FARNELL INSTRUMENTS LIMITED

STABILISED
VOLTAGE SUPPLY UNITS
TYPES L30 & L30/T

FARNELL INSTRUMENTS LTD.
Sandbeck Way, Wetherby, Yorkshire
Telephone Wetherby 2691/2/3

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SECTION 1
INTRODUCTION

The stabilised voltage supply type L30 is designed to provide a d.c. stabilised voltage which is variable from 0 to 30 volts at a maximum current of 0.5A.

The L30/T consists of two L30 units housed in the same case. The two outputs are completely independent of one another and may be used as separate supplies or alternatively may be connected in series or parallel, to provide higher output voltages or currents than can be obtained from a single L30 supply.

This instruction manual has been written in terms of the L30 supply, but the description applies also to the L30/T except for a few minor differences, which are indicated in the text.

The output voltage of the unit is covered in three overlapping ranges of 10 volts, with fine continuous adjustment over each range provided by a control potentiometer.

The output voltage or current is monitored by a switched voltmeter/ammeter, voltage or current range being selected by a front panel switch.

The units are designed to operate in ambient temperatures of up to 45°C. Units may be stacked vertically one on top of another, and, provided free air circulation is allowed, full output may be drawn.

Overload protection is provided to protect the power unit and apparatus being supplied. Protection is given against both progressive and sudden overloads. The protection circuit will automatically reset when the overload is removed or alternatively the load is temporarily disconnected from the output terminals.

The instrument will operate from mains supplies of 210, 220, 230 and 240v a.c. at 50/60 c/s.

(An alternative instrument is manufactured for use with mains supplies of 100 - 130v).

SECTION 2

OPERATING INSTRUCTIONS

1. *PREPARATION FOR USE*

The mains voltage selector plug at the rear of the instrument should be set to match the mains supply from which the unit is to be operated.

The mains lead is wired as follows:

RED	—	Mains Line
BLACK	—	Mains Neutral
GREEN	—	Earth

The voltage required from the output is set by the range switch and fine control.

2. *METERING*

A dual range meter is fitted to monitor either the output voltage or current. The required range is selected by a 'volts/amps' switch on the front panel.

On the L30/T two meters are fitted, one for each supply.

3. *OVERLOAD PROTECTION*

The current limiting facility is designed to protect the external equipment as well as the power unit. Hence the limiting point may be set for a little in excess of the expected maximum current in order to give optimum protection. The preset control, mounted at the rear of the unit, is scaled in tenths of an amp to allow ease of setting.

In operation the protective device limits the current that may be drawn from the unit. With a progressive overload the output voltage falls while the current remains approximately constant. To prevent over-dissipation in the unit on the top two ranges the current limit is automatically reduced with increasing overload so that the unit is not damaged by sudden or prolonged overloads or short circuits throughout the range.

On removal of the overload or disconnecting the load, the output will reset to its original voltage.

A curve of output voltage against output current is shown in Fig. 1, illustrating the overload characteristic of the supply.

4. *FUSES*

The mains input circuits and regulated output circuits are each protected by fuses, which are accessible at the rear of the instrument. On the L30/T each supply is independently fused, so that two sets of mains and output fuses are used.

5. *ON/OFF SWITCH AND INDICATION*

When the instrument is switched 'on' by the front panel mains on/off switch, the presence of supply voltage is indicated by the front panel neon lamp.

On the L30/T both supplies are switched on by the single on/off switch. The neon lamp indicates that the mains supply voltage is being fed to both supplies. If either input fuse blows, the neon is extinguished.

N.B. On the L30/T the fact that the neon is extinguished does not necessarily mean that both mains fuses have blown. One supply may still be energised even though the lamp is extinguished.

6. *SERIES CONNECTION*

Several power units may be connected in series to provide higher voltage supplies. Precaution should be taken to prevent the individual supplies from reverse voltages. Fig. 2 shows the arrangement necessary to protect the unit. A diode of 0.5A capability is inversely coupled across the output terminals to prevent a reverse voltage being developed across the terminals of a unit should it be switched off inadvertently.

On the L30/T diodes are connected internally across the output terminals in this way, so that the two supplies on this instrument may be series-connected without taking any precautions externally.

7. *PARALLEL CONNECTION*

Supplies may be connected in parallel to provide higher output currents. They should be switched to the same voltage range, the output terminals paralleled, and the fine voltage controls adjusted to equalise the currents drawn from each supply. The current limiting circuits prevent excessive current being drawn from any individual supply.

8. *OUTPUT CHANGE WITH TEMPERATURE*

Fig. 3 shows a typical curve of output voltage plotted against temperature.

