SOLARTRON

POWER SUPPLIES AS 1410.2 SERIES DATA SHEET

1964

AS 1410.2 UNIT.

- Automatic Constant Voltage/Constant Current Operation
- 1% Digital Voltage Setting Plus Smooth Control
- Stability Ratio 10,000:1
- 2 Microsecond Transient Loading Response
- Ripple and Noise Less than 200μV rms
- Full remote Programme Facilities
- Temperature Coefficient <0.01% per °C
- 1 milliohm Output Resistance
- Optimised Current Meter Ranging
- Multipile Unit Assembly with Slave Operation
- Modulation facilities

Power Supplies AS 1410.2 Series

The conventional Laboratory Power Supply provides merely a variable voltage source of low impedance, regulated against mains and load changes and incorporating some form of overload protection.

The AS1410.2 series introduces novel operational techniques combined with superior overall specification, thus creating an entirely new class of power unit far in advance of the conventional type.

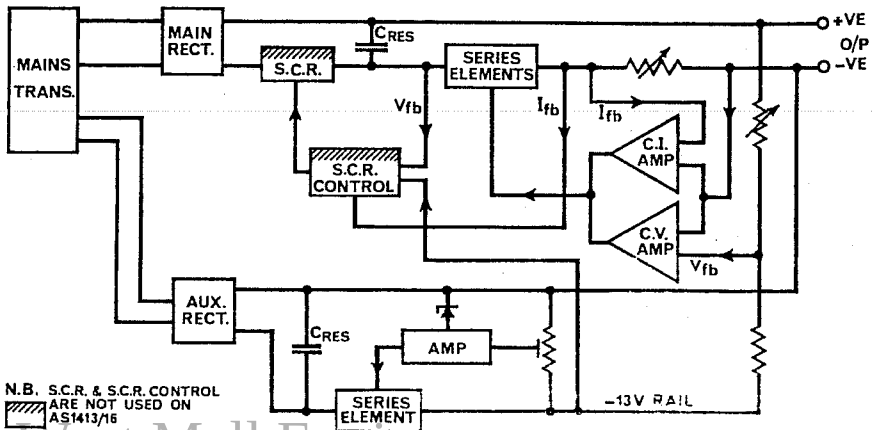
For example, the design allows continuous operation in either Constant Voltage or Constant Current output mode. Fast automatic transition from one characteristic to the other may be preset at any point in the current and voltage ranges to give perfect overload protection. A multi-range current meter, whose sensitivity is automatically controlled by the current setting selectors, provides accurate monitoring even at low levels.

Output voltage is determined either by fingertip digital controls or remote electrical command, with a performance approaching that of calibration standards. Yet these units are rugged and almost indestructible in use and can withstand rigorous temperature and vibration environment.

Circuit Principles

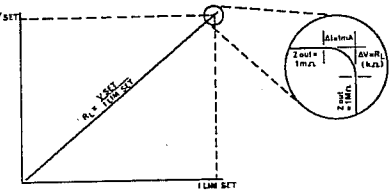
In operation the secondary series element, a silicon controlled rectifier (S.C.R.) maintains a constant voltage drop across the combination of series transistors and current sensing resistors. The S.C.R. is controlled by a mains synchronised blocking oscillator triggered by the feedback signal from the secondary control amplifier. This amplifier senses both the load current and the voltage developed across the primary series element comparing their composite signal with a reference voltage to produce the feedback signal. This secondary control regulates the reservoir capacitor charge despite variations in load current and mains input voltage. The primary series control element is driven in the constant voltage mode by a voltage sensing amplifier, or by a current sensing amplifier in the constant current mode. In the higher powered units an additional series control element is interposed between the reservoir capacitor and the primary control, and acts to absorb transient power surges produced by short circuiting the output.

The operational mode adopted by the unit is determined automatically by the resistance R_L of the applied load, the output voltage setting V_O, and the output current limit I_M. The transition from one mode to the other occurs at a critical load resistance value equal to: $\frac{V_O}{I_M}$



Automatic Constant Voltage/ Constant Current Mode

The correct operating mode for a given combination of voltage and current settings is provided automatically, as load conditions vary, by carefully balanced control circuits. These are dual amplifiers responding to voltage feedback and current feedback respectively. At the changeover from constant voltage to constant current, the current increase is less than 1mA while the voltage change is equal to the product of the current change and the load resistance, i.e. 1mAxERL. In a typical case, for example, with settings of 40V and 2A and at changeover from constant voltage to constant current, that is when RL equals 20, the voltage decreases by only 20mV. These are the transfer conditions for an impedance change from 1 milliohm in the constant voltage mode to the order of 1 megohm in the constant current mode.



