

90 01 7869

**Power Supply
Macrodrive 1
LKB 2301**

**Instruction Manual
incl. Spare Parts Catalogue**



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Macrodrive 1
Power Supply

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IMPORTANT USER INFORMATION

PLEASE READ THIS MANUAL CAREFULLY BEFORE

ATTEMPTING TO USE THE DEVICE

This manual describes the LKB 2301 Macrodrive 1 Power Supply. The sections deal with the appearance and usage of this unit and contain information regarding installation and operation.

If you have any comments on this manual, we will be pleased to receive them at:

LKB Produkter AB
Box 305
S-161 26 BROMMA
Sweden

Since product development and improvement is a continuous process, LKB reserves the right to make changes in the specifications without notice.

Warranty and Liability

LKB-Produkter AB guarantee that their delivered product has been thoroughly tested to ensure that it meets its published specification.

The warranty included in the conditions of delivery is valid only if the unit has been used according to the instructions supplied by LKB Produkter AB.

LKB Produkter AB can accept no liability for loss or damage, however caused, arising from the faulty or incorrect use of their product.

Note

The symbol  on the front panel of the instrument is an international symbol meaning "REFER TO OPERATING INSTRUCTIONS."

INTRODUCTION

The LKB 2301 Macrodrive 1 Power Supply is designed for the safe and simple conduction of an electrophoresis experiment. It is also possible to use the device for electroblotting and electrofocusing. It is ideal in particular for routine applications in electrophoresis, immuno-electrophoresis and 2-dimensional techniques. Because of its good regulation in the low voltage range, it is also perfect for microtechniques and preparative work.

The power supply provides pulse-free DC output, and can control two parameters internally: voltage and current. There is full automatic crossover between the two control modes. A built-in digital timer allows automatic time setting of the electrophoresis experiment. After a preset time (up to 60 hrs), a signal sounds and the high voltage output shuts down. It is also possible to have the high voltage on after the preset time, or use the device without the timer function.

Operation is simple, with two accurate LED displays enabling the user to read the preset or actual values of voltage, current and time. Light-emitting diodes indicate the working mode, displayed parameter, ground leakage and the presence of high voltage.

The limits for voltage, current and time are set by high precision 10-turn potentiometers and timer selectors. A range selector enables the operator to run in the high voltage mode (1000 V/200 mA) or in the high current mode (500 V/400 mA). The power supply automatically adapts itself to changing conditions in the electrophoresis medium in both working modes.

The LKB 2301 high voltage power supply has been designed to comply with all relevant safety standards. Two pairs of recessed safety output jacks, ground leakage detection, and protection for any overload condition provide complete safety for both the operator and the device.

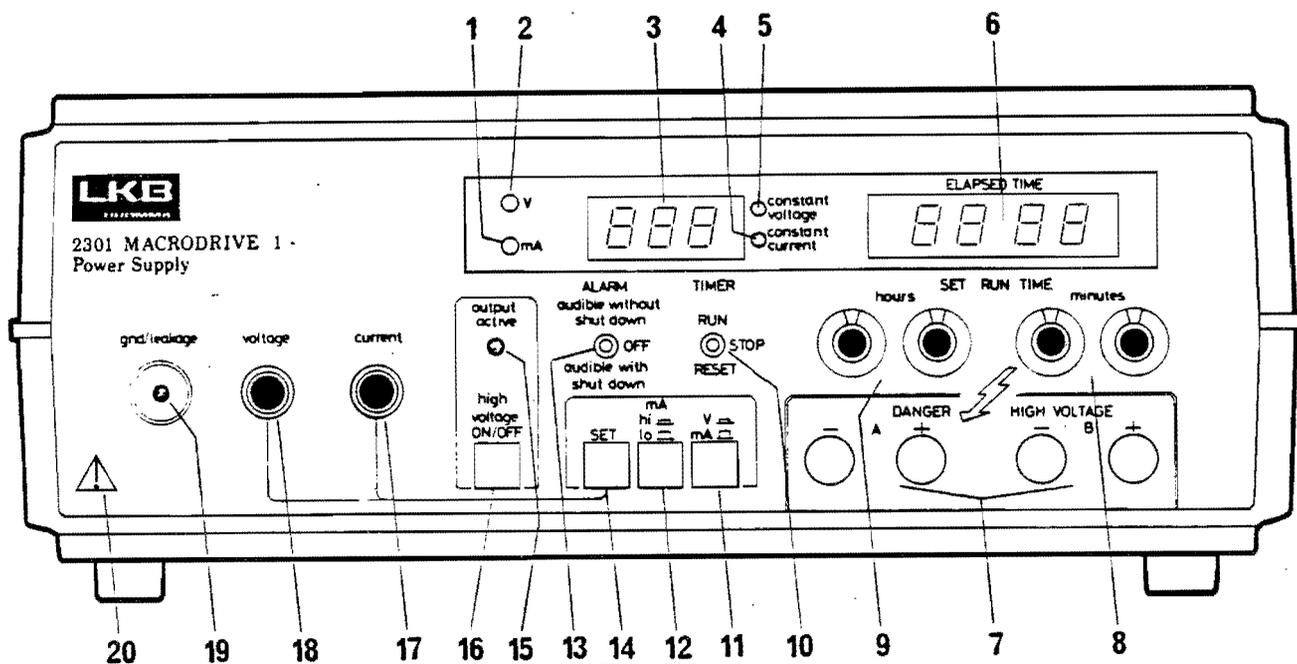


Fig.1

PHYSICAL DESCRIPTION

Please refer to Figure 1 for the front of the unit, and Figure 2 for the back.

