

Electronic VA Ω meter PM2505

9447 025 050.1

Service Manual

9499 475 01411

800301



S&I

Scientific & Industrial Equipment Division



**Scientific &
Industrial Equipment**

PHILIPS

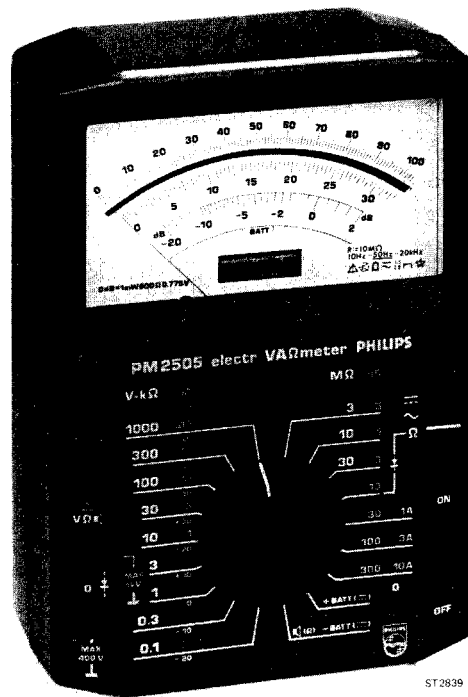
Electronic VA Ω meter PM2505

9447 025 050.1

Service Manual

9499 475 01411

800301



ST2839



PHILIPS

IMPORTANT

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

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

IMPORTANT**RECHANGE DES PIECES DETACHEES (Réparations)**

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

Note: The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

Bemerkung: Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.

Remarques: Cet appareil est l'objet de développements et améliorations continus. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.

CONTENTS	Page
1. Introduction	5
2. Technical data	5
2.1. Measuring performance	5
2.1.1. D.c. voltage measurements	5
2.1.2. A.c. voltage measurements	6
2.1.3. D.c. current measurements	6
2.1.4. A.c. current measurements	7
2.1.5. Resistance measurements	8
2.1.6. Semiconductor testing \downarrow	8
2.1.7. Continuity check \triangleleft (BUZZER mode)	9
2.1.8. dB measurements	9
2.2. General data -	9
2.2.1. Conversion characteristics	9
2.2.2. Display	9
2.2.3. Warm-up time	9
2.2.4. Operating conditions	10
2.2.5. Mechanical data	10
2.2.6. Power requirements	10
2.2.7. Input terminals arrangement	10
2.2.8. Calibration	11
2.2.9. Safety	11
3. Accessories	12
3.1. Accessories delivered with the PM2505	12
3.2. Optional accessories	12
3.2.1. HF probe PM9210 and accessory set PM9212	12
3.2.2. EHT probe PM9246	13
3.2.3. Current transformer PM9245	13
3.2.4. Shunt PM9244	13
3.2.5. RF probe PM9213	16
3.2.6. Carrying case PM9278	16
4. Circuit description	17
4.1. Introduction	17
4.2. Principle of operation	17
4.2.1. $V \text{ --- } , V \sim , + \text{ BATT and } - \text{ BATT}$ measurements	17
4.2.2. $A \text{ --- } , \text{ and } A \sim$ measurements	17
4.2.3. Ω , \downarrow and BUZZER measurements	17
4.2.4. Amplifier	17
4.3. Detailed circuit description	19
4.3.1. $V \text{ --- } , V \sim , \text{ BATT and } - \text{ BATT}$ attenuator	19
4.3.2. $A \text{ --- } , \text{ and } A \sim$ shunts	20
4.3.3. Ω , \downarrow and BUZZER measurements	21
4.3.4. Amplifier and guard circuit	23
4.3.5. Protection	24
5. Acces	29
5.1. General	29
5.2. Dismantling the PM2505	29
5.3. Replacing parts	29
5.3.1. Slide switch ON/OFF or $\text{---} , \sim , \Omega$	29
5.3.2. Range switch	29
5.3.3. Polarity indicator	30
6. Checking and adjusting	31
6.1. General -	31
6.2. Adjusting table	32
7. Parts list	34
7.1. Mechanical	34
7.2. Electrical	36
7.2.1. Capacitors	36
7.2.2. Resistors	37
7.2.3. Semiconductors	39
7.2.4. Integrated circuits	39

LIST OF FIGURES

	Page
1. Measuring leads with test pins PM9262	12
2. HF-probe PM9210	14
3. Accessory set PM9212	14
4. HT-probe PM9246	14
5. Current transformer PM9246	14
6. Shunt PM9244	14
7. RF-probe PM9213	16
8. Blockdiagram	18
9. V_{DC} , V_{AC} , +BATT and - BATT attenuators	19
10. A_{DC} , and A_{AC} shunts	20
11. Ω , \downarrow , BUZZER measurements principle	21
12. Ω , \downarrow , BUZZER current source	22
13. Feed back circuitry	23
14. Amplifier and buffer circuit	26
15. Protection	24
16. Full scale deflection values	28
17. Measuring system	30
18. Replacing the polarity indicator	30
19. Adjusting elements	31
20. P.c. board component side	40
21. P.c. board conductor side	41
22. Function switch lay-out component side	42
23. Function switch lay-out conductor side	42
24. List of used components	45
25. Circuit diagram	45

1. INTRODUCTION

The analog electronic multimeter PM 2505 is a universal measuring instrument with 62 measuring ranges. With the optional accessories the measuring ranges can be extended up to 77.

The PM 2505 measures:

- ac and dc voltages from 100mV f.s.d. to 1000V f.s.d.
- resistances with a linear scale from 100 Ω f.s.d. to 30M Ω f.s.d.
- ac and dc currents from 1 μ A f.s.d. to 10A f.s.d..

The ranges in the voltage, resistance and current functions are divided in 1-3-10 steps.

Separate ranges are available for testing semiconductors \downarrow , and for continuity check with the aid of an internal buzzer \blacksquare .

The instrument is powered by two 9V batteries which enable continuous measuring for at least 1000 hours.

2. TECHNICAL DATA

This apparatus has been designed and tested in accordance with IEC publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The present instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

All values mentioned in this description are nominal; those given with tolerances are binding and guaranteed by the manufacturer.

Manufacturer : N.V. Philips MIG S&I
 Typenumber : PM 2505
 Designation : Electronic VA Ω -meter
 Measuring quantities: Vdc, Vac, Adc, Aac, Ω , \downarrow , \blacksquare , dB

2.1. MEASURING PERFORMANCE

2.1.1. Dc voltage measurements

Ranges	mV 100 - 300
(full scale deflection)	V 1 - 3 - 10 - 30 - 100 - 300 - 1000
Sensitivity	1mV in 100mV range
Accuracy	\pm 1.5% f.s.d.
Temperature coefficient	\pm 0.1% f.s.d. / $^{\circ}$ C.
Input impedance	10 M Ω // 75pF
SMRR	> 60 dB at 50/60Hz
Maximum Series Mode signal	2 times full scale
CMRR with 1 K Ω unbalance	100dB for ac (48 - 62Hz) 120dB for dc
	As common is used a grounded metal plate.
Max. voltage between:	
Hi and Lo	1000V peak, on all ranges
Hi and earth	1000V rms, 1400V peak – V test 6kV
Lo and earth	400V rms, 580V peak – V test 4kV
Recovery time	20s within specification in the 100mV range, after measuring 1000V in the 1000V range

2.1.2. Ac voltage measurements

Ranges (full scale deflection)	mV	100 - 300
	V	1 - 3 - 10 - 30 - 100 - 300 - 1000

Sensitivity 1mV in 100mV range

Accuracy	Range	Frequency	Acc.
	100mV - 1000V	50 - 60Hz	± 2.5%
	100mV - 300 V	10Hz - 30kHz	± 5% f.s.d.
	1000V	10Hz - 1kHz	± 5% f.s.d.

Temperature coefficient ± 0.1% f.s.d. /°C

Input impedance 10MΩ//75pF

CMRR with 1kΩ unbalance 100dB for ac (48 - 62Hz)

Max. VHz product < 1.10⁷

Max. voltage between :

Hi and Lo 600V rms, 1000V peak on all ranges

Hi and earth 1400V peak - V test 6kV

Lo and earth 400V rms, 580V peak - V test 4kV

2.1.3. Dc current measurements

Ranges (full scale deflection)	μA	1 - 3 - 10 - 30 - 100 - 300
	mA	1 - 3 - 10 - 30 - 100 - 300
	A	1 - 3 - 10

Sensitivity 10nA in 1 μA range

Accuracy ± 1.5% f.s.d.

Temperature coefficient ± 0.1% f.s.d. /°C.

Voltage drop over shunt f.s.d.

Range	Voltage drop
1μA 10μA 100μA	31.6mV
3μA 30μA 300μA	100 mV
1mA 30mA 1 A	10 mV
3mA 100mA 3 A	31.6mV
10mA 300mA 10 A	100 mV

Voltage drop over input sockets f.s.d.

Range	Voltage drop
1μA - 30mA	< 100mV
100mA	< 150mV
300mA	< 450mV
1 A	< 50mV
3 A	< 100mV
10 A	< 250mV

Protection:

Range 1μA – 300mA

Ceramic or glass fuse 20x5mm. 400mm. 400mA fast 250V IEC 127/1 High breaking capacity.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of make shift fuses and the short circuiting of fuseholders are prohibited.

Range 1A – 10A	Not protected. Maximum current 16A for 1 minute
Max. overload voltage	250V rms (40 - 400Hz)
Max. voltage between:	
Hi and earth	400V rms
Lo and earth	400V rms

2.1.4. Ac current measurements

Ranges
(full scale deflection)

μA	1 - 3 - 10 - 30 - 100 - 300
mA	1 - 3 - 10 - 30 - 100 - 300
A	1 - 3 - 10

Sensitivity 10nA in $1\mu\text{A}$ range

Accuracy

Range	Frequency	Acc.
$1\mu\text{A}$ - 10 A	50 - 60 Hz	$\pm 3\%$
$1\mu\text{A}$ - $30\mu\text{A}$	10 - 70 Hz	$\pm 3\%$
$100\mu\text{A}$ - 10 mA	10 Hz - 20 kHz	$\pm 3\%$
30mA - 10 A	10 Hz - 10 kHz	$\pm 3\%$

Temperature coefficient

$\pm 0.1\%$ f.s.d. / $^{\circ}\text{C}$.

Voltage over shunt at f.s.d.

Range	Voltage drop
$1\mu\text{A}$ $10\mu\text{A}$ $100\mu\text{A}$	31.6mV
$3\mu\text{A}$ $30\mu\text{A}$ $300\mu\text{A}$	100 mV
1mA 30mA 1 A	10 mV
3mA 100mA 3 A	31.6mV
10mA 300mA 10 A	100 mV

Voltage drop over input sockets
at f.s.d.

Range	Voltage drop
$1\mu\text{A}$ – 30mA	< 100mV
100mA	< 150mV
300mA	< 450mV
1 A	< 50mV
3 A	< 100mV
10 A	< 250mV

Protection:

Range $1\mu\text{A}$ – 300mA

Ceramic or glass fuse 20x5mm 400mA Fast, 250V.
IEC 127/1 High breaking capacity

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of make shift fuses and the short circuiting of fuseholders are prohibited.

Range 1 A – 10 A

Max. overload voltage

Not protected. Max. current 16A for 1 minute.
250V rms (40 - 400Hz).

Max. voltage between:

Hi and earth

400V rms

Lo and earth

400V rms

2.1.5. Resistance measurements

Ranges

Ω	100 - 300
$k\Omega$	1 - 3 - 10 - 30 - 100 - 300
$M\Omega$	1 - 3 - 10 - 30

Sensitivity

Linear-scale 1 Ω in 100 Ω range

Accuracy

$\pm 3\%$ f.s.d. for 100 Ω to 10M Ω range

$\pm 10\%$ f.s.d. for 30M Ω range

Temperature coefficient

$\pm 0.1\%$ f.s.d. / $^{\circ}C$

Measuring voltage and measuring current

Range	Measuring Voltage f.s.d.	Measuring current
100 Ω 300 Ω	31.6mV 100 mV	316 μA
1k Ω 3k Ω	31.6mV 100 mV	31.6 μA
10k Ω 30k Ω	31.6mV 100 mV	3.16 μA
100k Ω 300k Ω	31.6mV 100 mV	316nA
1M Ω	1V	1 μA
3M Ω		316nA
10M Ω		100nA
30M Ω		31.6nA

Protection

With semi-conductor protection devices

Maximum overload voltage

250V rms (40 - 400Hz).

Maximum voltage between:

Hi and earth

400V rms

Lo and earth

400V rms

2.1.6. Semi-conductor testing ∇

Range

Semi-conductor ∇

Measuring current

316 μA

Measuring voltage f.s.d.

1V

	Meter indication	
	Conducting	Reversed
Si	50 - 80	100
Ge	10 - 30	100

Polarity for conducting

Anode on ∇ socket

Cathode on \square socket

Maximum reverse voltage

7.5V

Protection

With semi-conductor protection devices

Maximum overload voltage

250V rms (40 - 400Hz)

Max. voltage between:


Hi and earth

400V rms

Lo and earth

400V rms

2.1.7. Continuity check (BUZZER – RANGE)

Range	BUZZER 
Shortcircuit	Audible tone from 0Ω ... 20Ω
Isolation	Resistance $> 20\Omega$, no tone
Protection	With semi-conductor protection devices
Maximum overload voltage	250V rms (40 - 400Hz).
Max. voltage between:	
Hi and earth	400V rms
Lo and earth	400V rms

2.1.8. dB measurements

Ranges	dB	-20, -10, 0, +10, +20, +30, +40
		+50, +60
0 dB reference		0dB = 1mW 600Ω 0,775V

2.2. GENERAL DATA

2.2.1. Conversion characteristics

Kind of conversion	Linear by means of FET and IC. The IC consists of an amplifier and current source for resistance measurement.
Operating principle	Current moving coil with taut band, driven by integrated circuit.
Basic mode of operation	Continuous indication on moving coil
Range setting	Manual with mono-knob
Function setting	Manual with slideswitch $\text{---}, \sim, \Omega$.
Polarity setting	Automatic on separate moving coil system
Polarity indication	+ - \sim on separate moving coil system
Zeroing	Mechanical zero of moving coil Electrical zero of amplifier

2.2.2. Display

Visual representation:	3 scales: (0 - 100) (0 - 31.6) (-20 - +2 dB) Battery OK scale, mirror for parallax free reading.
Means of representation of measured value	Position of needle on the scale of the measuring system.
Means of polarity representation	Position of needle of polarity indicator - \sim +
Means of function representation	Position of function switch: $\text{---}, \sim, \Omega$.

2.2.3. Warm-up time

Warm-up time	None.
--------------	-------

2.2.4. Operating conditions in accordance with IEC 68 - 2.

<i>Climatic conditions</i>	Acc IEC 359 Class 1
Ambient temperature	23°C ± 2°C.
Rated range of use	0°C ... +55°C
	The apparatus has been designed for indoor use it may occasionally be subjected to temperatures between 0°C and –10°C without degradation of its safety.
Limit range of storage and transport	–40°C ... +70°C
Relative humidity	10% ... 90% at ≤ 35°C 10% ... 70% at 35° to 55°C
<i>Mechanical conditions</i>	Acc IEC 68–2–6 FC
Vibration test	Acc IEC 359 M2
<i>Fields and radiation</i>	
From external origin	Electric } fields acc. MIL std 461A –R303 Magnetic }
From internal origin	Electric } fields acc. MIL std 461A Magnetic }

2.2.5. Mechanical data

Material	ABS
Use of instrument	In three positions, horizontal, vertical and with stand-up bracket.
Dimensions	172 x 118 x 60mm.
Weight	Approx. 750 gr.

2.2.6. Power requirements

Batteries	Two 9V batteries 49 x 26 x 17.2mm dimensions acc. to IEC publ. 86 e.g. Philips 6F 22 TR
Battery life	Approx. 1000 hours Life-time in Ω, ♀ and BUZZER 🔊 mode is lower.
Battery check	Two separate positions on the range switch for + and –battery check. Battery is OK when pointer is within battery scale.

2.2.7. Input terminals arrangement

Inputs	Floating
Number of input sockets	4
	<input type="checkbox"/> Common socket for voltage, current, resistance, diode and BUZZER measurements.
	<input type="checkbox"/> High socket for voltage and resistance, diode and BUZZER measurements.
	<input type="checkbox"/> High socket for low current-measurement from 1μA ... 300mA f.s.d.
	<input type="checkbox"/> High socket for high current-measurement from 1A ... 10A f.s.d.

