PHILIPS

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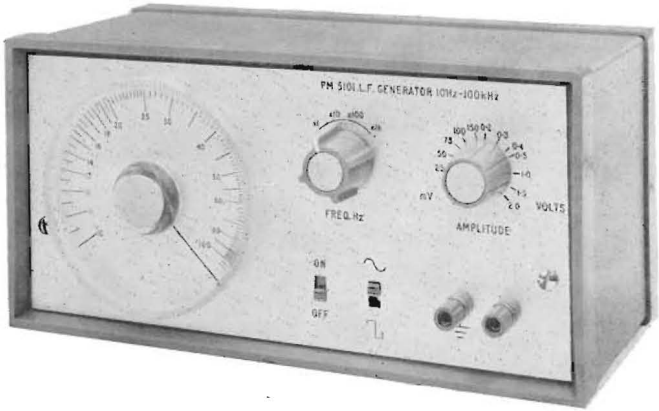
L.F. GENERATOR
PM 5101

9445 051 01031

9499 450 03511

2/1268/03



PEM 1563
E 1319

PHILIPS

Manual

L.F. GENERATOR
PM 5101

9445 051 01031

9499 450 03511

2/1268/03

IMPORTANT

In correspondence concerning this instrument, please quote the type number and the serial number as given on the type plate at the rear of the instrument.

Contents

List of figures

GENERAL

Introduction

I

The PM 5101 is a portable LF generator, which in the frequency range 10 Hz to 100 kHz supplies a sinusoidal voltage of 0 to 2 V_{rms} and a negative going square wave voltage of 0 to 4 V_{p-p}.
The apparatus is fully transistorised and is supplied by built-in batteries.

Technical data

II

Properties, expressed in numerical values with statement of tolerances are guaranteed. Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument. The numerical values hold good for the nominal mains voltage unless otherwise stated.

1. Frequency ranges	10 Hz – 100 Hz 100 Hz – 1 kHz 1 kHz – 10 kHz 10 kHz – 100 kHz
Frequency inaccuracy	± 5% ± 1 Hz at 20 °C and a 16-V supply voltage.
Frequency drift	0.1% in the 10 Hz to 1 kHz range. 0.15% in the 1 kHz to 100 kHz range. (measured during 7 hours, at which the supply voltage decreased from 17 to 16 V and the temperature rose from 19 to 28 °C)

2. Sinusoidal output voltage

Distortion	< 1% over a supply voltage of 14 to 18 V, at frequencies of 20 Hz – 100 kHz.
Amplitude	0 to 2 V_{rms} (unloaded)
Amplitude change due to a change in the frequency at a constant battery voltage	± 2%
Amplitude change due to a change in the battery voltage (14 to 18 V) at a constant frequency	± 2%
Output impedance	0 to 250 Ω (dependent on the position of the amplitude control).

3. Square wave output voltage

Amplitude	0 to 4 V_{p-p} when unloaded (superimposed on an 0 to –2 V d.c. voltage). Continuously adjustable.
Amplitude change due to a change in the frequency at a constant battery voltage	± 0.5%
Amplitude change due to a change in the battery voltage (14 to 18 V) at a constant frequency	< 10%

Output impedance	0–350 Ω (dependent on the position of the amplitude control).
Rise-time	10 Hz – 1 kHz: 1 µs 1 kHz – 100 kHz: 0.5 µs
Sag (see Fig. 4)	1% at 50 Hz, referred to the peak-peak value
Mark/space ratio (see Fig. 4)	1:1 ± 5% (for battery voltages of 14 to 18 V)
4. Temperature range	17 to 40 °C
5. Supply	two 9-V batteries in series
6. Battery current	25 mA ± 3 mA at an 18 V supply voltage
7. Dimensions	Width: 25 cm (9¾ inches) Depth: 14 cm (5½ inches) Height: 13 cm (5 inches)
8. Weight	1.5 kg (3.75 lbs.) without batteries 2.6 kg (5.75 lbs.) with batteries

DIRECTIONS FOR USE

Operation

III

For fitting the batteries refer to chapter V-A

A. SWITCHING ON (see Fig. 1)

Set switch "ON/OFF" (SK1) to position "ON". After approximately 30 seconds the apparatus is ready for use.

B. ADJUSTING THE FREQUENCY

The frequency ranges can be selected with knob "FREQ. Hz" (SK2). Continuous control of the frequency within each range can be effected with the aid of the frequency selector (R1).

