INSTRUCTION BOOK FOR

'L' SERIES
BENCH POWER SUPPLIES

FARNELL INSTRUMENTS LIMITED • SANDBECK WAY • WETHERBY LS22 4DH • YORKSHIRE • ENGLAND. TELEPHONE 0937 3541-6

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ERRATA & ADDENDUM

Alternative components to those listed on the circuit diagram may be used in the event of supply difficulties.

Major design changes since the date of this issue are listed below:-

SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to prevent damage in transit. When removing the unit from the box, be sure to remove all parts and accessories from the packing material.

The complete equipment comprises:-

a) 1 off L series power supply of the model specified

b) 1 off Instruction book

Note:- In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

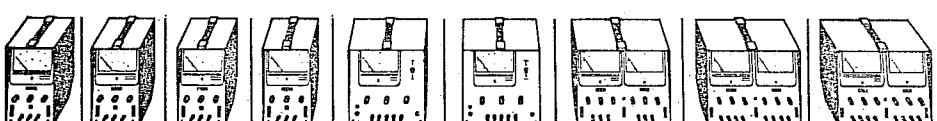
This instruction book covers the nine models which comprise the Farnell L series bench power supplies. The circuit diagram in the rear flap refers only to the particular model supplied.

The units may be set to provide constant voltage or constant current. The output is regulated and protected against overloads and short circuits. Two models feature adjustable overvoltage* crowbar, this additional protection making them suitable for applications involving integrated circuits.

Output is continuously variable by coarse and fine potentiometers and is monitored by a meter which is switched to show either voltage or current. Separate switching of the mains input and d.c. output is provided.

The higher current models have facility for remote sensing of the load voltage. Some models are twin output units and these outputs may be connected in series or parallel to provide twice the voltage or current.

Units available



L30A	L30B	L30C*	L30D	L30E	L30F*	L30A/T	L30B/T	L30D/T
0-50V at 500mA	0-30V at 1A	0-10V at 3A	0-30V at 2A	0-30V at 5A	0-12V at 10A	2x0-50V at 500mA	2x0-30V at 1A	2x0-30V at 2A

INTERNAL ADJUSTMENT

It may be that after effecting repairs to active circuitry it becomes necessary to adjust certain internal preset potentiometers. The following is the procedure which should be adopted:-

Voltage

Set link underneath unit to 'C.V.'.

Connect an accurate voltmeter (one which has an f.s.d. compatible with the maximum output voltage of the unit) between the 'O/P-' and 'O/P+' terminals.

Connect unit to mains supply. Switch on both the 'MAINS' and 'OUTPUT' switches. Set the 'COARSE' and 'FINE' controls fully clockwise.

Adjust T1 (on the circuit board) until the maximum output voltage specified for the unit is indicated on the external voltmeter. Disconnect external voltmeter.

Ensure that the 'METER' switch is set to 'VOLTS'. Adjust T3 for full scale deflection of the front panel meter.

Current

Leave the link underneath the unit set to 'C.V.'.

Connect an accurate ammeter, (one which has an f.s.d. compatible with the maximum current available from the unit) in series with a variable load, between the 'O/P+' and 'O/P-' terminals.

Connect unit to mains supply. Switch on both the 'MAINS' and 'OUTPUT' switches. Set the current 'LIMIT' control fully clockwise. Adjust the load until an output current 10% in excess of the maximum specified for the unit is indicated by the external ammeter. Adjust T2 until the current just starts to fall.

Set the 'METER' switch to 'CURRENT'. Re-adjust load to indicate maximum specified output current on the external ammeter. Adjust T4 until the front panel meter indicates full scale deflection.

MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and recalibration it is recommended that the complete instrument be returned to:-

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire.
LS22 4DH
Tel: 0937 3541 Telex: 557294

or

Service Depot,
Farnell Instruments Ltd.,
Hermitage Road,
London N4.

Tel: 01-802 5359

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

For those who operate their own comprehensive service departments and wish to repair and maintain the equipment themselves, a section on 'internal adjustment' follows.

