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BWD INSTRUMENTS

242A

DUAL D.C. POWER SUPPLY

INSTRUCTION MANUAL

ISSUE 7

INDEX

INSTRUMENT HANDBOOK

MODEL bwd 242A

D.C. POWER SUPPLY

1. GENERAL

Model bwd 242A dual high stability, all Silicon Solid State D.C. Power Supply provides both Constant Voltage and Constant Current operation over the full operating range. Front panel switching enables the supply to be used up to the following ratings.

1.	INDEPENDENT	2 x 0 -36V at 0 - 2 Amp.
2.	SERIES	0 - 72V at 0 - 2 Amp.
3.	PARALLEL	0 - 36V at 0 - 4 Amp.

Integrated Circuit control and reliable silicon semi-conductors coupled with the advanced circuit design provide very high stabilisation and regulation with low ripple.

Using a single unit, switched to any of the three modes of operation, the output may be programmed by several sources to provide the following operation.

1. Remote Load Sensing.
2. Constant Voltage Remote Resistance Programming.
3. Constant Voltage Remote Voltage Programming.
4. Constant Current Remote Resistance Programming.
5. Constant Current Remote Voltage Programming.

With two or more units, not necessarily of the same model, (See Section 4 for list of compatible supplies) the following operational modes can be used.

6. Auto Series with two or more units.
7. Auto Tracking, +ve to +ve, +ve to -ve, -ve to -ve, using two or more units.
8. Auto Parallel with two or more units.

The MASTER SUPPLY of any of the above modes using multiple supplies may be programmed internally or by any of the modes 1 to 5.

NOTE: For reliable operation, at least 2" of free space must be left at the rear of the heatsinks to ensure free flow of air past the power devides.

2. PERFORMANCE

	Independent Nos. 1 & 2.	Series	Parallel
2.1 Constant Voltage Output	Output current should be 40mA (80mA on PARA) less than S/C current.		
Continuously variable without switching	0 - 36V	0 - 72V	0 - 36V
Current Range	0 - 2A	0 - 2A	0 - 4A
Line Regulation for a 10% line change	0.002%+100μV	0.005%+200μV	0.005%+200μV
Output Impedance			
DC - 1kHz	1mΩ	1mΩ	1mΩ
1kHz - 10kHz	10mΩ	10mΩ	10mΩ
10kHz - 1MHz	100mΩ	100mΩ	100mΩ
Ripple at full load	2mV P-P	or	300μV RMS
Response Time 0 - 100% load to within 10mV of output. 20mV in Series and parallel.	60μSec	60μSec	100μSec
Temperature Stability 0 to 50°C	(0.01% + 2mV) per °C		
Long Term Stability 1,000 hours Constant load and temperature	0.1% + 2mV		
2.2 Constant Current Output	Maximum output voltage should be 100mV below O/C voltage.		
Continuously variable without switching	0 - 2.0A	0 - 2.0A	0 - 4.0A
Upper Voltage Limit	0 - 36	0 - 72	0 - 36
Line Regulation for a 10% line change	.02% + 100μA		
Output Impedance DC - 100Hz	100KΩ	10KΩ	10KΩ
Current Ripple	500μA RMS	500μA RMS	1mA RMS
Response Time 0V to upper voltage limit to within 4% of nominal output	See Page 8	See Page 22	See Page 34

2. PERFORMANCE (Cont'd.)

2.3 Remote Loading Sensing (Constant Voltage)

$$Ro = 2(2R\ lead)^2 \times 10^{-2} + 1 \times 10^{-3}\Omega$$

when (i) All four leads (output and sensing) have identical resistance.
(ii) R lead is the resistance of one lead only.
(iii) Ro is the output resistance at the load.
(iv) The voltage drop across any one lead does not exceed 0.5V.

2.4 Remote Programming, Constant Voltage

(i) Resistance Programming.
The output voltage will vary at a rate determined by the programming co-efficient 1.3kΩ per volt (i.e. the output voltage will increase one volt for each 1.3kΩ added in series with the programming terminals. Accuracy ± 10%.

(ii) Voltage Programming.
The output voltage will vary in a 1 to 1 ratio with the programming voltage. Accuracy within 10mV.
Slewing Rate : 10μS/V (Current Limit set to 2A).

2.5 Remote Programming, Constant Current

(i) Resistance Programming.
The output current will vary at a rate determined by the programming co-efficient 337Ω per amp. Accuracy ± 10%.
The upper limit on current is dependent on the constant current vernier at all times.

(ii) Voltage Programming.
The output current will vary at a rate determined by the programming co-efficient 500mV per amp. The upper limit on current is dependent on the constant current vernier setting. Accuracy ± 5% above 1A.

2.6 Auto Series

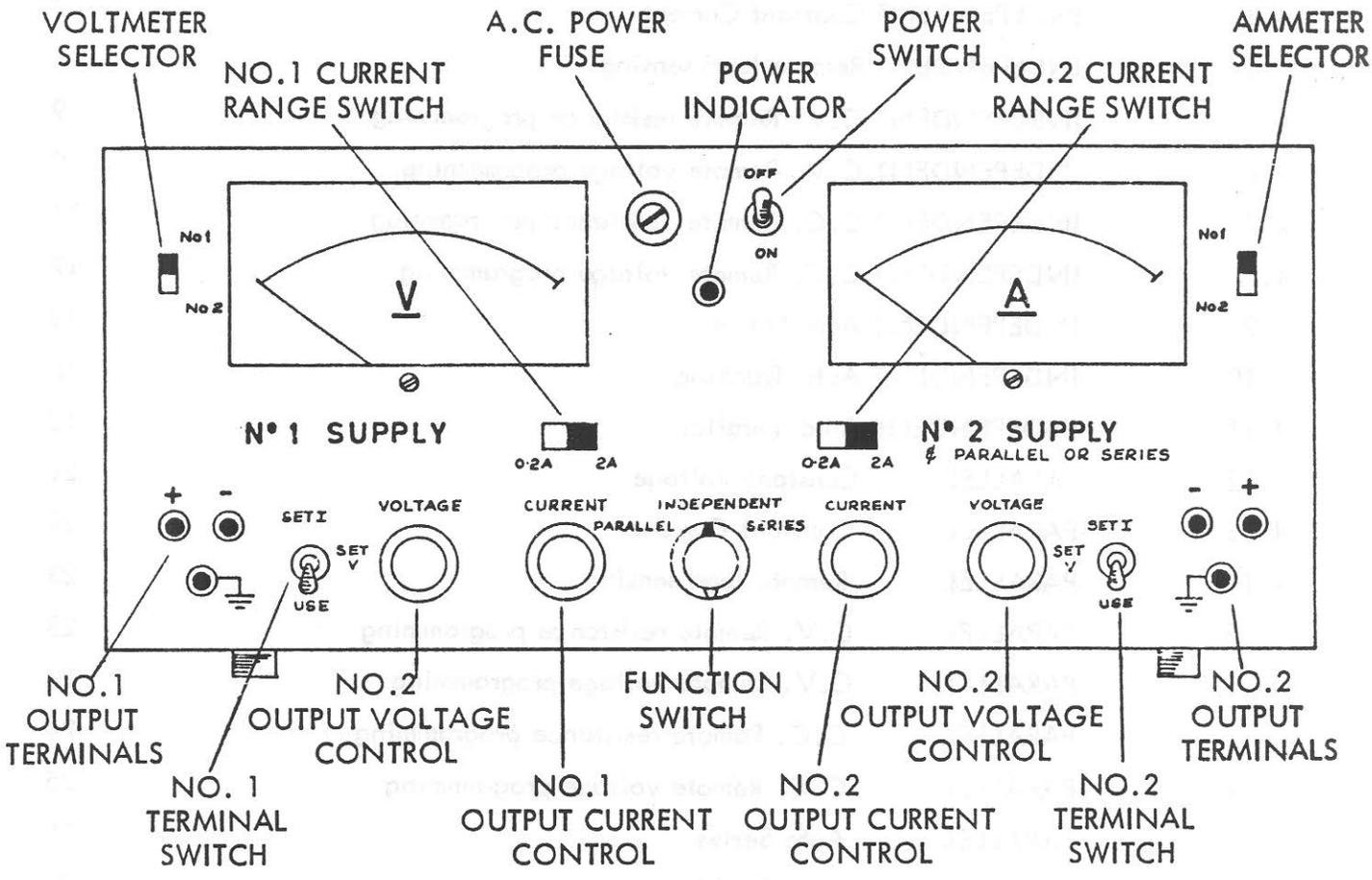
Two or more supplies may be connected in series noting that the maximum voltage of each supply is 36V. Also the current overloads of each supply are operative at the current set by the respective current verniers.

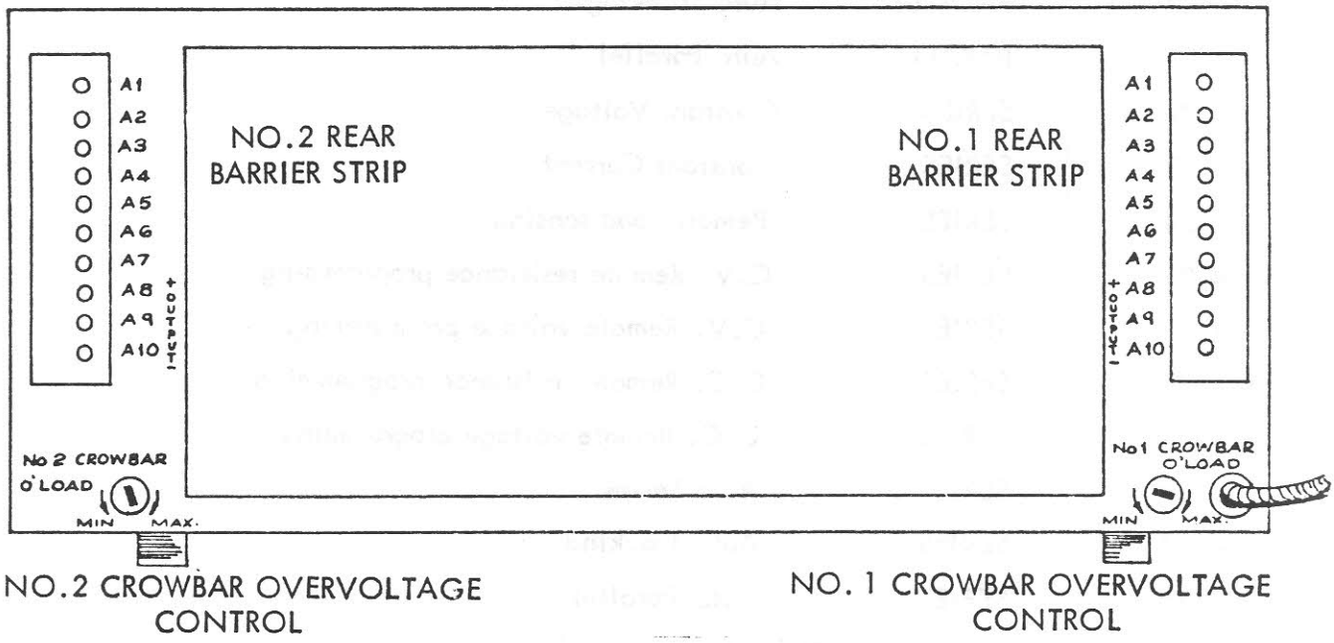
2.7 Auto Parallel

Two or more units may be connected in parallel, thereby doubling the available output current. The maximum current from each supply is dependent on the setting of the current vernier.

3. CONTROLS AND THEIR FUNCTIONS.

Power On-Off	Input Power Switch.
Power Fuse	2Amp delay fuse fitted after power switch in A.C. line.
Power Indicator	6.3V lamp wired into the power transformer secondary.
Parallel, Independent, Series (Function)	Internally connects both supplies in Parallel or Series, or allows both supplies to be operated independently.
Output Voltage	Continuously variable control to set output voltage from zero to 36V or 72V as selected by the function switch.
Output Current	Continuously variable control to set output current from 10mA to 200mA, 2.0A as selected by Current Range Switch.
Current Range	Selects both the maximum current output, 200mA or 2.0A, and the corresponding ammeter range.
Voltmeter Selector	Selects either No. 1 or No. 2 output voltage for display.
Ammeter Selector	Selects either No. 1 or No. 2 output current for display.
Set 1 - Set V - Use (Terminal Switch)	Enables the maximum current required (Set 1) to be set and the maximum voltage (Set v) to be set without disconnecting the load from the terminals. NOTE: Vo must be greater than 1V to set "1".
Terminals	Load - Red (positive) Black (negative) Ground - Uninsulated terminal
Barrier Strip (Rear Panel)	Designated A1 to A10 inclusive, the terminations provide output and remote sensing connections, together with remote control facilities.
Crowbar Overload	Continuously variable screwdriver control sets the over-voltage overload.


VOLTMETER SELECTOR
NO.1 CURRENT RANGE SWITCH
A.C. POWER FUSE
POWER INDICATOR
POWER SWITCH
NO.2 CURRENT RANGE SWITCH
AMMETER SELECTOR
No1
No2
V
A
OFF
ON
N° 1 SUPPLY
N° 2 SUPPLY
0·2A 2A
0·2A 2A
PARALLEL OR SERIES
+ -
SET I
SET V
USE
VOLTAGE
CURRENT
INDEPENDENT
PARALLEL
SERIES
CURRENT
VOLTAGE
SET I
SET V
USE
- +
NO.1 OUTPUT TERMINALS
NO. 1 TERMINAL SWITCH
NO.2 OUTPUT VOLTAGE CONTROL
NO.1 OUTPUT CURRENT CONTROL
FUNCTION SWITCH
NO.2 OUTPUT CURRENT CONTROL
NO.2 OUTPUT VOLTAGE CONTROL
NO.2 TERMINAL SWITCH
NO.2 OUTPUT TERMINALS


A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
CONTACTS
NO.2 REAR BARRIER STRIP
NO.1 REAR BARRIER STRIP
No 2 CROWBAR O'LOAD
MIN MAX.
No1 CROWBAR O'LOAD
MIN MAX.
NO.2 CROWBAR OVERVOLTAGE CONTROL
NO. 1 CROWBAR OVERVOLTAGE CONTROL

4. OPERATION

4.1 GENERAL

For reliable operation ensure that at least 2" of free space is present at the rear of the heatsinks and that adequate ventilation above and below the heatsinks is provided. For rack mounted units, do not operate above equipment producing heat in excess of 50°C in the vicinity of the heatsinks.

NOTE: Check that the mains voltage connections are correct for the supply in your location.

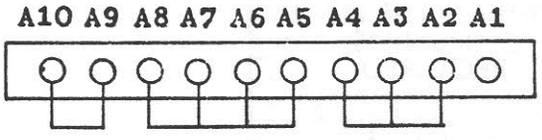
4.2 INDEPENDENT - Constant Voltage (0-36V, 0-2A)

Set the function switch to "INDEPENDENT", the terminal switch to "SET V", the current range to the desired current output range and the meter selectors to the required supplies.

Switch the Power switch "ON" and set the required output voltage via the output voltage control and the front panel meter. Switch the terminal switch to "SET 1" and set the required overload current with the output current control.

Connect the load to either the output terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip.

NOTE: When using the rear barrier strip for load termination make sure that the following terminals are linked.



Switch the terminal switch to "USE".

If the output voltage drops to less than that set earlier, the load is drawing more current than allowed for.

If the load is to be operated at a considerable distance from the power supply and the output impedance required is to be as low as possible, remote sensing may be employed; see section 4.4

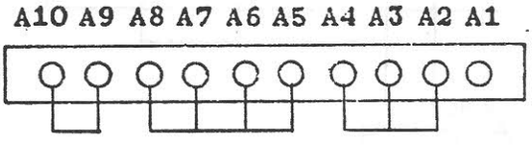
4.3 INDEPENDENT - Constant Current (0-2A, 0-36V)

Set the function switch to "INDEPENDENT", the terminal switch to "SET V", the current range to the desired current output range and the meter selectors to the required supplies.

Switch the Power switch "ON" and set the maximum voltage limit required by the Output Voltage Control and the front panel meter. Switch the terminal switch to "SET 1" and set the required output current by the output current control and the front panel meter.

Connect the load to either the output terminals or A8 (+ve) and A10(-ve) on the rear barrier strip.

NOTE: When using the rear barrier strip for load termination, make sure that the following terminals are linked.

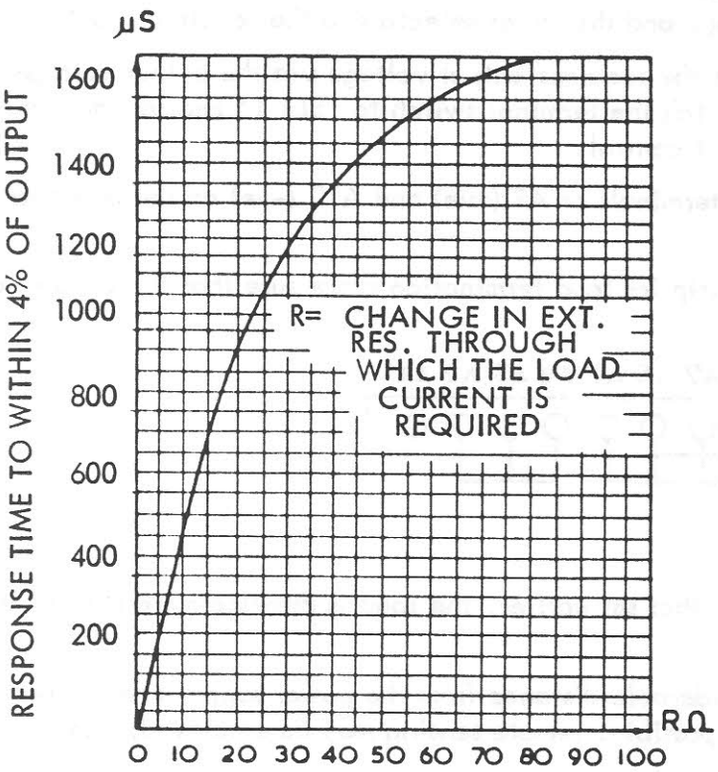


4.3 INDEPENDENT - Constant Current (0-2A, 0-36V) (Cont'd.)

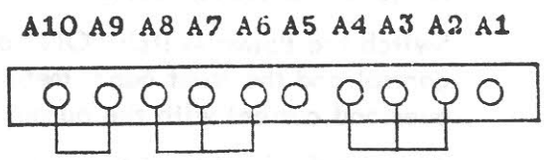
Switch the terminal switch to "USE".

If the output current is less than that set previously, the load impedance is higher than expected. To enable sufficient current to be drawn, the upper voltage limit may be increased until correct operation is achieved.

With the rear barrier strip linking above, the output capacitance is approximately 2200μF. This high capacity produces a long response time for rapid load changes. To reduce the output capacity the link on the rear barrier strip joining A5 to A6 (see below) is removed, giving a much improved transient response time.



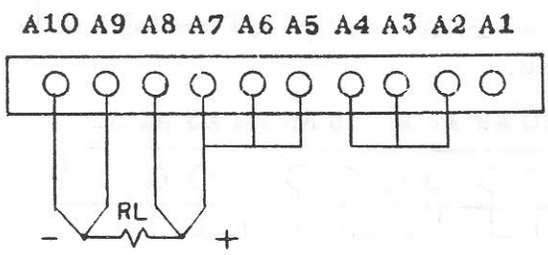
Constant Current Transient Response Time



4.4 INDEPENDENT - Remote Load Sensing (0-36V, 0-2A)

This mode of operation is only required when the supply is used in the constant voltage mode and the lead resistance between the load and the power supply is excessive.

Set the function switch to "INDEPENDENT", the terminal switch to "SET V", the current range to the desired current output range and the meter selectors to the required supplies. Connect the load as below from the rear barrier strip only.



4.4 INDEPENDENT - Remote Load Sensing (0-36V, 0-2A) (Cont'd.)

NOTE: (1) All four leads must have same resistance.

(2) To reduce hum pickup, shield all leads or twist together.

The output resistance at the load can be calculated quite closely using the following equation:-

$$Ro = 2\,(2R)^2 \times 10^{-2} + 1 \times 10^{-3} \quad \Omega$$

where Ro is the output resistance as seen at the load.

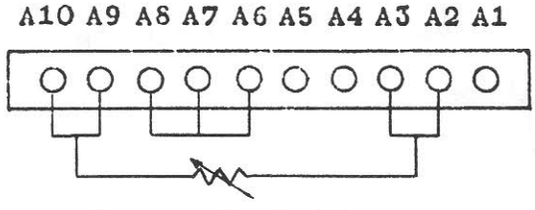
R is the resistance of one lead in ohms, assuming all four leads have identical resistance.

To supply power to the load, switch the terminal switch to "USE".

4.5 INDEPENDENT - Constant Voltage Remote Programming

Resistance Programming (0-36V, 0-2A)

The constant voltage output of the supply can be controlled from a resistance situated at a remote location. With the power supply switched "OFF" connect the programming resistor and rear barrier strip links as shown below.



Programming Resistor

Programming Co-efficient is equal to approximately 1.3kΩ per volt.

Set the function switch to "INDEPENDENT", the terminals switch to "USE", the current range to the desired current output range and the meter selectors to the required supplies. Connect the load to either the front panel terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip.

NOTE: (a) The terminal switch must be in the "USE" position at all times. High output voltage transients may occur across the load if the terminal switch is used.

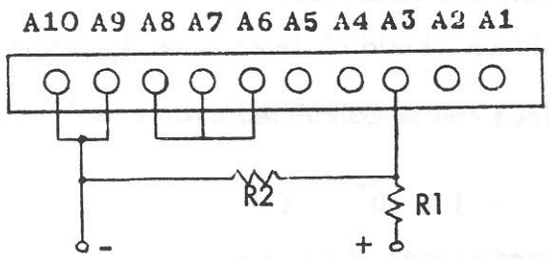
(b) Use the power ON-OFF switch if it is required to remove voltage from the load.

(c) The maximum current may be set using the terminal switch, the load should be disconnected if high voltage transients can cause damage to it.

4.6 INDEPENDENT - Constant Voltage Remote Programming

Voltage Programming (0-36V, 0-3A)

The constant voltage output of the supply can be controlled by a variable voltage produced at a remote source. The voltage gain of the system can be either greater, equal to, or less than unity depending on the connection of the rear barrier strip.