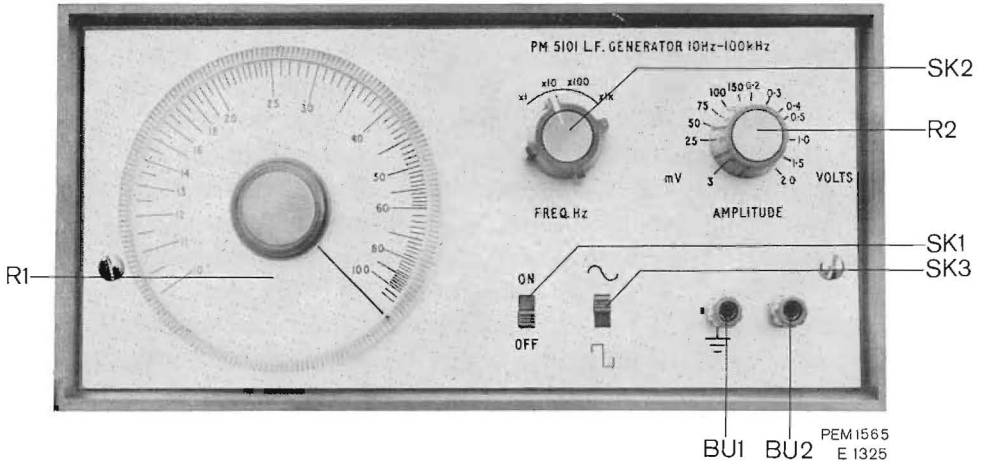


Fig. 1. Front view with indication of the controls

C. ADJUSTING THE OUTPUT VOLTAGE

1. Sinusoidal voltage

Set switch "~/ ⊓" (SK3) to position "~". The output voltage at sockets BU1-BU2 can be adjusted with knob "AMPLITUDE" (R2) between approximately 3 mV_{rms} and 2 V_{rms} (unloaded).

2. Square wave voltage

Set switch "~/ ⊓" (SK3) to position "⊓". The output voltage at sockets BU1-BU2 can be adjusted with knob "AMPLITUDE" (R2) between approximately 6 mV_{p-p} and $4V_{p-p}$ (unloaded). The output voltage consists of a square wave voltage which is superimposed on a negative d.c. voltage, equal to half the amplitude of the square wave voltage.
To obtain a square wave voltage which is symmetrical with respect to the zero line, a circuit should be used for changing the d.c. voltage level (in this case, a capacitor). The value of this capacitor depends entirely on the input impedance of the circuit to be fed and on the frequency. For this reason no capacitor has been fitted in the apparatus.

Note:
When using the sinusoidal or the square wave voltage, it is recommended that the output voltage of the generator is measured with a voltmeter with a high input impedance for obtaining accurate measurements. By doing so, the exact value of the voltage which is applied to the circuit connected will be known.

SERVICE NOTES

Technical description (see Fig. 2 and Fig. 8)

IV

A. INTRODUCTION

The generator comprises an RC oscillator. The sinewave voltage produced by the RC oscillator is applied either direct or via a limiter to the output voltage divider. In the latter case, a time symmetrical square wave signal (meandering signal, $T = T/2 + T/2$) will be available on the output.

B. OSCILLATOR

The oscillator consists of a frequency-determining Wien fourpole with equal branches and an amplifier, which is stabilised in the operating frequency range.

The resonant frequency of the Wien bridge can be calculated with the following formula:

$$f_o = \frac{1}{2 \pi RC}$$

At this frequency the input and the output voltage of the Wien bridge are in phase. The amplitude of the output voltage of the Wien network is three times smaller than that of the input voltage.

This means that, in order to satisfy the oscillation condition, the phase shift of the amplifier should be 0° and its gain factor should be 3.

Coarse frequency control (in steps of one decade) is achieved by switching the capacitors C12...C22-C29-C30.

A tandem potentiometer R1a–R1b is employed for fine control of the frequency within the selected range.

Potentiometer R18 and capacitors C1 and C22 serve for calibration.

The amplifier has a high degree of negative feedback, so that its gain is reduced to a factor 3. By means of potentiometer R26 the gain factor can be adjusted. The resistance setting of R26 is the shunt resistance in the feedback circuit. NTC resistor R16 provides the series resistance. As a result of this, the feedback will be amplitude dependent.

If for example the output voltage of the amplifier increases, the current

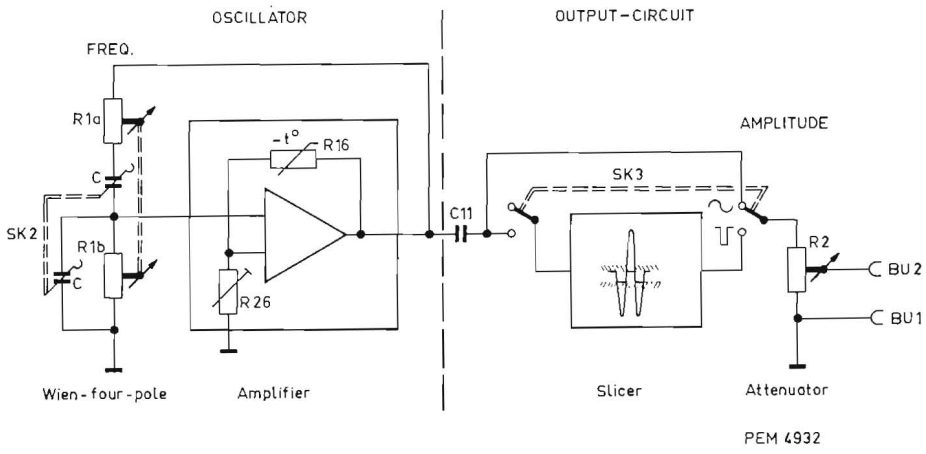


Fig. 2. Block diagram

through the feedback network R16//C9//resistance setting of R26 will also change.
The increased feedback current causes a temperature rise of the NTC resistor, so that its ohmic value will be reduced. As a result the feedback voltage increases, so that the output voltage will be reduced to its normal value. C9 serves for phase compensation.
With R26 the feedback has been adjusted so that the oscillator just starts oscillating.