Impedance between input-sockets

Between $\boxed{\text{V}\Omega}$ and $\boxed{0}$: $10\text{M}\Omega // 75\text{pF}$

Between $\boxed{\mu\text{A-mA}}$ and $\boxed{0}$: 1.8Ω in 300mA range.
to $31.6\text{K}\Omega$ in $1\mu\text{A}$ range.

Between $\boxed{\text{A}}$ and $\boxed{0}$: $20\text{m}\Omega$

2.2.8. Calibration

Calibration interval Every 6 months.

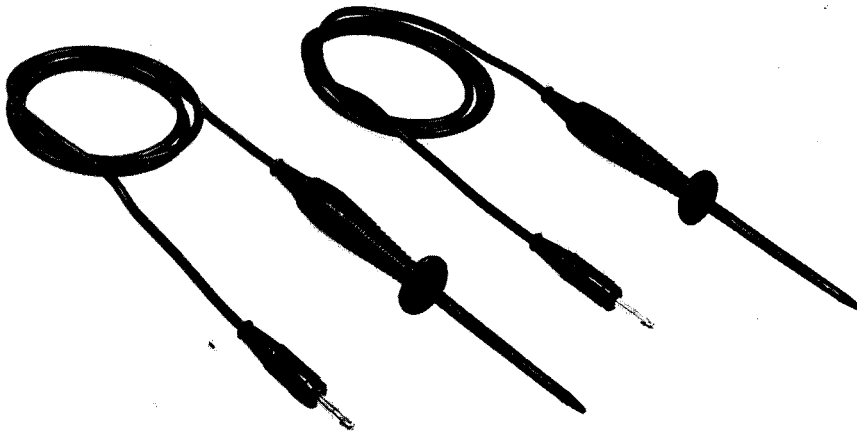
2.2.9. Safety

Safety class II acc IEC 348 and VDE 0411

3. ACCESSORIES

3.1. ACCESSORIES SUPPLIED WITH THE PM 2505

- 2 Fuses 400mA fast
- Measuring-leads with testpins PM 9260



ST 1038

Fig. 1. Measuring leads with testpins PM 9262

3.2. OPTIONAL ACCESSORIES

3.2.1. HF probe type PM 9210 (Fig. 2) Accessory set for the probe type PM 9212 (Fig. 3).

	PM 9210	PM 9210 + PM 9212
Frequency range	100kHz to 1GHz	100kHz to 1GHz
Straight line within 5%	100kHz to 6MHz	100kHz to 6MHz
Maximum deviation	3dB	3.5dB
Voltages ranges	150mV to 15V	15V to 200V
Max. voltage a.c.	30V	200V
Max. voltage d.c.	200V	500V
Input capacitance	2pF	2pF
<i>T-piece (included in PM 9212)</i>		
Impedance		50Ω
Standing wave ratio		1.25 at 700MHz and 1.15 at 1GHz

Probe type PM 9210, in combination with the probe accessories (adjustable earthing pin and dage adaptor), is suitable for measurements up to a frequency of 100MHz.

For measurements beyond this frequency it is advisable to use the 50Ω T-piece and the 50 terminating resistance which are included in the PM 9212 probe accessories set.

3.2.2. EHT probe type PM 9246 (Fig. 4.)

The EHT probe PM 9246 is suitable for measuring dc voltages up to 30kV. The PM 9246 can be used for measuring instruments having an input impedance of $100M\Omega$, $10M\Omega$ or $1.2M\Omega$ (selectable on the probe).

Maximum voltage	30kV
Attenuation	1000x
Input impedance	$600M\Omega \pm 5\%$
Accuracy	$\pm 3\%$
Relative humidity	20% to 80%

Note: Check that earth connections are made correctly.

3.2.3. Current transformer type PM 9245 (Fig. 5)

With this transformer it is possible to measure alternating currents over 10A up to 100A.

Transfer factor	1000x (100A = 100mA)
Transfer error	$\pm 3\%$
Frequency range	45Hz to 1kHz
Max. permissible secondary voltage loss.	200mV
Max. voltage with respect to earth	400V a.c.

Before measuring, connect the current transformer to the instrument.
Avoid contamination of the core parts.

3.2.4. Shunt type PM9244 (fig. 6)

With this shunt it is possible to measure direct- and alternating currents (max. 1kHz) up to 31.6A.

Current range	10A and 31.6A
Output voltage	100mV and 31.6mV
Accuracy	100mV : $\pm 1\%$ 31.6mV : $\pm 2\%$
Dissipation	Max. 3.16W
Dimensions	Height 55mm Width 140mm Depth 65mm

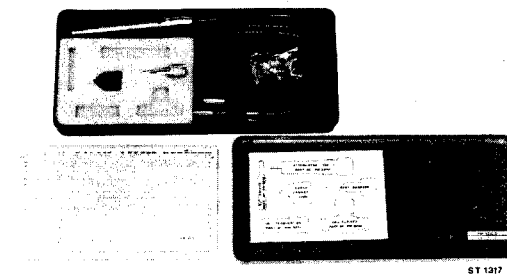


Fig. 2. HF-probe PM 9210

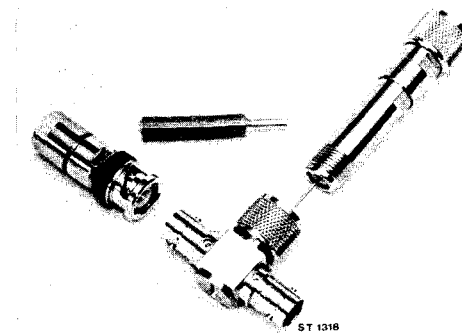


Fig. 3. Accessory set PM 9212



Fig. 4. HT-probe PM 9246

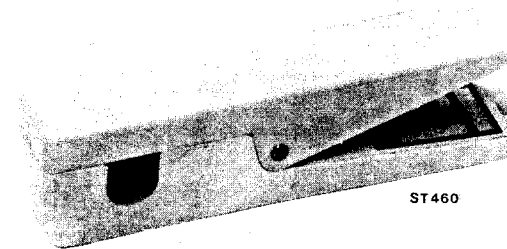


Fig. 5. Current transformer PM 9245

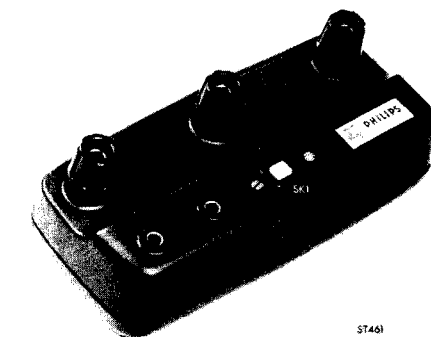


Fig. 6. Shunt PM 9244

3.2.5. RF probe PM 9213 (Fig. 7)

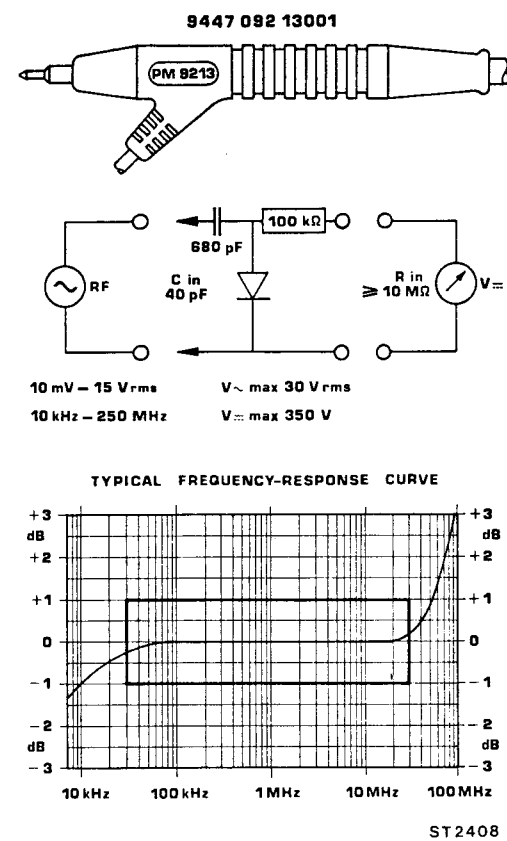


Fig. 7. RF-probe PM 9213

3.2.6. Carrying case PM 9278

The PM 9278 is a hard-plastic case carrying the PM 2505 and the accessories.

4. CIRCUIT DESCRIPTION

SERVICE DATA

4.1. INTRODUCTION

The circuitry of the PM 2505 is built-up of a complete integrated amplifier part, preceded by attenuators for the various voltage, current and resistance ranges. The integrated amplifier part consists of an operational amplifier (V201/A) together with the rectifier diodes for the measuring system and a reference amplifier (V201/B) for the resistance ranges.

The high input impedance of the PM 2505 is obtained by a FET-input stage.

The high sensitivity of the moving-coil system has been achieved by tautbandsuspension.

If sinusoidal voltages or currents are applied, the moving coil instrument measures the average value of the signal. With the aid of a formfactornetwork (x 1.11) the instrument indicates the rms value.

4.2. PRINCIPLE OF OPERATION (Fig. 8)

4.2.1. V_{DC} , V_{AC} , + BATT and – BATT measurements

The unknown direct or alternating voltage is connected to the voltage attenuator. Dependent on the selected range the unknown voltage is attenuated 3.16, 31.6, 316, 3160 or 31.600 times. From the attenuator the voltage is supplied to the amplifier, converted in to a current and measured.

At +BATT and -BATT measurements the +9V and -9V battery voltages are connected to a special voltage attenuator. From this attenuator the voltages are supplied to the amplifier and measured.

4.2.2. I_{DC} and I_{AC} measurements

The unknown direct or alternating currents are supplied to the shunts. For the 1A, 3A and 10A ranges a special shunt is built-in. Dependent on the range corresponding shunts are connected to the input. The resulting voltages are supplied to the amplifier, converted into a current and measured.

4.2.3. R , ∇ and measurements with BUZZER (continuity-check)

At resistance measurements a constant current flows through the unknown resistance. The constant current is generated by the current source. Dependent on the range selected different constant currents are generated. The voltage-drop over the unknown resistance is supplied to the amplifier, converted into a current and measured.

At diode measurements a constant current of $316\mu\text{A}$ (V measuring is 1V f.s.d.) is generated by the current source. The current flowing through the diode causes a voltage drop which is supplied to the amplifier, converted into a current and measured.

In the BUZZER mode a constant current of $316\mu\text{A}$ is generated by the current source. This current will flow for example through a wire which has a certain resistance value (R_x). The voltage drop over R_x is supplied to the amplifier and measured. At the same time the BUZZER will produce a tone. If R_x is greater than 20Ω the BUZZER is blocked. The BUZZER is coupled to the output of the amplifier.

4.2.4. Amplifier

The direct and alternating voltages from the attenuators, shunts, or unknown resistances are converted in to a current of $50\mu\text{A}$ f.s.d. by the amplifier.

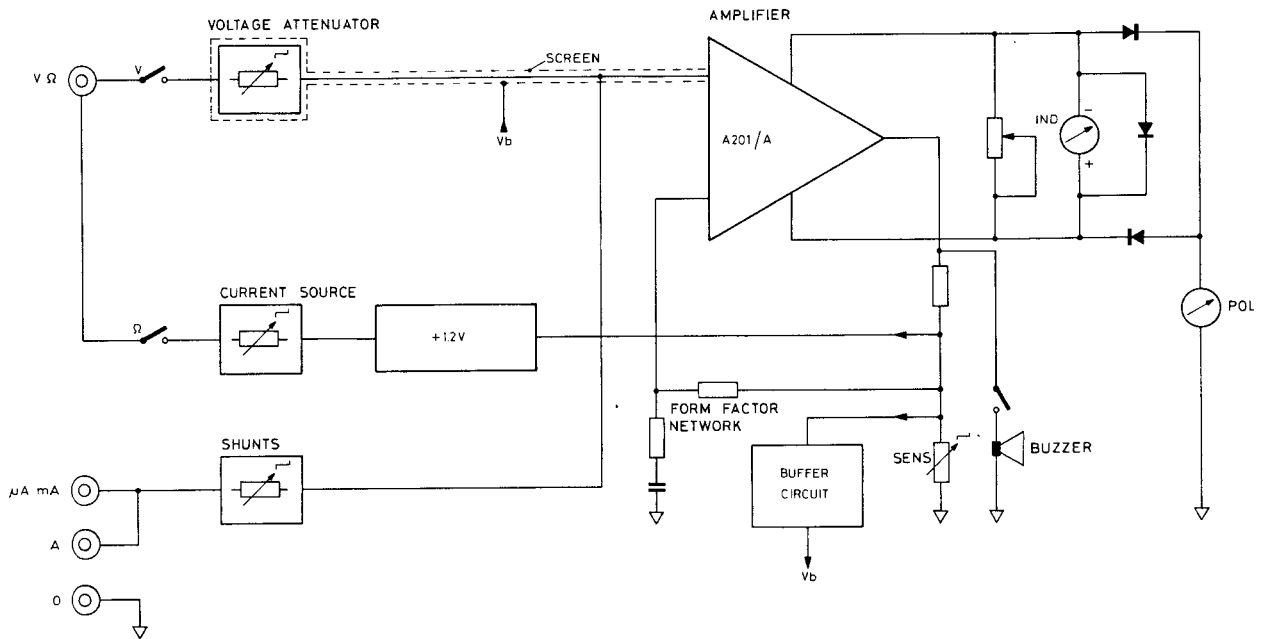
The output of the amplifier, with internal full-wave rectifier, is connected to the measuring system.

For + and – direct output voltages the internal full-wave rectifier ensures that the current through the measuring system flows in one direction and that the polarity indicator shows + or –.

Alternating output voltages are rectified by the full-wave rectifier. As a measuring system indicates the average value, a form-factor network is included in the feedback circuit of the amplifier. The network attenuates the feedback signal by $1,11 V_{rms} = \frac{V_{average}}{1,11}$ so that the measuring system will indicate the rms-value of the

input signal. This only applies for sinusoidal input signals.

To avoid leakage currents to influence the measuring result an internal buffer circuit is built-in.



ST2774

Fig. 8. Blockdiagram

4.3. DETAILED CIRCUIT-DESCRIPTION (Fig. 25)

4.3.1. V_{\sim} , V_{\sim} , + BATT and - BATT attenuators (Fig. 9)

V_{\sim} , V_{\sim} .

The input attenuator for dc voltages consists of R101 upto R110. For ac voltages also the frequency compensation capacitors C101 up to C116 are in use.

Capacitor C107 is used to block a dc component in V_{\sim} mode.

Trimmer C105 and cut-away adjusting capacitors C106 and C116 are used to calibrate the 300mV \sim range.

Trimmer C108 is used to calibrate the 3V \sim range.

Capacitor C115 is only used in the 100mV \sim range.

+ Batt and - Batt.

To attenuate the +9V and -9V from the batteries resistors R401 and R402 are used.

At +BATT, +9V is connected to R401 via the Ω /17 deck contact. From the attenuator R401/R402 the voltage is supplied to the amplifier via the A/17 and the V/17 deck-contacts.

At -BATT, -9V is connected to R401 via the A/18 deck-contact. From the attenuator R401/R402 the voltage is supplied to the amplifier via the V/18 deck-contact.

