this is operated (closed) the torch switch is electronically latched and can be released once current is detected as sensed from the sensing circuit (T5). Either re-operating the torch switch or pulling the torch away from the work will stop the arc and re-set the system.

Referring now to the main PCB1. Low voltage dc supplies are 24V unregulated, +15V, -15V, +5V. TP1O is OV (signal ground) and TP7,8 & 9 can be used to check the regulated supply voltages, see attached sheet marked section 5, page 168.

LED4 indicates that the relay K2 is powered turning on the Pilot Current, and LED1 indicates that the gas solenoid valve has been energised.

There is no LED indicating HF has been energised. This is energised via J3-1 & J3-2 on the PCB1, this controlling the High Frequency Control PCB2 that supplies the primary of the HF Transformer (T8).

The input from the flow & pressure switches should be OV if enough air is flowing and the switches are operated (+5V if not). Similarly the input from the thermal switch should be OV if the machine is not overheated (5V if it is).

Powercut 1500 – Measurements/Voltages

Fan Motor	-	230Vac
Torch Switch Circuit	-	12Vac
Gas Solenoid Valve	-	24Vac
Pilot Arc Relay Coil	-	24Vac

The following are all part of the Display PCB, connections are as follows:

Connections J1-1 is +15V
Connections J1-10 is OV

Current Control Potentiometer:

Top connected to J1-1, bottom to J1-10 and wiper to J1-9

Power On LED	– connected to J1-1 and J1-2
High/Low Volts LED	– connected to J1-1 and J1-3
Over Temp LED	– connected to J1-1 and J1-4
Fault LED	– connected to J1-1 and J1-5
Gas Pressure LED	– connected to J1-1 and J1-6
Trigger Lock Switch	– connected to J1-1 and J1-7
Air Check Switch	– connected to J1-1 and J1-8

To be read in conjunction with the troubleshooting section of the instruction manual pages 164-171.

4.1 GENERAL

If this equipment does not operate properly, stop work immediately and investigate the cause of the malfunction. Maintenance work must be performed by an experienced person, and electrical work by a trained electrician. Do not permit untrained persons to inspect, clean, or repair this equipment. Use only recommended replacement parts.

⚠ WARNING

Be sure that the wall disconnect switch or wall circuit breaker is open before attempting any inspection or work inside of the Powercut-1500.

4.2 INSPECTION AND CLEANING

Frequent inspection and cleaning of the Powercut-1500 is recommended for safety and proper operation. Some suggestions for inspecting and cleaning are as follows:

A. Check work cable for secured connection to workpiece
B. Check safety earth ground at workpiece and at power source chassis.
C. Check heat shield on torch It should be replaced if damaged.
D. Check the torch electrode and cutting nozzle for wear on a daily basis. Remove spatter or replace if necessary.
E. Make sure cable and hoses are not damaged or kinked.
F. Make sure all plugs, fittings, and ground connections are tight
G. With all input power disconnected, and wearing proper eye and face protection, blow out the inside of the Powercut-1500 using low-pressure dry compressed air.

CAUTION

Water or oil occasionally accumulates in compressed air lines. Be sure to direct the first blast of air away from the equipment to avoid damage to the Powercut-1500.

H Occasionally, bleed all water from the filter beneath the air filter-regulator.

4.3 PT-32EH TORCH CONSUMABLE PARTS

⚠ WARNING

Make sure power switch on POWERCUT-1500 is in OFF position before working on the torch.

⚠ WARNING

The PT-32EH torch head contains a gas flow check valve that acts in conjunction with the flow switch and circuitry within the power source. This system prevents the torch from being energized with high voltage if the torch switch is accidentally closed when the shield is removed. Always replace torch with the proper torch manufactured by ESAB since it alone contains ESAB's patented safety interlock.

To assemble the consumable parts, refer to Figure 3 3 .

4.4 IGBT Handling & Replacement

Since IGBT gates are insulated from any other conducting region, care should be taken to prevent static build up, which could possibly damage gate oxides. All IGBT modules are shipped from the factory with conductive foam contacting the gate and emitter sense pins.

Always ground parts touching gate pins during installation. In general, standard ESD precautions application to FETs should be followed.