Front Panel (Fig. 1)

No	Item	Description
1	Milliamps Indicator	This LED indicator indicates that milliamps are being shown on the display (3).
2	Volts Indicator	Indicates that volts are being shown on the display (3).
3	Voltage/Current Display	Three-digit display for voltage and current, as selected by switches 11 and 14. Voltage: 0-999 V Current: 0-400 mA Overrange voltage (>999) is indicated by "EEE".
4	Constant Current Indicator	Indicates constant current operation.
5	Constant Voltage Indicator	Indicates constant voltage operation.
6	Timer Display	Four-digit display (two for hours and two for minutes) showing time elapsed since timer switch is set to RUN position (start of experiment).
7	Outlets	The two outlets connected in parallel, accepting standard length banana plugs. Safety shielded banana plugs are strongly recommended. All recent LKB units are provided with shielded plugs.
8 and 9	Timer Selector Dials	For setting the number of minutes and hours needed for the experiment.
10	Timer Switch	Position RUN: With the ALARM switch (13) in position "audible without shut down", power supply operation commences and the alarm will sound when the time display

reaches the same numbers as shown by the preset run time dials (8) and (9). With the ALARM switch in position "audible with shut down" the power supply operates until the time display reaches the same time as the dials and then shuts down. When the ALARM switch is in the OFF position, the timer is inoperative.

Position STOP:

The timer will stop counting and the outputs are active or shut down depending on ALARM switch position.

Position RESET:

Resets the timer display to 00 00.

- | | | |
|----|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | Voltage/Current Display Selector | This selects voltage or current display (actual or preset depending on the SET selector). |
| 12 | High/Low Range Selector | Range switch for high or low current
Position high:
max. current 400 mA
max. voltage 500 V
Position low:
max. current 200 mA
max. voltage 1000 V |
| 13 | Alarm Switch | Position "audible without shut down":
When the time display (6) reaches the values as shown by the run time dials (8) and (9), the display flashes, an alarm sounds, but the power supply outputs do not shut down.
Position: OFF (middle): The power supply operates without the timer.
Position "audible with shut down":
When the time display reaches the preset time, the display flashes, an alarm sounds, and the power supply outputs are shut down. |
| 14 | SET Selector | Whilst pressed, this allows setting of the limits for maximum voltage and current with knobs 18 and 17. |
| 15 | Output Active | Indicates that the high voltage is on, as controlled by the ON/OFF switch. |
| 16 | ON/OFF High Voltage | This switch turns the high voltage on and off. |

- | | | |
|----|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| 17 | Current adjuster | Ten-turn potentiometer for adjusting the limit for maximum current. |
| 18 | Voltage adjuster | Ten-turn potentiometer for adjusting the limit for maximum voltage. |
| 19 | Ground Leakage Indicator | This indicator flashes and the high voltage shuts down, as soon as the ground leakage exceeds 0.4 mA. |
| 20 |  | This symbol is an international symbol meaning "Refer to Operating Instructions". |

Back Panel (Fig 2)

- | | | |
|---|--------------|--------------------------------------------------------------------------------------------------------------------------------|
| 1 | Fan | For cooling of internal circuits. An air filter prevents dust entering the instrument. |
| 2 | Mains Inlet | The mains cable is plugged in here. |
| 3 | Mains Switch | The power supply is turned on by pressing the upper half of the rocker switch. The displays and indicators will then light up. |
| 4 | Fuses | Mains Fuses
2 x 4 A slow (For 100-132 V)
1 x 400 mA slow

2 x 2 A slow (For 198-264 V)
1 x 200 mA slow |

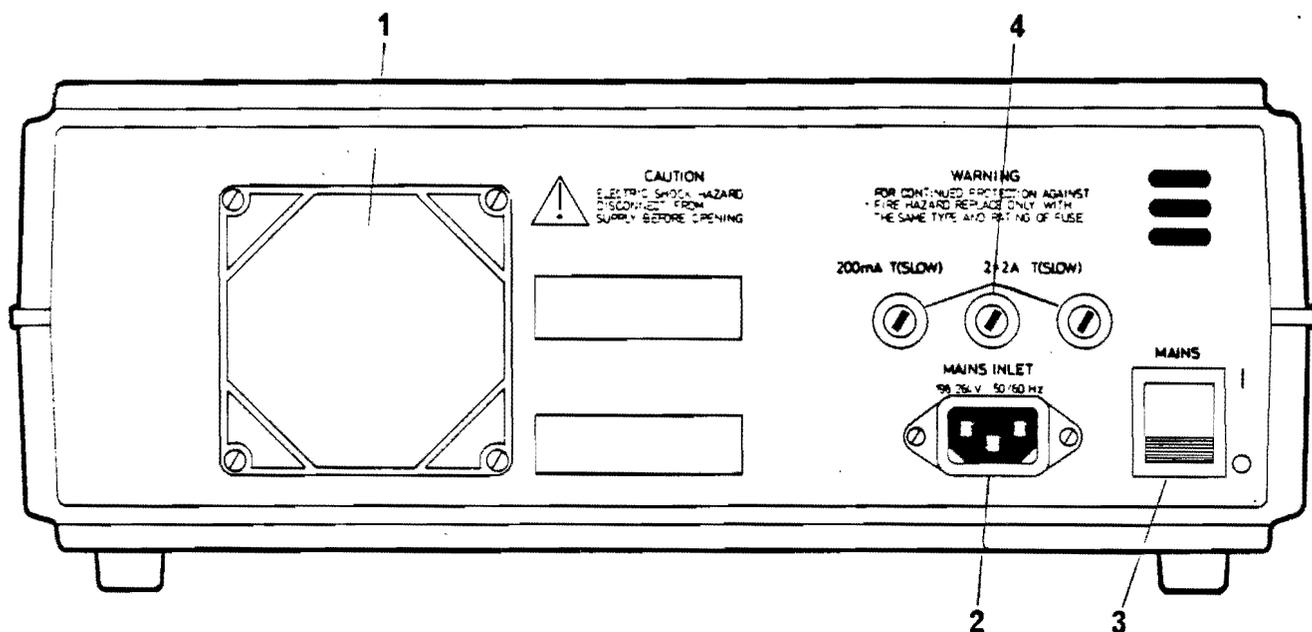


Fig.2

INSTALLATION

1. Check that the proper fuses (4 in Fig.2) are inserted on the back panel.

2 x 4 A slow (For 100-132 V)
1 x 400 mA slow

2 x 2 A slow (For 198-264 V)
1 x 200 mA slow

2. Connect an electrophoresis unit to one of the outlets (7 in Fig. 1). For operator protection use shielded banana plugs (two plugs are supplied with the instrument, LKB order no. 90 01 6579 red and 90 01 6578 black). The connection of these plugs must be done by a qualified technician for correct insulation and mechanical strength of the connection.

