Repair Manual for

Universal Machine Power Supply (UMPS) (P/No 220010)

Doc. No. 957-001

Revision A02

Position	Name	Signature	Date
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Revision	Changes	Author	Date
A01	Initial Release of document	S.A.	02-2-05
A02	Added section on Fan Kit	S.A.	14-4-05

1. Introduction

The purpose of this document is to furnish the technical reader with enough information to carry out repairs to the universal machine power supply (P/No 220010) used in the Benchtop version of the Ambassador gaming machine. A brief outline is given of the operation of the supply with the purpose of identifying which functional block may have failed. Within each functional block, in turn, a list of components is provided that may be subject to failure.

The following detail circuit diagrams & BOMs of the supply are useful:

- 210 514 Main assembly BOM (AGT1-al & AGT1-bg & AGT1-ic: Main board circuit diagram)
- 201 508 Front panel assembly BOM (AGT1-ge: Front panel circuit diagram)
- 201 509 9V Module assembly BOM (AGT1-ce: Logic module circuit diagram)
- 201 511 IO Module assembly BOM (AGT1-ff: IO module circuit diagram)
- 201 512 12V Module assembly BOM (AGT1-ef: LABS module circuit diagram)
- 201 513 13V Module assembly BOM (AGT1-de: COINS module circuit diagram)
- AGT1-hc: Wiring Harness circuit diagram

2. Overall Block Diagram

An overall block diagram of the DAPRO Power Supply is provided in Fig 1 of the Appendix. A brief outline of the function of each block is provided below. Included in the description for each block is some diagnostic information as well as an indication of components that have been known to fail (based on repair analysis history).

2.1 IEC Inlet & Filter

This provides EMC filtering & the IEC inlet connector in a single housing.

2.2 Mains fuse

This is a delayed action (“T” type) 4A 20mm x 5 mm fuse. The fuse should be checked if the power supply fails to give any output or visual indication at all.

- ✓ The fuse may “blow” in the event of PFC or resonant converter failure. If this is the case, replacing it will cause it to immediately “blow” again.

2.3 IEC Power output

This mains power outlet is switched but not fused. It is provided as a convenient means of supplying mains power to auxiliary equipment.

- ✓ The IEC outlet is not disabled by turning off the Rocker switch (mains power control cable).

2.4 Main Board

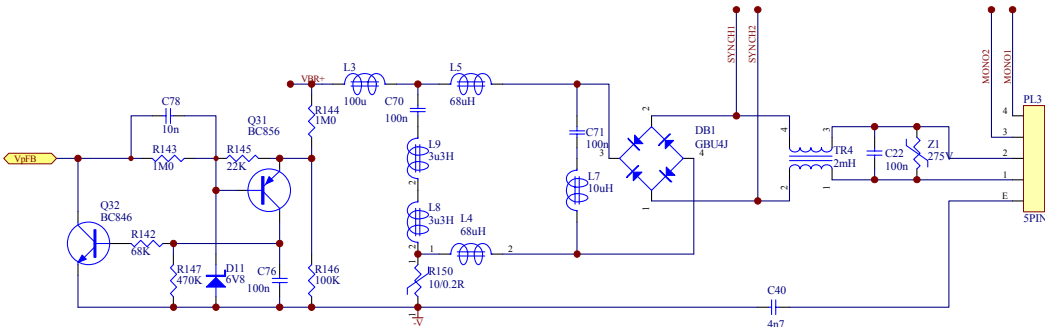
The main board is responsible for converting the mains supply to 24V DC for distribution to the individual DC-DC converters. Mains AC is first converted to DC (approx. 430 VDC, under load) by the Power Factor Correction (PFC) stage. A resonant converter then transforms this DC voltage to 24VDC (at about 8 amps). The main board also includes 4 “isolation/soft-switch” stages that are under control of the on-board microcontroller.

2.4.1 Mains input filtering & Protection

A network of L’s (L3-L5,L7-L9) & C’s (C70,C71,C22) and a common mode choke (TR4) are used to aid in filtering out EMC components from getting back to mains. A 275V Varistor (Z1) provides protection from mains transients. An NTC (R150) reduces current surge amplitude during turn on.