SPECIFICATION

MAINS INPUT	A.C. mains 210-220-230-240V 50-400Hz (105-110-115-120V to special order)
MAINS VARIATION TOLERATED	± 10%
LINE REGULATION Output change for a ± 10% mains change	Constant voltage less than .01%+1mV short term less than .02%+2mV long term Constant current less than .01%+1mA short term less than .02%+2mA long term
LOAD REGULATION Output change for a zero to full load change	Constant voltage less than .01%+2mV short term less than .02%+4mV long term Constant current less than .01% short term less than .02% long term
RIPPLE AND NOISE CONTENT at full load (Δf = 80kHz)	Constant voltage less than 1mV pk-pk Constant current less than 1mA pk-pk
OUTPUT IMPEDANCE (C.V.) typical	0.1 Ω measured at 100kHz and 20°C
TRANSIENT RECOVERY TIME typical	Less than 25 µS for output to recover within 50mV following a full load change of 1 µS risetime
TEMPERATURE COEFFICIENT typical	0.02% per °C
OPERATING AMBIENT TEMPERATURE RANGE	0 to 45°C
STORAGE TEMPERATURE RANGE	-20°C to +50°C
OVERLOAD PROTECTION	Adjustable constant current limiting from zero to maximum. Automatically resets. L30C and L30F have overvoltage crowbar adjustable 3.2V to 14V. Trip coefficient 0.04% per °C typical. Input and output fuses.

STABILITY

Output variations are due in the main to the following causes:-

a) Load change
b) Mains supply change
c) Component temperature change

a) Load change

i) Steady load - For a change in steady load from zero to full load the typical change in output is 1mV at full output voltage.

ii) Transient response - The typical response to a pulsed load is shown in fig. 1.

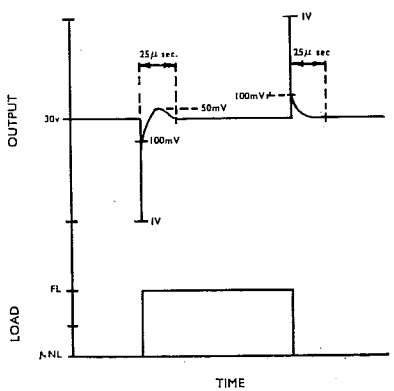


Fig. 1. Pulse Response

iii) Output impedance - For an alternating load superimposed on a steady load, the output impedance of the supply increases with frequency due to the fall off in gain of the amplifier until it is determined only by the output capacitor across the output terminals. A typical output impedance against frequency curve is shown in fig. 2.

See next page for fig. 2

Overvoltage protection

On units fitted with overvoltage protection, this is provided by means of a thyristor "crowbar" connected across the output terminals and driven from a voltage comparator amplifier which compares a fraction of the output voltage with a reference zener diode. R1a, Z1a, R7a and VT1a comprise a constant current source to feed the reference zener diode Z2a. Z9a and R10a feed a fraction of this voltage to VT3a base. VT3a and VT4a are the comparator transistors, the base of VT4a being fed from potential divider P1a, R6a and R13a. If the output voltage exceeds a level determined by this potential divider VT4a conducts, driving VTZa on. The drive now available from VT2a collector then fires SCR1a which short circuits the output terminal.

CIRCUIT DESCRIPTION

The circuit employs series regulator transistors driven via emitter followers from a differential amplifier which compares the voltage of a zener diode reference with a proportion of the output voltage derived from a resistive potential divider.

The mains supply is connected via fuse F1, SW1 and the input selector to MT1. The main secondary winding supplies a bridge rectifier, reservoir capacitor system which provides the main unregulated d.c. line. The positive line is connected via the series regulator transistors and SW2 to the positive output terminal. The negative line is connected via fuse F2 to the negative output terminal.

Supplies for the amplifier and reference section are derived from the auxiliary 36 volt secondary winding, via rectifier diodes D5 and D6 and smoothed by capacitor C2. The unstabilised reference line is fed to zener diode Z1 via resistor R2. The semi-stabilised voltage across Z1 is fed to zener diode Z2 and Z4 via R3 providing 10 volts positive and approximately 5 volts negative with respect to the positive output terminal. The voltage across Z2 feeds the reference zener diode Z3 and potential divider chain R7, T1, P1 and P2, via Resistor R4.

The base of VT1 and the negative of Z3 are connected to the positive output terminal. R7 and T1 are connected between the positive of Z3 and VT2 base via R8. Any difference between the voltages of VT1 and VT2 bases is amplified at the collector of VT2 and applied to VT3 base. After further amplifications at VT3 collector the signal is applied to the emitter followers of the series regulator stage in such a sense as to oppose the original signal at VT1 and VT2 bases. The action of the loop is therefore to maintain zero voltage between VT1 and VT2 bases.