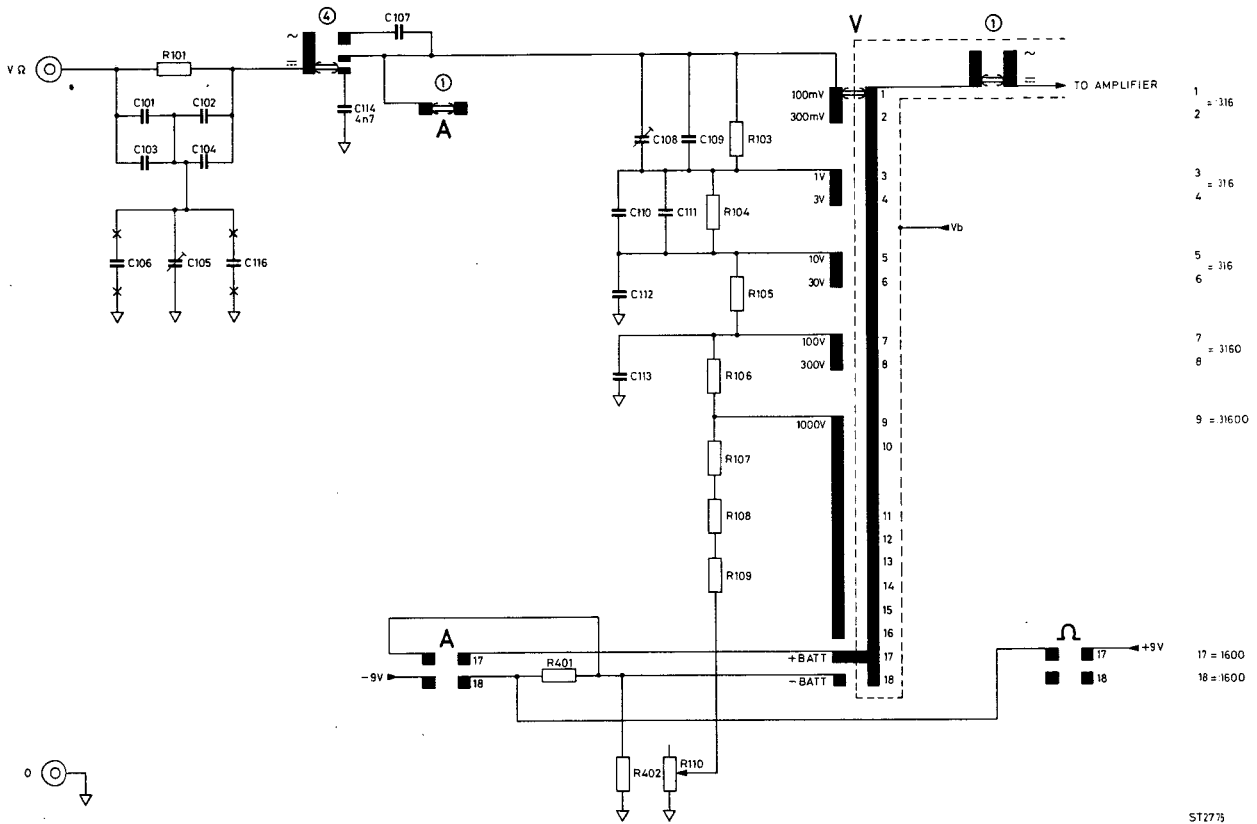


Fig. 9. V_{\sim} , V_{\sim} , +BATT and - BATT attenuators

4.3.2. $A \rightleftharpoons$ and $A \sim$ shunts (Fig. 10)

The shunts for the ranges $1\mu A$ up to $300mA$ consists of the resistors R105 up to R110. The shunts are selected by the A and the V deck.
 In the ranges 1,3 and 10A the current is supplied to shunt R110 (metal strip) via the A input socket.
 From the shunts the voltage is supplied to the amplifier and measured.
 Fuse F101, resistor R211 and bridge rectifier V101 serve for protection of the current ranges. For detailed information refer to chapter 4.3.5., page 24 PROTECTION

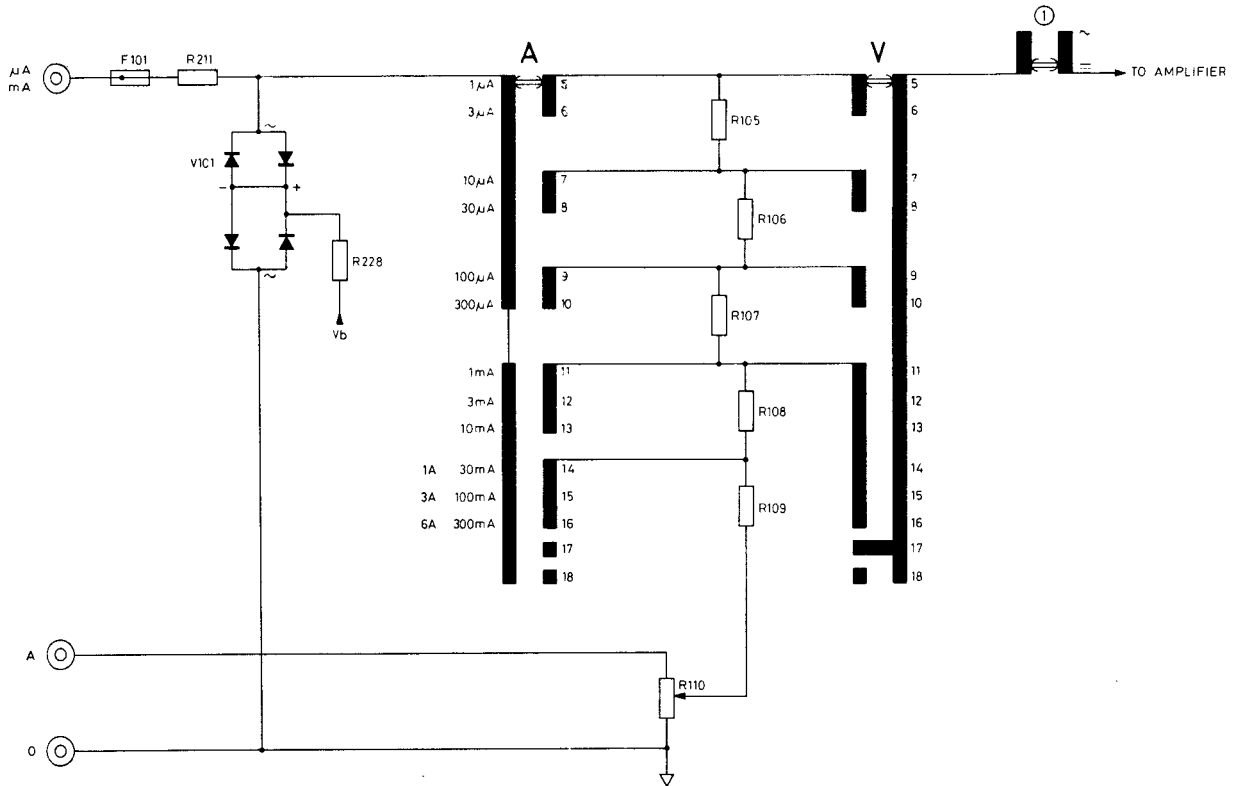


Fig. 10. $A \rightleftharpoons$, and $A \sim$ shunts

4.3.3. Ω , μ and BUZZER measurements

4.3.3.1. Principle (Fig. 11)

When a unknown resistance R_x (resistor, diode or wire) is connected to the PM 2505, a constant current generated by the constant current source will flow through it. The constant current causes a voltage drop V_x which is supplied to the amplifier (+) and measured. When the voltage is in balance on the – input of the amplifier and the + input of the current source V_x will be available. The amplifier A201/B of the current-source has an internal voltage source of 1.2V.

At the output of the amplifier A201/B $V_x + 1.2V$ will be available. On one side of series resistor R_5 , V_x is available and on the other side $V_x + 1.2V$. This means that over series resistor R_5 , 1.2V is available. Independent of the value of V_x (value of R_x) there always will be 1.2V across R_5 . This means that a constant current flows through R_x and R_5 .

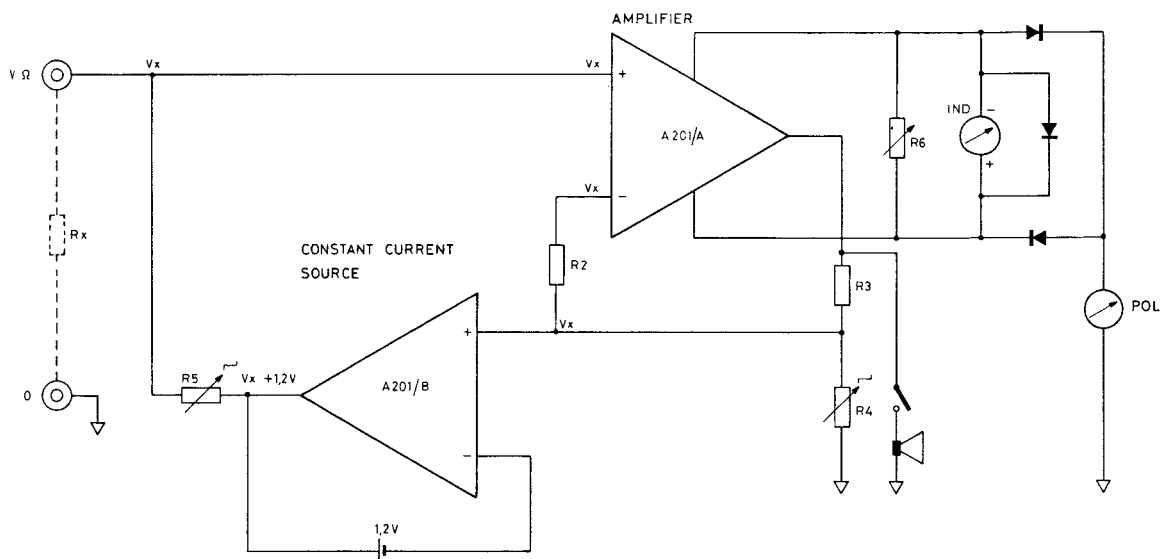
The constant current can be influenced by changing series resistor R_5 .

In case of Ω measurements R_5 is changed with the aid of the range selector.

At μ measurements a fixed range is selected with a constant current of $316\mu A$.

At BUZZER measurements a fixed range is selected with a constant current of $316\mu A$.

At the same time the BUZZER circuit is switched to the output of amplifier A201/A. If the measured R_x is $> 20\Omega$ the BUZZER is cut-off.



ST2777

Fig. 11. Ω , μ , BUZZER measurements principle

4.3.3.2. Ω , \downarrow and BUZZER current source (Fig. 12)

The series resistors R301 up to R309 for the constant current source are switched with the Ω range switch. The internal voltage source (1.2V) of OQ0051 can be adjusted with potentiometer R314 and cut-away resistor R316. At the input of the constant current source (A201/B) the feedback voltage of the amplifier (V_x) is available. At full scale deflection V_x is 10mV, 31.6mV, 100mV or 1V dependent to the range selected (refer to the gain table fig. 16). From the Ω range switch the constant current is supplied to the input sockets via the protection PTC R301 and the Ω ④ function-switch. The unknown voltage V_x over R_x is supplied to the amplifier via filter R318/C301 and the Ω ① function-switch.

In BUZZER mode (function Ω and position 18 of the range-selector) the -9V supply voltage is connected to the BUZZER-circuit via the A/18 range switch contact, by which the buzzer is switched-on. The base of transistor V302 is connected to the output of amplifier A301/A.

If the output of the amplifier exceeds $\approx 600\text{mV}$ then the buzzer is cut-off. In position 18 of the range selector the constant current source delivers $316\mu\text{A}$ to the input sockets (R_x).

The buzzer is switched off in case of ∞ measurements with the ② function switch. In case of \sim measurements with the function selector in position 18 the buzzer will also be switched on.

PTC R301 and zener diode V301 serve for protection.
Refer to chapter 4.3.5. PROTECTION.

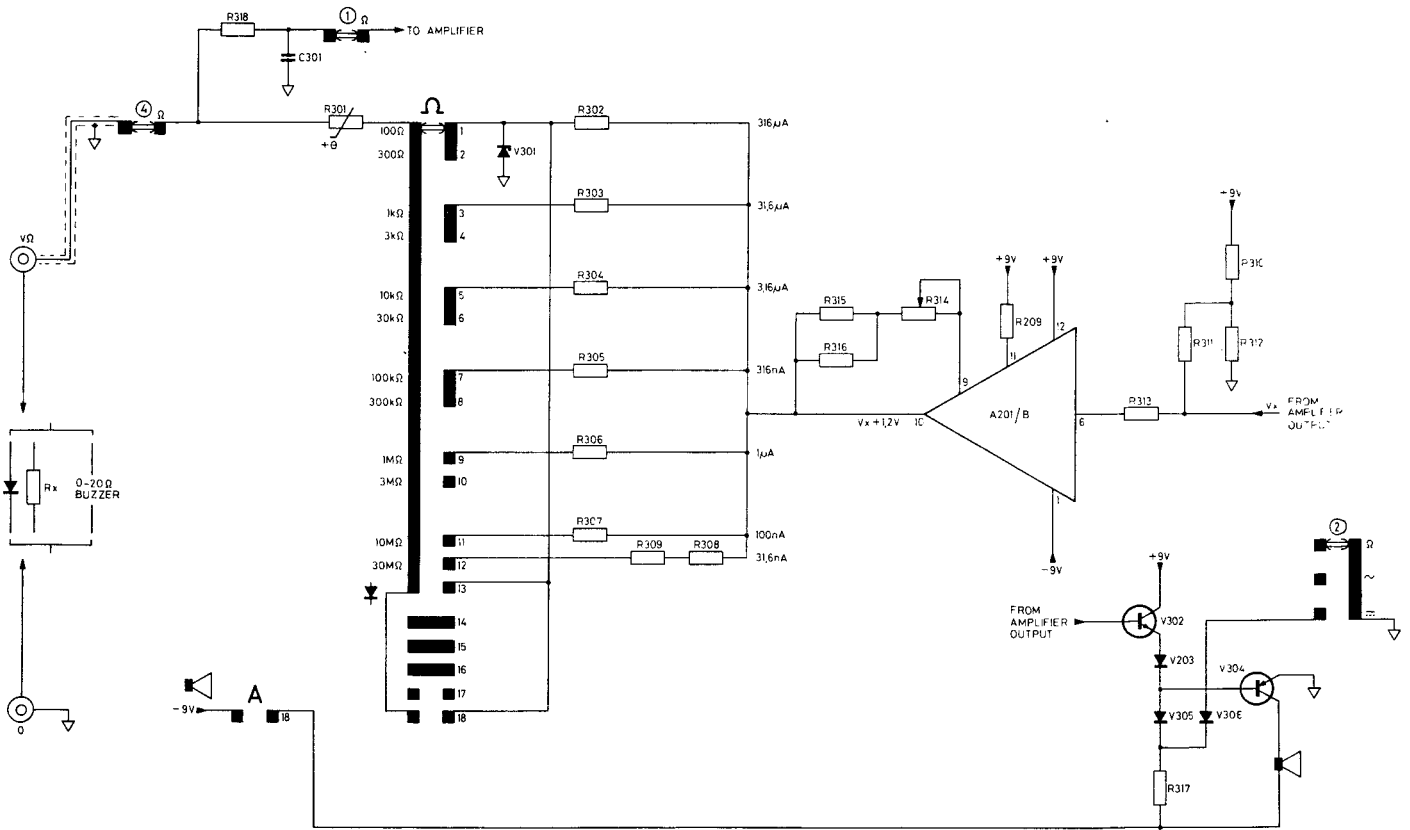


Fig. 12. Ω , \downarrow , BUZZER current source

4.3.4. Amplifier and buffer - circuit (fig. 14)

4.3.4.1. Amplifier

The total amplifier consists of a FET input stage (V204), an operational amplifier (A201/A, $\frac{1}{2}$ OQ0051) and the feedback circuitry. The amplifier ensures that the unknown input voltage, 1V, 100mV, 31.6mV or 10mV at full scale is converted into a current flowing through the measuring system of $50\mu\text{A}$.

The attenuated voltage from the attenuators, shunts or Rx is first supplied to a filter (R201//C203, C204).

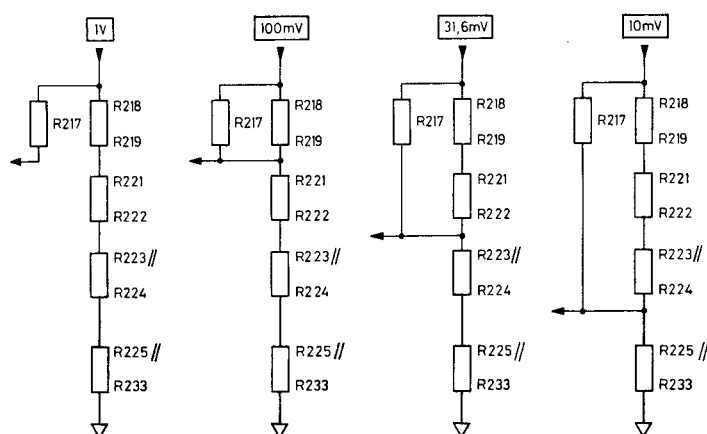
At dc measurements the filter connects the ac component to zero.

The filter is switched by FET V203. At dc measurements the FET is conductive (—●—○—), its gate is connected to zero via the ② function switch. At ac measurements the FET is non-conductive (—○—●—).

Also the polarity indicator is switched on at dc measurements via the ② function switch and FET V208.

