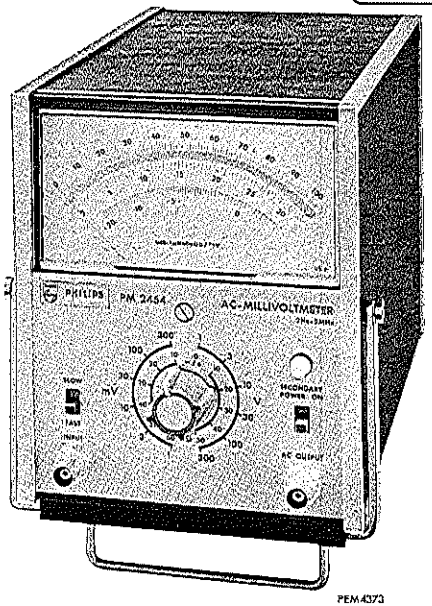
P52.21



PEM4373

AC-MILLIVOLTMETER

PM 2454

9447 024 54..1

9499 470 03711

30/668/01

CS16922

GENERAL

DIRECTIONS FOR USE

SERVICE DATA

LIST OF FIGURES

ERRATUM

In the chapters Technical Data and checking and adjusting the cur
consumption should be altered: at 115 V ⟶ 34 mA
at 230 V ⟶ 17 mA

GENERAL

I. INTRODUCTION

The PHILIPS AC-Millivoltmeter PM 2454 is a sensitive and accurate measuring instrument suitable for measuring voltages from 50 μ V... 300 V in the frequency range from 2 Hz... 2 MHz
The instrument is fully transistorised (Silicon transitors), mains-powered and of modular construction. It can, therefore, be used both as a table model and in combination with other equipment mounted in standard racks.
A special feature of this AC-Millivoltmeter is its high input impedance of 10 M Ω // 25 pF. On account of this it is also possible to measure voltages from high-ohmic sources.

The 12 measuring ranges of 1 mV... 300 V f. s. d. overlap so that a high reading accuracy is obtained. The moving-coil instrument is provided with a mirror scale with the ranges 0-30 and 0-100 as well as a dB scale from -20 dB... +2 dB (total scale span -80 dB...+52 dB. The indicating speed can be switched from "FAST" to "SLOW", so that it is also possible to obtain a high reading accuracy at lower frequencies.

The supply section, which is based on the INVERTED GUARD-system, permits of measuring free from earth currents, even when the instrument is earthed to the mains.
Due to its large bandwidth the instrument has wide range of applications, e.g. measurements on LF and IF amplifiers, carrier-wave telephony, infra and ultrasonics, etc.
The amplifier output, moreover,makes it possible to employ the instrument as a pre-amplifier for special purposes or may be used for connecting an oscilloscope.

II. TECHNICAL DATA

Tolerances: Numerical values with tolerances stated are guaranteed by the factory. Numerical values without tolerances serve merely for information and represent the properties of an average instrument.

A. ELECTRICAL:

Measuring range	: 50 µV... 300 V divided into 12 ranges from 1 mV... 300 V(f. s. d.)
dB Measuring range	: -80 dB... +52 dB (12 ranges) 0 dB = 1 m W into 600 Ω, 0.775 V
Measuring accuracy	: 10 Hz...300 kHz ± 1% of f. s. d. ± 1% of the reading Additional error at: 300 kHz...1MHz ± 1% of f. s. d. 1 MHz...2 MHz and 2 Hz...10 Hz ± 2% of f. s. d. Switchable indication speed
Preliminary deflection	in position 1 mV ≤ 25 µV (with short-circuited input)
Input impedance	: 10 M Ω//25 pF
Overload protection	: For d. c. and frequencies <100 Hz: at all ranges : 300 Vrms For frequencies >100 Hz Ranges 1 mV... 1 V: 30 Vrms Ranges 3 V...300 V: 300 Vrms
Effect of mains voltage variations	: A mains voltage variation of ± 15 % causes an additional measuring error of max. 0.2 %
Temperature range	: + 15°C... 35°C for the tolerances specified. Between 0°... 15° and 35°... 50°a temperature coefficient of ± 0.1% / °C should be taken into account.
Rectifying circuit for the meter section	: Full-wave rms value rectifier
Meter scale	: Mirror scale with knife-edge pointer. Calibrated in rms values of sinusoidal input voltages.

AC output	: Output impedance: 600 Ω ± 3% Output voltage at f. s. d.: 50 m Vrms ± Short-circuit proof
Supply	: Mains voltage: 115 V ± 15% or 230 V ± 15% Mains frequency: 40 Hz...100 Hz Current consumption at 230 V: 10 mA at 115 V: 20 mA
Long-term stability	: at min. 1000 operating hours 0.5% of on the average.
Max. permissible voltage between mains earth and instrument housing	: 500 Vp-p or 300 Vrms

B. MECHANICAL

Dimensions	: Height	180 mm
	Width	147 mm
	Depth	255 mm
Weight	: approx 4 kg.	
Mechanical construction	: modular cabinet; width 2 modules The mains section is of the "INVERTED GUARD" type	

III. ACCESSORIES

1 adapter from BNC to 4-mm sockets (PM 9051)
1 mains lead
1 spare fuse, 200 mA, delayed-action
1 manual

IV. BLOCK DIAGRAM (FIG. 1)

The voltage to be measured is applied to input attenuator I via input socket "INPUT". This attenuator is a capacitively compensated voltage divider, which effects an attenuation of 50 dB for all voltages from the 3 V range and upwards. For the lower ranges the input voltage is applied direct to the impedance matching stage.
Attenuator II is an ohmic voltage divider, which, in conjunction with attenuators I and III, divides the intermediate ranges into steps of 10 dB. The signal is now amplified by a factor 50 in a pre-amplifier and then applied to voltage divider III and from there to a second impedance matching stage. The latter consists of a double emitter-follower stage, so that the voltage divider is not influenced by the output amplifier.
The output of the second impedance stage is connected to output socket "AC OUTPUT" as well as to the amplifier and the rectifying circuit. In the feedback circuit of the multi-stage amplifier circuit a rectifier network has been included, which supplies the current for the meter. As the current in the feedback circuit is exactly proportional to the input voltage, the value indicated by the instrument will be equal to the value of the measuring voltage.
By means of switch "SLOW" the indicating speed of the meter can be reduced by including an additional capacitor, so that better reading is possible in the case of fluctuating measuring value indications.
The supply section of the instrument comprises a mains section, which is based on the "INVERTED GUARD" system. Due to the very low capacitance of the primary winding with respect to the secondary winding and with respect to the housing, only negligibly small earth currents will arise. As a result the properties of the instrument will be practically the same as those of battery-operated instruments.