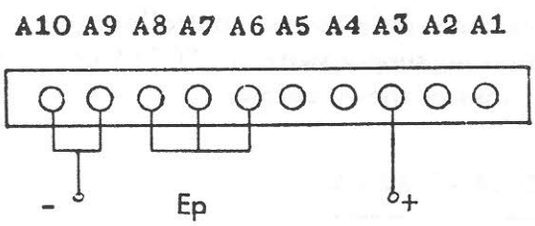


$$E_{out} = E_p \cdot \frac{R2}{R1 + R2}$$

$$A_v = \frac{R2}{R1 + R2}$$

Ep
Programming Voltage

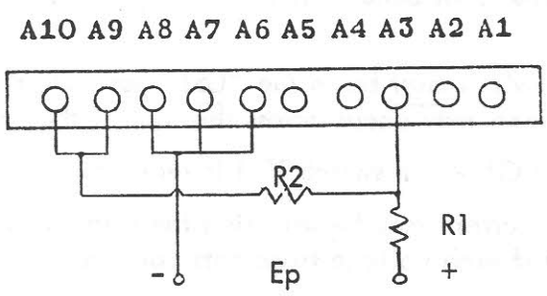
$A_v < 1$



$E_{out} = E_p$

Programming Voltage

$A_v = 1$



$$E_{out} = E_p \cdot \frac{R2}{R1}$$

$$A_v = \frac{R2}{R1}$$

Programming Voltage

$A_v > 1$

NOTE: (a) The maximum gain advisable is 500.

(b) If a circuit ground is required at high gain, ground A8.

4.6 INDEPENDENT - Constant Voltage Remote Programming - Voltage Prog. (Cont'd.)

The output voltage in all of the voltage programming modes may be obtained at either the front panel terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip.

Before connecting the supply to the programming voltage check that the D.C. conditions of the programming voltage and the power supply are correct, i.e. one side of the programming source (-ve) is connected to either the +ve or -ve output of the supply, ensure that the supply and the programming source do not become short circuited or cross connected by multiple ground connections. Set the function switch to "INDEPENDENT", the terminal switch to "USE", the current range to the desired current output, and the meter selectors to the required supplies. Connect the load to either the front panel terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip. With the power supply switched "OFF" connect the programming voltage into the rear barrier strip in either of the three modes.

NOTE: (a) The terminal switch must be in the "USE" position at all times to avoid damage to the load.

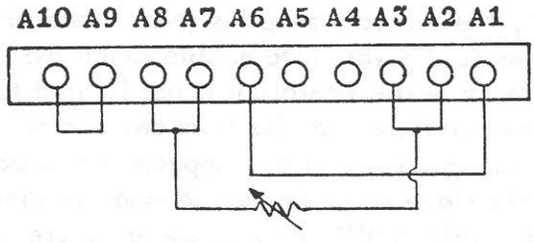
(b) Use the power ON-OFF switch if it is required to remove voltage from the load.

(c) The maximum current may be set using the terminal switch, the load should be disconnected if high voltage transients can cause damage to it.

4.7 INDEPENDENT - Constant Current Remote Programming

Resistance Programming (0-2A, 0-36V)

The constant current output of the supply can be controlled by a resistance situated at a remote location. With the power supply switched "OFF" connect the programming resistor and rear barrier strip links as shown below.



Programming Resistor

Programming Co-efficient is equal to approximately 337Ω per amp.

Set the function switch to "INDEPENDENT", the terminal switch to "SET V", the current range to the desired maximum current and the meter selectors to the required supplies. Connect the load to either the front panel terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip.

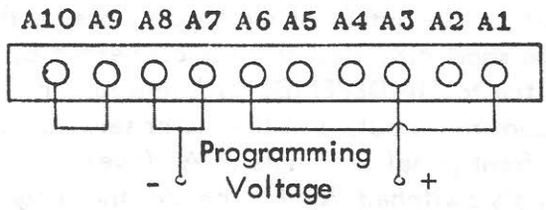
NOTE: The maximum current of the supply is still set by the normal current controls. To check the operation the terminal switch may be set to "SET 1" and the programming verified. Power may be connected to the load by setting the terminal switch to "USE".

NOTE: The upper voltage limit of 36V may be exceeded with no damage to the supply, however output ripple and regulation will be impaired.

4.8 INDEPENDENT - Constant Current Remote Programming

Voltage Programming (0-2A, 0-36V)

The constant current output of the supply can be controlled by a variable voltage produced at a remote source. With the power supply switched "OFF" connect the programming resistor and rear barrier strip links as shown below.



Programming Co-efficient is equal to approximately 500mV per Amp.

NOTE: Check that multiple ground paths do not cause excessive loading on the programming source or the supply.

Set the function switch to "INDEPENDENT", the terminal switch to "SET V", the current range to the desired maximum current and the meter selectors to the required supplies. Connect the load to either the front panel terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip.

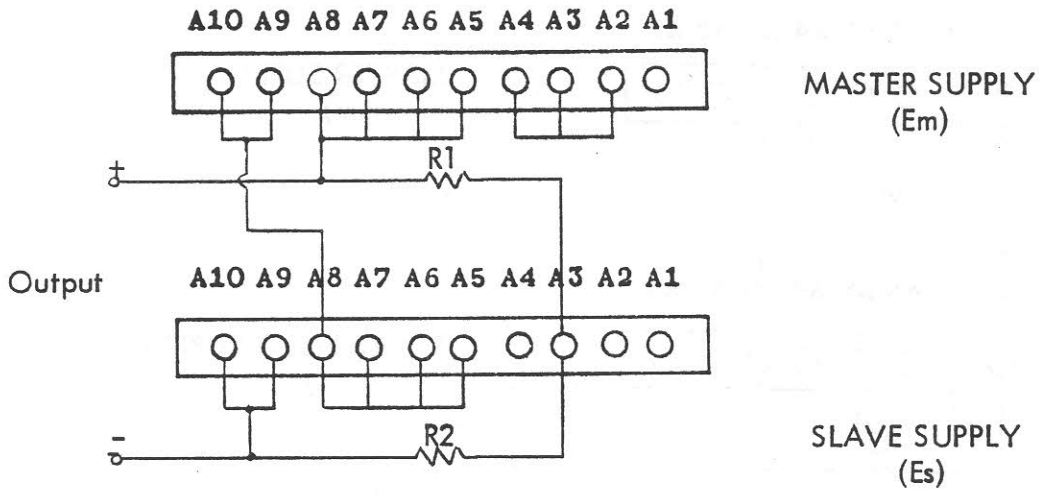
NOTE: The maximum current of the supply is still set by the normal current controls.

To check the operation the terminal switch may be set to "SET 1" and the programming verified. Power may be connected to the load by setting the terminal switch to "USE". The upper voltage limit of 36V may be exceeded with no damage to the supply, however output ripple and regulation will be impaired.

4.9 INDEPENDENT - Auto Series (0-72V, 0- 2A)

With the unit switched to INDEPENDENT, the separate supplies (No. 1 and No. 2) may be externally connected in an automatic series configuration to enable twice the output voltage of the MASTER SUPPLY to be produced. Auto Series operation is not limited to two sections of one unit but may be used for seriesing two or more supplies from any number of units. Normally auto series operation demands that an equal voltage appears across each supply. However by selection of various resistors the slave supplies may be made to supply varying proportional voltages to the master output. This facility may be useful where a Model bwd 242A is required to operate in auto series with another bwd power supply. For a list of compatible supplies see section 4-32. If another model supply is used set its front panel controls as indicated for this type of programming in the handbook for that supply.

To connect two supplies in auto series the rear barrier strip links and resistors are connected as shown overleaf with both supplies switched "OFF".



1. IMPORTANT. Use only SINGLE POINT EARTHING.

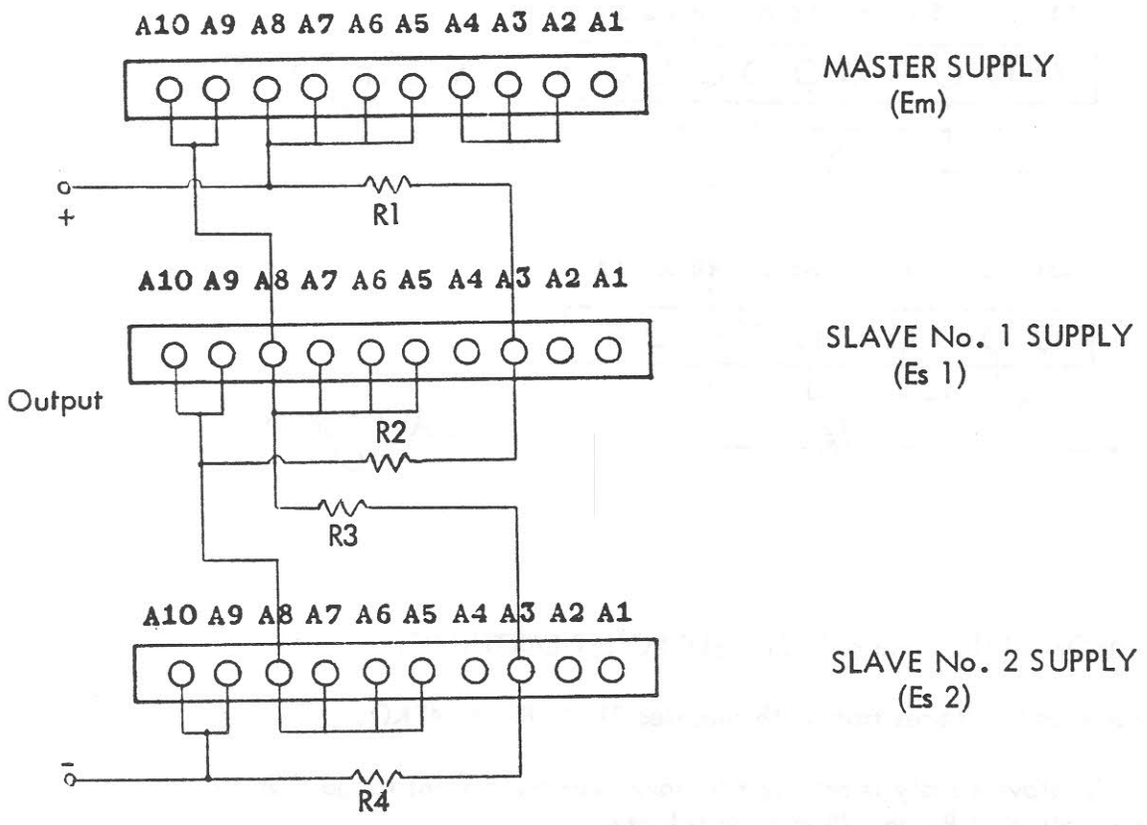
2. For equal voltages from both supplies R1 = R2 = 47KΩ.

3. If the slave supply is required to vary over a different range than the master the values of R1 and R2 may be selected.

$$\frac{Em}{R_1} = \frac{Es}{R_2}$$ i.e. the ratio of Em to Es is equal to the ratio of R_1 to R_2.

Where Em $\geqslant$ Es and R1 $<$ 50KΩ.

To connect three supplies in Auto Series the rear barrier strip links and resistors are connected as shown overleaf with all supplies switched "OFF".



1. IMPORTANT. Use Only SINGLE POINT EARTHING.
2. For equal voltages from all supplies $R_1 = R_2 = R_3 = R_4 = 47K\Omega$.
3. If the slave supplies are required to vary over different ranges than the master supply, the values of R_1 to R_4 inclusive may be selected.

$$\frac{EM}{R_1} = \frac{Es1}{R_2}$$ Where $EM \geq Es_1$ and $R_1 < 50K\Omega$.

and $$\frac{Es1}{R_3} = \frac{Es2}{R_4}$$ Where $Es1 \geq Es2$ and $R_3 < 50K\Omega$.

If $R_2 = R_3$ we have:-

$$\frac{EM}{R_1} = \frac{Es1}{R_2} = \frac{Es2}{R_4}$$ Where $EM \geq Es1 \geq Es2$ and $R_1 < 50K\Omega$.

4.9 INDEPENDENT - Auto Series (0-72V, 0-2A) (Cont'd.)

When using two or more supplies in auto series, the front panel controls of all supplies (units) concerned should be set as follows:-

Set the function switch to "INDEPENDENT", the terminal switch to "USE", all current range switches to the same range (if using different models use lowest current rated supply as the MASTER and set SLAVES to slightly higher max. current output). For best operation the MASTER supply should be set to the required current overload and the SLAVE supplies to a slightly higher output. This prevents the output dropping in steps as each current limit is reached. Set the meter selectors to the required supplies. When all supplies are operating in the constant voltage mode any one ammeter will indicate the total load current plus the current drawn by R1, 2, 3 and 4. To monitor the total output voltage all the separate supply voltages may be summed (by using the individual voltmeters) or an external voltmeter used. Connect the load between the indicated points and switch ON the SLAVE UNITS. The entire system may now be energised by switching the MASTER UNIT ON.

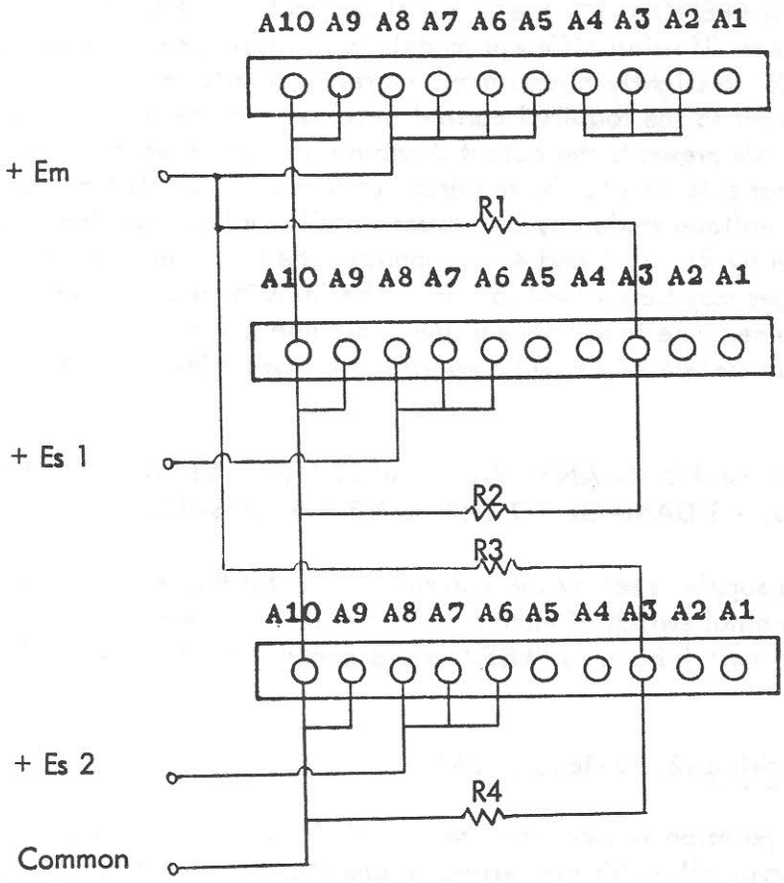
DO NOT ADJUST THE SLAVE UNITS IN ANY WAY WHILST THE SYSTEM IS OPERATING WITH A LOAD CONNECTED, AS DAMAGE TO THE LOAD MAY RESULT.

The maximum current of each supply is set by the current control for that supply. With the load disconnected the terminal switch of each supply may be switched to "SET 1" and the current set. Remember to switch back to "USE" before connecting the load to the output.

4.10 INDEPENDENT - Auto-Tracking (2 x 0-36V, 0-2A)

The Auto-Tracking mode of operation is used when several different voltages referred to a common line must vary proportionally with the setting of one supply. The MASTER SUPPLY must have the largest positive output voltage of any in the group and it must also be the most positive.

The general principle in auto-tracking is for the largest positive supply to be used as the programming source for all the SLAVE SUPPLIES which are operated in the Constant Voltage Remote Voltage Programming mode. For negative tracking supplies the Auto Series configuration is used to provide a +, - tracking supply. The interconnection of the two types of Auto-Tracking (i.e. + to + tracking and + to - tracking) will be shown separately; however using the same MASTER SUPPLY to provide the programming source a large number of positive and negative outputs can be made to Auto-Track.



MASTER SUPPLY
(Em)

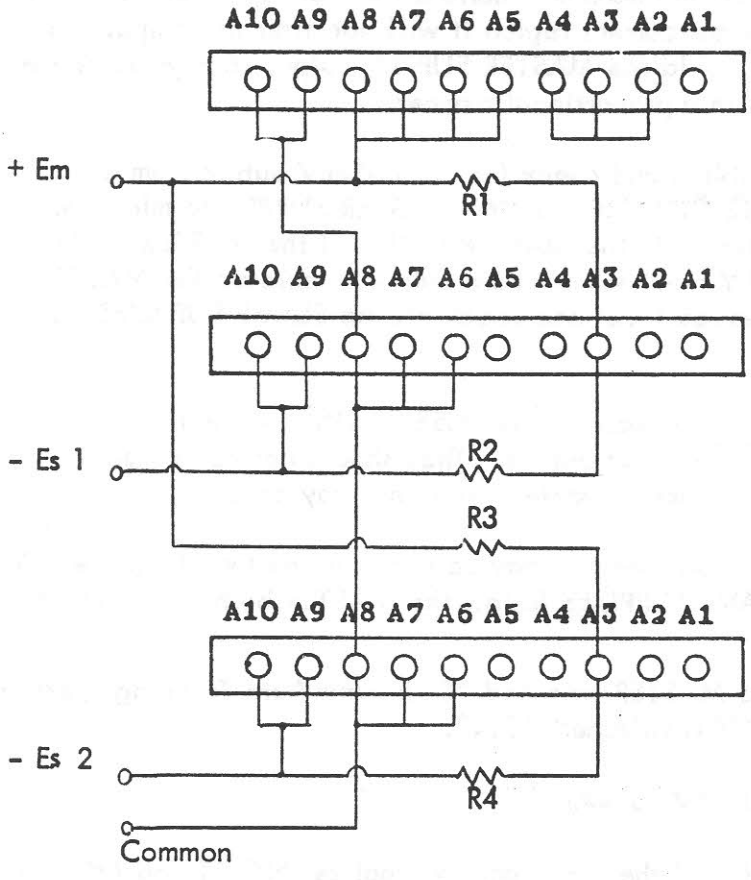
SLAVE No.1 SUPPLY
(Es 1)

$$Es\ 1 = Em \cdot \frac{R2}{R1 + R2}$$

SLAVE No.2 SUPPLY
(Es 2)

$$Es\ 2 = Em \cdot \frac{R4}{R3 + R4}$$

NOTE: This configuration may be extended to any number of slave units all using the MASTER SUPPLY as their programming source.



MASTER SUPPLY
(Em)

SLAVE No.1 SUPPLY
(Es 1)

$Es\ 1 = Em \cdot \frac{R2}{R1}$

SLAVE No.2 SUPPLY
(Es 2)

$Es\ 2 = Em \cdot \frac{R4}{R3}$

NOTE: The magnitude of the SLAVE SUPPLY output may be greater or less than "EM" depending on the value of the resistors.

This configuration may be extended to any number of slave units all using the MASTER SUPPLY as their programming source.

For equal voltages from all supplies $R_1 = R_2 = R_3 = R_4 = 47K\Omega$.

If both positive and negative supplies are required to track from the MASTER SUPPLY the connection to the MASTER SUPPLY is as for the particular SLAVE SUPPLY required noting that the MASTER SUPPLY is always the most positive.

With the supplies switched OFF the interconnections between MASTER and SLAVE supplies is carried out.

4.10 INDEPENDENT - Auto Tracking (2 x 0-36V, 0-2A) (Cont'd.)

The front panel controls are set as follows for all units connected together. Set the function switch to "INDEPENDENT", the terminal switch to "USE", the current range to the desired maximum current and the meter selectors to the required supplies. The CURRENT OUTPUT CONTROL of each SLAVE SUPPLY sets the maximum current for that supply and should one SLAVE SUPPLY operate into the constant current region it will not alter the output of any other associated supplies. However should the MASTER SUPPLY output change for any reason all the SLAVE SUPPLIES will change in a proportional manner.

NOTE: Switch ON all SLAVE UNITS and check for Ov ±100mV output from all units. Set the VOLTAGE CONTROL on the MASTER SUPPLY to minimum (c.c.w.) output and switch ON the MASTER UNIT: if the MASTER UNIT contains a SLAVE SUPPLY re-check for zero output. Increase the MASTER SUPPLY output to the desired level and check all the SLAVE SUPPLIES for correct output.

NOTE: The terminal switches MUST remain in the "USE" position except when checking and setting max. current output. They should not be operated when a load is connected since unwanted transients may occur.

A standby operation on all supplies simultaneously may be achieved by switching the MASTER SUPPLY "OFF", this ensures the SLAVE SUPPLIES follow the MASTER both on switch "ON" and on switch "OFF".

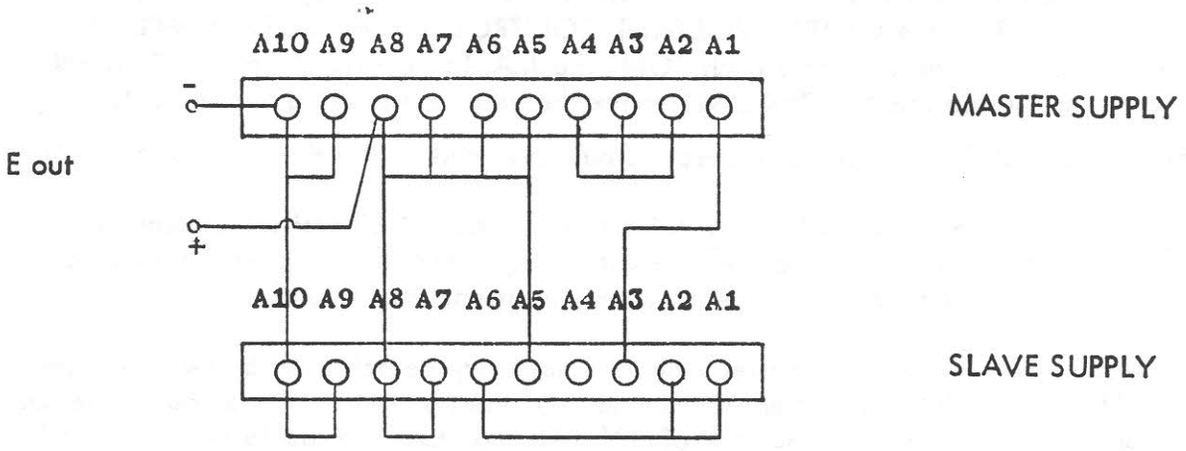
The loads may be connected with the MASTER switched "OFF" and Auto Tracking operation commenced when the MASTER SUPPLY is switched "ON".

