Kingshill

V SERIES
TECHNICAL DATA

1. INTRODUCTION

Kingshill V Series bench power supplies offer outputs of up to 150V and 10A and are ideally suited for use in Research, Development and Educational laboratories where precisely controlled and protected supplies are essential. The complete range of V Series units are switchable for constant voltage and constant current and have four-wire sensing facilities. Metering of output voltage and current by analogue or digital meter is provided, together with the facility to set the current limit level before connecting the load.

2. GENERAL INFORMATION

2.1. For the unit specification see Table 1.
2.2. For module sizes refer to the current Kingshill catalogue.
2.3. Unit items lists are available on request.

3. WARNINGS

3.1. Check rating labels on rear of unit and ensure correct input voltage rating before conecting to the mains supply. If at variance refer to section 4.2.
3.2. Kingshill V Series units should only be used within the parameters specified in the catalogue and in section 4.0. Installation, modification and servicing must be performed by skilled personel.

4. OPERATING INSTRUCTIONS

4.1. Installation.
Always ensure there is a free passage for cooling air flow under the instrument and out of the top vents to ensure overheating does not occur.

4.2 Input voltage.
Units are despatched set to 240Vac (unless otherwise specified by customer). The Mains on/off switch as supplied has an integral green bulb for 240V and orange for 110V. If adjustment is required it should be carried out in accordance with the following instructions.
4.2.1 Unscrew and retain the feet and all screws on the underside of the unit and slide unit front panel forward out of its case.

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4.2.2. Voltage adjustment is by altering soldered primary connections on the mains transformer panel. In standard units the transformer has two primaries of 5-0-100-110-120 covering the ranges 100 to 125 volts and 200-250 volts in 5 volt steps. On small units tappings are two primaries of 0-110-120V given adjustment in 10 volt steps. The brown and blue input voltage wires should be soldered such that the sum of the voltages marked on the two lugs is equal to the required voltage Both primaries should be paralleled for the 100-125V range and connected in series for the 200-250V range. If in doubt contact Kingshill Technical Department.
4.2.3. Ensure correct fuse rating is used for 100-125 VAC input, the fuse rating should be twice that as supplied standard for 200-250V operation. The fuse type is 5 x 20mm mains time delay type T see Table 2.

4.3. Output connections.
The unit output is from the red (positive) and the black (negative) terminals. Wiring from the terminals should be of the correct current rating and kept to minimum length. Four wire remote sensing is available from the blue remote sense terminals (see section 4.8). A green earth terminal is also fitted on the unit front panel.

4.4. Output Metering.
Both output voltage and output current can be monitored by appropriate selection of the meter volts/amps switch on the unit front panel. An analogue meter to BS 89 (1977) is fitted as standard with a bright 3 $^{1}/_{2}$ digit LED digital panel meter available as an option.
In voltage mode the top voltage scale on the analogue meter is used but for voltages less than $^{1}/_{2}$ rated value the voltsx2 switch can be depressed and the bottom voltage scale read (not applicable to DPM option).

4.5. Current Limit.
This is set by the front panel current limit control. It may be pre-set prior to attaching a load to the unit by depressing the current limit set switch and adjusting the current limit control to the desired level.The switch puts a virtual short circuit across the unit output to simulate maximum load and hence should be operated for the minimum required time only to prevent overheating

4.6. Constant Voltage Operation.
The constant voltage/constant current switch should be set to the constant voltage position. The output voltage is set by the coarse and fine voltage controls.

4.7 Constant Current Operation.
The constant voltage/constant current switch should be set to the constant current position. The output current is set by the constant voltage <u>fine control only.</u>

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4.8. Remote Sensing.
In voltage mode, the unit is capable of 4-wire voltage sensing to allow accurate control of voltage at a remote load position.
The following circuit connections are necessary to enable remote sensing:
4.8.1. Remove unit from it's cover (see section 4.2.1). On the rear of Front panel, remove the 2 wire links connecting sense+ to out+ and sense- to out- which are soldered to the backs of the output terminals. Re-assemble the unit.
4.8.2. The load should be connected as normal to the out+ and out- terminals. Seperate wires from sense+ and sense- should be connected to the remote position where the stabilised voltage is required. The following points must be noted :
(i) To minimise voltage drop, the largest cross section output leads as practical should be used.
(ii) It is good practice to run the sense leads as a twisted pair or under extreme conditions as screened cable. It is usually necessary to employ remote decoupling by connecting a capacitor at the sense point. A valve similar to that of C5 is suggested.
(iii)When used in remote sense the output lead voltage drop should be kept to a minimum to prevent the low mains capability of the unit being impaired.