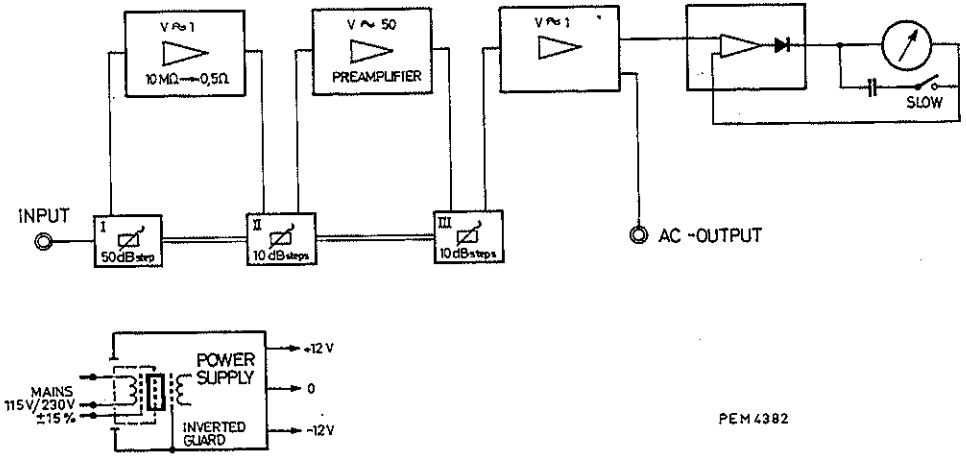


Fig. 1 Block diagram

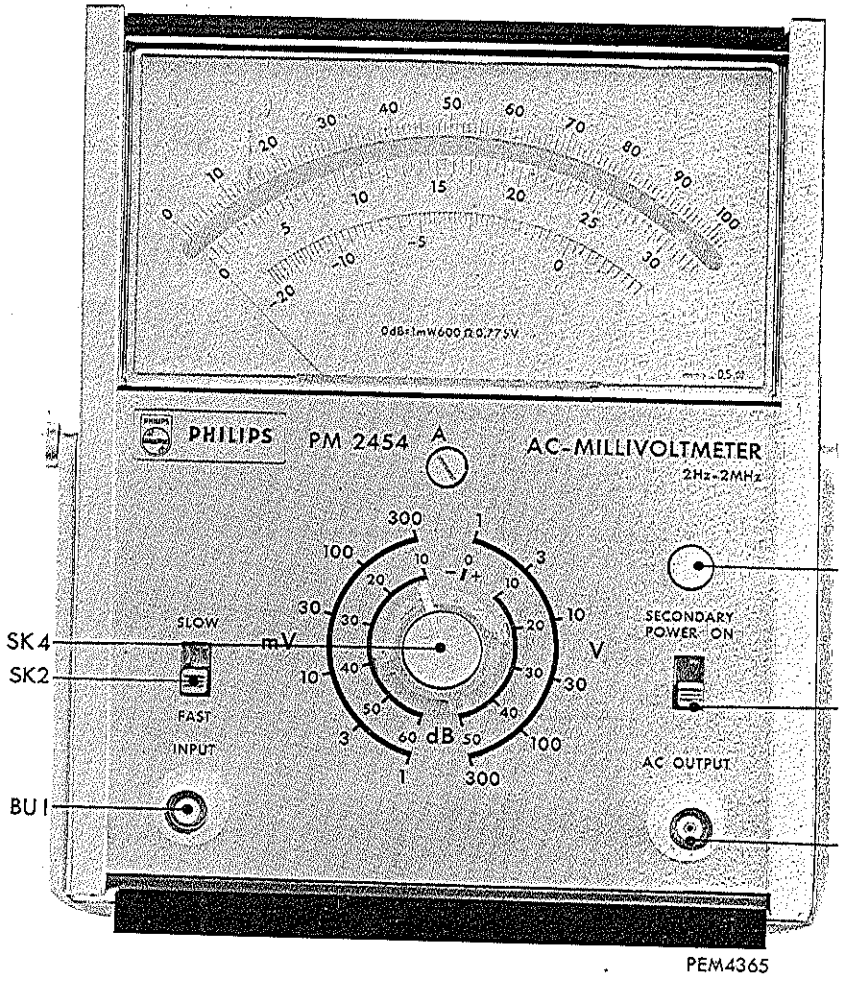


Fig. 3 Front view

VI. OPERATION (FIG. 3)

1. Mechanical zero setting

Place the instrument in a horizontal position and check the zero setting of the meter in the switched-off condition. If necessary, correct the setting by means of plastic screw A.

2. Switching-on

The primary side of the mains transformer is always connected to the mains. Therefore, the instrument has not been provided with a mains switch, but with a switch "SECONDARY POWER ON", which is included in the secondary circuit. The instrument is switched on by means of this switch after which the pilot lamp above the switch will light up.

3. Connecting the circuit under test

The voltage to be measured should be applied to coaxial socket "INPUT"(BU 1). The high input impedance of 10 MΩ //25 pF permits of carrying out measurements on very high-ohmic circuits.
As the mains section of the instrument is based on the "INVERTED GUARD" system, the capacitance between the instrument housing and the mains is very small(approx. 2 pF). As a result only very small earthing currents will arise, which can hardly effect the measurement.

4. Measuring at low frequencies

If it is not possible to obtain a proper reading due to pointer fluctuations at low frequencies, switch "SLOW-FAST"(SK 2) should be set to position "SLOW". As a result the indicating speed of the meter will be reducted and the pointer deflection will become more stable.

5. Amplifier output

Coaxial socket "AC OUTPUT"(BU2) is an amplifier output. At full scale deflection of the meter (100 or 30 scale divisions) the output voltage on this socket is approx. 50 mV, independent of the selected range. The output is short-circuit proof. The output impedance is 600 Ω ± 3%.
The waveform and phase of the output voltage correspond to the input voltage. The amplifier output is, therefore, extremely suitable for displaying the measuring signal by means of an oscilloscope.
The instrument can also be used as a sensitive distortion free pre-amplifier or as an attenuator for high voltages, for more accurate evaluation of the output signal.

6. Selective voltage measurements

Selective voltages measurements can be carried out with the aid of an external filter. For the connection of this filter, see chapter VI point D. For displaying selective signals(e.g. on an oscilloscope), a selective signal may be taken from output socket of the filter.

7. Errors due to distortion

Although the meter indicates the mean value of the full-wave rectified voltage, the scale of the instrument is calibrated in rms values of sinewave voltages. As a result measuring errors will ari when measuring non-sinusoidal voltages. The values of these depen on the coefficient of non-linear distortion. However, the voltmeter may be employed for comparative measurements of non-sinusoidal voltages with the same waveform. The measuring result may then differ from the value indicated by means of e.g. a thermo-couple voltmeter, which indicates the actual rms value.

Attention

At the rear of the instrument a hole has been provided for operating potentiometer R510 (see chapter X, point 4a) Because a very accurate calibration voltage is required, this potentiometer should readjusted in the case of re-calibration.

SERVICE DATA

VII. CIRCUIT DESCRIPTION (FIG. 20)

A. VOLTAGE RANGES

The 12 measuring ranges are determined by means of an attenuator consisting of three sections. The input attenuator (SK4/I) is a frequency-compensated voltage divider, which is operative in the measuring ranges from 3 V to 300 V. It causes an attenuation of the input voltage of 1: 316.2; which corresponds to 50 dB. The attenuator can be adjusted by means of potentiometer R404 and trimmer C403. At the ranges 1 mV...1 V the input voltage is applied direct to the input stage.

Two other sections, II and III, are ohmic voltage dividers, which are connected between the amplifier stages in order to reduce the operating range of the amplifier and to obtain a low signal-to-noise ratio. The attenuation effected by the input voltage divider in conjunction with the attenuator stages is 10 dB per step.

In other words, the first step is 0 dB and the highest step is 110 dB. The following table gives the sub-division relative to the switch sections. The total attenuation per stage is obtained by adding the attenuation of the individual attenuators.

Measuring range	Attenuator SK4/I	Attenuator SK4/II	Attenuator SK4/III	Total attenuation
1 mV	0 dB	0 dB	0 dB	0 dB
3 mV	0 dB	0 dB	10 dB	10 dB
10 mV	0 dB	0 dB	20 dB	20 dB
30 mV	0 dB	10 dB	20 dB	30 dB
100 mV	0 dB	20 dB	20 dB	40 dB
300 mV	0 dB	20 dB	30 dB	50 dB
1 V	0 dB	30 dB	30 dB	60 dB
3 V	50 dB	0 dB	20 dB	70 dB
10 V	50 dB	0 dB	30 dB	80 dB
30 V	50 dB	10 dB	30 dB	90 dB
100 V	50 dB	20 dB	30 dB	100 dB
300 V	50 dB	30 dB	30 dB	110 dB

B. IMPEDANCE MATCHING STAGE

This impedance matching stage is basically a 2-stage amplifier whose voltage is reduced to practically unity by means of negative feedback, (Fig. 4). The circuit is subjected to such a series-parallel feedback, that a stable amplification and a low output impedance are obtained thus compensating for temperature effects, and spread in in tolerances. To protect field-effect transistor TS301, two silicon diodes GR301 and GR302 are connected in the reverse direction at the input. When the input voltage exceeds the supply voltage, the latter will flow off via the diodes and limit the drive voltage to 12 Vp-p.
The output voltage is applied to intermediate attenuator SK4/II from R304 via C301, and then to the pre-amplifier.

C. PRE-AMPLIFIER

This circuit is a voltage amplifier consisting of TS303...TS307. It consists of 4 stages and has a gain factor of approx. 50 (Fig. 5). Series-parallel feedback ensures stable voltage amplification, a high input impedance and a low output impedance. The first amplifier stage is followed by an emitter-follower stage with TS305, which serves as an impedance matching and buffer stage. TS306 forms the second amplifier stage which is also connected to an emitter-follower (TS307). Zener diode GR303 serves for obtaining the proper working point. The output signal of TS307 is applied to attenuator SK4/III via C309 and is also fed back to the input stage via a frequency-dependent network and TS304. R314, C306, R313 and R312 + C304 in this feedback circuit serve for boosting the low frequencies. The high frequencies are boosted by R315, C308, C307 and Cx. These RC elements serve for extending the frequency characteristic at lower values, by compensation for the decline in frequency response, so that a larger bandwidth is obtained. The capacitance of Cx is very small and is adjusted by means of a piece of wire on the printed circuit board. TS304 is driven via the feedback circuit, whereby a feedback factor of 1 ensures stabilisation of the working point for d.c. voltages.

