PHILIPS

Digital VAΩ meter PM2522 A

9447 025 22201

INSTRUCTION MANUAL

9499 470 14602

780228

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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

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

PRINTED IN THE NETHERLANDS

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1. INTRODUCTION

The PM 2522A is a high class 4½ digit manual operated multimeter.
The instrument can measure:

Measuring functions	Measuring range
d.c. voltages	100 µV - 1000 V
a.c. voltages	100 µV - 600 V
d.c. currents	1 µA - 2000 mA
a.c. currents	1 µA - 2000 mA
resistances	0.1 Ω - 20 MΩ
temperature	-60°C - + 200°C

Protection of all measurement functions is provided.
The polarity at d.c. measurements and temperature measurements is indicated automatically.
The decimal point is set by the range switches. By means of push-button "HOLD" display hold is possible.

High accuracies are obtained thanks to automatic zero drift correction of the analog to digital convertor being carried out before each measurement.

The application of MOS-LSI digital integrated circuits decreases the number of discrete components and guarantees high accuracy and stability. The optional d.c. power supply PM 9216 enables the portability of the PM 2522A to be fully exploited.
Due to its high sensitivity, its great accuracy and wide range of measurement functions, the PM 2522A can be applied to a wide range of applications in research, production lines, service and education.

2. TECHNICAL DATA

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

2.1. Electrical specification

Reference conditions	Ambient temperature 23°C ± 1°C Relative humidity 45% ... 75%

2.1.1. D.C. voltage measurements

Range	2V, 20V, 200V, 2000V (max. input voltage 1000V)
Resolution	100 µV in the 2V range
Accuracy	± 0.03% of reading ± 0.01% of range
Temperature coefficient	± 50 ppm of reading ± 10 ppm of range /°C
Input impedance	10 MΩ ± 1% on all ranges
Response time within 2 digits of the final value.	< 1.2 sec.
Max. input voltage	Range 2V: 250V D.C. or A.C.$_{rms}$ continuously; 1000V D.C., 600V$_{rms}$ for 1 minute Range 20V .. 2000V: 1000V D.C. continuously; 600V$_{rms}$ continuously; 1400V peak

2.1.2. A.C. voltage measurements

Range	2V, 20V, 200V, 2000V (max. input voltage 600V$_{rms}$)
Resolution	100 µV in the 2V range
Accuracy	Frequency range 35 Hz ... 500 Hz ± 0.2% of reading ± 0.1% of range Frequency range 500 Hz ... 30 kHz ± 0.5% of reading ± 0.5% of range
Temperature coefficient	Frequency range 35 Hz ... 500 Hz ± 200 ppm /°C of reading Frequency range 500 Hz ... 30 kHz ± 400 ppm /°C of reading
Input impedance	1 MΩ ± 1% // 30 pF on all ranges
Response time within 2 digits of the final value	< 2.5 sec.
Max. input voltage	600Vrms continuously 1400V peak 400V D.C. continuously

2.1.3. D.C. current measurements

Range	2 mA, 20 mA, 200 mA, 2000 mA
Resolution	1 µA
Display	Digit 10^{0} is blanked Max. display 1999
Accuracy	± 0.3% of reading ± 0.1% of range
Temperature coefficient	± 200 ppm/°C of reading
Voltage drop	Range 2 mA, 20 mA and 200 mA: < 250 mV Range 2000 mA : < 600 mV
Response time within 2 digits of the final value	< 1.2 sec.
Max. voltage at the input terminals	$250V_{rms}$ or D.C. continuously 500V peak
Protection	2.5A fuse

2.1.4. A.C. current measurements

Range	2 mA, 20 mA, 200 mA, 2000 mA
Resolution	1 µA
Display	Digit 10^{0} is blanked Max. display 1999
Accuracy	± 0.3% of reading ± 0.1% of range
Frequency	35 Hz ... 1 kHz
Temperature coefficient	± 200 ppm/°C of reading
Voltage drop	Range 2 mA, 20 mA and 200 mA: < 250 mV Range 2000 mA : < 600 mV
Response time within 2 digits of the final value	< 2.5 sec.
Max. voltage at the input terminals	250 Vrms or D.C. continuously 500 V peak
Protection	2.5A fuse

2.1.5. Resistance measurements

Range	2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ
Resolution	0.1 Ω in the 2 kΩ range
Accuracy	Range 2 kΩ ... 2000 kΩ ± 0.3% of reading ± 0.1% of range Range 20 MΩ ± 0.5% of reading ± 0.3% of range

Measuring current

Range	Current
2 kΩ	1 mA
20 kΩ	100 mA
200 kΩ	10 μA
2000 kΩ	1 μA
20 MΩ	100 nA

Open voltage	< 7 V
Semiconductors	Can be measured in the 2 kΩ range
Display	The 10^0 digit is blanked in range 20 MΩ
Response time within 2 digits of the final value	Range 2 kΩ ... 200 kΩ < 1.2 sec. Range 2000 kΩ < 2 sec. Range 20 MΩ < 3.5 sec.
Temperature coefficient	Range 2 kΩ ... 200 kΩ ± 100 ppm/°C Range 20 MΩ ± 300 ppm/°C
Max. input voltage	250 Vrms or D.C. continuously 500 V peak

2.1.6. Temperature measurements (using resistance thermometer PM 9248)

Range	-60°C ... +200°C
Sensitivity	0.1°C
Accuracy (including inaccuracy of the probe)	-60°C ... +100°C ± 1% of reading ± 2°C + 100°C ... +200°C + 1,-3% of reading ± 2°C
Temperature coefficient	300 ppm/°C of reading

2.2. General data

Environmental conditions	According IEC359
Climatic conditions	Group 1 with extension of the upper temperature limit. Upper temperature limit : 45°C Ambient temperature : 23°C ± 1% (reference value) Rated range of use : 0°C ... + 45°C Limit range of storage and transport : -40°C ... +70°C Relative humidity : 20% ... 80 % (excluding condensation)
Mechanical conditions	Group 2
Supply conditions	Group 2 Nominal mains voltage 240V +50 -20% 110V ± 15% (switchable by means of jumper) Mains frequency 50 Hz / 60 Hz Power consumption 8 VA Optional: Battery power supply PM 9216 Discharging time 6 hours During charging 10^4 digit indicates "1" when instrument is switched-off.

Safety	Class 1 according IEC348
Display	11 mm 7 segment LED's Maximum display 19999
Decimal point	Depends on range Manual selected
Polarity indication	+ and - automatically
Overrange indication	.0... Polarity is indicated correctly
Function selection	Manual by pushbutton switches
Range selection	Manual by pushbutton switches
Data Hold	Manual by pushbutton switch External via °C socket
Analog to digital conversion system	Integrating
Conversion rate	2½ conv/second
Common mode rejection	100 dB for D.C. and A.C. signals 50Hz/60Hz
Series mode rejection	60 dB (50Hz/60Hz ± 5%)
Warming-up time	15 minutes
Recalibration interval	6 months
Max. voltage between "0" terminal and mains earth	630V peak 450 Vrms or D.C.

2.3. Mechanical data

Dimensions	Height	95 mm
	Width	235 mm
	Depth	280 mm
Weight	Approx.	2 kg

3. ACCESSORIES

3.1. Supplied with the instrument

- Set of measuring leads PM 9260 (Fig. 1, page 46)
- 1 Fuse 2.5A
- 2 fuses 50mA d.a., 220V mains
- 2 fuses 100 mA d.a., 110V mains
- Sticker 110V mains
- Sticker 2.5A
- Sticker 100 mA
- Mains cable
- Front cover
- Instruction manual

3.2. Optional

3.2.1. EHT probe type PM 9246 (Fig. 2, page 46)

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

Maximum voltage	30 kV
Attenuation	1000 x
Input impedance	600 MΩ ± 5%
Accuracy	± 3%
Relative humidity	20% to 80%

Note: Check that earth connections are made correctly.