The shunt resistance of the Wien bridge R1b is connected to the amplifier input in such a way, that the base current required for transistor TS1 passes through this potentiometer. The base voltage divider is formed by the resistor circuit R11, Ri of TS2, R8, R7 and R6.
On account of this galvanic coupling of TS1 and TS2, their working points will be extremely stable.
Emitter follower TS3 serves for decoupling and, consequently, for matching to output transistors TS4–TS5. These transistors are connected as a White emitter follower, so that a very low output impedance is obtained.

C. OUTPUT CIRCUIT

The waveform of the output voltage can be selected with SK3. The sinewave is obtained by connecting the amplifier output direct to the attenuator R2. To obtain the squarewave voltage, the sinewave signal is applied to an amplitude limiter TS6–TS7.
The limiting action can be adjusted with potentiometer R20.
Diode GR3 serves for rectification of the sinewave control voltage and thus determines the working point of TS6.
The amplitude of the squarewave output signal is stabilised by the biased diode GR2. The bias voltage for GR2 is provided by voltage divider R29–GR1.

D. POWER SUPPLY

The instrument is supplied by two series connected 9 V batteries.

Gaining access to parts

V

A. THE BATTERIES

- Remove the two screws at the rear. The rear panel then can be removed.
- Remove the connection wires from the battery.
- Remove the battery clamp.
- Remove the batteries.
- Fit the new batteries in the apparatus.
- Refit the battery clamp.
- Connect the series-connection wire to the new batteries.
- Connect the two remaining connection wires to the new batteries. (The batteries are provided with two different terminals for the positive and negative poles, so that it is impossible to interchange the connections.)
- Refit the rear panel.

B. THE PRINTED WIRING BOARD

Remove the rear panel (see V-A).
The cabinet then can be removed. The printed wiring board (with all components) is then accessible.
It is provided with figures 1...8, corresponding to figures 1...8 in the circuit diagram. These figures indicate the connection points between the parts mounted on the chassis and the printed wiring board.

C. REMOVING THE KNOBS (see Fig. 3)

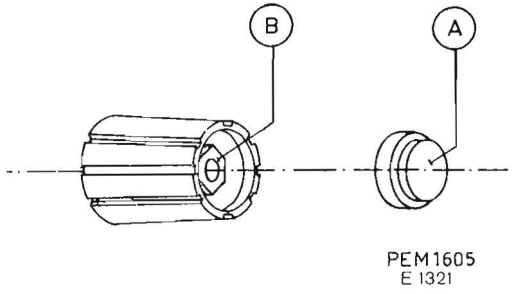


Fig. 3. Removing the knobs

- Remove cap A.
- Unscrew nut B and tap it slightly, while holding the knob.
- The knob then can be taken from the shaft.

Recommended batteries

VI

The batteries used are in accordance with the IEC standard, No. 86-6F100.

Type	*Make*	*Country of origin*
439	Pertrix	England
P.P.9	Berec	England
276	Eveready	U.S.A.
495	EMCE	Germany

Maintenance

VII

A. THE CABINET

If the cabinet becomes soiled it can, after removal (chapter V-B), be cleaned with soap and water, or with a light scouring agent.

B. THE SEGMENT SWITCHES

When the segment switches no longer function properly due to dirty contacts, they can be treated with switch oil (for code number see chapter XI-A). This oil has cleaning and lubricating properties.

Survey of adjusting elements

VIII

Adjustment	*Adjusting element*	*Fig.*	*Measuring device*	*Chapter IX*
Frequency response curve	R18 C22 C1	6	Oscilloscope + PM 5120 or PM 5121	B2
Distortion			Distortion meter	C
Amplitude	R26	6	LF valve voltneter Oscilloscope	D
Mark/space ratio of the square wave voltage (see Fig. 4)	R20	6	Oscilloscope	E

Checking and adjusting

IX

The tolerances stated below are factory tolerances which apply when the apparatus is re-adjusted. They may differ from the data given in Chapter II. All checks and adjustments should be carried out at a 16-V supply voltage, unless otherwise stated.

A. BATTERY CURRENT

- Set SK1 to position "ON".
- Measure the current consumption.
  At a supply voltage of 18 V the current consumption should be:
  24 mA ± 3 mA in position ⎓
  25 mA ± 3 mA in position ~

B. FREQUENCY RESPONSE CURVE

1. Mechanical check

- Set the frequency dial to position 15.
- Set SK3 to position ~.
- Set SK2 to position × 100.
- Connect an oscilloscope to sockets BU1–BU2.
- Check that the frequency is 1500 Hz ± 10 Hz. If the tolerance is greater, remove the cap from the frequency dial and loosen the nut.