SECTION 3
CIRCUIT DESCRIPTION

1. *GENERAL*

The output from the secondary of the mains transformer MT1 is rectified by the bridge rectifier MR1, and smoothed by the reservoir capacitor C1 to provide an unstabilised d.c. supply. The negative of the unstabilised supply is fed to a series regulator transistor VT7, then through the resistor R16 to the negative output terminal. The positive of the same unstabilised supply is routed to the positive output terminal through switch S3, which will either route the load current through the meter M1 or by-pass the meter to the output terminal.

A second supply is obtained from an additional winding on MT1. It is rectified and smoothed by diodes MR2 and capacitor C2 respectively, and then fed to the stabilisation circuitry.

2. *STABILISATION CIRCUIT*

Current is fed from C2 via R1 to bias the zener diode Z1 giving a stable voltage across Z1. Thus a stable current is fed through resistor R20, R6 and R7 to bias zener diode Z2 and give a voltage across Z2 with a high order of stability, which is used as a reference voltage. The positive voltage end is connected to the negative output terminal of the unit. The voltage difference between the positive output terminal and the negative end of Z2 is divided by the resistor chain of T3, R14 and P1 (with R18 on the second range, R17 and R18 on the top range) and connected to the base of transistor VT4. Any voltage difference between this and the negative terminal voltage on the base of VT3, which forms a differential amplifier with VT4, is amplified by VT4 then by transistor VT5. The amplified signal from VT5 collector is then passed through the emitter follower VT6 and provides on the base of the series regulator transistor VT7 a voltage signal in such a sense as to minimise the difference voltage.

The resistor R19 is connected across the output to provide a small bias current. R15 biasses VT6 and drains leakage current from VT7. Capacitor C4 is connected across the output terminals to compensate for the fall off in response of the unit at high frequencies.

Resistor R2 forms a balanced bridge with resistors R1, R7, R6, R20 and zener diode Z1, which minimises the effect of supply variations on the reference voltage across Z2.*

3. *OVERLOAD PROTECTION*†

As the current drawn from the output is increased, the voltage on the base of VT6, with respect to the negative output terminal, increases until a point is reached when transistor VT2 can conduct, since the voltage on its emitter is more negative than the base voltage which is set by potentiometer P2. At this point the voltage on the base of VT6 is clamped and further decreases in load resistance would give only a slight increase in output current. As a result the output voltage drops. To prevent over-dissipation in the unit, particularly across transistor VT7, it is necessary to reduce the current as the output voltage decreases. The voltage between the output terminal and the unstabilised negative line is monitored by the chain of resistors R5, R3, the preset resistor T1, and zener diode Z4. When the voltage exceeds the zener voltage Z4, current is passed down the chain causing transistor VT1 to conduct. This current flowing through resistors R8, R9 and T2 pulls the voltage on the junction of R8 and P2 towards the negative output terminal, so reducing the catching current level of the output. Thus as the output load is increased the output current is reduced to a safe short circuit level. On the bottom range of the unit, i.e., below 10v, this current reduction would not be operative, but on this range it is not necessary. A curve is drawn (Fig. 1) showing the characteristics of the output trip. On removing the overload the output will return to the preset stabilised value. Resistor R8 and diode MR4 prevent the current being cut off completely, when removal of overload would not result in resetting of the unit.

* Patent application No. 30115/61

† Patent application No. 31567/62

SECTION 4
SPECIFICATION

Power Requirements:	50/60 c/s supplies of 210, 220, 230, or 240 volts. Alternatively, instruments may be supplied for operation on 50/60 c/s supplies of 100, 110, 120, 130 volts. Tolerance allowable on nominal supply voltage: ± 7½%.
Output Capability:	VOLTAGE—0 - 30v in three equal switched ranges, with continuous fine adjustment in each range. CURRENT—0 - 0.5A. (L30/T contains two units of this capability).
Metering:	Weston model S157. Switched V/A meter, with ranges of 30 volts and 0.5 amps f.s.d. (L30/T has two meters).
Output Resistance:	Less than 0.04 ohms.
Line Regulation: (± 7½% mains variation at full load)	Less than one part in 1000 (i.e., <0.1%).
Output Ripple and Noise:	Less than 1mV peak to peak.
Output Impedance:	Less than 0.04 ohm, up to 1Kc/s.
Maximum ambient operating Temperature:	45°C.
Overload Protection:	Current limiting and reducing protection circuit. Under heavy overload or short circuit, output current is limited to a safe value. Output voltage resets automatically to its stabilised value when the overload is removed.
Dimensions:	L30—16.5cm x 19cm x 22cm high (6½" x 7½" x 8¾") L30/T—32cm x 21cm x 23cm high (12¾" x 8½" x 9")
Approximate Weight:	L30—8lbs. (3.65 kilos) L30/T—14½lbs. (6.5 kilos)

SECTION 5

MAINTENANCE

1. The unit is designed so that the maximum number of components are accessible with the minimum amount of effort. To obtain access to the stabilising reference circuitry all that is necessary is to unscrew the four screws holding the perforated base plate. This will also give access to the preset controls for voltage range and current limiting.