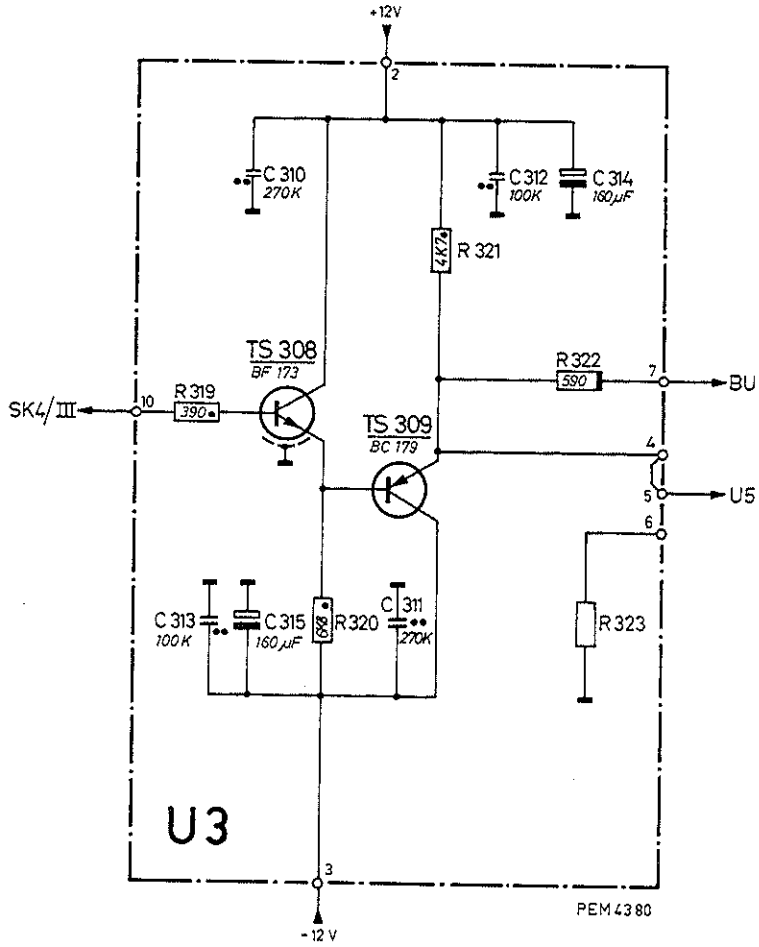


Fig. 6 Buffer stage

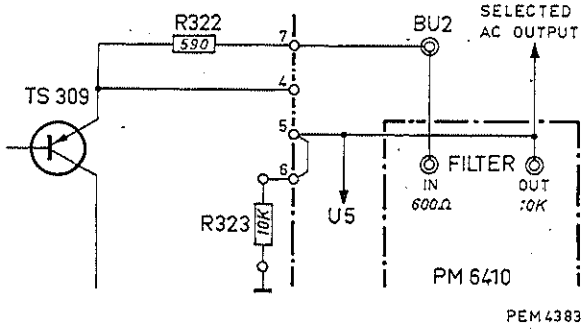


Fig. 7 Connecting octave filter PM 6410

D. BUFFER STAGE AND A.C. OUTPUT

After voltage divider SK4/III the measuring signal reaches a double emitter-follower, consisting of TS308 and TS309 (Fig. 6) . The high impedance of this stage ensures that the voltage divider is not affected by variations in the input impedance. From the emitter of TS309 the output voltage is applied to meter circuit U5 and to outpu socket BU2 via R322.

Connecting an external filter (Fig. 7)

Between connection points 4, 5 and 6 an external filter may be connec for selective measurements. The short-circuit connection between U3/4 and U3/5 should then be soldered to points 5 and 6.
The external filter can then be connected to BU2 and to point U3/5. Dependent on the filter employed a terminating resistor of suitable value should be fitted for R323. When the PHILIPS octave filter PM 6410 is used, the value of R323 is 10 kΩ.

E. METER CIRCUIT

The meter circuit (fig. 8) serves converting an alternating voltage signal into an exactly proportional direct current. The indication cor responds to the rectified mean value of the input voltage, the scale being calibrated in rms values of sinusoidal voltages.
The rectifier network plus the meter are included in the feedback circuit. As the feedback current also flows through rectifier diodes GR501 and GR503, the knee voltages and the temperature dependence of these diodes are influenced so that stabilisation of the slope (ratio between the meter current and the input voltage) is achieved.
A three-stage amplifier, consisting of TS501, TS502 and TS503, ensures a high no-load voltage gain, so that a linear indication is guaranteed. The working point of TS501 is stabilised by means of transistors TS505 and TS504.
In the case of a static current variation at TS 501 (e.g. due to thermal effects) this variation is eliminated by means of TS502 and TS503. The voltage variation at resistor R514 drives TS505; the latter drives TS504, which corrects the setting (when TS501 becomes more conductive, TS504 becomes less conductive so that the base potential of TS502 remains constant) This control circuit is not operative for alternating voltages, as these are blocked by C511.

Zener diodes GR504 and GR505 serve for adapting the voltage poten tials in the transistor circuit. GR506 ensures that the meter circuit is not overloaded. Choke L501 serves for maintaining the stability in case of oscillations which may occur in spite of the large bandwidth and the high amplification.
Potentiometer R510 can be employed for adjusting the meter to nominal value, and capacitor C508 can be included for conditionally increasing the time constant, with the aid of SK2.

F. POWER SUPPLY

1. Mains section

The mains section (Fig. 9) consists of a completely encased multiple-screened unit U1, in which the mains transformer, voltage adapter SK1, fuse VL 1 and mains connection sockets CS1 are accommodated (fuse VL 2 included in the primary circuit of the transformer).
This unit is of the "INVERTED GUARD" type. The primary winding of the mains transformer as well as all components connected to this winding are separately screened and the screening is isolated from the rest of the housing. This system ensures that the secondary winding and the instrument chassis are practically free from earth currents. The mains section may also be earthed normally via the mains ; earthing loops cannot be formed due to the completely isolated construction.

2. Voltage stabilisation

The mains transformer supplies an alternating voltage of 47 V to Graetz rectifier GR201. The output direct voltage is divided in two independent voltage circuits, which have a common zero connected to the centre tap of T101. Both circuits comprise a stabilising circuit (Fig. 10). These stabilising circuit are not indentical, one voltage circuit being positive and the other negative, but the working of both circuits is the same.
Therefore. only the positive voltage circuit is described. The pulsating direct voltage is applied to smoothing filter C201, R201 and C203.
Zener diode GR202 provides the reference voltage with which the output voltage taken from voltage divider R214, R 215 and R218 is compared .

Fig.

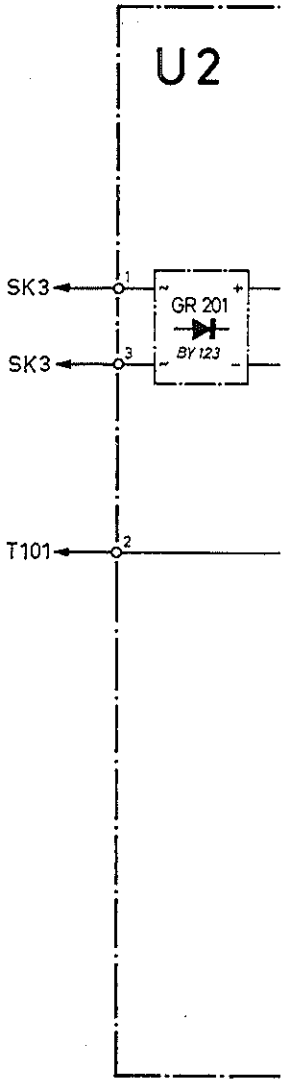
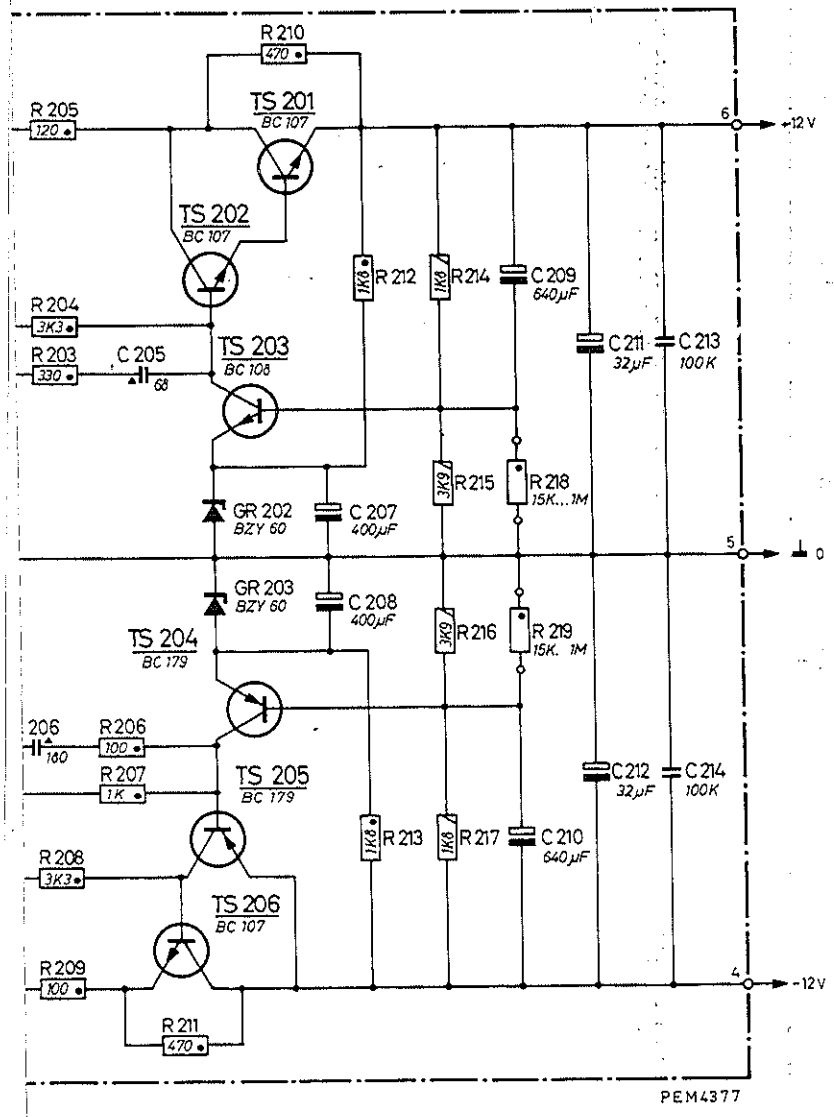