Diode bridge (DB1) provides rectified mains to the PFC stage. Q31,Q32 and associated components sense the mains voltage amplitude & shut down the PFC stage if the mains voltage falls below about 90V AC.

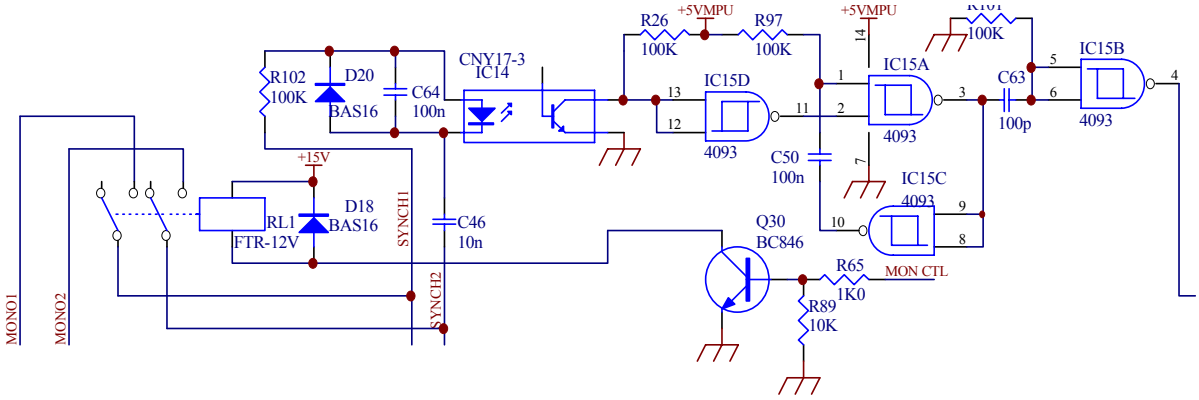
- ✓ These components are quite robust, however, the NTC has been known to sometimes fail (usually physically obvious).



2.4.2 Monitor relay

RL1 (12V relay) is switched on & off under control from the micro. ICs 14,15 & associated components provide mains information to the micro which uses this to activate the relay as close as possible to zero crossings.

- ✓ If the monitor relay fails to activate when pins 2 & 3 of the monitor control connector are shorted check the relay and/or transistor Q30. (a common problem is that pins 2 or 6 of the “monitor control” input connector are damaged or that the cable harness to it is faulty).
- ✓ Check for the presence of “mains sync” pulses on pin4/IC15.



2.4.3 PFC Stage

The Power Factor Controller chip (IC1 MC33262), transformer TR3 & Power FET Q1 (SPP20N60 form the core of the PFC stage. The resulting 430 VDC is stored on capacitors C15 (220uF, PCB mounted) and Cext (220uF, case mounted). These are large capacitors.

- ✓ These capacitors are fairly robust but may fail under certain conditions (usually physically obvious).

The PFC stage always runs, even when the rocker switch is in the off position. This is normal.

- ✓ If the PFC stage is suspected of a fault, check first that there is 410V to 450VDC on Cext (which is easily accessible with the supply running). If there is little or no voltage present the mains diode bridge (DB1) may be dead or there may be an open circuit somewhere in the input path (eg blown track). If there is voltage present but it is low (340VDC for 240VAC input or 170VDC for 120VAC input) then the PFC stage has almost certainly failed (most likely IC1). The following components should be checked:

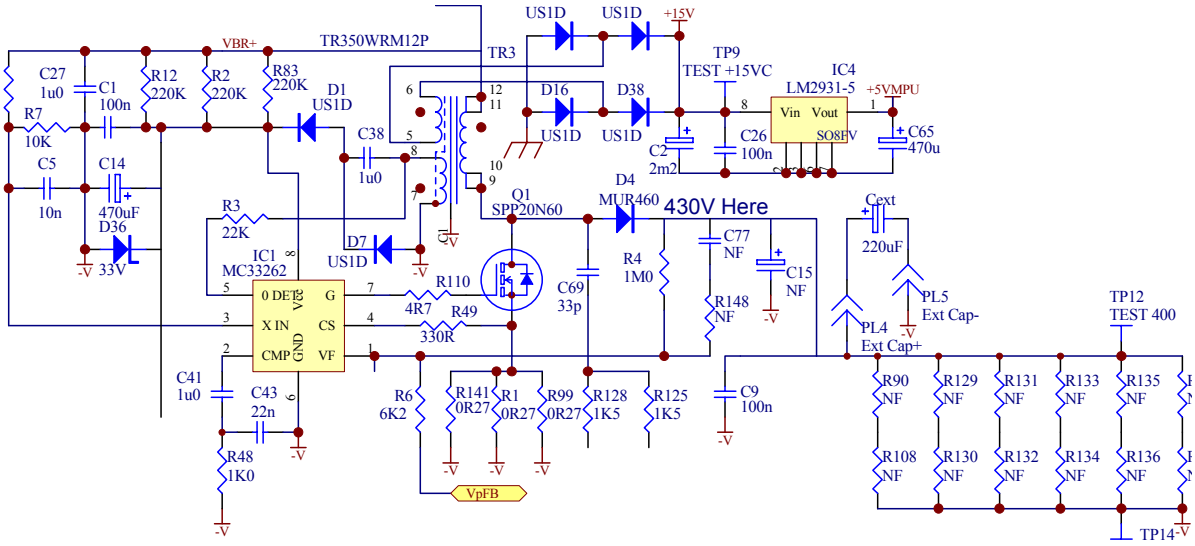
  R141,R1,R99 (0R30): These may go O/C due to excessive current flow (check with an appropriate multimeter).

  Q1: May go S/C

  R110: May fail if Q1 fails

  IC1: Replace this IC if other components OK & stage still not operational.

  D1,D7: Check that these diodes are OK (provide 33V supply to IC1).



IC4 and D15,D16,D37,D38 provide +5V power to the micro from the auxiliary winding on TR3. The PFC stage and this +5V supply are always running even when the mains is plugged in and the rocker switch turned off (this is not unlike many TVs , VCR's etc).

- ✓ If the PFC stage is OK but there is no +5V present check IC4 & the associated diodes for failure.

2.4.4 Resonant converter stage

Main components on the primary side are: Q2/Q3, IC5, TR2, Q4/Q6 (upper driver), Q7/Q8 (lower driver).

Main components on the secondary side are: D3, D5, IC3, IC8

The micro enables the resonant converter via the signal PWR CTLO (pin 2/IC8).

IC3 compares the output 24.8 VDC with VREF (2.5V) and varies the frequency of IC5 (astable multivibrator) via IC9 (opto).

- ✓ If the resonant converter is suspected of failure, check the following components:

  Q29, Q5: These provide 15V to power IC5

  Q2/Q3 (IRFBC40): These FETs may fail (usually S/C).

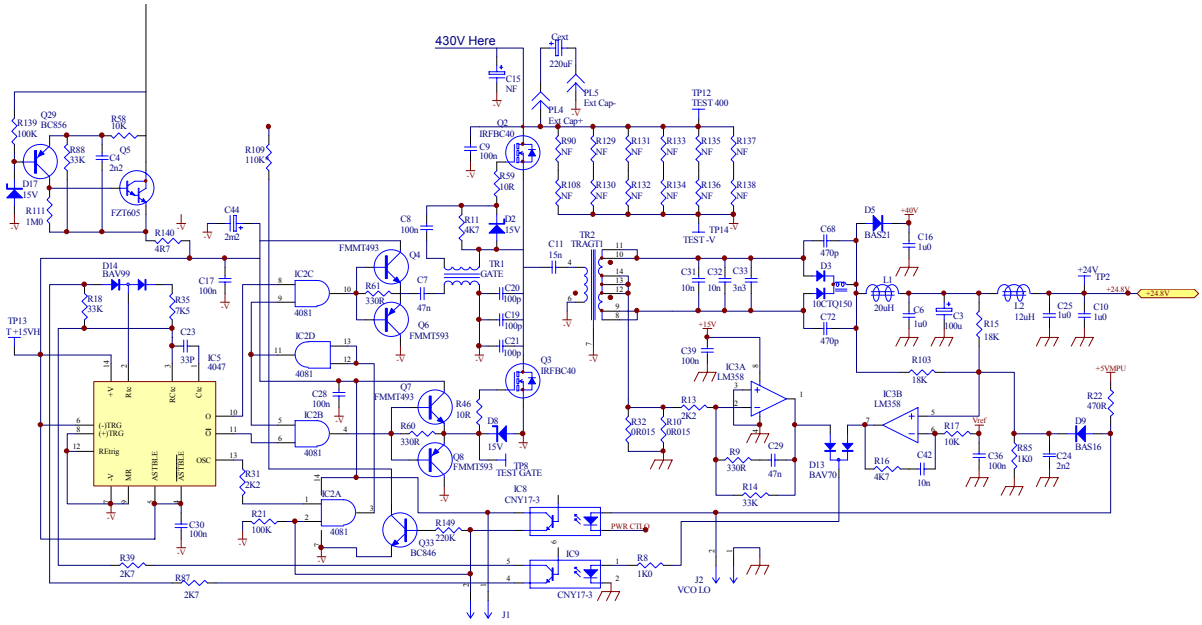
  Q4/Q6 & Q7/Q8: These driver transistors sometimes fail if Q2 or Q3, respectively, fail.