3.2.2. Current transformer type PM 9245 (Fig. 3, page 46)

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

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

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

3.2.3. Shunt type PM 9244 (Fig. 4, page 46)

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

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

3.2.4. HF probe type PM 9210 (Fig. 5, page 46) Accessory set for the probe type PM 9212 (Fig. 6, page 46)

	PM 9210	PM 9210 + PM 9212
Frequency range	100 kHz to 1 GHz	100 kHz to 1 GHz
Straight line within 5%	100 kHz to 6 MHz	100 kHz to 6 MHz
Maximum deviation	3 dB	3.5 dB
Voltages ranges	150 mV to 15 V	15 V to 200 V
Max. voltage a.c.	30 V	200 V
Max. voltage d.c.	200 V	500 V
Input capacitance	2 pF	2 pF
T-piece (included in PM 9212)		
Frequency range		100 kHz to 1.2 GHz
Impedance		50 Ω
Standing wave ratio		1.25 at 700 MHz and 1.15 at 1 GHz with 100: 1 attenuator

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

3.2.5. Battery supply unit type PM 9216

This battery supply unit can be attached to the rear of the instrument in order to provide battery operation.
The batteries are charged by current obtained from the power supply circuits of the instrument.

Nominale voltage	5 V
Capacity	3.5 Ah
Maximum charge current	350 mA
Maximum trickle charge current	35 mA
Operation time of PM 2522A from battery supply before recharge is necessary	6 h
Subsequent recharge time	15 h (with PM 2522A switched OFF)

3.2.6. Temperature probe PM 9248 (Fig. 7, page 50)

The resistance thermometer PM 9248 is a contact probe, suitable for measurement of surface temperature between -60°C and +200°C.

Range	-60 to +200°C
Resolution	0.1°C
Accuracy (combined with PM 2522A)	-60°C to +100°C ± 1% of reading ± 2°C + 100°C to + 200°C + 1% to -3% of reading ± 2°C
Permissible voltage at probe tip	60 V

3.2.7. Rackmounting set PM 9669/01

The rackmountig set PM 9669/01 is used to mount the PM 2522A into a 19" rack.

3.2.8. Data hold probe PM 9263 (Fig. 8, page 46)

Max. input voltage	500 V (DC + AC peak)
Max. voltage between 0 (common) and ground	42 V (DC + AC peak)
Data Hold function	The data on the display are held by switching the hold switch on this probe.

4. PRINCIPLE OF OPERATION (Fig. 9, page 50)

4.1. General

The PM 2522A consists of an analog part and a digital part.

The analog part comprises:
- Input circuit
- d.c. amplifier
- Analog to digital convertor

The digital part comprises:
- programme
- Counter memory
- Clock oscillator and Scan oscillator
- Display

4.2. Analog part

4.2.1. Input circuit

The input circuit of the PM 2522A consists of:

- d.c. attenuator
- a.c./d.c. convertor
- Shunts
- Current source

• Direct voltage measurements

The unknown input voltage is supplied to the d.c. attenuator which attenuates the input voltage in accordance with the range selected. At end of range the attenuated voltage is 2V d.c.

- Alternating voltage measurements

The unknown input voltage is supplied to the a.c./d.c. convertor. Dependent to the range selected the input voltage is attenuated. At end of range the attenuated voltage is 1V d.c. In the a.c./d.c. convertor a formfactornetwork is included by which the PM 2522A measures the r.m.s. value of sinusoidal input signals.

- Direct current measurements

The unknown current is supplied to the shunts. Dependent to the range selected the shunts are switched. The output voltage of the shunt is 0.2V end of range.

- Alternating current measurements

The unknown current is supplied to the shunts and dependent to the range selected the shunts are switched. The output voltage of the shunts (0.2V end of range) is supplied to the a.c./d.c. convertor. The output voltage of the a.c./d.c. convertor is 1V end of range. In the a.c./d.c. convertor a formfactornetwork is included, by which the PM 2522A measures the r.m.s. value of sinusoidal input signals.

- Resistance measurements

At resistance measurements, a constant current flowing through the resistor to be measured causes a voltage drop, which is 2V at end of range. Dependent to the range selected the current source which produces the measuring current is switched.

- Temperature measurements

In case of temperature measurements a constant current flowing through a resistance thermometer causing a voltage drop, which is measured.
At end of range (200°C) the voltage across the resistance thermometer is 0.2V.
To compensate the resistance at 0°C of the resistance thermometer a temperature compensation circuit is built in.

4.2.2. D.C. amplifier

The d.c. amplifier has a gain factor of x1.
Depending on the function selected, the output voltage of the d.c. amplifier is 0.2V, 1 V, or 2 V.

4.2.3. Analog to digital conversion (Fig's 10 and 11, page 54)

The conversion of analog signals into digital form is based on the integration principle.
The analog signal is applied to an integrator followed by a comparator.
The comparator supplies an output pulse, the width of which is proportional to the measuring voltage. Figures 10 and 11 show a graphical representation of the output voltage in the integrator as function of time, during the charging and discharging cycle.
Used ADC is equipped with an automatic zeroing circuit.
The ADC has a gain factor of 1, 2 or 10 depending on the function selected. At end of range the integrated voltage is 2 V.

4.3. Digital section

During the charging cycle of the ADC, 20.000 clockpulses of the clockoscillator are counted by the counter memory.
After counting the 40.000 pulses the counter supplies a pulse to the program which controls the ADC to start the discharging cycle.
The number of pulses counted during the discharging cycle is proportional to the height of the signal supplied to the input of the ADC, and when zero passage of the comparator is reached (t2) the number of clockpulses counted, are transferred to the memory.
The output of the memory is scanned by a scan oscillator, and the BCD information is supplied to the display via a BCD to 7-segment decoder.
At the same time the scan oscillator is driving the anodeswitches in order to get a sequential display.

4.4. Ranging

Ranging is effected manually by means of pushbutton.
The range switches control the attenuation factors of the d.c. attenuator, the a.c./d.c. convertor, the shunts, the measuring currents of the current source and the gain of the ADC.

5. INSTALLATION

Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (See section EARTHING).

5.1. Mains supply and fuse

Before inserting the mains plug into the mains socket, make sure that the instrument is set to the local mains voltage.

5.1.1. General

Adaptation to the mains voltage may be made only, by a skilled person who is aware of the risk involved. When a fuse is to be replaced or when the instrument is to be adapted to another mains voltage, the instrument must be disconnected from all voltage sources.

5.1.2. Adaptation of mains voltage (Fig. 11, page 54)

The instrument is set for a mains voltage of 220 V 50 Hz/60 Hz by the factory.
Adapting the instrument for a mains voltage of 110 V 50 Hz/60 Hz may be done by interconnecting the jumpers according Figure 11, page 54. The jumpers and the mains fuse F1001 are accessible after removing the top cover.

240 V +5% -20%	Fuse F1001 is 50 mA slow blow.
110 V ± 15%	Fuse F1001 is 100 mA slow blow.

5.1.3. Fuses

The mains fuse F1001 is located on unit U1 (see Fig. 12 page 54).
To replace the mains fuse, remove the top cover.
To protect the current ranges a fuse (F2) of 2.5A is mounted in the "A" input terminal (Fig. 13, page 54).

Make sure that only fuses with the required current ratings and of the specified types are used.
The use of repaired fuses and the short circuiting of fuse holders is prohibited.

5.2. Battery supply

The optional accessory PM 9216 is recommended for battery supply, because it becomes an integral part of the instrument.

5.2.1. Mounting the PM 9216

- Open the battery container cover of the multimeter.
- Connect the battery power supply plug to the battery socket of the multimeter.
- Place the PM 9216 in the battery container.
  The two hooks of the PM 9216 should be placed in the corresponding two slots "B" (Fig. 15 page 58) of the battery container.
- Secure the PM 9216 by inserting the two screws supplied with the PM 9216 into the corresponding holes.

5.3. Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:

- Via the three-core mains cable. The mains plug shall only be inserted into a socket outlet provided with a earth contact. The protective action shall not be made ineffective by the use of an extension without protective conductor. Replacing the mains plug is at the users own risk.

WARNING:	Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminals is likely to make the instrument dangerous. Intentional interruption is prohibited. When an instrument is brought from the cold into a warm environment, condensation may cause a hazardous condition. Make sure that the earthing requirements are strictly adhered to.

6. OPERATION

6.1. Switching on

The instrument is ready for use after connection to the mains and earthing.
It is switched on by means of pushbutton switch "POWER" (Fig. 14, page 58).