Warning:

The voltage delivered from this power supply can deliver a lethal electric shock. Regularly check the insulation and connections of the cables, that the instrument is not damaged and that nothing can come in contact with non-insulated parts of the high voltage circuitry.

3. If you are using the LKB 2010 Macrophor, LKB 2117 Multiphor II or LKB 2217 Ultrophor equipped with the special high voltage plug, order the LKB 2197-900 high voltage adapter which makes it possible to use the LKB 2301 Macrodrive 1 without exchange of plugs.
4. If a remote safety switch needs to be used, it can be connected internally. This modification of the instrument must be done by a qualified electronic engineer. LKB can accept no liability for damage caused by incorrect modifications to the instrument. If you are using LKB electrophoresis units there is no need for a safety interlock circuit.
5. Be certain to plug the mains cable into a fully grounded mains outlet.
6. Place the power supply on a shelf above the laboratory bench to avoid the possibility of spillage of buffers or other conducting liquids. The power supply is fully protected against spills, but a prolonged exposure to liquids and dust may increase the ground leakage. A shelf above the bench makes it much easier to set and control all the parameters. Special consideration should be given to free access of air to the fan and ventilation slots.
7. If the cabinet is dirty, clean it with a soft cloth moistened with a very dilute detergent-water solution. The fan filter (part no. 95 69 1021) must be replaced as soon as the collected dust inhibits the free flow of air. Never run the power supply without the fan filter.

OPERATION

1. Switch on the Mains Switch (3, Fig. 2) at the back of the instrument.
 Note: Switch off the Power Supply after use only if it is not to be used for a couple of days.
 The unit is now ready for parameter setting.
2. Check that the "output active" indicator is not lit; if it is, switch OFF high voltage.
3. If necessary reset the timer by pressing the timer switch (10) to the RESET position. The timer should now indicate 00 00.
4. Choose the current range by means of the mA High/Low selector (12).

 High 0-400 mA / 0-500 V
 Low 0-200 mA / 0-1000 V
5. With the Voltage/Current Display Selector (11), choose the setting of voltage or current limit values. The choice is indicated by the two LED's 1 and 2 in figure 1.
6. Press the SET push button, and while pressing the button adjust the preset limit value for the indicated parameter with knob 17 or 18. The set value is indicated on the display (3) as long as the SET button is pressed. After release of the SET button the actual measured value is indicated.
 Note: Voltage over 999 is indicated with EEE. Output voltage usually exceeds 1000 V with the adjuster in its maximum position.
7. Set the other parameter by pressing the Voltage/Current Display Selector (11) and repeating step 6.
 By setting both voltage and current limits, this guarantees that the total power (in Watts) will never exceed $0.001 \times \text{mA} \times \text{V}$. There is an automatic crossover between voltage-limiting and current-limiting.
8. Turn the timer Selector Dials (8 and 9) to the desired experimental time (max. 59 hours 59 minutes).
- 9.. Set the ALARM switch (13) in the desired position, with or without shut down of high voltage. With the switch in the OFF (middle) position, the power supply operates without the timer, which is then inactive.
10. The timer will start operating as soon as the TIMER switch (10) is put in the RUN position.
 Note: The High Voltage is not switched on until the high voltage ON/OFF switch (16) is activated. When the experimental time has elapsed, the time display (6) will start to flash, and a signal will be heard. The high voltage will be shut down if so selected by the alarm switch.

11. It is possible to halt an experiment for adjustments, sample application etc. The ALARM switch (13) must be in either of the two "on" positions: "with shut down" or "without shut down". Put the TIMER switch (10) into the STOP position to halt the timer. Continue the experiment by putting the switch in the RUN position.
Note: Switch OFF the High Voltage before disconnecting the electrophoresis unit.
12. The actual output voltage/current is shown on the display (3), as long as SET is not depressed. The V/mA selector (11) determines the displayed parameter.
13. The set maximum limits of voltage/current can be read on the display (3) at any time by pressing the SET button (14). Again, the V/mA selector determines the display of voltage or current.
14. The operating mode of constant voltage or constant current is indicated by the two indicators 4 and 5.
15. Make it a habit to always shut off the high voltage with the high voltage ON/OFF switch before opening the electrophoresis unit connected to the power supply.
Note: If the electrophoresis unit is opened with high voltage on, arcing may destroy the surfaces on the contacts or switches in the electrophoresis unit.

TYPICAL APPLICATIONS

The Macrodrive 1 Power Supply is the ideal power supply for any type of electrophoresis and may also be used for electrofocusing with limited demands on resolution and convenience. It can run with constant voltage or constant current, and due to automatic crossover between the working modes optimal conditions are always achieved in the system.

A. Constant Voltage

Most experiments in ordinary gel electrophoresis are run in the constant voltage mode. The electrophoretic migration rate is a function of the voltage gradient in the gel and thus running at constant voltage will give a constant migration rate.