4.11 INDEPENDENT - Auto Parallel (0-36V, 0-4A)

With the unit switched to INDEPENDENT the two separate supplies (NO. 1 and NO. 2) may be externally connected in an automatic parallel configuration to enable twice the output current of the MASTER SUPPLY to be produced. Auto Parallel operation is not limited to two sections of one unit but may be used for paralleling two or more supplies from any number of units. Normally auto parallel operation infers that each supply produces an equal output current, however this situation is not necessarily the case since any of the power supplies in Section 4.32 may be auto paralleled with any other supply on the compatibility list. When joining dissimilar units in auto parallel each SLAVE UNIT will supply its maximum rated current when the MASTER SUPPLY is supplying its maximum rated current. The front panel controls for any unit other than bwd 242A should be set according to its own handbook for this type of programming.

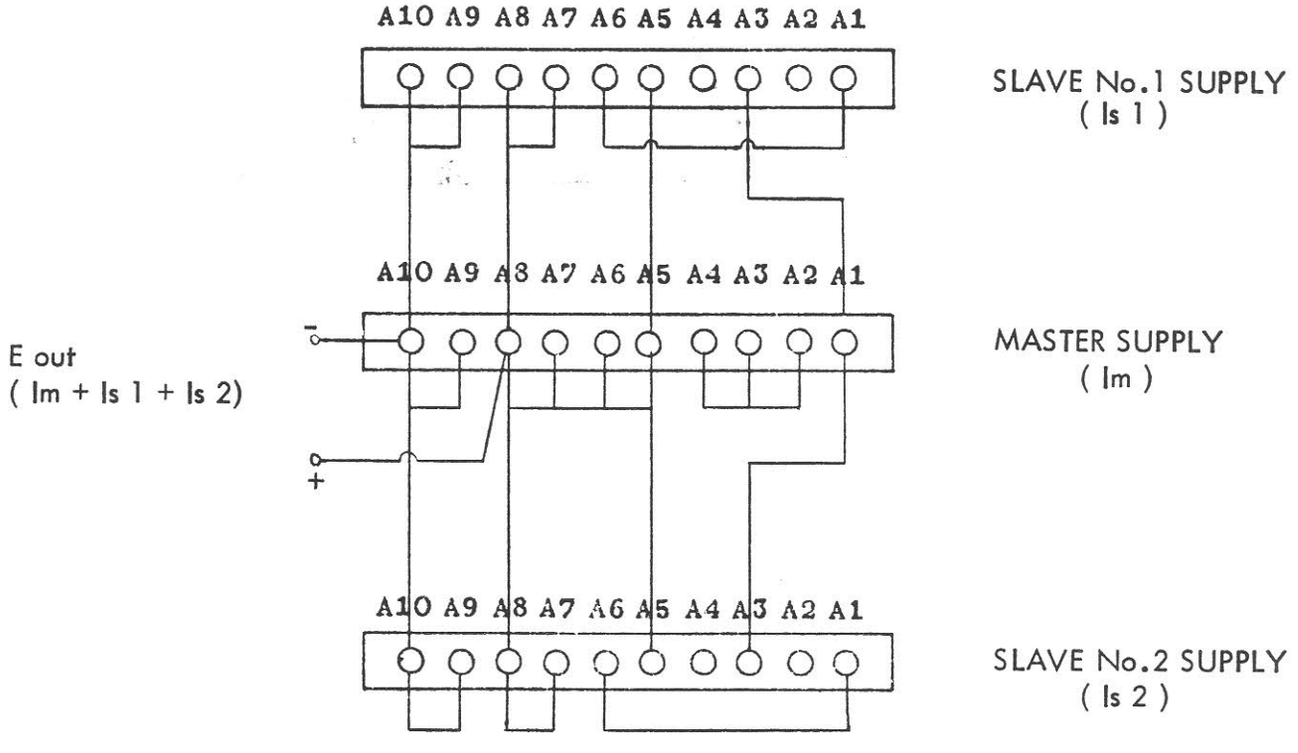
Switch "OFF" all supplies that are to be connected in auto parallel. On each supply set the function switch to "INDEPENDENT", the terminal switch to "USE", the current range switch to the maximum output and the meter selectros to the required supplies. The connection diagram overleaf shows two supplies in auto parallel.

4.11 INDEPENDENT - Auto Parallel (0-36V, 0-4A) (Cont'd.)



The total output current can be determined by summing the two individual currents. If dissimilar supplies are used there may be a large difference in the two currents. Either the high current or the low current supply will function as the MASTER SUPPLY with equally good results.

For three or more paralleled supplies each of the SLAVE SUPPLIES should be returned independently to the MASTER SUPPLY.



4.11 INDEPENDENT - Auto Parallel (0-36V, 0-4A) (Cont'd.)

With the load disconnected switch "ON" the SLAVE SUPPLY(IES). Eout should be Ov ±100mV. Turn the OUTPUT VOLTAGE CONTROL on the MASTER SUPPLY to minimum (c.c.w.) output and switch "ON" the MASTER UNIT. (If a SLAVE SUPPLY is contained within the MASTER UNIT check the zero volt reading before continuing).

Set the MASTER SUPPLY to the correct output level and switch the MASTER SUPPLY "OFF".

NOTE: The terminal switches MUST remain in the "USE" position except when checking and setting max. current output. They should not be operated when a load is connected since unwanted transients may occur.

A standby operation on all supplies simultaneously may be achieved by switching the MASTER SUPPLY "OFF", this ensures a transient free rise and fall of output. The load may be connected and the MASTER SUPPLY switched "ON" to supply power to the load.

NOTE: The CURRENT OUTPUT CONTROL on each supply is still operative and will set the maximum current available from each supply.

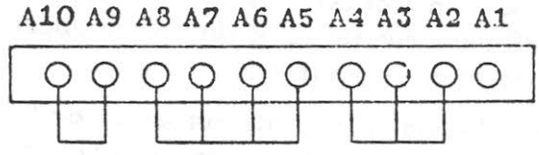
4.12 PARALLEL - Constant Voltage (0-36V, 0-4A)

Set the function switch to "PARALLEL", both terminal switches to "SET V" and No. 2 current range to 2A.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply.

Switch the power switch "ON" and set the required output voltage via No. 2 Output Voltage Control and the front panel meter. Switch No. 2 terminal switch to "SET 1" and set the required overload current with No. 2 Output Current Control and the front panel meter.

Check that the rear barrier strips (No. 1 and No. 2) are both wired as shown below and if an alteration is to be made switch the power switch "OFF".



The load may be connected to either No. 2 output terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip of No. 2 Supply ONLY.

Switch No. 2 terminal switch to "USE".

If the output voltage drops to less than that set earlier the load is drawing more current than allowed for.

If the load is to be operated at a considerable distance from the power supply and the output impedance required is to be as low as possible, Remote Sensing may be employed; see Section 4.14.

4.13 PARALLEL - Constant Current (0-4A, 0-36V)

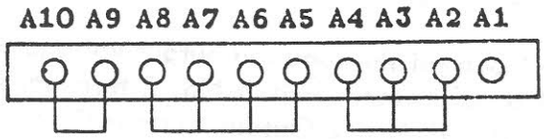
Set the function switch to "PARALLEL", both terminal switches to "SET V" and No. 2 current range to 2A.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply.

Switch the power supply "ON" and set the maximum voltage limit required by the Output Voltage Control and the front panel meter. Switch No. 2 terminal switch to "SET 1" and set the required output current by the Output Current Control and the front panel meter which automatically reads 4A F.S.D.

4.13 PARALLEL - Constant Current (0-4A, 0-36V) (Cont'd.)

Check that the rear barrier strips (No. 1 and No. 2) are both wired as shown below and if an alteration is to be made switch the power switch "OFF".

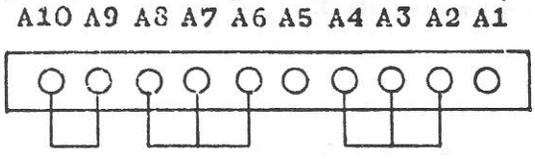


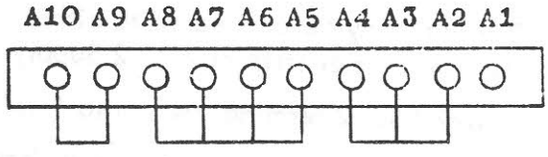
The load may be connected to either No. 2 output terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip of No. 2 Supply ONLY.

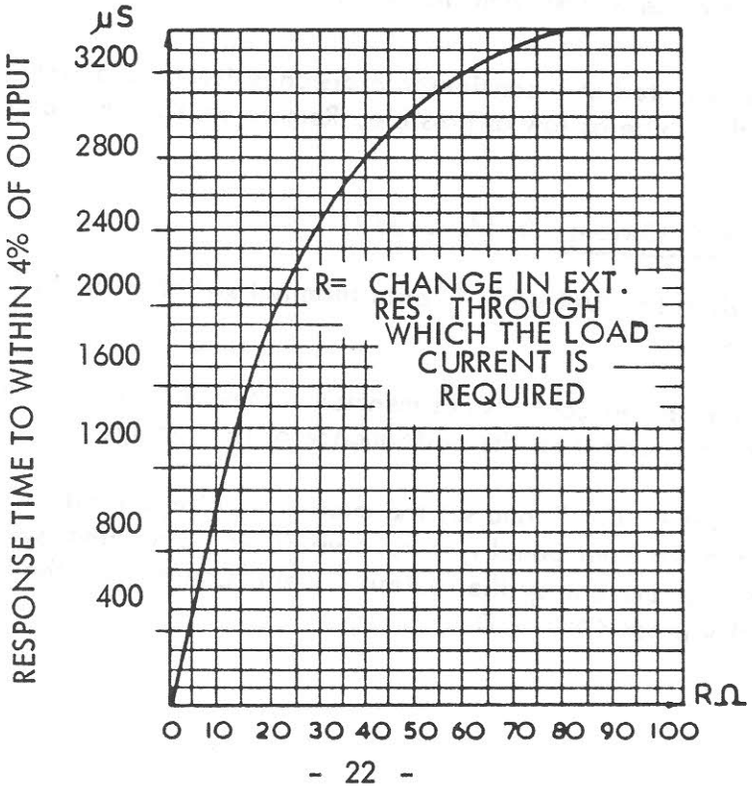
Switch No. 2 terminal switch to "USE".

If the output current is less than that set previously, the load impedance is higher than expected. To enable sufficient current to be drawn the upper voltage limit may be increased until correct operation is achieved.

With the rear barrier strip linking below, the output capacitance is approximately 2200μF. This high capacity produces a long response time for rapid load changes. To reduce the output capacity the link on No. 2 rear barrier strip joining A5 to A6 (See below) is removed giving a much improved transient response time.







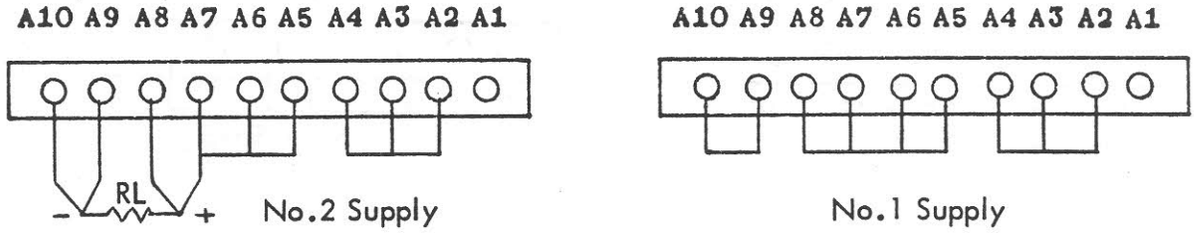
242A
245

4.14 PARALLEL - Remote Load Sensing (0-36V, 0-4A)

This mode of operation is only required when the supply is used in the Constant Voltage mode and the lead resistance between the load and the power supply is excessive.

Set the function switch to "PARALLEL", both terminal switches to "SET V" and No. 2 current range to 2A.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply. Connect the load as below from No. 2 rear barrier strip only.



NOTE: (1) All four leads must have same resistance.
(2) To reduce him pickup, shield all leads or twist together.

The output resistance at the load can be calculated quite closely using the following equation:-

$$RO = 2(2R)^2 \times 10^{-2} + 1 \times 10^{-3}\Omega$$

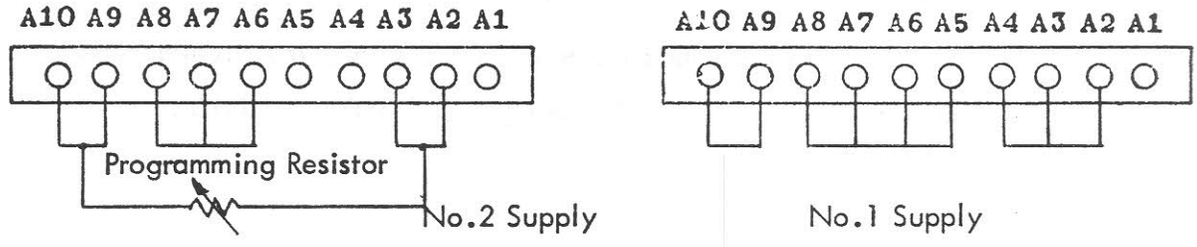
Where RO is the output resistance as seen at the load.
R is the resistance of one lead in Ohms, assuming all four leads have identical resistance.
Switch the Power Switch "ON".
If the output voltage drops to less than that set earlier, either the load is drawing excess current or the lead resistance is too high (0.5V max. is a typical figure).

4.15 PARALLEL - Constant Voltage Remote Programming

Resistance Programming (0-36V, 0-4A)

Set the function switch to "PARALLEL", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to 2A.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply. Connect the programming resistor and rear barrier strip links as shown below and take the output from the No. 2 output terminals or A8 (+ve) and A10 (-ve) on No. 2 rear barrier strip.



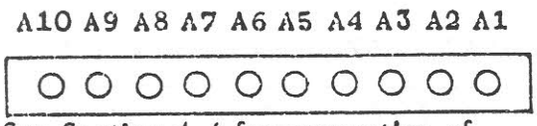
NOTE: DO NOT alter barrier strip connections with unit switched "ON". See "NOTE" - Section 4.5 using No. 2 Supply ONLY.

4.16 PARALLEL - Constant Voltage Remote Programming.

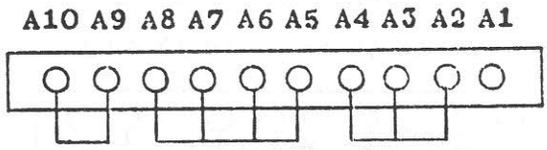
Voltage Programming (0-36V, 0-4A)

Set the function switch to "PARALLEL", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to 2A.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply. With the power switch "OFF", connect the rear barrier strip as shown below and take the output from the No. 2 output terminals or A8 (+ve) and A10 (-ve) on No. 2 rear barrier strip.



See Section 4.6 for connection of No. 2 Supply



No.1 Supply

All of the three types of Voltage programming described in Section 4.6 are applicable to PARALLEL operation.

USE ONLY NO. 2 CONTROLS AND CONNECTIONS.

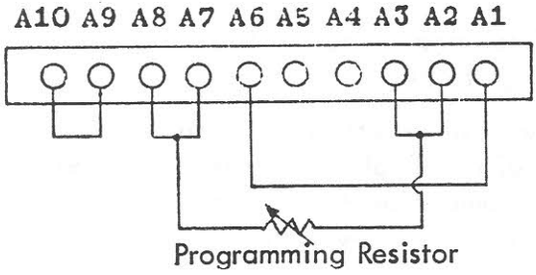
See "NOTE" :- Section 4.6

4.17 PARALLEL - Constant Current Remote Programming

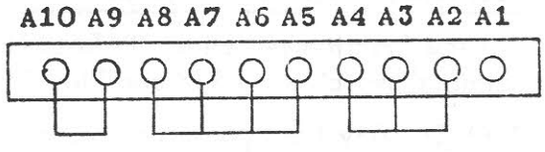
Resistance Programming (0-4A, 0-36V)

Read Section 4.7

Set the function switch to "PARALLEL", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to 2A. Set the maximum required current with No. 2 Current Output control and then switch the power "OFF". Connect the programming resistor and links as shown below.



Programming Resistor



No.1 Supply

No. 2 Supply Programming Co-efficient is equal to approx. 168Ω per Amp.

NOTE: DO NOT alter barrier strip connections with unit switched "ON".

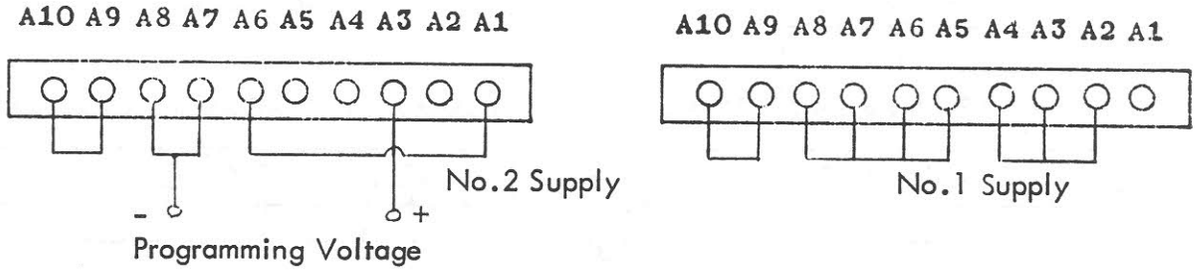
See "NOTE" :- Section 4.7 using No. 2 SUPPLY ONLY.

4.18 PARALLEL - Constant Current Remote Programming.

Voltage Programming (0-4A, 0-36V)

Read Section 4.8

Set the function switch to "PARALLEL", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to 2A. Set the maximum required current with the current output control and then switch the power "OFF". Connect the programming voltage and links as shown below.



No. 2 Supply. Programming co-efficient is equal to approx. 250mV per Amp.

NOTE: DO NOT alter barrier strip connections with unit switched "ON".

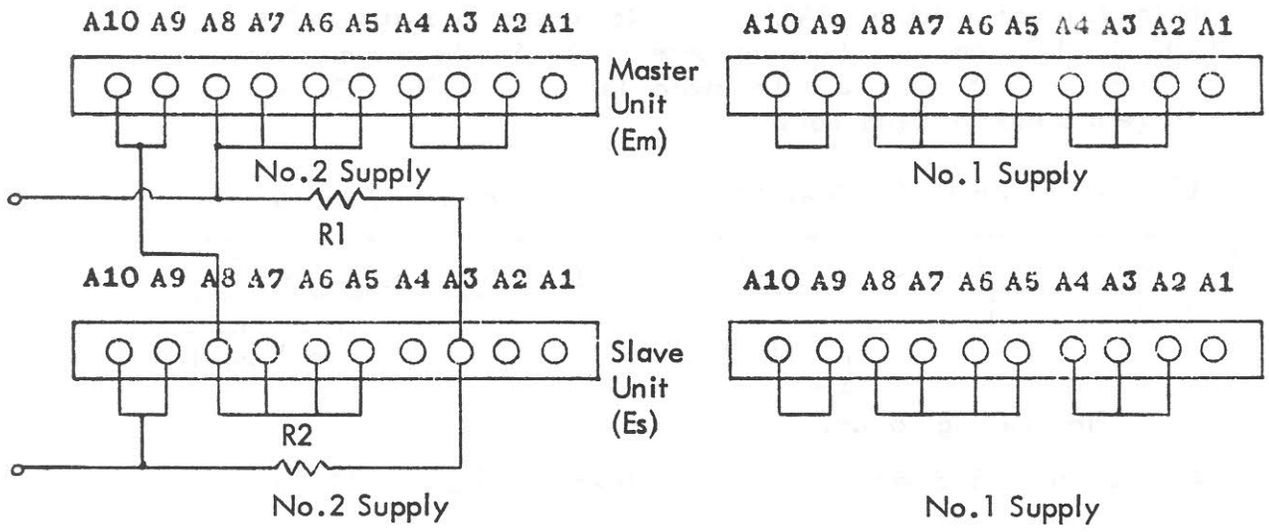
See "NOTE" :- Section 4.8 using No. 2 SUPPLY ONLY.

4.19 PARALLEL - Auto Series (0-72V, 0-4A).

Two units both switched to "PARALLEL" may be connected in an automatic series configuration to enable twice the output voltage of the MASTER SUPPLY to be produced. The Auto Series operation is not limited to two units of the same model number, but may be used to connect in series two or more units of differing model number. For list of compatible supplies, see Section 4.32. If another model supply is used, set its front panel controls as indicated for this type of programming in the handbook for that supply.

If using two model 242A supplies set, on BOTH SUPPLIES, the function switch to "PARALLEL", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to 2A. Set the maximum required current with No. 2 current output control on the MASTER UNIT and set the SLAVE current output to MAXIMUM.

For two units in Auto Series connect the rear barrier strip links and resistors as shown overleaf ensuring BOTH UNITS are switched OFF.