Output voltage is determined by:-

$$\frac{Vref\ (P1 + P2)}{R7 + T1}$$

Overload protection is provided by VT4 and VT8. As output current increases, the voltage drop across R17 increases until the base of VT4 is sufficiently positive to turn it on. This diverts current from the series regulator stage, thus reducing the output voltage. On further increase in load, VT4 will maintain a roughly constant voltage drop across R17 which gives a roughly constant current output. The point at which the initial current limit occurs is set by P3 and the maximum current limit point is set by T2.

cont'd.

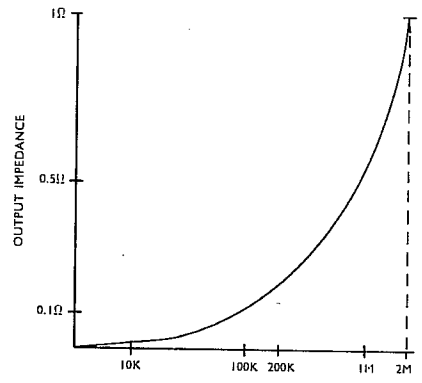


Fig. 2. Output Impedance

b) Mains supply change

Short term variations of up to 10% give corresponding variations of up to 0.01% on the output. Surges on the mains supply in the form of short rise time pulses can be fed on to the output by stray capacity. Where these conditions exist a capacitor suppressor filter should be connected to the mains lead.

c) Component temperature change

Output variation is caused by component value changes due to temperature change. The temperature change can be i) as a result of ambient change or ii) as a result of internal temperature change, caused by changing internal dissipation from a change in load or supply to the unit.

i) Ambient change - The typical temperature coefficient of output voltage is 0.02% per °C of ambient change.

ii) Internal change - Fig. 3 shows typical output variations caused by mains change and load change plotted against time.

See next page for fig. 3

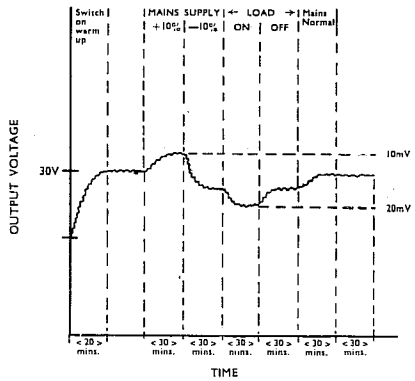


Fig. 3 Typical Output Voltage Variation against Time

C.I. mode

Two units can be connected directly in parallel in either the 'approximate C.I.' or 'accurate C.I.' mode, the load current being the sum of the two output currents. Fig. 6 shows the connections for 'accurate C.I.' operation. For 'approximate C.I.' operation, the units' output terminals are connected in parallel, taking care to observe polarity.