  TR1: This gate drive transformer should be checked that it is not shorted.

  IC5 4047 astable): Seldom fails, but may be checked.

  D5 (BAS21): Check that 40V is present on the Cathode.

  D3 (Dual diode): seldom fails but worth checking.



2.4.5 Microcontroller (IC6)

The micro controls the soft switches (via Q9 – Q12), DC-DC converter modules (via IC6 pins 3,4,5,6,23), resonant converter (via IC6 pin 11), monitor relay (via IC6 pin 22), and the Power Good output signal (via IC6 pin 12).

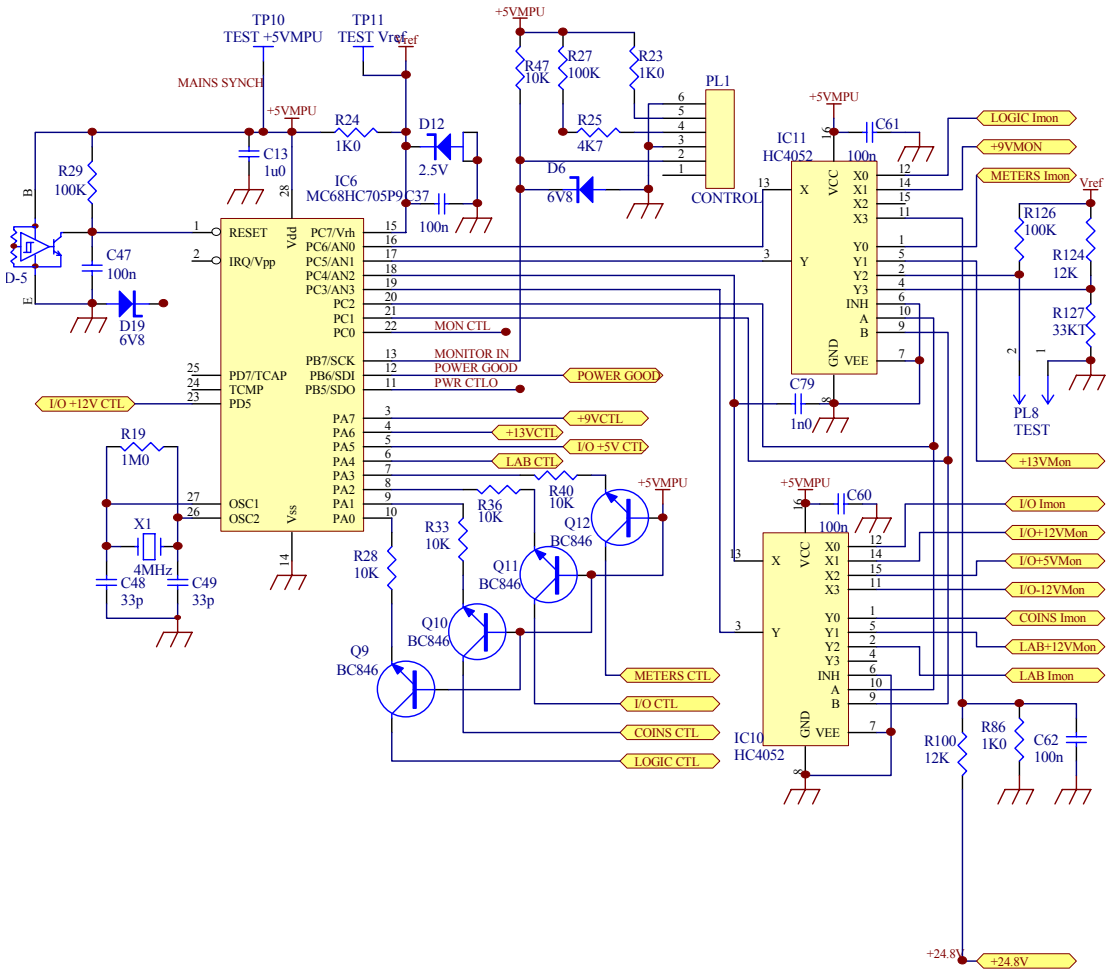
IC10 & IC11 are used to select which analogue voltage is fed to the micro's ADC. These signals are measured by the analogue to digital converter within the micro in order to monitor output currents and voltages (from the soft switches and/or DC-DC converters) for overload conditions. The internal temperature is also monitored (thermistor R127).

