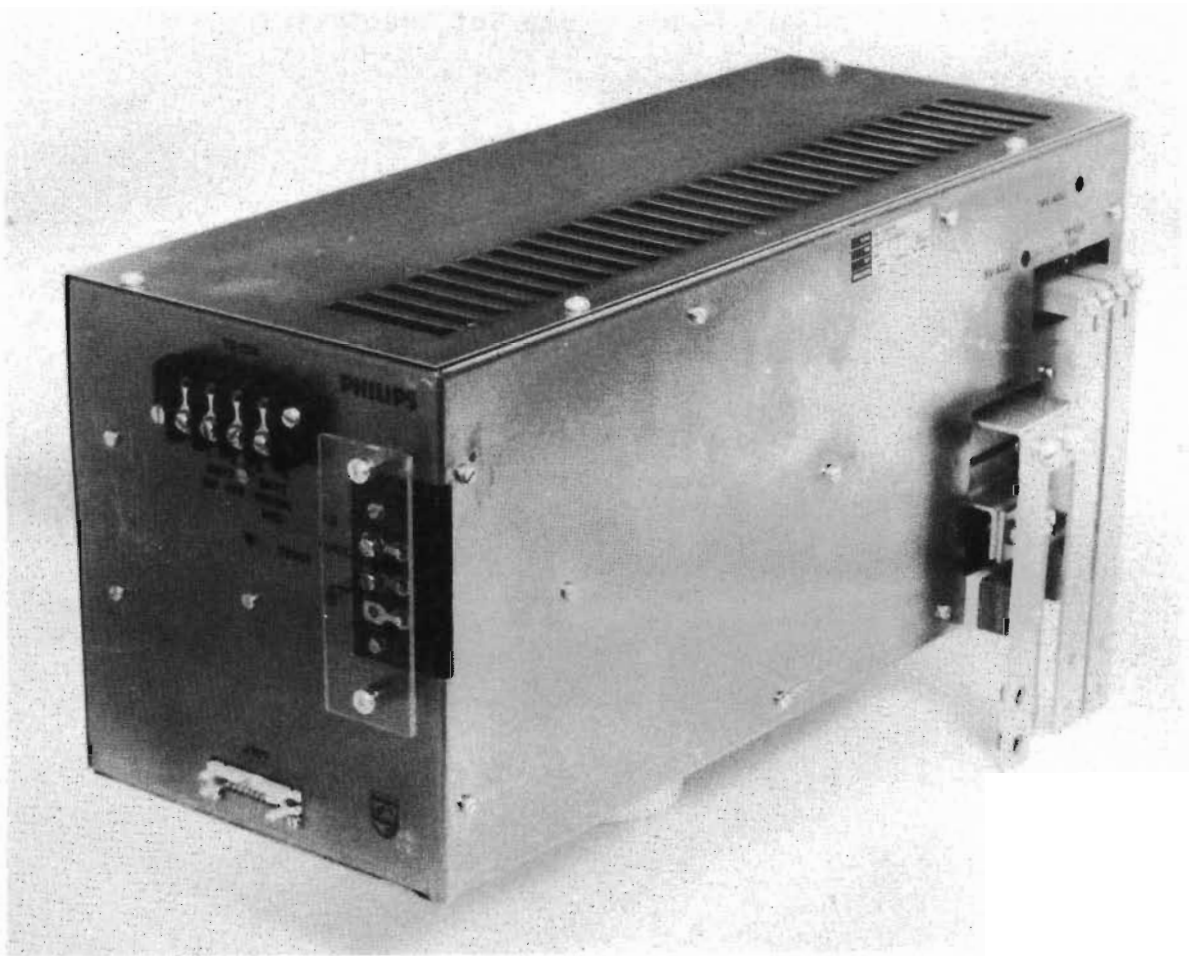
SWITCHED MODE POWER SUPPLY

PE 1759

INSTRUCTION MANUAL



PHILIPS

PHILIPS

STRÖM FÖRSÖRJNINGS GRUPPEN

Important

In correspondence concerning this power supply, please quote the type number and serial number as given on the type plate. The design of this power supply is subject to continuous development and improvement. Consequently, this power supply may incorporate minor changes in detail from the information contained in this manual.

Ordering number 4031 116 38670

CONTENTS

INTRODUCTION

The PE 1759 is a primary-switch-mode stand-by power supply designed to fit into a computer rack system. It is fed directly from the mains, 220V, 50Hz and provides two separate outputs, 5V/25A and 12V/4A. The two outputs have one common battery back-up which ensures the supply of both voltages in the case of a mains failure. The unit is fully remote controlled with battery on/off, remote on/off and a level shift for each output located on an external control panel.

CHARACTERISTICS

This power supply has been designed and tested in accordance with IEC Publication 435 for Class I instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings that shall be followed by the purchaser to ensure safe operation and to retain the power supply in a safe condition.

On delivery the power supply has been adjusted at an ambient temperature of 25°C with convection cooling. Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average power supply.

INPUT

Input voltage	184 - 264V
Mains frequency	45 - 65Hz
Mains switch	Relay via emergency off signal
Mains voltage connector	3-pole KULKA 601C-YSY-3SIF
Insulation	According to IEC 435 Class I

5V OUTPUT

Nominal voltage	+5V, adjustable ±5%
Load	0 - 25A
Regulation	Typical 1 %, and max. ±1 % at 0 - 100 % load change and line voltage 184-264V
Ripple	100mV_{pp}
Overvoltage protection	At 6.5V ±0.5V
Overload protection	At 30A ±5A, short-circuit current 20A ±5A
Level shift	Front panel switch shifts the output level by ±(4 - 6 %) of nominal value.
Temperature coefficient	±200 ppm/°C

12V OUTPUT

Nominal voltage	+12V, adjustable ±8 %
Load	0 - 4A
Regulation	±1 % including ripple from the line, temperature and load changes 0 - 100 %
Ripple	100 mV_{pp}
Temperature coefficient	±200 ppm/°C
Overvoltage protection	At 15V ±0.8V
Overload protection	At 5,0A ±1,0A, short-circuit current 1,5A
Level shift	Front panel switch shifts the output level by ±(7 - 9 %) of nominal value.

LOGIC FUNCTIONS

Power failure	The output is "low" (<0.8V at I = 5mA) when line voltage is OK
Remote ON/OFF	An input voltage "high" (>4.0V) stops the output power
Batt ON/OFF	The battery is on when an external switch is closed. Switch current approx 10mA.
Battery mode indicator	10mA to a LED is supplied when the Power supply is fed from battery
Level shift	Is included on both outputs (See output spec.)
Emergency off	When the mains is OK the output power is stopped by activating an emergency off switch
Over-temperature indicator	A thermostat opens if the temperature in the cabinet exceeds +60 ±3°C. It closes again at 45°C ±6°C

BATTERY BACK-UP

Type	NiCd high temperature RST 1.8
Capacity	Approximately 5 minutes at full load, room temperature and fully charged batteries
Charging time	Worst case: 36 hours
Control function	Battery ON/OFF (on external control panel)

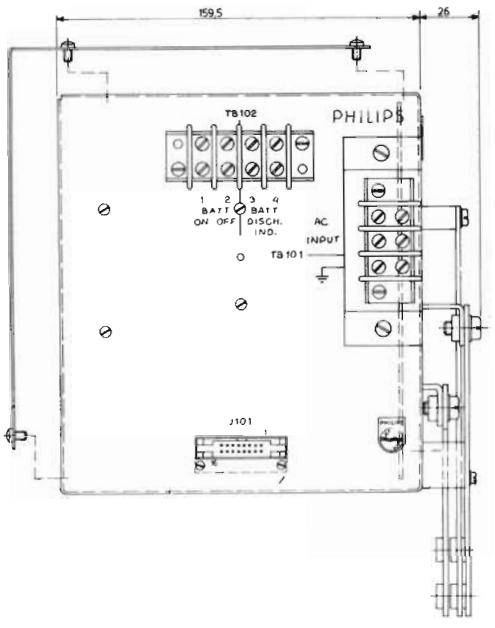
ENVIRONMENTAL DATA

Note: The Characteristics are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the Philips organization, in your country or by N.V. Philips Gloeilampenfabrieken, Test and Measuring department, Eindhoven, The Netherlands