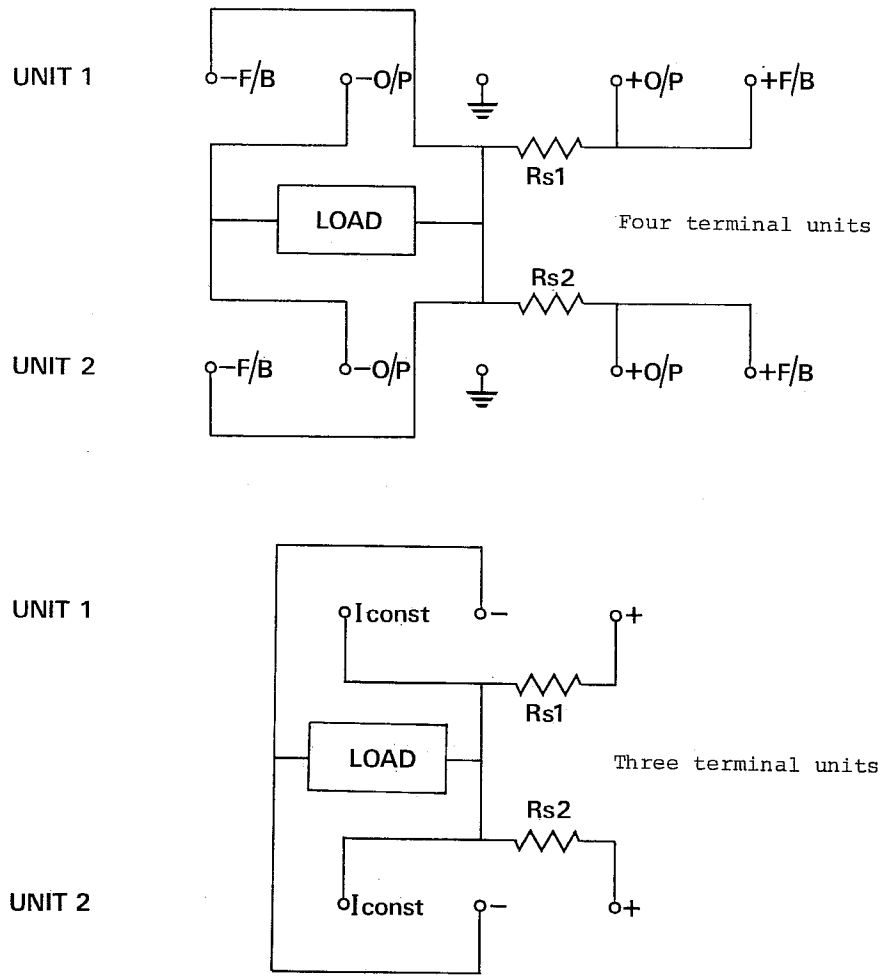


Fig 6 Connections for two units in parallel - accurate CI mode

Set the 'COARSE' and 'FINE' controls fully anti-clockwise. Switch the 'OUTPUT' or 'MAINS' switch to 'OFF' and then 'ON'. This resets the overvoltage trip. Re-adjust the output voltage controls to give the required operating voltage.

Series operation

Units may only be connected in series when the 'CV' (constant voltage) mode is selected.

Parallel operation

C.V. mode

Units which are set to approximately the same output voltage may be connected directly in parallel. On increasing load, the unit having the highest output voltage will carry the load until it current limits, thereafter the unit having the next highest voltage will supply the extra current until it limits, and so on. A typical output characteristic for a parallel combination of three units is shown in fig. 5.

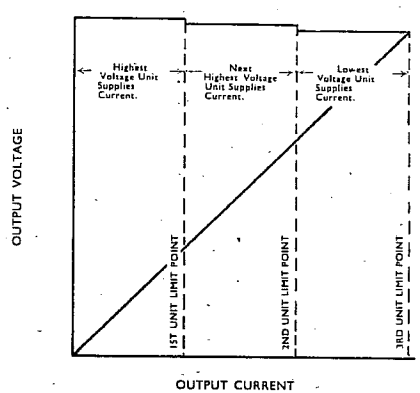


Fig 5 Parallel Operation

The characteristic shows a series of descending steps in output voltage at the current limit points of individual units. The amplitude of the steps depends on how closely the output voltages have been set and it may not be possible to adjust this to better than 50mV.

It is recommended that not more than three units are paralleled in this way.

OPERATING INSTRUCTIONS

Installation

Ensure that the mains input selector on the rear of the unit is on the appropriate setting for the local mains supply before switching on.

The fixed mains lead supplied is colour coded:-

Live.....Brown
Neutral.....Blue
Earth.....Green/Yellow

Operating instructions

CONSTANT VOLTAGE MODE (most common use)

Before connection to the mains supply is made the 'OUTPUT ON/OFF' switch should be set to 'OFF'. Check also that the link (situated underneath the unit near the output terminals) is set to the normal 'CV' position.

Connect the unit to the mains supply and switch the 'MAINS ON/OFF' switch to the 'ON' position. The mains indicator lamp should light.

Set the 'METER' switch to 'VOLTS'. Set current 'LIMIT' control to maximum (fully clockwise). Adjust the 'COARSE' and 'FINE' controls until the required output voltage is indicated by the meter. Unless the current limiting facility is to be used the supply may now be connected to the load via suitable leads by setting the 'OUTPUT' switch to 'ON'. Output current can be monitored by setting the 'METER' switch to 'CURRENT'.