A 4 MHz crystal provides timing to the micro.

IC7 is a power supply monitor chip for the micro.

The micro is powered from an auxiliary winding of the preconverter transformer (TR3) via diodes D15,D37,D16,D38 & IC4 (15 to 5V converter).

- ✓ 5V power is most easily checked by measuring the voltage on pins 2 and 6 of the monitor control connector. If this falls below about 4.5V, the micro will reset.



2.4.6 Common mode isolation & soft switch stages

These stages sense the current supplied to each DC-DC converter (except the LABS) from the 24V rail & feed a proportional voltage to the micro (only the the Logic stage is shown below). If the current exceeds the set limit the 24 “feed” to that stage is turned off (via the appropriate control signal from the micro).

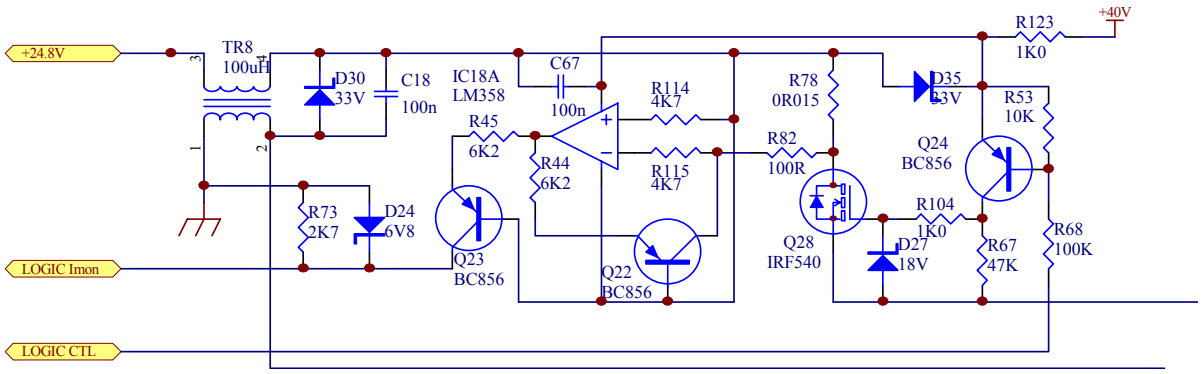
- ✓ Components to check in each of the 4 stages are given below:

  LOGIC: IC18 (op amp), Q28 (FET), R78 (current sense resistor), D30 (zener protection).

  COINS: IC17 (op amp), Q27 (FET), R76 (current sense resistor), D32 (zener protection).

  IO: IC13 (op amp), Q26 (FET), R77 (current sense resistor), D33 (zener protection).

  METERS: IC12 (op amp), Q25 (FET), R75 (current sense resistor), D31 (zener protection).



2.5 DC-DC Converter modules

There are 4 of these (LOGIC, IO, COINS, LABS). They provide the following voltages & currents to the front panel board connectors for distribution to various EGM loads:

LOGIC:

9V @ 4A

24V @ 2.5A

COINS

13V @ 2A

24V @ 3A

IO

24V @ 5A

12V @ 3A

5V @ 4A

-12V @ 1A

LABS:

12V @ 3.0A total.

