

3 October 2001

BULLETIN #173

## VORTEX DX16-0

### REPAIR AND TROUBLESHOOTING GUIDE

The attached Troubleshooting Guide explains the operating principles of the unit, outlines a procedure for testing and lists causes and remedies for known DX16-0 problems.

#### Theory of Operation

Use Figure 1 to locate each component.

1. **Power switch** - when turned on mains power is supplied to the Input PCB.
2. **Filter Network** – filters inlet power to suppress radio noise. 275volt varistor protects from over voltage.
3. **Soft start** - at turn on, power is diverted through a 100 ohm resistor to limit the current while the filter capacitors are charging.
4. **Relay** – driven by a photo triac on the Input PCB. The logic section turns this on when the capacitors have charged. The relay contacts close and current now bypasses the soft start resistor.
5. **Bridge Rectifier** – rectifies AC into DC.
6. **Filter Capacitors** filter the DC.
7. **Switch Mode Power Supply** – provides low voltage for the fan, logic and driver sections. Supplied with 340 volt DC from the Input PCB.
8. **Fan** – supplied with 240volt whenever the power switch is turned on.
9. **Logic Section** – receives signals and controls all loads.
10. **Pulse Transformer Section** – drives the Integrated Gate Bipolar Transistors (IGBT).
11. **IGBTs** – turned on and off at high frequency to provide a “chopped” waveform. The weld current increases when this frequency is increased.
12. **Capacitor** and 13. **Inductor** combine to form a resonant circuit which operates at high frequency.
14. **Transformer** – reduces the voltage, increases the welding current and electrically isolates the welding output from the mains supply.
15. **Rectifier** – converts the transformer output to DC.
16. **Snubber Circuit** – suppresses over voltage across the rectifier diodes.

*QUALITY WELDING PRODUCTS, SYSTEMS AND SERVICES*

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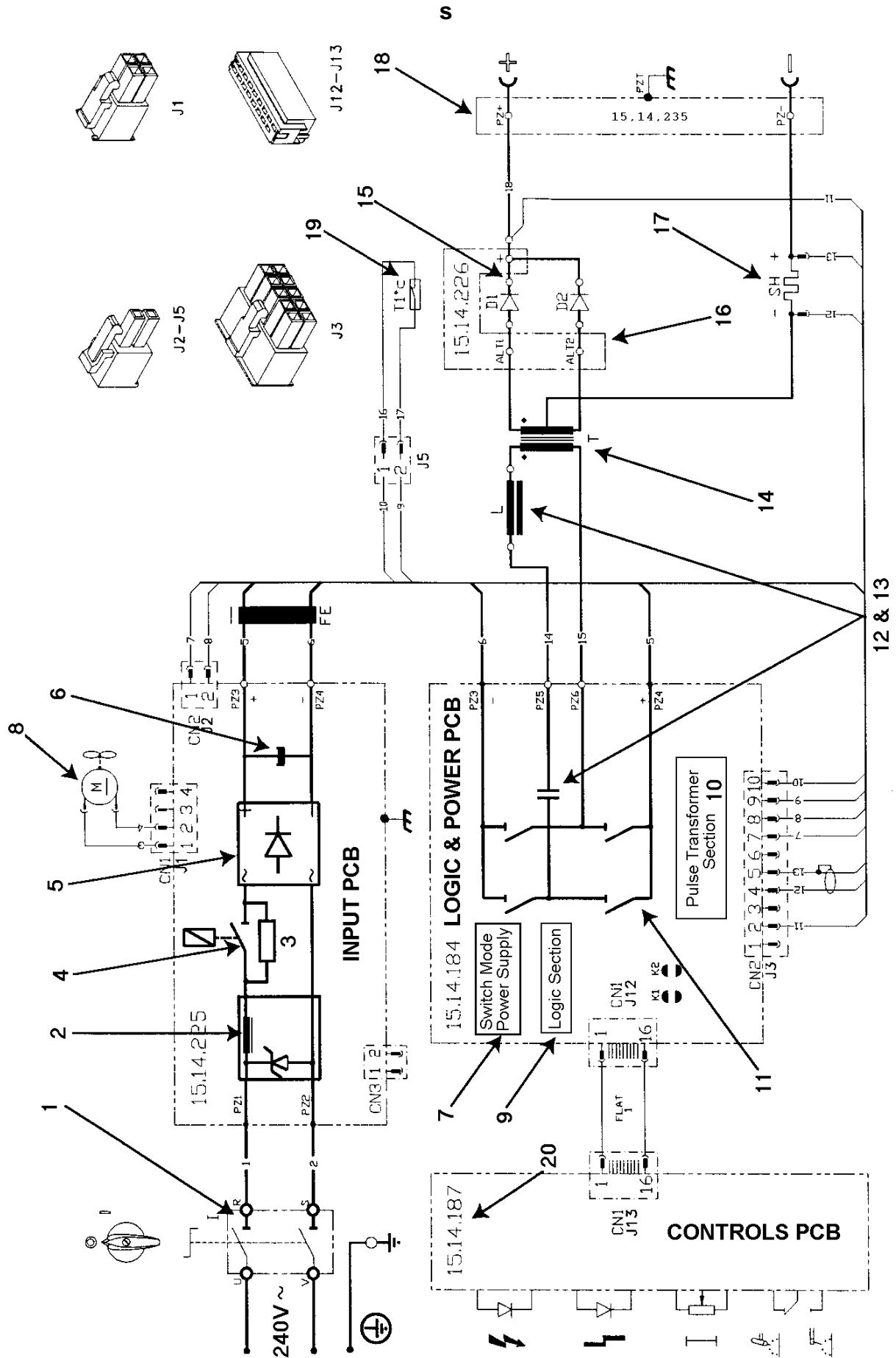
The information provided in this sheet is accurate and reliable , however no warranty of accuracy or reliability is given and no responsibility arising in any other ways by errors or omissions is accepted. Any information involving mains or high voltage is intended for use by qualified electrical personnel only.