6.2. Controls

6.2.1. Front panel (Fig. 14, page 58)

Item	Description	Application
S1001	V⎓, V~, mA⎓, mA~, kΩ, °C	Switches on the required measuring function.
S1002	POWER	Switches on the instrument.
S2001	2, 20, 200, 2000, 20MΩ	Switches on the required range
S2002	HOLD	Display hold
X2	°C	Input terminal for temperature measurements.
X3/F1	A	HI-input terminal for current measurements with 2,5A fuse F2 (see Fig. 13, page 54)
X4	VΩ	Combined HI-input terminal for voltage and resistance measurements.
X5	0	LO - input terminal
R1	0	Zero adjustment potentiometer

6.2.2. Rear panel (Fig. 15, page 58)

Item	Description	Application
X1	-	Mains supply input
X1001	-	Battery supply input

6.3. Zero setting

Before carrying out the zero setting a warming-up time of 15 minutes should be allowed.

- Depress pushbutton V⎓ and select the 2 V range.
- Short circuit the VΩ and 0 socket.
- Adjust the display to .0000 V by means of potentiometer "0".

NOTE: For complete readjustment of the PM 2522A refer to chapter 7 "Checking and Adjusting".

6.4. Measuring

6.4.1. Function selection

The measuring function required is manual selected by the function switches.

6.4.2. Range selection

The range required is manual selected by the range switches.

Function	Range
V⎓	2V, 20V, 200V and 2000V (max. input voltage 1000V).
V~	2V, 20V, 200V and 2000V (max. input voltage 600V rms)
mA⎓	2mA, 20mA, 200mA and 2000mA
mA~	2mA, 20mA, 200mA and 2000mA
kΩ	2kΩ, 20kΩ, 200kΩ, 2000kΩ and 20MΩ
°C	-60°C ... +200°C (using probe PM 9248)

- Overloading a range is indicated as .0... on the display.
  A higher range should be selected then.

6.4.3. Hold

When the "HOLD" pushbutton is depressed the complete display, prior to depressing, is held.

- By interconnecting the points 5 and 3 of the terminal °C by means of PM 9263 (see Fig.'s 8, 9 and 14) the complete display is also held.

6.4.4. Direct voltage measurements

- Depress pushbutton V⎓
- Select the correct measuring range
- Connect the test voltage to the terminals "0" and "VΩ"

NOTES:
- The polarity indicator indicates the polarity at terminal "VΩ" with respect to terminal "0".
- Maximum permissible voltage between terminals "VΩ" and "0" is;
  Range 2V: 250V d.c. or rms continuously
  1000V d.c. or 600V rms for 1 minute
  Range 20V ... 2000V: 1000V d.c., 600V rms, continuously 1400V peak

6.4.5. EHT voltages up to 30 kV with probe PM 9246

- Depress pushbutton V⎓
- Connect the probe PM 9246 to the terminals "0" and "VΩ".
- Connect the earthing clip of the probe to a proper earth.
- Select the 10 MΩ range on the probe.

NOTES:
- Maximum permissible d.c. voltage is 30 kV (range end is 100 kV)
- The position of the decimal point should be observed.

6.4.6. Alternating voltage measurements

- Depress pushbutton V∼
- Select the correct measuring range
- Connect the test voltage to terminals "0" and "VΩ".

NOTE:
- Maximum permissible voltage between terminals "VΩ" and "0" is 600 V rms, 400 V d.c. or 1400 V peak continuously.

6.4.7. UHF voltages with probe HF probe PM 9210 and T connector PM 9212

- Depress pushbutton V⎓
- Connect the probe to terminal "0" and "VΩ" with the earth pin into "0".
- Select the 20 V range.

NOTES:
- The maximum permissible voltage on the probe with attenuator is 200 V rms superimposed on 500 V d.c.
- The correction factor on the calibration curve of the probe should be taken into account.

6.4.8. Direct current measurements

- Depress pushbutton mA⎓
- Select the correct measuring range
- Connect the test current to terminals "0" and "A".

NOTES:
- The polarity indicator indicates the polarity at terminal "A" with respect to terminal "0".
- The 10^0 digit is blanked
- Maximum permissible input current is 2000 mA.
- Maximum permissible input voltage is 250 V rms or DC, 500 V peak.
- Currents upto 31,6 A can be measured with shunt PM 9244.

6.4.9. Alternating current measurements

- Depress pushbutton mA∼
- Select the correct measuring range
- Connect the test current to terminals "0" and "A"

NOTES:
- The 10^0 digit is blanked
- Maximum permissible input current is 2000 mA.
- Maximum permissible input voltage is 250 V rms or DC, 500 V peak.
- Currents upto 100 A can be measured with the aid of current transformer PM 9245.

6.4.10. Resistance measurements

- Depress pushbutton kΩ.
- Select the correct range

NOTE:
- When function kΩ is selected an additional 20 MΩ range is available. In the 20 MΩ range to the 10^0 digit is blanked.

- Connect the unknown resistor to terminals "0" and "VΩ"

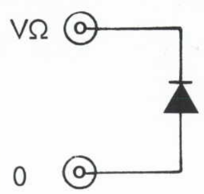
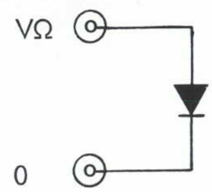
NOTE:
- The measuring currents are:

Range	Current
2 kΩ	1 mA
20 kΩ	100 μA
200 kΩ	10 μA
2000 kΩ	1 μA
20 MΩ	100 nA

- Maximum permissible input voltage is 250 V rms or DC, 500 V peak.

6.4.11. Diode measurements

- Depress pushbutton kΩ.
- Select the 2 kΩ range.
- Connect the diode in forward direction to terminals "0" and "VΩ".
- The display shows the diode voltage in forward direction with a current of 1 mA.

	FORWARD	REVERSED
		
Ge Si	0.1000 - 0.3000 0.6000 - 0.9000	> .0... > .0...

6.4.12. Temperature measurements

- Depress pushbutton °C.
- Connect the PM 9248 resistance thermometer to input °C.

NOTES: When using this probe, the following points must be observed.

- Remove all the other measuring leads from the PM 2522A.
- Do not use the probe for temperature measurements of components with a potential higher than 60 V.
- Select a contact surface as large as possible with the probe top. If necessary, a little silicone grease can be applied to improve the contact.
- Do not immerse the probe into a liquid.
- Before carrying out temperature measurements the instrument should be set to zero by means of potentiometer "0" (see chapter 6.3, page 18).

1. EINLEITUNG

ALLGEMEINES

Das PM 2522A ist ein hochwertiges $4\frac{1}{2}$ stelliges handbedientes Multimeter.
Das Gerät ist für folgende Messungen geeignet:

Messarten	Messbereich
Gleichspannungen	100 µV - 1000 V
Wechselspannungen	100 µV - 600 V
Gleichströme	1 µA - 2000 mA
Widerstände	0.1Ω - 20 MΩ
Temperatur	-60°C - +200°C

Alle Messfunktionen sind geschützt.
Die Polaritätsanzeige bei Gleichspannungs- und Temperaturmessungen erfolgt automatisch.
Der Dezimalpunkt wird von den Bereichsschaltern gesetzt. Drucktaste "HOLD" ermöglicht das Festhalten der Ablesung.
Dank der vor jeder Messung ausgeführten automatischen Nullpunkt-Korrektur des Analog-Digital Umsetzers werden hohe Messgenauigkeiten erreicht.
Anwendung von MOS-LSI digitalen integrierten Schaltungen vermindert die Anzahl diskreter Bauteile und gewährleistet hervorragende Genauigkeit und Stabilität. Die auf Wunsch erhältliche Gleichspannungsspeisung (Batterieeinheit) PM 9216 ermöglicht die vollste Ausnutzung der Mobilität des PM 2522A.
Durch seine hohe Empfindlichkeit, grosse Genauigkeit und die Vielzahl der Messfunktionen eignet sich das PM 2522A für ein breites Anwedungsgebiet in Forschung, Fertigung, Service und Unterricht.

2. TECHNISCHE DATEN

Alle hiernach erwähnten Werte sind Nennwerte, Zahlenwerte mit Angaben von Toleranzen sind bindend und werden vom Erzeuger garantiert.