Each DC-DC module is physically separate and anchored to the extrusion of the power supply. The circuit diagram for each module is almost identical apart from a few resistor value changes to provide the different required output voltages.

The IO DC-DC converter has additional stages to provide 5V & -12V outputs.

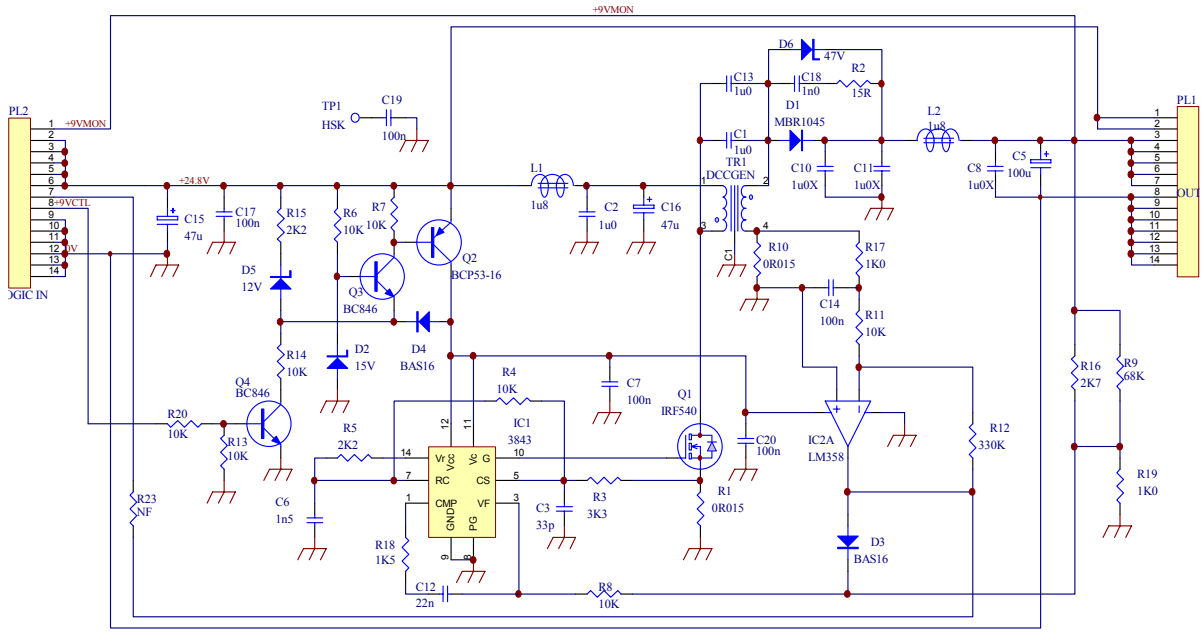
Each output rail is switched ON/OFF by a control signal from the microcontroller on the main board. The micro enables each module in order (LOGIC then IO then COINS then LABS) to ensure a smooth start-up. In the event of a fault condition (eg current overload or voltage outside range) all outputs are disabled (except for some of

the 24V outputs). When the rocker switch is turned OFF the main resonant converter is switched OFF, disabling all output rails.

2.5.1 Logic, Coins & LABs modules

Q1 switches current ON & OFF through TR1 primary under control of the IC1 (current mode PWM controller). The secondary voltage is rectified & smoothed. A proportion of the output voltage is fed back to IC1/pin 3 to close the feedback loop. An op-amp (IC2) monitors the output current and provides foldback limiting to the feedback signal (via D1) in the event of overload. The current sense resistor (R10) in conjunction with the amplifier gain (set by R17, R11 & R12) sets the trip level.