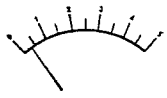
Constant Voltage/Constant Current Remote Indication

The relay selecting the internal mode indication lamps is provided with an additional set of changeover contacts rated for 230V and 1A. These isolated contacts are brought out to a terminal strip on the rear panel, and may be used to provide remote visual or audible alarm indication. Alternatively the addition of a simple relay circuit will provide automatic 'lock out' facilities.

Optimised Meter Ranging

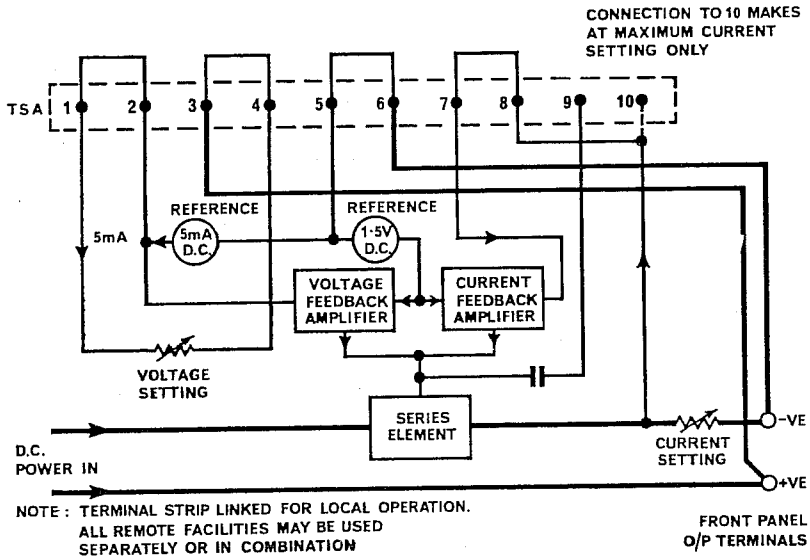
Good resolution and accuracy of load current indication is achieved by simultaneously varying the meter sensitivity with the current limit selected. Thus full-scale deflection represents 100.% of the selected limit current and the actual load current is shown as a percentage of this value. This technique ensures that open scale readings can be obtained even when drawing milliamps from 5 amp supply.

Optimised meter ranging allows 300mA drawn from a 5 amp supply to be accurately monitored. (AS 1412.2 meter can be read 500mA full scale i.e. 50mA per division).



Conventional single range meter provides inadequate deflection on low loads e.g. 300mA.

Remote Programming



Fully comprehensive programming facilities allow remote manual or automatic control in accordance with pre-selected requirements (including automatic protection) to be arranged using standard models.

Remote Current Programming may be effected by applying a voltage source of 0—1.5 volts to the current modulation terminals 7 and 8. When remote current programming by voltage is not required terminals 7 and 8 are strapped.

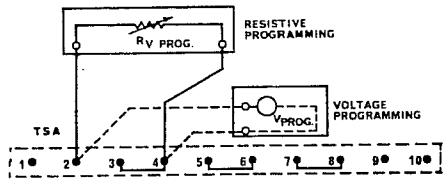
Current programming can also be effected by the insertion of an external resistor between terminals 5 and 6 (in series with the selected internal current setting resistor). The value of the total resistance,

$$R_{Itot.} = \frac{3}{2\ Iprog.}$$ ohms, Iprog. being

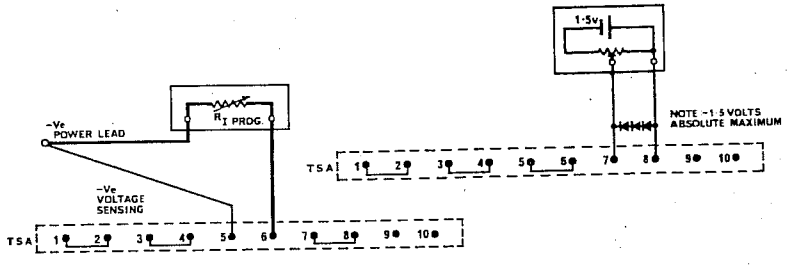
the programmed current.

It should be noted that the resistance of the leads connecting the programming resistor will appear in $R_{Itot.}$ as well as the internal current limiting resistor selected by the front panel switch.

Remote Voltage Programming may be obtained by disconnecting the internal voltage setting resistor chain and substituting either a potential Vprog. where Vprog. is



the required output voltage or an external resistor RVprog. equal in value to (200 Vprog.) ohms. When remote voltage programming is not required terminals 1 and 2 are strapped.



Voltage and Current Ranges:

Type No.	Voltage Range	Current Range
AS 1410·2	0—30	0—1A
AS 1411·2	0—40V	0—2A
AS 1412·2	0—40V	0—5A
AS 1413·2	0—40V	0—0.5A
AS 1414.2	0—60V	0—1A
AS 1416.2	2×0—30V	2×0—0.3A

Note: AS1416 is a double unit and the specification refers to either section.