2.1. Elektrische Daten

Referenzbedingungen	Umgebungstemperatur 23°C ± 1°C Relative Luftfeuchte 45% ... 75%

2.1.1. Gleichspannungsmessungen

Bereich	2V, 20V, 200V, 2000V (max. Eingangsspannung 1000V)	
Auflösung	100 µV im 2V Bereich	
Fehlergrenze	± 0,03% der Ablesung ± 0,01% des Bereichs	
Temperaturkoeffizient	± 50 Teil pro Mio der Ablesung/°C ± 10 Teil pro Mio des Bereich /°C	
Eingangsimpedanz	10 MΩ ± 1% in allen Bereichen	
Ansprechzeit innerhalb 2 Ziffern des Endwerts	< 1, 2 s	
Maximale Eingangsspannung	Bereich 2V	250V Gleichspannung oder Wechselspannung $_{eff}$ kontinuierlich. 1000V Gleichspannung, $600V_{eff}$ } über 1 Minute
	Bereich 20V...2000V	1000V Gleichspannung, kontinuierlich $600V_{eff}$, kontinuierlich 1400V Spitzenspannung, kontinuierlich

2.1.2. Wechselspannungsmessungen

Bereich	2V, 20V, 200V, 2000V (max. Eingangsspannung $600V_{eff}$)
Auflösung	100 µV im 2V Bereich
Fehlergrenze	Frequenzbereich 35 Hz ... 500 Hz ± 0,2% der Ablesung ± 0,1% des Bereichs Frequenzbereich 500 Hz ... 30 kHz ± 0,5% der Ablesung ± 0,5% des Bereichs
Temperaturkoeffizient	Frequenzbereich 35 Hz ... 500 Hz ± 200 Teil pro Mio/°C der Ablesung Frequenzbereich 500 Hz ... 30 kHz ± 400 Teil pro Mio/°C der Ablesung
Eingangsimpedanz	1 MΩ 1% // 30 pF in allen Bereichen
Ansprechzeit innerhalb 2 Ziffern des Endwerts	< 2,5 s
Maximale Eingangsspannung	600 V eff kontinuierlich 1400 V Spitzenspannung 400 V Gleichspannung kontinuierlich

2.1.3. Gleichstrommessungen

Bereich	2 mA, 20 mA, 200 mA, 2000 mA
Auflösung	1 µA
Anzeige	Digit 10^0 ist dunkelgetastet Maximale Anzeige 1999
Fehlergrenze	± 0,3% der Ablesung ± 0,1% des Bereichs
Temperaturkoeffizient	± 200 Teil pro Mio/°C der Ablesung
Spannungsabfall	Bereich 2 mA, 20 mA und 200 mA: < 250 mV Bereich 2000 mA : < 600 mV
Ansprechzeit innerhalb 2 Ziffern des Endwerts	< 1,2 s
Max. Spannung an den Eingangsklemmen	250 V eff oder Gleichspannung kontinuierlich 500 V Spitzenspannung
Schutz	Sicherung 2,5 A

2.1.4. Wechselstrommessungen

Bereich	2 mA, 20 mA, 200 mA, 2000 mA
Auflösung	1 µV
Anzeige	Digit 10^0 ist dunkelgetastet Maximale Anzeige 1999
Fehlergrenze	± 0,3% der Ablesung ± 0,1% des Bereichs
Frequenz	35 Hz... 1 kHz
Temperaturkoeffizient	± 200 pro Mio/° der Ablesung
Spannungsabfall	Bereich 2 mA, 20 mA, und 200 mA : < 250 mV Bereich 2000 mA : < 600 mV
Ansprechzeit innerhalb 2 Ziffern des Endwerts	< 2,5 s
Max. Spannung an den Eingangsklemmen	250 V eff oder Gleichspannung kontinuierlich 500 V Spitzenspannung
Schutz	Sicherung 2,5 A

2.1.5. Widerstandsmessungen

Bereich	2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ
Auflösung	0,1 Ω in 2 kΩ Bereich
Fehlergrenze	Bereich 2 kΩ ... 2000 kΩ ± 0,3% der Ablesung ± 0,1% des Bereichs Bereich 20 MΩ ± 0,5% der Ablesung ± 0,3% des Bereichs
Messstrom	(siehe Tabelle)

Bereich	Strom
2 kΩ	1 mA
20 kΩ	100 mA
200 kΩ	10 μA
2000 kΩ	1 μA
20 MΩ	100 nA

Messspannung mit offenen Eingang	< 7 V
Halbleiter	Im 2 kΩ Bereich messbar
Anzeige	Das 10^0 Digit wird im 20 M Bereich dunkelgetastet
Ansprechzeit innerhalb 2 Ziffern des Endwerts	Bereich 2 kΩ ... 200 kΩ < 1,2 s Bereich 2000 kΩ < 2 s Bereich 20 MΩ < 3,5 s
Temperaturkoeffizient	Bereich 2 kΩ,... 200 kΩ ± 100 pro Mio/°C Bereich 20 MΩ ± 300 pro Mio/°C
Max. Eingangsspannung	250 V_{eff} oder Gleichspannung kontinuierlich 500 V Spitzenspannung

2.1.6. Temperaturmessungen (mit Widerstandsthermometer PM 9248)

Bereich	-60°C ... +200°C
Auflösung	0,1°C
Fehlergrenze (einschl. Messkopffehler)	-60°C ... +100°C ± 1% der Ablesung ± 2°C +100°C ... +200°C + 1, - 3% der Ablesung ± 2°C
Temperaturkoeffizient	300 pro Mio/°C der Ablesung

2.2. Allgemeine Daten

Umgebungsbedingungen	Nach IEC 359
Klimatische Bedingungen	Klasse I mit Erweiterung der oberen Temperaturgrenze Obere Temperaturgrenze : 45°C Umgebungstemperatur : 23°C ± 1% (Referenzwert) Arbeitsbereich : 0°C ... 45°C Grenzbereich für Lagerung und Transport : -40°C ... +70°C Relative Luftfeuchte : 20% ... 80% (ausgenommen Kondensation)
Mechanische Bedingungen	Klasse 2
Stromversorgungsbedingungen	Klasse 2 Nennspannung des Netzes 240V +5 -20% 110V ± 15% (umschaltbar mit Hilfe von Drahtbrücke) Netzfrequenz 50 Hz/60 Hz Stromaufnahme 8 VA Wahlweise : Batteriespeisung PM 9216 Betriebszeit 6 Stunden Während des Ladens zeigt Ziffer 10^4 "1" im Falle das Instrument ausgeschaltet ist.
Schutz	Klasse I nach IEC 348
Anzeige	7-Segment lichtemmitierende Dioden (LED's) Maximale Anzeige 19999
Dezimalpunkt	Abhängig vom Bereich Von Hand gewählt
Polaritätsanzeige	+ und - automatisch
Uberlaufanzeige	.0... Polarität richtig angezeigt
Funktionswahl	Von Handmittels Drucktasten
Bereichwahl	Von Hand mittels Drucktasten
Fixieren der Anzeige	Von Hand mittels Drucktaste Extern über Buchse °C
Analog-Digital-Umsetzungsverfahren	Integrierend
Umsetzzeit	2½ Ums./s
Gleichtaktunterdrückung (CMR)	100 dB für Gleichspannungs- und Wechselspannungssignale 50 Hz / 60 Hz
Serientaktunterdrückung (SMR)	60 dB 50 Hz/60 Hz ± 5%
Anwärmzeit	15 Minuten
Neukalibrierungs-Abstand	6 Monate
Max. Spannung zwischen Buchse "0" und Netzerde	$450V_{eff}$ oder Gleichspannung 630V Spitzenspannung

2.3. Mechanische Daten

Abmessungen	Höhe	95 mm
	Breite	235 mm
	Tiefe	280 mm
Gewicht	ca.	2 kg.

3. ZUBEHÖREN

3.1. Mitgeliefertes Zubehör

- Satz Messkabel PM 9260 (Abb. 1, Seite 46)
- 1 Sicherung 2,5 A
- 2 Sicherungen 50 mA, träge, 220 V Netz
- 2 Sicherungen 100 mA, träge 110 V Netz
- Klebeschild 110 V Netz
- Klebeschild 2,5 A
- Klebeschild 100 mA
- Netzkabel
- Frontdeckel
- Bedienungsanleitung

3.2. Wahlzubehör

3.2.1. Hochspannungsmesskopf PM 9246 (Abb. 2, Seite 46)

Mit dem Hochspannungsmesskopf PM 9246 können Gleichspannungen bis 30 kV gemessen werden. Der PM 9246 kann für Messgeräte mit einer Eingangsimpedanz von 100 MΩ, 10 MΩ oder 1.2 MΩ (am Messkopf einstellbar) benutzt werden.