Temperature range:	storage without batteries -40 to +85°C storage with batteries 40 to +65°C operation within specification 0 to +55°
Cooling	Convection-cooled
Mains Interference	According to VDE 0875 grade N-12dB

MECHANICAL DATA

Connectors	mains	3-pole Kulka 60IC-YLUG-3SIF
	output	Bar connectors
	logic functions	2432 023 21601
	battery indicator	4-pole Kulka 60IC-YLUG-4SIF

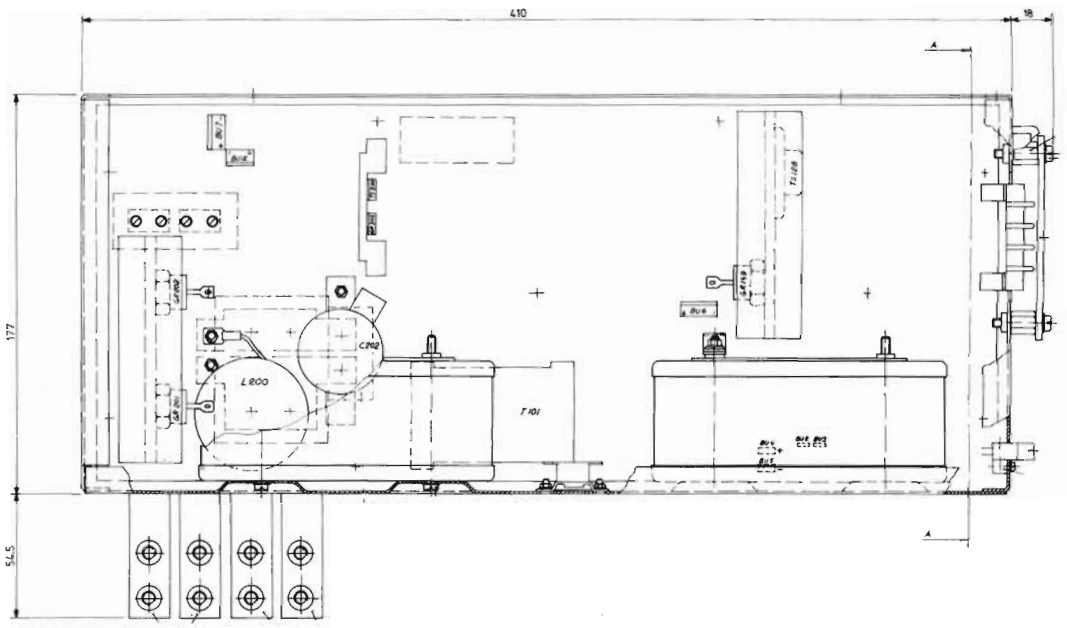


Connections on J101:

1	Thermostat
2	Remote on/off
3	5V -
4	Remote on/off
5	Marginal switch 12V
6	Power failure
7	Emergency off
8	Power failure
9	Marginal switch 5V
10	Marginal switch 12V
11	12V -
12	Marginal switch 5V
13	12V +
14	Marginal switch 12V
15	5V +
16	Marginal switch 5V

Dimensions

Width 410mm Depth 160mm Height 178mm
Weight 7.2kg



DIRECTIONS FOR USE

This section outlines the procedures and precautions necessary for installing the power supply. Before connections are made, visually check the cabinet and connectors to acertain whether any damage has occured in transit. If any defects are apparent, do not connect it to the mains. A claim should then be filed with the carrier and a Philips Sales or Service organization contacted in order to facilitate the repair.

INSTALLATION

When a power supply is brought from a cold into a warm environment, condensation may cause a hazardous condition. Therefore make sure that the earthing requirements are strictly adhered to. Before any other connection is made, the protective earth terminal shall be connected to a protective conductor

MAINS VOLTAGE AND FUSE

The PE 1759 is built for one wide voltage range 184 to 264V.
The input is equipped with a fuse, 4.0A delayed action, on the PC-board close to the mains connector.

WARNING: If the fuse has blown, first disconnect the power supply from all voltage sources and trace the fault. Never replace a blown fuse unless the fault has been found and remedied. If the fuse has blown due to a fault in the primary circuit, a second trial with a new fuse generally results in a burnt PC-board and damage to several other components.

EARTHING

Before any other connection is made, the power supply shall be connected to a protective earth connector via the protective earth terminal.

WARNING: Any interruption of the protective conductor inside or outside the power supply or disconnection of the protective earth terminal, is likely to make the unit dangerous. Intentional interruption is prohibited.

MOUNTING AND COOLING

The PE 1759 is designed for mounting on rails in a computer rack system. It must be fixed with four screws from underneath. Check that the airflow around the power supply is not impeded, as the power rating is valid only when the air circulates freely around the unit.

CONNECTIONS

* Make sure that the computer is switched off when connections are made.
* Connect the mains cable to three-pole connector marked AC input.
* Connect the cable for "battery on/off" and battery discharge indicator to the four-pole connector.
* Connect the control cable with 16 pole connector to the connector marked J101. For the pinning see list on "mechanichal data"

OPERATING INSTRUCTIONS

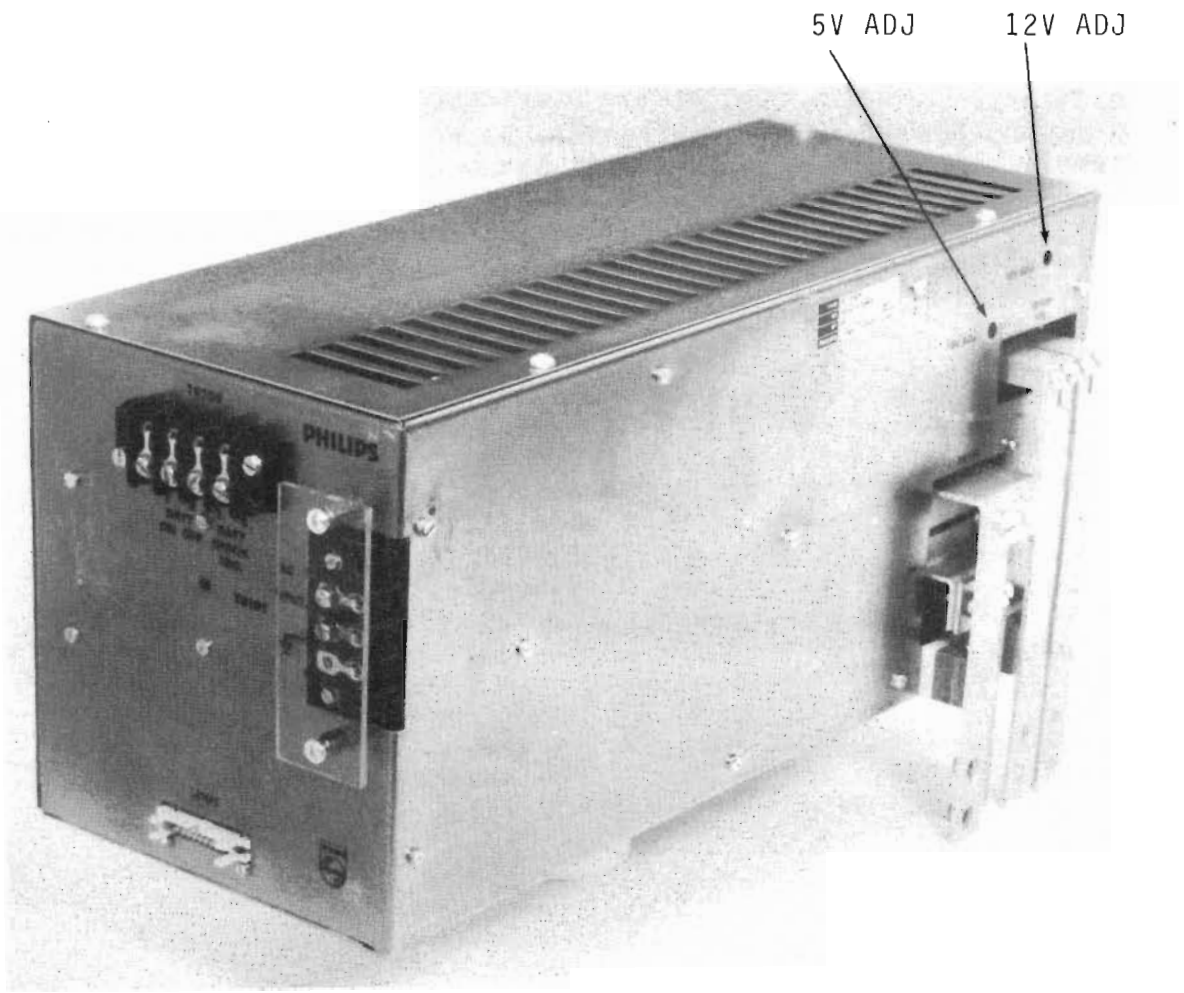
The PE 1759 has a mains voltage switch in relay RE1 controlled by the emergency-OFF function on the control panel.