This is usually the case with continuous buffer systems and with direct contact between buffer and gel. The resistance of the system does not change markedly during the run, and the results are reproducible.

Constant Voltage is recommended for the 2001 Vertical System and 2010 Macrophor System when continuous buffers are used. The high voltage output in the low current mode is ideal for gradient gels and ultra-thin gels with good heat transfer to the cooling plate.

It is advisable to set a maximum current limit when operating in the constant voltage mode, to safeguard the system in case of failure of the thermostatic circulator. Should a failure occur, the temperature would rise and the resistance decrease. Without such a limit the current may reach an undesirable level.

B. Constant Current

If the voltage drop is not maintained constant in all parts of the system (electrodes, buffers, wicks and gel), changes in resistance which usually always occur in the system will alter the voltage gradient available over the separation medium. Changes in resistance may also be caused by changes in temperature. By using a constant current, the separating voltage gradient is made independent of external resistance changes.

Those methods in which changes in resistance occur (such as disc-electrophoresis or isotachopheresis) must be run at constant current in order to reduce the running time and hence the diffusion. Any increase in resistance which occurs will be compensated for by a proportionate rise in voltage: thus shorter run times and sharper zones will be produced. Constant current operation is essential to maintain equal velocities for all ions.

It is advisable to set a maximum voltage limit when operating in the constant current mode. In case of the gel drying up, the resistance would increase and the voltage would increase to perhaps an undesirable level.

Constant current is recommended whenever a discontinuous buffer is used and for continuous electrophoresis in the LKB 2117 Multiphor System when wicks are used to make contact with the gel.

SAFETY PRECAUTIONS

Because this instrument can produce a lethal shock, caution should be taken in its operation. To maximise operator safety, the power supply is designed to comply with relevant safety standards. This means for example:

1. There is complete protection for any overload condition, including output short circuit.
2. Ground leakage greater than 0.4 mA will be detected in less than 1.0 millisecond and the power supply will shut down while discharging less than 1.0 millicoulomb residual charge.
3. A closely-fitting cabinet guards against spills.
4. Special shielded banana plugs in combination with deeply recessed outlets make it extremely difficult for any external object to come in contact with high voltage.

NOTE:

The instrument must always be used with the earth wire of the mains cable correctly grounded.

Connect only apparatus and associated wiring specified for use at 1000 V.

Before touching any of the electrical circuits, turn off the power supply and wait 60 seconds.

Only qualified service technicians should be allowed to service the Macrodrive 1 Power Supply.

BASIC CIRCUIT DESCRIPTION POWER SUPPLY 2301

The block diagram (Fig. 3) shows the principal circuits of the instrument. The mains voltage, after filtering to protect the mains net from noise pulses, is first rectified. The 100-132 V version doubles the voltage in order to feed the power switch with the same voltage (approx. 300 V) for both versions of 2301. Please note that there is a galvanic connection between the power switch and the mains, which is why special precautions must be taken during servicing of the instrument. A mains transformer isolates the rectifiers and voltage regulators for all the other circuits.

The power switch is fed with pulses with a frequency of about 22 kHz from a pulse-width modulator. The output power to T103 is regulated by varying the width of the pulses. T103 has two secondary windings connected to rectifiers and filters, and these are connected to produce an output voltage symmetric to ground.

Voltage and current sensors compare the output conditions with preset values, and any required correction is fed back to the power modulator. The preset values are set on the front panel by means of potentiometers, and are monitored along with the output conditions by means of a digital meter.

In the case of a leakage current from the positive or negative output to ground, a circuit responds and blocks the pulse width modulator. The leakage current is limited to less than 0.5 mA.

A digital timer is provided for automatically shutting off power to experiments after a preset time.