17. **Shunt** – sends a signal to the logic section proportional to the current in the welding circuit. This feedback signal is used to maintain the correct level of weld current.
18. **Output Filter PCB** - filters out unwanted high frequency signals at the welding terminals.
19. **Thermostat** – located on the output rectifier heat sink and goes open circuit if the temperature of the rectifier heat sink exceeds a critical value. This signals the logic section to stop driving the IGBTs and turn on the over temperature LED on the front control panel. The fan continues to operate and when the heat sink cools sufficiently the over temperature LED goes out and the unit can be used again.
20. **Front Control Panel**
- **Power on Lamp** (green)– is on whenever the main switch is on. Supplied with 5 volts from the switch mode power supply.
  - **Over Temperature LED** (yellow)– indicates that the rectifier temperature is too high.
  - **Current Control** – sets the weld current (from 5 amp to 160 amp) by varying a reference voltage to the logic section.
  - **TIG Mode** – used for GTAW welding. The output voltage is higher than that used for SMAW welding. The output current is limited to approximately 30 amp during the initial short circuit until the electrode is raised.
  - **Stick Mode** – used for SMAW welding.  
180% of the selected weld current is supplied until the arc is initiated.  
If a short circuit appears while welding, 130% of selected weld current is supplied. If the short circuit remains for more than a few tenths of a second, the output current is limited to 30 amp.

### Specifications:

Primary voltage .....	240volt
Maximum primary current .....	32.2amp @ 160 amp output 22.2amp @ 120 amp output
Welding Current .....	160amp @ 40% 130amp @ 60% 120amp @ 100%
Adjustable from .....	5amp to 160amp
Open Circuit Voltage .....	54volt

Figure 1 General Circuit Diagram



## PARTS LIST

Item	Part	Description
1	VR14.70.018	Front Cover Moulding
2	VR03.07.035	Top/Side Metal Cover
3	VR14.70.017	Back Cover Moulding
4	CP106-0/3	Primary Cable and Plug
5	VR06.37.087	Bottom Cover Moulding
6	VR10.13.010	Output Terminal
7	VR09.11.207	Current Control Knob
8	VR08.20.052	Cable Clamp
8a	VR08.20.053	Cable Clamp Nut
9	VR15.18.011	Logic and Power Circuit Board Kit (includes IGBTs)
10	VR06.37.093	Bottom Side Moulding
11	VR07.10.016	Cooling Fan
12	VR15.14.187	Controls Circuit Board
13	VR09.09.021	Relay
14	VR09.11.005	On/Off Switch
15	VR09.11.009	On/Off Switch Knob
16	VR14.05.076	Output Diode
17	VR15.18.010	Secondary Rectifier Kit (includes Snubber Circuit with Power MOSFET, but without Output Diodes)
18	VR15.14.225	Input Circuit Board
Includes		
	VR11.26.001	Varistor (275V)
	VR14.10.150	Diode Bridge

## Preliminary Testing

Before connecting power, clean out the dust from inside the machine and check the following:

### Visual Check

- Varistor for blackening or damage. If the varistor is damaged, it indicates that the unit has been connected to input voltage that was too high. This sort of damage is not covered by the manufacturers warranty, as it is caused by the input voltage being beyond specification. Advise the customer not to use the welder on a small capacity engine driven generator. Generators less than 16kva may have inadequate voltage control in this application
- Filter capacitors for damage or tracking to the PCB.
- Tracks and components on all PCBs.

Replace any damaged components or PCB's.

**Check by Meter**

Using a multimeter set to diode test the following:

1. Check the diode bridges on the Input PCB.

a - b = 0.4v

aa - b = 0.4v

b - a = open circuit

b - aa = open circuit

bb - a = 0.4v

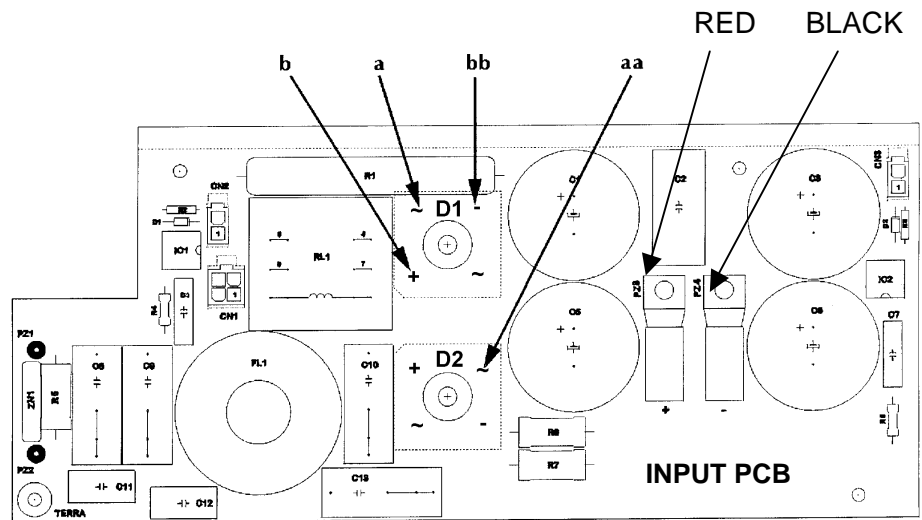
bb - aa = 0.4v

a - bb = open circuit

aa - bb = open circuit

Replace bridge rectifier or Input PCB if the results indicate a fault.

**Figure 2 Input PCB**



2. Check across the red/black output leads of the Input PCB. After waiting a few seconds for the capacitors to charge, if the result is not open circuit there is a problem with the power inverter section.

3. Check across the output weld terminals

+ve > -ve = open circuit

-ve > +ve = approx. 0.2v

If these results are not obtained, check the secondary power rectifier diodes.

**Secondary Power Diode Test**

Disconnect the power transformer cable from each of the output rectifier diodes.

With the multimeter set to diode testing, check:

1. +ve weld terminal to anode side of D1 = open circuit
2. anode side of D1 to +ve weld terminal = 0.2 volt
3. +ve weld terminal to anode side of D2 = open circuit
4. anode side of D2 to +ve weld terminal = 0.2 volt

If the results are different, replace the secondary power diode.

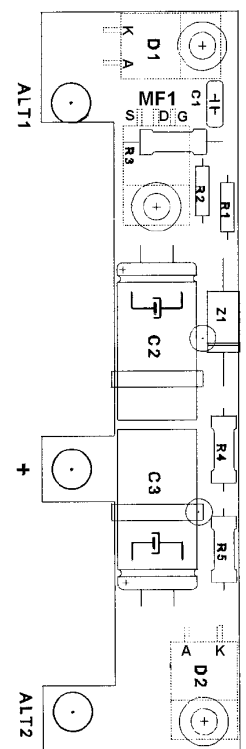
**Snubber Circuit Test**

With the multimeter set to diode testing, check:

1. D > S of MOSFET 1 (MF1) = open circuit
2. S > D of MOSFET 1 (MF1) = 0.4 volt
3. G > S of MOSFET 1 (MF1) = open circuit
4. A > K of D1 = 0.4 volt
5. K > A of D1 = open circuit
6. A > K of D2 = 0.4 volt
7. K > A of D2 = open circuit

If the results are different, replace the Snubber Circuit

**Figure 3 Snubber Circuit**



## Checking with the Machine Connected to Mains Power

If no faults show with the previous checks:

1. Select TIG Mode.
2. Set the current control to 80amps.
3. Connect mains power and turn on the on/off switch.
4. Check that the Green LED on the Controls PCB is lit. If not, go to Checking Power Supplies
5. Check that the fan is operating and blowing a steady stream of air from the front of the machine to the rear.

### Soft Start Bypass Relay

Check that the soft start bypass relay contacts close approx. 5 seconds after the on/off switch is turned on. If not, check:

Relay coil, opto triac on Input PCB, connections from pins 7 & 8 CN2 Logic & Power PCB to pins 7 & 8 CN2 on Input PCB. Signal to relay from Logic & Power PCB. (5V across pins 7 & 8 of CN2 on Logic & Power PCB).

### Power Supply Test

1. With multimeter set to AC Volts, check for 240 volt at the input to the Input PCB.  
If there is no 240 volts, disconnect the machine from the mains and check the connection to the primary plug, the continuity and connection of the primary cable, and the connections and operation of the on/off switch.
2. With power connected and the on/off switch closed, check for 240 volt between A2 and N2 on the diode bridges.  
If 240 volt not present, disconnect from power and check:
  - 100 Ohm between PZ1 and A1. If not, check 100 Ohm resistor and PCB tracks.
  - 0 Ohm between PZ2 and N1. If not, check PCB tracks.
3. With power connected, check for 340volt dc between red and black output terminals of the Input PCB. If not, perform Power Inverter Check.

### Low Voltage Test

Set the multimeter to dc volts and check:

1. TP1-TP3 = 17 volts dc
  2. TP4-TP3 = 5 volts dc
  3. TP5-TP3 = -10 volts dc
- If not, replace the Logic and Power PCB

### Open Circuit Voltage

Check between +ve and -ve output weld terminals. The result should be 55-56 volts dc. If not, check the power inverter and secondary diodes.

### Weld Current

With a suitable load connected and the current set to 100 amp, measure the output current. If not 100 amps ( $\pm 10$  amps), check the current control circuit.

### Power Inverter

Visually check for burns or damage to the IGBTs on the Logic and Power PCB.