The BATTERY ON/OFF switch on the control panel shall be in position ON during normal working conditions.

Note: When the power supply is not in operation the BATTERY ON/OFF switch must be set to OFF in order to avoid discharged batteries.

Readjustment of each output voltage may be done with potentiometers marked 5V ADJ and 12V ADJ accessible from the outside.

Before readjusting any voltage level, the load on each output must be measured.



SERVICE

SAFETY RULES

Warning: The opening of covers or removal of parts, exept those to which acess can be gained by hand, is likely to expose live parts and accessible terminals, which can be dangerous to life.

The power supply shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair is effected with the unit open. If afterwards any adjustment of the opened unit under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazards involved. Bear in mind that the capacitors inside the power supply may still be charged even if the supply has been separated from all voltage sources.

Note: The batteries are galvanicly connected to the line and must be handled with great care. To avoid unintentional discharge of the batteries during service, keep the battery switch in "off" position.

BLOCK DESCRIPTION

The PE1759 is a primary switched power supply with two outputs 5V/25A and 12V/4A. It is built for 200-240V nominal line voltage and has a battery back-up..

Input

The input is protected with a mains filter for symmetrical and asymmetrical disturbances and contains furthermore a rectifier with a filter capacitor.

Internal supply

The internal supply for the control circuit is during the starting up sequence taken from the mains and changes after some periods to the internal transformer.

Control circuit

The control IC is a TDA1060 giving pulse width modulated pulses to one of two different drive/switchstages, line or battery. The change from one drive stage to the other is made between two drive pulses when the mains are failing. The control circuit regulates the pulse width according to the load on the 5V output. It has inputs for over current protection (both line and battery mode) battery on /off and outputs for battery mode indicator and power failure.

Drive and switch stages

PE 1759 is equipped with separate drive and switch stages for line and battery mode. The line-switch is two BU426 in parallel, while the battery switch is a SDT 96303

Battery charger

The two Ni-Cd batteries are continuously charged from the internal charger. The charging time is 12...36 hours.

5V output

The 5V output is equipped with schottky diodes and gives a maximum of 25A. The output level is fed back to the control circuit by an opto-coupler which also serves the 5V current regulation function. A marginal switch allows a shift of the output level + or - about 5%.

12V output

This stage has its own series regulator syncronized with the pulses from the transformer. The pulse width is regulated by both voltage and current regulators in a pulse width modulator. A marginal switch allows a shift of the output level + or - about 8%.

CIRCUIT DESCRIPTION

Input

The input is equipped with a filter (chokes L101, L102 and capacitors C101...106) reducing both symmetrical and asymmetrical disturbances from internal and external sources. The input surge current is reduced with NTC-resistor R102. The AC current is rectified and filtered in GR104 and C110. During the start sequence the unit is powered by emitter follower TS101 and GR105, in continuous mode via TS102 and GR107.

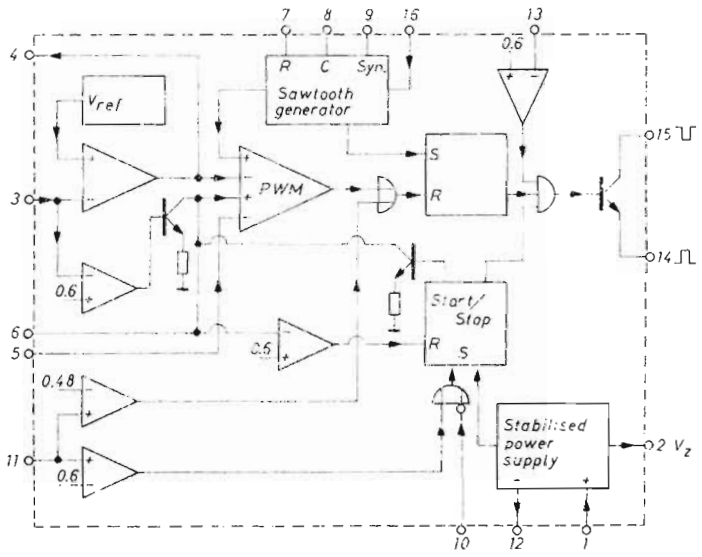
The emergency-off function is controlled by an external switch via J101:7 - TB102:4. It is powered from the mains via T1 and diods D1, D2. The emergency-off function inhibits both outputs but is not separating the unit from the supply.

Control circuit

The basic functions of the drive and control circuit TDA1060 (IC110) is explained below.

- A temperature compensated reference source.
- An error amplifier with pin 3 as input.The output is connected to pin 4 so that the gain is adjustabel with external resistors.
- A sawtooth generator with a TTL-compatible synchronization input (pins 7, 8, 9).
- A pulse-width modulator (PWM) with a duty-cycle (δ) range from 0 to 50%. The PWM has two additional inputs:
  Pin 6 can be used for a precise setting of δ max.
  Pin 5 gives a direct access to the modulator, allowing for real constant current operation.

- A gate at the output of the PWM provides a simple dynamic current limit.
- An RS latch that is set by the flyback of the sawtooth and reset by the output pulse of the above mentioned gate prohibits double pulses.
- Another latch functions as a start-stop circuit; it provides a fast switch-off and a slow start.
- A current protection circuit that operates via the start-stop circuit. This is a combined function with the current limit circuit. Therefore pin 11 has two trip-on levels.
- A TTL compatible remote on/off input at pin 10, also operating via the start-stop circuit.
- An inhibit input at pin 13. The output pulse can be inhibited immediately.
- An output gate that is commanded by the latches and the inhibit circuit.
- An output transistor of which both the collector (pin 15) and the emitter (pin 14) are externally available.
- A power supply that can be either voltage or current driven (pins 1 and 12). The internally generated stabilised output voltage VZ is connected to pin 2.



Block diagram of the TDA1060

- A special function is the so-called feed-forward at pin 16. The amplitude of the sawtooth generator is modulated in such a way that the duty cycle becomes inversely proportional to the voltage on this pin.
- Loop fault protection circuits assure that the duty-cycle is reduced to zero or a low value for respectively open or short circuited feedback loop.

The circuit is powered via pin 1 by approx 14V and functions here as follows:

The output voltage on the 5V output is sensed and fed to the control circuit IC110 via optocoupler IC201 and R163.The pulse-width-modulated output from IC110 is available on pin 15. The frequency in IC110 is defined by R156 and C143. During the start sequence the pulse width is limited by a resistor network and capacitor C141, providing a slow start function.

Pin 16 on IC110 senses the DC-voltage on the input rectifier via R149 and provides the feed forward function. At high input voltage the saw-tooth amplitude is raised and consequently the pulse width is reduced, this inhibits DC-magnetization of the transformer.

The current-limitation on IC110:11 senses the voltage drop over R127, R144 respectively, reducing the following pulses. At severe overload the unit changes to hick-up-mode.