Fig. 10 Stabili



The voltage difference then controls transsistors TS203 ar
controls emitter followers TS202 and TS201.
To prevent parasitic oscillations, RC circuit R203, C205 h
for phase correction. The direct voltage is smoothed by m
C211 andC213; C213 serves for the suppression of superim
voltages. R218 serves for adjusting the output voltage.

Stabilisation:

In case of a load increase the voltage at the base of TS203
slightly and so will the collector-emitter current. The bas
will, therefore, become more positive and the collector er
current will increase, so that the drive current of TS201 w
increase. On account of this the internal resistance of TS2
smaller and larger current will flow through the output cir
output voltage thus remains constant and will not deviate m
a small value of the control voltage difference.

VIII. GAINING ACCESS TO THE PARTS.

1. Removing the cabinet (Fig. 11)

Top panel: Turn bayonet screw "A" at the rear of the instrument a quarter and slide the panel out in backward direction.

Side panels: Remove the two screws of the carrying handle, remove the bracket and lift the plates (which are slid into the frame from the rear) slightly at the front and pull then out.

Bottom panel: Remove the tilting bracket by slightly compressing it at the corners and lifting it out of the guides. Remove screw "B" at the rear of the instrument and slide the bottom panel out in backward direction.

2. Printed circuit board

Printed circuit boards U2 (right-hand) and U3 (left-hand) can be tilted out sideways (Fig. 13-14). For this, remove the side pands and take out the printed circuit boards. Printed circuit board U5 at the rear of the instrument is accessible from the left and the right as well as from the bottom. For soldering operations the board should be taken out of the print holders and pressed slightly away from the chassis plate.

3. Range selector unit U4

For replacing one of the switch wafers of SK4, the complete unit should be removed; for this proceed as follows:
- Remove the bottom panel.
- Remove the knob of switch SK4, by prising off the knob cap and loosening the nut of the clamping cone.
- Unsolder all connection cables and their screens(observe the place of connections, if necessary, note them down! see Fig. 20).
- Remove the 4 screws "D" (Fig. 15);the complete range selector unit can now be taken out of the instrument after which the switch can be disassembled from the rear.

4. Mains unit U1

The mains unit can be simply removed, by taken off the top panel, unsoldering the three connection wires and removing the 4 screws "C" (Fig. 11) For opening the guard housing, recesses have been made in the covers via which the covers can be lifted out with the aid of a screwdriver.

5. Measuring instrument

This can be removed as follows:
- Remove the top and side panels.
- Unsolder the connection cables with a small soldering iro the instrument housing is sensitive to heat!)
- Remove two screws "E" at each side of the instrument an screw "F" on one side (Fig. 13-14).
- The relevant frame can be slightly pressed apart so that t instrument, together with the mounting plate, can be rem forward direction.

6. Textplate

- Remove all cabinet panels.
- Remove the knob of switch SK4 (See point 3).
- Unsolder the connections from sockets BU1 and BU2 and f lamp LA1.
- Remove the sockets and the lamp holder.
- Remove the rubber caps from the feet.
- Remove the two ornamental frames, by loosening the 4 gru "G" (Fig. 13-14) and the two screws "H" by means of whic relevant feet are secured.
- The text plate, which is glued to the chassis plate, can be means of a knife.

7. Pilot lamp LA1

This can be replaced after removal of the lens cap.

IX. MAINTENANCE

The PM 2454 comprises no componets which are subject to substantial wear; the instrument therefore reqiures no maintenance.
The stator of range selector SK4 can be lubricated lightly with Molykote grease, when it shows excessive friction. It is advisable to use a thin fluid oil (or sewing machine oil) for the switch spindles.
In case of faults the switch contacts may only be treated with the special switch oil, specified in the list of parts.
In order to ensure the proper working of the instrument it should not be exposed to excessive moisture, heat, corrison or dust.

X. CHECKING AND ADJUSTING

The tolerances mentioned are factory tolerances; they apply when th instrument is readjusted completely. They may differ from the data given in II. Adjustment should only be effected, if auxiliary equipme with the required tolerances are avaiable.

1. Mechanical zero setting

With switched off instrument, check that the mechanical zero of the instrument pointer is correct. Deviations can be corrected by mean: of the setscrew. For this adjustment the instrument should be place in a horizontal position.

2. Connection of the measuring instrument

For the following checks the measuring instrument should be supplie with nominal mains voltage, preferably via a variable transformator The mains voltage should be checked by means of a voltmeter.

Current consumption	Switched on	Switched off
at 115 V	20 mA	2 - 6 mA
at 230 V	10 mA	1 - 3 mA

3. Power supply

The supply voltages are +12 V and -12 V with respect to 0, tolerance ± 0.2 V.

Test points	+12 V:U2/6
	0 :U2/5
	-12 V:U2/4
Adjustment	+12 V with R218
	-12 V with R219

4. Adjustment the amplifier

a. Adjustment at low frequencies

-Apply a voltage of 10 mV or 100 mV ± 0,2%, 400 Hz, to socket BU1.
-Set SK4 to 10 or 100 mV.
-Adjust the pointer of the meter to exactly 100 scale divisions by means of potentiometer R510.
Potentiometer R510 is accessible via a hole in the rear panel of the instrument(Fig. 11).
-Check all the other ranges from 1 mV...1 V.
-Set SK4 to 3 V or 10 V.
-Apply a voltage of 3 V or 10 V ± 2%, 400 Hz, to Bu1.
-Adjust the pointer deflection to exactly 30 or 100 scale divisions by means of potentiometer R404. For adjusting R404 the bottom panel should be removed (Fig. 15)

- Check the voltage on BU2; this should be 50 mV ± 10%.
- Check all the other ranges from 3 V... 300 V.

b. Adjustment at high frequencies.

- Apply a voltage of 10 mV or 100 mV ± 0.5%; 2 MHz, to BU1.
- Set SK4 to 10 mV or 100 mV.
- Adjust the pointer deflection to exactly 100 scale divisions by means of C307. C307 is accessible from the top of the instrument after removal of the top panel (Fig. 16) Trimmer C307 serves for fine adjustment. If its control range is not sufficient for adjustment to 100 scale divisions, circuit capacitance Cx on printed circuit board U3 should be corrected by reducing or extending the soldered-in wire.
- Check all the other ranges from 1mV... 1 V.
- Apply a voltage of 3 V or 10 V ± 0.5%, 2 MHz, to BU1.
- Set SK4 to 3 V or 10 V.
- Adjust the pointer deflection to exactly 30 or 100 scale divisions with C403.
- Trimmer C403 is located at the bottom of the instrument and is accessible after removal of the bottom panel (Fig. 15)
- Check all the other ranges from 3 V... 300 V.

Remark

In case of breakdowns one can always apply to the world-wide PHILIPS Service Organisation.