From the filter the unknown input voltage is supplied to the dual FET-stage of the amplifier. On one side of the dual FET the input voltage is available. On the other side the feedback voltage is available.

In fig. 13 the feedback circuitry is given with the different sensitivities. Also refer to fig. 16.



ST2794

Fig. 13. Feedback circuitry

In the feedback circuit of the amplifier formfactor network is incorporated for ac voltages. If sinusoidal voltages or currents are measured the measuring system measures the average value. With the formfactor network the feedback of the total amplifier is raised by 1,11, so the measuring system measures the rms value of the ac signal.

The output current of the amplifier is supplied to the measuring system via the internal rectifier diodes of the OQ0051

Transistors V201, V202 and diode V206 serve for protection.

Refer to chapter 4.3.5. PROTECTION.

4.3.4.1. Buffer circuit (Fig. 14)

To prevent leakage currents through the protection devices (V101, V201, V202) and the switch in FET V203 to influence the measuring result, the leakage currents are compensated.

The compensation is made with the aid of the BUFFER-circuit.

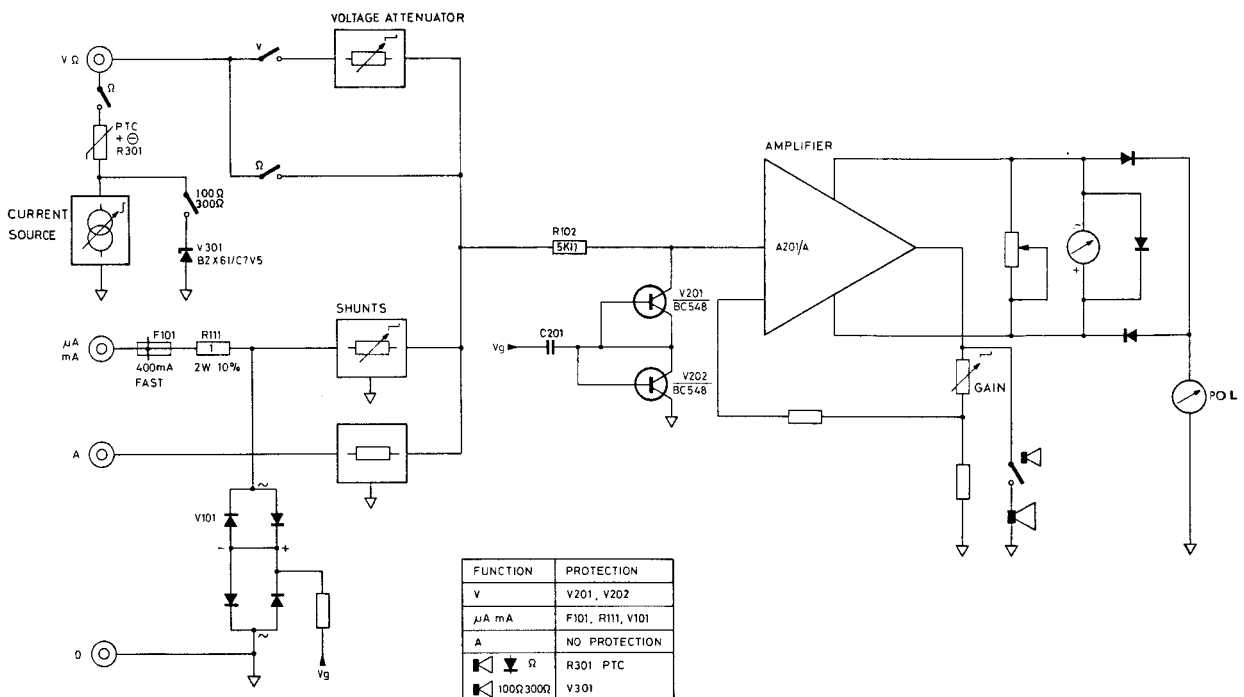
The Buffer circuit is an impedance converter with a high input impedance (base V211) and a low output impedance (collector V210).

4.3.5. Protection (Fig. 15)

Function V is protected by means of the protection transistors V201 and V202. If the input voltage of the amplifier exceeds 1.2V the transistors start conducting

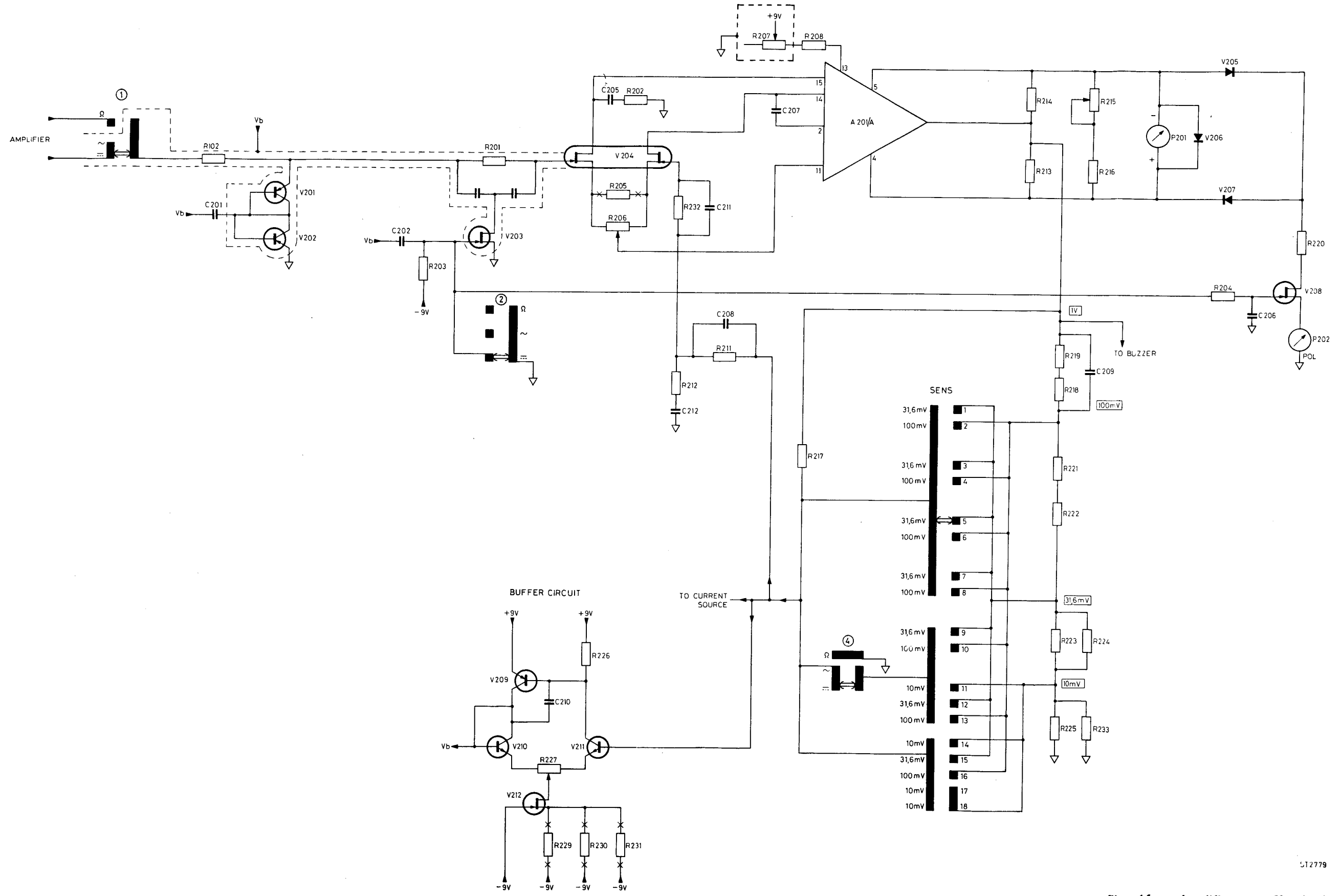
Function Ω \downarrow and ∇ are protected by a PTC R301. Range 100 Ω and 300 Ω and ∇ are additional protected with zener diode V301.

Function μA and mA are protected by Fuse F101, R111 and the diodes of bridge rectifier V101. The measuring system is protected by diode V206



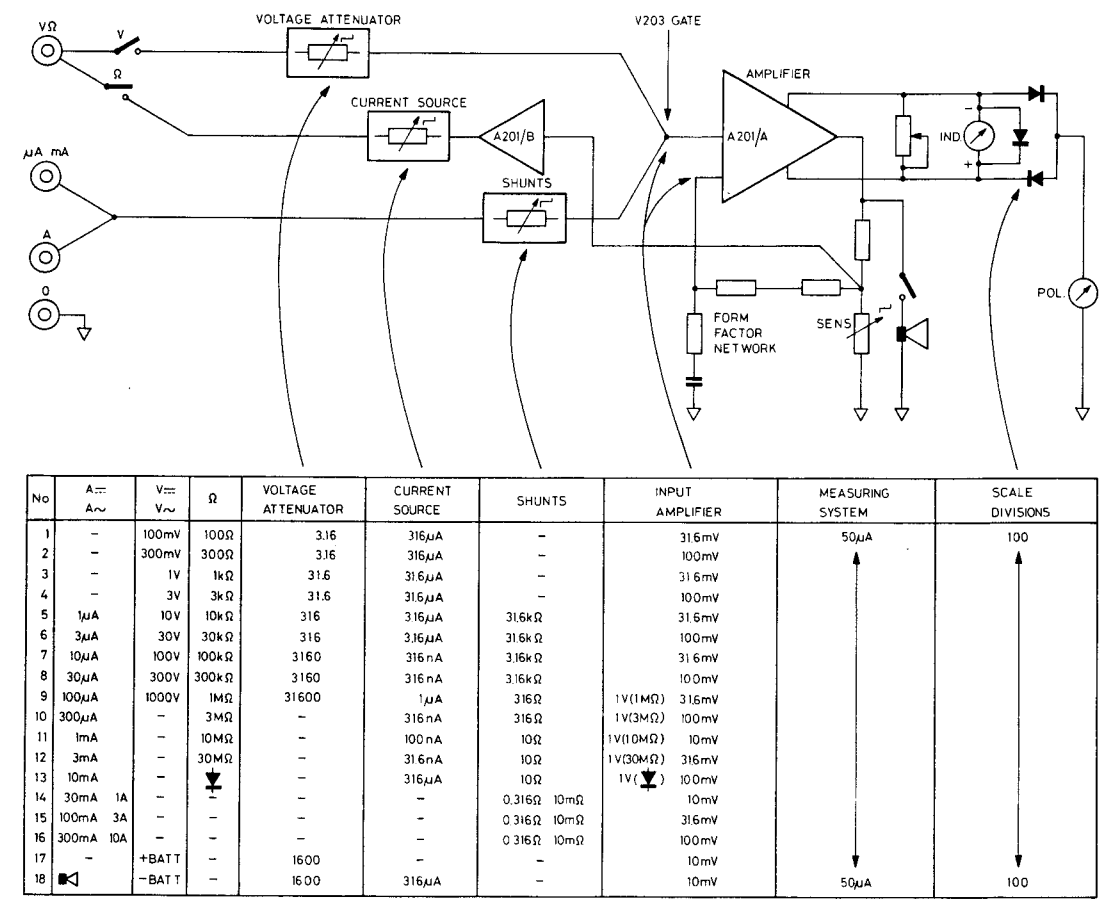
5T2780

Fig. 15. Protection



512779

Fig. 14. Amplifier and buffer circuit



NOTE: ALL VALUES ARE GIVEN AT FULL SCALE DEFLECTION.

ST2793

Fig. 16. Full scale deflection values

5. ACCESS

5.1. GENERAL

The opening of covers or removal of parts, except those which access can be gained by hand, is likely to expose live parts and also accessible terminals may be live.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or repair during which the instrument will be opened.

If afterwards any adjustment or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the danger involved.

Bear in mind that capacitors inside the instrument may still be charged, even if the instrument has been separated from all voltage sources.

5.2. DISMANTLING THE PM 2505

- Remove the battery cover.
- Remove the batteries.
- Loosen the two screws situated under the battery cover. The rear cover can be pulled off now.
- Remove the two screws which are situated in the rear of the measuring system.
- The printed circuit board together with clip-on measuring system can be pulled out of the top cover now.
The measuring system is clipped on the p.c. board and can be pulled off.

5.3. REPLACING PARTS

5.3.1. Slide switch ON/OFF or ∞ , \sim , Ω .

5.3.1.1. Printed circuit board part

Remove the two retaining rings from the slide bodies. The slide switch consists of two bodies. In the bodies the switch contacts are situated. A switch contact consists of a spring and a slider.

*Note: All parts of slide switch are in stock separately.
When a complete switch has to be replaced all parts should be ordered. When mounting the slide switch again, push both bodies slightly on the p.c. board and slide the retaining rings on the pins again.*

5.3.1.2. Topcover part

The topcover part consists of a locking spring, two ball-bearings and a knob.

Remove the locking spring by bending out the two lips.

The ball-bearings, the knob and the locking spring can be replaced now.

5.3.2. Range switch

5.3.2.1. Topcover part

Remove the screening plate situated inside the topcover. The function switch and the two leaf springs are accessible now.

5.3.2.2. Printed circuit board part

The p.c. board part of the range switch consists of:

- 2 slide bodies
- 4 springs
- 4 switch contacts

Remove the screws and nuts from the slide bodies. The bodies can be lifted from the p.c. board now.

Note: From function switch only the separate parts are in stock. When the complete switch has to be replaced all parts should be ordered.

5.3.3. Polarity indicator (fig.'s 17 and 18)

- Take the measuring system from the p.c. board (Refer to 5.2).
- Unsolder the wires from the polarity indicator.
Before removing the window ensure that you do not touch the inside of the window as it is treated with anty static liquid.
- Lever the window from the container by putting e.g. a screwdriver in the lever point (item 4).
- Unsolder the screen-wire (item 2).
- Remove the two screws (item 1) which fix the measuring system to the container.
- Take the measuring system out of the container, place it on the container (Fig. 18).
- Remove the mirror.
- Take the polarity indicator out of the container and replace it. Use the piece of self glueing foam again.
- Place the mirror in the container again.
- Place the measuring system in the container.
Take care that the counter-balance assembly (item 5) is not touched.
- Fix the measuring system to the container with the two fixing screws. Ensure that the top of the scale is fitted under the two fixing clips (item 3).
- Solder the screen-wire to the measuring system again (item 2)
- Fit the window on the container again.

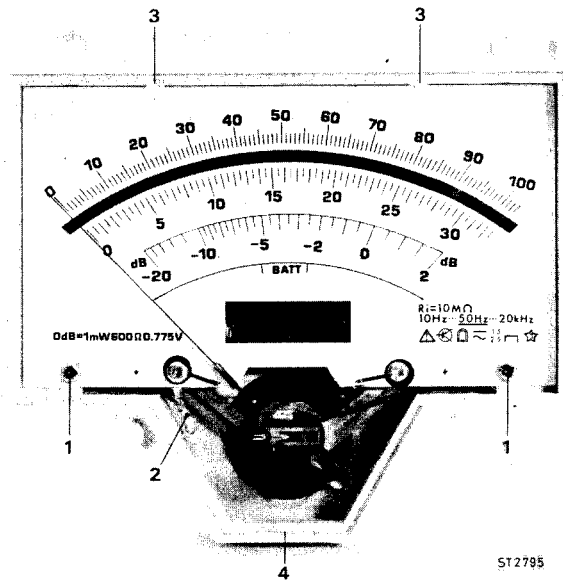


Fig. 17. Measuring system

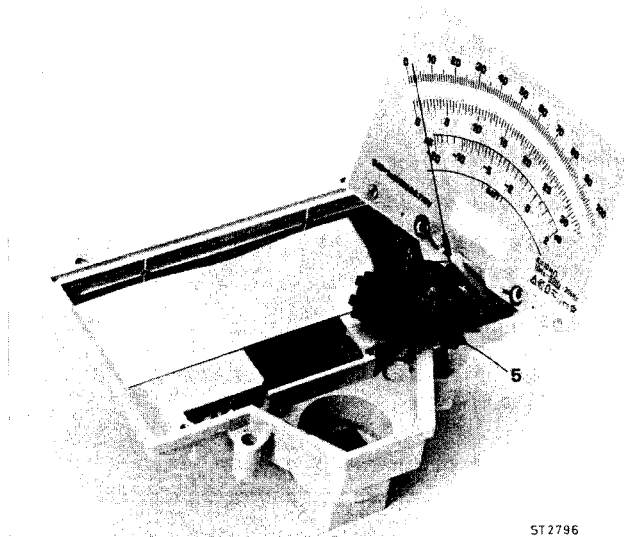


Fig. 18. Replacing the polarity indicator

6. CHECKING AND ADJUSTING

6.1. GENERAL

The tolerances in this chapter correspond to the factory data, which only apply to a completely re-adjusted instrument. These tolerances may deviate from those mentioned in the Technical Data (Chapter 2).