With the multimeter set to diode test, check the following, referring to **Figure 4**:

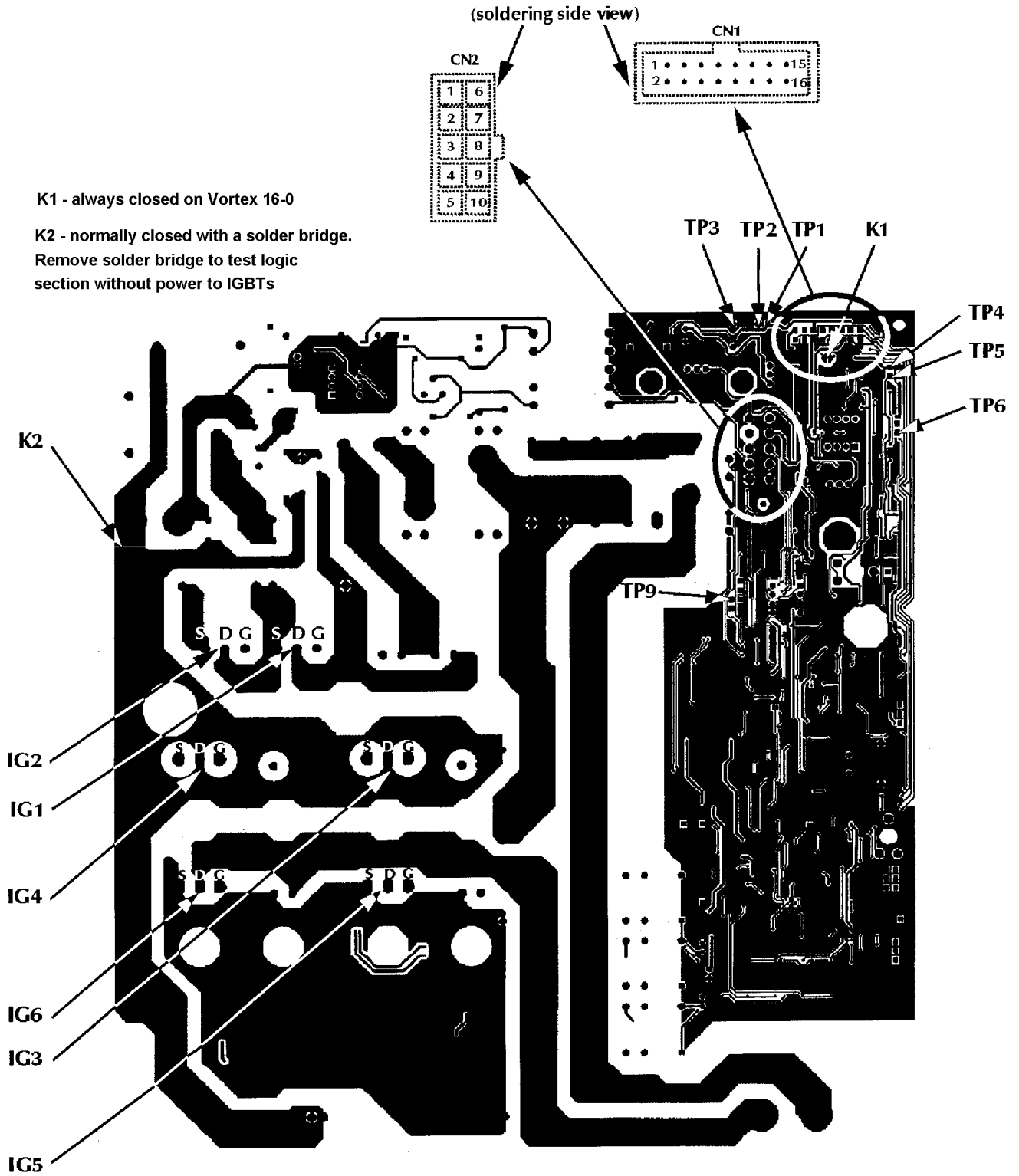
1. D > S for IGBT1 to IGBT 6 = open circuit
2. S > D for IGBT1 to IGBT 6 = approx. 0.4 volt

With the multimeter set to Ohm, check:

1. G > S for IGBT3 to IGBT 6 = 10 kOhm
2. G > S for IGBT1 to IGBT 2 = 22 Ohm

If any of results are incorrect, the Logic and Power PCB will need to be replaced.

Figure 4 Logic & Power PCB (solder side view)



## Current Control Circuit Test

With the power turned on, test:

1. TIG/SMAW Switch
2. Connector 1, Pin 3 to Pin 16 on the Control panel PCB. It should read 5v when in the SMAW mode, and 0V when in the TIG mode.
3. Thermal Protection LED  
Connector 1, Pin 2 to TP3 on the Logic & Power PCB should read 5v and LED 2 (yellow LED) should be off when the unit is not overheated. If this is not the case, check the thermostat and connections.
4. Output Voltage Feedback (set to SMAW mode)  
Connector 2, Pin 2 to Connector 2, Pin 5 on the Logic & Power PCB should read 55-56v dc (open circuit voltage). If not, check connections.
5. Shunt Feedback  
With static load (SMAW mode), or while welding (TIG mode) increase current from min to max. Measure the output current. If it doesn't match the current setting on the current control, check the connection to the shunt.
6. Current Control Setting  
Connector 1, Pin 8 to Connector 1, Pin 10 should read  $-2.7\text{v}$  dc.  
Connector 1, Pin 9 to Connector 1, Pin 10 should read from approx  $-100\text{mv}$  dc to  $-2.2\text{v}$  dc as the current control setting is increased.  
If not, check/replace the current control potentiometer or the Controls PCB.