Other handling precautions that should also be observed are as follows:

- Use grounded work station with grounded floors and grounded wrist straps when handling devices
- Use a 100Ω resistor in series with the gate when performing curve tracer tests.
- Never install devices into systems with power connected to the system.
- Use soldering irons with grounded tips when soldering to gate terminals.

When mounting IGBT modules on a heatsink, certain precautions should be taken to prevent any damage against a sudden torque. If a sudden torque ("one-sided tightening") is applied at only one mounting terminal the ceramic insulation plate or silicon chip inside the module may get damaged.

The mounting screws are to be fastened in the order shown in Figure 4-2. Also, care must be taken to achieve maximum contact (i.e minimum contact thermal resistance) for the best heat dissipation.

Application of a thermal pad on the contact surface improves its thermal conductivity. See Replacement Parts section for the required pad.

A torque wrench should be used. Tighten mounting screws to 28 in-lbs; wire connecting screws to 19 in-lbs. If torque is too heavy, the device can damage like the above "one-sided tightening"

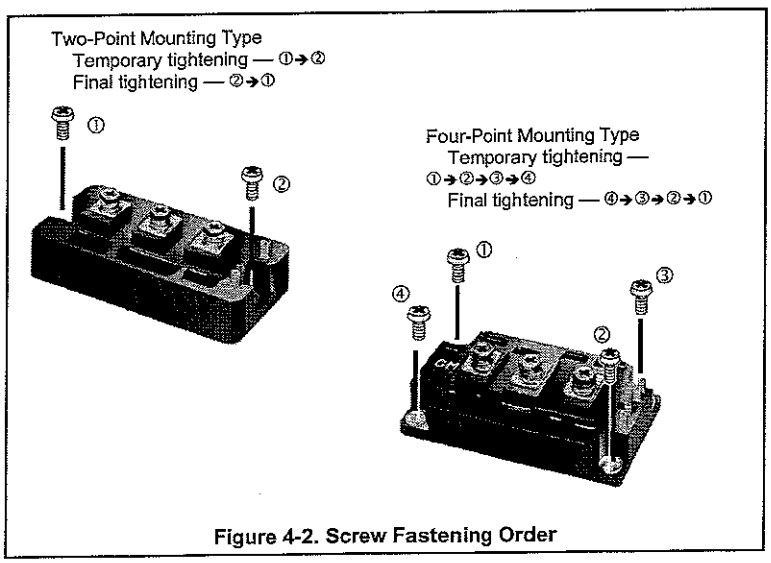


Figure 4-2. Screw Fastening Order

5.1 TROUBLESHOOTING

WARNING

ELECTRIC SHOCK CAN KILL! Be sure that all primary power to the machine has been externally disconnected. Open the line (wall) disconnect switch or circuit breaker before attempting inspection or work inside of the power source.

Check the problem against the symptoms in the following troubleshooting guide. The remedy may be quite simple If the cause cannot be quickly located, shut off the input power, open up the unit, and perform a simple visual inspection of all the components and wiring. Check for secure terminal connections, loose or burned wiring or components, bulged or leaking capacitors, or any other sign of damage or discoloration.

The cause of control malfunctions can be found by referring to the sequence of operations and electrical schematic diagram (Figure 5-1) and checking the various components. A volt-ohmmeter will be necessary for some of these checks.

WARNING

Voltages in plasma cutting equipment are high enough to cause serious injury or possibly death. Be particularly careful around equipment when the covers are removed.

NOTE

Before checking voltages in the circuit, disconnect the power from the high frequency PC Board (PCB-2, Connector J2) to avoid damaging your voltmeter.

5.2 TROUBLESHOOTING GUIDE

A. Power Light does not come on.

1. Visually inspect the machine for any damage

2. Check following:

   a. Check if the machine power cord is plugged into the input power receptacle.
   b. Measure the input power at the receptacle If not present, then check the wall disconnect switch and it's fuses.
   c. Check Fuse (F1)

3. If above items check OK , the problem is internal. Send unit to an Authorized Repair Station for repair

   a Ensure that ribbon cable is connected to main PCB-1 and front panel PCB-3
   b Measure voltage between pins P7-5 and P7-6 of the control board. If there is no voltage, then replace Control Transformer (T6).
   c. If the voltage is present, then the pilot light may be burnt out

B. No Air Flow

1. Check air inlet supply. Unit requires 350 cfh at 80psig.

2 Check air hose and connections. Tighten if leaking.

3 Does air flow when "air test" switch is in test position?

   a. If not, check torch consumables, replace if necessary.
   b. If above items check OK , the problem is internal. Take unit to an Authorized Repair Station for repair.