For a complete re-adjustment of the instrument the sequence in this chapter should be adhered too. When individual components, especially semi-conductors are replaced, the relevant section should be completely re-adjusted.

To calibrate this measuring instrument only reference voltages and measuring equipment with the required accuracy should be applied. If such equipment is not available, comparative measurements can be made with another calibrated PM 2505. However, theoretically the tolerances may be doubled in the extreme case.

The measuring arrangement should be such that the measurement cannot be affected by external influences. Protect the circuit against temperature variations (fans, sun).

With all the measurements the cables should be kept as short as possible; at higher frequencies co-axial leads should be used.

Non-screened measuring cables act as serials so that the measuring instrument will measure HF voltage values or hum voltages.

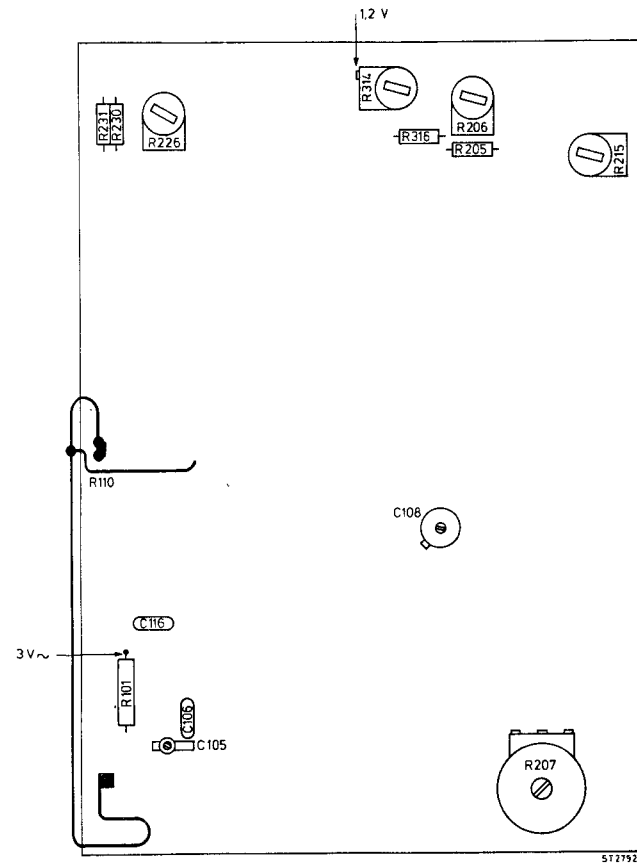


Fig. 19. Adjusting elements

6.2. ADJUSTING TABLE

No.	Adjustment	Adjusting element	Preparations	Measuring points	Adjustment data
1.	Mechanical zero-setting	Adjusting screw above the range selector knob.	Instrument switched OFF	Visible on measuring system	Adjust the pointer to zero
2.	Battery check.		Select: + BATT (⊖) and (Ω) -BATT (⊖).	Visible on measuring system	The meter indication should be in the BATT region (lowest scale).
3.	Electrical zero-setting. If this adjustment cannot be made, carry out first adjustment 4 and then 3 again.	Potentiometer "0" (R207)	Select: Range 1mA ⊖	Visible on the polarity indicator	Adjust the pointer to the middle of the ~ sign.
4.	Offset When adjustment 3 cannot be made first carry out this adjustment and then adjustment 3 again	Potentiometer R206 R207 Cut away resistor R205	Select: Range 1mA ⊖ Set potentiometer R207 in its mid-position.	Visible on the polarity indicator	Adjust the pointer to the middle of the ~ sign with R206
5.	Offset buffer circuit	Potentiometer R227 Cut away resistors R229 R230 R231	Select: Range 1mA ⊖ Set potentiometer R227 in its mid-position.	Across R230 (Factory adj.) Hi = coll V211 Lo = 0 socket (Service adj.)	-Factory adjustment (R229, R230, R231) refer to table below. -Service adjustment (227) 0V ± 1mV
6.	1.2V internal voltage source of OQ0051	Potentiometer R314 Cut-away resistor R316	Select: Range 1kΩ Short circuit the VΩ ⊚ and 0 socket	Hi = OQ0051/10 or R314 	1190mV ± 2mV If the adjustment cannot be made, remove cutaway resistor R316.
7.	Calibration of range 100mV ⊖	Potentiometer R215	Select: Range 100mV ⊖ Supply: 100mV ± 0,1% to the VΩ ⊚ and 0 socket	Visible on measuring system	100 scale divisions ± 0.2 ± 0.2 scale divisions
8.	Calibration of range 1A ⊖	Wire on shunt R110	Select: Range 1A ⊖ Supply: 1A ⊖ ± 0.2% to the A and 0 socket	Visible on measuring system	100 scale divisions ± 0.2 ± 0.2 scale divisions.
9.	Calibration of range 3V~	Trimmer C108	Select: Range 3V~ Supply: 3V~ ± 0.2% 10kHz to R101 and the 0-socket.	Visible on measuring system	100 scale divisions ± 0.2 ± 0.2 scale divisions
10.	Calibration of range 300mV~	Trimmer C105 Cut-away capacitors C106 C116	Select: Range 300mV~ Supply: 300mV~ ± 0.2% 10kHz to the VΩ ⊚ and 0 socket	Visible on measuring system	100 scale divisions ± 0.2 scale divisions. If the adjustment cannot be made remove cutaway capacitors C106 and C116

ADJUSTING TABLE R229, R230, R231.

Voltage across R230	Actions (start adjustment with R299, R230 and R231 mounted)
< 520mV	Replace V212
> 520mV < 675mV	-
> 675mV < 900mV	Cutaway R229
> 900mV < 1200mV	Cutaway R229 and R230
> 1200mV < 1500mV	Cutaway R231
> 1500mV < 2300mV	Cutaway R229, R229, R230 and replace them by a resistor of 61 kg, metalfilm MR25 series
> 2300mV < 2800mV	Cutaway R229 and R231
> 2800mV < 3500mV	Cutaway R230 and R231
> 3500mV	Replace V212

7. PARTS LIST

7.1. MECHANICAL

<i>Description</i>	<i>Ordering number</i>	<i>Qty</i>
TOPCOVER		
Topcover	5322 456 94088	1
RANGE SWITCH		
Knob for range switch	5322 414 64099	1
Leaf spring	5322 492 64676	2
Ω, ~, Ω SWITCH		
Knob	5322 414 64098	1
Lock spring	5322 492 64742	1
Ball-bearing	4822 520 40012	2
ON/OFF SWITCH		
Knob	5322 414 64119	1
Lock spring	5322 492 64742	1
Ball-bearing	4822 520 40012	2
BOTTOM COVER		
Bottom cover assy (incl. screening, feet and stand-up bracket).	5322 447 94572	1
Stand-up bracket	5322 405 94164	1
Rubber foot	5322 462 44148	2
BATTERY COVER		
Battery cover assy (incl. feet).	5322 447 94573	1
Rubber foot	5322 462 44148	2
MEASURING SYSTEM		
Measuring system assy (incl. polarity indicator window and correction screw)	5322 694 54011	1
Window	5322 459 24098	1
Correction screw	5322 500 14213	1
Polarity indicator	5322 347 10061	1
PRINTED CIRCUIT BOARD		
Printed circuit board assy (incl. range and function switch)	5322 216 74054	1
RANGE SWITCH		
Body	5322 405 94155	2
Switch segment	5322 492 64628	4
Spring	5322 492 54291	4

<i>Description</i>	<i>Ordering number</i>	<i>Qty</i>
⎓, ~, Ω SWITCH		
Body	5322 278 54001	2
Switch segment	5322 492 64628	4
Spring	5322 492 54291	4
Retaining ring	4822 530 70122	2
ON/OFF SWITCH		
Body	5322 278 54001	2
Switch segment	5322 492 64628	2
Spring	5322 492 54291	2
Retaining ring	4822 530 70122	2
Buzzer	5322 280 14026	1
Fuse holder	5322 256 34097	1
Fuse 400mA FAST	5322 253 30016	1
IC foot 16p	5322 255 44218	1
Input socket	5322 268 24109	4
Battery cable	4822 290 80013	2
Testpin RED	5322 264 24013	1
Testpin BLACK	5322 264 24014	1

7.2. ELECTRICAL

7.2.1. Capacitors

<i>Item</i>	<i>Ordering number</i>	<i>Farad</i>	<i>Tol (%)</i>	<i>Volts</i>	<i>Remarks</i>
C101	4822 122 31081	100p	2	500	Ceramic plate
C102	4822 122 31081	100p	2	500	Ceramic plate
C103	4822 122 31205	47p	2	500	Ceramic plate
C104	4822 122 31205	47p	2	500	Ceramic plate
C105	5322 125 54027	5p5		400	Trimmer
C106	4822 122 31195	10p	2	500	Ceramic plate
C107	5322 121 44025	33n	10	400	Polyester
C108	4822 125 50045	22p		250	Trimmer
C109	4822 122 31081	100p	2	500	Ceramic plate
C110	4822 121 50566	1n	1	160	Polystyrene
C111	4822 122 31081	100p	2	500	Ceramic plate
C112	4822 121 50602	10n	1	160	Polystyrene
C113	4822 122 30034	470p	2	100	Ceramic plate
C114	4822 122 31174	2, 7n	10	500	Ceramic plate
C115	4822 122 31192	6, 8p	$\pm 0,25\mu\text{F}$	500	Ceramic plate
C201	4822 122 31166	560p	10	100	Ceramic plate
C202	4822 122 31166	560p	10	100	Ceramic plate
C203	4822 122 30103	22n	-20+80	40	Ceramic plate
C204	4822 122 30103	22n	-20+80	40	Ceramic plate
C205	4822 122 31166	560p	10	100	Ceramic plate
C206	4822 122 31174	2, 7n	10	100	Ceramic plate
C207	4822 122 31177	470p	10	100	Ceramic plate
C208	4822 122 31054	10p	2	100	Ceramic plate
C209	4822 122 30103	22n	-20+80	40	Ceramic plate
C210	4822 122 31072	47p	2	100	Ceramic plate
C211	4822 122 30103	22n	-20+80	40	Ceramic plate
C212	4822 121 40232	220n	10	100	Polyester
C301	4822 122 31175	1n	10	500	Ceramic plate
C401	4822 124 20459	22 μ	-10+50	10	Electrolytic
C402	4822 124 20459	22 μ	-10+50	10	Electrolytic

7.2.2. Resistors

<i>Item</i>	<i>Ordering number</i>	<i>Ohm</i>	<i>Tol(%)</i>	<i>Type</i>	<i>Remarks</i>
R101	5322 116 64106	6,81M	1	VR37	High voltage
R102	5322 116 54595	5,11k	1	MR25	Metal film
R103	5322 116 64107	2,87M	0,5	SPEC	High voltage
R104	5322 116 55463	287k	0,5	MR25	Metal film
R105	5322 116 55462	28,7k	0,5	MR25	Metal film
R106	5322 116 55279	2,87k	0,5	MR25	Metal film
R107	5322 116 55464	309	0,5	MR25	Metal film
R108	5322 116 54423	9,76	1	MR25	Metal film
R109	5322 113 44229	0,301	1	2W	Pot. meter
R111	4822 113 60056	1	10	2W	Pot. meter
R201	4822 110 63192	1,5M	10	CR25	Carbon
R202	5322 116 54513	332	1	MR25	Metal film
R203	4822 110 63187	1M	5	CR25	Carbon
R204	5322 116 54696	100k	1	MR25	Metal film
R205	5322 116 54519	402	1	MR25	Metal film
R206	4822 100 10038	470	20	0.05W	Pot.meter
R207	5322 101 24173	100k	20	0.1W	Pot.meter
R208	5322 116 50481	22,6k	1	MR25	Metal film
R209	4822 110 63214	10M	10	CR25	Carbon
R211	5322 116 54655	30,1k	1	MR25	Metal film
R212	5322 116 54738	274k	1	MR25	Metal film
R213	4822 110 63212	8,2M	10	CR25	Carbon
R214	4822 110 63212	8,2M	10	CR25	Carbon
R215	4822 100 10035	10k	20	0.05W	Pot.meter
R216	5322 116 50479	15,4k	1	MR25	Metal film
R217	5322 116 54637	17,8k	1	MR25	Metal film
R218	5322 116 55459	15,4k	0,5	MR25	Metal film
R219	5322 116 54502	261	1	MR25	Metal film
R220	5322 116 50572	12,1k	1	MR25	Metal film
R221	5322 116 50926	40,2	1	MR25	Metal film
R222	5322 116 55465	1,15k	0,1	MR24C	Metal film
R223	5322 116 50451	21,5k	1	MR25	Metal film
R224	5322 116 54163	383	0,1	MR24C	Metal film
R225	5322 116 55461	174	0,5	MR25	Metal film
R226	5322 116 50483	38,3k	1	MR25	Metal film
R227	4822 100 10036	4,7k	20	0.05W	Pot.meter
R228	5322 116 54683	68,1k	1	MR25	Metal film
R229	5322 116 54696	100k	1	MR25	Metal film
R230	5322 116 54689	82k5	1	MR25	Metal film
R231	5322 116 50872	61k9	1	MR25	Metal film
R232	4822 110 63192	1,5M	10	CR25	Carbon
R233	4822 111 30265	22k	5	CR25	Carbon
R301	4822 116 40006	100	20	265V	PTC
R302	5322 116 54587	3,65k	1	MR25	Metal film
R303	5322 116 54663	37,4k	1	MR25	Metal film
R304	5322 116 55457	374k	1	MR25	Metal film

<i>Item</i>	<i>Ordering number</i>	<i>Ohm</i>	<i>Tol(%)</i>	<i>Type</i>	<i>Remarks</i>
R305	5322 116 64104	3,74M	1	VR37	High voltage
R306	5322 116 64101	1,18M	1	VR37	High voltage
R307	5322 116 64102	11,8M	1	VR37	High voltage
R308	5322 116 64103	31,6M	1	VR37	High voltage
R309	5322 116 64105	5,9M	1	VR37	High voltage
R310	5322 116 54704	121k	1	MR25	Metal film
R311	4822 110 63214	10M	10	CR25	Carbon
R312	5322 116 50481	22,6k	1	MR25	Metal film
R313	5322 116 54632	14,7k	1	MR25	Metal film
R314	4822 100 10107	470k	20	0.05W	Pot.meter
R315	5322 116 55458	442k	1	MR25	Metal film
R316	5322 116 54696	100k	1	MR25	Metal film
R317	5322 116 54696	100k	1	MR25	Metal film
R318	5322 116 54696	100k	1	MR25	Metal film
R401	5322 116 54743	301k	1	MR25	Metal film
R402	5322 116 50506	154	1	MR25	Metal film

7.2.3. Semi conductors

<i>Item</i>	<i>Ordering number</i>	<i>Type/Description</i>	
V101	5322 130 34761	BY224-600	Bridge rectifier
V201	4822 130 40938	BC548	Transistor
V202	4822 130 40938	BC548	Transistor
V203	5322 130 44418	BF256A	Transistor
V204	5322 130 44405	ON528	Dual FET
V205	4822 130 30613	BAW62	Diode
V206	4822 130 30613	BAW62	Diode
V207	4822 130 30613	BAW62	Diode
V208	5322 130 44418	BF256A	FET
V209	4822 130 40941	BC558	Transistor
V210	4822 130 44246	BX545C	Transistor
V211	4822 130 44246	BC549C	Transistor
V212	5322 130 44418	BF256A	FET
V301	5322 130 34123	BZX61 - C7V5	Zener diode
V302	4822 130 40964	BC549	Transistor
V303	4822 130 30613	BAW62	Diode
V304	4822 130 40963	BC559	Transistor
V305	4822 130 30613	BAW62	Diode
V306	4822 130 30613	BAW62	Diode

7.2.4. Integrated circuits

<i>Item</i>	<i>Ordering number</i>	<i>Type/Description</i>	
A201	5322 209 84444	0Q0051	