To obtain access to the transformer and large capacitors, etc., it is necessary to remove the cover of the unit. This is done by removing the four mushroom headed screws adjacent to the carrying handle, and the two screws on the lower half of each side panel. The cover may then be removed.

2. *RE-ALIGNMENT OF THE VOLTAGE RANGES*

To re-align the voltage ranges proceed as follows:

(1) Invert the unit and remove the base plate.
(2) Set the output range switch to the 20 - 30 volt range and the fine control to its maximum clockwise position.
(3) Adjust the trimmer T3 (marked on the diagram Fig. 4), until the output voltage reads 30.5v.
(4) Set the fine control to the fully anti-clockwise position and check that the output voltage is then 19.5 volts approximately.

3. *ADJUSTMENT OF THE OVERLOAD CUT-OUT CIRCUIT*

Adjust the overload cut-out to give a characteristic as shown in Fig. 1. When adjusting the cut-out it is advisable to monitor the load current with an external meter. This meter should be placed in series with a variable load and coupled to the output terminal.

To make an adjustment proceed as follows:

(1) Invert the unit and remove the base plate.
(2) Set the output to 30v.
(3) Set the external current limiting control to its maximum clockwise position.
(4) Set the variable load resistor to give an output current of 0.55A.
(5) Adjust the trimmer T2 until the output voltage just starts to fall. Increase the load current still further. When the output voltage reaches about 20v the output current should begin to reduce. Adjust T1 until the voltage falls gradually to zero with increasing load. The current falls to about 100 - 150mA when the load is a short circuit.
(6) Decrease the load current by increasing the load resistance until the unit resets.

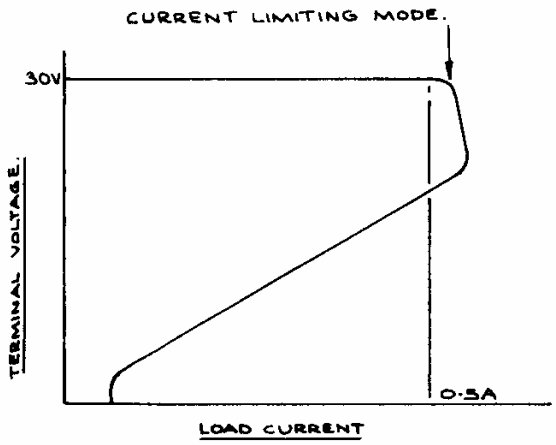

FIG. 1. TYPICAL OVERLOAD CHARACTERISTIC.

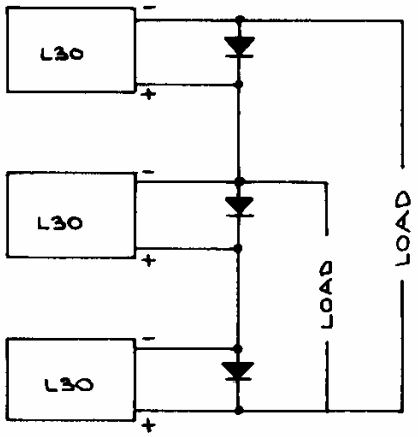

FIG 2. PROTECTION ARRANGEMENT FOR THE SERIES CONNECTION OF L30 POWER UNITS.