- Set potentiometer R18 to the centre position.
- Turn the spindle of double potentiometer R1 until the nominal frequency is obtained.
- Set the frequency dial to position 15 and tighten the nut without moving the spindle of double potentiometer R1.
- Check the frequency dial setting at 1500 Hz.

2. Electrical check

- Set the frequency dial to position 100.
- Set SK3 to position ~.
- Set SK2 to position × 100.
- Check that the frequency is 10 kHz ± 2% (with the beat frequency method).
- Set the frequency dial to position 10.
- Check that the frequency is 1 kHz ± 2%. If necessary, adjust R18 so that the frequency inaccuracy is smaller than 2%.
- Set SK2 to position × 1 k.
- Set the frequency dial to position 10.
- Check that the frequency is 10 kHz ± 2%. If necessary, correct the frequency with C22.
- Set the frequency dial to position 100.
- Check that the frequency is 100 kHz ± 2%. If necessary, correct the frequency with C1.
- Check the frequency at all ranges in the positions 10, 25, 40, 70 and 100 of the frequency dial. Tolerance: ± 3% ±0.7 Hz.

C. DISTORTION OF THE SINEWAVE VOLTAGE

- Set SK3 to position ~.
- Measure the distortion with a non-linear distortion meter.
  The distortion should be smaller than 0.7% at 20 Hz and 100 KHz.
  At 1 kHz the distortion should be smaller than 0.3%.

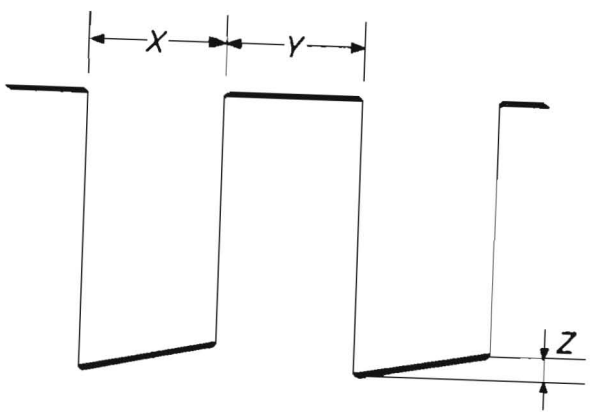
D. AMPLITUDE

- Set attenuator R2 to position 2.0 V.
- Set SK3 to position ~.
- Check that the output amplitude (no load at BU1–BU2) at all frequencies is 2 V_{rms}. If necessary, correct with R26.
- Set SK3 to position ⊓.

- Check that the output amplitude is 4 V_{p-p}.
- Set SK3 to position $\sim$.
- Check the calibration of attenuator R2 at a frequency of 1 kHz.
- Check the amplitude response of the output signal at 10, 30 and 100 Hz (SK2 in position $\times$ 1) and at 10, 30 and 100 kHz (SK2 in position $\times$ 1K). Tolerance: $\leq$ 1% of the output amplitude at 1 kHz.

E. SQUARE WAVE VOLTAGE

- Set SK3 to position $\sqcap$.
- Check that the mark/space ratio at 2 kHz is 1 : 1 (see Fig. 4). If necessary, adjust with R20.
- Set attenuator R2 to position 2.0 V.
- Check that the output voltage is 4 $V_{p-p} \pm 5\%$.
- Check that the sag at 50 Hz and 4 V_{p-p} is $\leq$ 10 mV.



x : y = mark/space ratio
z = sag

PEM 1515
E 1320

Fig. 4. Square wave voltage shape

Replacing parts

No special parts have been used in this apparatus.
After replacing parts, it may be necessary to readjust the relevant part of the circuit (see chapter IX, Checking and adjusting).
During replacement of parts, the apparatus should be switched off.
For gaining access to parts, see chapter V.

List of parts

XI

A. MECHANICAL PARTS

Item	*Number*	*Fig.*	*Ordering number*	*Description*
1	1	5	4822 693 70011	Front plate
2	1	5	4822 455 70088	Text plate
3	1	5	4822 413 40112	Knob
4	2	5	4822 413 70037	Cap for knob
5	1	5	4822 413 40211	Knob
6	1	5	4822 273 40058	Switch SK2
7	2	5	4822 290 40011	Socket
8	2	5	4822 277 20014	Switch SK1–SK3
9	1	5	4822 413 70017	Cap
10	1	5	4822 522 30465	Dial
—	1 bot.	—	4822 390 10007	Switch oil

