NEW ZEALAND POST OFFICE

NEGATIVE 50V D.C. TO POSITIVE 50V D.C. SUPPLY

NOTES PR 2157 **ISSUE 1** **APRIL 1977**

1. GENERAL.

1.1 These PR notes supersede notes PR 2133 and should only be used in conjunction with the attached schedule of drawings.

1.2 The power supply can be used for all applications where plus 50V at up to 1A is required. Efficiency at full load is generally better than 70% and load regulation better than 5% from $^{1}/_{10}$ load to full load.

1.3 The supply operates on a one plus one redundancy basis and contains two separate -50V/+50V d.c. - d.c. converters, a changeover and alarm circuit, a voltage alarm unit and a converter current limit circuit. In the event of one of the converters failing, automatic changeover to the second converter is effected, the yellow LED lights up and an alarm is extended. If the second converter fails the red LED lights up and a second alarm is extended. The current limit circuit limits the maximum output to approximately 1.5A and has a thermal trip mechanism to prevent thermal overload. This will operate after some 8 minutes on a direct short circuit. The voltage alarm unit monitors the system output and will give an alarm if the voltage rises or falls outside the set limits.

The converter fail alarms can be reset with the reset key mounted inside the supply cabinet. Note that this reset key will not restore the thermal trip circuit.

2. ASSOCIATED DRAWINGS.

2.1

NZPO 40982	-50V/+50V D.C. to D.C. Power Supply Circuit.
NZPO 40980	-50V/+50V D.C. to D.C. Converter Circuit.
NZPO 40978	-50V/+50V D.C. to D.C. Converter Fail, Changeover and Alarm Circuit.
NZPO 40979	-50V/+50V D.C. to D.C. Current Limit Circuit.
NZPO 40435	-50V/+50V D.C. to D.C. Power Supply General Construction Details.
NZPO 40977	-50V/+50V D.C. to D.C. Power Supply Mechanical Details.
NZPO 40462	Voltage Alarm Unit Mk II.

3. DESCRIPTION.

3.1 The power supply which is housed in a 24” by 12” Gael cabinet contains two -50V/+50V converters on a gear plate and the current limit circuit. Also mounted on the gear plate are the terminal block, reset key and auxiliary tag board.

The converters are easily removed in case of failure and a replacement fitted.

4. INSTALLATION.

4.1 The supply should be located indoors and mounted in a position which will not impede air flow through the cabinet. The temperature of air entering the bottom of the cabinet must not exceed 40°C.

4.2 The supply is fixed to the wall by removing the gear plate and screwing the cabinet securely through the four holes at the rear of the cabinet.

4.3 There are seven external connections to the supply and these are terminated on the 8 way terminal block.

Terminal T1	-50V Battery Input.
Terminal T2	Earth.
Terminal T3	Earth.
Terminal T4	+50V D.C. Output.
Terminal T5	Converter 1 Fail Alarm Output.
Terminal T6	Converter 2 Fail Alarm Output.
Terminal T7	System Fail Alarm Output.

5. SETTING UP AND TESTING.

5.1 The only setting up required is the adjustment of voltage alarm unit. This unit should be adjusted in accordance with the PR notes to the following limits :-

High Volts - Not Used, turn H.V. pot fully clockwise.

Low Volts - 42.0 V

5.2 The following procedure is to be used to obtain the correct voltage for setting up the voltage alarm unit.

5.2.1 Remove fuses FS1 and FS2.

5.2.2 Connect a variable 50V power supply between the converter side of FS1 and earth.

5.2.3 Connect a meter between the output terminal T4 and earth.

5.2.4 Adjust the power supply so that the output voltage reads the required 42.0 volts.

5.2.5 Adjust the voltage alarm unit in accordance with notes PR 2094 Issue 3.

5.2.6 Remove the power supply and meter and replace the fuses FS1 & FS2.

5.2.7 The changeover and alarm circuit is checked by removing fuses FS1 and FS2 and checking that the converter fail LED's light up. Replace the fuses and reset both converters by operating the reset key to Reset 1 then Reset 2.

This completes the setting up and testing.

6. CIRCUIT EXPLANATORY.

6.1 D.C. to D.C. Converter. (Ref NZPO drg 40980)

Assume transistor TR1 is off and TR2 is on and the transformer saturated. When TR1 starts to conduct, the voltage developed across the primary winding Np induces voltage in the feedback winding Nf such as to rapidly drive TR1 into saturation and turn TR2 off. When this is completed, a constant voltage Vp = Vcc -Vce (sat) is applied to Np. Since $\frac{d\varnothing}{dt} = \frac{Vp}{Np}$ flux $\varnothing$ must increase in the transformer at a constant rate causing the flux density to increase from point C towards D on the BH curve in Fig 1.