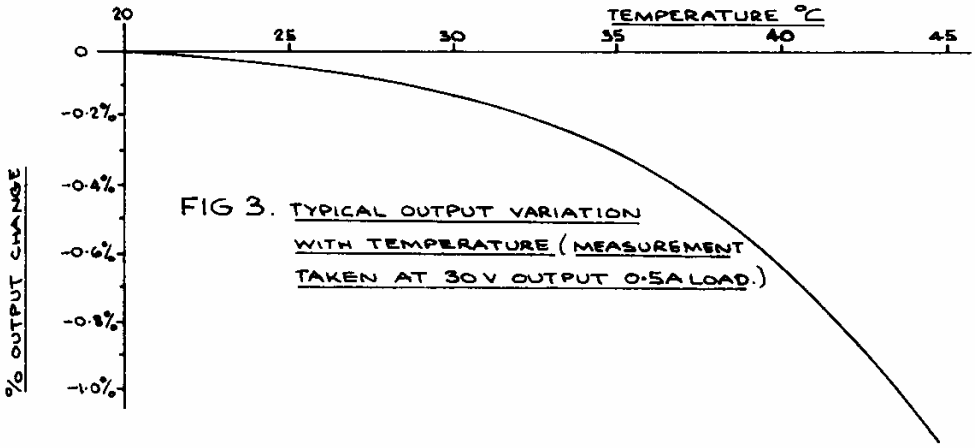

FIG 3. TYPICAL OUTPUT VARIATION WITH TEMPERATURE (MEASUREMENT TAKEN AT 30V OUTPUT 0·5A LOAD.)

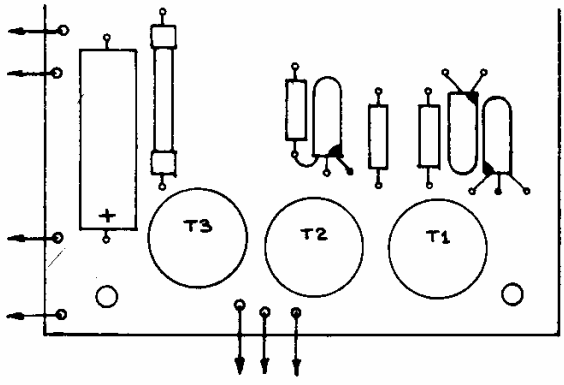

FIG 4. TRIMMER POSITIONS ON CIRCUIT BOARD.

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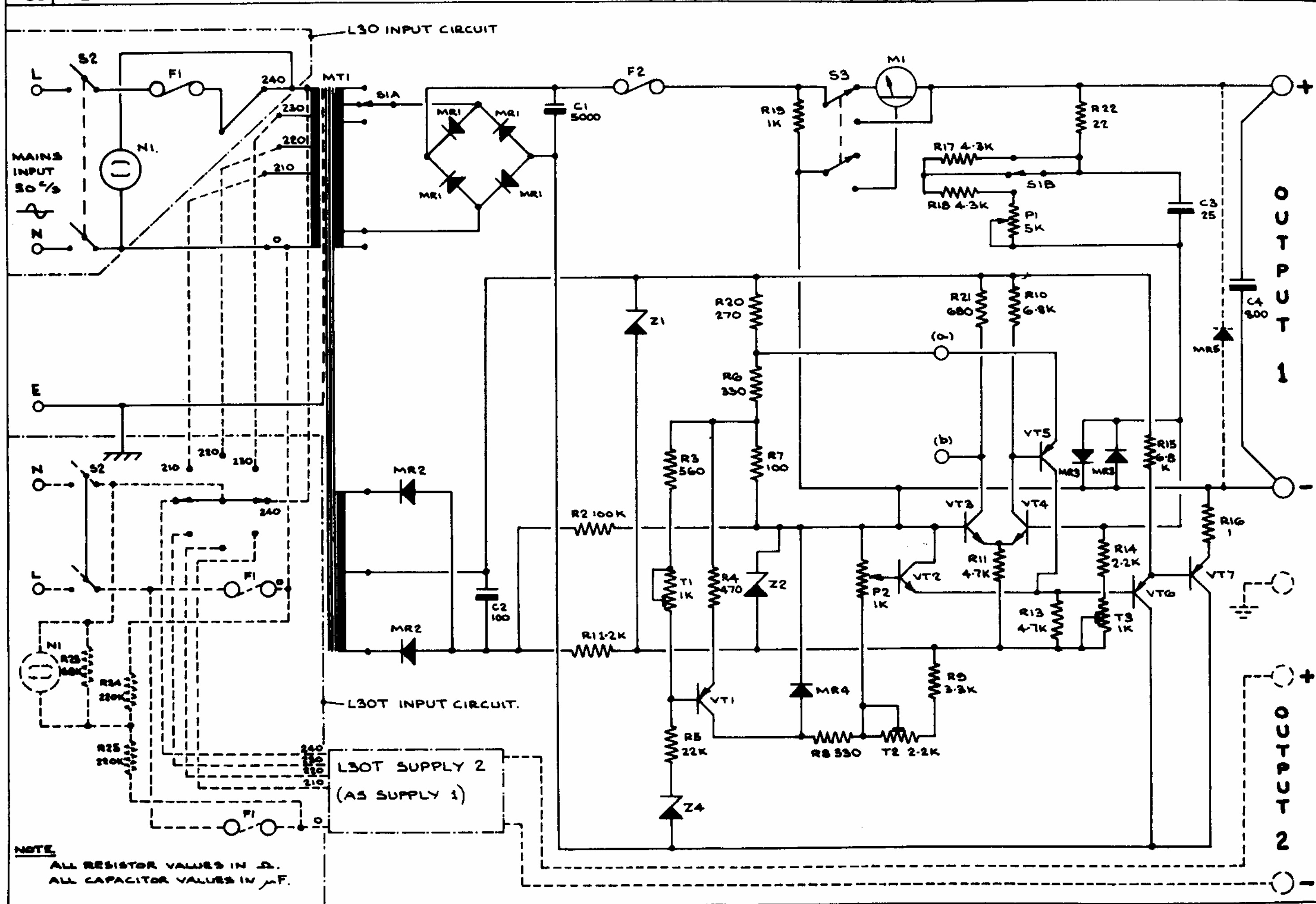
THIRD ANGLE PROJECTION