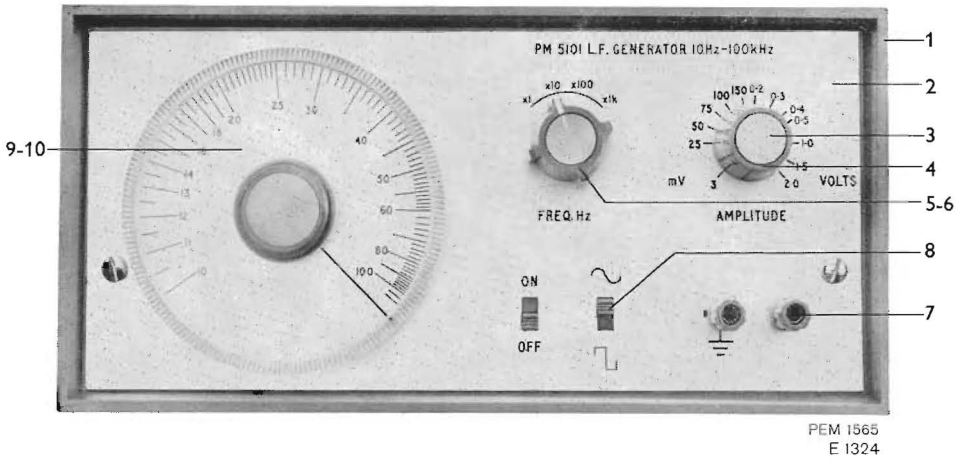


Fig. 5. Front view with indication of the mechanical parts

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
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
0,25 W ≦ 1 MΩ, 5%
> 1 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%

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%

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

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

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

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

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

Polyester capacitor
Polyesterkondensator
Polyesterkondensator
Condensateur au polyester
Condensador polyester
400 V

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

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

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

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

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

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

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

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

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.
Pour les pièces universelles et standard veuillez consulter le Catalogue Service PHILIPS.
Para piezas universales y standard consulte el Catálogo de Servicio PHILIPS.

RESISTORS

No.	*Ordering number*	*Value*	*Description*
R1	4822 102 30111	2 × 50 kΩ	Double carbon potentiometer
R2	4822 101 30053	1 kΩ	Carbon potentiometer
R16	4822 116 90002		Thermistor
R18	4822 101 10026	4.7 kΩ	Carbon potentiometer
R20	4822 101 10026	4.7 kΩ	Carbon potentiometer
R26	4822 101 10018	1 kΩ	Carbon potentiometer

CAPACITORS

No.	*Ordering number*	*Value*	*Volt*	*Description*
C2	4822 124 20407	400 µF	25	Electrolytic
C4	4822 124 20407	400 µF	25	Electrolytic
C6	4822 124 20381	64 µF	64	Electrolytic
C7	4822 124 20399	250 µF	25	Electrolytic
C11	4822 124 20399	250 µF	25	Electrolytic
C12	4822 121 50421	0.16 µF	63	Polystyrene
C14	4822 121 50421	0.16 µF	63	Polystyrene
C15	4822 121 50235	3 300 pF	125	Polystyrene
C16	4822 121 50419	33 000 pF	63	Polystyrene
C17	4822 121 50419	33 000 pF	63	Polystyrene
C18	4822 121 50235	3 300 pF	125	Polystyrene
C19	4822 121 50421	0.16 µF	63	Polystyrene
C21	4822 121 50421	0.16 µF	63	Polystyrene
C24	4822 124 20399	250 µF	25	Electrolytic
C29	4822 121 50097	10 000 pF	63	Polystyrene
C30	4822 121 50097	10 000 pF	63	Polystyrene

MISCELLANEOUS

No.	*Ordering number*	*Value*	*Description*
L1	4822 158 10261	30 µH	Choke

SEMICONDUCTORS

No.	*Type*	*Ordering number*	*Description*
TS1	BCY70	4822 130 40324	Transistor
TS2	BCY70	4822 130 40324	Transistor
TS3	BCY70	4822 130 40324	Transistor
TS4	BCY72	4822 130 40486	Transistor
TS5	BCY72	4822 130 40486	Transistor
TS6	BCY72	4822 130 40486	Transistor
TS7	BCY72	4822 130 40486	Transistor
GR1	BZY88/C4V7	4822 130 30264	Zener diode
GR2	BAX13	4822 130 40182	Diode
GR3	BAX13	4822 130 40182	Diode