4.9. Series and Parallel Operation.
V series units can be used in series connection up to a total output voltage of 300 volts. An unlimited number of units can be used in parallel.

4.10.Active Loads.
When using the unit to supply an active load, such as battery, it is recommended to incorporate an external output series diode of sufficient current rating. This will prevent voltage feeding back into the unit if switched off with load still connected.

4.11.Twin Units.
All V series units can be supplied as twin units. These comprise of 2 independant units with a common mains input cable and outer casing. The exception is module size "C" & "CV" (see Kingshill Catalogue) units which are purpose built with one common mains transformer, on/off switch and mains input cable.

5. CIRCUIT DESCRIPTION

The circuit shown in Figure 1 is, apart from minor differences, common to all V series units. Twin units are essentially two single units with a common mains input supply. The general operation of a V series unit is described below.

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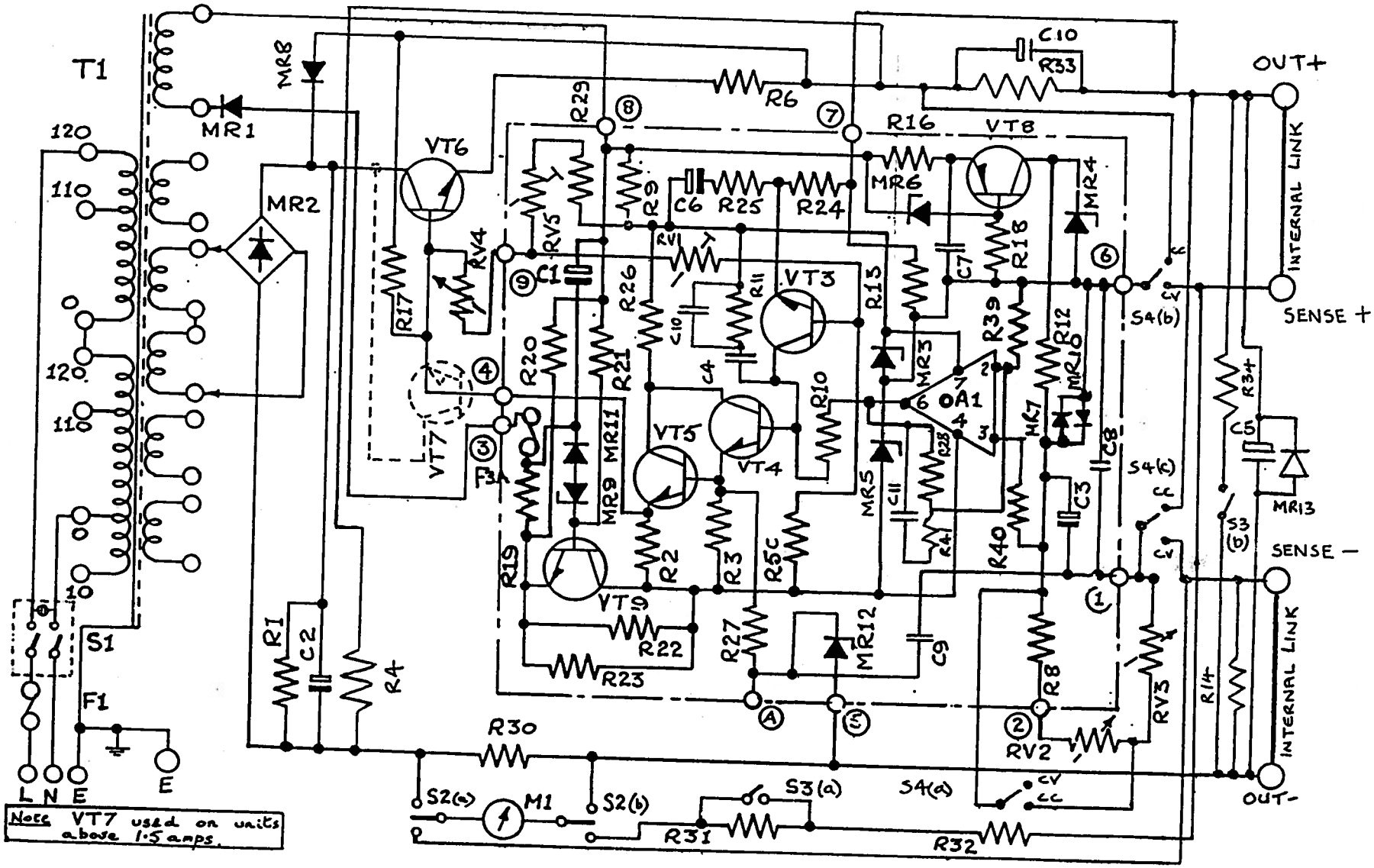
5.1. General Description.
The mains input to the unit is transformed to the required secondary voltage by a multi-tapped transformer T1 and is rectified by bridge rectifier MR2. This voltage is smoothed by capacitor C2 and the unregulated DC is fed to the linear series regulator VT6 consisting of one or more power transistors (depending on unit rating) with equal current sharing determined by resistor R6. This voltage is fed to the positive output terminal and returns via the load and negative terminal to complete the circuit.
A stabilised output voltage is maintained by sensing the output voltage and comparing it to a fixed reference voltage with an operational amplifier whose resulting error signal is used to maintain a stabilised output from the unit by controlling the conduction of VT6. The control circuitry is mounted on one printed circuit board and is supplied by an auxilllary 35 volt winding from transformer T1.

