OLTRONIX

OLTRONIX-ELECTRONICS: Regulated Power Supplies - Digital Voltmeters - Oscillators

OPERATING AND SERVICE MANUAL

LABPAC

B 8 - 7

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SECTION 1

GENERAL DESCRIPTION

A. GENERAL

Oltronix LABPAC B8-7 is a low voltage, regulated DC power supply.
The model number B8-7 is a code for the performance of the power supply.
The first letter "B" indicates the approximate stability for ± 10% line voltage change, which is 0,01 - 0,03%.
The figures in the model number state the maximum output voltage, that is 8V, at which a max. constant output current of 7A can be maintained.

B. FEATURES

LABPAC B8-7 is equipped with volt- and ammeter for simultaneous reading of output voltage and current.
LABPAC B8-7 has a calibrated, adjustable current limit control for protecting the load and the power supply from excessive current.
It also incorporates an adjustable calibrated overvoltage protection circuit, which short-circuits the output voltage within 10 usec.
Further facilities are: resistance programming, constant current programming, constant current with external shunt and remote sensing.
Resistance programming and constant current programming give the possibility to control the output voltage by an external resistor.
The remote sensing circuit allows the power supply to regulate the voltage across the load instead of at the output terminals. This compensates voltage drops in long cables to the load.
The terminals for operating the power supply are available from the binding posts on the front panel as well.
If higher voltage or current is desired, two or more units can be connected in series or parallel. Then remote sensing and programming is still possible.

C. INCOMING INSPECTION

a. Mechanical check

When the power supply is received, verify that the package contents are complete and as ordered. Inspect the instrument for any physical damage; such as a scratched panel surface, broken knobs or connectors etc. incurred in shipping. Visually check inside the instrument for loose or damaged components. To facilitate possible reshipment, keep the original packing. If damage is found, file a claim with the responsible carrier or insurance company and refer to the warranty, last page in this manual.

b. Performance check

The power supply may be checked for electrical operation within the specifications of section 2 by following the alignment procedures of section 5. If the instrument does not operate as specified, refer to the warranty page of this manual.

SECTION 2

SPECIFICATIONS

Model	DC output			Stability 10 % line voltage change %	Stability 100 % load change mV	Noise mV RMS	Recovery time (0—100 % load) μsec	Environ-mental tempera-ture range °C	Dimensions height x width x depth mm	Weight kg
	Voltage range	Amperes								
		Short circuit current	Max current							
B8-7	0—8	4.0	7.0	0.005	5	0.3	40	0—40 (0—55 for 5 A)	160x99x315	6.1

Input: 220 VAC ± 10%, 50 - 60 Hz.
Temperature coefficient is typically less than ± 50 ppm/°C.
Long term stability is ± 0.02% for 8 hours.
Storage temperature range for the supply is -40°C to +70°C.
The output is totally floating: positive or negative may be grounded.
Output voltage is adjustable from zero.
Programming constant is 300 ohms/V.

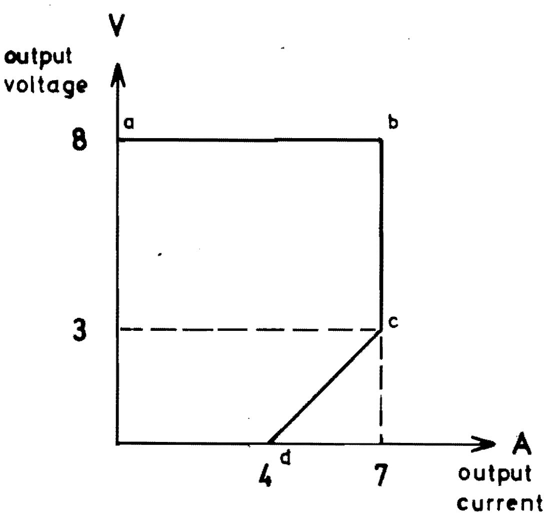


Figure 1. Voltage current characteristic.

LABPAC B8-7 can deliver any current and voltage within the area limited by the curve a - b - c - d. Maximum output current is limited by the factory preset "fold back" current limit c - d.
When increasing the load from a low value, the output voltage remains constant, until the current limit curve is reached. The output voltage and current are factory preset to 10% above the specified value.
Important to note is that maximum available current is decreasing with decreasing output voltage.

SECTION 3

OPERATION

A. GENERAL

Presentation

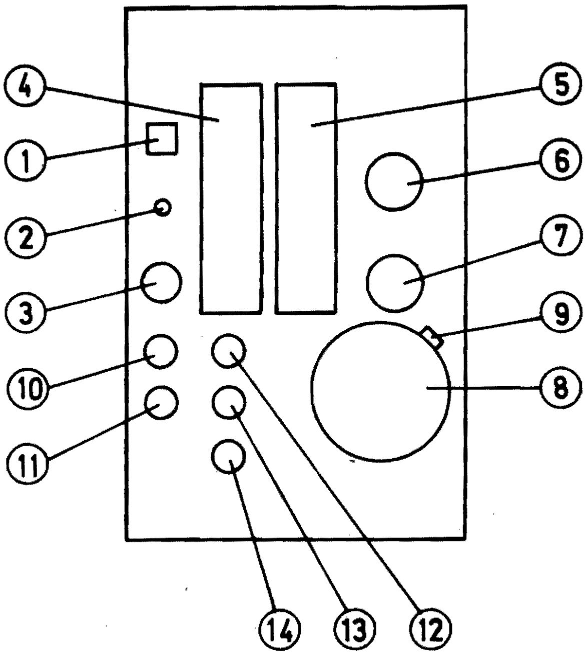


Figure 2.

Front side of LABPAC B8-7

1. AC pilot lamp
2. Line switch, AC only
3. AC fuse
4. Output DC voltmeter
5. Output DC ammeter
6. Voltage limit control
7. Current limit control
8. Output voltage control
9. Voltage control lock
10. " -Sense" terminal
11. DC power "-" terminal
12. " +Sense" terminal
13. DC power "+" terminal
14. Power supply ground terminal

Line

Unless otherwise specified, this model is wired for 220 VAC ± 10%, 50 - 60 Hz operation.

Fuses

The line fuse is mounted on the front panel of the power supply. Use slow blow type.
The OVP fuse is located under the top cover plate, and is accessible by unscrewing this cover plate and pulling it backward.

Power

The power supply is switched on with the toggle switch (pos. 2) and the pilot lamp is lit.

Voltage

The desired voltage is set with the output voltage control (pos. 8). The voltage control can be locked by turning the knob on the voltage control dial clockwise. (pos. 9). Read the output voltage from the voltmeter (pos. 4).

Voltage limit

Set the "Voltage limit" (pos. 6) to maximum and the voltage control to the desired trip over voltage for the "Voltage limit". Turn the "Voltage limit" slowly CCW until the output voltage suddenly disappears.
WARNING: If the power supply is connected to an external power source, e.g. for charging a battery, the VOLTAGE LIMIT MUST NOT BE USED.
The "Voltage limit" is switched off by turning the knob fully clockwise.

Current limit

Set "Current limit" control at a value well above the expected peak current, but below the value which could damage the load. Read output current from the ammeter (pos. 5). The characteristic of the current limit is shown in figure 1.
The current limit function is the following:
If the load is increased above the value giving maximum output current (knee current), the current will decrease. This means that if the power supply is adjusted for 8V, it maintains a constant voltage as long as the output current is less than 7A. If the load resistance decreases from its value down to zero ohms, the output voltage decreases naturally to zero and the output current decreases to 4A.

Meters

The left-hand panel meter (pos. 4) indicates the output voltage. The right-hand meter (pos. 5) indicates the output current.

B. NORMAL OPERATION

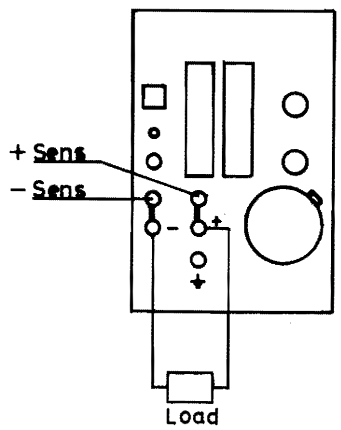


Figure 3.