Max. Spannung	30 kV
Abschwächung	1000 ×
Eingangsimpedanz	600 MΩ + 5%
Fehlergrenze	± 3%
Relative Luftfeuchte	20% bis 80%

Bemerkung: Es ist darauf zu achten dass die Erdverbindungen einwandfrei ausgeführt sind.

3.2.2. Stromwandler PM 9245 (Abb. 3, Seite 46)

Mit diesem Transformator lassen sich Wechselströme von 10 A bis 100 A messen.

Übertragungsfaktor	1000 x (100 A = 100 mA)
Übertragungsfehler	± 3%
Frequenzbereich	45 Hz ... 1 kHz
Höchstzulässiger Sekundärspannungs-verlust	200 mV
Max. Spannung gegen Erde	400 V Wechselspannung.

Den Stromwandler von der Messung an das Gerät anschliessen.
Verschmutzung der Kernteile sind zu vermeiden.

3.2.3. Shunt PM 9244 (Abb. 4, Seite 46)

Mit Hilfe dieses Shunts lassen sich Gleich- und Wechselströme (max. 1 kHz) bis 31,6 A messen.

Strombereich	10 A und 31,6 A
Ausgangsspannung	100 mV und 31,6 mV
Fehlergrenze	100 mV ± 1% 31,6 mV : + 2%
Verlustleistung	max. 3,16 W
Abmessungen	Höhe : 55 mm Breite : 140 mm Tiefe : 65 mm

3.2.4. HF-Messkopf PM 9210 (Abb. 5, Seite 46) Zubehörsatz für Messkopf PM 9212 (Abb. 6, Seite 46)

	PM 9210	PM 9210 + PM 9212
Frequenzbereich	100 kHz...1 GHz	100 kHz...1 GHz
Gerade innerhalb	100 kHz...6 MHz	100 kHz...6 MHz
Max. Abweichung	3 dB	3,5 dB
Spannungsbereiche	150 mV...15 V	15 V...200 V
Max. Wechselspannung	30 V	200 V
Max. Gleichspannung	200 V	500 V
Eingangskapazität	2 pF	2 pF
T-Stück (im PM 9212 enthalten)		
Frequenzbereich		100 kHz...1.2 GHz
Impedanz		50 Ω
Stehwellenverhältnis		1.25 bei 700 MHz und 1.15 bei 1 GHz mit 100 : 1 Abschwächer

Mit dem Messkopf PM 9210 in Verbindung mit dem Messkopfzubehör (Einstellbarer Erdstift und Dage-Adapter) können Messungen bis zu 100 MHz ausgeführt werden.
Für Messungen über dieser Frequenz empfiehlt es sich das 50 Ω T-Stück und den 50 Ω Abschlusswiderstand zu verwenden. Beide sind im PM 9212 Messkopf-Zubehörsatz inbegriffen.

3.2.5. Batterieeinheit PM 9216

Diese Einheit kann an der Rückseite des Gerätes befestigt werden und ermöglicht einen Batteriebetrieb des Gerätes.
Die Batterien werden vom Netzteil des PM 2522 A geladen.

Kenndaten:

Nennspannung	5 V
Kapazität	3,5 Ah
Maximaler Ladestrom	350 mA
Maximale Pufferladung	35 mA
Betriebszeit des PM 2522 A mit Batteriespeisung bevor Wiederaufladung erforderlich ist	6 Stunden
Wiederaufladedauer	15 Stunden (mit ausgeschaltetem PM 2522A)

3.2.6. Temperaturmesskopf PM 9248 (Abb. 7, Seite 46)

Das Widerstandsthermometer PM 9248 ist ein Kontaktmesskopf, geeignet für Messungen von Oberflächentemperaturen zwischen -60°C und +200°C.

Bereich	-60 ... +200°C
Auflösung	0.1°C
Fehlergrenze (in Verbindung mit PM 2522 A)	-60°C bis +100°C ± 1% der Ablesung ± 2°C +100°C bis +200°C + 1% bis -3% der Ablesung ± 2°C.
Zulässige Spannung an der Messspitze	60 V

3.2.7. Gestelleinbausatz PM 9669/01

Der Gestelleinbausatz PM 9669/01 dient zum Einbau des PM 2522 A in ein 19" Gestell.

3.2.8. Anzeigefixierung-Messkopf PM 9263 (Abb. 8, Seite 50)

Max. Eingangsspannung	500V (Gleichspannung + Spitze einer Wechselspannung)
Max. Spannung zwischen 0 (gemeinsam) und Erde	42 V (Gleichspannung + Spitze einer Wechselspannung)
Anzeigefixierfunktion	Mit Hilfe des Schalter "HOLD" auf dem Messkopf werden die angezeigten Daten festgehalten.

4. ARBEITSWEISE (Abb. 9, Seite 50)

4.1. Allgemeines

Das PM 2522A umfasst ein Analogteil und ein Digitalteil.

Das Analogteil zerfällt in:
- Eingangsschlatung
- Gleichspannungs-Verstärker
- Analog-Digital-Umsetzer

Das Digitalteil zerfällt in:
- Program
- Zähler-Speicher
- Taktoszillator und Abtastoszillator
- Anzeige

4.2. Analogteil

4.2.1. Eingangsschaltung

Die Eingangsschaltung des PM 2522 A besteht aus:

- Gleichspannungs-Abschwächer
- Wechselspannungs/Gleichspannungs Wandler
- Shunts
- Stromquelle

• Gleichspannungsmessungen

Die unbekannte Spannung wird an den Gleichspannungs-Abschwächer gelegt, der die Eingangsspannung dem gewählten Bereich entsprechend abschwächt. Am Bereichsende beträgt die abgeschwächte Spannung 2 V DC.

• Wechselspannungsmessungen

Die unbekannte Eingangsspannung wird dem Wechselspannungs/Gleichspannungswandler zugeführt. Abhängig vom gewählten Bereich wird die Eingangsspannung abgeschwächt. Am Bereichsende beträgt die abgeschwächte Spannung 1 V DC. Im Wechselspannungs/Gleichspannungswandler ist ein Formfaktor-Netzwerk vorgesehen, mit dessen Hilfe das PM 2522 A den Effektivwerk sinusförmiger Signale misst.

• Gleichstrommessungen

Der unbekannte Strom wird den Shunts zugeführt. Abhängig vom gewählten Bereich werden die Shunts geschaltet. Die Ausgangsspannung des Shunts beträgt am Ende des Bereichs 0.2 V.

• Wechselstrommessungen

Der unbekannte Strom wird den Shunts zugeführt und abhängig vom gewählten Bereich werden die Shunts geschaltet. Die Ausgangsspannung der Shunts (0.2 V am Bereichsende) wird an den Wechselspannungs/Gleichspannungswandler geleitet. Die Ausgangsspannung des Wechselspannungs/Gleichspannungswandler beträgt am Bereichsende 1 V. Im Wechselspannungs/Gleichspannungswandler ist ein Formfaktor-Netzwerk vorgesehen, mit Hilfe das PM 2522 A den Effektivwert sinusförmiger Signale misst.

• Widerstandsmessungen

Bei Widerstandsmessungen verursacht ein durch den zu messenden Widerstand fliessender Konstantstrom einen Spannungsabfall, der am Bereichsende 2 V beträgt. Abhängig vom gewählten Bereich, wird die den Messstrom erzeugende Stromquelle geschaltet.

• Temperaturmessungen

Bei Temperaturmessungen verursacht ein durch ein Widerstandsthermometer fliessender Konstantstrom einen Spannungsabfall, der gemessen wird.
Am Bereichsende (200°C) ist die Spannung durch das Widerstandsthermometer 0.2 V.
Zum Ausgleich des Widerstands bei 0°C des Widerstandsthermometers ist eine Temperaturkompensationsschaltung eingebaut.