Whenever it is desired to send the apparatus to a PHILIPS Service Centre for repair, the following points should be observed:

- tie on a label, bearing full name and address of the sender.
- indicate as complete as possible the sympton (s) of the fault (s)
- carefully pack the apparatus in the original packing, or, if no longer available, in a wooden crate.
- send the apparatus to the address provided by your local PHILIPS representative.

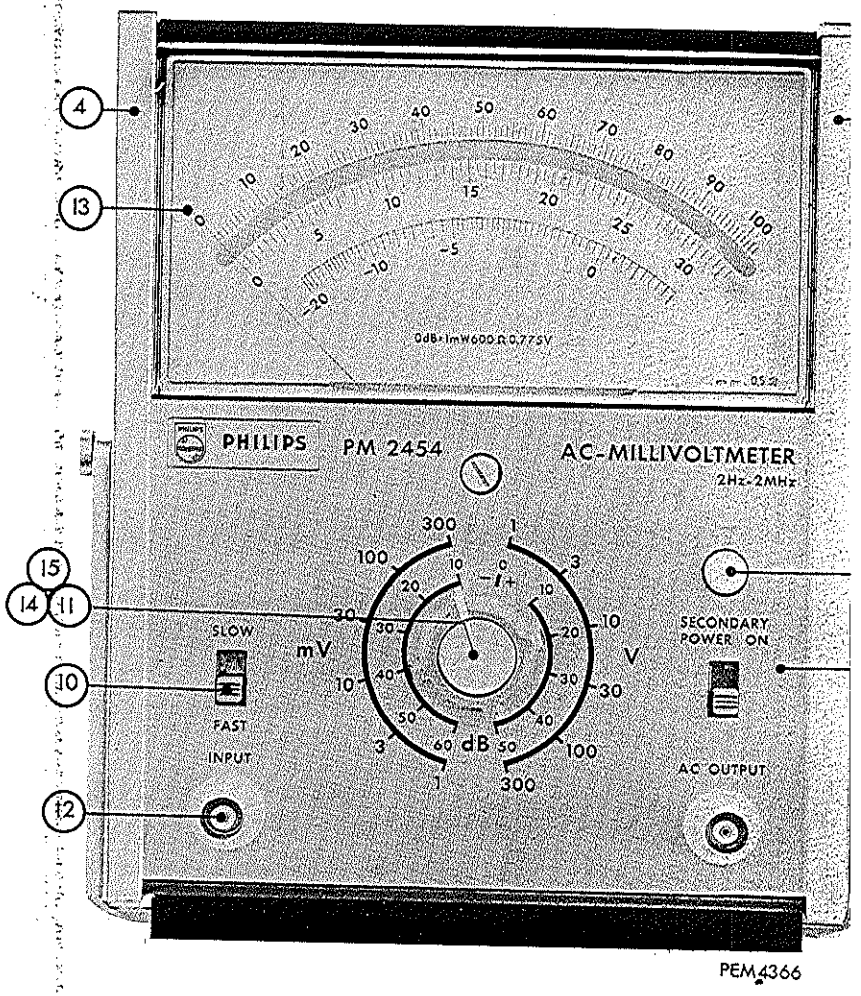


Fig. 12 Location of components

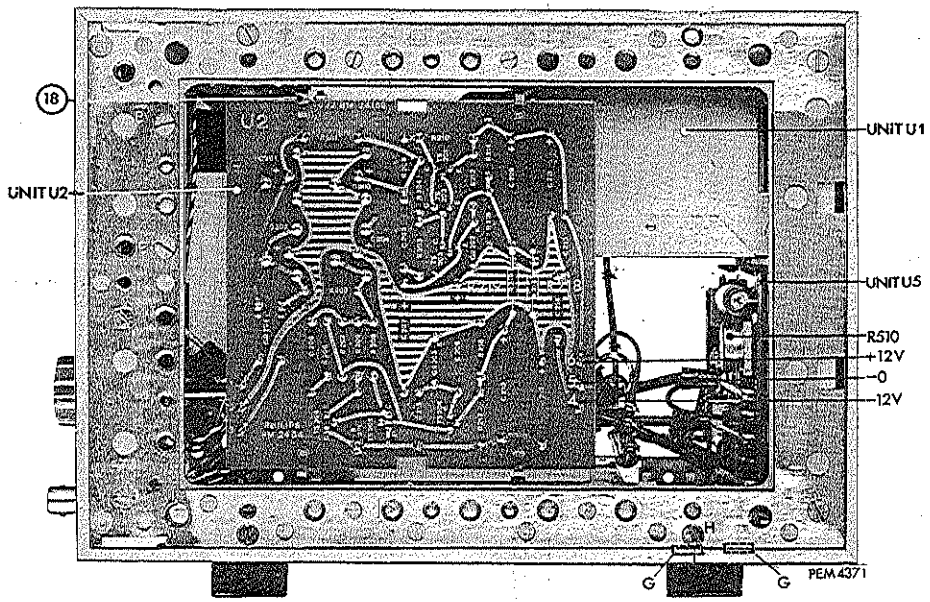


Fig. 13 Right-hand view

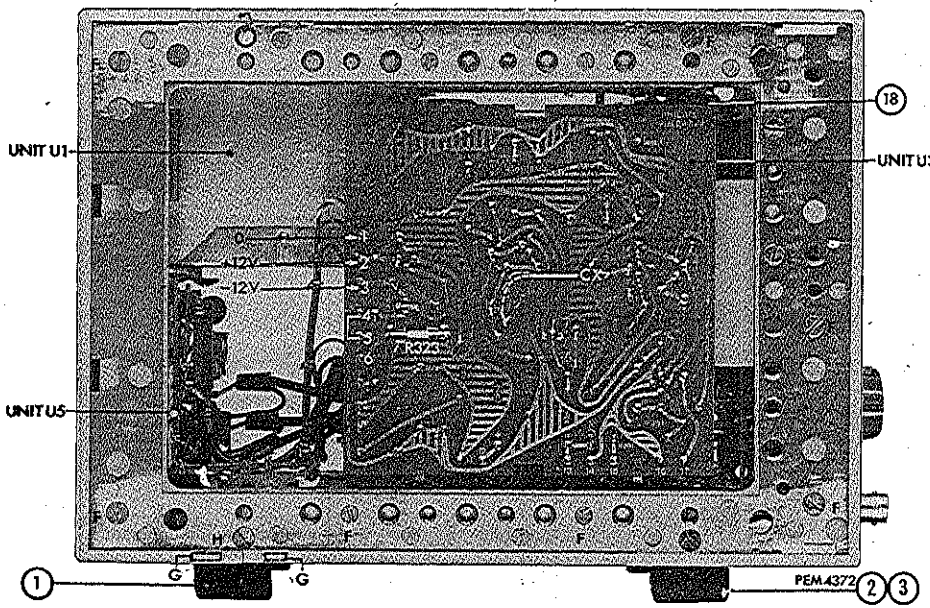


Fig. 14 Left-hand view

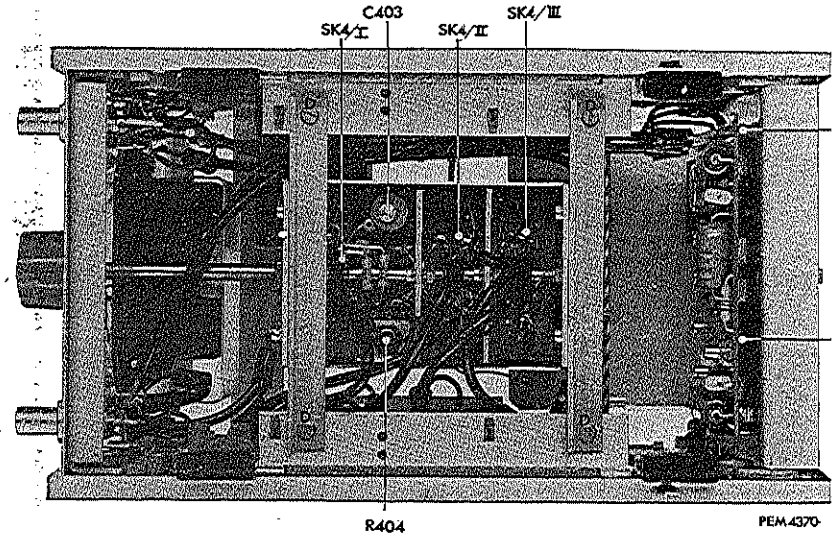


Fig. 15 Bottom view

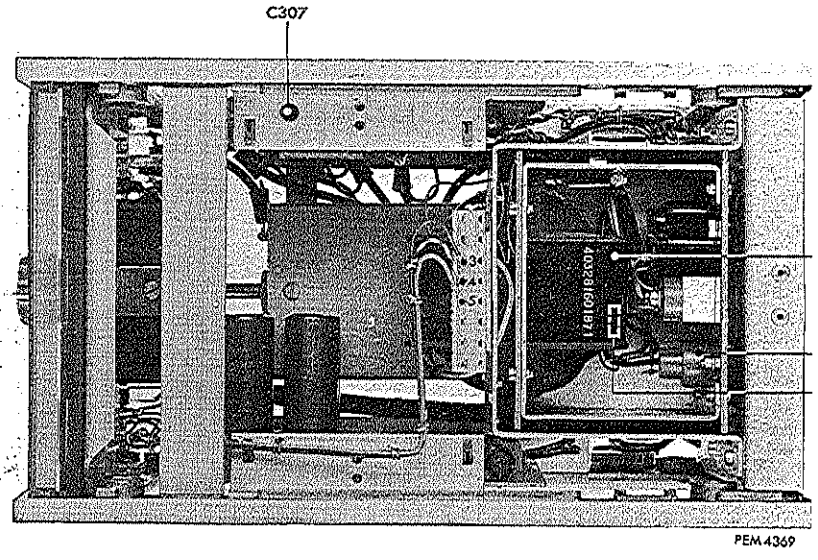


Fig. 16 Top view

B. ELECTRICAL — ELEKTRISCH — ELEKTRISCH — ELECTRIQUE — ELECTRICOS

This parts list does not contain multi-purpose and standard parts. These components are indicated in the circuit diagram by means of identification marks. The specification can be derived from the survey below.

Diese Ersatzteilliste enthält keine Universal- und Standard-Teile. Diese sind im jeweiligen Prinzipschaltbild mit Kennzeichnungen versehen. Die Spezifikation kann aus nachstehender Übersicht abgeleitet werden.

In deze stuklijst zijn geen universele en standaardonderdelen opgenomen. Deze componenten zijn in het principeschema met een merkteken aangegeven. De specificatie van deze merktekens is hieronder vermeld.

La présente liste ne contient pas des pièces universelles et standard. Celles-ci ont été repérées dans le schéma de principe. Leurs specifications sont indiquées ci-dessous.

Esta lista de componentes no comprende componentes universales ni standard. Estos componentes están provistos en el esquema de principio de una marca. El significado de estas marcas se indica a continuación.

Carbon resistor E24 series
Kohleschichtwiderstand, Reihe E24
Koolweerstand E24 reeks
Résistance au carbone, série E24
Resistencia de carbón, serie E24
0,125 W 5%

Carbon resistor E12 series
Kohleschichtwiderstand, Reihe E12
Koolweerstand E12 reeks
Résistance au carbone, série E12
Resistencia de carbón, serie E12
0,25 W ≦ 1 MΩ, 5%
> 1 MΩ, 10%

Carbon resistor E24 series
Kohleschichtwiderstand, Reihe E24
Koolweerstand E24 reeks
Résistance au carbone, série E24
Resistencia de carbón, serie E24
0,5 W ≦ 5 MΩ, 1%
> 5 10 MΩ, 2%
10 MΩ, 5%

Carbon resistor E12 series
Kohleschichtwiderstand, Reihe E12
Koolweerstand E12 reeks
Résistance au carbone, série E12
Resistencia de carbón, serie E12
0,5 W ≦ 1,5MΩ, 5%
> 1,5MΩ, 10%

Wire-wound resistor
Drahtwiderstand
Draadgewonden weerstand
Résistance bobinée
Resistencia bobinada
10 W 5%

Carbon resistor E12 series
Kohleschichtwiderstand, Reihe E12
Koolweerstand E12 reeks
Résistance au carbone, série E12
Resistencia de carbón, serie E12
1 W ≦ 2,2 MΩ, 5%
> 2,2 MΩ, 10%

Carbon resistor E12 series
Kohleschichtwiderstand, Reihe E12
Koolweerstand E12 reeks
Résistance au carbone, série E12
Resistencia de carbón, serie E12
2 W 5%

Wire-wound resistor
Drahtwiderstand
Draadgewonden weerstand
Résistance bobinée
Resistencia bobinada
0,4 – 1,8 W 0,5%

Wire-wound resistor
Drahtwiderstand