Current limit setting

If a certain maximum current must not be exceeded then the setting-up procedure is as follows:-

With the mains supply connected to the unit, 'MAINS' and 'OUTPUT' switches set to 'ON', the 'METER' switch set to 'CURRENT' and the voltage controls set to the required value, connect a variable load to the output terminals and adjust it so that the required maximum current is indicated on the meter. The current 'LIMIT' control is then adjusted until the current just starts to fall. The current limiting circuitry will not allow higher currents to be drawn. It is normal practise to set the current ceiling approximately 10% in excess of the expected maximum, to prevent any modification to the voltage regulation characteristic. The variable load is now disconnected and the unit is ready for use.

CONSTANT CURRENT MODE

Approximate

With the mains supply connected to the unit, 'MAINS' and 'OUTPUT' switches set to 'ON', the 'METER' switch set to 'CURRENT' and the output voltage controls set to maximum, link the positive output terminal to the negative output terminal and set the current 'LIMIT' control to indicate the required current. Remove the link across the output terminals and connect the supply to the load via suitable leads. The unit will give a roughly constant current if the load resistance falls within the range zero Ω to $\frac{Vmax}{Iset}$

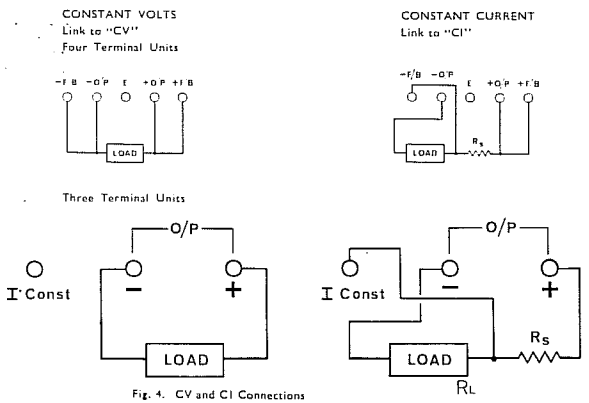


Fig. 4. CV and CI Connections

Accurate (see fig. 4)

Principle

A simple link change and the addition of a current sensing resistor R_S in series with the load R_L will ensure a constant current supply for the load with regulation equal to the normal constant voltage performance.

The unit will keep the voltage across R_S constant. Thus a constant current will flow in R_S. Since R_L is in series with R_S, the same constant current will flow in R_L, the load.

Three factors should be considered before connecting up for this accurate constant current mode.

1) The voltage across R_S should not be less than 1 volt so that R_S should have a minimum value of:-

$$R_S \text{ min} = \frac{1}{I \text{ out}}$$

2) The sum of the voltages across R_S and R_L must not exceed the maximum rated output voltage of the unit or the unit will not meet its specification.

3) R_S must have a power rating well in excess of the power it dissipates in order that change in resistance due to self heating is minimised. The power dissipated by R_S is given by:-

$$P(R_S) = I \text{ out}^2 . R_S$$

Practice

Set the current 'LIMIT' control to maximum. Set the link on the bottom of the unit to 'CI'. Connect resistor R_S between 'O/P+' and 'I CONST' (or '-F/B') terminals. Short the latter terminal to the 'O/P-' terminal. Adjust the 'COARSE' and 'FINE' controls until the meter indicates the required current. Remove the shorting link and connect the load in its place. The load is now being supplied by an accurate and well regulated constant current.

GENERAL

Remote sensing

The higher current models in the range have been provided with four terminal output, two marked 'OUTPUT' and two marked 'FEEDBACK'. The terminals are colour coded red and black in both cases to indicate positive and negative terminals respectively.

The feedback terminals are used to sense the voltage at the load itself, and the feedback signal obtained is used to correct for any voltage drop due to the resistance of the load connecting leads.