Voltage Selection: Three decade setting of voltage in 10V, 1V and 0.1V steps.

Calibration accuracy ± 1% (typically 0.25%). All units (except AS1416) have an additional 0.1V continuous coverage at any point of the range.

Current Selection: All models provide switched selection of current.

AS1410, 1411, 1412, 1414.

Main Selector: Ten steps of 10% of maximum output current.

Fine Selector Ten steps of 1% of maximum output current.

These controls give a combined upper limit of 110%.

AS1413: Ten settings: 10, 20, 40, 60, 80, 100, 200, 300, 400 and 500mA.
AS1416: Ten settings: 10, 15, 20, 30, 45, 60, 100, 150, 200 and 300mA.

Setting Resolution: Calibration accuracy ± 1% (typically 0.25%) or 1mA. 1.5mV on volts except AS1416 .2

Calibration Accuracy:

10mV/V (typically 2.5mV/V)
10mA/A (typically 2.5mA/A).

Temperature Coefficient:

100μV/V/°C } i.e.0.01% per °C.
100μA/A/°C }

Long Term Stability:

0.5mV/V/1000 hrs } i.e. 0.05% in
0.5mA/A/1000 hrs } 1000 hrs

Ambient Temperature Range: 0°C—50°C.

These units are designed to give extremely long life and stability of parameters over this ambient range. If required, units will operate at higher temperatures with some reduction of total life.

Remote Facilities:

(a) Voltage sensing
(b) Voltage programming
(c) Current programming
(d) Mode indication and/or alarm.

Isolation: Outputs are isolated and can be floated at potentials up to 600V from chassis.

Master/Slave Facilities: Several units can be connected for series and/or parallel operation subject to isolation limitations.

Power Requirements: 100-125V/200-250V
44-66c/s.
Input VA is approximately equal to regulated watts times three.

Maximum Mains Deviation from Nominal: ± 10%.

Constant Current Mode:

Ripple and Noise: 500μA rms.

Stability Ratio (Improvement Factor):

10,000:1 (percentage change of mains supply against percentage change of power supply unit output).

10% change in mains gives 0.001% change in output.

Output Resistance:

Of the order of 500K Ω or better.

Constant Voltage Mode:

Ripple and Noise: Less than 200μV rms

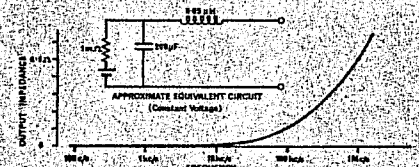
Stability Ratio (Improvement Factor):

10,000:1 (percentage change of mains supply against percentage change of power supply unit output).

Load Regulation: 0.005% at maximum voltage output for 80% current change of unit's maximum.

Output Impedance (Magnitude):

100kc/s — 100 milliohm
1 Mc/s — 500 milliohm
This corresponds to the impedance characteristic of a few inches of appropriate output connecting lead.



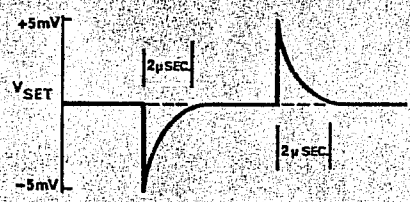
Pulse Loading Characteristics:

Transient Recovery Time: 2μs for recovery to within DC regulation limits. This figure is maintained even for full load changes in either direction.

Voltage Transient Amplitude: The maximum voltage deviation produced by any pulse loading condition will not exceed the value as given by the product of the current change and the appropriate AC impedance.

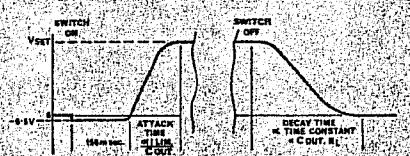
The actual value, V_T may be calculated from $V_T = L.\frac{di}{dt}$ where L is the effective series inductance of the power supply (as specified) and $\frac{di}{dt}$ being determined by the load.

For example, a 0.1 amp load current in the form of a 100kc/s square-wave with 1μsec edges, would cause a disturbance of only 5mV as shown.



Switching Characteristics:

Main Supply: The diagram below shows the complete absence of overshoot and the insignificant undershoot which occurs when the mains supply is switched.

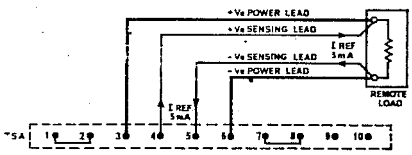


Voltage Controls: Similar 'attack' and 'decay' times occur when a voltage change is commanded, either by manual re-adjustment of the controls or by remote programming. The 150mS delay naturally does not occur in these circumstances.