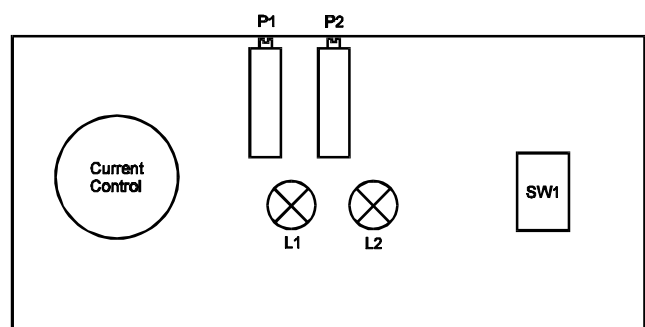
## Adjustments and Testing

### Output Current Adjustment

Use a calibrated shunt to measure the output current.  
Set the unit to TIG.

1. **Minimum**  
Set to 5 amp on the current control dial.  
Adj. VR P2 on the Control Panel PCB until an output current of 5 amp is measured.
2. **Maximum**  
Set to 160 amp on the current control dial.  
Adj. VR P1 on the Control Panel PCB until an output current of 160 amp is measured.

Figure 5 controls PCB



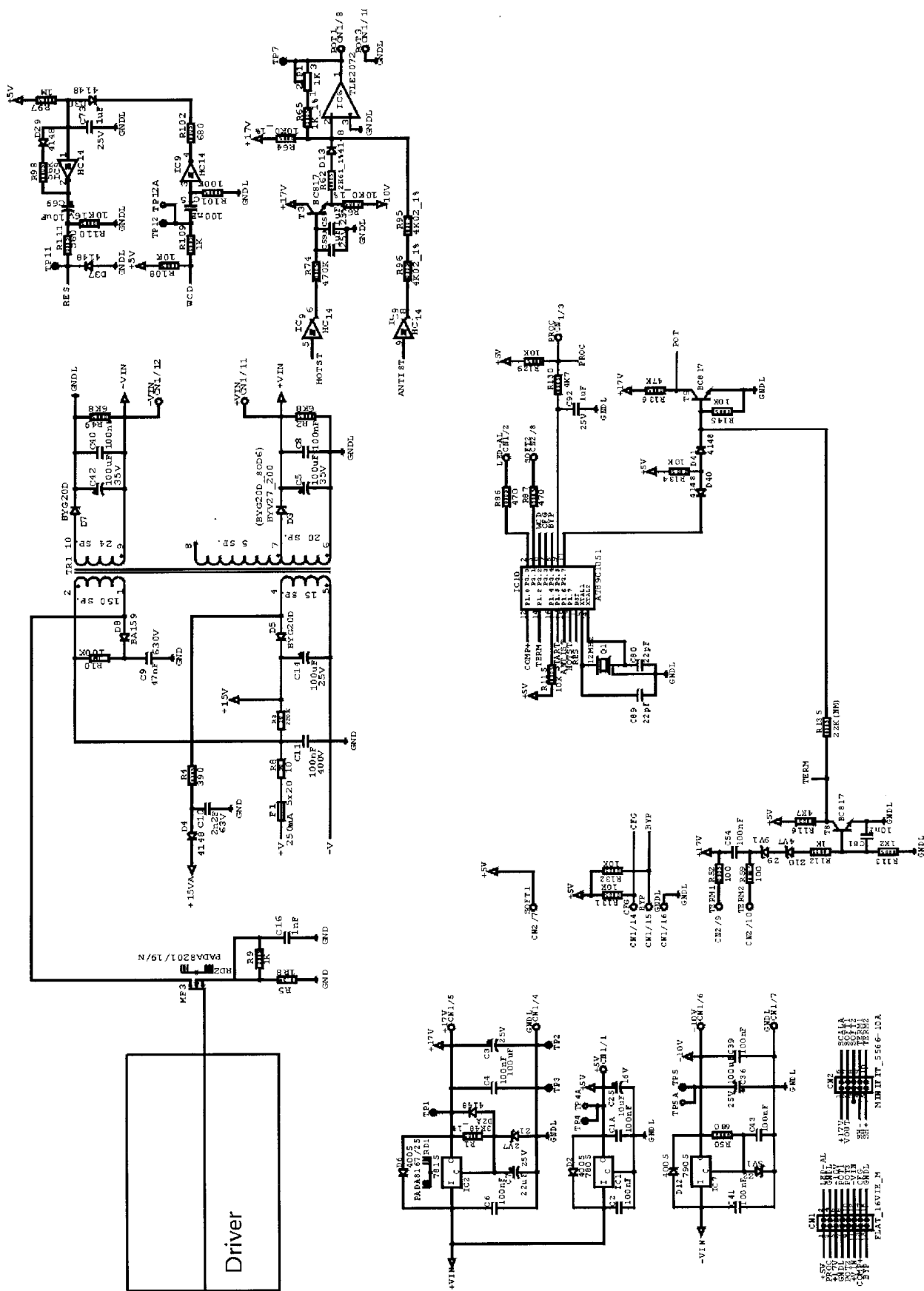
Note: After adjusting min. current, recheck max. current, and recheck min. current after adjusting max. current.