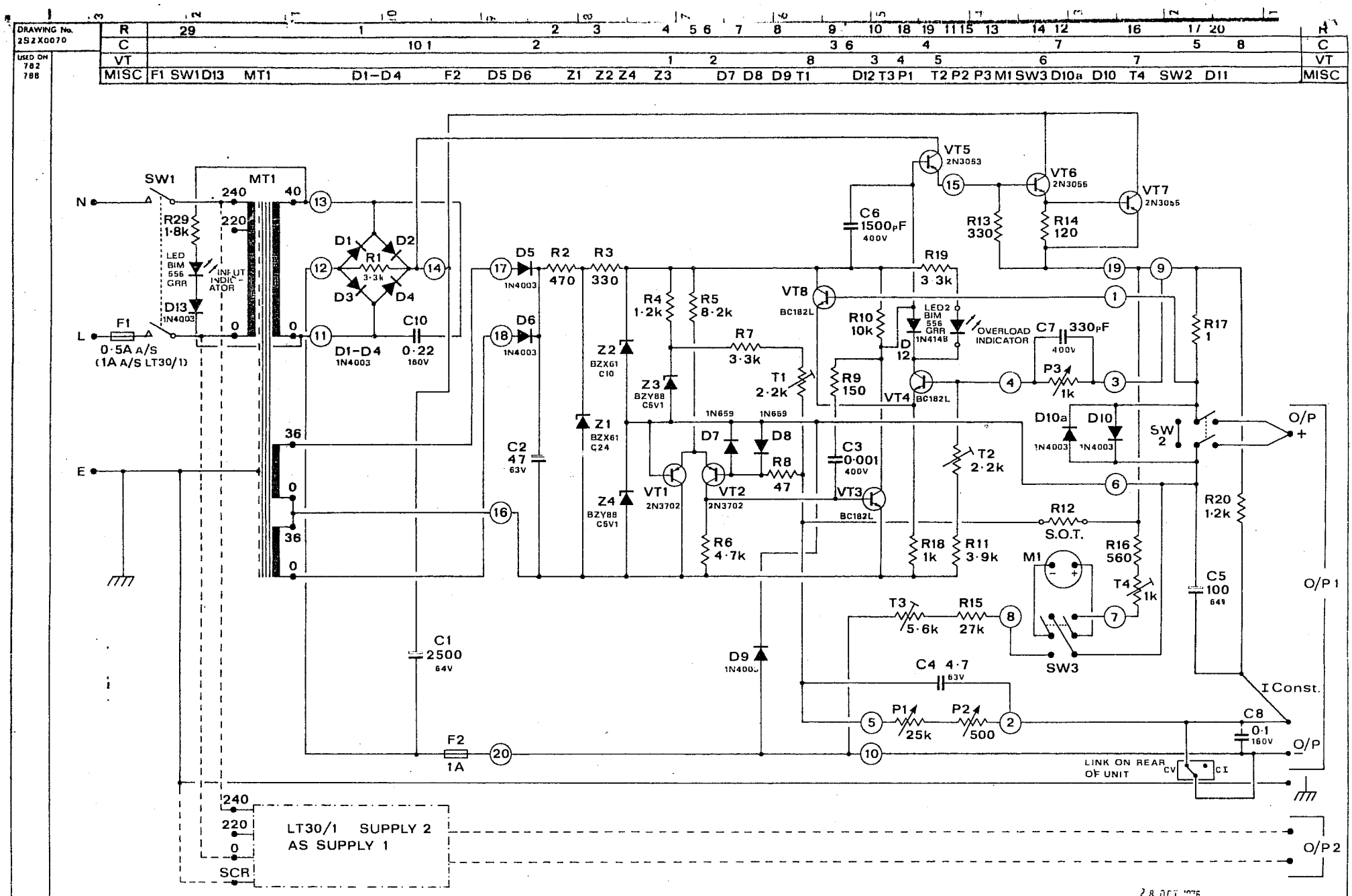
For general use this facility may not be necessary and the links between '+F/B' and '+O/P' and similarly between '-F/B' and '-O/P' may be left in place.

When the correction is required the links should be removed. The load is connected to the output terminals as usual and the '+F/B' and '-F/B' terminals are connected to the positive and negative sides of the load via separate wires. It may be necessary to decouple at the load with an electrolytic capacitor.

Overvoltage protection

On units fitted with overvoltage protection the overvoltage trip level adjustment is on the front panel of the unit, and the current limit control on the back panel.

To set a given trip level, set the output voltage to this level and adjust the 'OVERVOLTAGE' control until the output falls to a low level.



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	C	27·9·76	4025			
	B	21·9·76	3914			

NOTE :–
CAPACITOR VALUES GIVEN IN μF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION NOS.