Demagnetization of the transformer is checked after each period via pin 13 which then remains high and prohibits next output pulse. If the line voltage falls out, this is sensed by R103, R104. Input 5 in IC104 then goes low and, if the BAT ON/OFF switch is on, the signal passes 2x IC101 to IC105:5. This allowes the pulses from IC110:15 to pass via IC102 and IC101:6 to the C-MOS buffer IC107 and the driving stage. The Remote on/off function is connected via J101 to IC109 which shuts down IC110.

The Power Fail signal on J101:6, 8 is taken from IC103. The over-temperature indication consist of a thermostat connected between J101:1 and J101:2.

In battery-mode a current is drawn from IC105:2 through IC108 which activates the transistor TS202 in the 5V output stage giving about 10mA to an external LED "Battery operation indicator" connected to J101:15-TB102:3

Drive and switch stages

In line mode the pulses from IC110 is fed via C-MOS buffer IC102, and emitter follower TS120 to the two switch-transistors TS122, TS123. GR129 and C122 provides a level shift. R124 and GR123, GR124 defines a constant current for the drive stage. At turn-off is the emitter follower TS 121 activated and reduces the base current.

GR127 and GR128 provides a proportional driving by sensing the collector voltage and limiting the base current. C124, GR131 and R128 is a slow rise circuit protecting the switch-transistors at turn-off.

In battery-mode the drive is performed by TS125 and TS126 in a similar way as the line mode. Reduction of the base drive prior to turn-off is performed by TS129 on a shift from IC104. Slow rise is secured by C128, GR146 och R143.

Battery charge

The battery charging circuit is powered from T101 via diodes GR147, GR148 and choke L103. It is filtered by C129 and fed to the batteries via R141. The charging time is 12...36 hours.

5V output

The 5V output voltage is taken via schottky-diodes GR201 and GR202 and the choke L200, filtered with C202. R202 is a bleeder, C204 takes care of high frequency noise. The output is protected with a tranzorb GR202. The voltage regulation circuit senses on IC200:6 the output level via resistor chain R203, R219, R220, R221, the level is set with R220. At too high level, IC200:6 goes high and pin 7 low. Via TS201 current is drawn through IC201 changing the pulse width from IC110.

Over-current is sensed via T200 giving a voltage over R206, and via the network C207, GR204, GR205, R207, R208 the level is fed to IC200:2. This input goes low at over-current and the output is via TS200 and IC201 reducing the pulse width from IC110. The current regulation circuit has a fold-back characteristic due to resistors R212, R222 and R224. Reference for the voltage regulation and current regulation is IC201 giving about 2.5V. The diode GR200, R205, GR206 and C213 gives the internal DC-supply. A marginal switch is connected to the 5V circuit via J101, it is used to change the output level up or down 4...6%, it changes the resistor chain used for level setting.

12V output

The 12V output consist of rectifier GR301, serie switch TS300, free-wheel diode GR305, choke L300 and filter capacitor C305. The square-wave from the transformer passes GR301 and is in TS300 regulated. At too high output-level, the resistor-chain R334, R332, R331 and R330 gives via R320 a higher level at IC 302:3. This makes IC302:1 high and consequently IC301:8 high. In IC301 this level is compared with a saw-tooth voltage on pin 9 taken from the square-wave at T101:19 via R310 and C311. As a result we get a pulse width modulated signal on IC301:14 driving TS300 via TS301. The voltage level is set with potentiometer R331.

The current regulation circuit senses the voltage drop over a resistor 0.02 ohm integrated in the PC-board and connected to IC302:5, the output of this regulator goes via GR309 to the pulse-width-modulator IC301:8. At too high output current the output voltage will be reduced with a foldback characteristic realized by the resistor-chain R321, R324 and R325. Internal power supply to the 12V output is taken via GR303 and C302. GR307 gives a zener stabilized reference on 2.5V for IC302. A marginal switch is connected to the 12V circuit via J101 it changes the resistor chain used for levelsetting. The marginal switch changes the output level up or down by about 8%.

CHECKING AND ADJUSTING

The following information provides the complete checking and adjusting procedure for the power supply. As various control functions are interdependent, a certain order of adjustment is necessary, so please follow the text. For each test the settings shall be as the previous one if nothing else is stated. It is assumed that the operator doing this test is familiar with the supply and its characteristics.

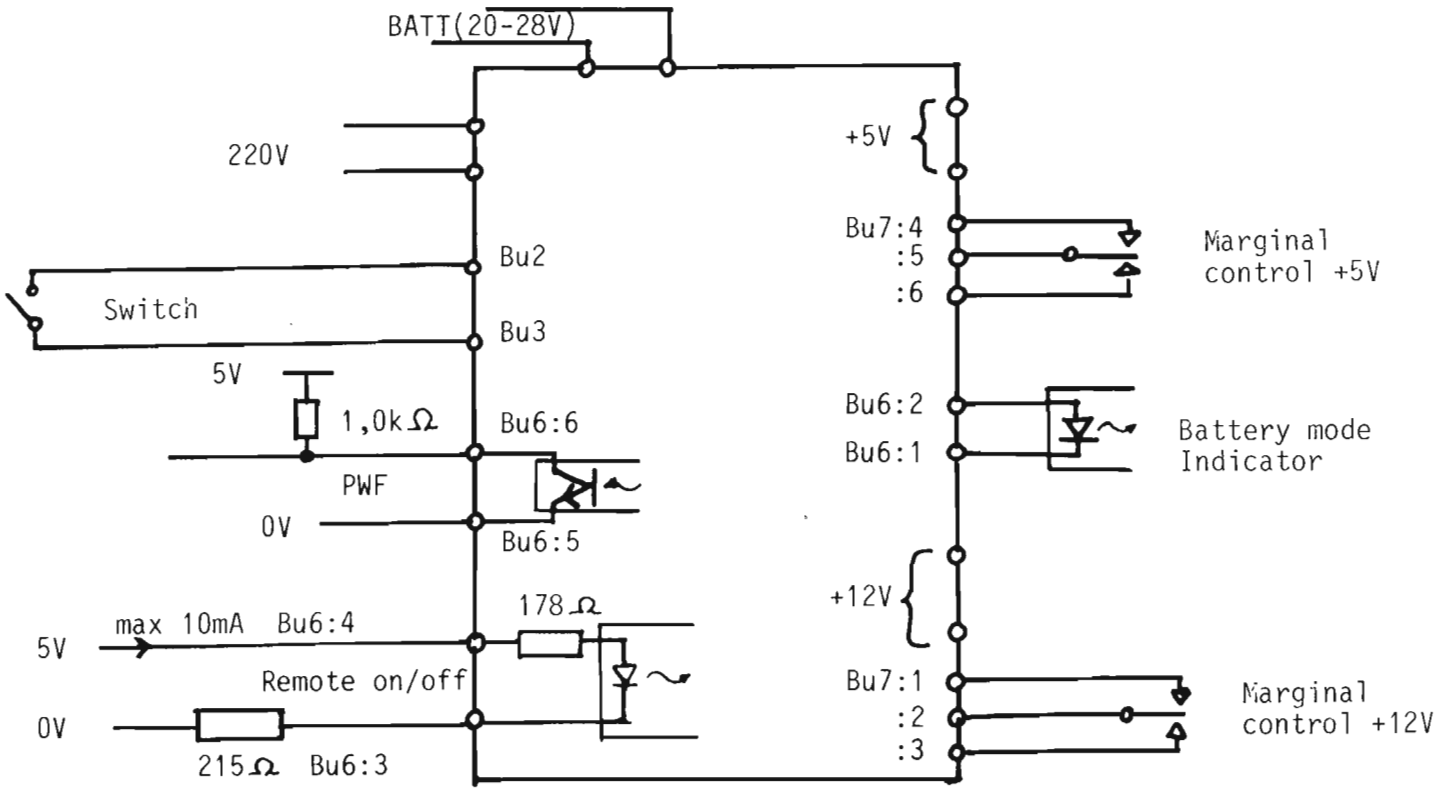
- Before adjustments are made, leave the supply on, to attain its normal operating temperature.
- All limits and tolerances given in this section are calibration guides and should not be interpreted as specifications unless they are published in the characteristics section.
- Tolerances given are for the power supply under test and do not include test equipment error.