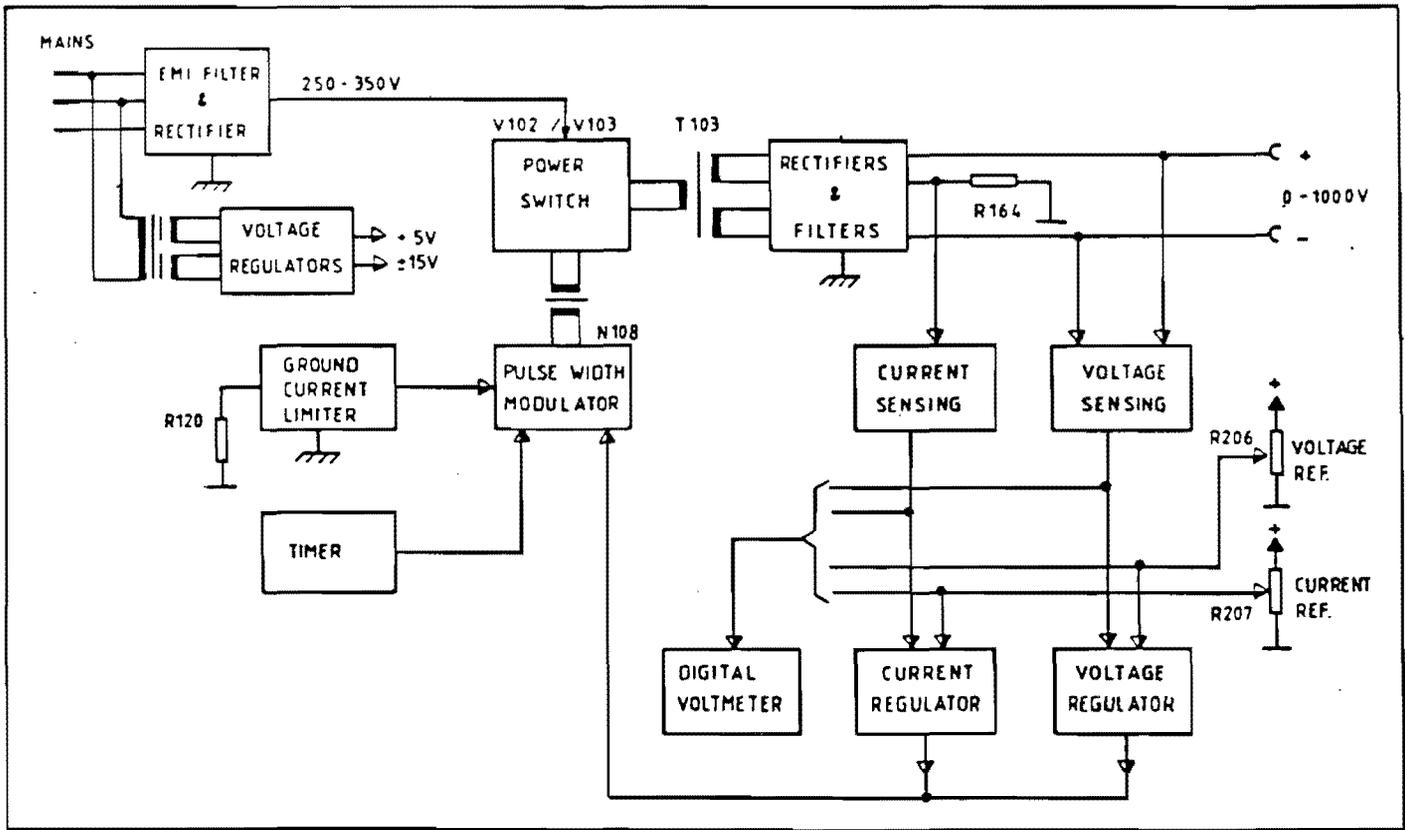


Fig.3

TECHNICAL SPECIFICATION

Regulation:	constant voltage and constant current in two ranges, with automatic crossover at any preset limit
Timer:	digital, 1 minute to 59 hours 59 minutes, with acoustic signal and auto cut off.
Output:	voltage 0-500V D.C., current 0-400 mA; or voltage 0-1000V D.C., current 0-200 mA; continuously variable. Maximum power 200 W
Accuracy:	voltage $\pm 1\%$ of set value or $\pm 5V$ current $\pm 2\%$ of set value or $\pm 2\text{ mA}$
Stability against load variation:	voltage better than $\pm 1\%$ current better than $\pm 1\%$
Protection:	- complete protection for any overload condition, including short circuit of output - ground leakage detection ($>0.4\text{ mA}$) automatically responds within 1.0 msec
Ambient operating temperature:	0-40°C; no warm-up time.
Mains voltages:	100-132 V, 198-264 V; 50 or 60 Hz.
Power consumption:	max 300 W.
Dimensions (WxDxH):	355 x 425 x 145 mm
Weight:	8.7 kg

GENERAL INFORMATION

This Spare Parts Catalogue describes your new LKB instrument by means of drawings and parts lists. It enables you to find the order number for spare parts that you may require.

Your local LKB representative is often able to supply you immediately with most spare parts. However, certain parts may have to be ordered from LKB in Bromma, Sweden, and we will endeavour to supply these as quickly as possible.

LKB guarantees the correct function of your new instrument, the terms of this guarantee being given in your purchase agreement. The guarantee is valid normally only if service is provided by LKB or its representatives and if LKB parts are used. Please contact your representative if your instrument fails to perform satisfactorily.

LKB carries out continual product development and reserves therefore the right to change specifications without notice.

HOW TO USE THIS CATALOGUE

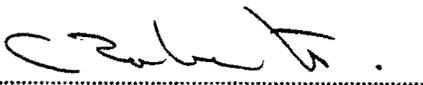
1. Turn to the drawing where the required part is illustrated, and locate the part. Usually all the normal spare parts have an identifying number.
2. In the adjacent parts list, note the part number corresponding to the required item. Check that the name is correct, and that any serial number range given in "FROM S/N" is valid for your instrument. Additional identifying information is occasionally given under "NOTES".
3. Order the spare part from your LKB representative using the part number obtained from the parts list.

We are happy to receive your suggestions if you feel that anything is unclear or incorrect in this catalogue. Please feel free to contact us at the following address:

LKB PRODUKTER AB
INTERNATIONAL SERVICE DEPT.
BOX 305
S-161 26 BROMMA
SWEDEN

Originator:

Approved:


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FRONT SIDE

FIG 1

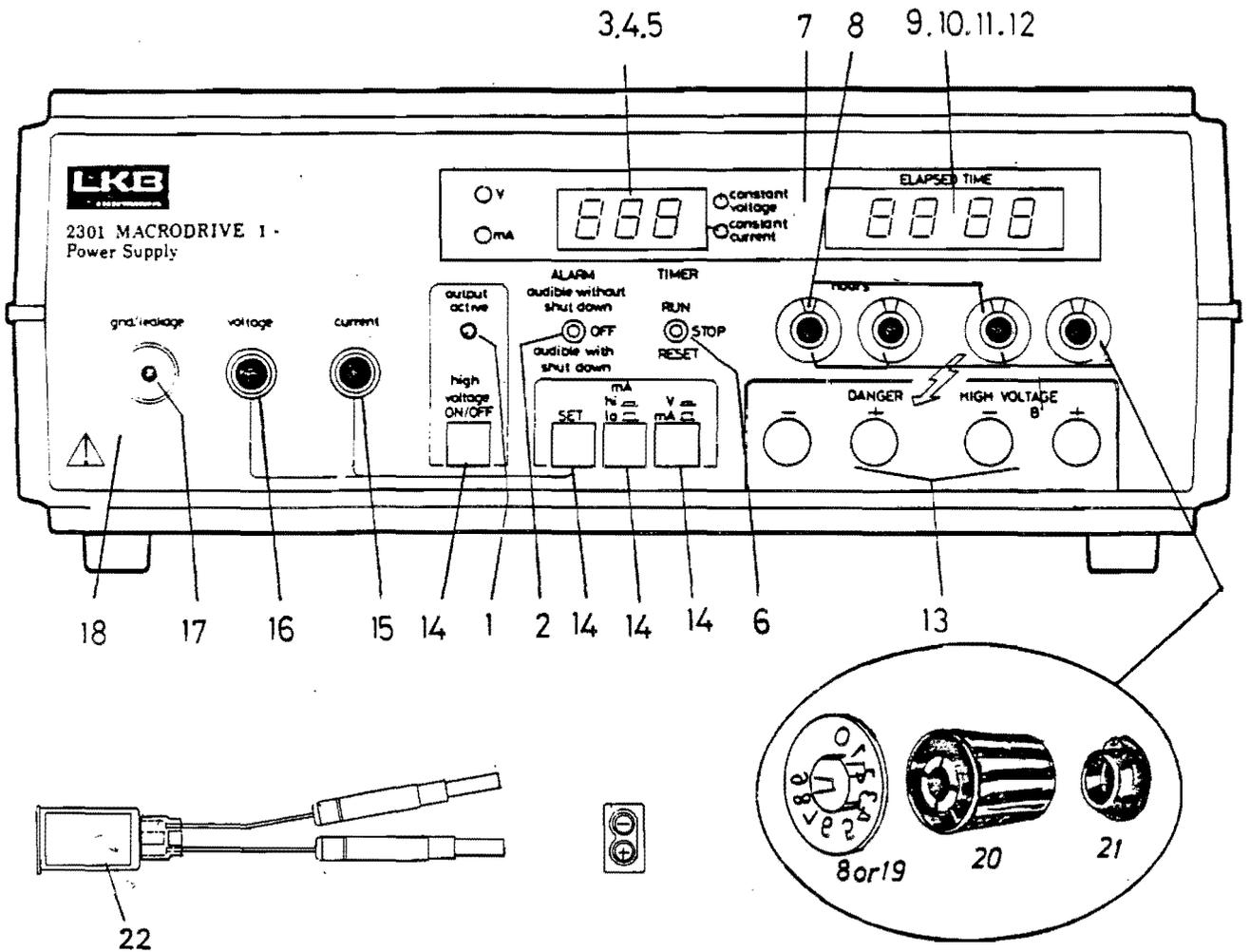


Fig 1

ITEM	PARTNO	DESCRIPTION	NOTES	S/N
1	95 78 0173	YELLOW LED	H 211	
2	95 84 1020	SWITCH	S 201	
3	95 82 1006	DISPLAY 7-SEGMENT	H 201	
4	95 82 1006	DISPLAY 7-SEGMENT	H 202	
5	95 82 1006	DISPLAY 7-SEGMENT	H 203	
6	95 84 1021	SWITCH	S 202	
7	90 01 7748	WINDOW		
8	90 01 3601	DIAL (0-5)		
9	95 76 1000	LED DISPLAY	H 206	
10	95 76 1000	LED DISPLAY	H 207	
11	95 76 1000	LED DISPLAY	H 208	
12	95 76 1000	LED DISPLAY	H 209	
13	90 01 0926	CONNECTOR	J 101	
14	90 01 7718	SWITCH WITH BUTTONS	S 101	
15	95 37 1009	KNOB		
16	95 37 1009	KNOB		
17	95 78 1020	LED RED	H 210	
18	90 02 2914	FRONTPANEL		
19	90 01 3590	DIAL (0-9)		
20	95 37 0170	KNOB		
21	95 37 0134	CAP, BLACK		
22	2197-900	ADAPTER P.S.		