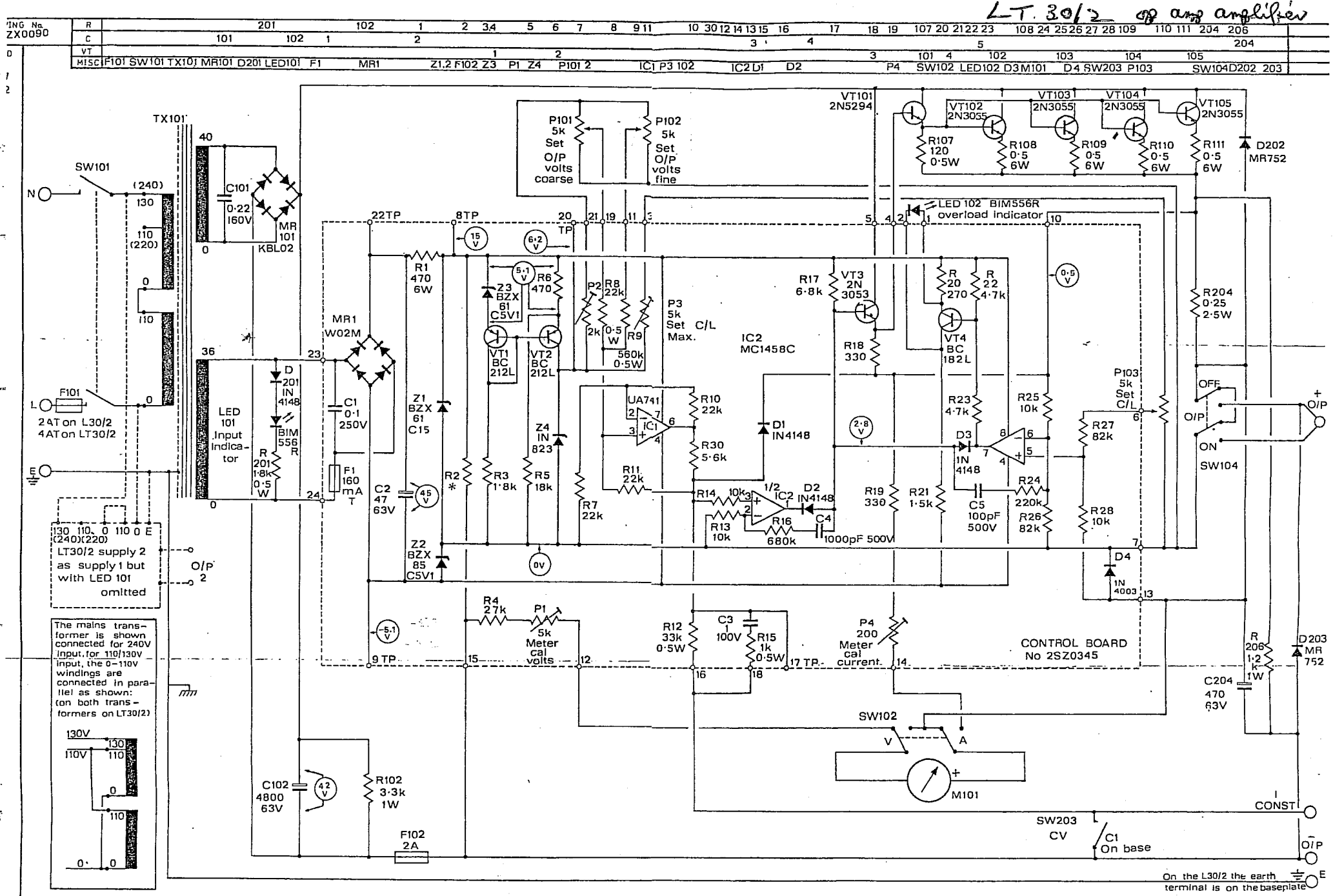
FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE: CIRCUIT DIAGRAM L30/1 & LT30/1

DRAWING No. 2SZX007C

SHEET 1 OF 1 SHEETS

LT 30/2 op amp amplifier



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KED	C	11.7.78	4815.	
	B	7.7.78	4813	
WN	ISS	DATE	MOD No	
V	A	25.5.78		

Components numbered 2__ are on the output circuit board

P2: set O/P volts max.

Resistor values in Ω

Capacitor " " µF unless otherwise stated

*Not fitted

Note: voltages measured with respect to control board pin 7. unless otherwise shown, using a 20,000Ω/V meter, at nominal input voltage.

Output 30V 2A

FARNELL INSTRUMENTS LTD. WETHERBY.

TITLE: L30/2 & LT30/2 CIRCUIT DIAGRAM

DRAWING No. 2SZX0090

SHEET 1 OF 1 SHEETS