Warning: Working with an opened PE 1759 asks for extra attention as the batteries are on line potential and the input capacitor may carry high voltage for some minutes after switching off. High voltage on the cooling fin of TS122 and TS123 is present also in battery mode.

Recommended test equipment

Instrument needed	Specification	Suggested brand
DC supply	20V, 0-100mA	Philips PE 1535
DC supply	0-28V, 0-14A	Philips PE 1645
DC supply	5V, 0-100mA	Philips PE 1535
Oscilloscope	DC...50MHz	Philips PM 3215
2 pcs Voltmeter	0-50VDC	Philips PM 2517X
1 Currentmeter/ Current shunt	0-50ADC 100A/60mV	
1 Currentmeter	0-10ADC	Philips PM 2517X
1 Voltmeter	0-30VAC	Philips PM 2517X
Load	220ohms, 11W	
Load	0-35A at 5V	AC-DC Electronics mod EL 750
Load	0-5A at 12V	
Variable transformer	0-265V, 6A	Philips 530-05415
Voltage tester	0-2100VDC	Norma 1806 30303

Test set-up



Test points 5 V : Bu12:3 +
Bu 6:1 -

12 V : Bu12:2 +
Bu12:1 -

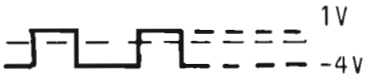
PC-BOARD TEST

Adjust the potentiometers to min. position. Connect a load (220 ohm, 11W) on BU4-BU5 to avoid too high voltage over C129 during the test procedure.

Check the line drive stage by connecting 20VDC to BU13 (BU14=0V) and check the following waveforms:

IC102 pin 3 

IC102 pin 2 

GR130 cathode 

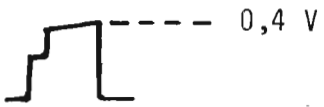
Disconnect the 20V supply. Connect a DC supply 0...28V, 0...14A to BU4 (BU5=0V) adjust it to 24V. Close the battery switch BU2/BU3. Check that U_5 is less than 5V. If not disconnect the input voltage as some components may be damaged.

Check the signal at the base of TS128 

Load the outputs 1_5=5A, 1_{12}=1A. Adjust the outputs to U_5=5.00V U_{12}=11.0V. Check the voltage over C129, it should be about 33V.

Full load

Increase the load to 1_5=25A 1_{12}=4A. Check the signal at IC110:11



Current limits

Increase the load on the 5V output. Current limit should start at 25...35A. Short circuit the 5V output, the short circuit current should be 15...25A. Repeat it several times, short direct on the output bars.

Increase the load on the 12V output. Current limit should start at 4-5A. Short circuit the 12V output, the current should be less than 1A. Repeat it several times.

Line mode

Open the battery switch and interconnect BU22 and BU23. Connect the mains voltage with both outputs at zero load. Repeat measurements "Full load" and "Current Limits"

Regulation

Check the regulation at different input voltages and loads. At input voltage 180-264V, it should be:

U_5=5.0V ±1% at 0...25A
U_{12}=12.0V ±1% at 0...4A

Close and open the battery switch. Check that the 5V output is stable.

Check the regulation in the same way in battery-mode with the DC-supply varying between 20...28VDC.

Marginal switches

Check that the marginal switches gives a change of about:

5V:	4.75	- 5.00	- 5.25V
12V:	11.0	- 12.0	- 13.0V

Battery-mode indicator

Check that the indicator is on in battery-mode

Power failure

Measure the voltage on BU6:6 - BU6:5 it shall be less than 0.8V when a resistor of 1.0 kohm is connected in series with a supply on 5VDC

Remote on/off

Connect a 5V supply in series with 215 ohm, note max. 10mA, to BU6:4-BU6:3. Check that the remote on/off works in both line and battery-mode.

Test points

Check that the right voltages are present at following test points:

5V at BU12:3+ and BU6:1-
12V at BU12:2+ and BU12:1-

Ripple

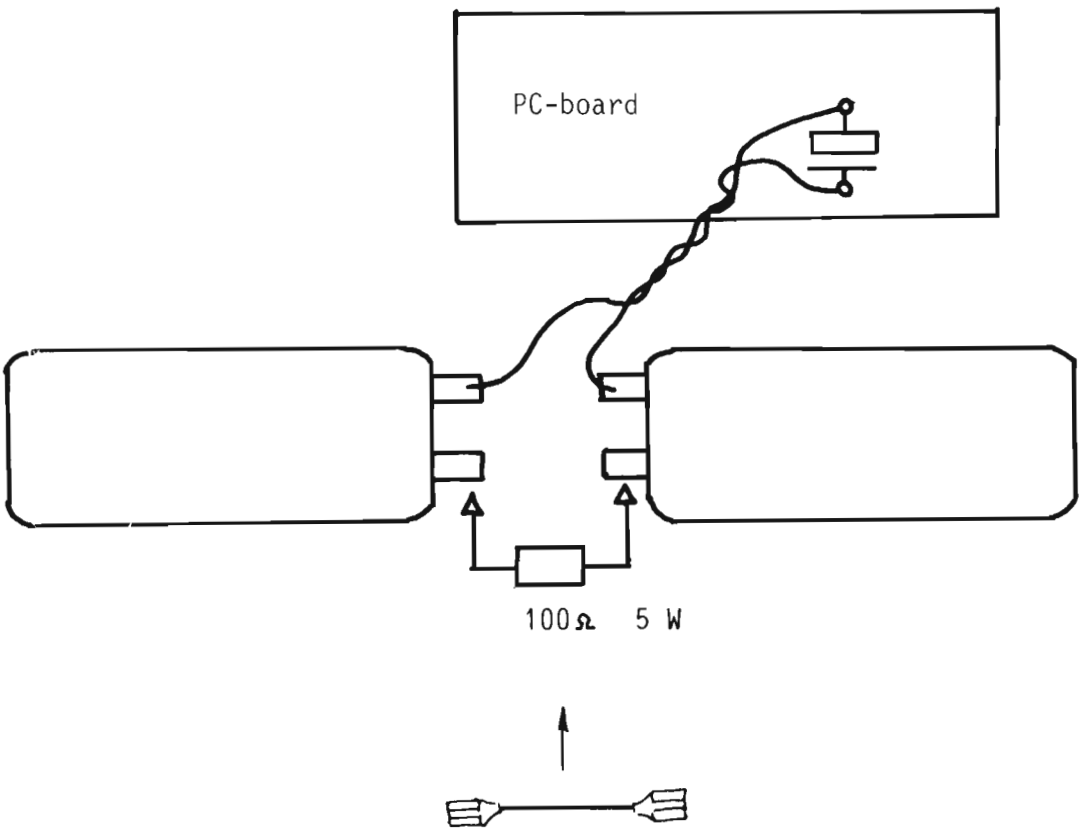
Check that the ripple on each output is less than 100mVpp, full load.

CHARGING THE BATTERIES

Before testing the supply with batteries, they must be charged with 300mA during 10 hours or 200mA during 15 hours. When charged in the power supply, the 5V output has to be loaded with 1...2A. The charging should then continue for at least 36 hours.

Connecting the batteries

Note that the battery switch should be open.



First interconnect via a 100 ohm resistor in order to charge C130, then connect the cable with AMP-connectors.

FINAL TEST

Check the isolation with a high voltage test 2100VDC, the isolation resistance shall be mains - ground: more than 10 Mohm

Check the earth resistance from BU1 to chassi, shall be less than 500 mohm, measured with 25A.

Check that the outputs are at the right level at different mains voltages and different loads.

Check that the marginal switches, battery indicator, power failure, remote on/off and ripple are according to the previous text.

Check that emergency off works in mains-mode.

Close the battery switch. Adjust to max. load. Disconnect the mains and measure the time until the 5V output goes below 4.90V. This period should be longer than 5 minutes.

Recharge the batteries and open the battery switch.