4.2.2. Gleichspannungsverstärker

Der Verstärkungsfaktor ist 1 x.
Abhängig von der gewählten Funktion ist die Ausgangsspannung 0,2 V, 1 V oder 2 V.

4.2.3. Analog-Digital Umsetzung (Abb. 10 und 11, Seite 54)

Die Umsetzung analoger Signale in digitale Form beruht auf dem Integrationsprinzip. Das Analogsignal gelangt an einen Integrator gefolgt von einem Komparator.
Der Komparator liefert einen Ausgangsimpuls, dessen Länge proportional zur Messspannung ist.
Abb. 10 und 11 zeigen graphische Darstellung der Ausgangsspannung in abhängigkeit von der Zeit während der Lade- und Entladephase.
Der ADC enthält eine Schaltung für automatische Nullstellung.
Der ADC hat eine Verstärkungsfaktor von 1, 2 oder 10 Abhängig von den gewählten Funktion.
Am Bereichsende ist die integrierte Spannung 2 V.

4.3. Digitalteil

Während der Ladephase des ADC werden vom Zähler-Speicher 40.000 Taktimpulse des Oszillator abgezählt.
Nach dem Abzählen der 40.000 Impulse liefert der Zähler einen Impuls an das den Zähler steuernde Programm zur Einleitung der Entladephase.
Die Zahl der während der Entladephase abgezählten Impulse ist proportional zur Höhe des an den ADC-Eingang gelegten Signals.
Sobald der Nulldurchgang des Komparators erreicht ist (t2) wird die Zahl der abgezählten Taktimpulse in den Speicher übertragen.

Der Speicherausgang wird von einem Abtastoszillator (Scan-Oscillator) abgetastet und die BCD-Information wird über einen BCD nach 7-Segment Decodierer an die Anzeige geliefert.
Zugleich steuert der Abtastoszillator die Anodeschalter so dass eine sequentielle Anzeige erhalten wird.

4.4. Bereichsumschaltung

Die Bereichsumschaltung geschieht von Hand mittels Drucktasten.
Die Bereichsschalter regeln die Abschwächungsfaktoren des Gleichspannungs-Abschwächers, den Wechselspannungs/ Gleichspannungswandler, die Shunt die Messströme der Stromquelle an die Verstärkungsfaktor vom ADC.

5. INSTALLATION

Bevor irgendein Anschluss ausgeführt wird muss die Schutzerde mit einem Schutzleiter verbunden werden (Siehe Abschnitt "ERDEN").

5.1. Netzanschluss und Sicherung

Vor dem Einführen des Netzsteckers in die Netzbuchse, überzeuge man sich ob das Gerät für die örtliche Netzspannung eingestellt ist.

5.1.1. Allgemeines

Anpassung der Netzspannung darf nur von einer mit den möglichen Gefahren bekannten Fachkraft durchgeführt werden. Beim Ersetzen von Sicherungen oder bei Anpassen des Geräts an eine andere Netzspannung muss es von allen Spannungsquellen getrennt sein.

5.1.2. Anpassung der Netzspannung (Abb. 12, Seite 54)

Das Gerät wird eingestellt für ein 220 V, 50 Hz/60 Hz Netz geliefert.
Durch Durchverbindung der Drahtbrücken gemäss Abb. 12, Seite 54, lässt sich das Gerät für ein 110 V, 50 Hz/60 Hz Netz einstellen.
Die Drahtbrücken (Jumpers) und die Netzsicherung F1001 sind nach Abnahme des Gerätedeckels zugänglich.

240V +5% -20%	Sicherung F1001 ist 50 mA, träge
110 V ± 15%	Sicherung F1001 ist 100 mA, träge

5.1.3. Sicherungen

Die Netzsicherung F1001 befindet sich auf Einheit U1 (siehe Abb. 12, Seite 54).
Zum Ersetzen der Netzsicherung, Gerätdeckel abnehmen.
Zum Schutz der Strombereiche ist in Eingangsbuchse "A" eine 2,5A Sicherung (F2) angebracht. (Abb. 13, Seite 54).
Es dürfen nur Sicherungen des erforderlichen Wertes und vorgeschriebenen Typs verwendet werden. Verwendung reparierten Sicherungen und das Kurzschliessen der Sicherungshalter ist nicht zulässig.

5.2. Batteriespeisung

Als Batteriespeisung wird das Wahlzubehör PM 9216 empfohlen, da es als Teil des Geräts integriert wird.

5.2.1. Einbau des PM 9216

- Den Deckel des Batteriebehälter des Multimeters öffnen.
- Den Stecker der Batteriespeisung mit der Batteriebuchse des Multimeters verbinden.
- Die PM 9216 in den Batteriebehälter einsetzen.
  Die beiden Haken der PM 9216 müssen in die beiden entsprechenden Schlitze "B" (Abb. 15 Seite 58) des Batteriebehälters eingesetzt werden.
- Die PM 9216 durch Einschrauben der beiden mitgelieferten Schrauben in die entsprechenden Löchern verriegeln.

5.3. Erden

Vor dem Einschalten muss das Gerät auf eine der folgenden Arten mit einem Erdschutzleiter verbunden werden.

- Über das dreiadrige Netzkabel. Der Netzanschlussstecker darf nur in eine Schutzkontaktdose eingeführt werden. Diese Schutzmassnahme darf nicht unwirksam gemacht werden, z.B. durch eine Verlängerungsleitung ohne Schutzleiter. Ersetzen des Netzsteckers geschieht auf eigene Gefahr !

> WARNUNG: Jede Unterbrechung des Schutzleiters innerhalb oder ausserhalb des Geräts oder Trennung von der Erdschutzklemme ist gefährlich.
> Absichtliche Unterbrechung ist unzulässig.
> Wenn ein Gerät von kalter in warme Umgebung gebracht wird, kann Kondensation einen gefährlichen Zustand herbeiführen.
> Darauf achten dass alle Erdungsvorschriften genauestens eingehalten werden.

6. BEDIENUNG

6.1. Einschaltung

Nach Netzanschluss und Erdung ist das Gerät betriebsbereit.
Es wird mit Drucktaste "POWER" (Abb. 14, Seite 58) eingeschaltet.

6.2. Bedienungselemente

6.2.1. Frontplatte (Abb.14, Seite 58)

Nr.	Bezeichnung	Funktion
S1001	V⎓ , V∼ , mA⎓ , mA∼ , kΩ, °C	Einschaltung der erforderlichen Messfunktion.
S1002	POWER	Einschaltung des Geräts
S2001	2, 20, 200, 2000, 20 MΩ	Einschaltung des erforderlichen Bereichs
S2002	HOLD	Fixierung der Anzeige
X2	°C	Eingangsklemme für Temperaturmessungen
X3/F1	A	HI-Eingangsklemme für Strommessungen mit 2,5A Sicherung F2 (Siehe Abb. 13, Seite 54).
X4	VΩ	Kombinierte HI-Eingangsklemme für Spannungs und Widerstandsmessungen.
X5	0	LO-Eingangsklemme
R1	0	Nullpunkteinstellungs-Potentiometer.

6.2.2. Rückwand (Abb. 15, Seite 58)

Nr.	Bezeichnung	Funktion
X1	-	Netzspeisung - Eingang
X1001	-	Batteriespeisungs-Eingang

6.3. Nullpunkteinstellung

Vor Durchführung der Nullpunkteinstellung ist eine Anwärmzeit von 15 Minuten zu berücksichtigen.

- Taste V⎓ eindrücken und 2V Bereich einstellen.
- VΩ und Buchse 0 kurzschliessen.
- Mit Hilfe von Potentiometer "0" die Anzeige auf .0000 V einstellen.

BEMERKUNG: Bezüglich vollständigen Neuabgleichs des PM 2522A, siehe Abschnitt "Checking and Adjusting".

6.4. Messung

6.4.1. Funktionswahl

Die erforderliche Messfunktion wird von Hand mittels Funktionsschalter gewählt.

6.4.2. Bereichswahl

Der erforderliche Bereich wird von Hand mittels Bereichsschalter gewählt.