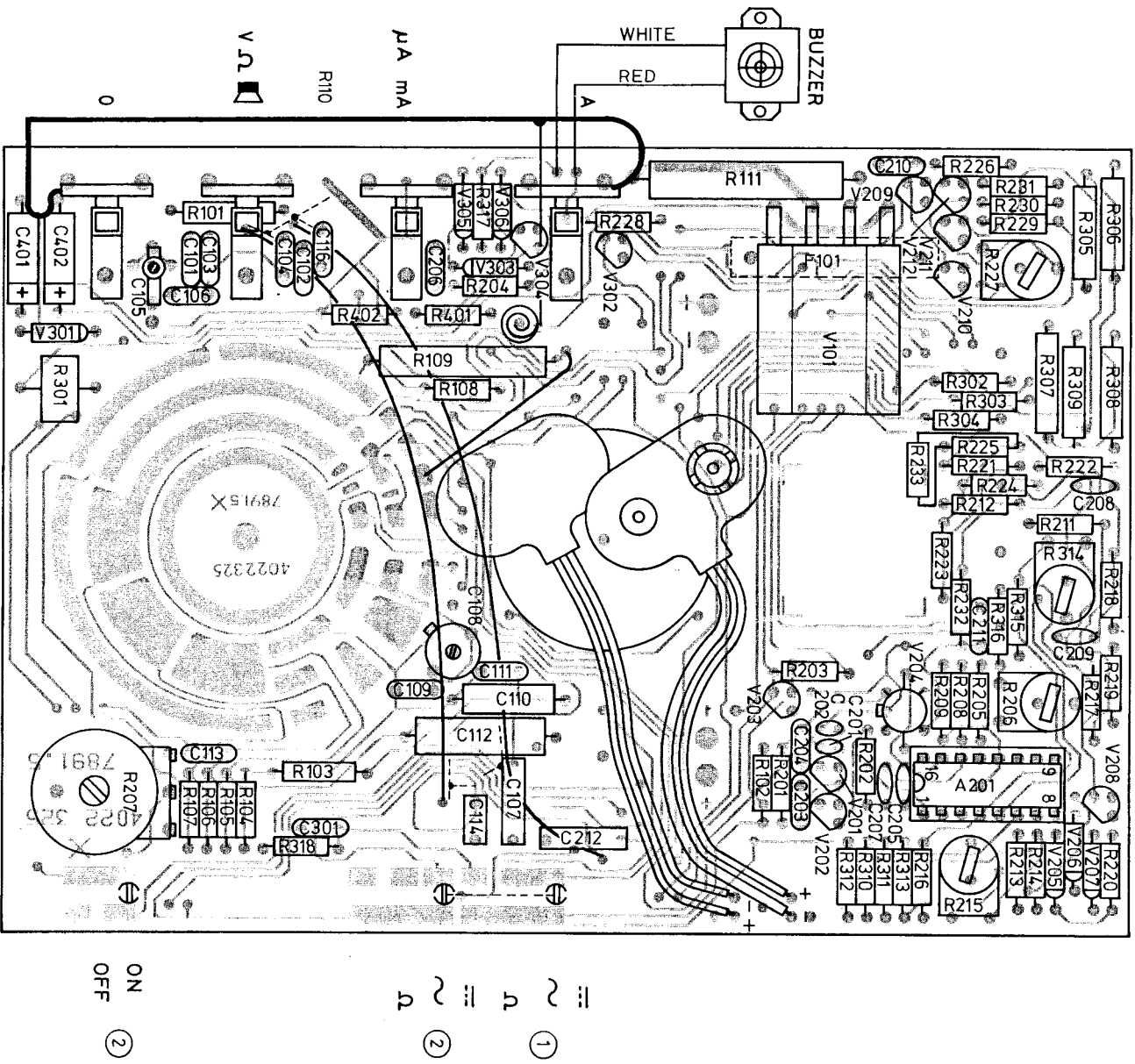


Fig. 20. P.c. board component side

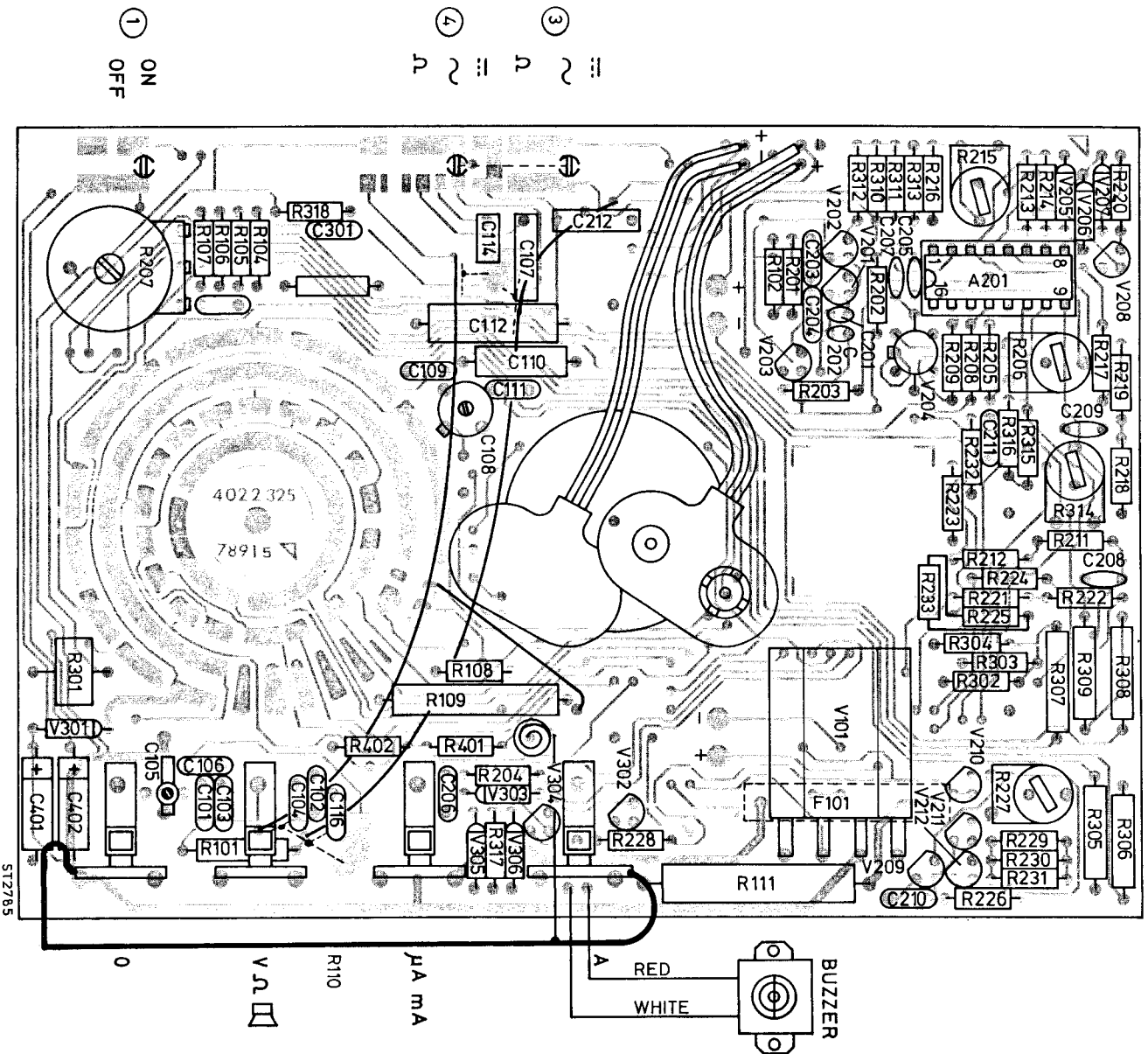
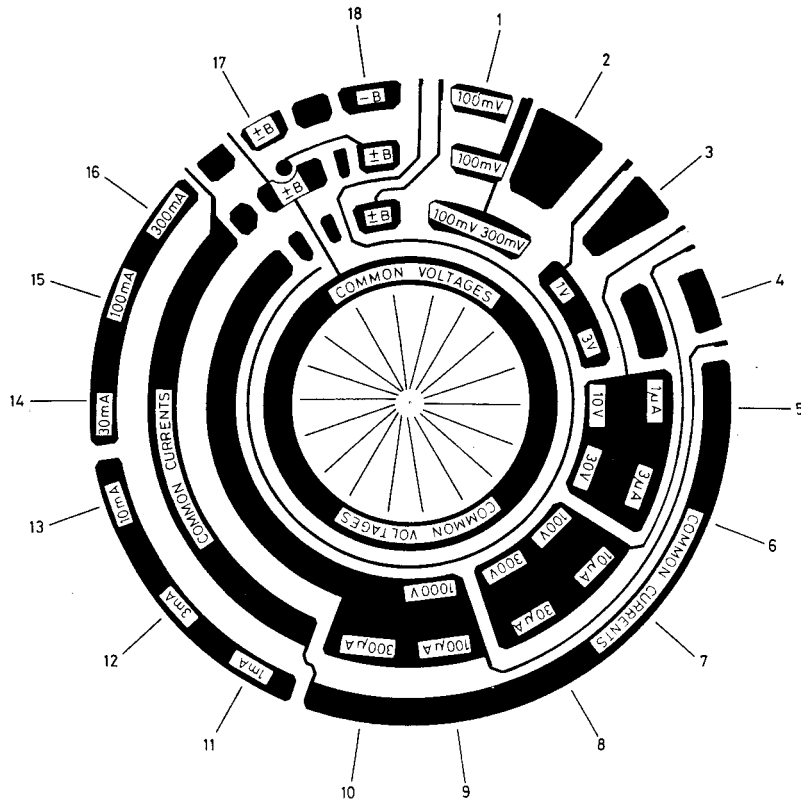
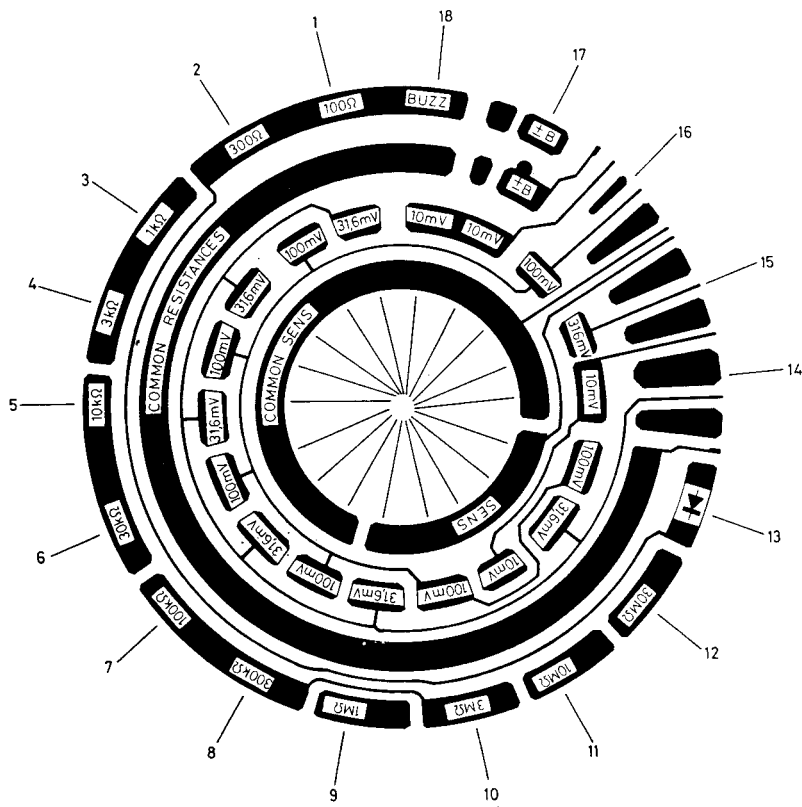