The output may be positive, negative or floating, depending on how the jumper is connected, i.e. respectively between ground and "-", between ground and "+", or removed.
The maximum voltage to ground is limited to 500V.
WARNING: It is important that the load is connected to the terminals marked "-" and "+". Using the "sense" terminals for current output may damage the instruments This applies for all LABPAC B8-7 applications.

C. REMOTE SENSING

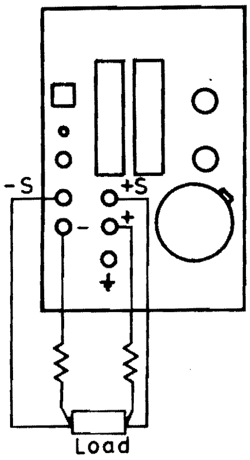


Figure 4.

This circuit permits sensing the voltage at the load terminals instead of at the power supply terminals. Thus regulation loss caused by IR drops in the load leads is compensated for.
The influence from the resistance in the "sense" leads is negligible as a low (a few mA) and almost constant current flows through them. If possible, connect cable with lowest expected voltage drop to "+".

When using the remote sensing circuit, the following limitations should be taken into account:

1. The voltage drop in the "+" cable should not exceed 0,5V.
2. The maximum voltage at the instrument terminals should not exceed the maximum rating of the power supply. This means that the maximum available voltage at the load is the maximum power supply voltage minus the voltage drop in the power cables.
3. The power supply voltmeter indicates the voltage at the instrument terminals (not the voltage at the load).

D. RESISTANCE PROGRAMMING

When the "Resistance programming" mode is used, the output voltage is controlled by an external resistor. The connection procedure is as follows:

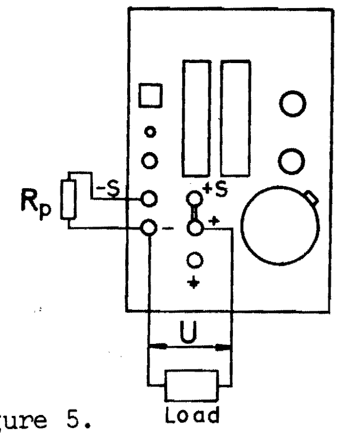


Figure 5.

1. Switch off the power.
2. Set voltage control at zero.
3. Connect load and programming resistor Rp according to figure 5.
4. Now the output voltage is controlled by Rp.
   The relation between Rp and output voltage (U) is:

   U = Kp . Rp (Rp in ohms)

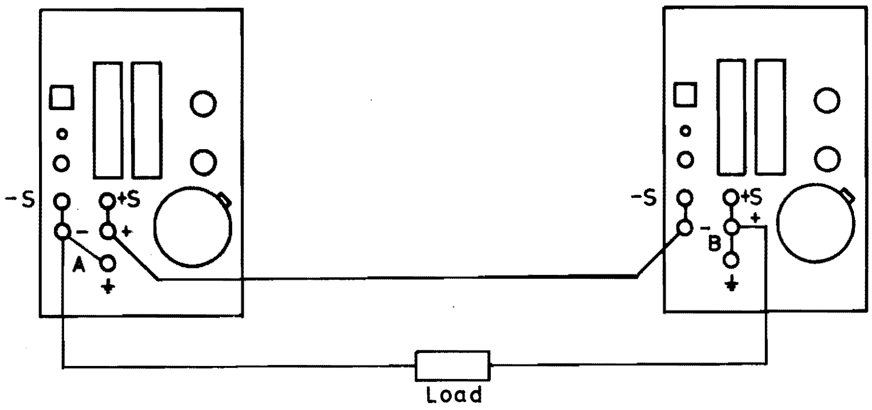
where: Kp = 3,35. (programming constant 300 ohms / V)

Note 1: Maximum specified output voltage of 8V should not be exceeded in the "Resistance programming" mode. Therefore max. Rp is 2,38 kOhms.

Note 2: If the programming terminals (that is "-" and "+" sense) are left open, the power supply will deliver an unregulated output voltage, which is considerably higher than the specified maximum output voltage.

E. SERIAL OPERATION

If higher output voltage is desired, two or more units can be connected in series, provided the maximum voltage to ground does not exceed 500V. The output may be positive, negative or floating, depending on how jumpers A and B (figure 6) are connected. Jumper A to ground gives positive output; jumper B to ground gives negative output. Jumpers between "-" and "-sense" respectively "+" and "+sense" are applied at each power supply any time.



Set current limit on all units well above the expected peak output current, but below the value that can damage the load.

Figure 6.

F. SERIAL OPERATION, REMOTE SENSING

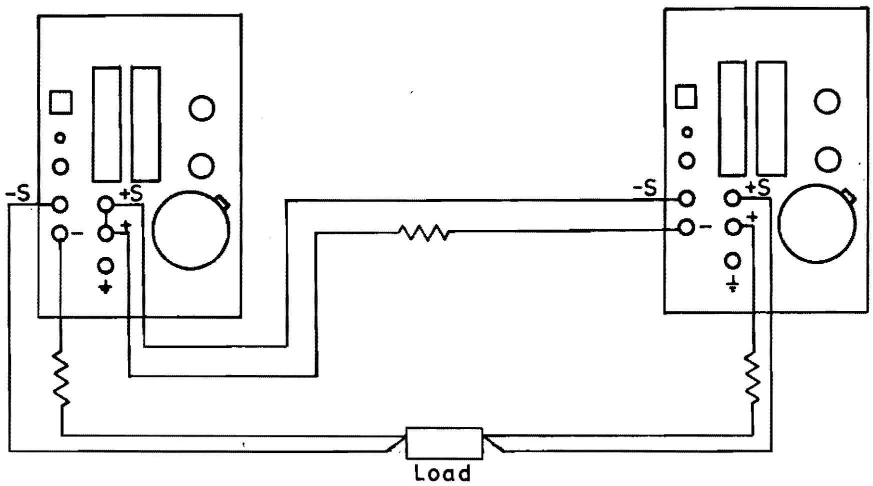


Figure 7.

Connect power supplies according to figure 7.
If one power cable is short so that only a small voltage drop is expected in it, the sensing circuit for this cable can be omitted. Then connect this "sense" terminal by means of a jumper with the same polarity output terminal on the power supply in question.

G. SERIAL OPERATION, PROGRAMMING

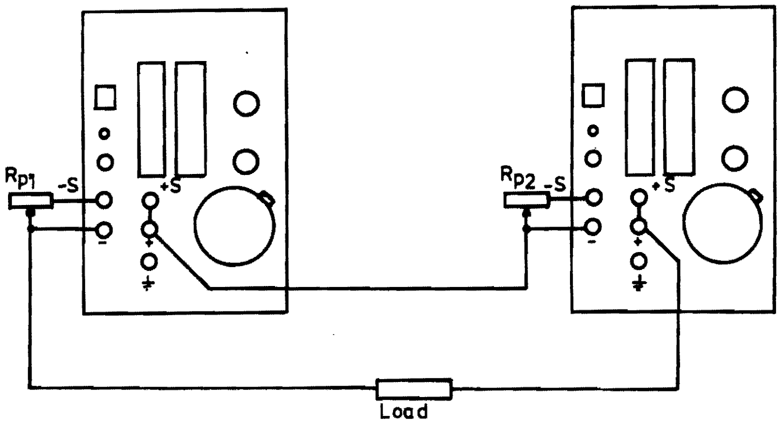


Figure 8.

The output voltage is controlled by the resistors Rp1 and Rp2. The relation between Rp1 and Rp2 and output voltage U is:

$$U = Kp\ (Rp_1 + Rp_2)$$

where: Kp = 3,35 (see section 3D).

If the voltage variation range wanted is less than the control range of one of the power supplies, one Rp can be omitted and the corresponding power supply is arranged for serial operation in the usual way. Also refer to "Resistance programming", section 3D and "Serial operation", section 3E.

H. PARALLEL OPERATION

If higher output current is required, two or more units can be connected in parallel.