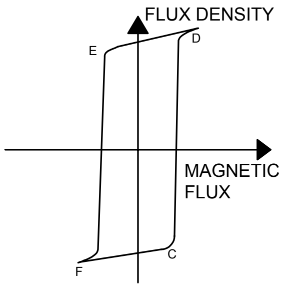

Fig 1

As long as the core remains non-saturated, the magnetisation current $Im = \frac{Hl}{Np}$ is small but as saturation point (point D) is approached a large magnetisation current Im is required to keep $\frac{d\varnothing}{dt}$ constant(l = magnetic path length). When the reflected load current plus the sharply increasing magnetising current exceed the collector current TR1 can supply with the available drive, TR1 comes out of saturation causing Vp to decrease and the field to collapse thus ending the half cycle. The process is then repeated for TR2.

R2 provides the bias for TR1 or TR2 on startup and R1 regulates the amount of base drive current available.

Capacitors C4 and C5 are speed-up capacitors which aid the transistors to switch from the “off” to the “on” state and vice versa.

C1, C2 and L1 form a pi section filter to reduce noise on the battery supply. R3 and C5 help damp any ringing and spikes in the collector voltage waveform.

The square wave output is rectified by diodes D2-D5 which are fast recovery diodes and is smoothed by capacitor C6.

It must be noted that some adjustment of resistors R1 and R2 may be necessary to achieve optimum performance during manufacture or subsequent servicing due to the spread of transistor characteristics. To minimise this, matched pairs of transistors should be used.

R1 is adjusted for best efficiency whilst still providing sufficient base drive on full load (see fig 2) and R2 is adjusted so that the converter will start will start under full load conditions. R2 should be approximately 80 times R1.

COLLECTOR - COLLECTOR VOLTAGE WAVEFORMS

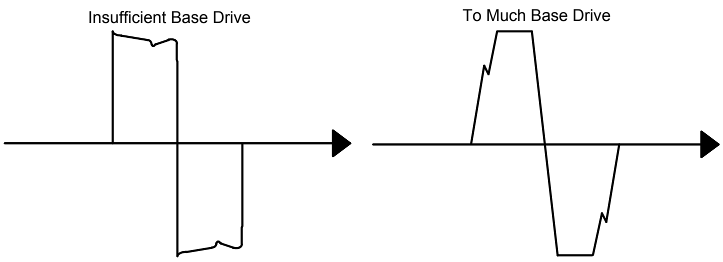

Fig 2

6.2 Converter Fail, Changeover and Alarm Circuit. (Ref NZPO drg 40978)

This circuit is designed to monitor the output of the operating converter and, if a failure occurs, switch over to the other converter and extend an alarm. If failure of the second converter occurs, a second alarm is extended.

R1 and OPT1 (a photo darlington) monitor the output voltage of the first converter. When the output voltage and hence the current fails, the darlington transistor pair in OPT1 is turned off which allows the voltage divider chain of R2, R3 and R4 to bias SCR1 into conduction and hence operate relays RLA and RLC. Once triggered, the SCR will stay latched until the supply is interrupted by pushing the reset button. C1 is to prevent spurious triggering by noise. When RLA is operated, LED1 is turned on and an alarm is extended via contacts RLA2 and RLA1 changes over the input from converter 1 to converter 2. At the same time RLC1 releases the short circuit on SCR2 which allows the alarm circuitry for converter 2 to come into operation.

The alarm circuit for converter 2 is identical to that of converter 1 except that a small time delay via C3 is included to prevent it operating at the instant of changeover.

If converter 2 fails the a second alarm is extended via relay contacts RLB1 to LED2 (red) and the input to converter 2 is disconnected by RLB2.

6.3 Auxiliary Tag Board.

This tag board contains the two steering diodes which serve to isolate the alarm circuitry from the section which it is not monitoring.

6.4 Current Limit Circuit. (Ref NZPO drg 40979)

This circuit is designed to monitor the output current of the converter and prevent it exceeding 1.5A under overload conditions.

Transistor TR1 is normally turned hard on by TR2, T1 and R2. When the current in the output circuit exceeds 1A the voltage developed across R1 turns on TR3 which causes the voltage at the base of TR2 to be reduced. This brings TR1 out of saturation and limits the current available to the output circuit.

When the output current falls below 1A, TR1 is automatically turned hard on and the circuit is back to normal.

Microtherm T1 is attached to TR1. The contacts of the microtherm are normally closed and open when the case temperature exceeds 125°C. This ensures that the temperature of TR1 and Heatsink under fault conditions does not exceed the ratings of TR1.

6.5 Voltage Alarm Unit. (Ref NZPO drg 40462)

See Notes PR 2094 Issue 4