C. The Power light is on, but nothing happens when the torch switch is depressed. Fault light does not activate.

NOTE: Unplug high frequency connection before attempting to work on this problem.

1. With the machine power on, depress the torch switch. On the control board the LED 1 should be lit as long as the switch is depressed. If not then check:

   a Turn power off to the machine. Unplug Control board. Put an ohmmeter across J3-3 and J3-4 to take resistance reading. Depress torch switch Meter should read a short. If not, then one of the following is not working properly:
   b Torch switch or the leads. Unplug the torch switch leads at the machine. Put a meter across the two plug pins Should read a short when the torch switch is depressed. If not, then either broken switch leads or malfunctioning switch.

2. Check transformer secondary voltages at the output diode modules.

Refer to system schematic. Replace the transformer module if the correct secondary voltages are not present.

3 If everything above checks out all right, then the PCB1 Control Board should be replaced.

D. Fault light activates when torch switch is closed.

The machine monitor conditions necessary for the safe operation of the Powercut-1500. The fault lights will glow under the following conditions and operations will come to a stop.

1 **High/Low line voltage**. The "AC LINE" light will blink to indicate that the input voltage is outside the +/- 15% range of the nominal voltage.

2. **Gas Flow indicator** - The fault light will blink to indicate that the air flow is low or that the torch is not providing any back pressure.
   a. Check the air pressure at the machine regulator. It should be adjusted to 80 psig. If no air pressure, check the air at the supply point. Also, check for any obstructions in the air hose.
   b. Air flow may be blocked at the torch tip. Check the torch consumables (see Figure 3.3). Also check for any obstructions in the torch leads.

   NOTE: If above items check OK , the problem is internal. Send unit to an Authorized Repair Station for repair.

   c. Put the 'Air Check' switch to On position. Air should flow through torch. If not, and air pressure is set at required 80 PSIG, check gas Solenoid (SOL1) for proper operation.
   d. Air Check switch may also be malfunctioning if the air is flowing continuously or putting in the On position does not turn air on.

3. **Over Temperature indicator .** The fault light will blink to indicate that the machine is overheated. This generally indicates that the air flow has been blocked. Clear blockage and allow the power source to cool before operating.

   a. Thermal Switch (TS1) may be open. It will open if the heat sink temperature reaches 80°C. With the machine power off, check the continuity between P6-7 and P6-8 of the control board. If the switch is OK, then the ohmmeter should read a direct short. If not then it should read open
   b. If the switch is malfunctioning, replace it. Clean the surface of the heat sink before installing the switch

4. **Fault Indicator**. When this light blinks, either the system failed to initiate a pilot arc after a number of attempts, or there has been an over-current event within the system.

   a. If the light blinks for 10 seconds and then stops, then the problem is pilot arc initiation. Check the consumables in the torch.
   b. If the light continues to blink, and the system does not reset, then the fault is an over-current event. One likely source of an over-current fault is a nozzle to electrode short. Turn off the machine and inspect the torch and its consumables. Replace the consumables as needed. Turn the machine back on. If the problem occurs again, the machine may require service.

c. To check if the output is shorted, measure the resistance by putting the ohmmeter leads across the output. Put the black lead to the "work" terminal and the red lead to the torch electrode terminal. The reading should be about 2K OHMs.

b. If the resistance reading is different than above, check the torch, the output bridge and Start-up Board (PCB-6).

E. Air is On but nothing happens when torch switch is operated.

1. Check the torch. Make sure that the valve pin is installed and the heat shield is very tight.

2. Check to assure high frequency is present at the torch. **Disconnect HI FREQUENCY leads.** Check for 575 volt supply to the high frequency unit between P2A-1 & P2A-3 of the High Frequency Board (PCB2) with torch switch closed.