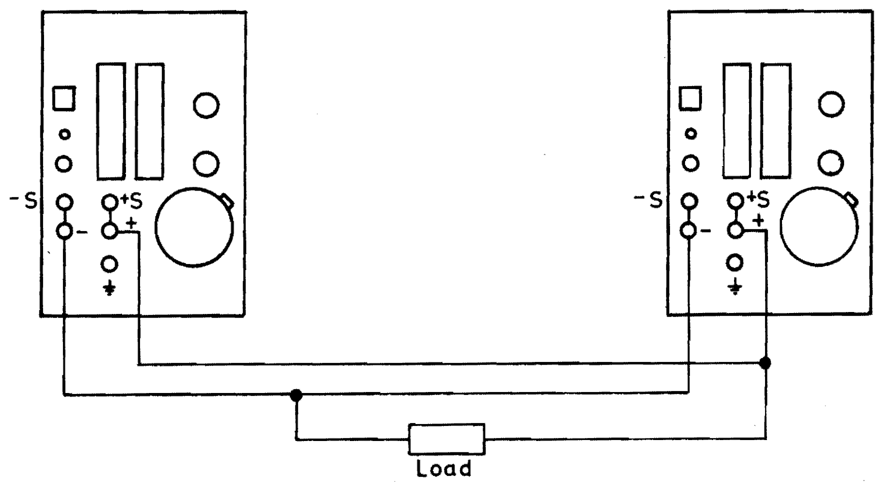


Figure 9.

Adjustment

1. Jumpers are connected between "+sense" and "+", respectively "-sense" and "-" on each unit.
2. Set all voltage controls at desired voltage.
3. Set all current limit controls to approximately the same percentage of maximum and so, that the sum of them is the desired current limit.
4. Switch off the "Voltage limit" by turning fully CW.

As there will likely be a small difference between the adjusted voltages the power supplies are adjusted to, the following will happen: as long as the load current is less than the capability of the power supply adjusted to the highest output voltage, this unit will carry the whole load current. When the current limit of this power supply is reached, the next highest adjusted power supply takes over the part of the load current, which power supply no. 1 cannot carry. When switching from power supply no 1. to no 2. the output voltage will drop by an amount corresponding to the voltage difference between the settings of these two power supplies. The same thing happens when the third, fourth and so on power supply takes over. Thus a slightly stepwise output voltage will result from any difference between the output voltages of the parallel connected power supplies. It is thus necessary to adjust the power supplies sufficiently accurate so that the incremental voltage steps become negligible.

I. CONSTANT CURRENT WITH EXTERNAL SHUNT

When using the power supply as a constant current source, an external shunt resistor is required, across which a voltage proportional to the output current is produced.
The instrument senses the voltage across this resistor and regulates the output voltage so that the voltage across the shunt is constant.
The relative current stability achieved with this method is in the same order as the relative voltage stability in the voltage stabilizing mode, measured at an output voltage equal to the voltage across the shunt. In this case it is necessary that the shunt resistance is a high stability, low temperature coefficient type, as the stability of the constant current is directly affected by the stability of the shunt resistance.
Choose the resistance of the shunt so that it takes 10% of the maximum output voltage. If it takes too great part of the available output voltage, it can be reduced to 5% with little sacrifice in performance.

Operation procedure

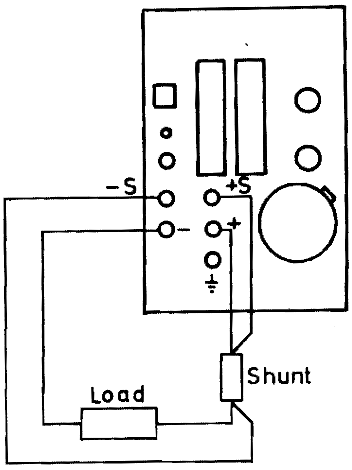


Figure 10

1. Connect shunt resistor according to figure 10. Resistor MUST be in "+" output cable.
2. Set the voltage control to zero.
3. Switch on and set the current with the voltage control.

The resolution with the current adjustment is sometimes not high enough, as just a small part of the voltage control adjustment range will give full current. In such a case constant current programming (section 3J) is recommended.

J. CONSTANT CURRENT PROGRAMMING

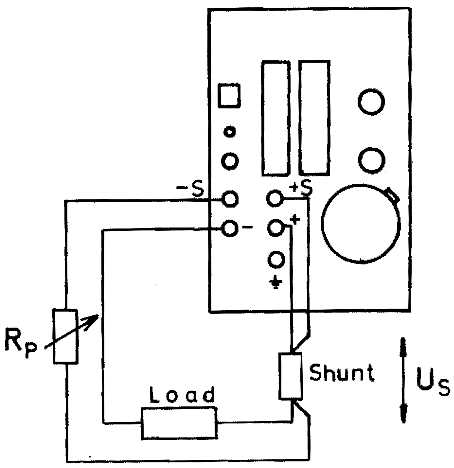


Figure 11

Choose the value of Rp (in kOhms) according to:

$Rp = \frac{Us}{Kp}$ Kp = 3,35 (Section 3D)

where U_s is the maximum expected voltage across the shunt. The adjustment procedure is as above, but set the constant current with Rp.

The current limit protects the instrument against overload also in constant current operation. The maximum output voltage that the constant current circuit can supply is considerably higher thanthe maximum specified voltage for LABPAC B8-7 for certain combinations of line voltage and load current.

The panel meters will show the output current and the voltage across the load and the shunt.

SECTION 4

CIRCUIT DESCRIPTION

A. GENERAL

This section describes the electrical operation of the circuit. First the principal operation is described by means of a block diagram. A detailed description of the blocks follows. Also refer to the complete diagram, section 7 in this manual.

B. BLOCK DIAGRAM

The complete block diagram of the power supply is shown in figure 12.

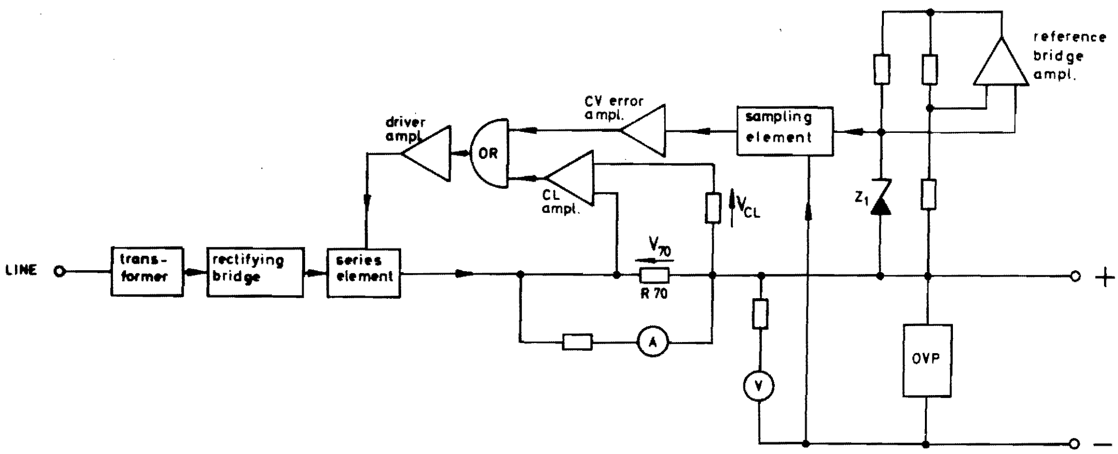


Figure 12. Block diagram

The line delivers power to transformer, where it is transformed to a suitable voltage. In the block "Rectifying bridge" the voltage from the transformer is rectified. The "Sampling element" is designed so, that the input voltage to the "CV error amplifier" is zero if the output voltage is correct. If for example the output voltage is lower, the error is amplified in the "CV error amplifier", the "OR-gate" and the "Driver amplifier". The phase angle of this chain is such that the "Series element" is controlled to decrease the voltage across itself. As this happens, the output voltage returns to its correct value.
To make sure that the output current will never be excessive, the instrument is equipped with a current limit system. The output current is monitored through the resistor R70. (see also circuit diagram, section 6)
When the voltage across R70 is higher than the voltage at the wiper arm of P93, the "CL amplifier" comes in through the "OR-gate" and the "Driver amplifier" and controls the "Series element" in such a way that the voltage across R70 does not exceed a predetermined value.
The "Reference bridge" together with the "Reference bridge amplifier" supplies an extremely constant reference voltage across Z1. This circuit also supplies voltages for the other amplifiers in the instrument. The CV-CL indicator" monitors in the "OR-gates" if the "CV error amplifier" is controlling output voltage or current.