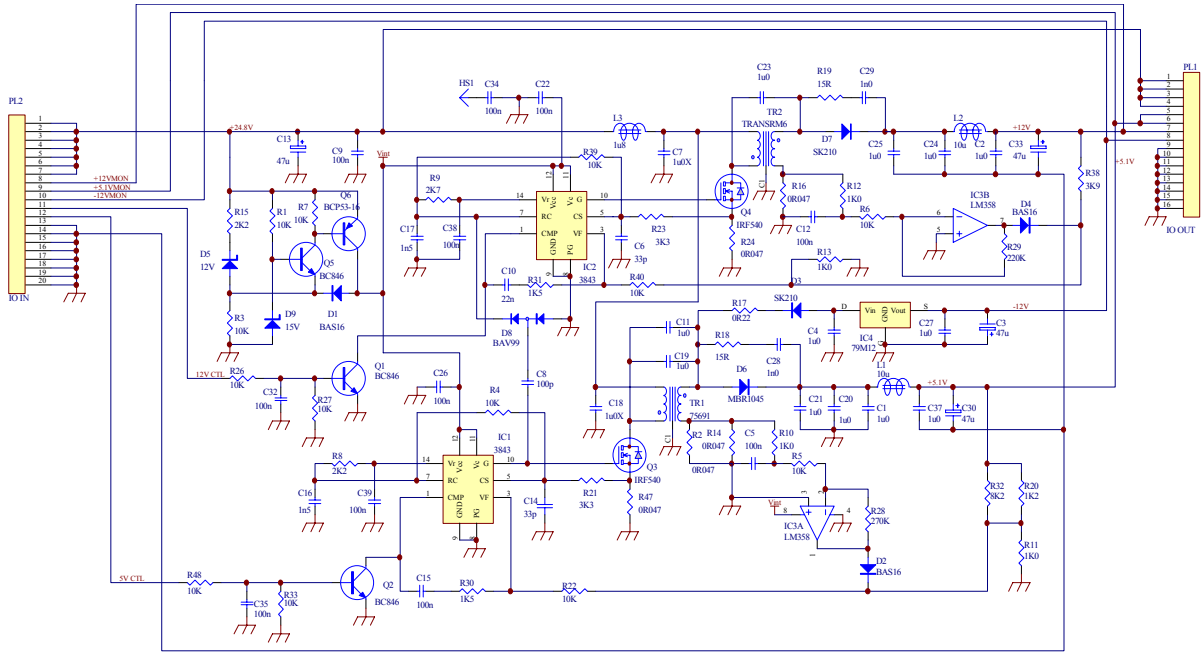
- ✓ Components to check include: Q4, IC1, Q1, D1 & R10.



2.5.2 IO module

IC2, Q4, TR2 & IC3B act as described above for the other modules. The additional stage centered around IC1, Q3, TR1 & IC3A is used to produce the 5V rail. D3 & IC4 are used to provide the –12V output.

- ✓ Components to check for the +12V output include: IC2, Q4, TR2, D7, IC3B, R24.
- ✓ Components to check for the +5V output include: IC1, Q3, TR1, D6, IC3A, R47.
- ✓ Components to check for the -12V output include: D3, IC4.