3. With HI FREQUENCY leads disconnected, measure open circuit voltage. It should be 320 VDC between "Work" and "Torch" terminals If it is not present then any one of the following may not be working properly:

   a. Check the operation of the Thermal Switch (TS1). See D.3 a. above.
   b. Check Air Check switch operation. It might be stuck in On position. Pilot arc will not initiate if this switch is in the ON position. (safety reasons)
   c. Check air flow switch. There may be internal short. See D.2 c above.
   d Measure voltage across C5 or C6 capacitor. It should be as follows:

   approx. 325 VDC with 230 V supplied to the 230/460 volt unit.
   approx. 294 VDC with 208 V supplied to the 230/460 volt unit
   approx. 325 VDC with 460 V supplied to the 230/460 volt unit
   approx. 400 VDC with 575 V supplied to the 575 volt unit

   If not, one of following could be malfunctioning:

   1). Check the capacitors C5 and C6 for any damage.

   2.) Check input bridge/SCR Module (BR1) This can be checked without taking it out of the circuit using an volt/ ohmeter. Replace it if found malfunctioning. Follow bridge installation instructions.

   3.) Check Inrush current resistor (R1), located on the Input Bridge Heatsink and SCR (Q1) Replace if malfunctioning

   e. IGBTs may be damaged See IGBT installation procedure. Before replacing IGBTs, make sure to check the zener diodes and pico fuses on the IGBT driver boards

F. High Frequency and Pilot Arc are on but Main Arc does not transfer.

1. Make sure work clamp is connected to work material.
2. Check the torch. Replace consumables if necessary.

G. Poor Cutting Performance.

1. Check air supply regulator It should be adjusted to 80 psig.
2. The air supplied to the torch should be free of oil and water.
3. Make sure the consumables in the torch are acceptable.
4. Check open circuit voltage. See E.3 above.
5. Check the output. Use a calibrated current probe capable of measuring 100 amps in the presence of high frequency.

H. Air does not shut off.

1. Check air test, the gas solenoid valve is energized when the switch is in the "on" position.
2. Does air flow stop when the torch switch is unplugged? If yes, check and repair the torch If not, send unit to an Authorized Repair Station for repair.
   a. Check voltage to solenoid coil, if present when torch switch is unplugged, replace PCB1. If voltage is "0", replace solenoid valve.

I. Main arc is difficult to start.

1. The most common reason is worn or missing consumables. Check and replace if necessary.
2. Input air must be clean and dry.
3. Input air pressure must be 80 psig.
4. Torch connections must be tight.
5. Work cable and clamp must be in good condition and must make a good electrical connection to the material to be cut.
6. If above items check OK , the problem is internal Send unit to an Authorized Repair Station for repair.
   a. Missing or weak pilot arc. Check pilot arc fuse, open circuit voltage and pilot arc wiring
   b Inoperative Start-up Board (PCB-6).

5.3 REFERENCE VOLTAGE CHECKS

A. Control Board Assembly (PCB1)

1. **LED's**

LED- (D9)- Torch Switch
LED- (D4)- Pilot Arc Relay
LED- (D1)- Gas Solenoid Valve

2. **Voltage Test Points**

Tests are made with power on - no arc

Disable High Frequency by disconnecting blue wire with black sleeve

TP-1 - Torch trigger signal
TP-4 - IGBT's driving signal - switching frequency = 18.5 KHz
TP-5 - IGBT's driving signal - switching frequency = 18.5 KHz
TP-7 - +5 vdc
TP-8 - +15 vdc
TP-9 - -15 vdc
TP-10- Ground