If the "CV error amplifier" controls the output it implies that the power supply is under constant voltage operating condition and the "CV-CL indicator" lights the CV lamp. Under the other condition the CL lamp is lit. The OVP circuit senses the 6V output voltage with respect to an internal reference. If this output is above the value, the OVP is set for, it is switched on and the output is shortcircuited. This is made to protect the load in case the panel voltage control is accidentally set to a too high value.

The "Sampling element" consisting of the voltage divider R1 + P1 and P90 is designed so that the voltage over R1 + P1 becomes exactly identical to the reference voltage if the output voltage has the correct value. This implies that the voltage between the input of the "CV error amplifier" T1 + T2 is zero. Should the output voltage e.g. decrease, a positive voltage is applied at the input of the "CV error amplifier". This increases the base current of the series regulator through the "OR-gate" and "Driver amplifier", resulting in a lower voltage drop over "Series regulator" and the output voltage returns to the correct value.

The "Driver amplifier" increases the voltage and current gain to a sufficient level to control the "Series regulator". T1 + T2 is a temperature compensated pair and hence should be matched.
P1 is the programming constant (K_p) adjustment.
P90 is the output voltage control.
Referring to the circuit diagram (section 6), D1, D2 and R2 form a protection circuit for the "CV error amplifier".
C91 is an AC feedback, reducing ripple and noise.
T6 together with T7 form the "OR-gate" where T7 is the CV input. Under CV conditions the CC input of the "OR-gate" is not active as the base of T6 is reversed biased.

C. RECTIFYING CIRCUIT

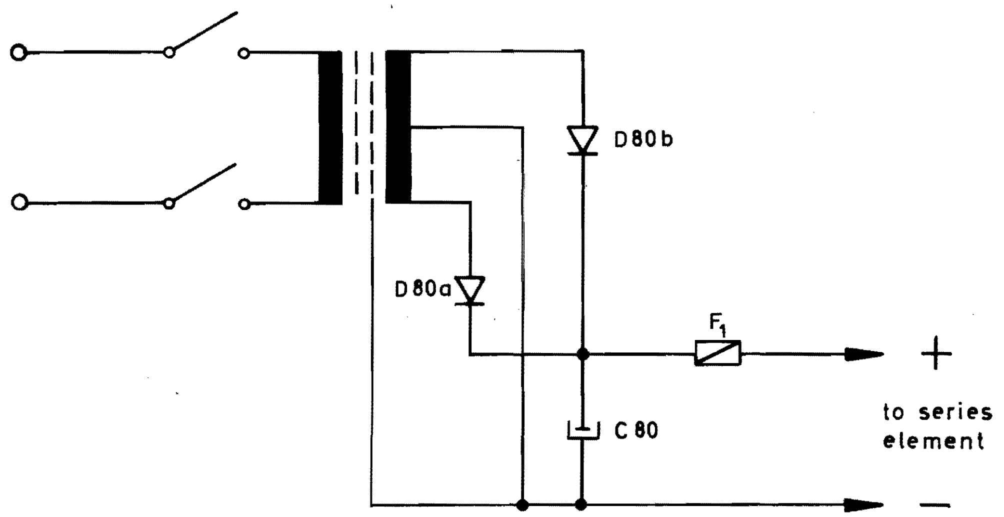


Figure 13.

The rectifying circuit supplies a rectified voltage to the series regulator.

D. REFERENCE CIRCUIT

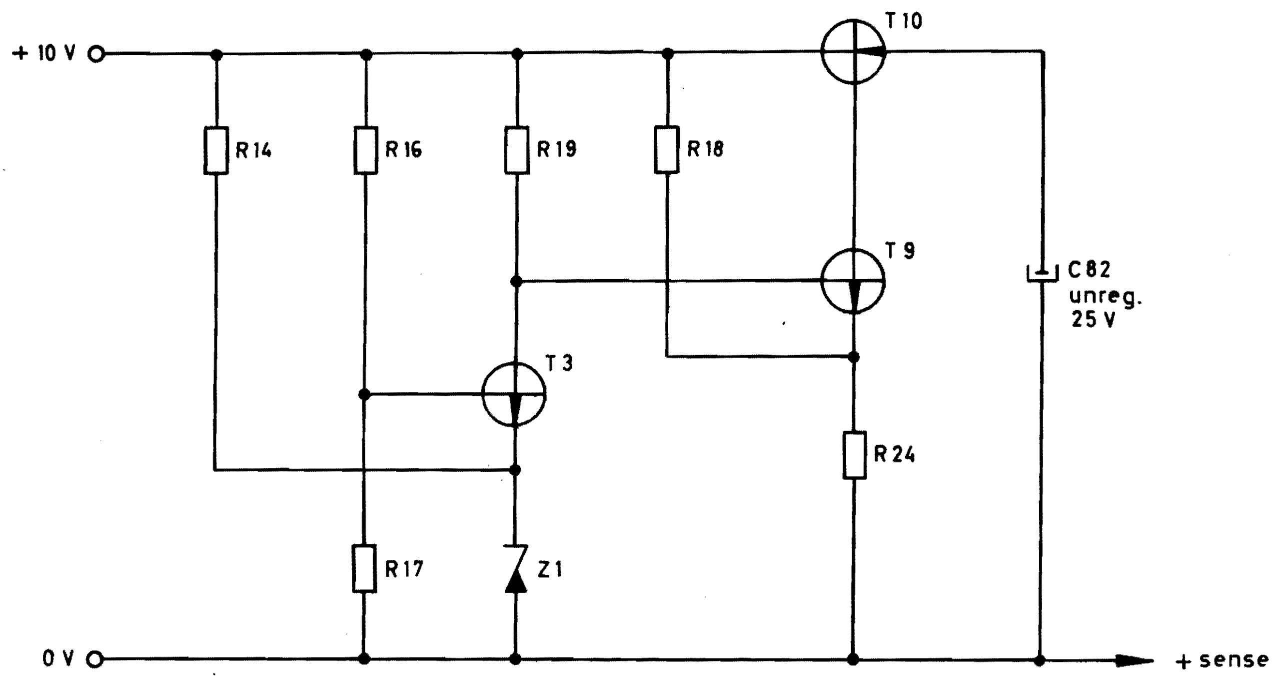


Figure 14. Stabilizer for reference and internal supply voltages

Z1 is a temperature compensated zener diode, which supplies a highly stable reference voltage for the instrument. The "Reference bridge" is stabilized by the "Reference bridge amplifier". This serves two purposes:

1. To supply a stable current to the reference zener diode Z1.

2. To supply a stable voltage (+10V) to other amplifiers.

The "Reference bridge amplifier" consists of a temperature compensated input stage T3, a driver stage T9 and an output stage T10.