Fig. 21. P.c. board conductor side



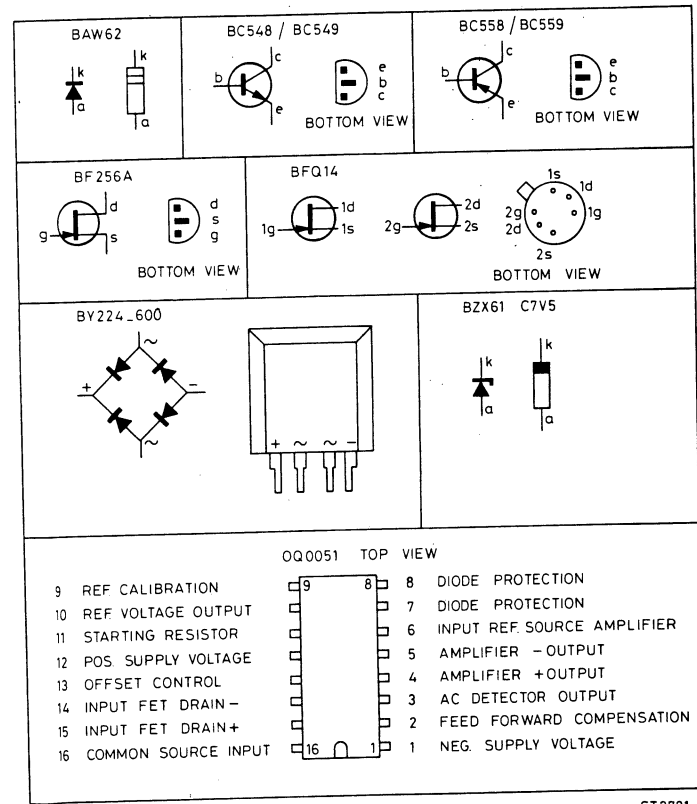
ST2783

Fig. 22. Function switch lay-out component side



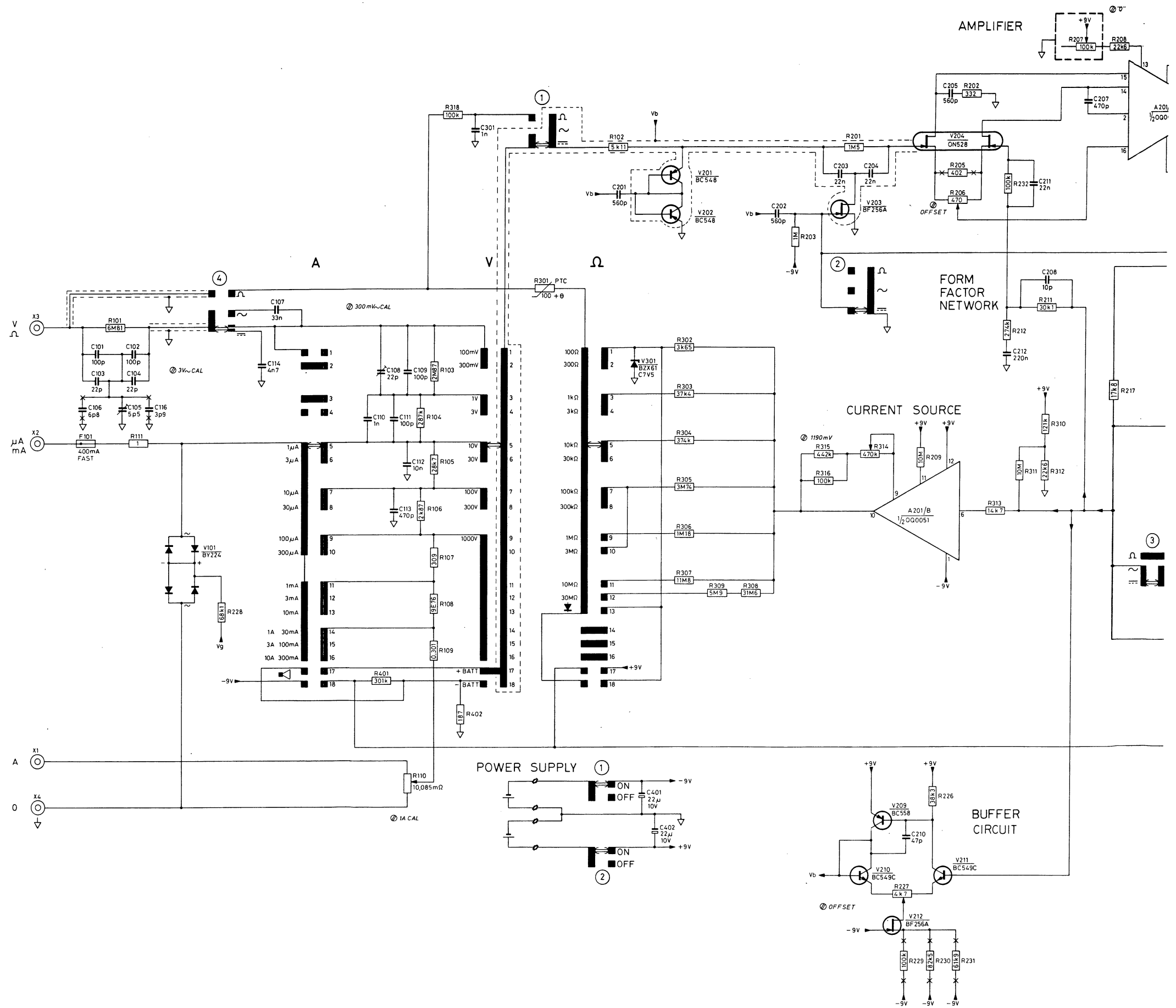
ST2782

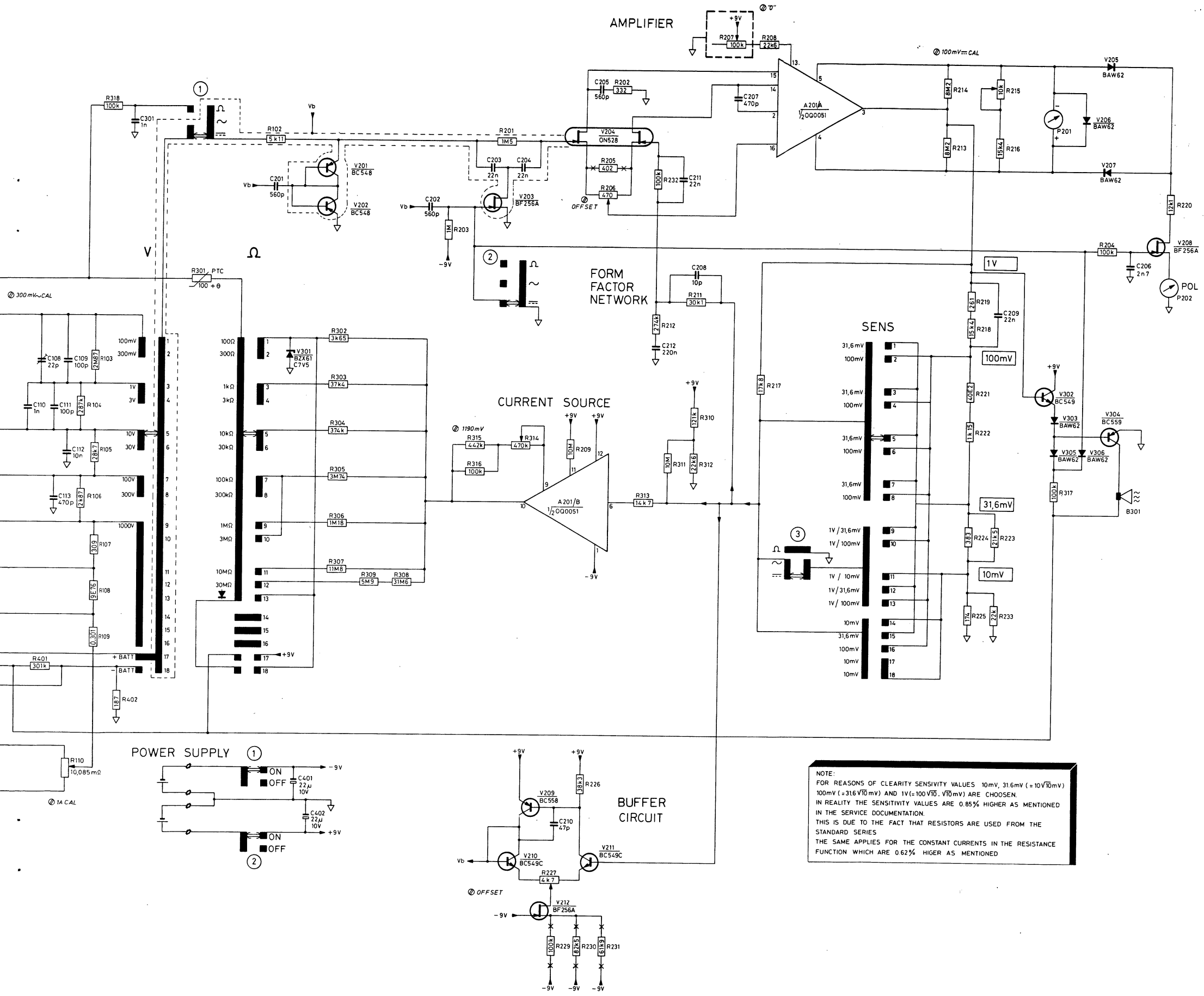
Fig. 23. Function switch lay-out conductor side



ST2781

Fig. 24. List of used components





RANGE SWITCH

SWITCH CONTACTS	A = OR ~	V = OR ~	Ω	SENS
1		100mV	100Ω	31.6mV
2		300mV	300Ω	100mV
3		1V	1k	31.6mV
4		3V	3k	100mV
5	1μA	10V	10k	31.6mV
6	3μA	30V	30k	100mV
7	10μA	100V	100k	31.6mV
8	30μA	300V	300k	100mV
9	100μA	1000V	1M	1V/31.6mV
10	300μA		3M	1V/100mV
11	1mA		10M	1V/10mV
12	3mA		30M	1V/31.6mV
13	10mA			1V/100mV
14	30mA 1A			10mV
15	100mA 3A			31.6mV
16	300mA 10A			100mV
17	+BATT			10mV
18	-BATT			10mV

NOTE:
 FOR REASONS OF CLARITY SENSITIVITY VALUES 10mV, 31.6mV (=10√10mV),
 100mV (=31.6√10mV) AND 1V (=100√10, √10mV) ARE CHOSEN
 IN REALITY THE SENSITIVITY VALUES ARE 0.85% HIGHER AS MENTIONED
 IN THE SERVICE DOCUMENTATION
 THIS IS DUE TO THE FACT THAT RESISTORS ARE USED FROM THE
 STANDARD SERIES
 THE SAME APPLIES FOR THE CONSTANT CURRENTS IN THE RESISTANCE
 FUNCTION WHICH ARE 0.62% HIGHER AS MENTIONED

S12750

Fig. 25. Circuit diagram

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY
ASSESSMENT OF T & M INSTRUMENTS
(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

①	②	③	④
Country	Day Month Year	Typenumber	/Version
3 2	1 5 0 4 7 5	O P M 3 2 6 0 0 2	D O 0 0 7 8 3

CODED FAILURE DESCRIPTION ⑥

⑤	⑦																																																
Nature of call	Location																																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td><input type="checkbox"/></td><td>Installation</td></tr> <tr><td><input type="checkbox"/></td><td>Pre sale repair</td></tr> <tr><td><input type="checkbox"/></td><td>Preventive maintenance</td></tr> <tr><td><input checked="" type="checkbox"/></td><td>Corrective maintenance</td></tr> <tr><td><input type="checkbox"/></td><td>Other</td></tr> </table>	<input type="checkbox"/>	Installation	<input type="checkbox"/>	Pre sale repair	<input type="checkbox"/>	Preventive maintenance	<input checked="" type="checkbox"/>	Corrective maintenance	<input type="checkbox"/>	Other	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>0</td><td>0</td><td>2</td><td>1</td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>							0	0	2	1																												
<input type="checkbox"/>	Installation																																																
<input type="checkbox"/>	Pre sale repair																																																
<input type="checkbox"/>	Preventive maintenance																																																
<input checked="" type="checkbox"/>	Corrective maintenance																																																
<input type="checkbox"/>	Other																																																
0	0	2	1																																														
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>T</td><td>S</td><td>0</td><td>6</td><td>0</td><td>7</td></tr> <tr><td>R</td><td>0</td><td>0</td><td>6</td><td>3</td><td>1</td></tr> <tr><td>9</td><td>9</td><td>0</td><td>0</td><td>0</td><td>1</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>	T	S	0	6	0	7	R	0	0	6	3	1	9	9	0	0	0	1													<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>5</td></tr> <tr><td>2</td></tr> <tr><td>4</td></tr> <tr><td></td></tr> <tr><td></td></tr> </table>	5	2	4															
T	S	0	6	0	7																																												
R	0	0	6	3	1																																												
9	9	0	0	0	1																																												
5																																																	
2																																																	
4																																																	
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>																									<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>																								
	<input checked="" type="checkbox"/> Job completed <input type="checkbox"/> Working time ⑧ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td><td></td><td>1</td><td>2</td></tr> </table> Hrs			1	2																																												
		1	2																																														

Detailed description of the information to be entered in the various boxes:

- ① Country: 3 2 = Switzerland
- ② Day Month Year 1 5 0 4 7 5 = 15 April 1975
- ③ Type number/Version O P M 3 2 6 0 0 2 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)
- ④ Factory/Serial number D O 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

- ⑤ Nature of call: Enter a cross in the relevant box
- ⑥ Coded failure description

<p>Location</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td><td></td><td></td><td></td></tr> </table> <p>These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual). Example: 0001 for Unit 1 000A for Unit A 0075 for item 75</p> <p>If units are not numbered, do not fill in the four boxes; see Example Job sheet.</p>					<p>Component/sequence no.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table> <p>These six boxes are intended to pinpoint the faulty component. A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric, the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes. B. Parts not identified in the circuit diagram: 990000 Unknown/Not applicable 990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.) 990002 Knob (incl. dial knob, cap, etc.) 990003 Probe (only if attached to instrument) 990004 Leads and associated plugs 990005 Holder (valve, transistor, fuse, board, etc.) 990006 Complete unit (p.w. board, h.t. unit, etc.) 990007 Accessory (only those without type number) 990008 Documentation (manual, supplement, etc.) 990009 Foreign object 990099 Miscellaneous</p>							<p>Category</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td></td></tr> </table> <ul style="list-style-type: none"> 0 Unknown, not applicable (fault not present, intermittent or disappeared) 1 Software error 2 Readjustment 3 Electrical repair (wiring, solder joint, etc.) 4 Mechanical repair (polishing, filing, remachining, etc.) 5 Replacement (of transistor, resistor, etc.) 6 Cleaning and/or lubrication 7 Operator error 8 Missing items (on pre-sale test) 9 Environmental requirements are not met 	

- ⑦ Job completed: Enter a cross when the job has been completed.
- ⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

		1	2
--	--	---	---

 = 1,2 working hours (1 h 12 min.)



PHILIPS

SERVICE

Cryogenic Equipment / Electro Chemistry /
Electron Optics / Electronic Weighing /
Industrial Data Systems / Numerical Control /
Philips Pollution Measuring / Radiation Measuring Equipment / Test and Measuring Equipment / Welding Equipment / X-Ray Analytical Equipment

equipment
for science
and industry

800904

PM 2505

SME 86

Already issued: - - -

- Re : 1. Modification of the technical data
2. Corrections of the service manual

This service note is intended to be used in combination with the service manual of the PM 2505, ordering number 9499 475 01411.

1. MODIFICATION OF THE TECHNICAL DATA

The frequency range of the a.c. current accuracy has been modified.

Page 7 2.1.4. A.c. current measurements, Accuracy

Former design		
Range	Frequency	Acc.
1 μ A - 10A	50-60Hz	±3%
1 μ A - 30 μ A	10Hz - 70Hz	
100 μ A - 10mA	10Hz - 20kHz	
30mA - 10A	10Hz - 10kHz	

Present design		
Range	Frequency	Acc.
1 μ A - 10A	50-60Hz	±3%
1 μ A - 30 μ A	10Hz - 70Hz	
100 μ A - 10A	10Hz - 2kHz	

2. CORRECTIONS OF THE SERVICE MANUAL

Page 12 3.1. ACCESSORIES SUPPLIED WITH THE PM 2505


Add: Directions for use



Fig. 1. Measuring leads with testpins PM 9262

Change: PM 9262 into PM 9260

Page 23

4.3.4.1. Amplifier

At ac measurements the FET is non conductive ().

Change () into ()

Page 24

Fig. 15 Protection

Change: Vg into Vb

9499 478 11011

PRINTED IN THE NETHERLANDS

Page 32

6.2. ADJUSTING TABLE

In the adjustment data of the adjustments 7, 8 and 9, ± 0.2 is mentioned twice.
Omit one time ± 0.2

ADJUSTIGE TABLE R229, R230, R231

Change: Cut away R229, R229, R230 and replace them
by a resistor of 61 kg. metal film MR25 series
Into: Cut away R229, R231, R230 and replace them
by a resistor of 61 k9 metal film MR 25 series

Page 35

7.1. MECHANICAL parts list

Change: Fuse 400 mA FAST 5322 253 30016
Into: Fuse 400.mA FAST SAND FILLED 4822 255 20013

Page 36

7.2.1. Capacitors parts list

Omit: C115
Add: C116 4822 122 31217 3 p9 2 500 Ceramic plate

Page 39

7.2.3. Semiconductors parts list

Change: V210 4822 130 44246 BX 545C Transistor
Into: V210 4822 130 44246 BC 549C Transistor

Page 43

Fig. 25 Circuit diagram

Change: C114 4n7 Into: C114 2n7
Change: 3V~CAL Into: 3V~CAL
Interchange: ① and ② of the POWER SUPPLY
Interchange: the + and - of the measuring system P201
Change: Vg on R228 into Vb



PHILIPS

SERVICE	Scientific & Analytical Equipment
	Test & Measuring Instruments
	Industrial Automation
	Advanced Automation Systems
	Welding

**Scientific &
Industrial
Equipment
Division**

820702

PM2505

SME96

Already issued: SME86
Reason: 1. Modification of the Technical Data
2. Modification of the parts list and the circuit diagram

This service note is intended to be used in combination with the service manual of the PM2505, ordering number 9499 475 01411.

1. MODIFICATION OF THE TECHNICAL DATA

The Technical Data, chapter 2 is modified as follows:

- 2.1.3. DC current measurements
- 2.1.4. AC current measurements

Voltage drop over the input sockets f.s.d., should be changed into:

Range	Voltage drop
1 μ A ... 30mA	< 135mV
100mA	< 350mV
300mA	< 1050mV
1A ... 10A	< 250mV

2.2.6. Power requirements

Add: Current consumption at 2 x 9V batteries
< 600 μ A in all ranges except Ω (< 1,5mA)
and \square (< 6mA).

9499 478 12711

PRINTED IN THE NETHERLANDS

2. MODIFICATIONS TO THE PARTS LIST AND CIRCUIT DIAGRAM

C213 is added: 3,3 μ F 20% 16V, Electrolytic, 4822 124 20947

C213 is placed in parallel to the polarity indicator P201 and diode V206.
+ to anode and – to cathode of V206.

Reason: To prevent resonance of the pointer at 50Hz input signals.

R318 is modified to: 1M Ω 1% MR25, 5322 151 54188

Reason: To prevent oscillation in the lowest ohm ranges when measuring the ohmic value of large self inductions.

R215 is modified to: 22k 20% 0,05W potentiometer, 4822 100 10051

R216 is modified to: 14k7 1% MR25 , 5322 151 54632

Reason: Adaption of the circuitry to the measuring system.

R310 is modified to: 1M2 VR25 high voltage 5322 110 72189

R312 is modified to: 226k MR25 5322 151 54729

Reason: Reduce of current consumption from the + battery with 90 μ A.



PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Automation
Advanced Automation Systems
Welding

Scientific &
Industrial
Equipment
Division

830801

PM2505/03/04/..

SME 105

Already issued : SME 86, SME 96
Re : 1. Cracking of the stand-off lugs in the top-cover PM2505/03
2. Too small creeping distance between battery cover and batteries in PM2505/03
3. Brown version PM2505/04
4. Oscillation when measuring the ohmic value of high inductions

1. Problem : Cracking of stand-off lugs in the top-cover

Cause : Chemical reaction of oil on the metal screening (should have been cleaned) with the topcover can affect the stand-off lugs, causing cracking of the plastic.

Serial numbers involved : PM2505/03 DM13067 - DM14317 (grey version)

Remedy : New topcover assembly (with screening, knobs und function selector) if the above instruments are returned for repair with this problem.

The topcovers can be obtained **free of charge** from:

Mr. J. Stegeman
Service Voltmeters
Test & Measuring Instruments
Nederlandse Philips Bedrijven B.V.
Scientific & Industrial Equipment Division
Lelyweg 1
7602 EA Almelo, The Netherlands
Tel. 0(internat.-31)5490-18291
Telex 36591 nlxalsu

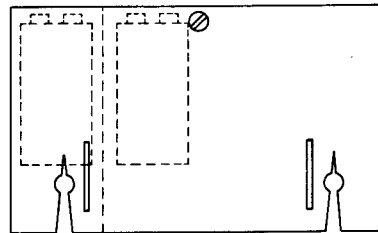
If possible please indicate how many topcovers are needed in total, so that they can be sent at once.