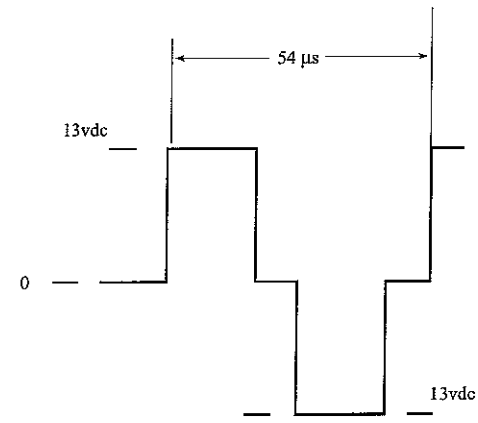
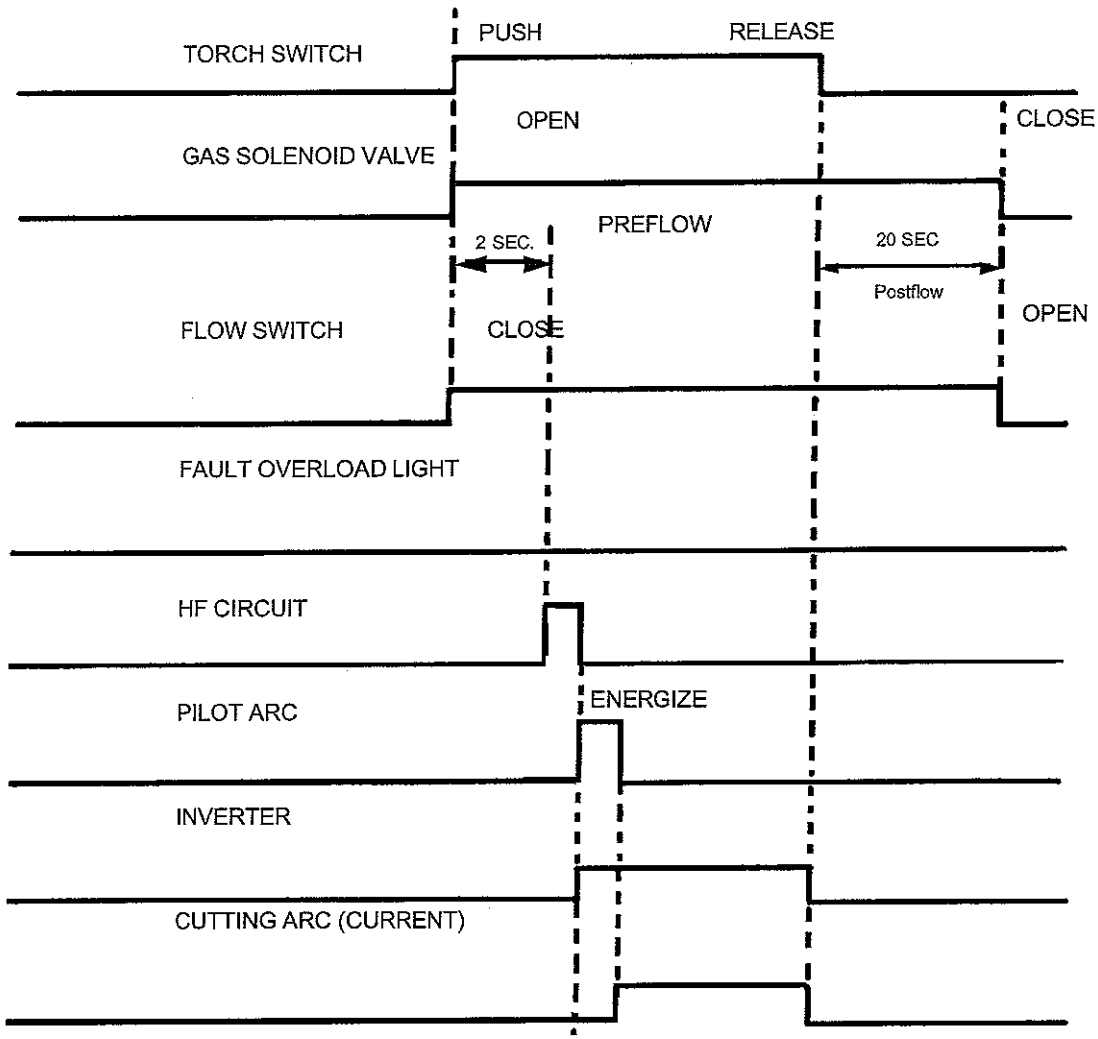