E. VOLTAGE STABILIZING

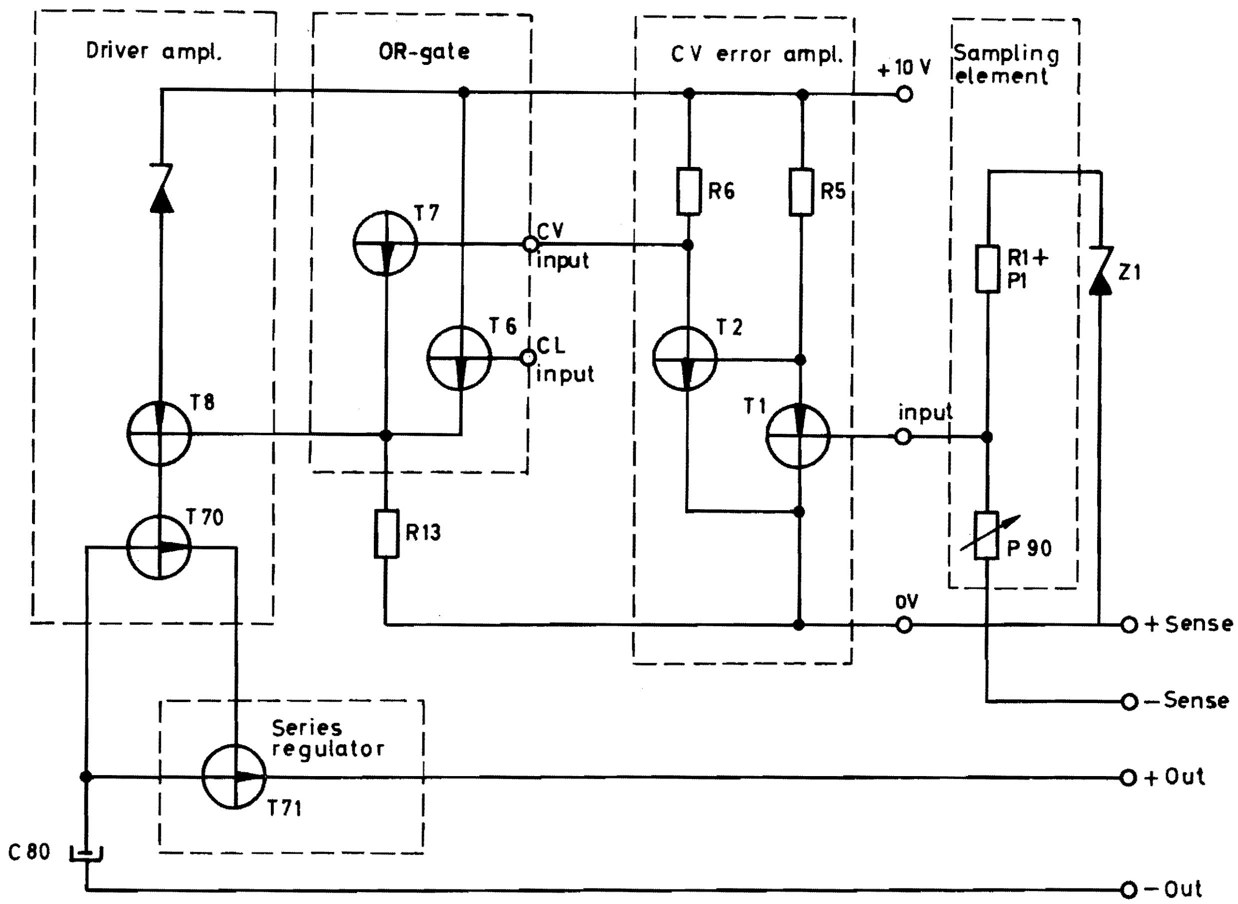


Figure 15. Principle drawing of voltage stabilizing

The "Sampling element" consisting of the voltage divider R1 + P1 and P90 is designed so that the voltage over R1 + P1 becomes exactly identical to the reference voltage if the output voltage has the correct value.
This implies that the voltage between the inputs of the "CV error amplifier" T1 + T2 is zero. Should the output voltage e.g. decrease, a positive voltage is applied at the input of the "CV error amplifier". This increases the base current of the series regulator through the "OR-gate" and "Driver amplifier" resulting in a lower voltage drop over "Series regulator" and the output voltage returns to the correct value.

The "Driver amplifier" increases the voltage and current gains to a sufficient level to control the "Series regulator". T1 + T2 is a temperature compensated pair and hence should be matched.
P1 is the programming constant (K_p) adjustment.
P90 is the output voltage control.
Referring to the circuit diagram, section 6.
D1, D2 and R2 form a protection circuit for the "CV error amplifier".
C91 is an AC feedback, reducing ripple and noise.
T6 together with T7 form the "OR-gate" where T7 is the CV input.
Under CV conditions the CL input of the "OR-gate" is not active as the base of T6 is reversed biased.

F. CURRENT LIMITING

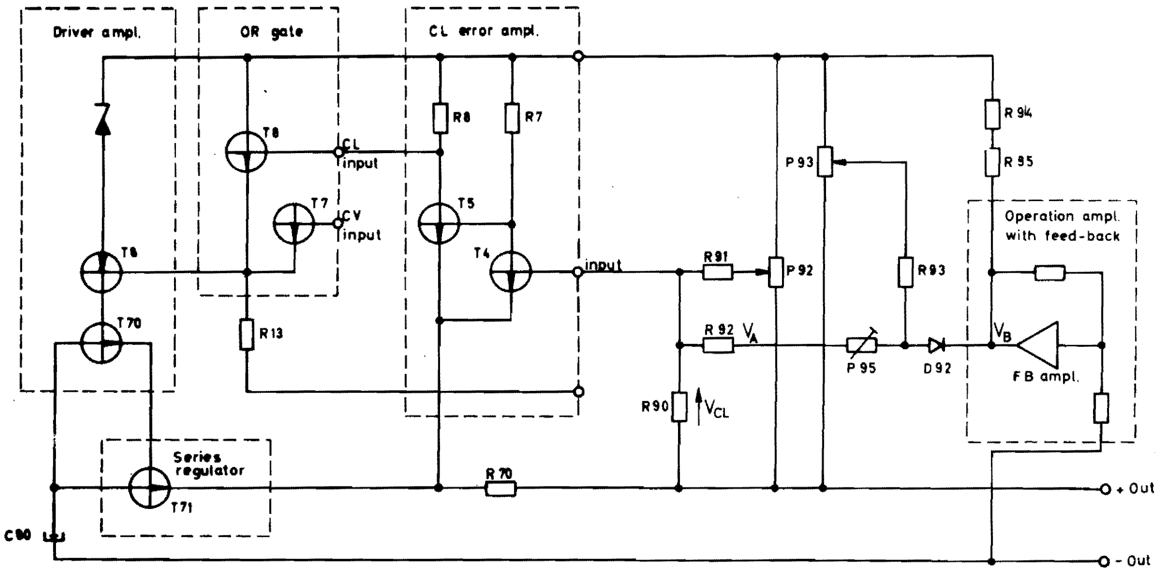


Figure 16. Principle drawing of current limiting

The output current passes through the emittor resistors of T71 and T72 where they give voltages proportional to the current through each transistor. With the resistors R73a and R73b the average of the currents through T71 and T72 is taken. Thus the voltage is proportional to the output current, and so that 100% current corresponds to an average of 0,5V over R70a-b.

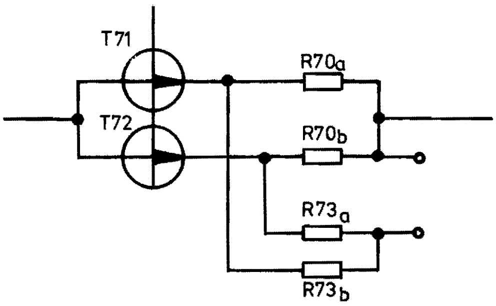


Figure 17.

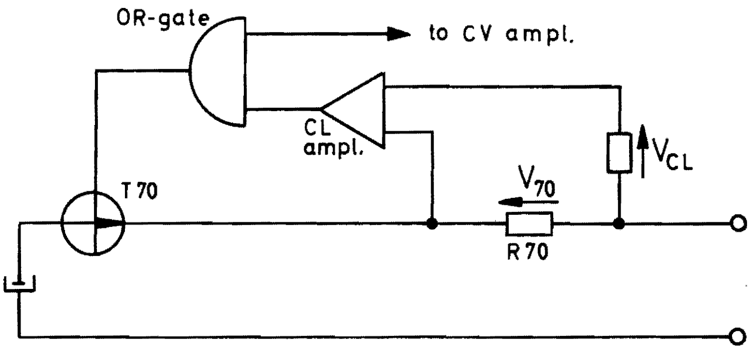


Figure 18.

When the output current is low, V_{CL} is higher than V70. The "CL amplifier" is then disconnected by the "OR-gate". If the output current increases, V70 becomes greater than V_{CL}, causing the input to the "CL amplifier" to change polarity. The "CL amplifier" then overpowers the "CV amplifier" in the "OR-gate" and controls the series transistors so that the output current is limited to a value resulting in V70 = V_{CL}. To obtain partly constant current and partly foldback, the desired characteristic would be as shown in figure 19.

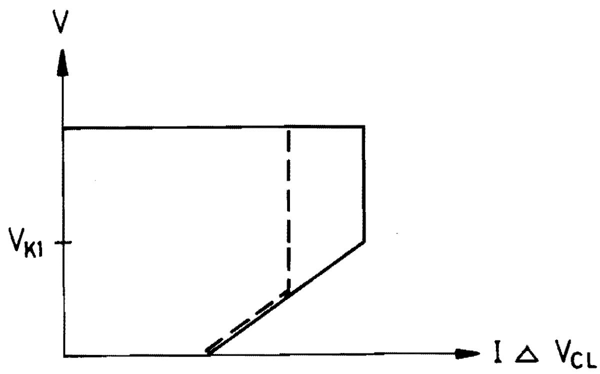


Figure 19.