1. IMPORTANT. Use only SINGLE POINT EARTHING.

2. For equal voltages from both supplies R1 = R2 = 47KΩ.

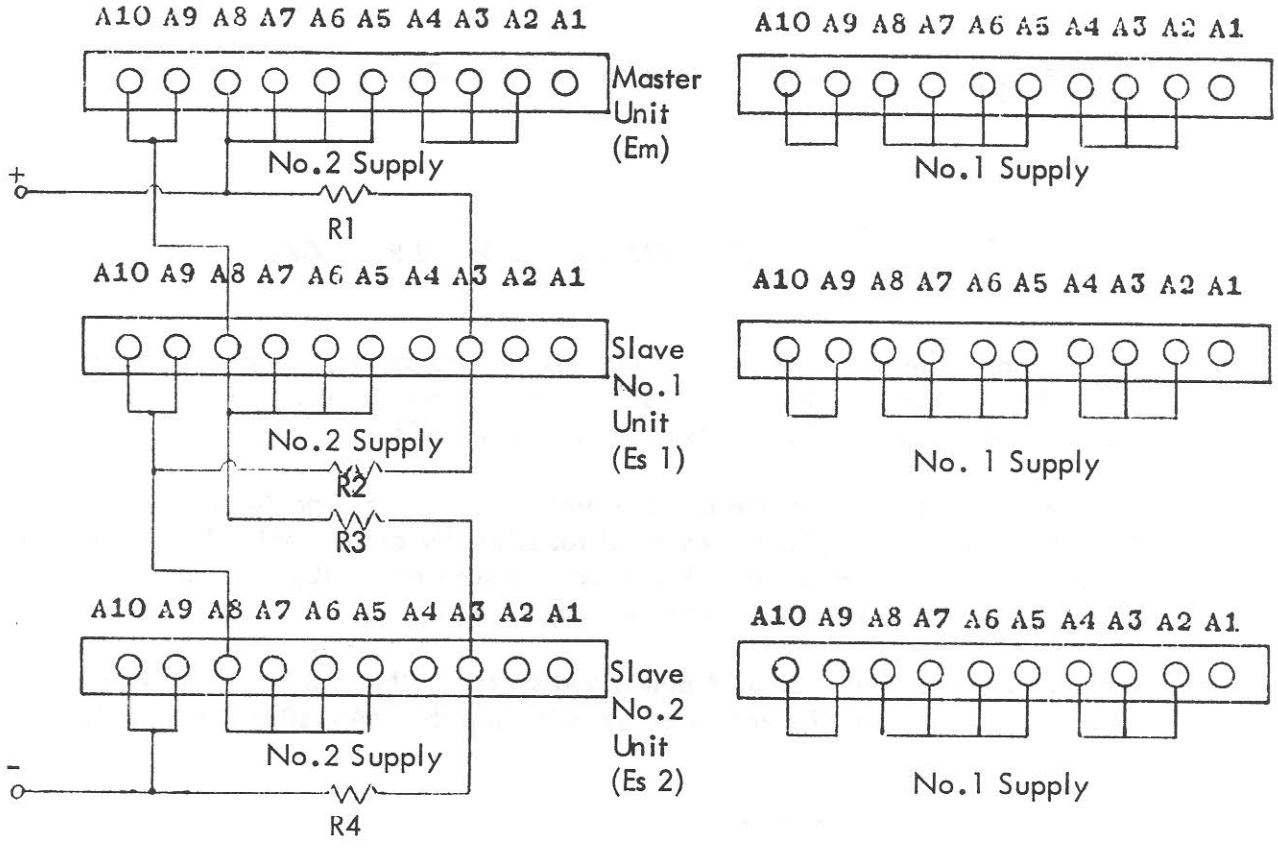
3. If the SLAVE UNIT is required to vary over a different range than the MASTER UNIT the values of R1 and R2 may be selected.

$$\frac{EM}{R_1} = \frac{Es}{R_2}$$ i.e. the ratio of EM to Es is equal to the ratio of R_1 to R_2.

Where EM $\geq$ Es and R_1 <50KΩ.

4.19 PARALLEL - Auto Series (0-72V, 0-4A) (Cont'd.)

To connect three units in Auto Series the rear barrier strip links and resistors are connected as shown below with ALL UNITS switched OFF.



E out = Em + Es 1 + Es 2

4.19 PARALLEL - Auto Series (0-72, 0-4A) (Cont'd.)

1. IMPORTANT. Use only SINGLE POINT EARTHING.

2. For equal voltages from all units $R_1 = R_2 = R_3 = R_4 = 47K$

3. If the SLAVE UNITS are required to vary over a different range than the MASTER UNIT the resistor values may be selected.

$$\frac{EM}{R_1} = \frac{Es1}{R_2}$$ Where EM $\geq$Es1 and R_1 <50KΩ.

$$\frac{Es1}{R3} = \frac{Es2}{R4}$$ Where Es1 $\geq$Es2 and R_3 <50KΩ.

If R2 = R3 we have :-

$$\frac{EM}{R_1} = \frac{Es1}{R_2} = \frac{Es2}{R_4}$$ Where EM $\geq$Es1 $\geq$Es2 and R1 <50KΩ.

NOTE: When using different model power supplies in Auto Series, select the lowest current supply as the MASTER and set the maximum current output of the SLAVE UNITS slightly higher than the MASTER UNIT.

When the supplies are operating in the constant voltage mode any one Ammeter will indicate the total load current plus the external resistive divider current. To monitor the total output voltage all the separate supply voltages may be summarised (by using the individual voltmeters) or an external Voltmeter may be used.

Connect the load between the indicated points and switch "ON" the SLAVE UNITS ONLY. The entire system may be energised by switching the MASTER UNIT "ON".

* * * * * * * * *

DO NOT ADJUST THE SLAVE UNITS IN ANY WAY WHILST THE SYSTEM IS OPERATING WITH A LOAD CONNECTED, AS DAMAGE TO THE LOAD MAY RESULT.

* * * * * * * * *

The maximum current for each unit is set by the No. 2 current control for that unit. With the load disconnected the terminal switch of each supply may be switched to "SET 1" and the maximum current set. Remember to switch ALL units back to USE before commencing to use the supply.

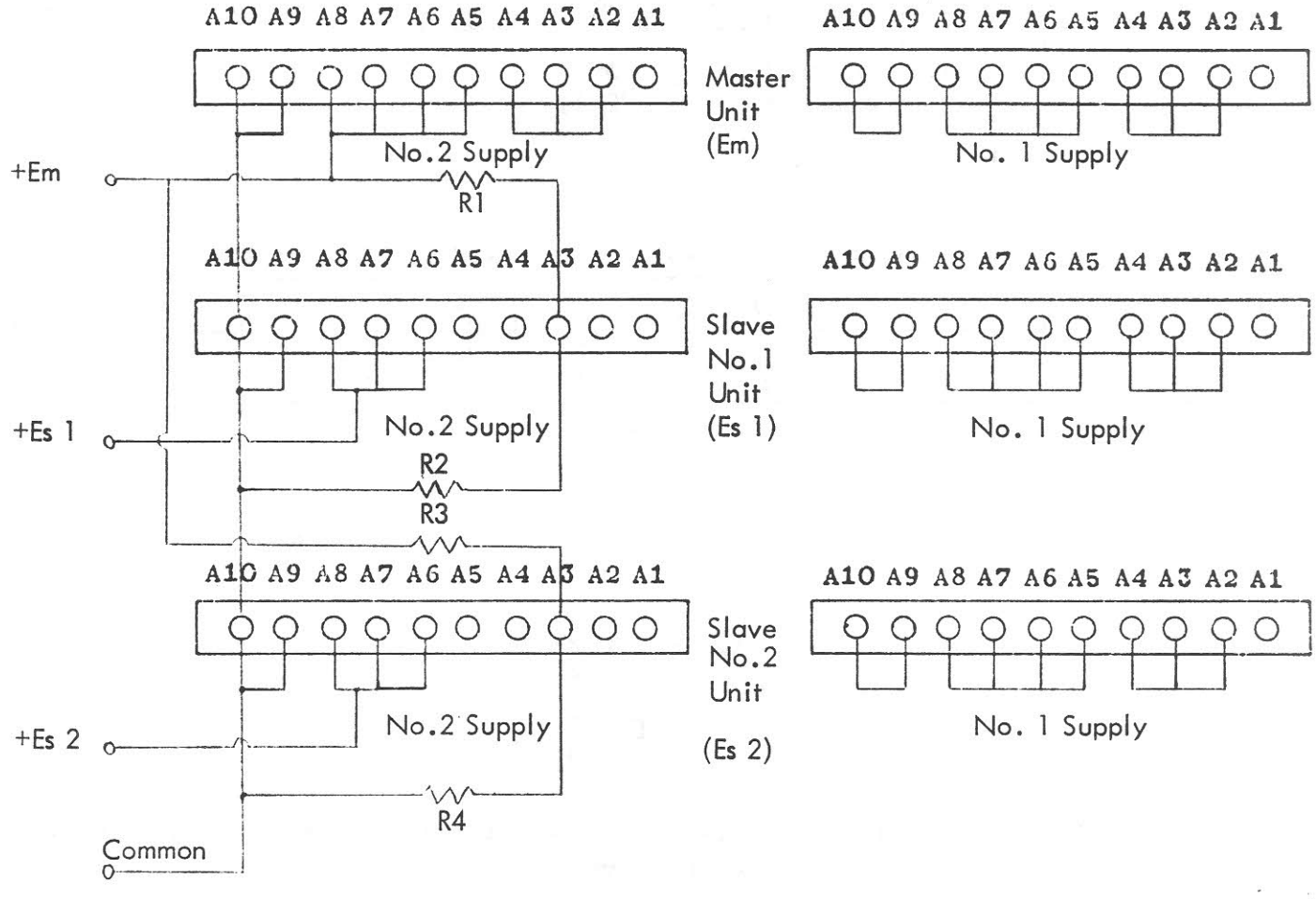
4.20 PARALLEL - Auto-Tracking (2 x 0-36V, 0-4A)

Several units switched to PARALLEL may be used in the Auto Tracking mode of operation. The rear barrier strip connections for the two basic types of Auto Tracking are shown below. For a description of the system, uses and precautions read Section 4-10. The setting up procedure is identical except for the following items:-

1. Set the function switch, on each supply used, to PARALLEL, all No. 2 terminal switches to "USE", all No. 1 terminal switches to "SET V" and all No. 2 Current Range switches to 2A.

2. Where any controls are referred to in Section 4.10 they shall apply to No. 2 power supply ONLY.

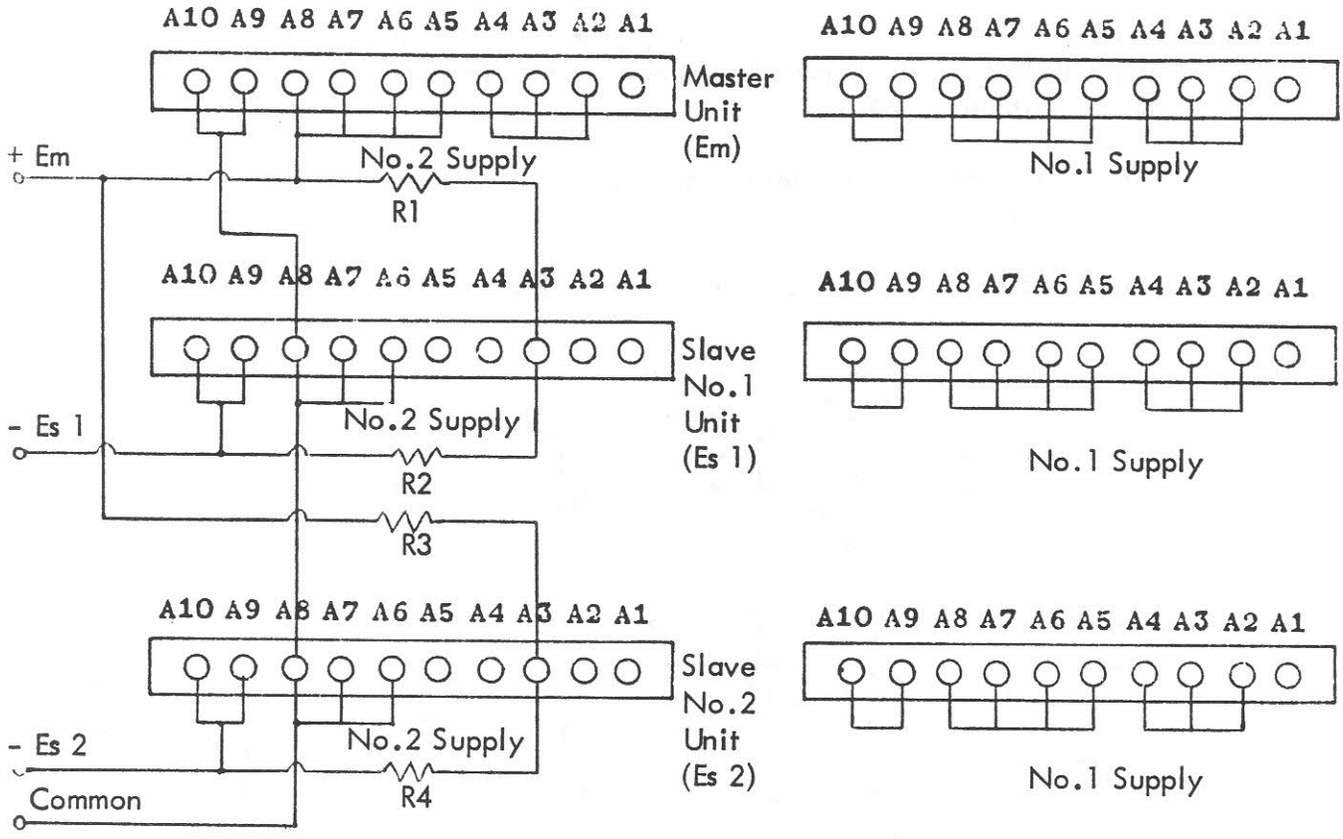
3. Outputs and Inputs shall be applied to No. 2 supply (ies) only.



$$Es\ 1 = Em \cdot \frac{R2}{R1 + R2}$$

$$Es\ 2 = Em \cdot \frac{R4}{R3 + R4}$$

NOTE: This con figuration may be extended to any number of SLAVE UNITS all using the MASTER UNIT as their programming source.



$$Es1 = EM. \frac{R2}{R1}$$

$$Es2 = EM. \frac{R4}{R3}$$

NOTE: The magnitude of the SLAVE SUPPLY output may be greater or less than EM depending on the value of the resistors.

This configuration may be extended to any number of SLAVE UNITS all using the MASTER UNIT as their programming source.

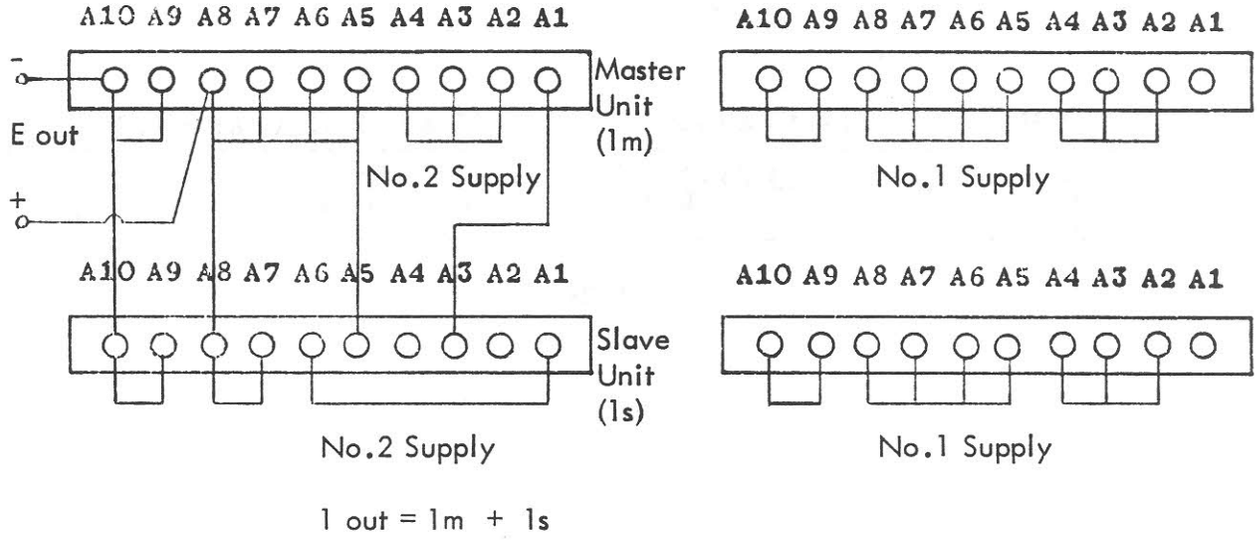
4.21 PARALLEL - Auto Parallel (0-36V, 0-8A).

With several units switched to PARALLEL on Auto Parallel configuration may be used to increase the output current of a single unit. i.e. two units 8 ampere, three units 12 ampere, etc. The description of the interconnection, uses and precautions can be found in section 4.11, however the front panel controls MUST be set up as follows and the interconnection as per the following diagrams. These directions apply to ALL units.

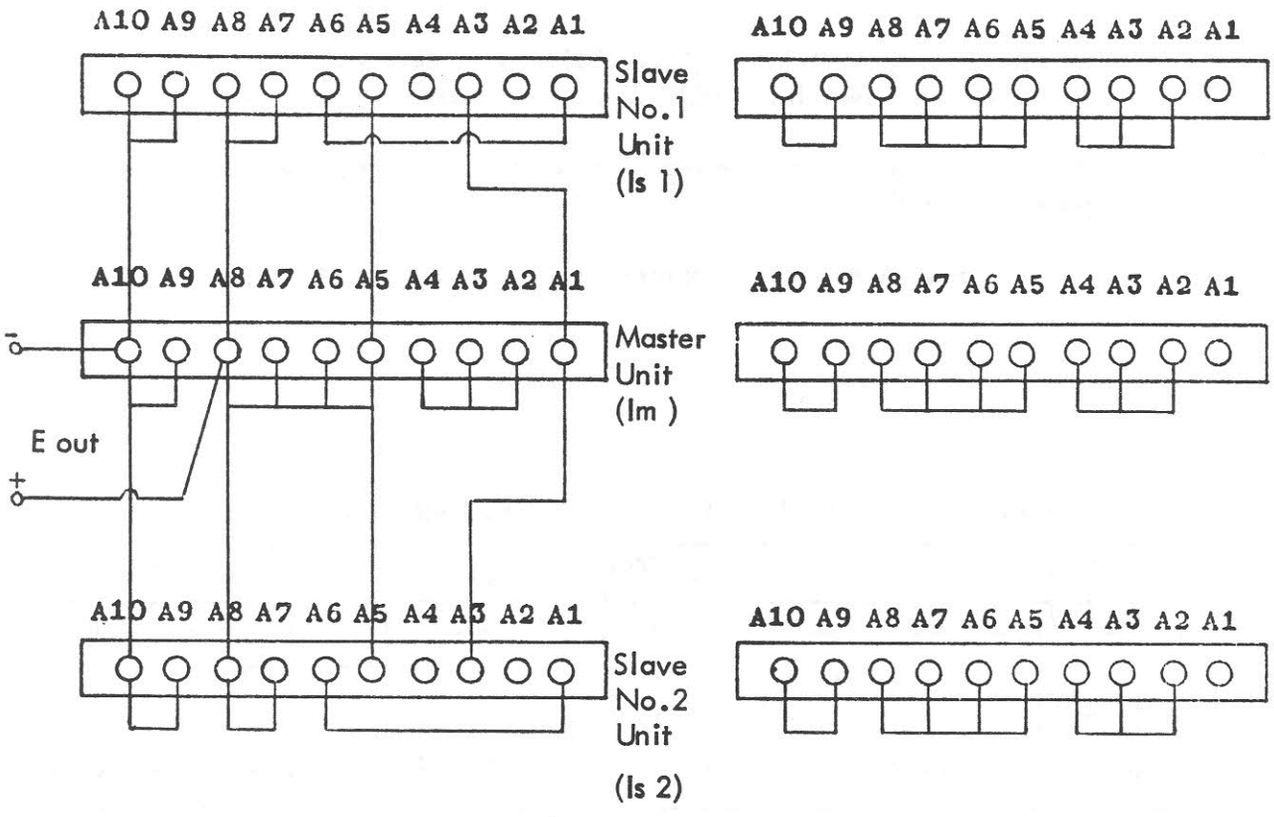
1. Set the function switch to "PARALLEL", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range switch to 2A.

2. Where any controls are referred to in section 4.11 they shall apply to No. 2 power supply ONLY.

3. Outputs and Inputs shall be applied to No. 2 supply (ies) only.



1 out = 1m + 1s



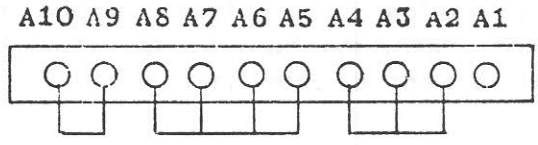
I out = Im + Is 1 + Is 2

4.22 SERIES - Constant Voltage (0-72V, 0-2A).

Set the function switch to "SERIES", both terminal switches to "SET V' and No. 2 current range to the desired value.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply.

Check that the rear barrier strips (No. 1 and No. 2) are both wired as shown below and if an alteration is to be made switch the power "OFF".



Switch the power "ON" and set the required output voltage via No. 2 Output Voltage Control and the front panel meter. Switch No. 2 Terminal Switch to "SET 1" and set the required overload current with No. 2 Output Current Control and the front panel meter.

The load may be connected to either No. 2 Output Terminals or A8 (+ve) and A10 (-ve) on the rear barrier strip of No. 2 supply ONLY.

Switch No. 2 terminal switch to "USE".

If the output voltage drops to less than that set earlier, the load is drawing more current than allowed for.

If the load is to be operated at a considerable distance from the power supply and the output impedance required is to be as low as possible, remote load sensing may be employed. See Section 4.24

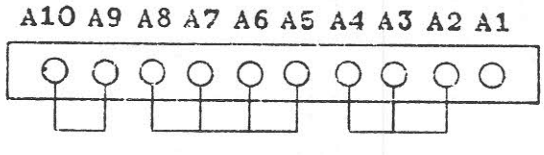
4.23 SERIES - Constant Current (0-2A, 0-72V).

Set the function switch to "SERIES" both terminal switches to "SET V" and No. 2 current range to the desired value.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply.

Switch the power supply "ON" and set the maximum voltage limit required by the Output Voltage control and the front panel meter. Switch No. 2 terminal switch to "SET 1" and the required output current by the output current control and the front panel meter.

Check that the rear barrier strips (No. 1 and No. 2) are both wired as shown below and if an alteration is to be made switch the power switch "OFF".



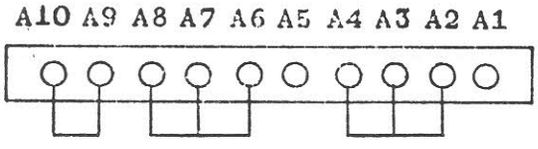
4.23 SERIES - Constant Current (0-2A, 0-72V) (Cont'd.)

The load may be connected to either the output terminals of No. 2 Supply or A8 (+ve) and A10 (-ve) on the rear barrier strip of No. 2 Supply only.

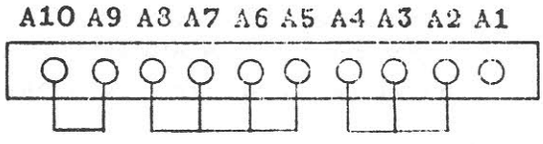
Switch No. 2 terminal switch to "USE".