Draadgewonden weerstand
Résistance bobinée
Resistencia bobinada
5,5 W ≦ 200 Ω, 10%
> 200 Ω, 5%

Tubular ceramic capacitor
Rohrkondensator
Keramische kondensator, buistype
Condensateur céramique tubulaire
Condensador cerámico tubular
500 V

Tubular ceramic capacitor
Rohrkondensator
Keramische kondensator, buistype
Condensateur céramique tubulaire
Condensador cerámico tubular
700 V

Ceramic capacitor, "pin-up"
Keramikkondensator "Pin-up" (Perltyp)
Keramische kondensator "Pin-up" type
Condensateur céramique, type perle
Condensador cerámico, versión "colgable"
500 V

"Microplate" ceramic capacitor
Miniatur-Scheibenkondensator
"Microplate" keramische kondensator
Condensateur céramique "microplate"
Condensador cerámico "microplaca"
30 V

Mica capacitor
Glimmerkondensator
Micakondensator
Condensateur au mica
Condensador de mica
500 V

Polyester capacitor
Polyesterkondensator
Polyesterkondensator
Condensateur au polyester
Condensador polyester
400 V

Flat-foil polyester capacitor
Miniatur-Polyesterkondensator (flach)
Platte miniatuur polyesterkondensator
Condensateur au polyester, type plat
Condensador polyester, tipo de placas planas
250 V

Paper capacitor
Papierkondensator
Papierkondensator
Condensateur au papier
Condensador de papel
1000 V

Wire-wound trimmer
Drahttrimmer
Draadgewonden trimmer
Trimmer à fil
Trimmer bobinado

Tubular ceramic trimmer
Rohrtrimmer
Buisvormige keramische trimmer
Trimmer céramique tubulaire
Trimmer cerámico tubular

SERVICE

For multi-purpose and standard parts, please see PHILIPS' Service Catalogue.
Für die Universal- und Standard-Teile siehe den PHILIPS Service-Katalog.
Voor universele en standaardonderdelen raadplege men de PHILIPS Service Catalogus.

Capacitors

No.	Ordering code	Value	Tolerance (%)	Voltage (V)	Description
C201	4822 124 40092	320 µF		40	Electrolytic
C202	4822 124 40092	320 µF		40	
C203	4822 124 40012	500 µF		35	
C204	4822 124 40012	500 µF		35	
C207	4822 124 20403	400 µF		10	
C208	4822 124 20403	400 µF		10	
C209	4822 124 20414	640 µF		6.4	
C210	4822 124 20414	640 µF		6.4	
C211	4822 124 20366	32 µF		16	
C212	4822 124 20366	32 µF		16	
C213	4822 121 40036	0.1 µF	10	250	Polyester
C214	4822 121 40036	0.1 µF	10	250	Polyester
C301	4822 124 10076	150 µF		15	Electrolytic
C304	4822 124 10081	330 µF		6	Electrolytic
C307	4822 125 60027	6 pF			Ceramic tubul trimmer
C309	4822 124 20398	250 µF		6.4	Electrolytic
C314	4822 124 20394	160 µF		25	Electrolytic
C315	4822 124 20394	160 µF		25	Electrolytic
C403	4822 125 60031	25 pF			Air trimmer
C405	4822 120 60115	2 nF	1	125	Polyester
C501	4822 124 20394	160 µF		25	Electrolytic
C503	4822 124 20394	160 µF		25	
C506	4822 124 20374	50 µF		10	
C507	4822 124 20374	50 µF		10	
C508	4822 124 20414	640 µF		6.4	
C511	4822 124 20383	100 µF		10	

Resistors

No.	Ordering code	Value	Tolerance (%)	Power (W)	Description
R1	4822 112 20103	680 Ω	5	5.5	Wire-wound
R404	4822 101 20074	2.2 kΩ			Potentiometer,
R411	4822 113 40089	1 kΩ	¼	0.6	
R412	4822 113 10024	320 Ω	¼	0.4	
R414	4822 113 10046	100 Ω	¼	0.4	
R415	4822 113 10133	464.4 Ω	¼	0.4	Measuring resi
R421	4822 113 40089	1 kΩ	¼	0.6	
R422	4822 113 10024	320 Ω	¼	0.4	
R424	4822 113 10046	100 Ω	¼	0.4	
R425	4822 113 10133	46.4 Ω	¼	0.4	