V_{CL} will be proportional to the output voltage below V_{K1} and constant above it. When the CL control is set below 100%, the dotted characteristic is followed.

V_{CL} is composed by two components, one fixed determined by P92 and the variable component determined by P93 on the front panel.

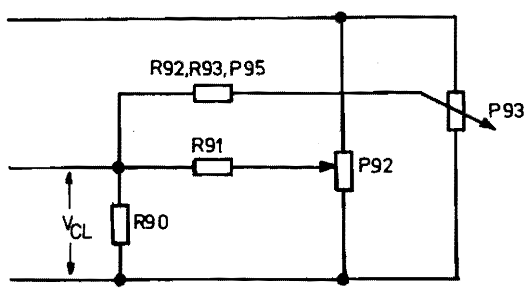


Figure 20.

For output voltages below V_{K1} the variable component must be limited so that the output current cannot exceed the desired characteristic. This is done with an "Operational amplifier" type circuit with feedback in inverting configuration.

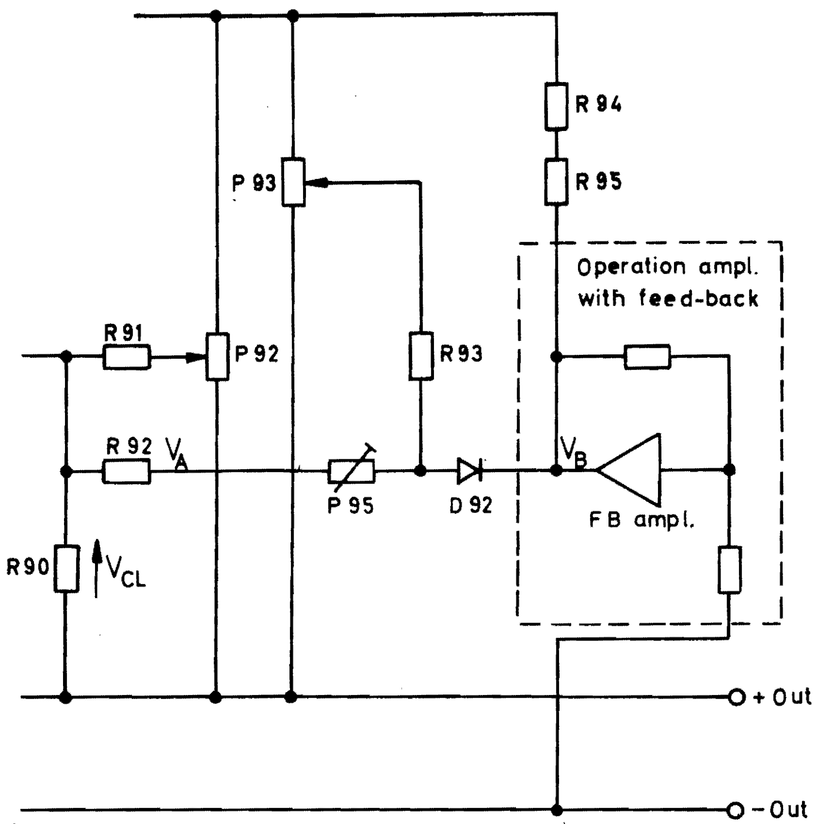


Figure 21.

For high output voltages the "FB amplifier" is overcontrolled so that the output is in positive saturation. Then the "FB amplifier" is disconnected by D92.

At an output voltage above V_{K1}, V_A and V_B have the same voltage, if the CL potentiometer P93 is set to maximum. At voltages below V_{K1} the component to V_{CL} control P93 is limited by the "FB amplifier" to lower values as is shown in figure 19.

The "Operational amplifier" consists of T90, R94, P94, R95, P96 and R96.

G. OVERVOLTAGE PROTECTION

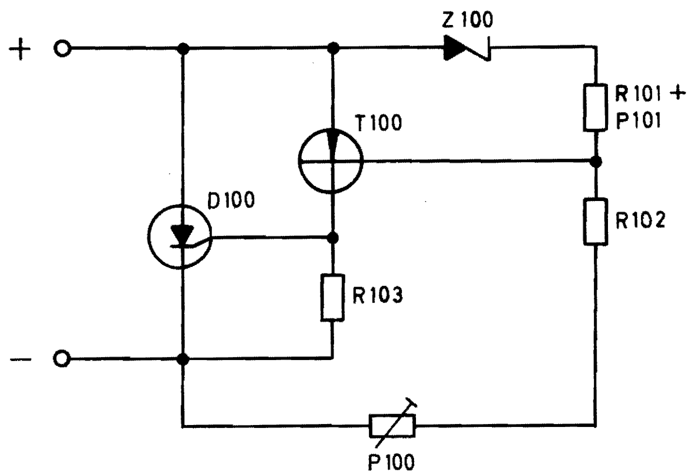


Figure 22

The "Overvoltage protection" serves to protect the connected load for overvoltage, which may be caused by abusive adjustment of the "voltage control" on the front panel.
The protection circuit obtains own reference voltage from Z100.
The voltage divider R101 + P101, R102 + R100 is designed so that as long as the output voltage is lower than the "Voltage limit" control is set to (P100), the voltage at the base of T100 is actuated and thyristor D100 is fired. The output is consequently short-circuited.
If the "Overvoltage protection" is actuated, the power supply switches over to current limit with output voltage near zero. The power supply is reset by adjusting the voltage control to the correct voltage.

SECTION 5

MAINTENANCE AND CALIBRATION

A. GENERAL

This section contains information on maintenance and adjustment with the Oltronix power supply LABPAC B8-7.

This power supply is fully equipped with semiconductors and under normal operating conditions requires little or no maintenance throughout its life. If any doubt about the function of this power supply arises during maintenance or adjustment, please refer to section 4 for complete circuit description. Switch off the power supply before any component replacement is made.

B. COVER REMOVAL

1. Unscrew the four screws on the front panel and remove front panel by pulling it backward.
2. Remove the two side panels by pulling them out.

C. VISUAL INSPECTION

Inspect the power supply once a year for possible circuit defects. These defects may include e.g. loose or broken connections, broken PC board, or burned components. The cure for most of these faults is obvious but special care must be taken when a burned component is found. This kind of fault often indicates that there is another fault in the circuit as well. It is therefore essential to find out what has caused the actual component to overheat before it is replaced.

D. ALIGNMENT PROCEDURE

All power supplies are completely aligned when delivered from the factory. Though it is unlikely that the power supply will fall out of trim when used under normal operating conditions, the power supplies may need readjustment in case of component replacement. Information on these tests is given in the following paragraphs a-c. Always perform the alignment in this order. For "Identification of components" see section 6.

a. Voltage adjustment

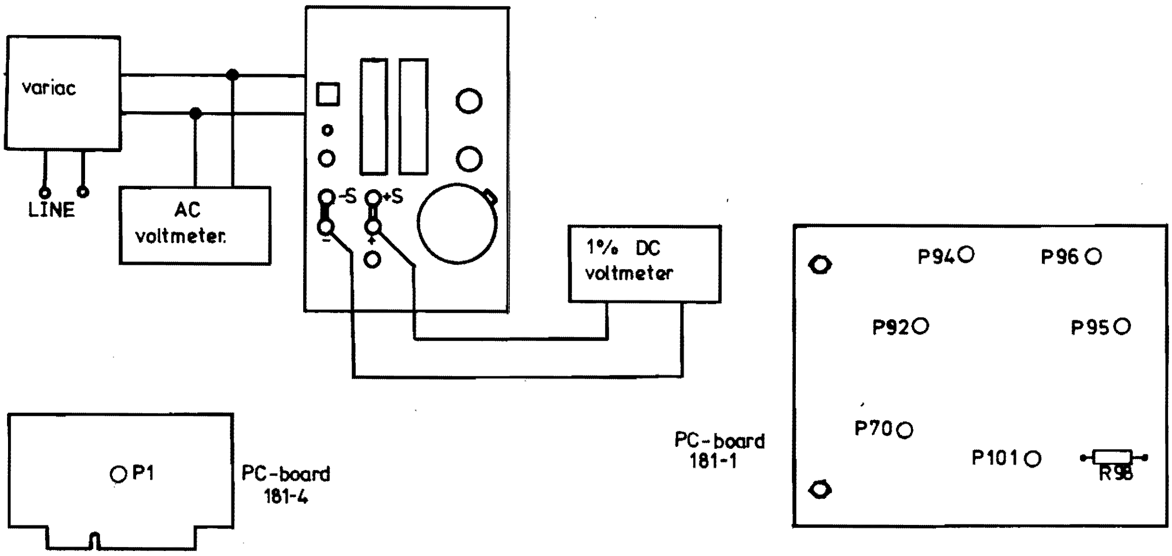


Figure 23 Voltage adjustment

1. Set variac to 220V.
   Set voltage control P90 (front panel) fully CCW and check that output voltage is 0 to ± 0,01V. Note polarity.
   Set output voltage control scale to the output voltage measured.