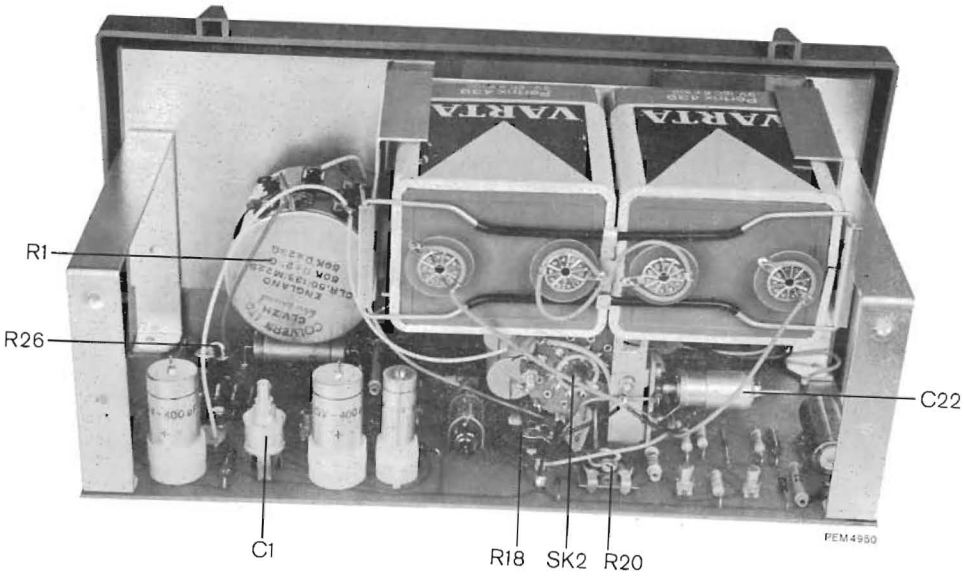


Fig. 6. Inside view

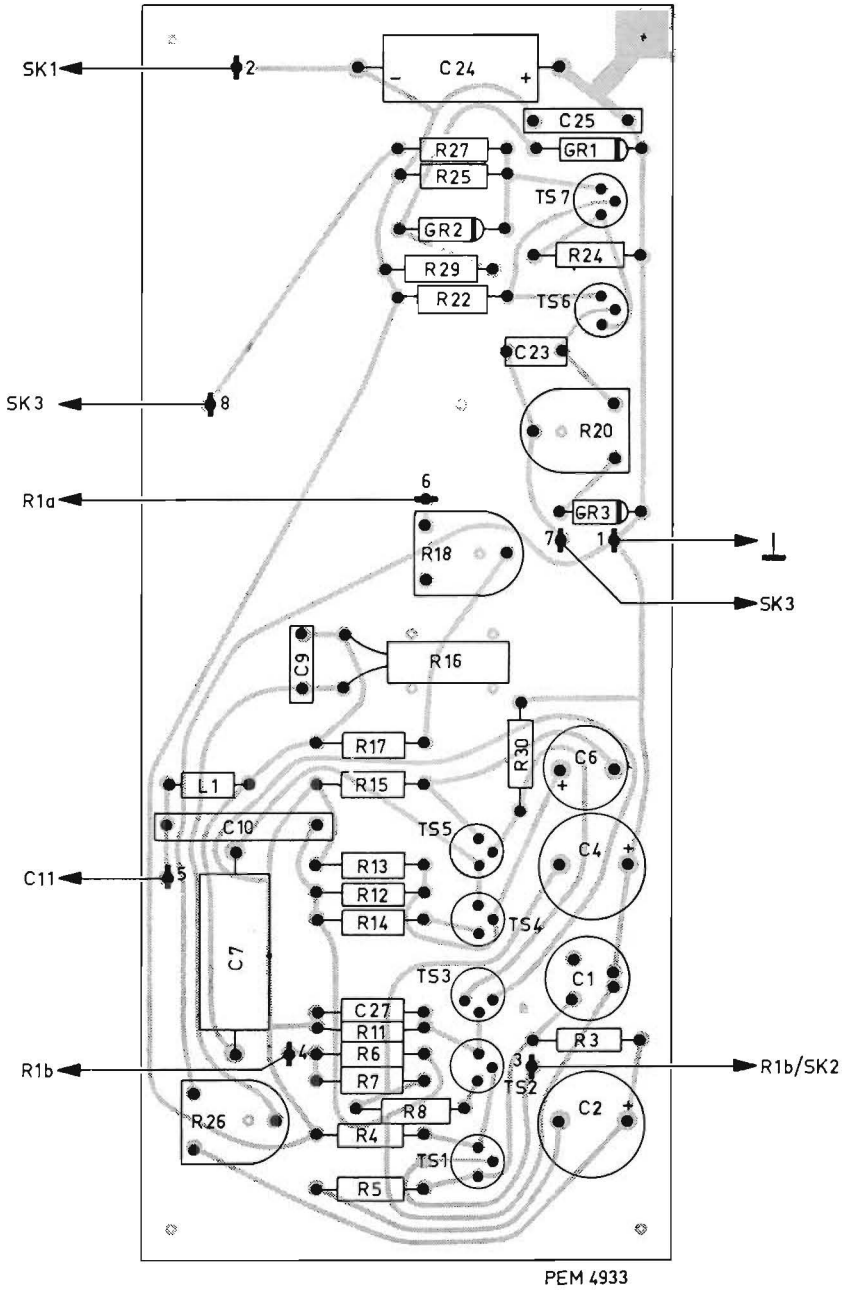
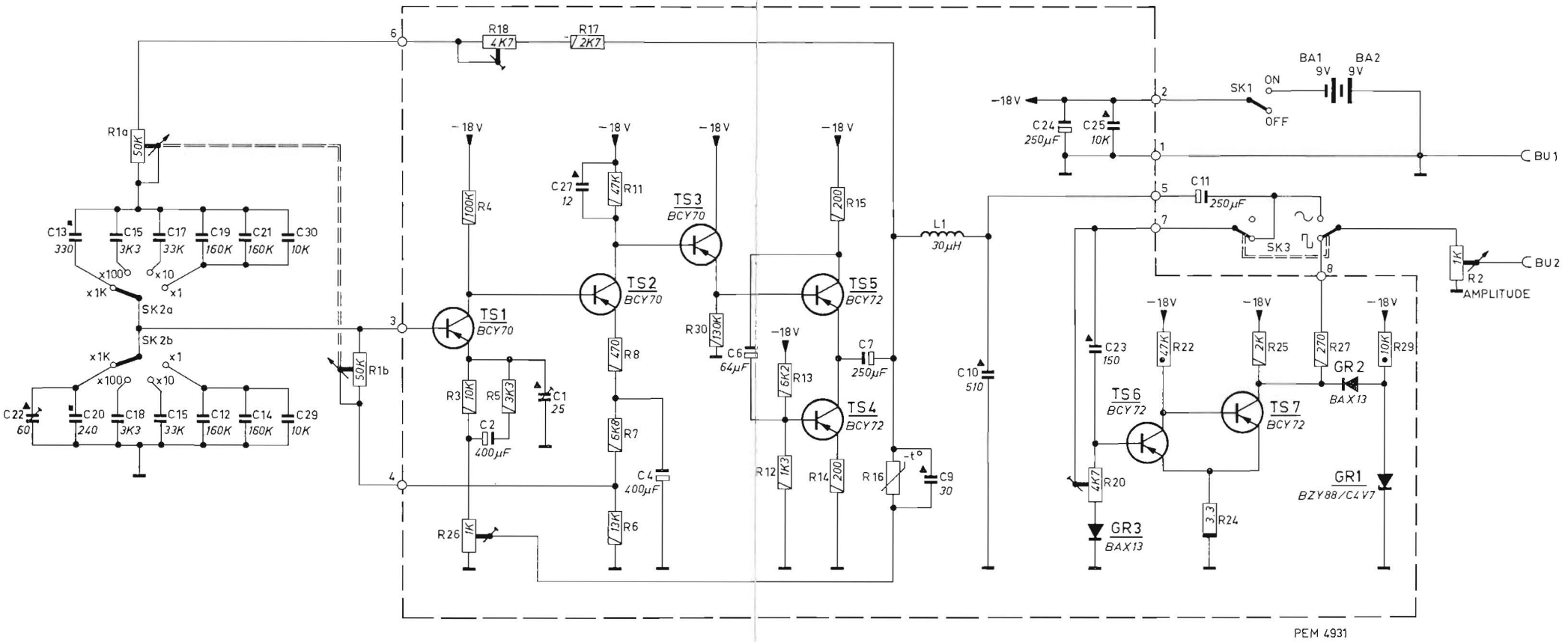