Funktion	Bereich
V⎓	2V, 20V, 200V and 2000V (max. Eingangsspannung 1000V).
V∼	2V, 20V, 200V and 2000V (max. Eingangsspannung 600V rms)
mA⎓	2mA, 20mA, 200mA und 2000mA
mA∼	2mA, 20mA, 200mA und 2000mA
kΩ	2kΩ, 20kΩ, 200kΩ, 2000kΩ and 20 MΩ
°C	-60°C...+200°C mit Gebrauch von Messkopf PM 9248)

- Überlastung eines Bereichs wird als .0... angezeigt. In einem solchen Fall muss ein höhere Bereich gewählt werden.

6.4.3. Fixieren der Anzeige

Wenn Taste "HOLD" eingedrückt wird bleibt die vollständige Anzeige, wie sie vor dem Eindrücken ersichtlich war, fixiert.

- Wenn Punkt 5 und 3 der Klemme °C miteinander verbunden wird mit Hilfe vom PM 9263, wird ebenfalls die gesamte Anzeige fixiert (siehe Abb. 9 und 14).

6.4.4. Gleichspannungsmessungen

- Drucktaste V⎓ eindrücken
- Richtigen Messbereich wählen
- Die Prüfspannung an die Buchsen "0" und "VΩ" anschliessen

Anmerkungen:
- Die Polaritätsanzeige gibt die Polarität von Buchse "VΩ" in Bezug auf Buchse "0" an.
- Die maximal zulässige Spannung zwischen den Buchsen "V" und "0" ist:
  2V Bereich : 250V Gleichspannung oder effektiv, kontinuierlich
  1000V Gleichspannung oder 600V $_{eff}$ über 1 Minute

  20...2000V Bereich: 1000V Gleichspannung, 600V $_{eff}$, kontinuierlich
  1400V Spitzenspannung,

6.4.5. Hochspannungsmessungen bis zu 30 kV mit Messkopf PM 9246

- Drucktaste V⎓ eindrücken
- Messkopf PM 9246 mit Buchsen "0" und "VΩ" verbinden
- Mit dem Erdstift eine geeignete Erdverbindung herstellen.
- Bereich 10 MΩ am Messkopf einstellen.

Anmerkungen:
- Maximale zulässige Gleichspannung 30 kV (Bereichsende ist 100 kV)
- Die Position des Dezimalpunktes ist zu beachten.

6.4.6. Wechselspannungsmessungen

- Drucktaste mA∼ einsrücken
- Richtigen Messbereich wählen
- Die zu messende Spannung an Buchsen "0" und "VΩ" anschliessen

Anmerkung:
- Maximal zulässige Spannung zwischen Buchsen "0" und "VΩ" ist 600V$_{eff}$, 400V Gleichspannung kontinuierlich oder 1400V s.

6.4.7. UHF-Spannungen mit Messkopf PM 9210 und T-Stück PM 9212

- Taste V⎓ eindrücken
- Messkopf an Buchsen "0" und "VΩ" anschliessen; Erdstift in Buchse "0".
- 20V Bereich wählen

Anmerkungen:
- Die maximal zulässige Spannung für den Messkopf mit Abschwächer beträgt 200V$_{eff}$ überlagert auf 500V Gleichspannung
- Der Korrekturfaktor der Eichkurve des Messkopfs muss berücksichtigt werden.

6.4.8. Gleichstrommessungen

- Taste mA ⎓ eindrücken
- Den Prüfstrom an Buchsen "0" und "A" legen.

Anmerkungen:
- Die Polaritätsanzeige gibt die Polarität der Buchse "A" in Bezug auf Buchse "0" an.
- Das 10^0 Digit ist dunkelgetastet.
- Maximal zulässiger Eingangsstrom 2000 mA
- Maximal zulässige Eingangsspannung $250V_{eff}$ oder Gleichspannung, 500V s.
- Ströme bis zu 31,6A können mit Shunt PM 9244 gemessen werden.

6.4.9. Wechselstrommessungen

- Drucktaste mA~ eindrücken
- Richtigen Messbereich wählen
- Prüfstrom an Buchsen "0" und "A" legen.

Anmerkungen:
- Das 10^0 Digit ist dunkelgetastet.
- Maximal zulässige Eingangsstrom 2000 mA.
- Maximal zulässige Eingangsspannung $250V_{eff}$ oder, Gleichspannung 500V s.
- Ströme bis zu 100A können mit Hilfe des Stromwandlers PM 9245.

6.4.10. Widerstandsmessungen

- Taste kΩ eindrücken.
- Richtigen Bereich wählen

Bemerkung:
- Wenn Funktion kΩ eingestellt wird, steht ein zusätzlicher 20 MΩ Bereich zur Verfügung. Im 20 MΩ Bereich ist das 10^0 Digit dunkelgetastet.
- Den unbekannten Widerstand mit Buchsen "0" und "VΩ" verbinden.

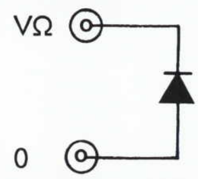
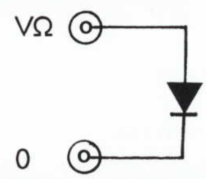
Bemerkung:

Bereich	Strom
2 kΩ	1 mA
20 kΩ	100 µA
200 kΩ	10 µA
2000 kΩ	1 µA
20 MΩ	100 nA

- Maximale zulässige Eingangsspannung $250V_{eff}$ oder Gleichspannung 500V s.

6.4.11. Diodenmessungen

- Taste kΩ eindrücken
- Bereich 2 kΩ einstellen.
- Diode in Flussrichtung an Buchsen "0" und "VΩ" anschliessen.
- Die Anzeige gibt die Diodenspannung in Flussrichtung mit einem Strom von 1 mA an.

	FORWARD	REVERSED
		
Ge	0.1000 - 0.3000	> .0...
Si	0.6000 - 0.9000	> .0...

6.4.12. Temperaturmessungen

- Taste °C eindrücken
- Das Widerstandsthermometer PM 9848 an Eingang °C anschliessen.

Bermerkungen: Bei Verwendung dieses Messkopf sind folgende Punkte zu Beachten:

- Alle übrigen Messkabel vom PM 2522 A trennen.
- Den Messkopf nicht bei Bauteilen mit einem höheren Potential als 60 V für Temperaturmessungen verwenden.
- Eine so gross wie mögliche Kontaktfläche mit der Messkopfspitze wählen. Nötigenfalls zur Verbesserung des Kontakts etwas Silikonenfett auftragen.
- Den Messkopf nicht in Flüssigkeit tauchen.
- Bevor Temperaturmessungen ausgeführt werden, soll das gerät auf Null eingestellt werden mit hilfe von Potentiometer "0" Siehe kapitel 6.3, Seite 35).

1. INTRODUCTION

Le PM 2522A est un multimètre digital à $4\frac{1}{2}$ chiffres à commande manuelle.
L'appareil peut être utilisé aux mesures suivantes:

Fonctions	Gamme
Tensions continues	100 µV - 1000 V
Tensions alternatives	100 µV - 600 V
Courants continus	1 nA - 2000 mA
Courants alternatifs	1 µA - 2000 mA
Résistances	0,1 Ω - 20 MΩ
Température	-60°C - +200°C

La protection de toutes les fonctions est garantie.
La polarité des mesures de courant continu et de température est indiquée automatiquement.
Le point décimal est réglé automatiquement en commutant les gammes.
Le bouton-poussoir "HOLD" permet le maintien de l'affichage. De hautes précisions sont possibles grâce à la correction automatique de dérive du zero du convertisseur analogique-digital avant chaque mesure.
L'application de circuits intégrés MOS-LSI fait décroître le nombre de composants discrets et garantit hautes stabilité et précision. L'alimentation de puissance continue en option PM 9216 permet d'exploiter entièrement la portabilité du PM 2522A.
Etant donné ses nombreuses gammes et fonctions, sa haute précision et sa grande sensibilité, Le PM 2522A est un appareil idéal d'usage universel pour la recherce, les chaînes de production, ainsi qu'à des fins d'entretien et de formation.

2. CARACTÉRISTIQUES TECHNIQUES

Toutes les valeur mentionnées sont nominales.
Les propriétés exprimées en valeurs numériques avec tolérances sont garanties par l'usine. Les valeurs numériques sans indication de tolérance sont indiquées à titre d'information et correspondent aux propriétés d'un appareil moyen.