*Hugh Stewart*

Hugh Stewart,  
Technical Service Co-ordinator – Marketing

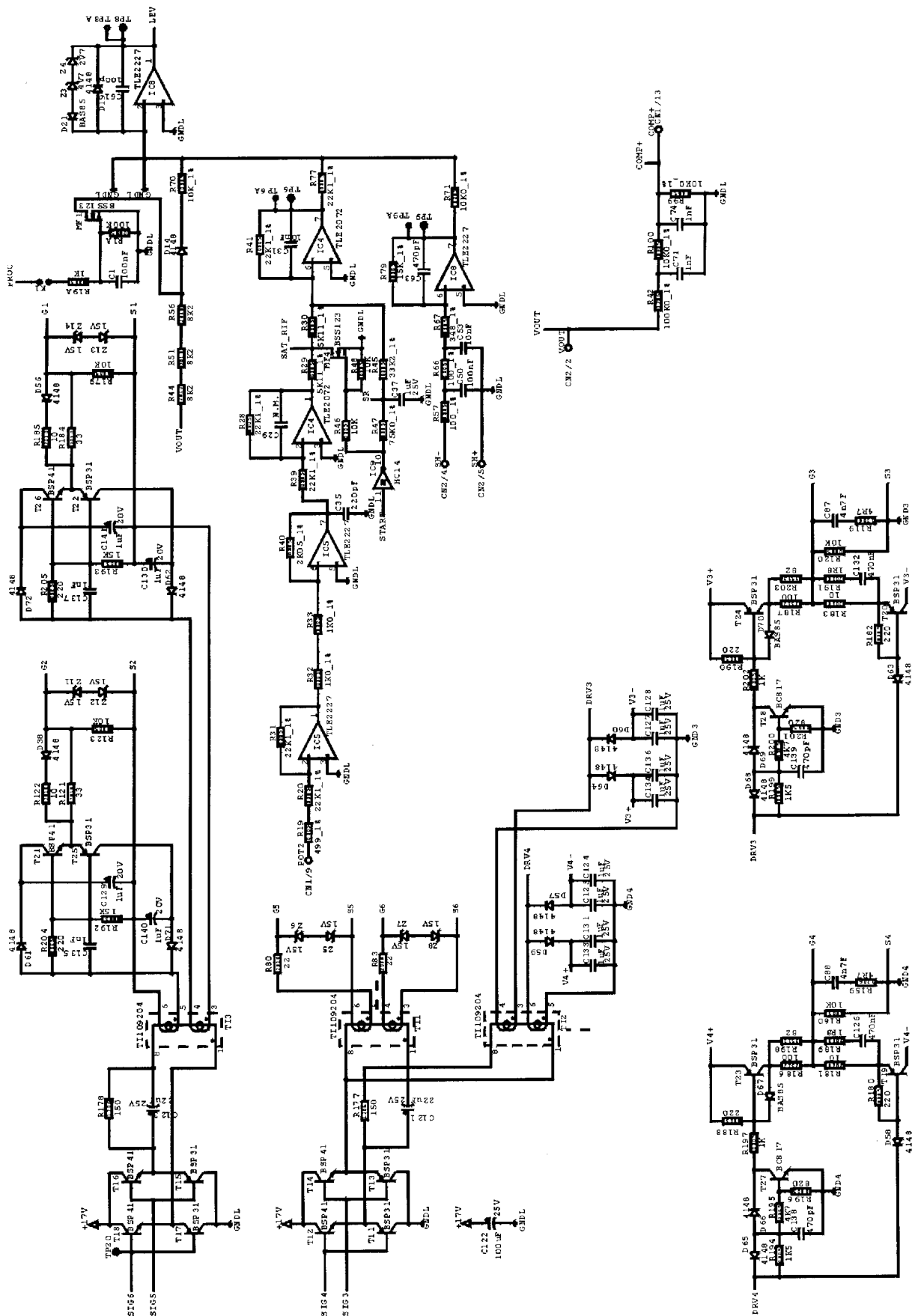