If the output current is less than that set previously the load impedance is higher than expected. To enable sufficient current to be drawn the upper voltage limit may be increased until correct operation is achieved.

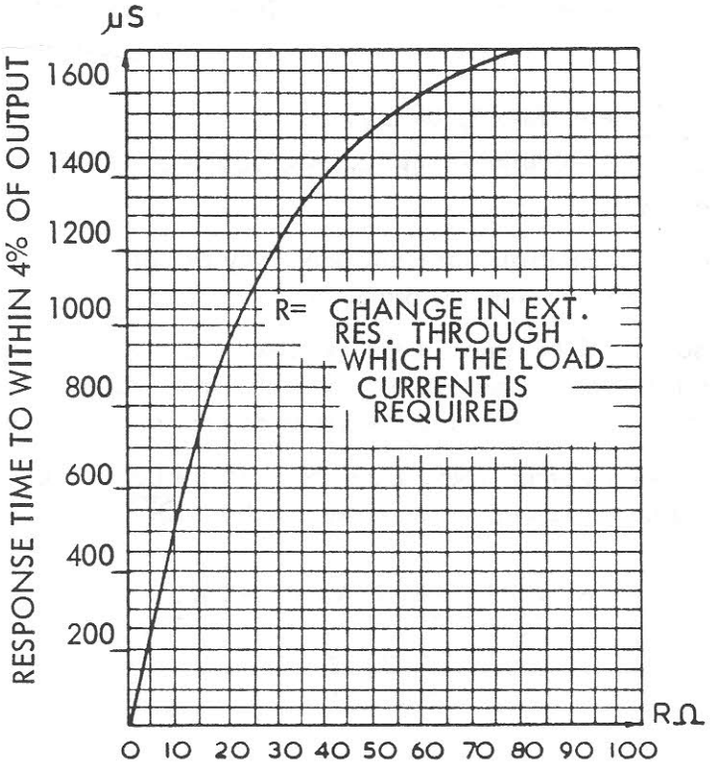
With the rear barrier strip linking above the output capacitance is approximately 2200μF. This high capacity produces a long response time for rapid load changes. To reduce the output capacity the link on No. 2 rear barrier strip joining A5 to A6 (see below) is removed giving a much improved transient response time.



No. 2 Supply



No. 1 Supply

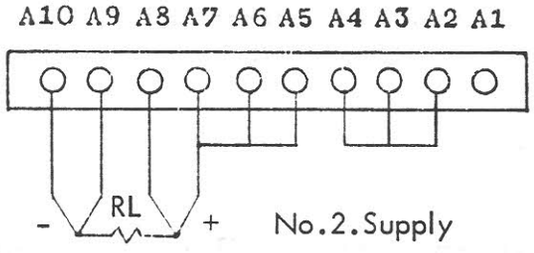


4.24 SERIES - Remote Load Sensing (0-72V, 0-2A).

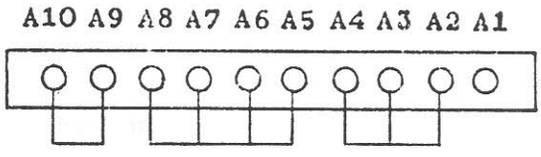
This mode of operation is only required when the supply is used in the Constant Voltage mode and the lead resistance between the load and the power supply is excessive.

Set the function switch to "SERIES", both terminal switches to "SET V" and No. 2 current range to 2A.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply. With the power switch "OFF" connect the load as shown below from No. 2 barrier strip only.



No.2.Supply



No. 1 Supply

NOTE: 1. All four leads must have same resistance.

2. To reduce him pickup shield all leads or twist together.

The output resistance at the load can be calculated quite closely using the following equation:-

$$Ro = 2(2R)^2 \times 10^{-2} + 2 \times 10^{-3} \Omega.$$

Where Ro is the output resistance as seen at the load.

And R is the resistance of one lead in Ohms assuming all four leads have identical resistance.

Switch the power switch "ON". If the output voltage drops to less than that set earlier either the load is drawing excess current or the lead resistance is too high (0.5V max. is a typical figure).

4.25 SERIES - Constant Voltage Remote Programming.

Resistance Programming (0-72V, 0-2A)

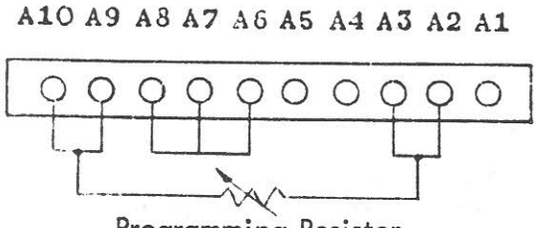
Set the function switch to "SERIES", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to the desired maximum current.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply.

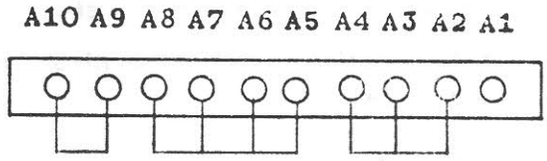
Connect the programming resistor and rear barrier strip links as shown overleaf and take the output from No. 2 output terminals or A8 (+ve) and A10 (-ve) on No. 2 rear barrier strip.

4.25 SERIES - Constant Voltage Remote Programming.

Resistance Programming (0-72V, 0-2A) (Cont'd.)



Programming Resistor



No.1 Supply

Programming Co-efficient is equal to approximately 680Ω per Volt.

NOTE: DO NOT alter barrier strip connections with unit switched "ON". See "NOTE" :- Section 4.5 using No. 2 SUPPLY ONLY.

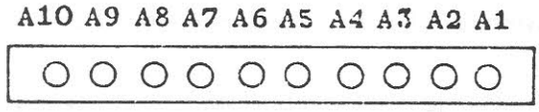
4.26 SERIES - Constant Voltage Remote Programming

Voltage Programming (0-72V, 0-2A).

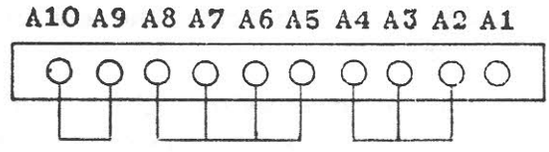
Set the function switch to "SERIES", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to the desired value.

NOTE: Any front panel controls not mentioned may be left in any position without having any effect on the performance of the supply.

With the power switch "OFF" connect the rear barrier strip as shown below and take the output from the No. 2 output terminals or A8 (+ve) and A10 (-ve) on No. 2 rear barrier strip.



See Section 4.6 for Connection of No.2 Supply



No.1 Supply

All of the three types of voltage programming described in Section 4.6 are applicable to SERIES operation.

USE ONLY NO. 2 CONTROLS AND CONNECTIONS.

See "NOTE: - Section 4.6

4.27 SERIES - Constant Current Remote Programming.

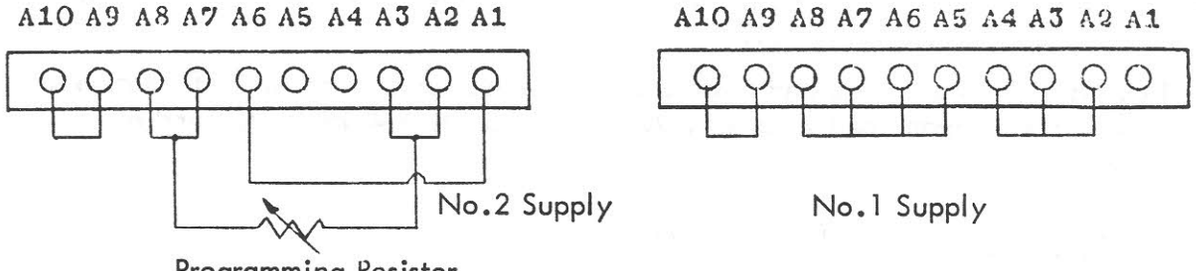
Resistance Programming (0-2A, 0-72V).

Read Section 4.7

Set the function switch to "SERIES", No. 1 terminal switch to "SET V", No. 2 terminal switch to "USE" and No. 2 current range to the desired current range.

Set the maximum required current with No. 2 current output control and then switch the power "OFF".

Connect the programming resistor and links as shown below.



Programming Co-efficient is equal to approx. 337Ω per amp.

NOTE: DO NOT alter barrier strip connections with unit switched "ON".

See "NOTE" :- Section 4.7 using No. 2 SUPPLY only.

4.28 SERIES - Constant Current Remote Programming.

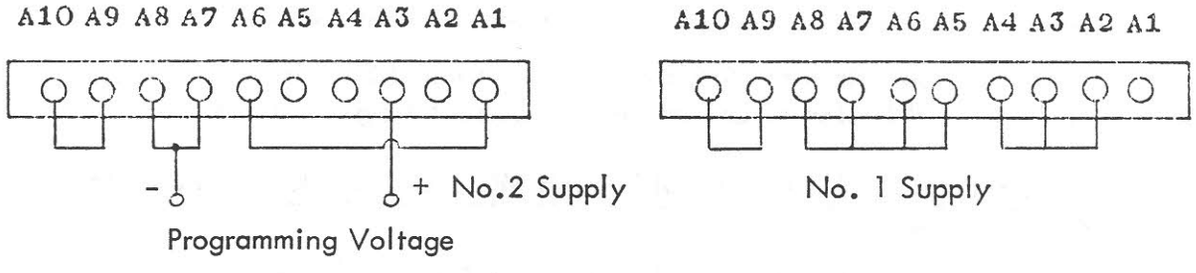
Voltage Programming (0-2A, 0-72V).

Read Section 4.8

Set the function switch to "SERIES", No. 2 terminal switch to "USE", No. 1 terminal switch to "SET V" and No. 2 current range to the desired current range.

Set the maximum required current with No. 2 current output control and then switch the power "OFF".

Connect the programming voltage and links as shown below.



Programming Co-efficient is equal to approx. 500mV per Amp.

NOTE: DO NOT alter barrier strip connections with unit switched "ON".

See "NOTE" :- Section 4.8 using No. 2 SUPPLY ONLY.

4.29 SERIES - Auto Series (0-144V, 0-2A).

Two units both switched to "SERIES" may be connected in an automatic series configuration to enable twice the output voltage of the MASTER SUPPLY to be produced. The auto series operation is not limited to two units of the same model number, but may be used to connect in series two or more units of differing model number. For list of compatible supplies see Section 4.32. If another model supply is used, set its front panel controls as indicated for this type of programming in the handbook for that supply.

If using two model 246A supplies, set, on BOTH SUPPLIES, the function switch to "SERIES", No. 1 Terminal Switch to "SET V", No. 2 Terminal Switch to "USE" and No. 2 Current Range to the desired current range. Set the maximum required current with No. 2 Current Output Control ensuring that the MASTER SUPPLY is set for the lowest current of all the supplies in auto series. Switch the power "OFF" and connect the rear barrier strip links and resistors as shown in Section 4.19.

For full description of both two and three unit auto series connection ALL information after and including the diagram for two units in Auto Series Section 4.19, to the end of Section 4.19, is directly applicable.

4.30 SERIES - Auto Tracking (2 x 0-72V, 0-2A).

Several units switched to "SERIES" may be used in the Auto-Tracking mode of operation. The rear barrier strip connections for the two basic types of Auto-Tracking are shown in Section 4.20. For a description of the system, uses and precautions read Section 4.20. The setting up procedure is identical except for the following items.

1. Set the function switch on each supply used to "SERIES", all No. 1 Terminal Switches to "SET V", all No. 2 Terminal Switches to "USE" and all No. 2 Current Range Switches to 5A. Set all SLAVE UNIT current controls to max. clockwise and set the MASTER UNIT No. 2 Current Control to the required maximum output current for that supply (if required, each SLAVE UNIT output current may be set to a specific value depending on the load requirements).

4.31 SERIES - Auto Parallel (0-72V, 0-2A).

With several units switched to "SERIES" an auto-parallel configuration may be used to increase the output current of a single unit, i.e. two units 4 ampere, etc. The description of the interconnection, used, precuations and connection diagrams can be found in Section 4.21. However all the front panel controls must be set up as follows:-

1. Set the function switch to "SERIES", No. 1 Terminal Switch to "SET V", No. 2 Terminal Switch to USE and No. 2 Current Range Switch to 2A.

4.32 COMPATIBLE SUPPLIES THAT MAY BE USED WITH MODEL BWD 242A IN REMOTE PROGRAMMING MODES.

bwd 246A Identical operation to bwd 242A except ratings are higher
36V @ 5A + 36V @ 5A

bwd 272A Single supply with three switched ranges
0 - 12V @ 2A
0 - 25V @ 1A
0 - 50V @ 0.5A

bwd 275 Single supply with two switched ranges
0 - 36V @ 2A
0 - 72V @ 1A

5. CIRCUIT DESCRIPTION.

5.1 Model bwd 242A is a dual supply, the two halves of which are practically identical except for various frequency compensating networks. The following circuit description is based around the No. 2 supply switched to the INDEPENDENT mode. From the circuit diagram at the rear of the book it can be seen that the circuit layout is almost identical so that equivalent components in No. 1 supply may easily be found once located on No. 2 circuit.

5.2 The power supply, (refer figure 1), consists of two rectifier-filter circuits; one supplying the auxiliary supply, the other supplying the series regulator and, via the current sensing resistor, the output. The voltage developed across the current sensing resistor is the input to the constant current circuit. The output voltage of the supply is sampled by the voltage input amplifier via the sensing leads, compared against the voltage across the voltage control and any changes amplified and fed to the OR gate. The constant current circuit also feeds into the OR gate. Any changes required are amplified and applied to the series regulator in the correct phase and amplitude to correct the output. The auxiliary supply is used throughout the circuit to provide DC power to the amplifier and a stable voltage where comparison is necessary.

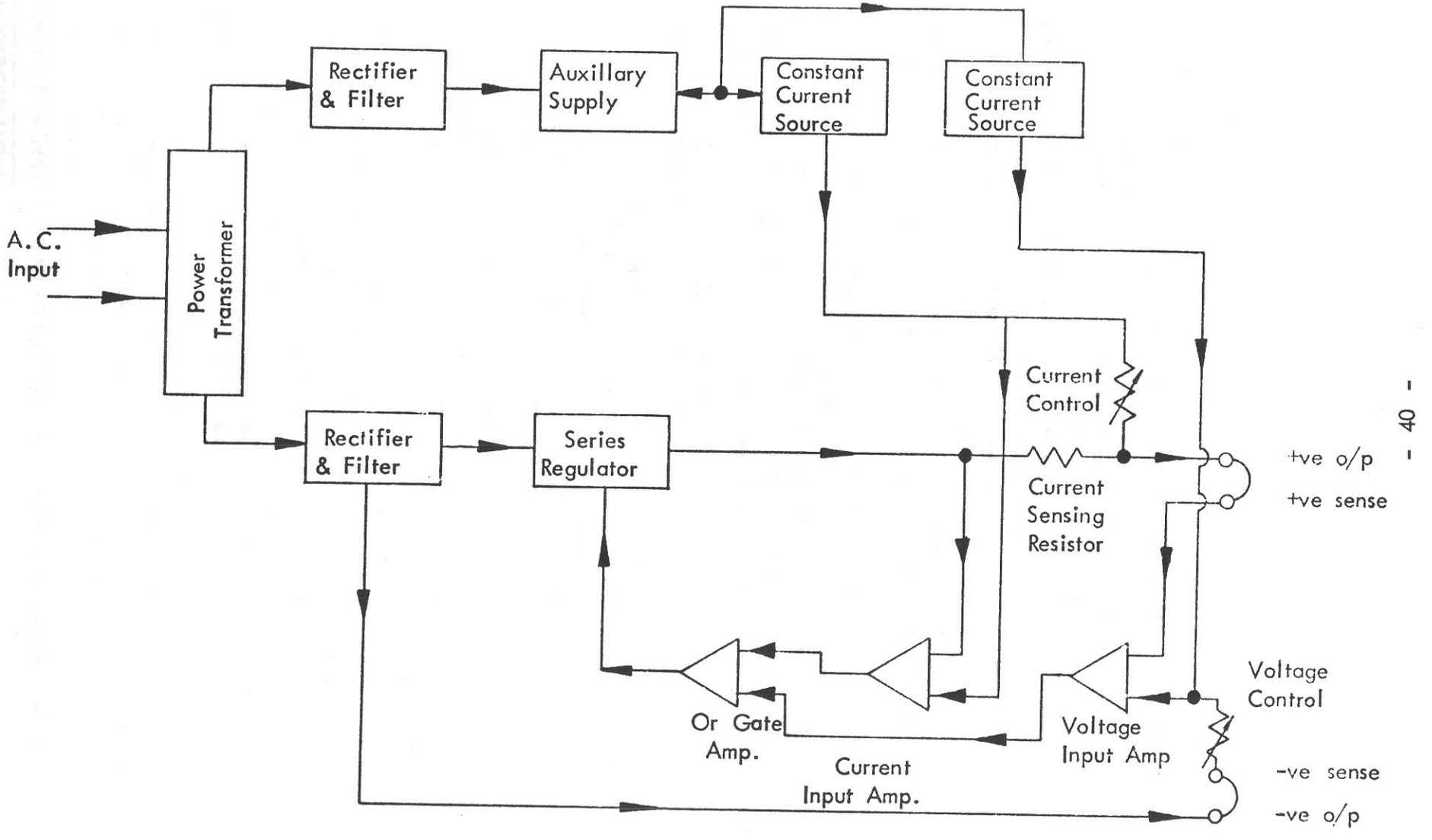
5.3 Power transformer T1 has two main secondary windings, 0-30V, 0-49V. The 0-30V winding is rectified by D1 filtered by C1 and regulated by Q15, 16 and 17 to provide a +16V auxiliary supply with reference to the +ve output. The reference voltage to Q17 is supplied by D2 which also provides a -6V supply. The 0-49V winding is bridge rectified by DR1, and filtered by C15.

Series regulator Q13 is driven by emitter follower Q9, which is in turn driven via D24, D25 by Q7 and Q18.

5.4 Transistors Q8 and Q11 form a pre-regulator. When the voltage across Q13 is greater than 1V, Q8 and Q11 are cut off and the output current flows via R75, to Q13. As the current and hence the voltage drop across R75, increase the voltage across Q1 will drop to a value lower than 1V. Q8 will conduct causing Q11 to conduct and maintain a minimum voltage across Q13 under all conditions.

5.5 The +ve output is taken from A8 to A7 where it becomes the +ve sensing line. The rear terminal strip link between A2 and A3 takes the +ve sensing line to pin 6 of IC2B via R21. Referring to the Integrated Circuit schematic, the +ve sensing is taken to Q5 base. Q6 base (pin 9) is taken via R18 to A5 which is linked externally to A4 and A6. A6 is connected to RV1, the Output Voltage Control, the other end being connected to the -ve sensing line via S6A and S4B. A constant current source provided by Q20, R20 and RV5 is taken to A4, and this current through RV1 sets the base voltage of Q6. Balance in the differential pair (Q5, Q6) will occur when the +ve sensing voltage is equal to the voltage across RV1. The output of IC2B is taken from the collector of Q5 via D4 to emitter follower Q18.

Figure 1 BLOCK DIAGRAM.



An increase in the value of RV1 will cause the base of Q6 to rise in a positive direction. Q6 emitter and hence Q5 emitter will also rise tending to reduce conduction in Q5. Q5 collector will also rise and via D4, Q18 and the series regulator circuit the output voltage will also rise until the bases of Q5 and Q6 are at an equal potential. Any changes in the output voltage not caused by RV1 will appear on the base of Q5 which will invert and amplify the change and via D4, Q18 and the regulator circuit correct the output.

5.6 The current sensing resistor R16 develops a voltage across itself proportional to the output current. The base of Q1 (IC2A) is connected to the input of R16 via R15 so that the base of Q1 will increase its potential in a positive direction as the output current increases. The base of Q2 is taken via R80 to the positive end of RV3, the Output Current Control. Constant current source Q19, R10 and RV7 feeds into RV3 producing a voltage at Q2 base which is proportional to the value of RV3.

When the output current rises such that the base of Q1 rises above the base potential of Q2, Q1 increases its conduction and via D3 and Q18 reduces the output of the supply. A quiescent level of output is reached when the bases of Q1 and Q2 are at an equal potential.

5.7 The output impedance compensation networks introduce positive feedback into their respective amplifiers to achieve an easily adjustable output characteristic. RV11 connected across the current sensing resistor R16 produces a voltage at its wiper which is proportional to the output current and increases in a positive direction as the current increases. This voltage is fed via R25 into pin 12 of IC2B (emitter Q4). As the emitter of Q4 goes positive the collector of Q4 and hence the emitters of Q5 and Q6 will go positive. Q5 will reduce its conduction and via D4, Q18 and the Series Regulator, increase the output voltage. The amount of feedback can be varied by adjusting RV11 to produce a range of output impedance either side of zero.

The Constant Current output impedance feedback voltage is derived from the positive end of RV1 the Output Voltage Control. In constant voltage operation this voltage always stays at zero volts with respect to the positive output line, however, as the constant current circuit comes into operation the output voltage will be lower than that of the output voltage control. D6 will conduct and the wiper of RV14 will pick up a positive potential which via R17 will increase the conduction of Q1 (IC2A) and reduce the output current as the output voltage descreases in the constant current mode the output current will tend to increase. Adjustment of RV14 will correct for this producing a range of control either side of infinite output impedance.