REAR SIDE

FIG 2

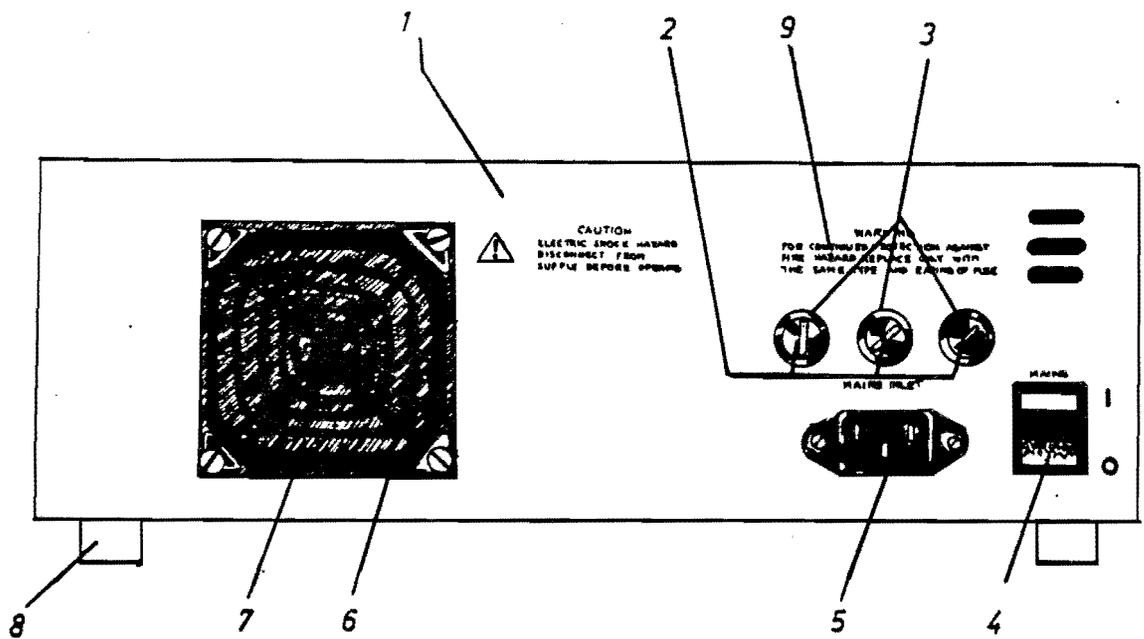


Fig 2

ITEM	PARTNO	DESCRIPTION	NOTES	S/N
1	90 01 7728	REAR PANEL 220V		
1	90 01 7727	REAR PANEL 115V		
2	95 88 1003	FUSE CAP / AM		
2	95 88 1002	FUSE CAP / EU		
3	95 88 1001	FUSE HOLDER		
4	95 84 0175	MAINS SWITCH	S1	
5	95 86 1006	SOCKET FOR MAINS CABLE		
6	95 69 1020	FAN 220 V AC		
6	95 69 1019	FAN 115 V		
7	95 69 1021	AIR FILTER		
8	95 39 0007	RUBBER FOOT		
9	95 83 0044	FUSE 4A/US(PKT/10)	F1/F2	
9	95 83 0014	FUSE 2A/EU(PKT/10)	F1/F2	
9	95 83 1021	FUSE 400 MA/SLOW US (PKT/10)	F3	
9	95 83 0074	FUSE 200 MA/SLOW EU (PKT/10)	F3	

SIDE VIEW

FIG 3

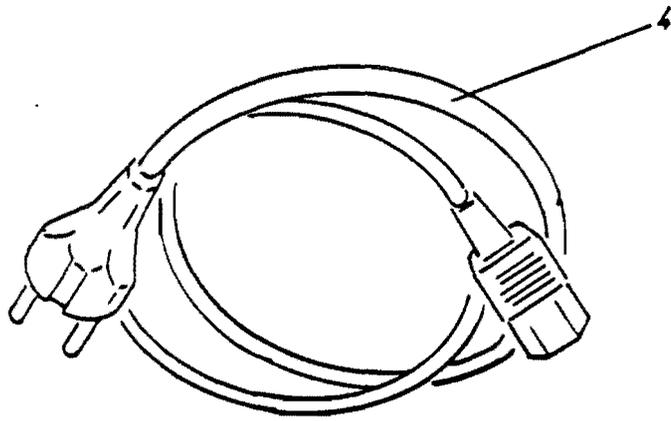
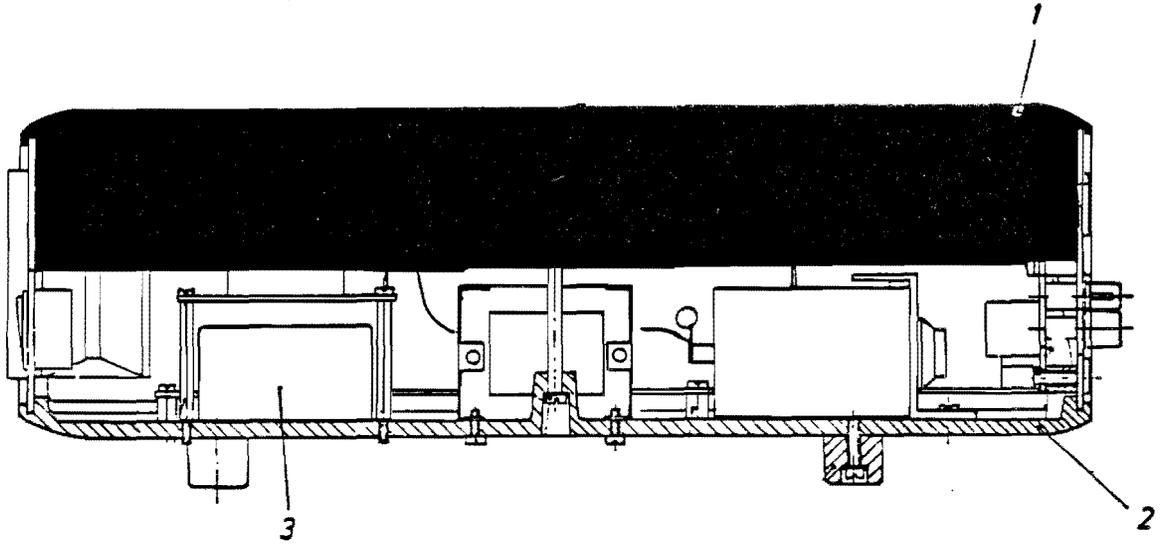


Fig 3

ITEM	PARTNO	DESCRIPTION	NOTES	S/N
1	90 01 7842	TOP COVER		
2	90 01 7843	BOTTOM COVER		
3	95 67 1005	EMI FILTER	Z1	
4	95 46 0137	MAINS CABLE EU		
4	95 46 0138	MAINS CABLE US		

Fig 4

ITEM	PARTNO	DESCRIPTION	NOTES	S/N
1	90 01 7714	PCB CPL (MAINS FILTER)		
2	95 69 1019	FAN 115 V		
2	95 69 1020	FAN 220 V AC		
5	95 60 1127	TERMISTOR	R 4	
6	95 60 1127	TERMISTOR	R3	
7	95 65 1006	CHOKE	L 1	
11	95 60 0220	RESISTOR KO 0.67W 270K 5%	R 5	
13	90 01 5026	MAINS TRANSFORMER	T 1	
14	95 78 1017	RECTIFIER BRIDGE 600V/10A	V 1	
15	95 60 0190	RESISTOR 39K 1.33W	R 1	
16	95 60 0190	RESISTOR 39K 1.33W	R 2	
17	95 63 1029	CAPACITOR ELY 1000U	C 1	
18	95 63 1029	CAPACITOR ELY 1000U	C 2	
19	95 69 1021	AIR FILTER		
20	90 01 7322	MOTHER BOARD COMPLETE	(FIG.5)	