9499 478 13611

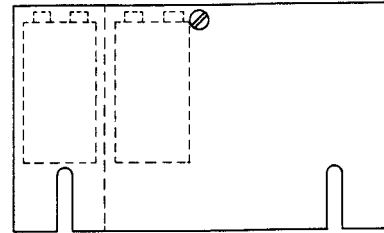
PRINTED IN THE NETHERLANDS

2 Problem : Too small creeping distance between batteries and the stand-up bracket holes in the PM2503/03.

Cause : PM2503/03 is equipped with old version battery covers without the piece of distance foam.



OLD BATTERY COVER
(TOP VIEW)

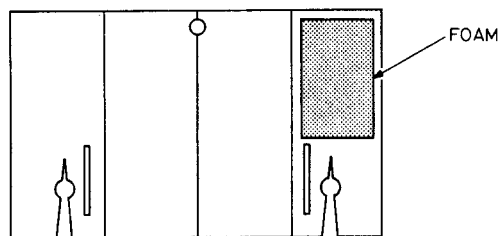


NEW BATTERY COVER
(TOP VIEW)

ST4111
830816

Serial numbers involved : PM2503/03 DM13474 – DM14554 (Grey version)

Remedy : Stick a piece of selfadhesive foam (ordering number 5322 446 60953) on the inside of the battery cover.



(BOTTOM VIEW)

ST4112
830816

It is advised to modify all instruments which are returned for repair.

3 Brown version PM2505/04

The following parts have been modified from grey to brown

Topcover	brown	5322 447 70074
Bottom cover assy	brown	5322 447 70073
Battery cover assy	brown	5322 447 70072
Measuring system	brown	5322 694 54021

4 Problem : Oscillation of the OQ0051 when measuring the ohmic value of high inductions.

Remedy : Modify R318 from 100 k Ω to 1 M Ω (5322 116 54188)



PHILIPS

SERVICE

Scientific & Analytical Equipment
 Test & Measuring Instruments
 Industrial Automation
 Advanced Automation Systems
 Welding

Scientific & Industrial Equipment Division

840116

PM2505/..

SME110

Already issued: SME86, SME96, SME105

Re : 1. Erratum SME86
 2. Modifications in the service manual of the PM2505 (9499 475 01411)

This service-note should be used in combination with the service manual of the PM2505 (9499 475 01411) and the service-notes SME86, SME96 and SME105.

1. Erratum SME86

-The correct ordering number for FUSE 400mA FAST SANDFILLED is 4822 253 20013.

-Page 43, Change: $3V_{\sim}CAL$ Into: $3V_{\sim}CAL$

should be modified into:

Interchange: $300mV_{\sim}CAL$ and $3V_{\sim}CAL$

2. Modifications in the Service Manual (9499 475 01411)

-Chapter 6. CHECKING AND ADJUSTING page 32, Adjustment No 9.

Under heading PREPARATIONS, Supply: $3V_{\sim} \pm 0.2\%$

should be changed into: Supply: $1V_{\sim} \pm 0.2\%$

-Chapter 7. PARTS LIST page 34.

The following items have been modified:

C101/C102	to	4822 122 31626	100p 2% 500V Ceramic plate.
C103/C104	to	4822 122 31199	22p 2% 500V " "
C106		4822 122 31192	6p8 2% 500V " "
V210		4822 130 40938	BC548

-CIRCUIT-DIAGRAMS AND BLOCK-DIAGRAMS

The arrows of transistors V201/V202 should be reversed (NPN BC548)

9499 478 1411

Sales and service all over the world

Alger: Bureau de Liaison Philips,
24 bis, Rue Bougainville,
El Mouradia, Alger; tel.: 565672

Argentina: Philips Argentina S.A.,
Casilla de Correo 3479, (Central), 1430 Buenos Aires;
tel. 542-2411/51 and 41-4071/78

Australia: Philips Scientific & Industrial
Equipment Division, Centre Court,
25 - 27 Paul Street, P.O. Box 119,
North Ryde/NSW 2113; tel. (2)888-8222

Bangla Desh: Philips Bangla Desh Ltd.,
P.O. Box 62; Ramna, Dacca; tel. 234280

België/Belgique: Philips & MBL associated S.A.,
Scientific and Industrial Equipment Division,
80 Rue des Deux Gares 1070 Bruxelles;
tel. (2) 523.00.00

Bolivia: Industrias Bolivianas Philips S.A.,
Cajón Postal 2964, La Paz;
tel.: 351581

Brasil: Philips do Brasil Ltda,
Avenida 9 de Julho 5229, Caixa Postal 8681,
CEP 01407 - Sao Paulo (S.P.);
tel. 2821611

Service Centre:
Sistemas Profissionais
Rua Amador Bueno, 474,
Caixa Postal 3159 - S. Amaro,
CEP 04752 - Sto Amaro (S.P.);
tel. (11) 2476522

Canada: Philips Test and Measuring Instruments Inc.,
2375 Steeles Avenue West, Unit 126,
Downsview (Ontario) M3J-3A8;
tel. (416) 665-8470

Chile: Philips Chilena S.A.,
Division Profesional, Avda. Santa Maria 0760,
Casilla Postal 2687, Santiago de Chile; tel. 770038

Colombia: Industrias Philips de Columbia S.A.,
Calle 13 no. 51-39, Apartado Aereo 4282,
Bogota; tel. 2600600

Danmark: Philips Elektronik-Systemer A/S,
Afd. for Industri og Forskning, Strandlodsvej 4,
P.O. Box 1919, 2300 København S;
tel. (1) 572222

Deutschland (Bundesrepublik): Philips GmbH,
Unternehmensbereich Elektronik für
Wissenschaft und Industrie, Miramstrasse 87,
Postfach 310 320; 35 Kassel-Bettenhausen;
tel. (561) 5010

Ecuador: Philips Ecuador S.A.,
Casilla 4607, Quito; tel. 396100

Egypt: Resident Delegate Office of Philips Industries,
5 Sherif Street, Corner Eloufi, P.O. Box 1687, Cairo;
tel. 754039/754257

Eire: Philips Electrical (Ireland) Ltd.,
Newstead, Clonskeagh, Dublin 14; tel. (1) 693355

España: Philips Ibérica S.A.E.,
Dpto Aparatos de Medida, Martinez Villergas 2,
Apartado 2065, Madrid 27;
tel (1) 4042200

Service Centre:
Dpto Tco. de Instrumentación,
Calle de Albasanz 75, Madrid 17;
tel. (1) 2047100

Ethiopia: Philips Ethiopia (Priv. Ltd. Co.),
Ras Abebe Areguay Avenue,
P.O.B. 2565,
Addis Ababa; tel. 448300

Finland: See Suomi

France: S.A. Philips Industrielle et Commerciale,
Science et Industrie,
105 Rue de Paris, 93 002 Bobigny;
tel. (1) 8301111

Great Britain: Pye Unicam Ltd., York Street,
Cambridge CB1-2PX; tel. (223) 358866

Service Centre:
Beddington Lane, Croydon, Surrey CR9-4EN;
tel. (1) 6843670

Greece: See Hellas

Hellas: Philips S.A. Hellénique,
54 Avenue Syngrou, P.O. Box 153,
Athens 403; tel. (1) 9215311

Hong Kong: Philips Hong Kong Ltd.,
Hopewell Centre, 27-29th floor,
No. 17, Kennedy Road, P.O. Box 2108,
Wanchai, Hong Kong;
tel. (5) 283298

Service Centre:
Hopewell Centre, 16th floor;
tel. (5) 283575

India: Philips India, Peico Electronics & Electrical Ltd.,
S&I Equipment, Shivsagar Estate,
Block "A", Dr. Annie Besant Road,
P.O.B. 6598, Worli, Bombay 400 018 (WB);
tel. 391431

Indonesia: P.T. Philips Development Corporation,
Department for Science and Industry Wisma PeDe,
Jalan Let. Jen. Haryono M.T. Kav. 17,
P.O.B. 2287, Jakarta-Selatan; tel. (21) 820808

Iran: Philips Iran Ltd., P.O.B. 1297, Teheran;
tel. 372081/5

Iraq: Philips Iraq W.L.L., Munir Abbas Building,
4th floor, South Gate, P.O. box 5749, Baghdad;
tel. 8880409

Island: Heimilisteaki SF, Saetún 8, Reykjavik;
tel. 24000

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

Italia: Philips S.p.A., Sezione S&I/T&M,
Viale Evezia 2, 20052 Monza; tel. (39) 36351

Jamaica: Philips (Jamaica) Ltd.,
Savannah Av. & Washington Blvd.,
P.O. Box 61, Kingston - 6;
tel. 92 - 53041

Japan: See Nippon

Jordan: Philips Delegate Office,
P.O. Box 35268, Amman; tel. 43998

Kenya: Philips (Kenya) Ltd.,
01 Kalou Road, Industrial Area,
P.O.B. 30554, Nairobi; tel. 557999

Kuwait: Delegate Office of Philips Industries,
P.O. Box 3801, Safat, Kuwait; tel. 428678

Lebanon: Philips Middle East S.A.R.L.,
P.O. Box 11670, Beirut; tel. 285748/9

Malaysia: Philips Malaysia Snd Bhd.,
Professional Division,
Lot 2, Jalan 222, Section 14,
P.O. Box 2163, Petaling Jaya,
Selangor; tel. 774411/562144

México: Philips Mexicana S.A. de C.V.,
Div. Científico Industrial, Calle Durango 167,
Apartado Postal 24-328, Mexico 7 (D.F.);
tel. 544-91-99/525-15-40

Morocco: S.A.M.T.E.L., Casa Bandoeng,
B.P. 10896, Casablanca 05; tel. 303192/302992

Nederland: Philips Nederland,
Hoofdgroep PPS, Boschdijk 525, Gebouw VB,
5600 PB Eindhoven; tel. 793333

Service centre:
Technische Service Prof. Activiteiten,
Hurksestraat 42, Gebouw HBK,
5652 AL Eindhoven; tel. 723094/722295

Ned. Antillen: Philips Antillana N.V.,
Postbus 523, Willemstad, Curaçao;
tel. 414071/74

New Zealand: Philips Electrical Industries of N.Z. Ltd.,
Scientific and Industrial Equipment Division,
68-86 Jerovis Quay, P.O. Box 2097,
Wellington C1; tel. 735735

Nigeria: Associated Electronic Products (Nigeria) Ltd.,
Ikorodu Road, P.O.B. 1921, Lagos; tel. 900160/61

Nippon: NF Trading Co. Ltd.,
Kirimoto Bldg. 11-2,
Tsunashima Higashi 1 - Chome, Kohoku-ku,
Yokohama

Norge: Norsk A.S. Philips,
Dept. Industry and Telecommunication
Postboks 1, Manglerud, Oslo 6; tel. (2) 680200

Oesterreich: Oesterreichische Philips Industrie GmbH,
Abteilung Industrie Elektronik,
Parttargasse 34, A-1230 Wien;
tel. (222)-841611/15.

Pakistan: Philips Electrical Co. of Pakistan Ltd.,
El-Markz, M.A. Jinnach Road, P.O.B. 7101,
Karachi 3; tel. 70071

Paraguay: Philips del Paraguay S.A.,
Av. Artigas 1497,
Casilla de Correo 605, Asunción;
tel. 291924

Perú: Philips Peruana S.A.,
Av. Alfonso Ugarte 1268,
Apartado Aereo 1841, Lima 100; tel. 326070

Philippines: Philips Industrial Development Inc.,
2246 Pasong Tamo, P.O.B. M.C.C. 911,
Makati, Metro, Manila; tel. 868951/868959

Portugal: Philips Portuguesa S.A.R.L.,
Av. Eng. Duarte Pacheco 6, Apartado 1331, Lisboa 1000;
tel. (19) 683121
Service Centre:
Serviços Técnicos Profissionais, Ourela,
2795 Linda-a-Velha; tel. (19) 683121

Saoudi Arabia: Delegate Office Philips Industries,
Sabreen Bldg., Airport Road, P.O. Box 9844,
Riyadh; tel. 4777808/4778463

Schweiz-Suisse-Svizzera: Philips A.G.,
Allmendstrasse 140, Postfach, CH-8027 Zürich;
tel. (1) 4882211/4882629

Singapore: Philips Singapore Private Ltd.,
Lorong 1, Tao Payoh, 1st floor,
P.O. Box 340, Toa Payoh Central Post Office,
Singapore 1231; tel. (2) 538811/537622

South Africa: South African Philips (Pty) Ltd.,
2 Herb Street, New Doornfontein, P.O.B. 7703,
Johannesburg 2000; tel. (11) 6140411

South-Korea: Philips Electronics (Korea) Ltd.,
G.P.O. Box 3680, Seoul; tel. 794 5011/5

Suomi: Oy Philips AB.,
Kaivokatu 8,
P.O. Box 10255,
SF-00101 Helsinki 10; tel. 17271
Service Centre:
P.O. Box 11, SF-02631 Espoo 63;
tel. (0) 523122

Sverige: Philips Försäljning AB,
Div. Industrielektronik, Lidingövägen 50,
Fack, S11584 Stockholm; tel. (8) 635000

Syria: Philips Moven-Orient S.A.R.L., Rue Fardoss 79,
Immeuble Kassar and Sadate, B.P. 2442, Damas;
tel. 118605/221650

Taiwan: Philips Taiwan Ltd.,
San Min Building, 57-1 Chung Shan North Rd., Sec. 2,
P.O. Box 22978, Taipei;
tel. (2) 5631717

Tanzania: Philips (Tanzania) Ltd.,
P.O. Box. 20104, Dar es Salaam; tel. 29571

Thailand: Philips Electrical Co. of Thailand Ltd.,
283 Silom Road, P.O. Box 961, Bangkok 5;
tel. 233-6330/9

Tunisia: S.T.I.E.T., 32 bis, Rue Ben Ghedhahem,
Tunis; tel. 244268

Türkiye: Türk Philips Ticaret A.S.,
Posta Kutusu 504, Beyoglu,
Istanbul 1; tel. 435910

United Arab Emirates: Philips Middle East B.V.,
Dubai International Trade Centre, Level 11,
P.O. Box 2969, Dubai; tel. 475267

Uruguay: Industrias Philips del Uruguay S.A.,
Avda Uruguay 1287, Casilla de Correo 294,
Montevideo; tel. 915641

U.S.A.:
Philips Test and Measuring Instruments Inc.,
California, Garden Grove 92645
12882 Valley View Street, Suite 9;
tel.: (213) 594-8741/(714) 898-5000
California, Milpitas 95035
489 Valley Way;
tel. (408) 946-6722
Florida, Winter Park 32789
1850 Lee Road, Suite 229;
tel. (305) 628-1717
Georgia, Norcross 30071
7084 Peachtree Industrial Blvd., Suite 220;
tel. (404) 586-0238
Illinois, Itasca 60143
500 Park Blvd., Suite 1170;
tel. (312) 773-0816
Massachusetts, Woburn 01801
21 Olympia Avenue;
tel. (617) 935-3972
Minnesota, Minneapolis 55420
7801 Metro Parkway, Suite 109;
tel. (612) 854-2426
New Jersey, Mahwah 07430
85 McKee Drive;
tel. (201) 529-3800, Toll-free (800) 631-7172

Venezuela: Industrias Venezolanas Philips S.A.,
Av. Ppal de los Ruices,
Apartado Aereo 1167, Caracas 107;
tel. (2) 393611/353533

Zaire: S.A.M.E./S.Z.A.R.L., B.P. 16636, Kinshasa;
tel. 31693

Zambia: Philips Electrical Zambia Ltd.,
Mweneshi Road, P.O.B. 31878, Lusaka;
tel. 218511

Zimbabwe: Philips Electrical (PVT) Ltd.,
62 Umtali Road, P.O. Box 994, Beverley/Harare;
tel. 47211

For information on change of address:
Philips Export B.V.,
Scientific and Industrial Equipment Division,
Test and Measuring Instruments, Building TQ III-4, P.O. Box 218,
5600 MD Eindhoven - The Netherlands

For countries not listed here:
Philips Export B.V., S&I Export,
Test and Measuring Instruments, Building TQIII-3, P.O. Box 218,
5600 MD Eindhoven - The Netherlands;
Tel. (40) 782285