5.8 The Series, Independent, Parallel switch (S6) is shown on the circuit diagram in the Parallel position. The functions of each section are listed below:-

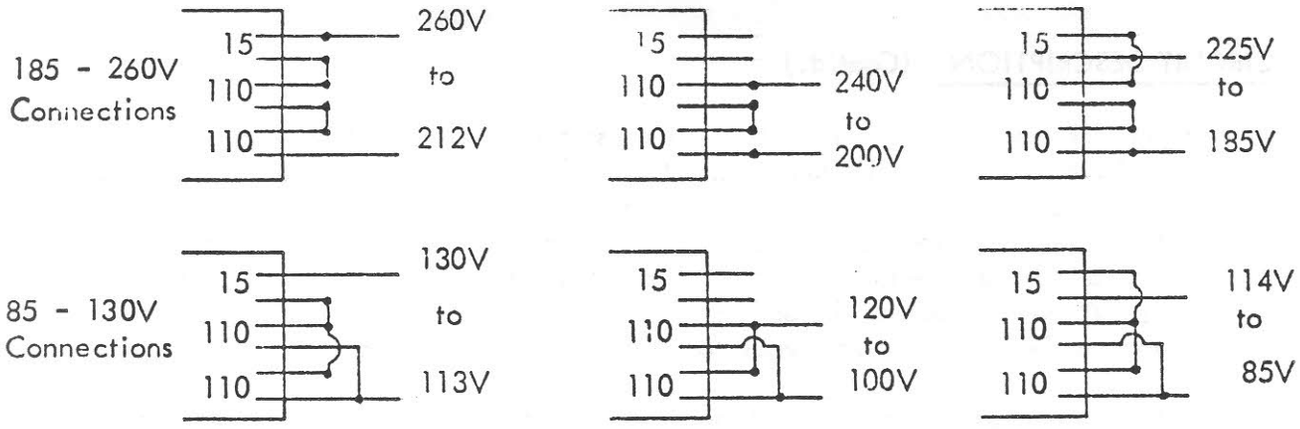


Figure 2. Transformer Connections

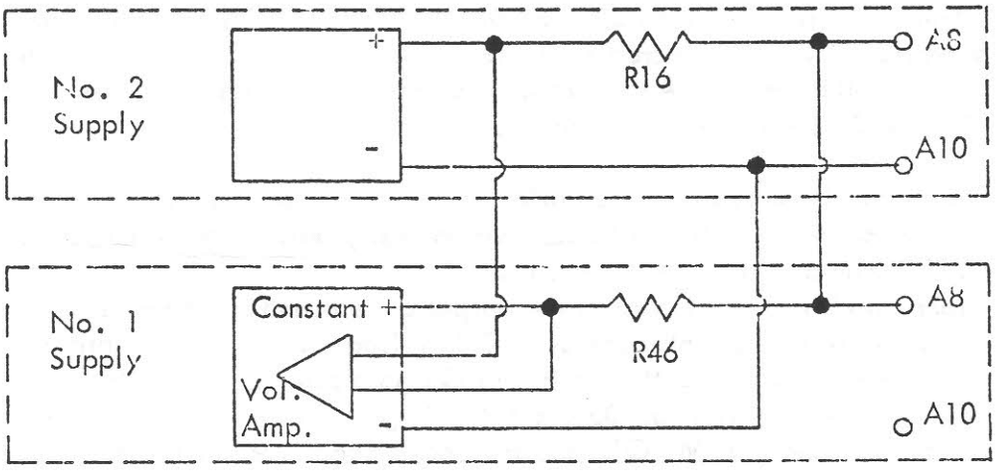


Figure 3 Parallel Connections

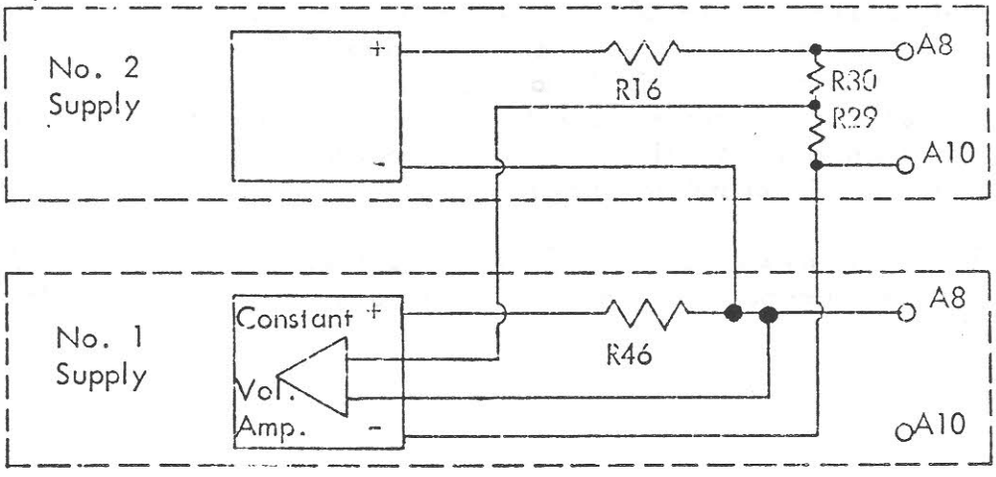


Figure 4 Series Connections

5. CIRCUIT DESCRIPTION. (Cont'd.)

S6A in Independent and Parallel connects the bottom end of RV1, the output voltage control to the negative sensing terminal of No. 2 supply. In Series RV1 is connected to the centre tap of the two supplies.

S6B switches either RV11 (in Parallel or Independent) or RV12 (in Series) into the constant voltage output impedance feedback network, providing separate adjustment for Series operation.

S6C connects the negative output of No. 2 Supply to either its own -ve output terminal or the +ve output of No. 1 Supply.

S6D, E select the points to which the inputs of the Constant Voltage amplifier, No. 1 Supply, are taken to for the three modes of operation.

S6F performs two functions, the first being to disable the constant current control on No. 1 Supply for Series and Parallel operation, and the second to connect the two +ve outputs together in Parallel operation.

S6G connects the -ve output (No. 1) to its own output terminals in Independent. In Series and Parallel the -ve output is taken to the -ve output terminals of No. 2 Supply.

S6H switches the negative end of the voltmeter circuit to the appropriate points when S6 is operated.

For connection diagrams of the supplies when in Parallel and Series see Figure 3 and Figure 4 respectively.

5.9 The Ammeter and Voltmeter switching enables either voltage or current measurements to be made on either supply completely independently. The Ammeter Selector S8A and B selects either No. 1 or No. 2 Supply for current metering. For No. 1 Supply the current sensing resistor is R46 and two preset controls RV18 and RV19 are switched by S3B to provide 0-200mA and 0-2A meter ranges. When the unit is switched to Series the output current flows through both current sensing resistors so that the position of S8 will not vary the meter reading.

NOTE: If the centre tap of the supply is used to provide current output, there will be a different current in each supply which will be shown on the ammeter. Since the currents are balanced equally between the two supplies in Parallel mode the operation of S8 will not affect the reading appreciably. For more accurate measurement of current in parallel, the meter readings may be added together to provide the total current.

The Voltmeter switching is essentially identical to the Ammeter switching since in Series and Parallel the output voltages of the two supplies are identical resulting in no appreciable difference in meter reading when S7 is operated.

5.10 The "Set 1, Set V, Use" switch - S4A and B for No. 2, S5A and B for No. 1 - disconnects the negative output terminal and negative sensing circuit when in the Use position enabling the output voltage to be set internally. In the "Set 1" position the supply is internally shorted via R28 (No. 2) or R58 (No. 1) enabling the output current to be set whilst maintaining the voltage at the output terminals at zero.

5. CIRCUIT DESCRIPTION. (Cont'd.)

5.11 The AC input to the supply is taken via S1A and S1B and a 5A Delay fuse to the two transformers T1 and T2 whose primary windings are connected in parallel across the supply. Interconnection of the voltage tappings on the primary windings give a wide range of input voltages, see Figure 2.

6. ALIGNMENT.

Component changes will not normally affect the performance of the supply, subject to the replacement component being of similar size stability and performance to the original component.

6.1 Test Instruments Required.

Type	Characteristics.	Use
DC Voltmeter	At least 0-40V and 0-80V 1% accuracy	Voltage Check (meter cal.)
DC Ammeter	0-200mA, 0-2A and 0-4A ranges 1% accuracy	Current Check (meter cal.)
DC Millivoltmeter	Max. sensitivity at least 1mV FSD	Output Z measurement
DC Bucking Supply	0v to >72V	

6.2 RV5 Maximum Voltage Preset No. 2 Supply.

Switch the supply to Independent and set the No. 2 Output Voltage Control to maximum clockwise. Adjust RV5 to give 36.5V across the output terminals.

6.3 RV6 Maximum Voltage Preset No. 1 Supply.

Adjust as for RV5 using No. 1 output terminals and Voltage Control.

6.4 RV7 Maximum Current Preset 2A No. 2 Supply.

Switch the supply to Independent and set the No. 2 Output Current Control to Max. clockwise. Adjust RV7 with an external ammeter connected across the output terminals so that the maximum current lies within the range 2.1A to 2.3A. NOTE: Range Switch in 2A position.

6.5 RV8 Maximum Current Preset 200mA No. 2 Supply.

Adjust RV8 in the same manner as RV7 ensuring that the range switch is in the 0.2A position and the maximum current range is 550mA to 600mA.

6.6 RV9 Maximum Current Preset 2A No. 1 Supply.

Adjust as for RV7 using No. 1 controls and terminals.

6. ALIGNMENT (Cont'd.)

6.7 RV10 Maximum Current Preset 200mA No. 1 Supply.

Adjust as for RV8 using No. 1 controls and terminals.

6.8 RV11 Constant Voltage Output Impedance Preset No. 2 Supply.

RV11 is adjusted so that when a 0-2A load change is applied to No. 2 Supply, the change in output voltage is less than 2mV. Should a large change occur, check that the Constant Current is set to greater than 2.1A. See Figure 5 for measurement of ΔV.

6.9 RV12 Constant Voltage Output Impedance Preset Series.

RV12 is adjusted in the manner as RV11 ensuring that the Supply is switched to SERIES and No. 2 output terminals are used.

6.10 RV13 Constant Voltage Output Impedance Preset No. 1 Supply.

Adjust as for RV11 using No. 1 terminals and controls with the Supply switched to INDEPENDENT.

6.11 RV14 Constant Current Output Impedance Preset No. 2 Supply.

With the Supply switched to INDEPENDENT and a load across the terminals drawing 2A at 36V the Current Output Control is adjusted to give 30V output. Placing a short circuit across the load resistor should result in a current increase of less than 0.3mA. Adjust RV14 to produce less than 0.3mA increase.
NOTE: Current monitoring can be done using a small series resistor which is not shorted out and the measurement technique for V section 6.8.

6.12 RV15 Constant Current Output Impedance Preset No. 1 Supply.

Adjust as for RV14 using No. 1 terminals and controls with the Supply switched to INDEPENDENT.

6.13 RV16 Ammeter Calibrate Preset 2A No. 2 Supply.

Switch the Supply to INDEPENDENT and the No. 2 Current Range Switch to 2A. Connect a 2A Ammeter across the supply and adjust the Output Current Control until the external ammeter reads 2.0A. Adjust RV16 for the front panel ammeter to read 2.0A. NOTE: Check before and after the adjustment that the mechanical zero of the meter is set correctly.

6.14 RV17 Ammeter Calibrate Preset 200mA No. 2 Supply.

Adjust as for RV16 ensuring that the Current Range Switch is set to 0.2A and use a 0.2A Ammeter.

6. ALIGNMENT. (Cont'd.)

6.15 RV18 Ammeter Calibrate Preset 2A No. 1 Supply.

Adjust as for RV16 using No. 1 terminals and controls with the supply switched to INDEPENDENT.

6.16 RV19 Ammeter Calibrate Preset 200mA No. 1 Supply.

Adjust as for RV17 using No. 1 terminals and controls with the Supply switched to INDEPENDENT.

6.17 RV22 Crowbar Overvoltage Range Preset No. 2 Supply.

See Section 9. Option 08.

6.18 RV23 Crowbar Overvoltage Range Preset No. 1 Supply.

See Section 9. Option 08. (Crowbar overload normally fitted).

6.19 RV24 Minimum Current Preset No. 2 Supply.

Switch the supply to Independent and set the No. 2 Output Current Control to minimum output. Adjust RV24 with an external ammeter connected across the output terminals so that the output current is less than 10mA, typically 5mA. Check the output current with the Current Range switch in both positions adjusting RV24 for less than 10mA in both positions.

6.20 RV25 Minimum Current Preset No. 1 Supply.

Set RV25 using the same procedure as RV24 ensuring only No. 1 terminals and controls are used.

6.21 RV26 Voltmeter Calibrate Preset.

Switch the supply to Parallel and set the output voltage using an external voltmeter to 36.0V. RV26 is then set so that the front panel voltmeter reads F.S.D. A compromise may be necessary when the Meter Selector is varied to obtain optimum accuracy.

7. MAINTENANCE.

7.1 Removal of Covers.

(a) Remove the eight (8) screws retaining the handle and covers.
(b) Remove the four large screws and one small screw from each side of the unit.
(c) The top cover may now be removed.
(d) With unit inverted remove the two screws in the runners.
(e) The bottom cover may now be removed.
(f) Remove the four small screws at each corner of the rear perforated

7. MAINTENANCE. (Cont'd.)

heatsink cover. Remove the two large screws near the centre of the cover and withdraw cover from heatsink assembly.

7.2 Removal of Heatsinks.

(a) Two heatsinks are mounted together on a backing plate which can be removed by unscrewing the two screws situated at the top and bottom of the backing plate.

(b) Removal of the two 1/4" WHIT. screws on each heatsink will release the heatsink from the backing plate.

7.3 Semiconductor Replacement.

Before removing any transistors from the power supply the transistor should be labelled so that in the event a detective transistor is found its circuit location may be identified thus isolating the source of trouble.

Should it be necessary to remove a matched pair of transistors ensure that they are returned to the same point. DO NOT replace one of a matched pair, replace only with a pair obtained from the manufacturer : See Section 8.

8. REPLACEMENT PARTS.

Spares are normally available from the manufacturer, B.W.D. Electronics Pty.Ltd., When ordering, it is necessary to indicate the model and serial number of the instrument. If exact replacements are not to hand, locally available alternatives may be used, provided they possess a specification not less than, or physical size not greater than the original components.

As the policy of B.W.D. Electronics Pty.Ltd., is one of continuing research and development, the Company reserves the right to supply the latest equipment and make amendments to circuits and parts without notice.

9. OPTIONS. (Description, Use and Alignment).

9.1 Option 02 - 10 Turn Voltage Control with Digit Dial.

This option may be fitted to either or both voltage controls resulting in a resolution of 6mV.

The setting of Maximum Voltage presets (RV5 and RV6) remain the same except that a different maximum voltage, i.e. 36V or 37V may be chosen so that interpolation of the dial indication against output voltage may be easier. Once the voltage has been set a multiplier of the dial reading can be established to facilitate accurate setting of the output without requiring a voltmeter.

9. OPTIONS. (Cont'd.)

9.2 Option 03 - 10 Turn Current Control with Digit Dial.

This option may be fitted to either or both current controls resulting in a resolution of 60μA for the 200mA range and 0.6mA for the 2A range.

The setting of Maximum Current presets (RV7, RV8, RV9 and RV10) remain the same, however, for convenience of producing a single logging scale RV7 and RV9 should be set to exactly ten (10) times the value of RV8 and RV10.

9.3 Option 05 - 10 Turn Voltage Control (No Digit Dial.)

The control fitted for this option is identical to that fitted in Option 02 but without a digit dial indicator. Adjustment of RV5 and RV6 is the same as detailed in Section 6.2 and 6.3 respectively. Resolution is equal to 6mV.

9.4 Option 06 - 10 Turn Current Control (No Digit Dial.)

The control fitted for this option is identical to that fitted in Option 03, but without a digit dial indicator. Adjustment of RV7, RV8, RV9 and RV10 is the same as detailed in section 6. Resolution is equal to 60μA for the 200mA range and 0.6mA for the 2A range.

9.5 Option 08 - Crowbar Overvoltage Overload. (Normally fitted as standard)

Option 08 when fitted to a supply provides an overvoltage protection. When an overvoltage condition exists a silicon controlled rectifier places a short circuit across the output which will remain until the overload is reset.

The circuit of the crowbar overload can be seen on the main circuit drawing and is shown connected directly across the output terminals. The overload circuit of No. 2 supply will be described since the operation of both circuits is identical.

SCR1 silicon controlled rectifier is connected directly across the output of No. 2 supply. The gate of SCR1 is driven via S10A by the two transistors Q27 and Q28 which form a simulated regenerative SCR with its gate, the base of Q28, connected to a voltage divider consisting of R63, RV22 and RV20 which senses the output voltage.

S10A and B, on the rear of RV20 overvoltage control, function as an ON-OFF control by (a) removing the drive circuit from the gate of SCR1 and (b) open circuiting the overvoltage control thus preventing input signals to Q28.

RV22 (or RV23) is set in the following manner:-

Turn the Crowbar Overvoltage control to maximum clockwise and then back off by approximately 20°. Set the Output Voltage of the particular supply to zero and switch the unit "ON". Set the terminal switch to "USE" and slowly increase the output voltage noting where the overload trips.

9. OPTIONS. (Cont'd.)

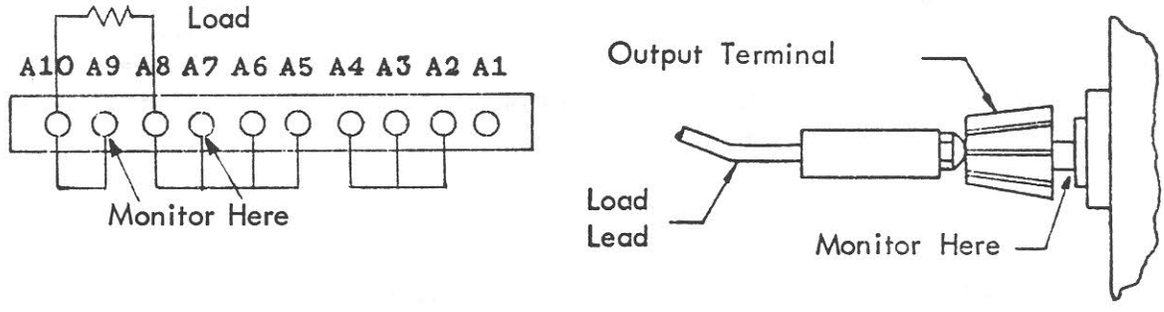
RV22 is adjusted so that in the SERIES mode the trip voltage is 72V. RV23 is adjusted so that in the INDEPENDENT mode the trip voltage is 36V. The setting of RV22 (or RV23) may take several attempts since once the overload has been operated the output voltage must be (a) reduced to zero to reset the crowbar overload and then (b) increased slowly after RV22 (or RV23) has been adjusted to obtain the correct trip point.

NOTE: Should an internal malfunction of the Series Regulator occur which attempts to increase the output voltage above the trip point, the Crowbar Overvoltage control will operate and blow either the internal DC fuse or the front panel mounting AC fuse.

10. GUARANTEE.

The equipment is guaranteed for a period of twelve (12) months from the date of purchase against faulty materials and workmanship.

Please refer to Guarantee Registration Card No. ..... which accompanied instrument for full details of conditions of warranty.



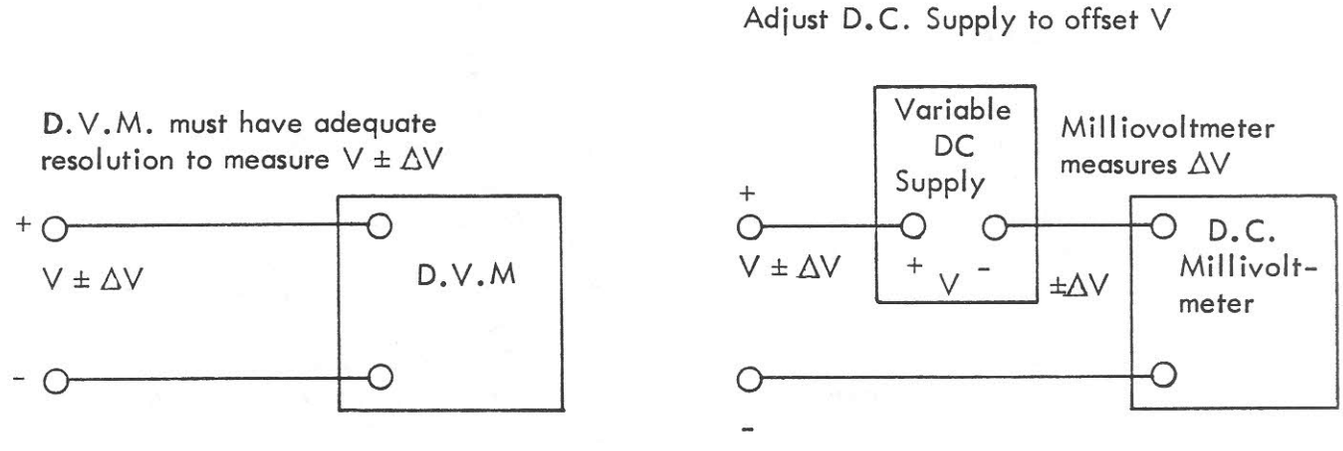


Figure 5 : Measurement of ΔV

B.W.D. INSTRUMENTS PTY. LTD.

REPLACEABLE PARTS

1. This section contains information for ordering replacement parts, it provides the following details:-

   (a) Description of part (see list of abbreviations)
   (b) Typical manufacturer or supplier of the part (see list of abbreviations).
   (c) Manufacturer's Part Number, and
   (d) Defence Stock Number, where applicable.

2. Ordering - Please quote Model Type No., e.g. bwd 539C Serial No. Circuit Reference No. and component details as listed in parts list.

COMPONENT DESIGNATORS

A	Assembly	H	Heater	RV	Resistor Variable
B	Lamp	J	Jack (socket)	S	Switch
C	Capacitor	L	Inductor	T	Transformer
D	Diode	M	Meter	TH	Thermistor
DL	Delay Line	P	Plug	V	Valve
E	Misc. Elect.Part	Q	Transistor	VDR	Voltage Dependent Resistor
F	Fuse	R	Resistor		

ABBREVIATIONS

Amp	Ampere	L	Inductor
C	Capacitor	lin	Linear
cc	Cracked Carbon	Log	Logarithmic Taper
c	Carbon	m	Milli = 10^{-3}
cd	Deposited Carbon	MHz	Mega Hertz = 10^{6} Hz
comp	Composition	MF	Metal Film
CDS	Ceramic Disc Capacitor	ma	Milli Ampere
cer	ceramic	MΩ	Meg Ohm = 10^{6} Ω
Com l	Common	mfr	Manufacturer
DPST	Double Pole Single Throw	MO	Metal Oxide
DPDT	Double Pole Double Throw	MHT	Polyester/Paper Capacitor
ELECTR	Electrolytic	MPC	Metalised Polyester Capacitor
F	Farad	Ne	Neon
f	Fuse	NPO	Zero temperature co-efficient
FET	Field Effect Transistor	nsr	Not separately replaceable
Ge	Germanium	NC	Normally Closed
H	Henry(ies)	NO	Normally Open
H.S.	High Stability	ns	Nano second
HTC	High Temp Coating	obd	Order by Description
ins	Insulated	OD	Outside Diameter
KHz	Kilo Hertz = 10^{3} Hz	p	Peak
KΩ	Kilo Ohm = 10^{3} Ω	pf	pico farad = 10^{-12}F

COMPONENT ABBREVIATIONS (Cont'd)

PL	Plug
PS	Socket
Preset	Internal Preset
PYE	Polyester
pot	Potentiometer
prec	Precision
PC	Printed circuit
PIV	Peak Inverse Voltage
PYS	Polystyrene
p-p	Peak to Peak
P.Shaft	Plain Shaft
Q	Transistor
R	Resistor
rot	Rotary
R log	Reverse Logarithmic Taper
rms	Root Mean Squared
SM	Silver Mica
SPDT	Single Pole Double Throw
SPST	Single Pole Single Throw
S.Shaft	Slotted Shaft
Si	Silicon
Ta	Tantalum
tol	Tolerance
trim	Trimmer
V	Volt(s)
var	Variable
vdcw	Volts Direct Current Working
w	Watt(s)
ww	Wire Wound
Z	Zener
*	Factory Selected value, nominal value may be shown
**	Special component, no part no. assigned.