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
BU6	2422 025 02473	CONNECTOR	6.00	POL	22-27-2061 6410-6
BU7	2422 025 02473	CONNECTOR	6.00	POL	22-27-2061 6410-6
C101	2031 220 03005	CAPACITOR	4.70	NF	20% 250V PME271Y447
C102	2031 220 00016	CAPACITOR	220.00	NF	10% 250V PME271M622
C103	2031 220 03005	CAPACITOR	4.70	NF	20% 250V PME271Y447
C104	2031 220 03005	CAPACITOR	4.70	NF	20% 250V PME271Y447
C105	2031 220 00016	CAPACITOR	220.00	NF	10% 250V PME271M622
C106	2031 220 03005	CAPACITOR	4.70	NF	20% 250V PME271Y447
C107	2222 344 51474	CAPACITOR	470.00	NF	10% 400V
C108	2031 220 03008	CAPACITOR	10.00	NF	20% 250V PME271Y510
C109	2031 220 03008	CAPACITOR	10.00	NF	20% 250V PME271Y510
C110	2222 052 58221	CAPACITOR	220.00	UF	-10/+30% 385V 35X55
C111	2222 122 55228	CAPACITOR	2.20	UF	-10/+50% 16V
C112	2222 344 21105	CAPACITOR	1.00	UF	10% 100V
C120	2222 679 10101	CAPACITOR	100.00	PF	2% 100V NP0 2M
C121	2222 679 10101	CAPACITOR	100.00	PF	2% 100V NP0 2M
C122	2222 344 21105	CAPACITOR	1.00	UF	10% 100V
C123	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
C124	2012 326 10008	CAPACITOR	1.50	NF	10% 1000V FKPI
C126	2222 122 54478	CAPACITOR	4.70	UF	-10/+50% 10V
C127	2222 030 34101	CAPACITOR	100.00	UF	-10/+50% 10V
C128	2222 357 71473	CAPACITOR	47.00	NF	10% 600V
C129	2222 030 37479	CAPACITOR	47.00	UF	-10/+50% 40V
C130	2222 050 57472	CAPACITOR	4700.00	UF	-10/+30% 40V 35X45
C131	2222 122 55228	CAPACITOR	2.20	UF	-10/+50% 16V
C132	2222 630 53102	CAPACITOR	1.00	NF	10% 100V 2M
C133	2222 630 53102	CAPACITOR	1.00	NF	10% 100V 2M
C139	2222 122 55228	CAPACITOR	2.20	UF	-10/+50% 16V
C140	2222 679 10101	CAPACITOR	100.00	PF	2% 100V NP0 2M
C141	2222 122 54339	CAPACITOR	33.00	UF	-10/+50% 10V

PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
C142	2222 630 53102	CAPACITOR	1.00	NF	10% 100V 2M
C143	2222 443 42322	CAPACITOR	2.32	NF	1% 63V
C145	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
C200	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
C201	2222 347 21104	CAPACITOR	100.00	NF	10% 100V
C202	2222 106 33223	CAPACITOR	22000.00	UF	-10/+50% 6.3V
C204	2222 122 53689	CAPACITOR	68.00	UF	-10/+50% 6,3V
C205	2031 220 00014	CAPACITOR	100.00	NF	20% 250V PME271M610
C206	2222 344 21474	CAPACITOR	470.00	NF	10% 100V
C207	2222 122 55228	CAPACITOR	2.20	UF	-10/+50% 16V
C208	2222 344 21104	CAPACITOR	100.00	NF	10% 100V
C210	2222 344 21474	CAPACITOR	470.00	NF	10% 100V
C211	2222 344 21473	CAPACITOR	47.00	NF	10% 100V
C212	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
C213	2222 122 55159	CAPACITOR	15.00	UF	-10/+50% 16V
C214	2222 344 21104	CAPACITOR	100.00	NF	10% 100V
C216	2222 122 53689	CAPACITOR	68.00	UF	-10/+50% 6,3V
C300	2222 630 53102	CAPACITOR	1.00	NF	10% 100V 2M
C302	2222 344 21474	CAPACITOR	470.00	NF	10% 100V
C304	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
C305	2222 032 15152	CAPACITOR	1500.00	UF	-10/+50% 16V
C307	2222 122 55159	CAPACITOR	15.00	UF	-10/+50% 16V
C308	2031 220 00014	CAPACITOR	100.00	NF	20% 250V PME271M610
C309	2222 122 55228	CAPACITOR	2.20	UF	-10/+50% 16V
C310	2222 679 10101	CAPACITOR	100.00	PF	2% 100V NP0 2M
C311	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
C312	2222 630 53221	CAPACITOR	220.00	PF	10% 100V 2M
C314	2222 640 53103	CAPACITOR	10.00	NF	-20/+50% 100V 2M
D1	9331 190 60701	DIODE	1.00	A	1N4005/600 DO-41
D2	9331 190 60701	DIODE	1.00	A	1N4005/600 DO-41
GR101	9331 190 60701	DIODE	1.00	A	1N4005/600 DO-41
GR102	9331 190 60701	DIODE	1.00	A	1N4005/600 DO-41

PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION	
GR103	9331 190 60701	DIODE	1.00	A	1N4005/600	DO-41
GR104	9332 987 30701	RECTIF BRIDGE	3.60	A	BY224/600	SOT-112
GR105	9331 178 10701	DIODE	0.40	W	BZX79/C12	DO-35
GR106	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR107	9331 178 30701	DIODE	0.40	W	BZX79/C15	DO-35
GR109	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR110	9331 834 80701	DIODE	7.00	A	BYX71/600	SOD-38
GR111	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR120	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR121	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR122	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR123	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR124	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR126	9332 518 60701	DIODE	1.00	A	1N5060/400	
GR127	9331 177 10701	DIODE	0.40	W	BZX79/C4V7	DO-35
GR128	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR129	9331 591 10701	DIODE	1.50	W	BZX87/C5V1	SOD-51
GR130	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR131	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR132	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR133	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR134	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR135	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR136	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR137	9331 177 30701	DIODE	0.40	W	BZX79/C5V6	DO-35
GR138	9331 591 10701	DIODE	1.50	W	BZX87/C5V1	SOD-51
GR139	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR140	9333 912 80701	DIODE	7.00	A	BYW29/100	SOD-59
GR142	9331 190 60701	DIODE	1.00	A	1N4005/600	DO-41
GR143	9331 190 60701	DIODE	1.00	A	1N4005/600	DO-41
GR144	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR145	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57

PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION	
GR146	9331 834 80701	DIODE	7.00	A	BYX71/600	SOD-38
GR147	9335 001 80701	DIODE	1.50	A	BYV95C/600V	SOD-57
GR148	9335 001 80701	DIODE	1.50	A	BYV95C/600V	SOD-57
GR149	4031 105 70610	DIODE	120.00	A	SD51/32	DO-5
GR150	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR151	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR152	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR200	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR201	4031 105 70610	DIODE	120.00	A	SD51/32	DO-5
GR202	4031 105 70610	DIODE	120.00	A	SD51/32	DO-5
GR203	9333 660 60701	DIODE	1.50	KW	1N5907	DO-13
GR204	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR205	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR206	9331 592 00701	DIODE	1.50	W	BZX87/C12	SOD-51
GR207	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR208	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR301	9333 912 80701	DIODE	7.00	A	BYW29/100	SOD-59
GR303	9335 001 90701	DIODE	1.50	A	BYV96E 1000V	SOD-57
GR305	9333 912 80701	DIODE	7.00	A	BYW29/100	SOD-59
GR307	9331 592 00701	DIODE	1.50	W	BZX87/C12	SOD-51
GR308	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR309	9331 185 60701	DIODE	0.30	A	BAV10/60	DO-35
GR310	9334 533 60701	TRANZORB	1.50	KW	1N5637A	DO-13
IC101	9332 764 10701	IC	0.00		4011PC	
IC102	9332 885 00701	IC	0.00		4049PC	
IC103	9333 869 30701	OPTOCOUPLER	0.00		H15A1	
IC104	9333 511 30701	IC	0.00		LM339N	
IC105	9332 776 10701	IC	0.00		HEF4013BP	
IC107	9332 885 00701	IC	0.00		4049PC	
IC108	9335 734 30701	OPTOCOUPLER	0.00		H24B2	
IC109	9333 869 30701	OPTOCOUPLER	0.00		H15A1	
IC110	9333 347 60701	IC	0.00		TDA1060	

PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
IC200	9332 989 30701	IC	0.00		CA358T
IC201	9333 869 30701	OPTOCOUPLER	0.00		H15A1
IC202	9335 380 00701	IC	0.00		TL431C-LP
IC300	9335 380 00701	IC	0.00		TL431C-LP
IC301	9333 511 30701	IC	0.00		LM339N
IC302	9332 989 30701	IC	0.00		CA358T
L101	4031 116 32480	BALUN	0.00		
L102	4031 116 32280	CHOKE	0.00		PE1746
L103	4031 116 32940	CHOKE	0.00		P26/16
L200	4031 116 32930	CHOKE	0.00		HYP50/4
L300	4031 116 32920	CHOKE	0.00		P36/22
R102	2322 644 90005	THERMISTOR	15.00	OHM	20% 2.2A NTC
R103	2322 153 54644	RESISTOR	464.00	KOHM	1% 1.0W MR52
R104	2322 151 51963	RESISTOR	19.60	KOHM	1% 0.4W MR25
R105	2322 214 13224	RESISTOR	220.00	KOHM	5% 1.15W CR68
R106	2322 151 51473	RESISTOR	14.70	KOHM	1% 0.4W MR25
R107	2322 330 42153	RESISTOR	15.00	KOHM	5% 11.0W WR0842E
R108	2322 151 52612	RESISTOR	2.61	KOHM	1% 0.4W MR25
R120	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R121	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R122	2322 151 51004	RESISTOR	100.00	KOHM	1% 0.4W MR25
R123	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R124	2322 151 51008	RESISTOR	1.00	OHM	1% 0.4W MR25
R125	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R126	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R127	2108 259 00149	RESISTOR	0.12	OHM	10% 200-0
R128	2322 330 42102	RESISTOR	1.00	KOHM	5% 11.0W WR0842E
R129	2322 151 53162	RESISTOR	3.16	KOHM	1% 0.4W MR25
R130	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R131	2322 330 22102	RESISTOR	1.00	KOHM	5% 4.2W WR0617E
R132	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R133	2322 151 52154	RESISTOR	215.00	KOHM	1% 0.4W MR25

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
R134	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R135	2322 151 51473	RESISTOR	14.70	KOHM	1% 0.4W MR25
R136	2322 151 51473	RESISTOR	14.70	KOHM	1% 0.4W MR25
R137	2322 151 52151	RESISTOR	215.00	OHM	1% 0.4W MR25
R138	2322 151 53838	RESISTOR	3.83	OHM	1% 0.4W MR25
R139	2112 104 20018	RESISTOR	0.22	OHM	10% 0.7W RN3
R140	2112 104 20011	RESISTOR	0.33	OHM	10% 0.7W RN3
R141	2322 330 22689	RESISTOR	68.00	OHM	5% 4.2W WR0617E
R142	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R143	2322 330 22101	RESISTOR	100.00	OHM	5% 4.2W WR0617E
R144	2322 151 53838	RESISTOR	3.83	OHM	1% 0.4W MR25
R145	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R146	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R147	2322 151 51781	RESISTOR	178.00	OHM	1% 0.4W MR25
R148	2322 151 52153	RESISTOR	21.50	KOHM	1% 0.4W MR25
R149	2322 153 54644	RESISTOR	464.00	KOHM	1% 1.0W MR52
R150	2322 151 53163	RESISTOR	31.60	KOHM	1% 0.4W MR25
R151	2322 151 51783	RESISTOR	17.80	KOHM	1% 0.4W MR25
R152	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R153	2322 151 56192	RESISTOR	6.19	KOHM	1% 0.4W MR25
R154	2322 151 52152	RESISTOR	2.15	KOHM	1% 0.4W MR25
R155	2322 151 52152	RESISTOR	2.15	KOHM	1% 0.4W MR25
R156	2322 151 52153	RESISTOR	21.50	KOHM	1% 0.4W MR25
R157	2322 151 54642	RESISTOR	4.64	KOHM	1% 0.4W MR25
R158	2322 153 54644	RESISTOR	464.00	KOHM	1% 1.0W MR52
R159	2322 151 51004	RESISTOR	100.00	KOHM	1% 0.4W MR25
R161	2322 151 51004	RESISTOR	100.00	KOHM	1% 0.4W MR25
R162	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R163	2322 151 52612	RESISTOR	2.61	KOHM	1% 0.4W MR25
R164	2322 151 54643	RESISTOR	46.40	KOHM	1% 0.4W MR25
R165	2322 151 51783	RESISTOR	17.80	KOHM	1% 0.4W MR25
R166	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25

PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
R168	2322 151 54642	RESISTOR	4.64	KOHM	1% 0.4W MR25
R169	2322 151 54642	RESISTOR	4.64	KOHM	1% 0.4W MR25
R200	2322 192 31009	RESISTOR	10.00	OHM	5% 2.5W PR52
R201	2322 192 31009	RESISTOR	10.00	OHM	5% 2.5W PR52
R202	2322 330 22159	RESISTOR	15.00	OHM	5% 4.2W WR0617E
R203	2322 151 56811	RESISTOR	681.00	OHM	1% 0.4W MR25
R205	2322 330 22151	RESISTOR	150.00	OHM	5% 4.2W WR0617E
R206	2322 151 51009	RESISTOR	10.00	OHM	1% 0.4W MR25
R207	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R208	2322 151 53832	RESISTOR	3.83	KOHM	1% 0.4W MR25
R209	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R210	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R211	2322 151 51004	RESISTOR	100.00	KOHM	1% 0.4W MR25
R212	2322 151 52612	RESISTOR	2.61	KOHM	1% 0.4W MR25
R213	2322 151 54641	RESISTOR	464.00	OHM	1% 0.4W MR25
R214	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R215	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R216	2322 151 51004	RESISTOR	100.00	KOHM	1% 0.4W MR25
R217	2322 151 53161	RESISTOR	316.00	OHM	1% 0.4W MR25
R219	2322 151 54641	RESISTOR	464.00	OHM	1% 0.4W MR25
R220	2122 362 00123	POTENTIOMETER	200.00	OHM	10% 72P
R221	2322 151 55629	RESISTOR	56.20	OHM	1% 0.4W MR25
R222	2322 151 51212	RESISTOR	1.21	KOHM	1% 0.4W MR25
R223	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R224	2322 151 52612	RESISTOR	2.61	KOHM	1% 0.4W MR25
R225	2322 151 55629	RESISTOR	56.20	OHM	1% 0.4W MR25
R236	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R300	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R304	2322 330 22472	RESISTOR	4.70	KOHM	5% 4.2W WR0617E
R305	2322 151 52151	RESISTOR	215.00	OHM	1% 0.4W MR25
R307	2322 191 31502	RESISTOR	1.50	KOHM	5% 1.6W PR37
R308	2322 214 13101	RESISTOR	100.00	OHM	5% 1.15W CR68