2. Refer to above PC board. Set voltage control to 8,0V and adjust the voltage with potentiometer P1 to 7,995 - 8,005V.

3. Check that voltmeter on the power supply indicates 8,0V. If not, exchange resistor R98 (approx. 270K). (PC board).

4. Calibrate "Voltage limit" control (P100) (front panel) with P101 (PC board) at 7A.

5. Check calibration in 1V steps over the range 0 - 10V.
   Set voltage control to 1V and measure voltage, and so on
   Accuracy: ± 25mV.

b. Current limit adjustment

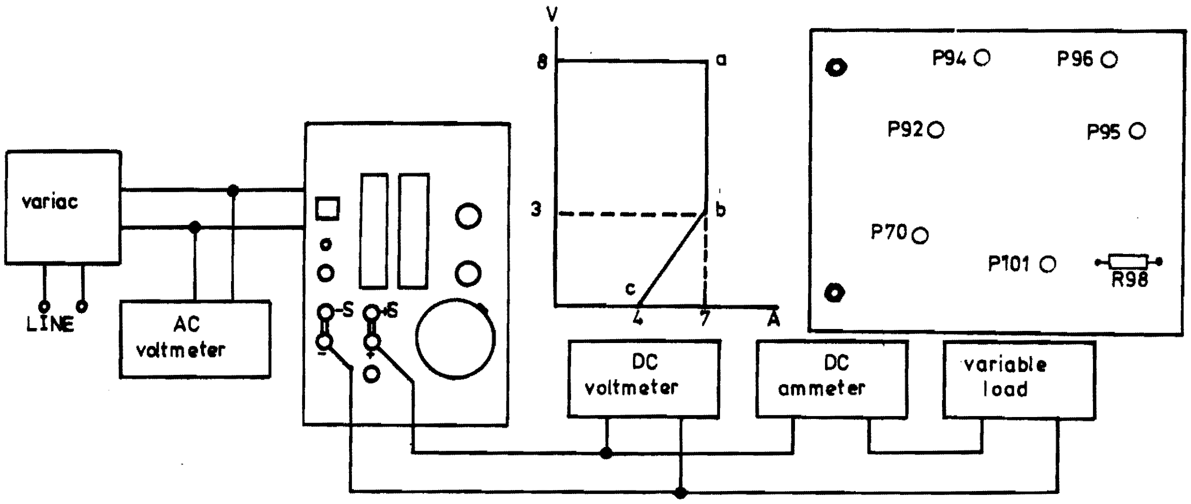


Figure 24. Current limit adjustment

1. Refer to above figure.
   Set variac to 220V. Set potentiometers P92, P94, P95, P96 in mid position.
   Set output voltage to 8V.
   No load.

2. Set "Current limit" control (front panel) to 7A, and adjust output current to 7A with P95.

3. Short-circuit the power supply (jumper between "+" and "-" terminal) and set short-circuit current to 4A with P94.

4. Adjust the knee b - c with P96.

5. Disconnect the jumper
   Set variable load so that the current limit is actuated and the voltage decreases to 3V.
   Set the current with P96 to 7A.

6. Set "Current limit" control to 0,7 and adjust the current to 0,7A with P92.

7. Check that the characteristic is according to the one above.
   If not repeat adjustment procedure.

c. Performance check

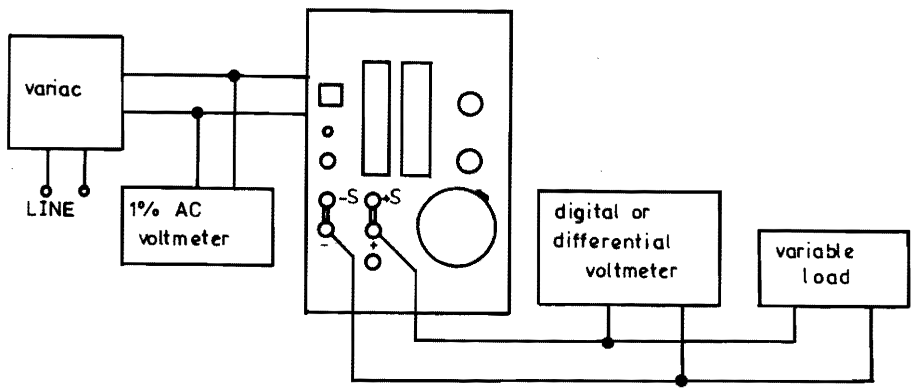


Figure 20.

Prior to all short term performance checks

1. Connect the power supply as shown.

2. Adjust the variac for 220V power. Switch on.
3. Adjust the power supply for a 100% output voltage and the load for maximum current.

Line voltage regulation

1. Adjust the variac for 240V power input. Read the differential voltmeter.
2. Adjust the variac for 200V power input. Read the differential voltmeter.
3. The difference between these two readings, divided by a factor 1,8 is the power supply regulation for 10% line voltage variation. (The factor 1,8 is because 200-240V is an 18% voltage variation.)

Load regulation

1. Adjust the variac for 220V power. Read the differential voltmeter.

2. Disconnect the load. Read the differential voltmeter.

3. The difference between these two readings is the load regulation.

Ripple

1. Connect the load resistor for 100% output current.

2. Measure the output ripple by means of an AC RMS voltmeter connected across the output.

Order spare parts from your local representative or from
OLTRONIX AB
Box 180, S-685 00 Torsby
Sweden
Mark order "Spare parts".

SECTION 6

SPARE PARTS AND CIRCUIT DIAGRAM

A. GENERAL

Replacement parts are available from the Oltronix factory. All standard parts can also be ordered through most well-equipped component distributors. Note that some transistors have a letter-number combination e.g. H25 in the spare parts list in addition to the part number. This combination indicates the quality of the transistor expressed in current gain and maximum voltage. This description should always accompany the transistor when a replacement is ordered. For further information on the classification refer to the "Oltronix transistor identification code" which is found after the spare parts list.
When ordering parts listed below, state the following information for each part:

a. Model and serial number of the instrument
b. Circuit reference
c. Type and value

For parts not listed below state:
a. Model and serial number of the instrument
b. Complete description of the part
c. Function and location of the part

B. ABBREVIATIONS

Cer = ceramic
EMC = electrolytical metal case
K = Kilo or 10^3
M = Mega or 10^6
MF = metal film
MP = metalized paper
pF = pico Farad or 10^{-12} F
Pos = position
Si = silicon
Tan = Tantalum
Trim = trimpotentiometer
uF = micro Farad or 10^{-6} F
V = Volt
W = Watt
WW = wire wound

C. SPARE PARTS

Pos	Value		Part no	Type
Capacitors				
C1, C2	4,7 uF	20-25V	1415	Tan
C3	2200 pF	350V	1426	Cer
C4, C6	0,02uF	100V	1398	MP
C75	0,01uF	400V	1385	MP
C80	10000 uF	25V	1464	EMC
C82	200 uF	25V	1493	EMC
C90	470 uF	25V	1512	EMC
C91	0,68uF	250V	1405	MP

Pos	Value			Part no	Type

Diodes

Pos	Value			Part no	Type
D1, D2, D3, D4, D5, D81, D91, D92	1S921			1667	Si
D80 a-b, D90,	1N3209			1664	Si
D100	2N2575			1701	Si

Transistors

Pos	Value			Part no	Type
T1, T4, T8, T10	BC 178B			2862	Si
T2, T5	BC 109C			2930	Si
T3, T6, T7, T9	BC 108B			2861	Si
T70	2N 3055			1529	H25
T71, T72	2N 3055			1529	H25red
T90	2N 3710			1591	L25
T100	2N 3703			1584	L25

Zener Diodes

Pos	Value			Part no	Type
Z1	1N 823			1674	violet
Z2	ZF 5,6			1686	unclass.
Z100	ZF 6,8			1687	red

Resistors

Unless otherwise specified, all resistors are 10%, 0,25W and carbon.