# Circuits

## Logic and Power Part 1

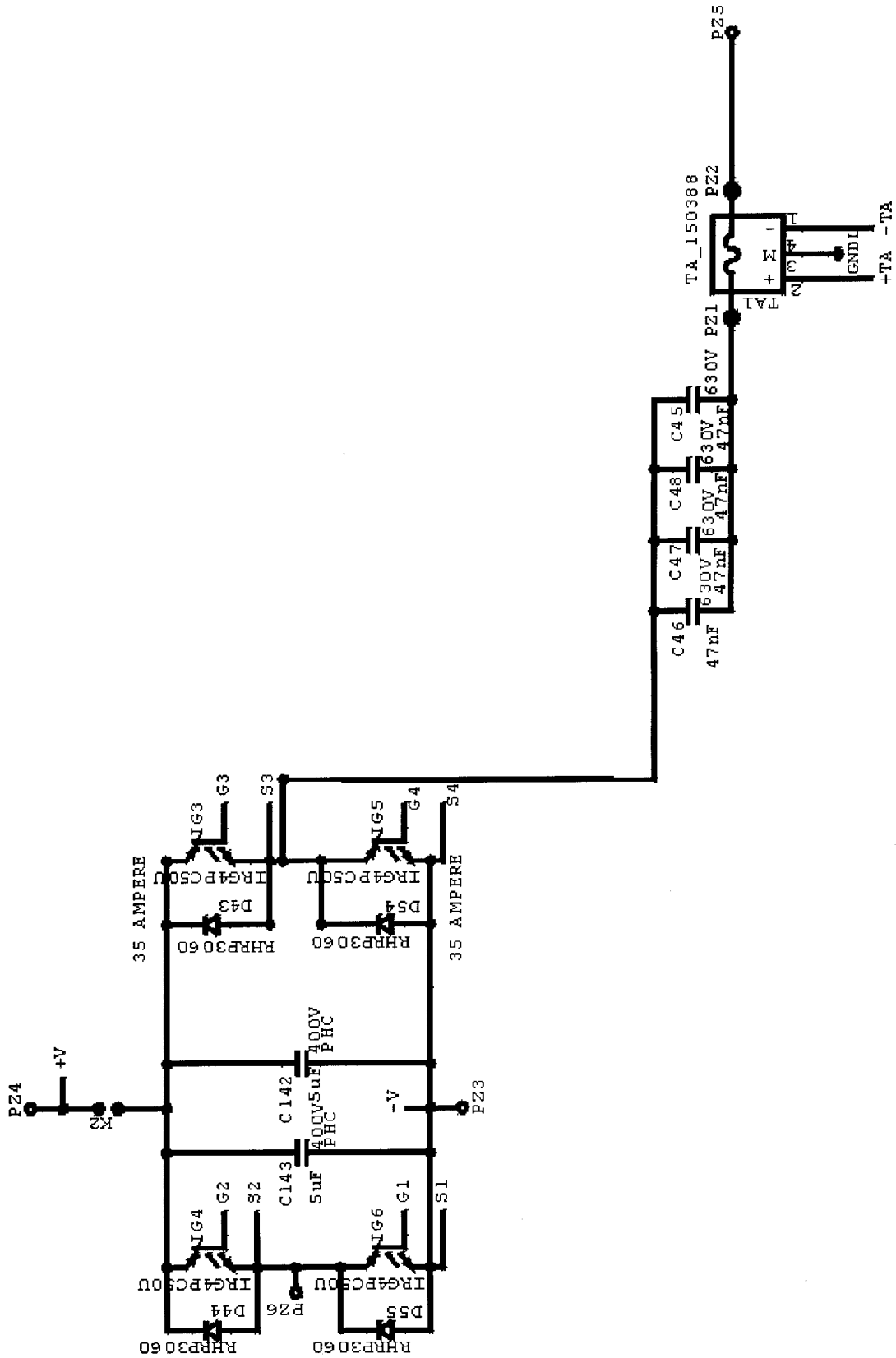




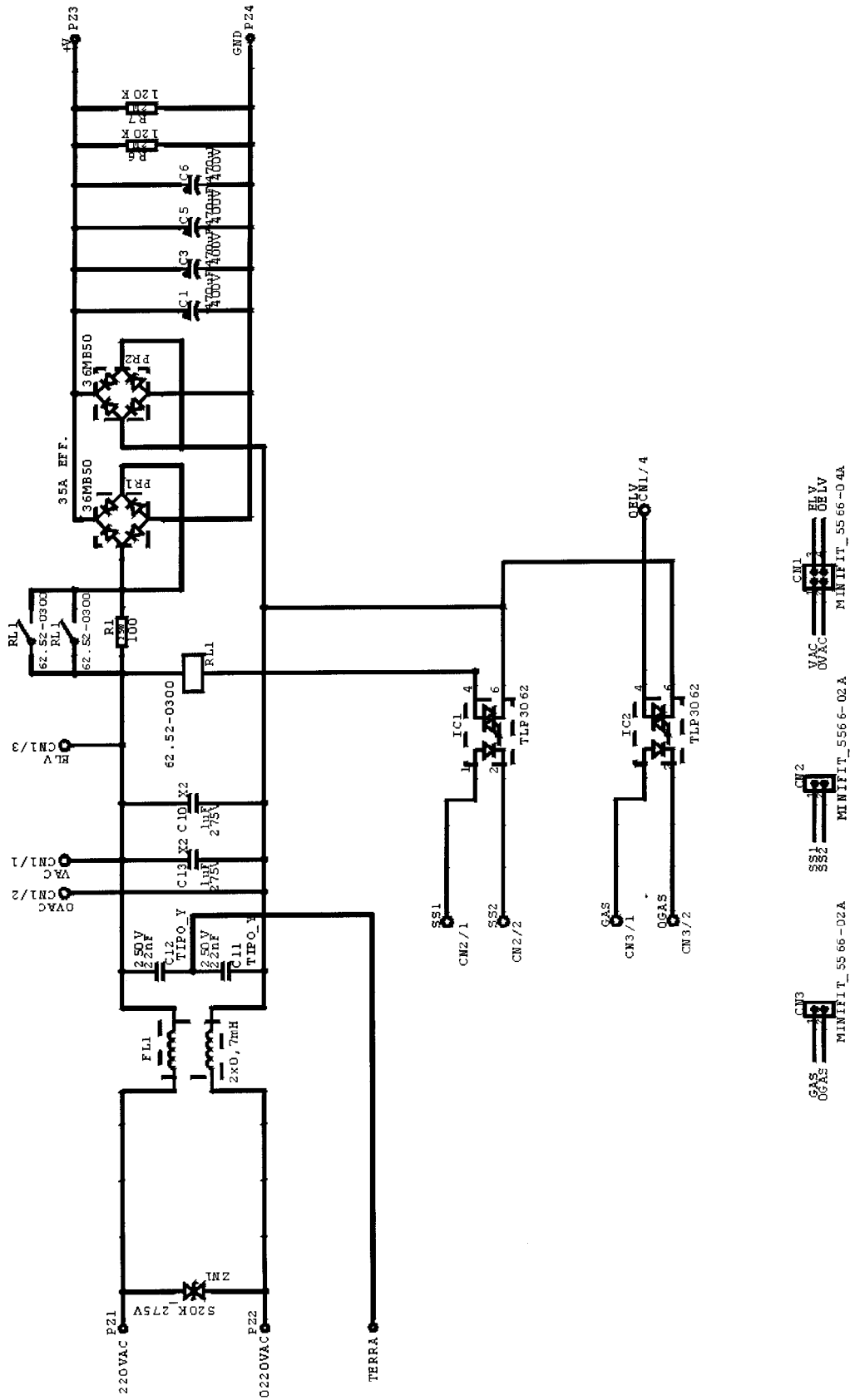
Logic and Power Part 3