USED ON

R	23 24,25 1,2 3,5 4,20,6,7 19 8 9,17,18,21,11,10, 13,22,14 15 16	R
C	2 1 3 4	C
VT	1 2 3 4,5 6 7	VT
MISC.	S2 N1 F1 MT1 S1A MR2 MR1 F2,Z1,T1,Z4 Z2 MR4,S3,P2,T2,M1 P1,S1B MR3,T3 MR5	MISC.



NOTE. ALL RESISTOR VALUES IN Ω. ALL CAPACITOR VALUES IN μF.

COMPONENT DETAILS L30

R1. 10% 1W CARBON FILM RESISTOR
R2-R11. 10% ½W " " "
R13 10% ½W " " "
R14 1% ½W HIGH STAB. CARBON FILM RESISTOR
R15 10% ½W CARBON FILM RESISTOR
R16 5% 3W WIRE WOUND RESISTOR
R17 1% ¼W HIGH STAB. CARBON FILM RESISTOR
R18 " " " " " "
R19 10% 1W CARBON FILM RESISTOR
R20-R22 10% ½W " " "

C1 50V CAPACITOR. PLESSEY CE 1360/9
C2 " " HUNTS MEF 43AT
OR " " " MEF 43T
C3 " " " MEW 39T
OR 12μF 50V. TCC. CE431DD
C4 40V CAPACITOR MULLARD C431BR/G800
OR " " PLESSEY CE 1234/409

MT1. TRANS. WESTOOL BTX 2025A5PG

Z1. DIODE. IRC MEZ15T5
Z2. " GEC SX51
Z4 " IRC MEZ22T5
MR1 " FERRANTI ZS72 OR ZS74
MR2 " TEXAS 1S132
MR3 " FERRANTI ZS72
MR4 " MULLARD OA6

VT1. TRANSISTOR. MULLARD OC72
VT2-VT4 " " 2N1302
OR " " OC139
VT5 " " OC44
VT6, VT7 " " OC36

P1 1W POT. COLVERN CLR1106/115
P2 ½W " 10% PLESSEY. TYPE EP.
T1, T3 TRIMMER " " TYPE MP
T2 " " " " OR G

F1. FUSE. 500 mA
F2 " 750 mA

S1. SWITCH. NSF. 77768JKM1

COMPONENT DETAILS L30T

AS ABOVE x 2 PLUS THE COMPONENTS SHOWN THUS -----

R23-R25 10% ½W CARBON FILM RESISTOR
MR5 DIODE FERRANTI ZS72

NOTE. ALTERNATIVE COMPONENTS TO THE ABOVE MAY BE USED IN THE EVENT OF SUPPLY DIFFICULTIES.

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TITLE :- CIRCUIT DIAGRAM & KEY. TYPE L30 & L30T.

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SHEET 1 OF 1 SHEETS

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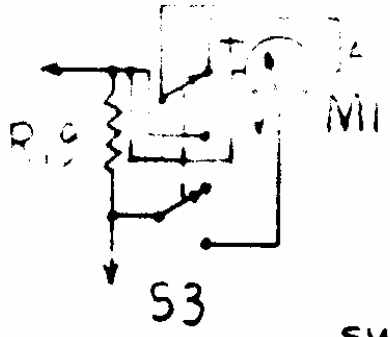

METER CONNECTIONS

FROM SERIAL N°S ON

L30 - 1861

L30T - 366

SWITCH SHOWN IN AMPS POSITION