5.2. Control Circuit
5.2.1. In constant voltage mode the sense terminal voltage is sampled by R12, R8, RV2 and RV3 and is compared by operational amplifier OA1 with the reference voltage across zener diode MR4. Transistor VT8 is a constant current source for the reference chain. The output voltage is thus controlled by varying the coarse and fine voltage potentiometers RV2 and RV3 creating an offset voltage at virtual earth point pin 3 of OA1 which is amplified and produced at OA1 output pin 6. This signal is coupled via emitter followers VT4 and VT5 (and VT7 on units above 1.5A) to transistor VT6 base such as to adjust the drive and hence output voltage to compensate for the offset created.
5.2.2. In constant current mode switch S4 changes the sense lines to sense the voltage drop across resistor R33 is directly proportional to output current) and links out coarse control potentiometer RV2. Control of current is thus maintained similarly as in constant voltage mode except with adjustment being by fine control potentiometer RV3. The control circuit only maintains a constant voltage drop across R33 and hence a stable output current. The constant current will flow in any load from a short circuit to the maximum compliance of the unit.
5.2.3.Under certain conditions, if the coarse voltage control is rapidly reduced to minimum, output capacitor C5 may discharge rapidly through MR7 to damage RV2 potentiometer. To prevent this, a low value resistor R8 acts to limit this current. This resistor, however is part of the voltage reference chain and prevents the output voltage from reaching absolute zero. If a near zero condition is required, R8 may be short-circuited but care must be taken not to vary the voltage controls too rapidly.
5.2.4.The control boards is stabilised by zener diodes MR3 and MR5 and constant current transistor VT9. A small 2A pcb mounted fuse F3A is fitted on the control board.



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5.3. Current Limit

The current limit is of the constant current limit type. The voltage developed across the resistors R6 and R33 (which is proportional to load current) is sampled at VT3 emitter. This is compared to a preset voltage across RV1 which is coupled to VT3 base. Assuming the front panel current limit potentiometer RV4 to be turned fully clockwise (i.e. maximum current limit) and the unit operating within its rated current, VT3 is biassed fully off. As load current increases towards it rated value VT3 becomes forward biassed and clamps the drive from OA1 to VT4 to a constant value. Any attempt to increase current by lowering output load resistance results in a reduction of output voltage since the available load current is now fixed by VT3.

This principle can be prematurely initiated by adjusting the front panel current limit control RV4 anticlockwise. VT3 conducts earlier and the unit limits at a lower output current. Potentiometer RV5 is preset to inject a bias to maintain a minimum current limit setting of approx. 20% rated current.

5.4. Output Protection

A reverse polarity diode MR13 is fitted across the unit output terminals to protect the unit against external transient reverse voltages. Diode MR8 protects the series regulator transistor VT6 against external high voltages applied across the unit output terminals. Diodes MR7 and MR10 protect operational amplifier OA1 inputs against extreme voltages applied across the sense terminals.

MAINS INPUT		
UNIT VA	200-250V	100-125V
15 - 36	500ma	1A
45 - 72	1A	2A
90 - 200	2.5A	5A
Fuse type is 5 x 20mm "T" type		