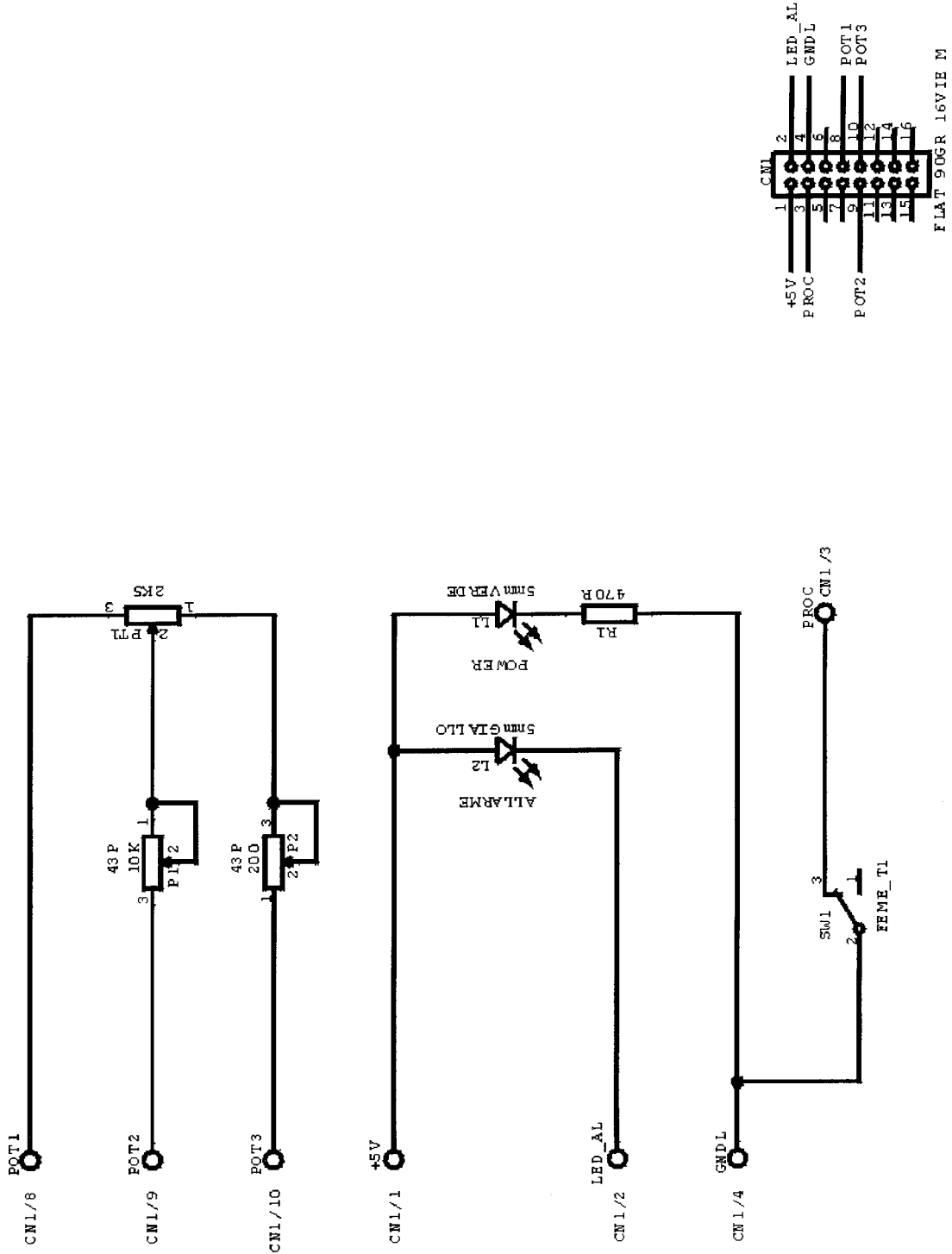
Logic and Power Part 4



### Input PCB



### Controls PCB



### Output Filter PCB