MANUFACTURERS ABBREVIATIONS

AB	A.B. Electronics
AEE	AEE Capacitors
AC	Allied Capacitors
AST	Astronic Imports
AWA	Amalgamated Wiress of Aust.
ACM	Acme Engineering Pty.Ltd.
AMP	Aircraft Marine Products(Aust)P/L
AR	A.& R. Transformers
AUS	Australux Fuses
AWV	Amalgamated Wireless Valve Co.
ACA	Amplifier Co.of Aust.
ARR	Arrow
BWD	B.W.D. Instruments Pty.Ltd.
BL	Belling & Lee Pty.Ltd.
BR	Brentware(Vic.) Pty.Ltd.
BU	Bulgin
CF	Carr Fastener
CAN	Cannon Electrics Pty.Ltd.
CIN	Cinch
DAR	Darstan
DIS	Distributors Corporation P/L.
ELN	Elna Capacitors(Sonar Elec.P/L).
ETD	Electron Tube Dist.
F.	Fairchild Australia Pty.Ltd.
GRA	General Radio Agencies
GE	General Electric (USA)
GEC	General Electric Co.(UK)
GES	General Electronic Services
HW	Hurtle Webster
HOL	R.G. Holloway
H	Haco Distributors(National)
HS	Hawker Sidley
J	Jabel
McH	McKenzie & Holland(Westinghouse)
MAS	Master Instrument Co.Pty.Ltd.
MOR	Morganite(Aust.) Pty.Ltd.
MSP	Manufacturers Special Products(AWA)
McM	McMurdo(Aust.) Pty.Ltd.
MOT	Motorola
NU	Nu Vu Pty.Ltd.
NAU	A.G. Naunton Pty.Ltd.
NS	National Semiconductor
PA	Painton
PAL	Paton Elect.Pty.Ltd.
PI	Piher Resistors(Sonar Electronics)
PH	Philips Electrical Industries Pty.Ltd.
PL	Plessey Pacific
PRO	Procel
PV	Peaston Vic.
RC	Radio Corporation(Electronic Inds).
RCA	Radio Corporation of America
RHC	R.H. Cunningham
STC	Standard Telephone & Cables
SI	Siemens Electrical Industries
SIM	Simonson Pty.Ltd.
SF	Selectronic Components
SON	Sonar Electronics
TR	Trimax Erricson Transformers
TI	Texas Instruments Pty.Ltd.
TH	Thorn Atlas
UC	Union Carbide
W	Wellwyn Resistors (Cannon Elec. P/L).
WH	Westinghouse
Z	Zephyr Prod.Pty.Ltd.

CCT Ref	DESCRIPTION				Mfr. or Supply	PART NO.	
	RESISTORS						
R1	6.8KΩ	½Watt	5%	CC	PI		
R2	10KΩ	½Watt	5%	CC	PI		
R3	15KΩ	½Watt	5%	CC	PI		
R4	6.8KΩ	½Watt	5%	CC	PI		
R5	1KΩ	½Watt	5%	CC	PI		
R6	47KΩ	½Watt	5%	CC	PI		
R7	820Ω		2%	MO	T	TR5	
R8	47KΩ	½Watt	5%	CC	PI		
R9	100Ω	1Watt	10%	CC	D		
R10	1.5KΩ		2%	MO	T	TR5	
R11	15KΩ		2%	MO	T	TR5	
R12	470KΩ	½Watt	5%	CC	PI		
R13	6.8KΩ	½Watt	5%	CC	PI		
R14	1KΩ		2%	MO	T	TR5	
R15	560Ω	½Watt	5%	CC	PI		
R16	0.5Ω	20Watt	5%	WW	HW		
R17	150KΩ	½Watt	5%	CC	PI		
R18	2.2KΩ		2%	MO	T	TR5	
R19	22KΩ	½WWatt	5%	CC	PI		
R20	1KΩ		2%	MO	T	TR5	
R21	330Ω	½Watt	5%	CC	PI		
R22	2.2KΩ		2%	MO	T	TR5	
R23	4.7KΩ	1Watt	5%	CC	PI		
R24	82KΩ	½Watt	5%	CC	PI		
R25	5.6KΩ	½Watt	5%	CC	PI		
R26	100Ω	1Watt	10%	CC	D		
R27	100Ω	1Watt	10%	CC	D		
R28	0.1Ω	5Watt	5%	WW	HW		
R29	36KΩ		2%	MO	T	TR5	
R30	36KΩ		2%	MO	T	TR5	
R31	6.8KΩ	½Watt	5%	CC	PI		
R32	10KΩ	½Watt	5%	CC	PI		
R33	15KΩ	½Watt	5%	CC	PI		
R34	6.8KΩ	½Watt	5%	CC	PI		
R35	330Ω	½Watt	5%	CC	PI		
R36	47KΩ	½Watt	5%	CC	PI		
R37	820Ω		2%	MO	T	TR5	
R38	47KΩ	½Watt	5%	CC	PI		
R39	100Ω	1Watt	10%	CC	D		
R40	1.5KΩ		2%	MO	T	TR5	
R41	15KΩ		2%	MO	T	TR5	

CCT Ref	DESCRIPTION				Mfr. or Supply	PART NO.	
	RESISTORS (Cont'd)						
R42	470KΩ	½Watt	5%	CC	PI		
R43	6.8KΩ	½Watt	5%	CC	PI		
R44	1KΩ		2%	MO	T	TR5	
R45	560Ω	½Watt	5%	CC	% PI		
R46	0.5Ω	20Watt	5%	WW	HW		
R47	150KΩ	½Watt	5%	CC	PI		
R48	2.2KΩ		2%	MO	T	TR5	
R49	22KΩ	½Watt	5%	CC	PI		
R50	1KΩ		2%	MO	T	TR5	
R51	330Ω	½Watt	5%	CC	PI		
R52	2.2KΩ		2%	MO	T	TR5	
R53	4.7KΩ	1Watt	5%	CC	PI		
R54	82KΩ	½Watt	5%	CC	PI		
R55	5.6KΩ	½Watt	5%	CC	PI		
R56	100Ω	1Watt	10%	CC	D		
R57	100Ω	1Watt	10%	CC	D		
R58	0.1Ω	5Watt	5%	WW	HW		
R59	1KΩ	6Watt	5%	MO	CAN	F33	
R60	1KΩ	6Watt	5%	MO	CAN	F33	
R61	2.2KΩ	½Watt	5%	CC	PI		
R62	10KΩ	½Watt	5%	CC	PI		
R63	270Ω	½Watt	5%	CC	PI		
R64	470Ω	½Watt	5%	CC	PI		
R65	10KΩ	½Watt	5%	CC	PI		
R66	2.2KΩ	½Watt	5%	CC	PI		
R67	27KΩ	½Watt	1%	CC	PI		
R68	27KΩ	½Watt	1%	CC	PI		
R69	10MΩ	½Watt	5%	CC	PI		
R70	1KΩ	½Watt	5%	CC	PI		
R71	330Ω	½Watt	5%	CC	PI		
R72	4.7KΩ	½Watt	5%	CC	PI		
R73	1KΩ	½Watt	5%	CC	PI		
R74	10MΩ	½Watt	5%	CC	PI		
R75	18Ω	75Watt	5%	WW	HW		
R76	22Ω	½Watt	5%	CC	PI		
R77	10Ω	½Watt	5%	CC	PI		
R78	22Ω	½Watt	5%	CC	PI		
R79	10Ω	½Watt	5%	CC	PI		
R80	2.2KΩ		2%	MO	T	TR5	
R81	2.2KΩ		2%	MO	T	TR5	
R82	100Ω	½Watt	5%	CC	PI		
R83	100Ω	½Watt	5%	CC	PI		
R84	1KΩ	½Watt	5%	CC	PI		
R85	100K	1/4 Watt	5%				
R86	100K	1/4 Watt	5%				
R90	470K	1/4 Watt	5%				
R92	1K8	1 Watt	5%				
R93	10K	1/4 Watt	5%				

B.W.D. INSTRUMENTS PTY. LTD. - PARTS LIST - MODEL bwd 242A

CCT Ref	DESCRIPTION				Mfr. or Supply	PART NO.	
	CAPACITORS						
C1	68uF	63V		ELEC	PH	2222-017-18689	
C2	220uF	16V		ELEC	PH	2222-016-15221	
C3	22uF	25V		ELEC	PH	2222-015-16229	
C4	150pf	630V	10%	PYS	AC	TCS 602	
C5	470pf	630V	10%	PYS	AC	TCS 608	
C6	150pf	630V	10%	PYS	AC	TCS 602	
C7	15uf	40V		ELEC	PH	2222-015-17159	
C8	470pf	630V	10%	PYS	AC	TCS 608	
C9	47uF	25V		ELEC	PH	2222-015-16479	
C10	470pf	630V	10%	PYS	AC	TCS 608	
C11	0.0047uF	400V	10%	PYE	PH	2202-315-51472	
C12	470pf	630V	10%	PYS	AC	TCS 608	
C13	0.0022uF	400V	10%	PYE	PH	2202-315-51222	
C14	12.5uF	150V		ELEC	PH	2222-040-11139	
C15	4000uF	75V		ELEC	ELN	TYPE RG	
C16	0.22µF	630V	10%	G/C	SOAN	TYPE N	
C17	68uF	63V		ELEC	PH	2222-017-18689	
C18	220uF	16V		ELEC	PH	2222-016-15221	
C19	22uF	25V		ELEC	PH	2222-015-16229	
C20	150pf	630V	10%	PYS	AC	TCS 602	
C21	470pf	630V	10%	PYS	AC	TCS 608	
C22	150pf	630V	10%	PYS	AC	TCS 602	
C23	15uF	40V		ELEC	PH	2222-015-17159	
C24	470pf	630V	10%	PYS	AC	TCS 608	
C25	47uF	25V		ELEC	PH	2222-015-16479	
C26	470pf	630V	10%	PYS	AC	TCS 608	
C27	0.0047uF	400V	10%	PYE	PH	2202-315-51472	
C28	470pf	630V	10%	PYS	AC	TCS 608	
C29	0.0022uF	400V	10%	PYE	PH	2202-315-51222	
C30	12.5uF	150V		ELEC	PH	2222-040-11139	
C31	4000uF	75V		ELEC	ELN	TYPE RG	
C32	0.22µF	630V	10%	G/C	SOAN	TYPE N	
C33	0.1uF	400V	10%	PYE	PH	2222-342-51104	
C34	2200uF	100V		ELEC	ELN	TYPE RG	
C35	0.022uF	160V	10%	PYE	PH	2202-315-31223	
C36	2200uF	100V		ELEC	ELN	TYPE RG	
C38	0.047µF	100V	10%	G/C	SOAN	TYPE N	
C39	0.047µF	100V	10%	G/C	SOAN	TYPE N	
C40	4.7µF	64V		ELEC	PH		
C41	6.4µF	400V		ELEC	PH		
C42	470pf	630V	10%	PYS	AC	TCS 608	
C43	470pf	630V	10%	PYS	AC	TCS 608	
D1	100V PIV	500mA	DIODE	SI	S	EM 401	
D2	6.2V	300mW	ZENER	SI	PH	BZY88/C6V2	
D3	60V PIV	100mA	DIODE	SI	PH	IN4148	
D4	60V PIV	100mA	DIODE	SI	PH	IN4148	
D5	60V PIV	100mA	DIODE	SI	PH	IN4148	
D6	60V PIV	100mA	DIODE	A1	PH	IN4148	

CCT Ref	DESCRIPTION					Mfr. or Supply	PART NO.	
	DIODES (Cont'd)							
D7	1200V	PIV	2A	DIODE	SI	W	MR752	
D8	100V	PIV	500mA	DIODE	SI	S	EM 401	
D9	200V	PIV	20A	DIODE	SI	PH	BYX21/200	
D10	100V	PIV	500mA	DIODE	SI	S	EM 401	
D11	100V	PIV	500mA	DIODE	SI	S	EM 401	
D12	6.2V		300mW	ZENER	SI	PH	BZY88/C6V2	
D13	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D14	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D15	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D16	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D17	1200V	PIV	2A	DIODE	SI	W	MR752	
D18	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D19	200V	PIV	20A	DIODE	SI	PH	BYX21/200	
D20	100V	PIV	500mA	DIODE	SI	S	EM 401	
D21	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D22	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D23	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D24	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D25	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D26	60V	PIV	100mA	DIODE	SI	PH	IN4148	
D27	60V	PIV	100mA	DIODE	SI	PH	IN4148	
SCR1	100V	PV	20Amp	SCR	SI	CAN	MCR3818-3	
SCR2	100V	PV	20Amp	SCR	SI	CAN	MCR3818-3	
	TRANSISTORS							
Q1								
Q2								
Q3	Incorporated in I.C.1 and I.C.2							
Q4								
Q5								
Q6								
Q7	60V	VCE	10A	NPN	SI	CAN	MJE3055	
Q8	60V	VCE	10A	NPN	SI	CAN	MJE3055	
Q9	60V	VCE	10A	NPN	SI	CAN	MJE3055	
Q10	40V	VCE	hfe 100	PNP	SI	PH	BC157	
Q11	60V	VCE	15A	NPN	SI	AWA	2N3055	
Q12								
Q13	60V	VCE	15A	NPN	SI	AWA	2N3055	
Q14								
Q15	Selected Characteristics				SI	BWD	2N3819-RW	
Q16	300V	VCE	1A	NPN	SI	CAN	MJE340	
Q17	40V	VCE	hfe100	NPN	SI	PH	BC147	
Q18	300V	VCE	1A	NPN	SI	CAN	MJE340	
Q19	Selected Characteristics				SI	BWD	2N3819-RW	
Q20	Selected Characteristics				SI	BWD	2N3819-RW	

CCT Ref	DESCRIPTION				Mfr. or Supply	PART NO.	
	TRANSISTORS (Cont'd)						
Q21	300V VCE 1A		NPN	SI	CAN	MJE340	
Q22	Selected Characteristics			SI	BWD	2N3819-RW	
Q23	40V VCE hfe100		NPN	SI	PH	BC147	
Q24	300V VCE 1A		NPN	SI	CAN	MJE340	
Q25	Selected Characteristics			SI	BWD	2N3819-RW	
Q26	Selected Characteristics			SI	BWD	2N3819-RW	
Q27	300V VCE 1A		NPN	SI	CAN	MJE340	
Q28	150V VCE hfe100		PNP	SI	F	2N4888	
Q29	300V VCE 1A		NPN	SI	CAN	MJE340	
Q30	150V VCE hfe100		PNP	SI	F	2N4888	
I.C.1A-B	Dual Differential Amp.			SI	AWA	CA3054	
I.C.2A-B	Dual Differential Amp.			SI	AWA	CA3054	
DR1	Bridge Rectifier Assembly				BWD	4xBYX21/200	
DR2	Bridge Rectifier Assembly				BWD	4xBYX21/200	
	POTENTIOMETERS						
RV1	50KΩ	2Watt	VAR	WW	NAU		
RV2	50KΩ	2Watt	VAR	WW	NAU		
RV3	1KΩ	2Watt	VAR	WW	NAU		
RV4	1KΩ	2Watt	VAR	WW	NAU		
RV5	1KΩ		PRESET	WW	DAR	P121 or VTP	
RV6	1KΩ		PRESET	WW	DAR	P121 " "	
RV7	1KΩ		PRESET	WW	DAR	P121 " "	
RV8	10K		PRESET	WW	DAR	P121 " "	
RV9	1KΩ		PRESET	WW	DAR	P121 " "	
RV10	10K		PRESET	WW	DAR	P121 " "	
RV11	220Ω		PRESET	cd	PH	EO97AC/220E	
RV12	220Ω		PRESET	cd	PH	EO97AC/220E	
RV13	220Ω		PRESET	cd	PH	EO97AC/220E	
RV14	10KΩ		PRESET	cd	PH	EO97AC/10K	
RV15	10KΩ		PRESET	cd	PH	EO97AC/10K	
RV16	100Ω		PRESET	cd	PH	EO97AC/100E	
RV17	220Ω		PRESET	cd	PH	EO97AC/220E	
RV18	100Ω		PRESET	cd	PH	EO97AC/100E	
RV19	220Ω		PRESET	cd	PH	EO97AC/220E	
RV20	50KΩ with DPST switch		VAR	cd	D	PSS2039	
RV21	50KΩ with DPST switch		VAR	cd	D	PSS2039	
RV22	220Ω		PRESET	cd	PH	EO97AC/220E	
RV23	220Ω		PRESET	cd	PH	EO97AC/220E	

B.W.D. INSTRUMENTS PTY. LTD. - PARTS LIST - MODEL bwd 242A

CCT Ref	DESCRIPTION	Mfr. or Supply	PART NO.	
	SWITCHES			
S1	2 Position 2 Pole Toggle Switch	AWA	8370K8	
S2	2 Position 2 Pole Slide Switch	S	3570	
S3	2 Position 2 Pole Slide Switch	S	3570	
S4	3 Position 2 Pole Toggle Switch	ARR	93A/102A-13	
S5	3 Position 2 Pole Toggle Switch	ARR	93A/102A-13	
S6	3 Position 4 Pole 2 Deck Rotary Switch	BWD	SR70A	
S7	2 Position 2 Pole Slide Switch	S	3570	
S8	2 Position 2 Pole Slide Switch	S	3570	
	FUSES			
F1	2 Amp Delay Fuse	Y	3AG	
F2	5 Amp Delay Fuse	Y	3AG	
F3	5 Amp Delay Fuse	Y	3AG	
	MISCELLANEOUS			
B1	6.3V Pilot Indicator	S	3280	
M1	Voltmeter	BWD	242A-V	
M2	Ammeter	BWD	242A-A	
	ITEMS NOT LISTED ON CIRCUIT DIAGRAM			
	Rectifier Printed Circuit Board	BWD	160/133	
	Main Printed Circuit Board	BWD	160/125	
	Regulator Printed Circuit Board	BWD	160/127	
	Rear Panel Terminal Strip	CIN	77903-10way	
	Circuit Diagram	BWD	No.879	
	ALL OTHER ITEMS ORDER BY DESCRIPTION QUOTING MODEL NO. AND SERIAL NO.			