POWER - CONTROL BOARD

FIG 5

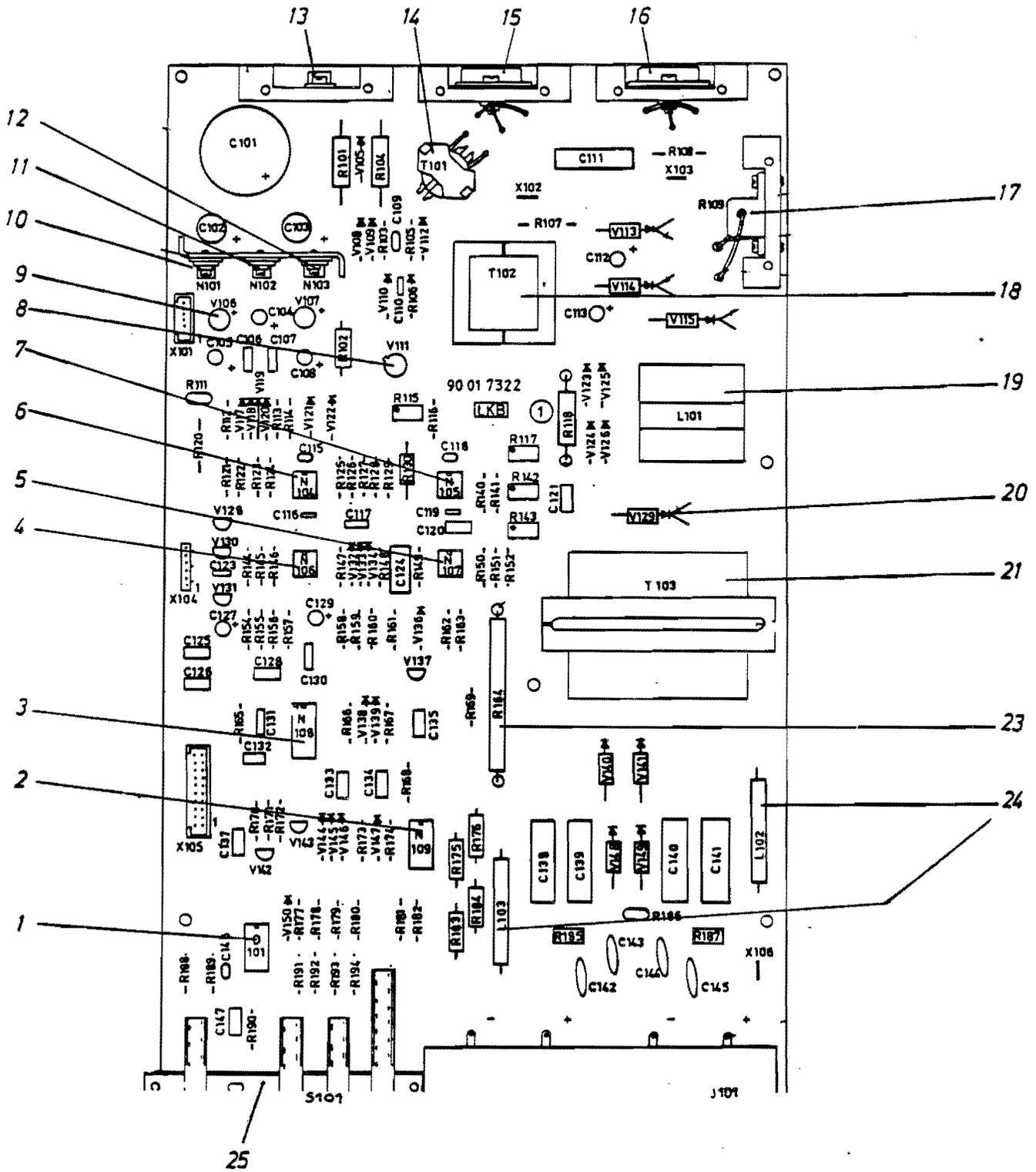


Fig 5

ITEM	PARTNO	DESCRIPTION	NOTES	S/N
	90 01 7322	MOTHER BOARD COMPLETE		
1	95 81 0246	INT CIRCUIT MC 14011 (D2)	D101	
2	95 81 0188	INT.CIRCUIT UA3403	N109	
3	95 81 1016	INT CIRCUIT SG 3524	N108	
4	95 81 0016	INT.CIRCUIT 741CN	N106	
5	95 81 0016	INT.CIRCUIT 741CN	N107	
6	95 81 0117	INT.CIRCUIT 308AN	N104	
7	95 81 0117	INT.CIRCUIT 308AN	N105	
8	95 80 0081	TRANSISTOR BSW 66	V111	
9	95 78 0105	RECTIFIER 250V 1A	V106	
10	95 81 0061	INT.CIRCUIT UA7815	N101	
11	95 81 0048	VOLTAGE REG. 7805	N102	
12	95 81 0237	INT.CIRCUIT UA7915	N103	
13	95 80 0083	TRANSISTOR 2N 6107	V101	
14	90 01 5779	TRANSFORMER	T101	
15	95 80 1011	TRANSISTOR BUX 48	V102	
16	95 80 1011	TRANSISTOR BUX 48	V103	
17	95 60 1128	RESISTOR 30R 25W 5%	R109	
18	90 01 5778	TRANSFORMER	T102	
19	90 01 7720	CHOKE	L101	
20	95 78 1004	DIODE SI 2A 800V	V129	
21	90 01 7719	TRANSFORMER	T103	
23	95 60 0050	RESISTOR 120R/11W	R164	
24	95 65 1009	CHOKE	L102	
24	95 65 1009	CHOKE	L103	
25	90 01 7718	SWITCH WITH BUTTONS	S101	
	90 02 1220	SPACER (PKT/6)		