Figure 5.1 IGBT Gating Signal

5.4 SEQUENCE OF OPERATION

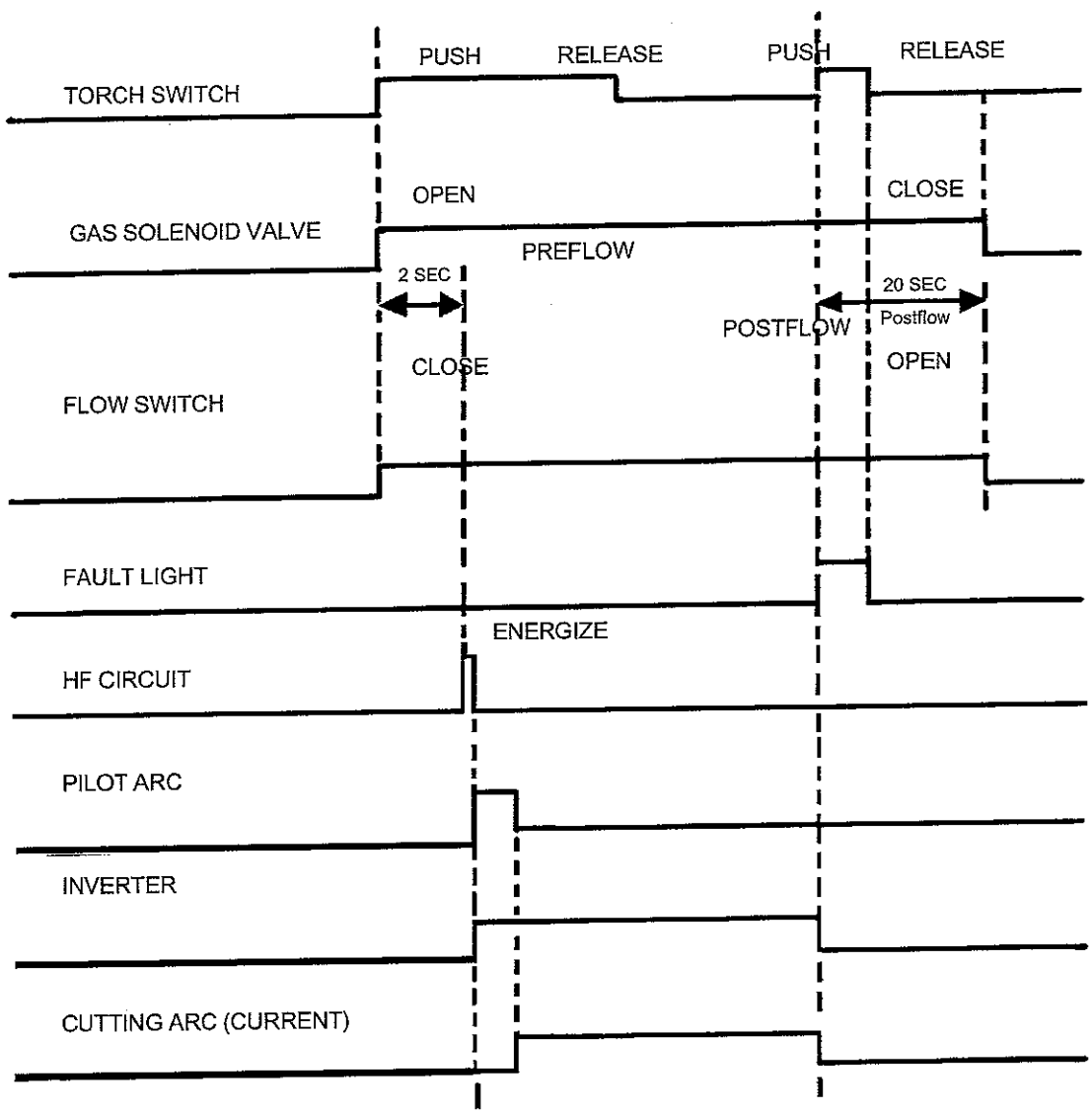
A. TRIGGER LOCK "UNLOCK" position



NOTES:

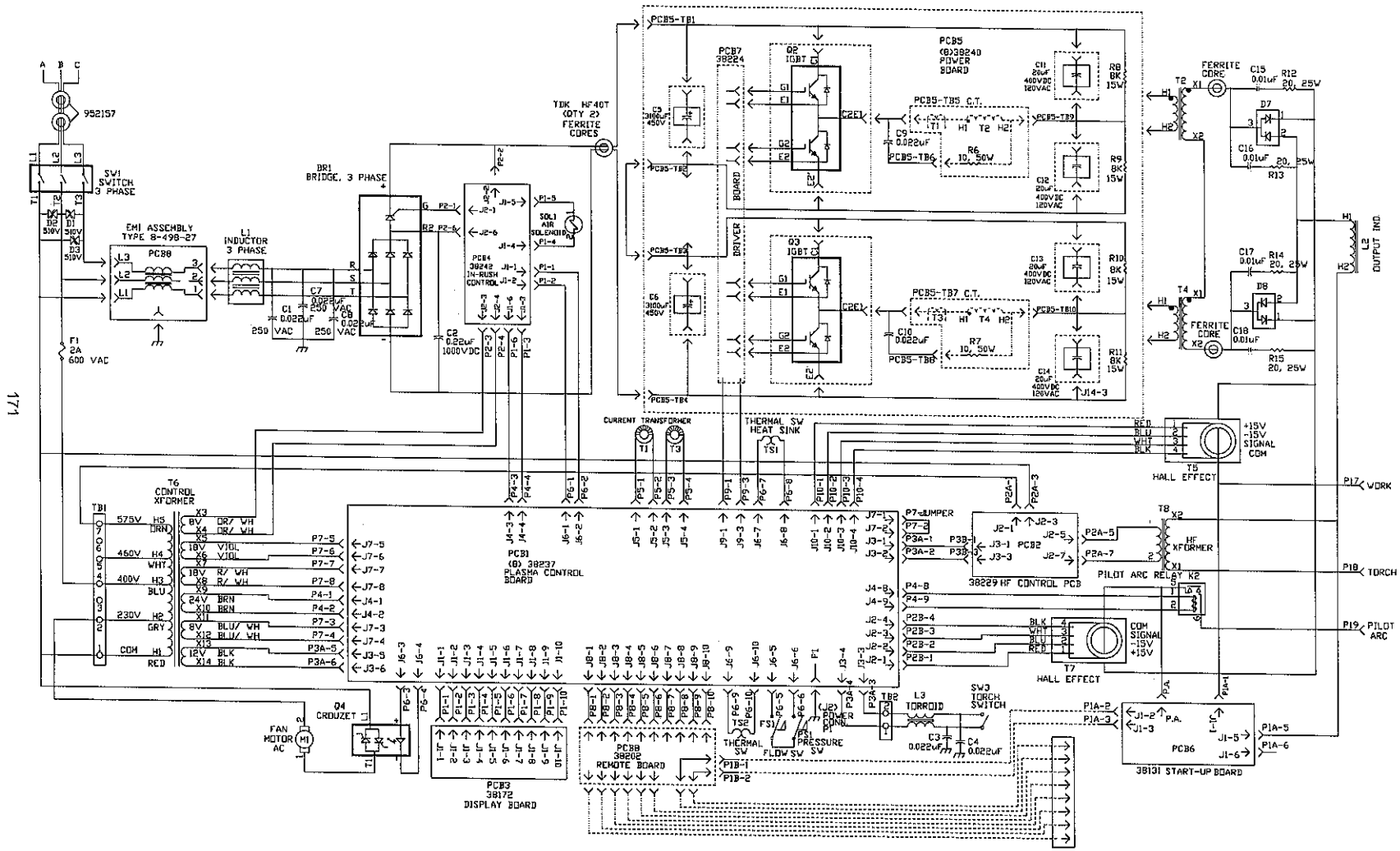
1. When the torch switch is pushed during postflow period, the postflow and preflow times are canceled, and the HF is energized immediately
2. When the amber fault light comes on, cutting operation should be stopped. The postflow time starts from the moment the torch switch is released.

B. **TRIGGER LOCK "LOCK" position**



NOTES:

1. When the torch switch is pushed during postflow period, the postflow time is reset, the preflow time is canceled, and the HF is energized immediately.
2. When the red fault light comes on, cutting operation should be stopped. The postflow time starts from the moment the torch switch is released.
3. FAULT light is on during second "turn-off" trigger only. This does not affect performance in any way.



Powercut-1500 Schematic Diagram