R 93 C 39 D 36

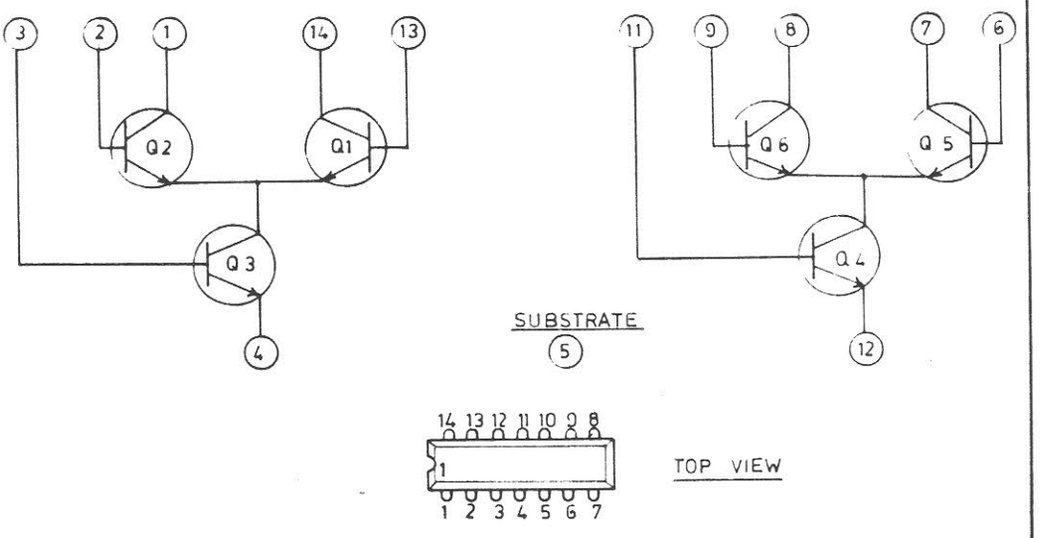
CONTROLS

RV1	OUTPUT VOLTAGE CONTROL	NO. 2
RV2	OUTPUT VOLTAGE CONTROL	NO. 1
RV3	OUTPUT CURRENT CONTROL	NO. 2
RV4	OUTPUT CURRENT CONTROL	NO. 1
RV5	MAXIMUM VOLTAGE PRESET	NO. 2
RV6	MAXIMUM VOLTAGE PRESET	NO. 1
RV7	MAXIMUM CURRENT PRESET 2A	NO. 2
RV8	MAXIMUM CURRENT PRESET 200mA	NO. 2
RV9	MAXIMUM CURRENT PRESET 2A	NO. 1
RV10	MAXIMUM CURRENT PRESET 200mA	NO. 1
RV11	CONSTANT VOLTAGE OUTPUT IMPEDANCE	NO. 2
RV12	CONSTANT VOLTAGE OUTPUT IMPEDANCE	SERIES
RV13	CONSTANT VOLTAGE OUTPUT IMPEDANCE	NO. 1
RV14	CONSTANT CURRENT OUTPUT IMPEDANCE	NO. 2
RV15	CONSTANT CURRENT OUTPUT IMPEDANCE	NO. 1
RV16	AMMETER CALIBRATE 2A	NO. 2
RV17	AMMETER CALIBRATE 200mA	NO. 2
RV18	AMMETER CALIBRATE 2A	NO. 1
RV19	AMMETER CALIBRATE 200mA	NO. 1
RV20	CROWBAR OVERVOLTAGE CONTROL	NO. 2
RV21	CROWBAR OVERVOLTAGE CONTROL	NO. 1
RV22	CROWBAR OVERVOLTAGE RANGE	NO. 2
RV23	CROWBAR OVERVOLTAGE RANGE	NO. 1
RV24	MINIMUM CURRENT PRESET	NO. 2
RV25	MINIMUM CURRENT PRESET	NO. 1
RV26	VOLTMETER CALIBRATE	—

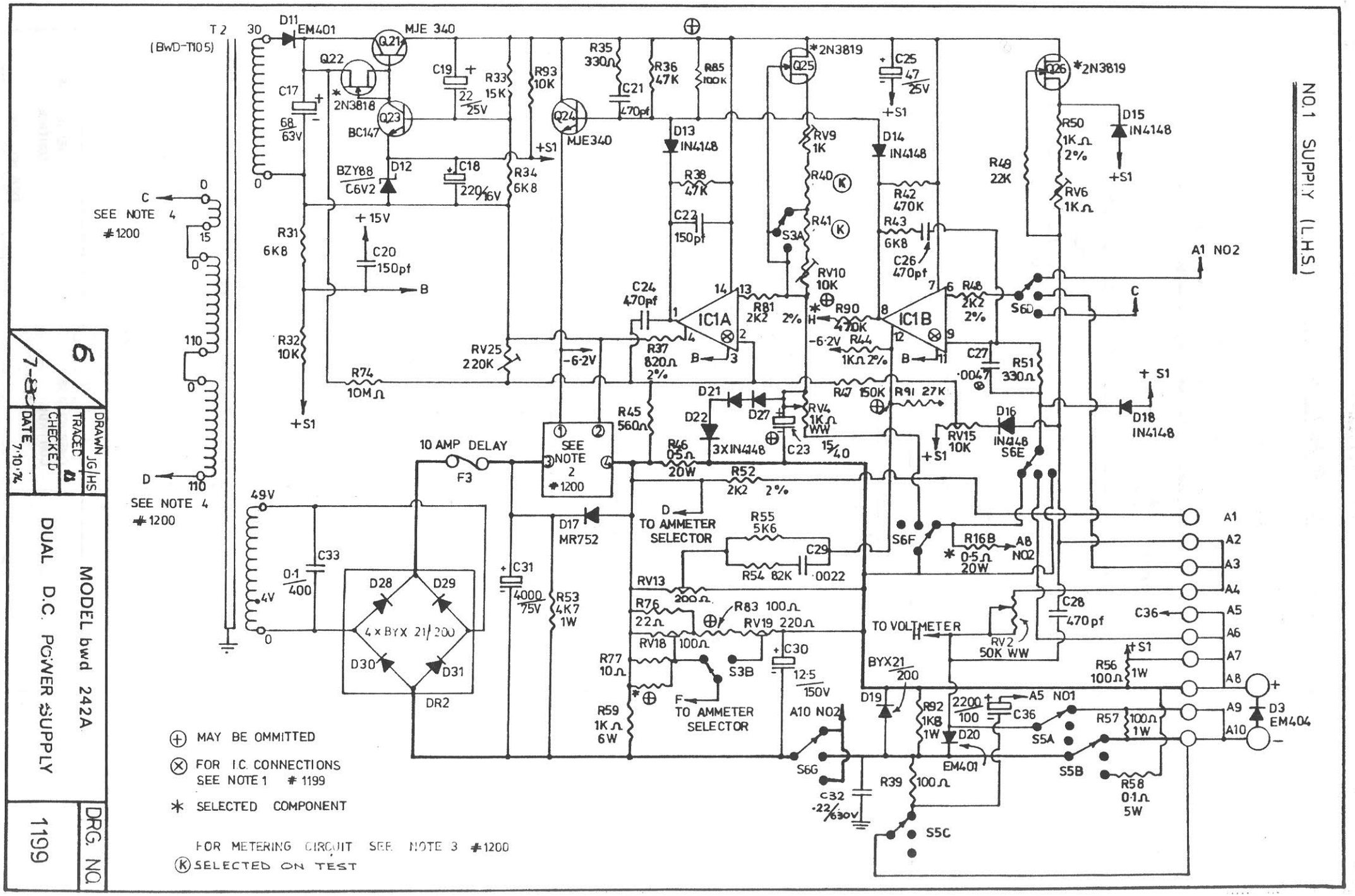
SWITCHES

		POS. SHOWN
S1A-B	POWER ON-OFF	OFF
S2A-B	CURRENT RANGE NO. 2	2A
S3A-B	CURRENT RANGE NO. 1	2A
S4A-C	SET I, SET V, USE NO. 2	USE
S5A-C	SETI, SET V, USE NO. 1	USE
S6A-H	SERIES INDEPENDENT PARALLEL	PARALLEL
S7A-B	VOLTMETER SELECTOR	NO. 1
S8A-B	AMMETER SELECTOR	NO. 1
S10A-B	CROWBAR OVERLOAD ON-OFF NO. 2	OFF
S11A-B	CROWBAR OVERLOAD ON-OFF NO. 1	OFF

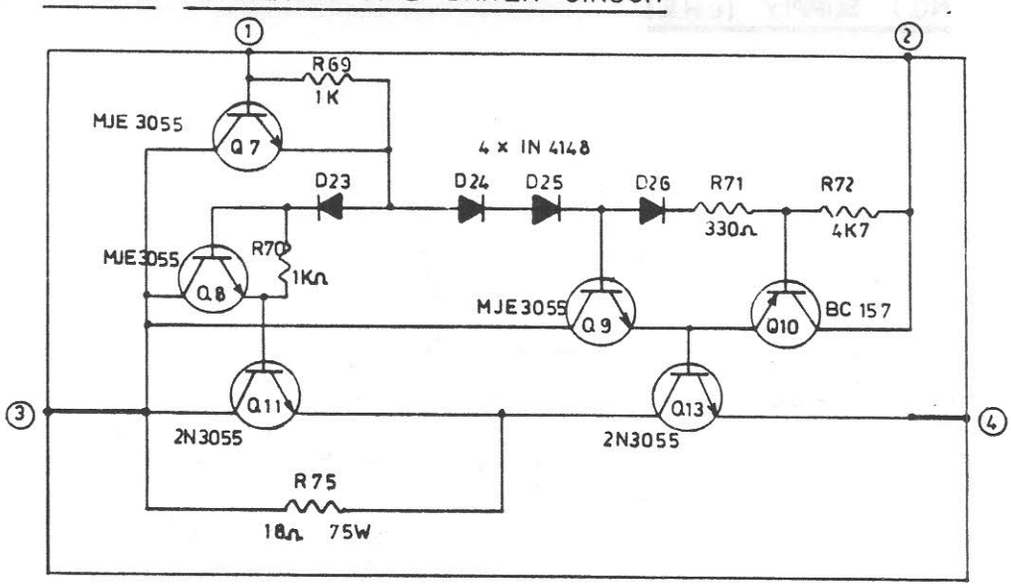
NOTE 1 INTEGRATED CIRCUIT SCHEMATIC



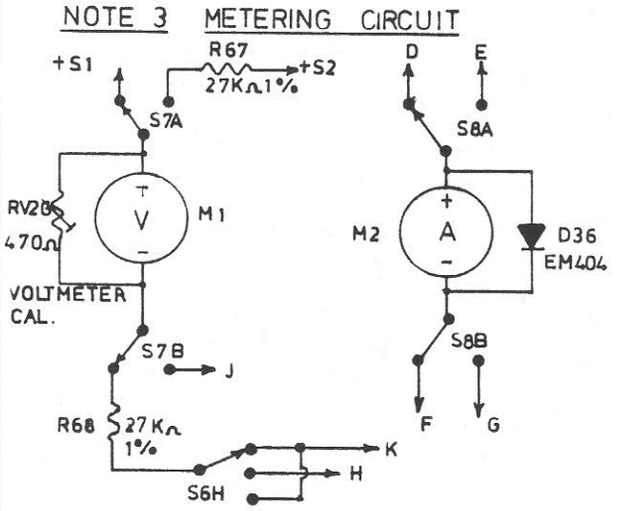
DRG. NO. 1199


NO.1 SUPPLY (L.H.S.)
MODEL bwd 242A
DUAL D.C. POWER SUPPLY
DRG. NO. 1199
DRAWN JG/HS
TRACED
CHECKED
DATE 7-10-74
6
7-83
T2
(BWD-T105)
SEE NOTE 4 #1200
SEE NOTE 4 #1200
D11 EM401
Q21 MJE 340
Q22 *2N3818
Q23 BC147
Q24 MJE340
Q25 *2N3819
Q26 *2N3819
D12 BZY88 C6V2
D13 IN4148
D14 IN4148
D15 IN4148
D16 IN4148
D18 IN4148
D17 MR752
D19 BYX21 200
D20 EM401
D21
D22
D27
3XIN4148
D28 D29 D30 D31
4 x BYX 21/200
DR2
D3 EM404
C17 68 63V
C18 220/16V
C19 22/25V
C20 150pf
C21 470pf
C22 150pf
C23 15/40
C24 470pf
C25 47/25V
C26 470pf
C27 .0047
C28 470pf
C29 .0022
C30 12·5 150V
C31 4000/75V
C32 ·22/630V
C33 0·1/400
C36 2200/100
IC1A
IC1B
R31 6K8
R32 10K
R33 15K
R34 6K8
R35 330Ω
R36 47K
R37 820Ω 2%
R38 47K
R40 (K)
R41 (K)
R42 470K
R43 6K8
R44 1KΩ 2%
R45 560Ω
R46 0·5Ω 20W
R47 150K
R48 2K2 2%
R49 22K
R50 1KΩ 2%
R51 330Ω
R52 2K2 2%
R53 4K7 1W
R54 82K
R55 5K6
R56 100Ω 1W
R57 100Ω 1W
R58 0·1Ω 5W
R59 1KΩ 6W
R74 10MΩ
R76 22Ω
R77 10Ω
R81 2K2 2%
R83 100Ω
R90 470K
R91 27K
R92 1KΩ 1W
R93 10K
RV2 50K WW
RV4 1K Ω WW
RV6 1KΩ
RV9 1K
RV10 10K
RV13 200Ω
RV15 10K
RV18 100Ω
RV19 220Ω
RV25 220K
S3A
S3B
S5A
S5B
S5C
S6B
S6E
S6F
S6G
F3 10 AMP DELAY
SEE NOTE 2 #1200
TO AMMETER SELECTOR
TO AMMETER SELECTOR
TO VOLTMETER
BYX21 200
A1 NO2
A5 NO1
A8 NO2
A10 NO2
+15V
-6·2V
+S1
49V
4V
110
MAY BE OMMITTED
FOR I.C. CONNECTIONS SEE NOTE 1 #1199
SELECTED COMPONENT
FOR METERING CIRCUIT SEE NOTE 3 #1200
(K) SELECTED ON TEST

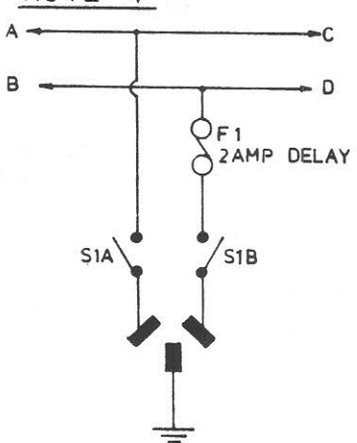
NOTE 2 REGULATOR AND DRIVER CIRCUIT



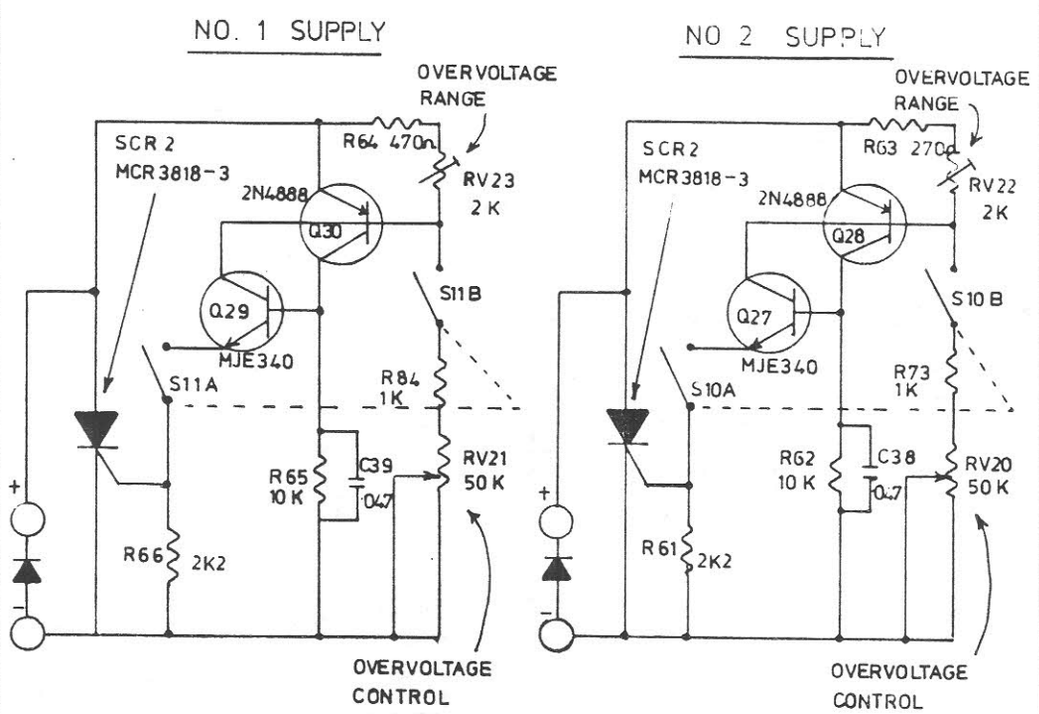
NOTE 3 METERING CIRCUIT



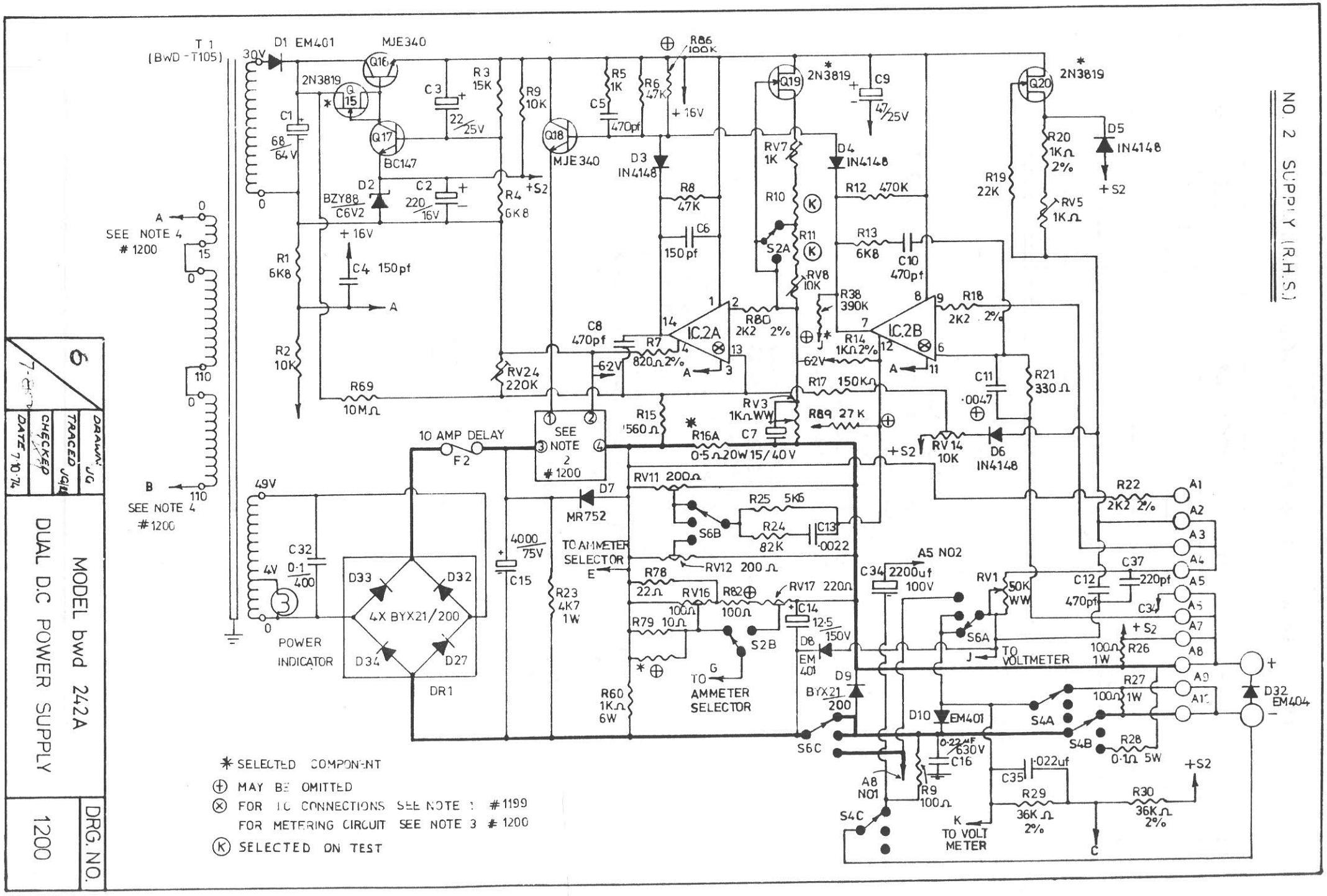
NOTE 4



NOTE 5 CROWBAR OVERLOAD OPTION 08



DRG. NO 1200


MODEL bwd 242A
DUAL D.C POWER SUPPLY
1200
DRG. NO.
DRAWN JG
TRACED JQB
CHECKED
DATE 7-10-74
NO. 2 SUPPLY (R.H.S.)
T 1 (BWD-T105)
D1 EM401
MJE340
Q16
2N3819
Q15
Q17
BC147
Q18
MJE340
Q19
2N3819
Q20
2N3819
30V
49V
4V
SEE NOTE 4 #1200
SEE NOTE 4 #1200
10 AMP DELAY
F2
SEE NOTE 2 #1200
POWER INDICATOR
4X BYX21/200
DR1
D33
D32
D34
D27
TO AMMETER SELECTOR
TO AMMETER SELECTOR
TO VOLTMETER
TO VOLT METER
IC.2A
IC.2B
S2A
S2B
S2C
S4A
S4B
S4C
S6A
S6B
A5 NO2
A8 NO1
D2 BZY88 C6V2
D3 IN4148
D4 IN4148
D5 IN4148
D6 IN4148
D7 MR752
D8 EM 401
D9 BYX21 200
D10 EM401
D32 EM404
C1 68 64V
C2 220 16V
C3 22 25V
C4 150pf
C5 470pf
C6 150pf
C7
C8 470pf
C9 47/25V
C10 470pf
C11 ·0047
C12 470pf
C13 ·0022
C14 12·5 150V
C15 4000 75V
C16 0·22µF 630V
C32 0·1 400
C34 2200uf 100V
C35 ·022uf
C37 220pf
R1 6K8
R2 10K
R3 15K
R4 6K8
R5 1K
R6 47K
R7 820Ω 2%
R8 47K
R9 10K
R10
R11
R12 470K
R13 6K8
R14 1KΩ 2%
R15 560Ω
R16A 0·5Ω 20W 15/40V
R17 150KΩ
R18 2K2 2%
R19 22K
R20 1KΩ 2%
R21 330Ω
R22 2K2 2%
R23 4K7 1W
R24 82K
R25 5K6
R26 100Ω 1W
R27 100Ω 1W
R28 0·1Ω 5W
R29 36KΩ 2%
R30 36KΩ 2%
R38 390K
R69 10MΩ
R78 22Ω
R79 10Ω
R80 2K2 2%
R82
R86 100K
R89 27K
RV1 50K WW
RV3 1KΩ WW
RV5 1KΩ
RV7 1K
RV8 10K
RV11 200Ω
RV12 200Ω
RV14 10K
RV16 100Ω
RV17 220Ω
RV24 220K
+16V
-6·2V
+S2
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
* SELECTED COMPONENT
⊕ MAY BE OMITTED
⊗ FOR IC CONNECTIONS SEE NOTE 1 #1199
FOR METERING CIRCUIT SEE NOTE 3 #1200
Ⓚ SELECTED ON TEST

B.W.D. INSTRUMENTS PTY. LTD.

MANUAL CHANGE INFORMATION FOR MODEL BWD 242A

FROM SERIAL NO.	ISSUE	DATE	FROM SERIAL NO.	ISSUE	DATE
22700	1	15.10.73		6	14.7.80
33950	2	2.5.76			
42327	3	6.4.79			
22700	4	18.7.79			
ALL	5	9.4.80			

Issue	Page	Sect.	Cct.	AMENDMENT
1	1	A	1200	Add R9 10KΩ ½ Watt 50% cc
1	2	A	1199	Add R93 10KΩ ½ Watt 50% cc
2	2	2		Ripple at full load Series only 4mV p-p or 300μV rms
3	1	A	1200	R17 220KΩ changed to 150KΩ
3	2	A	1199	R47 220KΩ changed to 150KΩ
4	3	2		Para 2.4(i) 1.3kΩ was 680Ω
4	4	3		'Crowbar Overload' - subheading '(Option 08 only)' removed
4	9	4		Para 4.5 1.3kΩ was 680Ω
4	36	4		Para 4.25 680Ω was 340Ω
4	46	6		Para 6.18 '(Crowbar overload normally fitted)' added
4	48	9		Para 9.5 (Normally fitted as standard) added to heading
4	5	A	1199	RV2 25k W.W. changed to 50k W.W.
4	5	A	1200	RV1 25k W.W. changed to 50k W.W.
5	-	-	1199	S2A-B. Position shown should be 2A.
5	-	-	1199	S3A-B. Position shown should be 2A.
6			1199/ 1200	R10-11-40-41 NOW SELECTED ON TEST.
6			1199/ 1200	R85 & R86 added
6			1199/ 1200	C16/C32 WERE 0.1μF
7	3	A	1199/ 1200	C40 & C41 added to output. C42 & C43 may be fitted.

F75A/648/mb