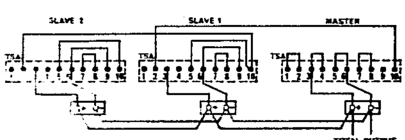
POWER SUPPLIES
AS 1410.2 SERIES
DATA SHEET

SOLARTRON

Remote Voltage Sensing: This facility is provided to overcome the effect of resistance in the connecting leads. It may compensate for a voltage drop of up to 500mV. In the event of the feedback leads accidentally becoming open circuit, the output is cut-off automatically. When remote sensing is not required, terminal pairs 3/4, and 5/6 are strapped.



Parallel Operation: Any number of units, irrespective of type, can be connected in parallel to provide increased current capacity. The control amplifier of the unit chosen for the master is fully operative. Those of the slave units control their series elements to share the load in the ratios of the appropriate current limit selectors.
N.B. The voltage of the group cannot exceed the capability of the lowest rated unit.



Output Modulation: The output voltage will follow a voltage applied to the remote programming terminals 2 and 4, and similarly the available output current will follow a signal voltage on 7 and 8. As an approximation, the maximum value product of the amplitude and frequency may be taken as 1000 volt cycles per second. The upper frequency limit is of the order of 300c/s for small signal amplitudes and 10c/s for large amplitudes. Thus input signals with frequency components in excess of the indicated figures will not be faithfully reproduced.
Applications using this facility would be with servo-mechanisms, for instance, where it is required to operate high power devices from a low power signal source, and the output must be accurately related to input.

Dimensions & Weight

AS	Max. Output	Dimensions	Weight
1410.2	30V @ 1A	A	12 lb (5·4kg)
1410.2T	2x (30V @ 1A)	C	24 lb (10·8kg)
1411.2	40V @ 2A	B	17.5 lb (7·9kg
1411.2T	2x (40V @ 2A)	D	35 lb (15·8kg)
1412.2	40V @ 5A	C	32 lb (14·5kg)
1413.2	40V @ 0.5A	A	12 lb (5·4kg)
1413.2T	2x (40V @ 0.5A)	C	24 lb (10·8kg)
1414.2	60V @ 1A	B	17.5 lb (7·9kg)
1414.2T	2x (60V @ 1A)	D	35 lb (15·8kg)
1416.2	2x (30V @ 0.3A)	B	14.5 lb (6·6kg)
1416.2T	4x (30V @ 0.3A)	D	29 lb (13·2kg)

	A	B	C	D
Width:	4.25 in (10·8 cm)	5·6 in (14·2 cm)	8·5 in (21·6 cm)	11·2 in (28·4 cm)
Height:	7 in (17·8 cm)	7 in (17·8 cm)	7 in (17·8 cm)	7 in (17·8 cm)
Depth:	14·5 in (36.8 cm)	14·5 in (36·8 cm)	14·5 in (36·8 cm)	14·5 in (36·8 cm)

SEMICONDUCTOR TYPES

	AS 1410.2	AS 1411.2	AS 1412.2	AS 1413.2	AS 1414.2	AS 1416.2
Diodes						
Texas Insts. 1S020	*			*	*	*
Texas Insts. 1S921	*	*	*	*	*	*
Texas Insts. 1N914	*	*	*		*	
R.C.A. 40110		*	*			
Plessey 40AS				*		*
Mullard OAZ243	*	*	*	*	*	*
Motorola 1N935	*	*	*	*	*	*
Bridges						
Texas Insts. 1B40K20	*					
Texas Insts. 1B40K40				*	*	
S.C.Rs.						
S.T. & C. CRS25/10	*	*	*			
S.T. & C. CRS25/20				*	*	
Transistors						
Texas Insts. 2S301	*	*	*	*	*	*
Motorola 2N3055	*	*	*	*		*
R.C.A. 2N3053	*	*	*	*	*	*
Plessey SA56	*	*	*	*	*	*
Si.Trans.Corp. 2N3233					*	
S.T.&C. BSY95	*	*	*	*	*	*
Motorola 2N3251	*	*	*	*	*	*
Motorola 2N3447			*			
Motorola MM1614			*			
Fairchild U3323/1				*	*	*

Standard Rack Nests (Height 8¾ in (22.3 cm) are available to rack mount up to four 4.25 in width units, three 5.6 in width units or two 8.5 in width units.
Note: These units are natural convection cooled and it is necessary to ensure adequate ventilation to restrict the ambient temperature in their immediate vicinity to less than the stated maximum.

SEG
THE SOLARTRON ELECTRONIC GROUP LTD
FARNBOROUGH · HAMPSHIRE · ENGLAND
TELEPHONE: 44433. CABLES: SOLARTRON, FARNBOROUGH; HANTS. TELEX: 85245 SOLARTRON FNBRO