Miscellaneous

Fig.	Item	Quantity	Ordering code	Description
19	L501	1	4822 158 10222	Coil
16	T1	1	4822 145 40086	Mains transformer
16	VL1	1	4822 253 30012	Fuse, 200 mA, delayed-action
16	VL2	1	4822 252 20001	Thermal fuse
13		1	4822 216 70102	Printed circuit board, with components (unit U2)
14		1	4822 216 70103	Printed circuit board, with components (unit U3)
15		1	4822 216 70104	Printed circuit board, with components (unit U5)

SEMI-CONDUCTORS

Diodes

No.	Type	
GR201	BY123	
GR202	BZY60	
GR203	BZY60	zener diode
GR301	BAY38	
GR302	BAY38	
GR303	BZY60	zener diode
GR501	1N 4009	
GR502	AAZ18	
GR503	1N 4009	
GR504	BZY61	zener diode
GR505	BZY61	zener diode
GR506	AAZ18	

Transistors

No.	Type	
TS201	BC107B	
TS202	BC107B	
TS203	BC108B	
TS204	BC179	
TS205	BC179	
TS206	BC107B	
TS301	BFW11	FET
TS302	BC179	
TS303	BC108B	
TS304	BC108B	
TS305	BC179	
TS306	BC179	
TS307	BC179	
TS308	BF173	
TS309	BC179	
TS501	BF173	
TS502	BF173	
TS503	BC179	
TS504	BC179	
TS505	BC168B	

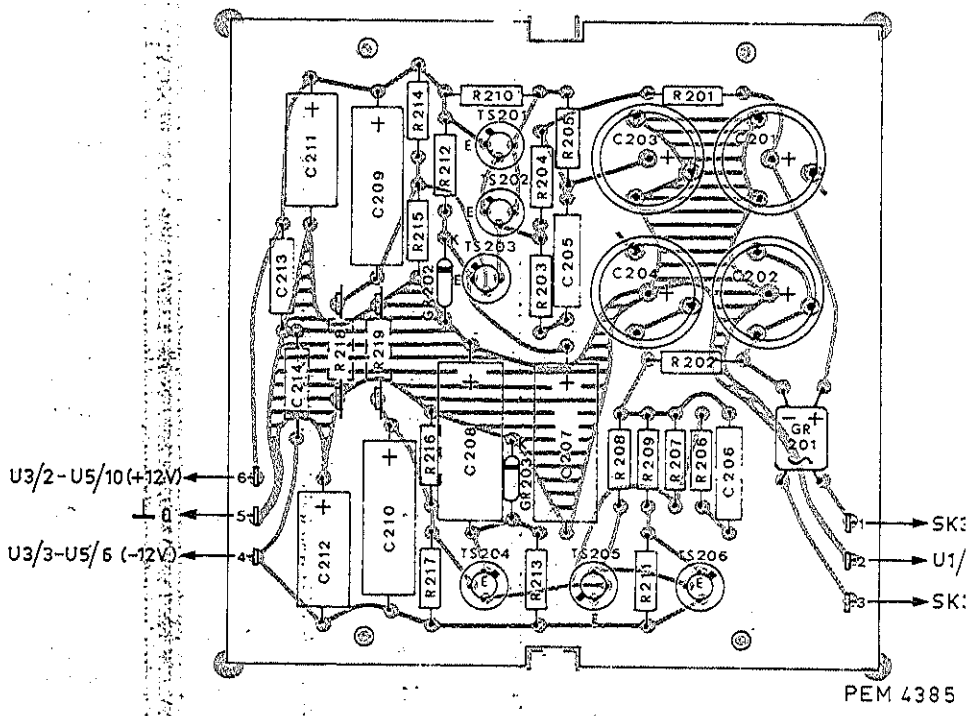


Fig. 17 Printed circuit board U2

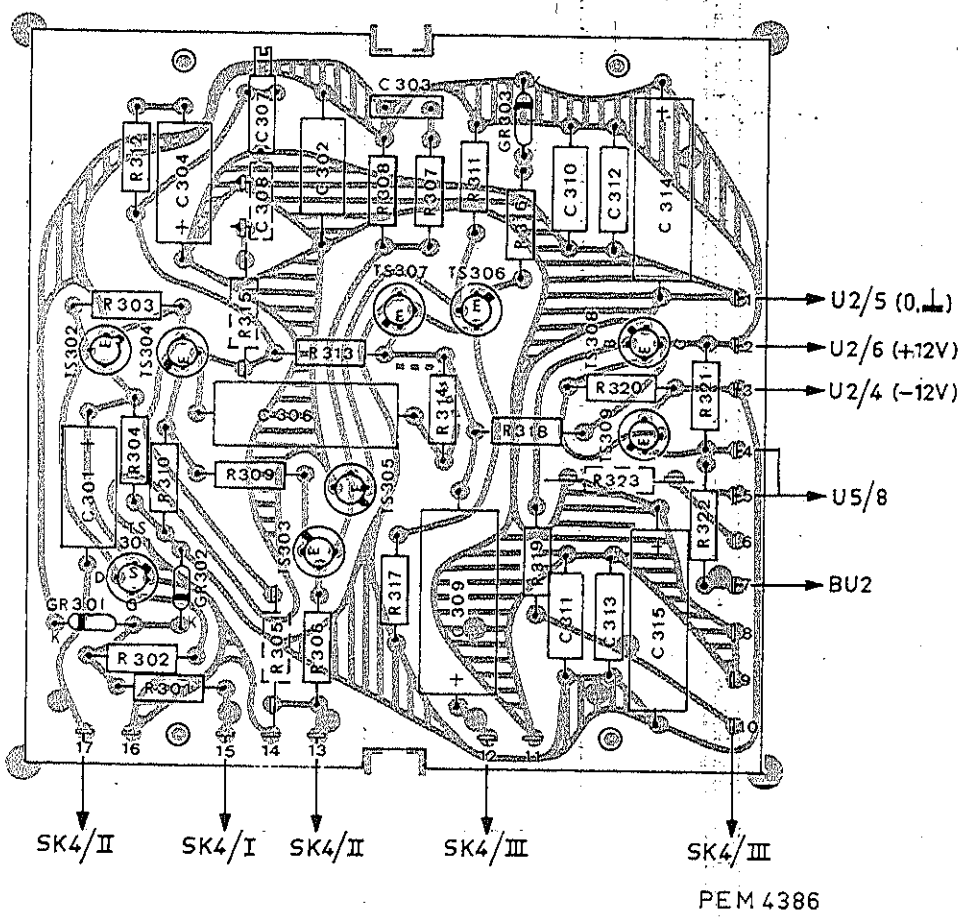
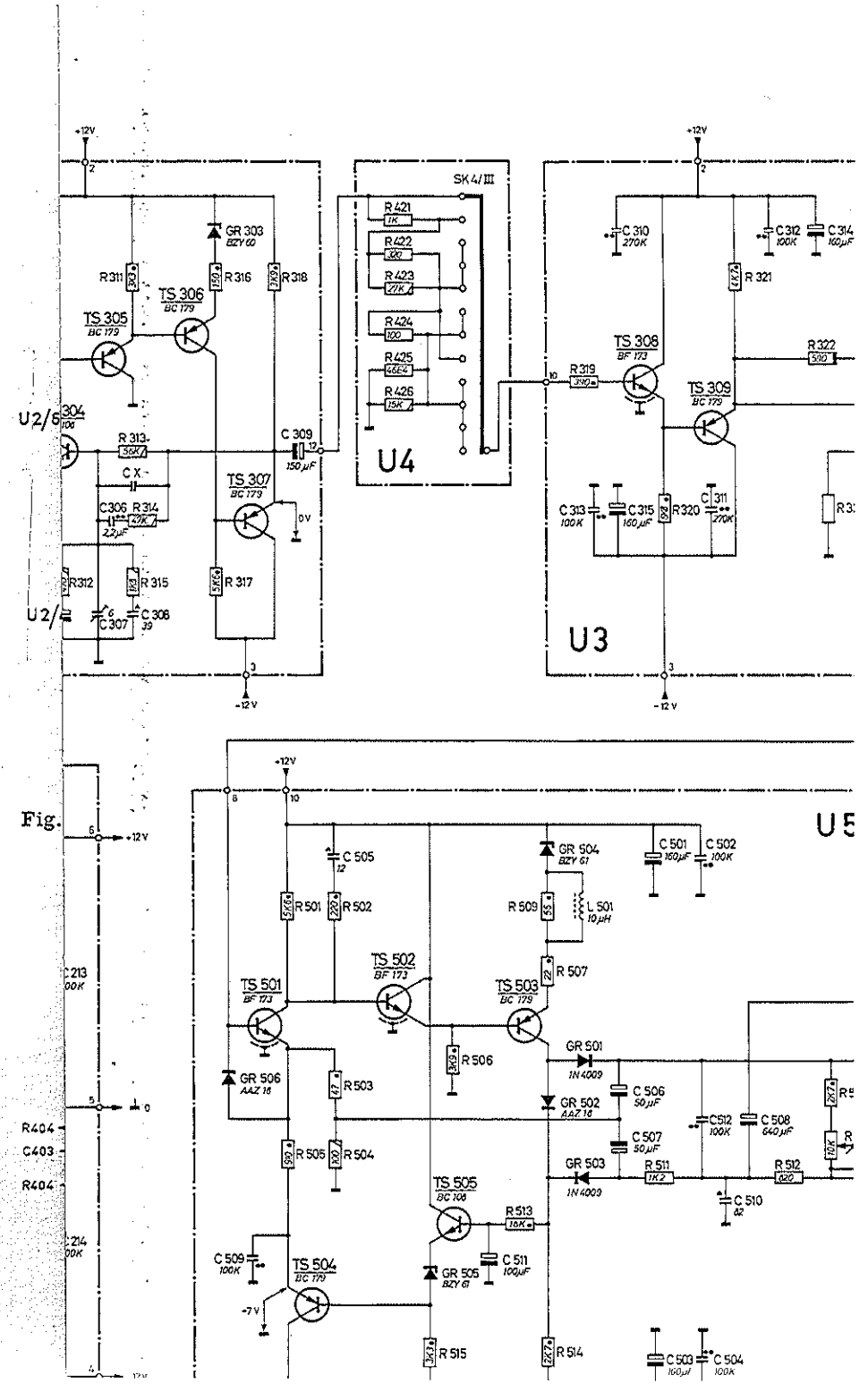