Pos	Value			Part no	Type
R1	1,2K	0,13 W	1%	1284	MF
R2	1 K			1016	
R5	180 K			1043	
R6	100 K			1040	
R7	470 K			1048	
R8	100 K			1040	
R9, R10	1,5K			1018	
R11	100			1004	
R12	1 K			1016	
R13	10 K			1028	
R14	330 white Z1			1010	
	390 violet Z1			1011	
	470 green Z1			1012	
R16	3,9K			1023	
R17	6,8K			1026	
R18	1,5K			1018	
R19	39 K			1035	
R21	1 K			1016	
R22	3,3K			1022	
R23	1 M			1052	
R24	4,7K			1024	
R26, R27	47			1002	
R70a-b	0,1			1200	WW
R71	2,2K			1020	
R72	470			1012	
R73a-b	100			1004	

Pos	Value			Part no	Type
R74a-b	560			1013	
R75	5,6K			1025	
R90	1 K			1016	
R91	180 K			1043	
R92	8,2K			1027	
R93	12 K			1029	
R94	2,2K			1020	
R95	8,2K			1027	
R96	10 K			1028	
R97	10 K	0,5 W	1%	1300	MF
R100	680	0,125W	1%	2375	MF
R102	680	0,125W	1%	2375	MF
R103	3,3K	0,125W	1%	1290	MF

Potentiometers

P1	200	0,5 W	5%	1363	Trim
P70	100	0,05W		1347	Trim
P90	2 K	2 W	5%	1381	WW
P92	25 K	0,05W		1351	Trim
P93	5 K	2 W	10%	1328	WW
P94	1 K	0,05W		1348	Trim
P95	25 K	0,05W		1351	Trim
P96	5 K	0,05W		1349	Trim
P100	1,5K	2 W	10%	1326	WW
P101	1 K	0,05W		1348	Trim

D. OLTRONIX TRANSISTOR IDENTIFICATION CODE

To assure that the transistors in the Oltronix power supplies have good enough data for their actual application, all transistors are tested with a Tektronix Curve Tracer before they are mounted in any instrument. Certain transistors e.g. power transistors and transistors for high voltage use pass a more complete test after which a classification mark is applied. This mark is a letter-number combination on the power transistors and a colour dot on the smaller transistors.
The letter indicates high "H" or low "L" current gain. The number shows the maximum working voltage.
The test conditions are:

Test	Power transistors TO-3 and TO-36	Other transistors TO-5 and similar
Current gain	$I_c = 2A$ $V_{CE} = 10V$ High if $h_{FE} \geq 50$ Low if $h_{FE} < 50$	$I_c = 1$ mA $V_{CE} = 10V$ High if $h_{FE} \geq 50$ Low if $h_{FE} < 50$
	Transistors with extremely high or extremely low h_{FE} are rejected.	
Voltage	$I_c = 400$ mA $R_{BE} = 100$ ohms	$I_c = 1$ mA $R_{BE} = 1,5k$

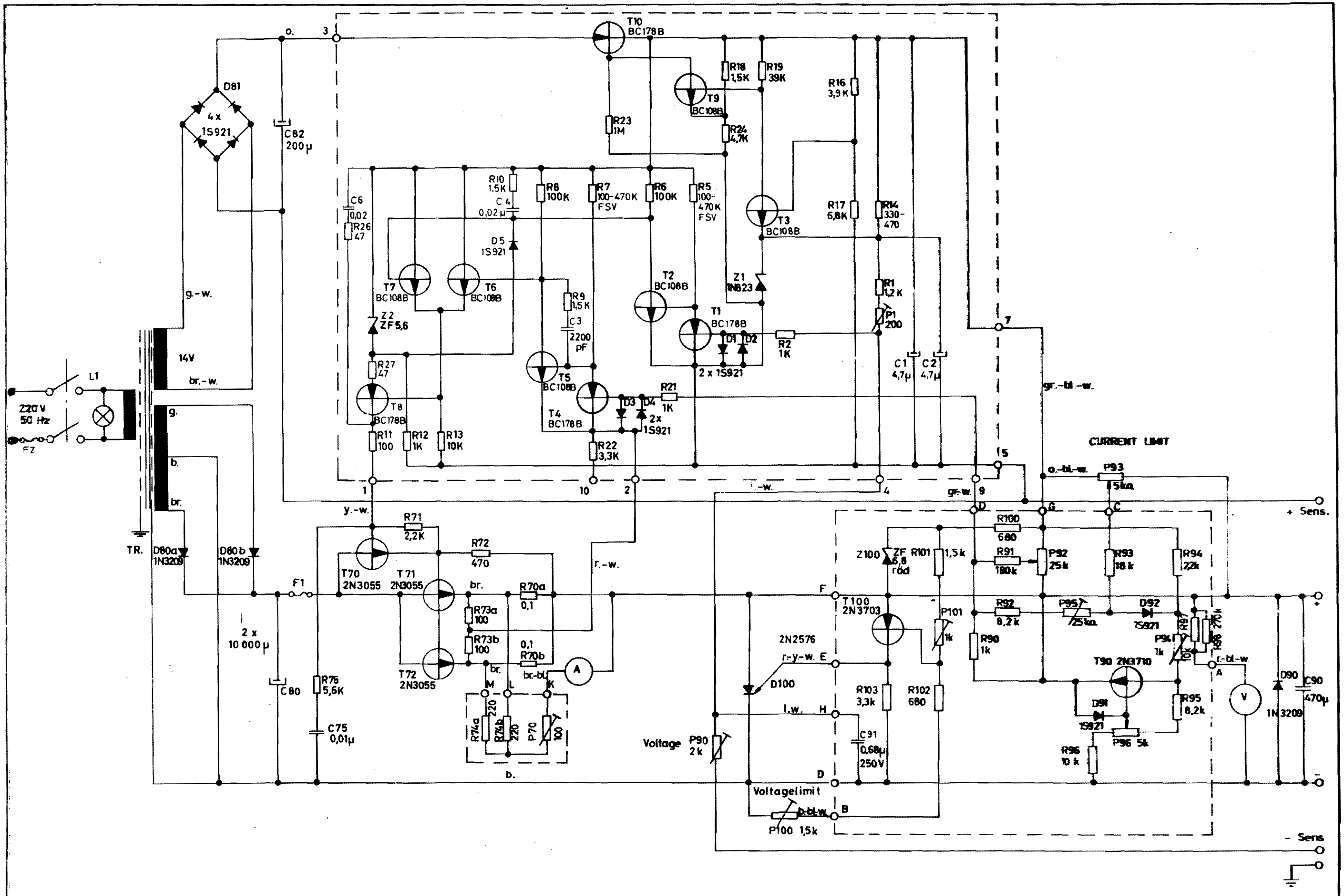
The colour code is:

Class	Colour	Class	Colour
L25	Brown	L100	Silver
H25	Red	H100	Black
L50	Yellow	L125	Silver and brown
H50	Green	H125	Black and red
H65	Blue	L150	Silver and yellow
L75	White	H150	Black and green
H75	Violet	L175	Silver and white
		H175	Black and violet

Colour code for wiring is:

b = blue
bl = black
br = brown
g = green
gr = grey
l = violet
o = orange
r = red
w = white
y = yellow

E.g. an orange-black wire is indicated as o-bl.



Rev① 15.5.68 PG Rev② 21.1.69.PG Rev③ 28 5 69 PG Rev④ 1.7 69 PG

OLTRONIX

Power Supply B8-7
Gäller f.o.m. ser. nr. 316
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WARRANTY

All our products are warranted against defects in materials and workmanship for one year from the date of shipment.

Our obligation is limited to repairing or replacing products which prove to be defective during the warranty period.

We are not liable for consequential damages.

For assistance of any kind, including help with instruments under warranty, contact nearest Oltronix factory or representative for instructions.

Give full details of the difficulty and include the instrument model and serial number.

There will be no charge for repair of instruments under warranty, except transportation charges.