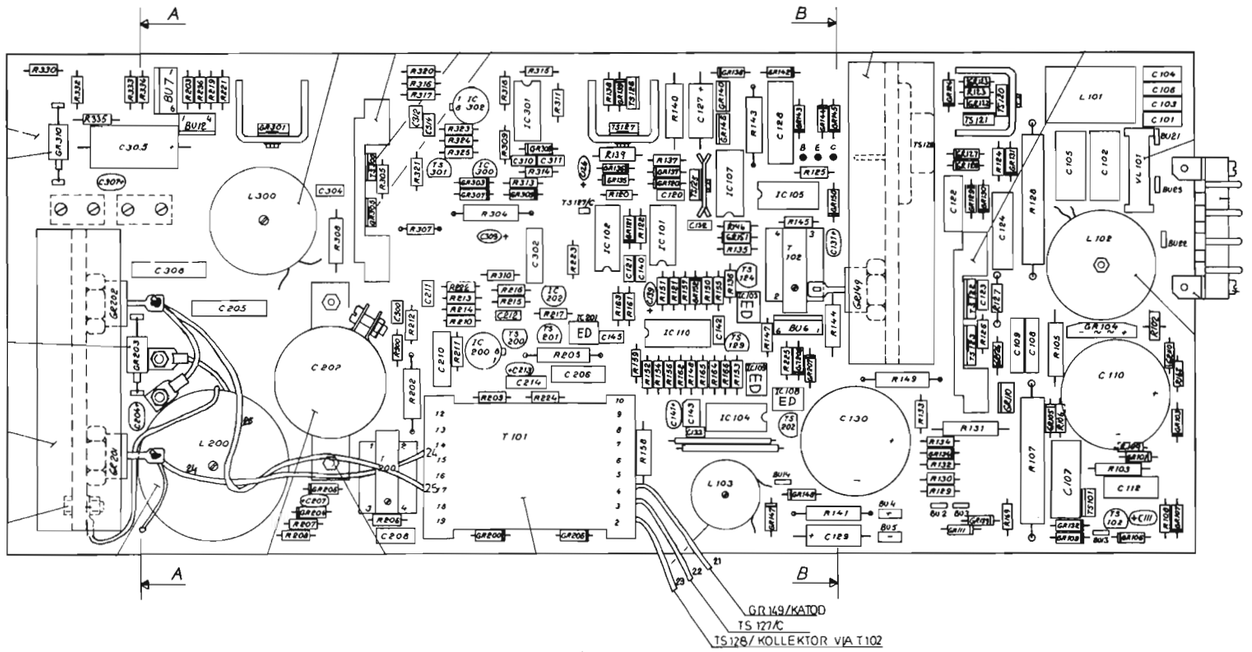
PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
R309	2322 151 52152	RESISTOR	2.15	KOHM	1% 0.4W MR25
R310	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R311	2322 151 53161	RESISTOR	316.00	OHM	1% 0.4W MR25
R313	2322 151 51005	RESISTOR	1.00	MOHM	1% 0.4W MR25
R314	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R315	2322 151 52152	RESISTOR	2.15	KOHM	1% 0.4W MR25
R316	2322 151 52154	RESISTOR	215.00	KOHM	1% 0.4W MR25
R317	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R318	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R320	2322 151 51003	RESISTOR	10.00	KOHM	1% 0.4W MR25
R321	2322 151 55622	RESISTOR	5.62	KOHM	1% 0.4W MR25
R323	2322 151 51005	RESISTOR	1.00	MOHM	1% 0.4W MR25
R324	2322 151 51002	RESISTOR	1.00	KOHM	1% 0.4W MR25
R325	2322 151 53839	RESISTOR	38.30	OHM	1% 0.4W MR25
R330	2322 151 51001	RESISTOR	100.00	OHM	1% 0.4W MR25
R331	2122 362 00123	POTENTIOMETER	200.00	OHM	10% 72P
R332	2322 151 58251	RESISTOR	825.00	OHM	1% 0.4W MR25
R333	2322 151 53832	RESISTOR	3.83	KOHM	1% 0.4W MR25
R334	2322 151 53832	RESISTOR	3.83	KOHM	1% 0.4W MR25
R335	2322 191 34701	RESISTOR	470.00	OHM	5% 1.6W PR37
TS101	9332 715 60701	TRANSISTOR	0.00		BUX86 1A 400V TO126
TS102	9331 492 00701	TRANSISTOR	0.00		BC337 .5A 45V TO92
TS120	9330 822 40701	TRANSISTOR	0.00		BD131 6A 45V TO126
TS121	9330 822 50701	TRANSISTOR	0.00		BD132 6A 45V TO126
TS122	9333 275 90701	TRANSISTOR	0.00		BU426A 8A375V SOT93
TS123	9333 275 90701	TRANSISTOR	0.00		BU426A 8A375V SOT93
TS124	9331 492 00701	TRANSISTOR	0.00		BC337 .5A 45V TO92
TS125	9330 822 40701	TRANSISTOR	0.00		BD131 6A 45V TO126
TS126	9330 822 50701	TRANSISTOR	0.00		BD132 6A 45V TO126
TS127	9334 913 50701	TRANSISTOR	0.00		D44H11 10A 80V TO220
TS128	9335 342 50701	TRANSISTOR	0.00		SDT96303 120A140VTO3
TS129	9331 492 00701	TRANSISTOR	0.00		BC337 .5A 45V TO92

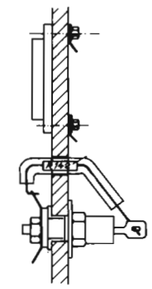
PE1759 4031 116 32800 FACTORY PART LIST BY ITEM-NO DATE 82-11-19

ITEM-NO	FACTORY-CODE	DESCRIPTION	VALUE	SORT	TECHN DESCRIPTION
TS200	9331 491 80701	TRANSISTOR	0.00		BC327 .5A 45V TO92
TS201	9331 491 80701	TRANSISTOR	0.00		BC327 .5A 45V TO92
TS202	9331 492 00701	TRANSISTOR	0.00		BC337 .5A 45V TO92
TS300	4031 105 88090	TRANSISTOR	0.00		BDX34C TO220
TS301	9332 066 00701	TRANSISTOR	0.00		BSS38 .1A 100V TO92
T101	4031 116 32900	TRANSFORMER	0.00		E42/21/15
T102	4031 116 30210	TRANSFORMER	0.00		U20/16/7
T200	4031 116 30210	TRANSFORMER	0.00		U20/16/7
VL101	2413 088 00134	FUSE HOLDER	0.00		L2222/K
VL101	2422 086 01118	FUSE	4.00	A	20T 5X20MM S-MÄRKT

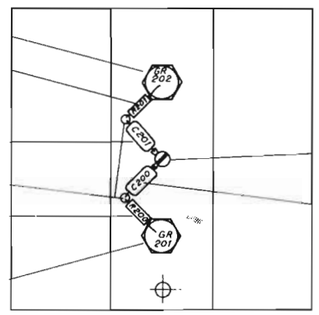
9 DATA LINES READ
0 DATA LINES REJECTED

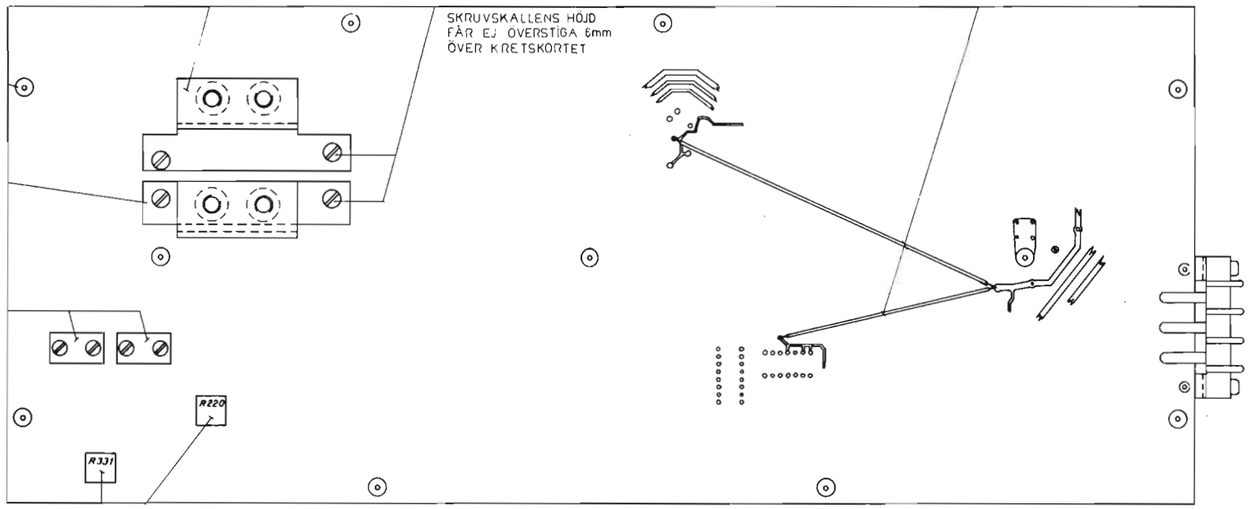


SNITT C-C



VY A-A





VY B-B