Fig. 18 Printed circuit board U3



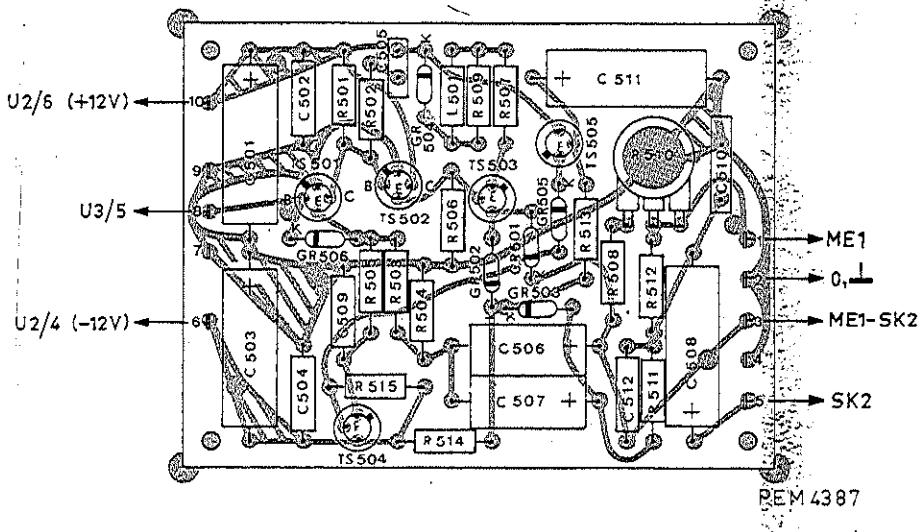
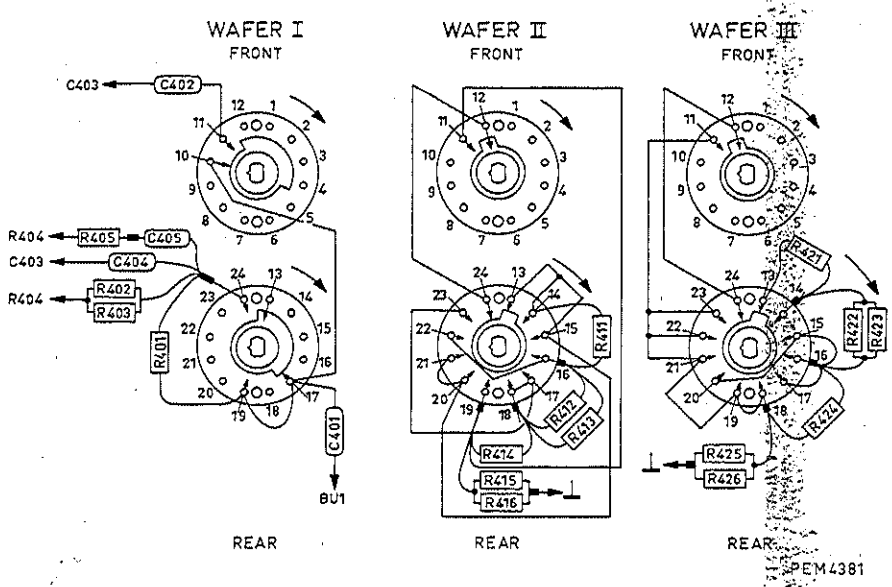


Fig. 19 Printed circuit board U5



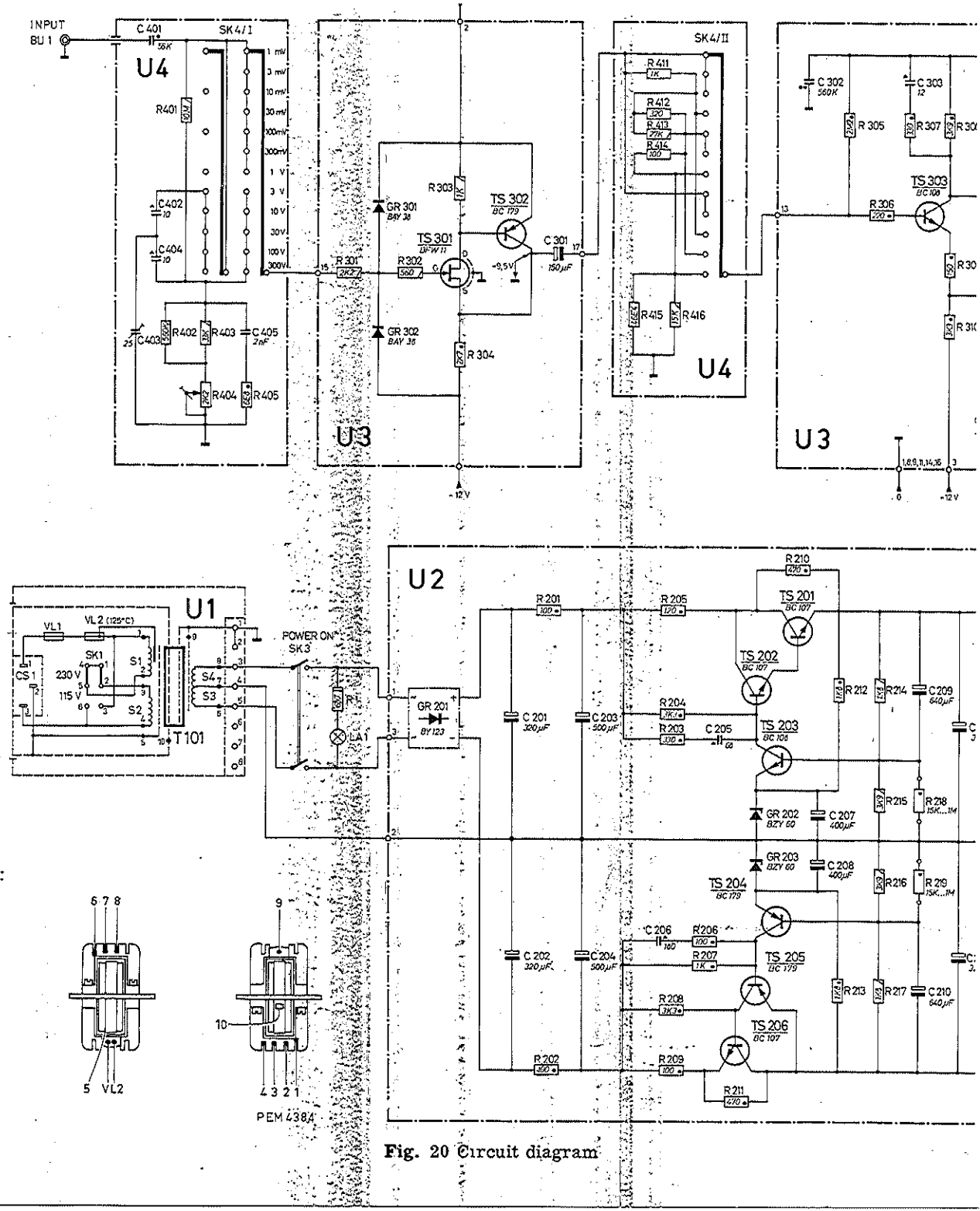


Fig. 20 Circuit diagram