SK1
2
C 24
C 25
GR1
R27
R25
TS 7
GR2
R24
R29
R22
TS6
C23
SK3
8
R20
R1a
6
GR3
R18
7
1
SK3
C9
R16
R17
R30
C6
L1
R15
C10
TS5
C4
C11
5
R13
R12
R14
TS4
C7
TS3
C1
C27
R11
R6
R7
R3
R1b
4
3
R1b/SK2
TS2
R26
R8
C2
R4
TS1
R5
PEM 4933

Fig. 7. Unit A



Erratum: the value of C23 has been changed into 270 pF

Fig. 8. Circuit diagram

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Colombia: Philips Colombiana S.A., Communications Department, Apartado Nacional 1505, Bogotá; tel. 473-640

Congo: Philips S.A.R.L., 620, Avenue Industrielle, B.P. 2546, Lubumbashi; Philips Congo S.C.R.L., 137, Boulevard du 30 Juin, B.P. 1798, Kinshasa; 52, Avenue des Eucalyptus, B.P. 2020, Stanleyville

Costa Rica: Philips de Costa Rica Ltd., Apartado Postal 4325, San José; tel. 5670

Curaçao: Philips Antillana N.V., Postbus 523, Willemstad; tel. Curaçao 36222-35464

Danmark: Philips A.S., Prags Boulevard 80, København; tel. Asta 2222

Deutschland (Bundesrepublik): Philips Industrie Elektronik GmbH, Röntgenstrasse 22, Postfach 111, 2 Hamburg 63; tel. 501031

Ecuador: Philips Ecuador S.A., Casilla 343, Quito; tel. 30064

Egypt: Resident delegate office, P.O.B. 1687, 43 Kasr El Nil Street, Cairo; tel. 74933

El Salvador: Philips de El Salvador, Apartado Postal 865, San Salvador; tel. 7441

España: Philips Ibérica S.A.E., Avenida de America, Apartado 2065, Madrid; tel. 246 22 00

Ethiopia: Philips Ethiopia (Priv. Ltd., Co), P.O.B. 659, Cunningham Street, Addis Abeba; tel. 13440

France: Philips Industrie S.A., 105 Rue de Paris, Bobigny 93; tel. 845 28-55, 845 27-09

Ghana: Philips (Ghana) Ltd., P.O.B. M 14, Accra

Great Britain: M.E.L. Equipment Company Ltd., Manor Royal, Crawley (Sussex); tel. 28787

Guatemala: Philips de Guatemala S.A., Apartado Postal 238, Guatemala City; tel. 20607-08-09

Hellas: Philips S.A. Hellénique, B.P. 153, Athènes; tel. 230476

Hong Kong: Philips Hong Kong Ltd., P.O.B. 2108, Rooms 1006/1008 Prince's Building, Hong Kong; tel. 33728, 28548

India: Philips India Ltd., PIT/S.E. Dept., 254, Dr. Annie Besant Road, P.O.B. 6598, Worli, Bombay 18; tel. 245144

Iran: Philips Iran Ltd., P.O.B. 1297, Teheran; tel. 48344-68344

Iraq: Philips (Iraq) W.L.L., P.O.B. 5749, South Gate Post Office, Baghdad; tel. 98844

Ireland: Philips Electrical (Ireland) Ltd., Newstead, Clonskeagh, Dublin 14; tel. 976611

Island: Mr. Snorri P.B. Arnar, P.O.B. 354, Reykjavik; tel. 13869

Islands Canarias: Philips Ibérica S.A.E., Triana 132, Las Palmas; Castilla 39-41 Santa Cruz de Tenerife.