2.6 Front panel Board

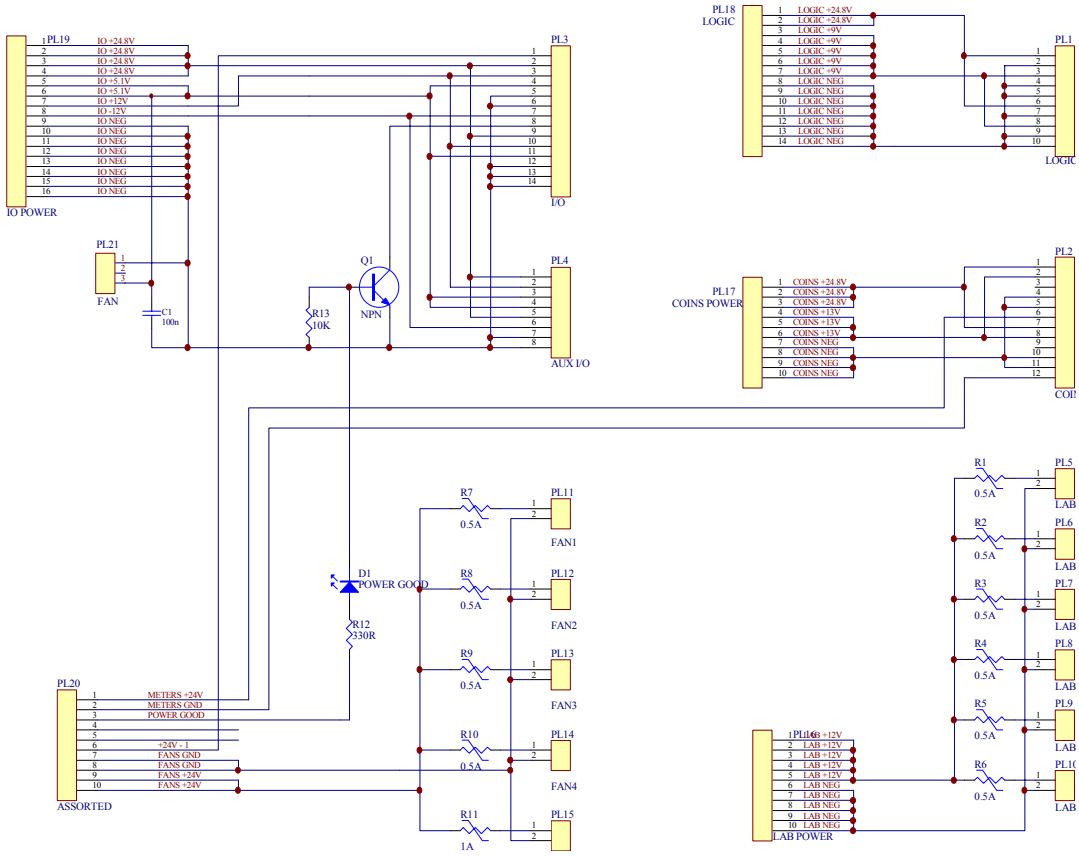
The front panel board simply houses the DC output connectors. It is mounted to the front panel on stand-offs and connects to the DC-DC converter modules via a set of ribbon cables. A 5V fan is mounted off the front panel board to allow the resonant transformer to be conveniently cooled once the front panel is mounted in its correct position.

- ✓ The fan should be checked to see that it is properly running.

The only active component on the front panel board is Q1 which supplies the PowerGood signal to pin 8 of the IO connector. If power is “good” LED D1 will be ON.

PTC devices are used on LAB outputs (0.5A), the LAMP output (1.0A) and the FANS outputs (0.5A).

- ✓ If a PTC trips due to short or overload condition, it will recover once the load is removed & reconnected.



2.7 Other items

The following operational aspects are discussed and may be useful in diagnosing faults.

2.7.1 Overtemperature

In the event of excess overheating for any number of reasons (eg fan failure, blocked ventilation etc) the supply will shutdown if the internal temperature exceeds approx 85 deg C. In this condition the PowerGood LED will flash 14 times (continuously). The supply will not automatically reset.

- ✓ In order to reset the supply from an overtemperature condition, turn the supply mains off for approx 10 seconds then reapply power.

2.7.2 Overload or short on DC outputs

In the event of excessive overload or short circuit on any DC output, the micro will detect the condition and shutdown most output supply rails (unless a 24V fault is detected, in which case all rails are shutdown). An error sequence is flashed on the PowerGood led on the front panel.

- ✓ The error code & its meaning is printed on the front panel & are useful in diagnosing possible fault conditions.

After approx 9 seconds the power supply will automatically try to recover from the fault condition. However, if the fault condition is still present, the supply will immediately re-enter shutdown & display the fault condition again.

- ✓ If the same fault condition reoccurs 5 times (with less than 45 secs between re-occurrences) the supply will not automatically restart but will remain in the shutdown condition. This can be "reset" by turning off the rocker switch for 10 seconds the back ON again or by turning off the mains for 10 seconds and then reapplying it.

2.8 Power Supply Fan Kit

To improve the reliability of the Dapro 220 010 Power supply a Power Supply Fan Kit was introduced & is recommended fitting where approved by the relevant jurisdiction.

The kit (Dapro Power Supply Fan Kit P/No 011 449) consists of a new Top cover plate with Fan & capacitor mount, a new bottom plate (open mesh), associated mounting hardware & fitting instructions (document: WI 220020). The fan plugs into a connector on the main board & runs continuously when the power supply is on, greatly decreasing the internal air temperature.

Rev D manufactured power supplies have the fan already fitted.

Appendix

Figure 1: DAPRO Power Supply Block Diagram