Israël: Isralectra Ltd., 12, Allenby Road, P.O.B. 1608, Haifa; tel. 526231

Italia: Philips S.p.A., Casella Postale 3992, Milano; tel. 69.94

Liban: Philips Liban S.A., P.O.B. 670, Beyrouth; tel. 232303-232458/59

Malaya: Philips Singapore Ltd., P.O.B. 1358 N.T.S. Building, d'Almeida Street, Singapore; tel. 94914

Maroc: Société Anonyme Marocaine de Télécommunications, Place Lemaigre Dubreuil, Casablanca; tel. 439-92

Mexico: Philips S.E.T., Apartado Postal 24420, Mexico 7 D.F.; tel. 25-15-40

Nederland: Philips Bedrijfsapparatuur Nederland N.V., Boschdijk VB, Eindhoven; tel. 3-33-33

Ned. Antillen: Philips Antillana N.V., Postbus 523, Willemstad, Curaçao

New Zealand: Electronic Development and Applications Co. Ltd., 18-20 Lorne Street, P.O.B. 2097, Wellington; tel. 54-039

Nigeria: Philips (Nigeria) Ltd., Philips House, 6, Ijora Causeway, P.O.B. 1921, Lagos; tel. 56051/2

Nippon: Philips Products Sales Corporation of Japan, Kokusai Building, 7th Floor, Marunouchi, Chiyoda-Ku, Tokyo; tel. (216) 2441

Norge: Norsk A.S. Philips, Postboks 5040, Oslo; tel. 463890

Österreich: Philips GmbH, Abt. Industrie, Triesterstrasse 64, 1101 Wien X; tel. 64 55 11

Pakistan: Philips Electrical Co. of Pakistan Ltd., Bunder Road, P.O.B. 7101, Karachi; tel. 70071

Paraguay: Philips del Paraguay S.A., Casilla de Correo 605, Asunción; tel. 8045-5536-6666

Perú: Philips Peruana S.A., Apartado Postal 1841, Lima; tel. 34620-40265

Philippines: Electronic Development & Application Center, Room 715, Don Santiago Bld., 134 Taft Avenue, Manila

Portugal: Philips Portuguesa S.A.R.L., Rua Joaquim Antonio d'Aquiar 66, Lisboa; tel. 683121/9

Rhodesia: Philips Rhodesian (Private) Ltd., P.O.B. 994, Gordon Avenue, Salisbury; tel. 29081

Rwanda: Philips Rwanda S.A.R.L., B.P. 449, Kigali

Schweiz-Suisse-Svizzera: Philips A.G., Binzstrasse 18, 8027 Zürich; tel. 051 44 22 11

Singapore: Philips Singapore Ltd., P.O.B. 1358, N.T.S. Building, d'Almeida Street, Singapore 1

South Africa: South African Philips (Pty) Ltd., P.O.B. 7703, 2, Herb Street, New Doornfontein, Johannesburg; tel. 24-0531

Sudan: Gellatly Hankey & Co. (Engineering) Ltd., P.O.B. 150, Khartoum; tel. 71183

Suomi: Oy Philips Ab, Frederikinkatu 48, Helsinki; tel. 10915

Sverige: Svenska A.B. Philips, Fack, Lidingövägen 50, Stockholm 27; tel. 08/635000

Syrie: Philips Moyen Orient S.A., P.O.B. 2442, Damas; tel. 18605-21650

Taiwan: Yung Kang Trading Co. Ltd., 6 Nan King East Road, 1 Section, P.O.B. 1467, Taipei; tel. 43540

Thailand: Philips Thailand Ltd., 283 Silom Road, Bangkok; tel. 36985-8

Tunisie: Société Tunisienne d'Industrie Electronique et de Télévision, 32 bis Rue Ben Ghedhahem, Tunis

Türkiye: Türk Philips Ticaret A.S., Posta Kutusu 504, Istanbul; tel. 447486

Uruguay: Philips de Uruguay, Avda Uruguay 1287, Montevideo; tel. 956 41-2-3-4

U.S.A.: Philips Electronic Instruments, 750 South Fulton Ave., Mount Vernon, N.Y. 10550-(914) 664-4500

Venezuela: C.A. Philips Venezolana, Apartado Postal 1167, Caracas; tel. 72 01 51

Zambia: Philips Electrical Ltd., Freetown Road, P.O.B. 553, Kitwe; Philips Electrical Ltd P.O.B. 1878, Lusaka