2.1. Caractéristiques électriques

Conditions de référence	Température ambiante 23°C ± 1°C Humidité relative 45%...75%

2.1.1. Mesures de tension continue

Gamme	2V, 20V, 200V, 2000V (tension maximale d'entrée 1000 V).	
Résolution	100 µV dans la gamme 2V	
Précision	± 0,03% de l'affichage ± 0,01% de la gamme	
Coefficient de température	± 50 ppm de l'affichage ± 10 ppm de gamme/°C	
Impédance d'entrée	10 MΩ ± 1% dans toutes les gammes	
Temps de réponse dans 2 chiffers de la valeur finale	< 1,2 sec.	
Tension maximale d'entrée	Gamme 2V	250V eff continu ou alternatif de façon continue 1000V, $600V_{eff}$ } pour 1 minute
	Gamme 20V ...2000V	1000V continu de façon continue $600V_{eff}$ de façon continue 1400V crête

2.1.2. Mesures de tension alternative

Gamme	2V, 20V, 200V, 2000V (tension maximale d'entrée $600V_{eff}$).
Résolution	100 µV dans la gamme 2 V
Précision	Gamme de fréquence 35 Hz...500Hz ± 0,2% de l'affichage ± 0,1% de la gamme Gamme de fréquence 500 Hz...30 kHz ± 0,5% de l'affichage ± 0,5% de la gamme
Coefficient de température	Gamme de fréquence 35 Hz...500 Hz ± 200 ppm/°C de l'affichage Gamme de fréquence 500 Hz... 30kHz ± 400 ppm/°C de l'affichage
Impédance d'entrée	1 MΩ ± 1% // 30 pF dans toutes les gammes
Temps de réponse dans 2 chiffres de la valeur finale	< 2,5 sec.
Tension maximale d'entrée	$600V_{eff}$ de façon continue $1400V_{crête}$ $400V_{continue}$ de façon continue

2.1.3. Mesures de courant continu

Gammes	2 mA, 20 mA, 200 mA, 2000 mA
Résolution	1 µA
Affichage	Chiffre 10^{0} supprimé Affichage maximal 1999
Précision	± 0,3% de l'affichage ± 0,1% de la gamme
Coefficient de température	± 200 ppm/°C de l'affichage
Chute de tension	Gamme 2 mA, 20 mA, et 200 mA : < 250 mV Gamme 2000 mA : < 600 mV
Temps de réponse dans 2 chiffres de la valeur finale	< 1,2 sec.
Tension maximale aux bornes d'entrée	250 V_{eff} ou continu 500 V crête
Protection	fusible 2,5 A

2.1.4. Mesures de courant alternatif

Gamme	2 mA, 20 mA, 200 mA, 2000 mA
Résolution	1 µA
Affichage	Chiffre 10^{0} supprimé Affichage maximal 1999
Précision	± 0,3% de l'affichage ± 0,1% de la gamme
Fréquence	35 Hz... 1 kHz
Coefficient de température	± 200 ppm/°C de l'affichage
Chute de tension	Gamme 2 mA, 20 mA et 200 mA: < 250 mV Gamme 2000 mA : < 600 mV
Temps de réponse dans 2 chiffres de la valeur finale	< 2,5 sec.
Tension maximale aux bornes d'entrée	250 V_{eff} ou continu 500 V crête
Protection	fusible 2,5 A

2.1.5. Mesures de résistance

Gamme	2 kΩ, 20 kΩ, 200 kΩ, 2000 kΩ, 20 MΩ
Résolution	0,1 Ω dans la gamme 2 kΩ
Précision	Gamme 2 kΩ...2000 kΩ ± 0,3% de l'affichage ± 0,1% de la gamme Gamme 20 MΩ ± 0,5% de l'affichage ± 0,3% de la gamme

Courant de mesure

Gamme	Courant
2 kΩ	1 mA
20 kΩ	100 mA
200 kΩ	10 μA
2000 kΩ	1 μA
20 MΩ	100 nA

Tension ouverte	< 7 V
Semi-conducteurs	Peuvent être mesurés dans la gamme 2 kΩ
Affichage	Le chiffre 10° est supprimé dans la gamme 20 MΩ
Temps de réponse dans 2 chiffres de la valeur finale	Gamme 2 kΩ...200 kΩ < 1,2 sec. Gamme 2000 kΩ < 2 sec. Gamme 20 MΩ < 3,5 sec.
Coefficient de température	Gamme 2 kΩ...200 kΩ ± 100 ppm/°C Gamme 20 MΩ ± 300 ppm/°C
Tension maximale d'entrée	250 V_{eff} ou continu 500 V crête

2.1.6. Mesures de température (à l'aide du thermomètre à résistance PM 9248)

Gamme	-60°C ... +200°C
Sensibilité	0,1°C
Précision (imprécision de sonde comprise)	- 60°C ... +100°C ± 1% de l'affichage ± 2°C +100°C ... +200°C + 1, -3% de l'affichage + 2°C
Coefficient de température	300 ppm/°C de l'affichage

2.2. Caractéristiques générales

Conditions d'environment	Conforme à CEI 359
Conditions climatiques	Groupe 1 avec extension de la limite supérieure de température Limite supérieure de température : 45°C Température ambiante : 23°C ± 1% (référence) Gamme de travail : 0°C ... +45°C Gamme limite de transport et de stockage : -40°C ... +70°C Humidité relative : 20% ... 80% (condensation exclue)
Conditions mécanique	Groupe 2
Conditions d'alimentation	Groupe 2 Tension secteur nominale 240 V + 5 -20% 110 V + ±15% (commutable à l'aide d'une connexion volante) Fréquence secteur 50 Hz / 60 Hz Consommation de puissance 8 VA Option: Alimentation par batteires PM 9216 Temps de décharge : 6 heures Pendant la recharge le digit 10^4 indique "1" lorsque l'appareil est mis hors service.
Sécurité	Classe 1 conforme à CEI 348
Affichage	LED 7 segments 11 mm Affichage maximal 19999
Point décimal	En fonction de la gamme Sélectionné manuellement
Indication de polarité	+ et - de façon automatique
Indication de dépassement	.0... La polarité est indiquée correctement
Sélection de fonction	Manuelle à l'aide de boutons-poussoires
Sélection de gamme	Manuelle à l'aide de boutons-poussoirs
Maintien d'information	Manuel à l'aide de boutons-poussoirs Externe par borne °C
Système de conversion analogique-digital	Intégrant
Taux de conversion	2½ conv/seconde
Réjection en mode commun	100 dB pour signaux continus ou alternatifs 50 Hz / 60 Hz
Réjection en mode série	60 dB 50 Hz / 60 Hz ± 5%
Temps de chauffage	15 minutes
Intervalle de réétalonnage	6 mois
Tension maximale entre borne "0" et borne de terre	450 V_{eff} ou continu 630 V crête

2.3. Caractéristiques mécaniques

Dimensions	Hauteur	95 mm
	Largeur	235 mm
	Profondeur	280 mm
Poids	env.	2 kg.

3. ACCESSOIRES

3.1. Compris à la livraison de l'appareil

Compris à la livraison de l'appareil

- Jeu de câbles de mesure PM 9260 (Fig. 2, page 46)
- 1 fusible 2,5 A
- 2 fusibles 50 mA lent, 220 V secteur
- 2 fusibles 100 mA lent, 110 V secteur
- Etiquette 110 V secteur
- Etiquette 2,5 A
- Etiquette 100 mA
- Cordon secteur
- Couvercle frontal
- Mode d'emploi

3.2. Options

3.2.1. Sonde HT PM 9246 (Fig. 1, page 46)

La sonde HT PM 9246 est appropriée à la mesure de tension continues jusqu'à 30 kV.
Il est possible d'utiliser la probe PM 9246 pour des instruments de mesure avec une impédance d'entrée de 100 MΩ, 10 MΩ et 1,2 MΩ (sélectionable).

Caracteristiques techniques

Tension maximale	30 kV
Attenuation	1000 ×
Impédance d'entrée	600 MΩ ± 5%
Précision	± 3%
Humidité relative	20% à 80%

Attention: Veiller à effecteur une bonne connection de terre.

3.2.2. Transformateur de courant PM 9245 (Fig. 3, page 46)

Avec ce transformateur il est possible de mesurer les courants alternatifs supérieures à 10 A jusque 100 A.

Rapport de transformation	1000 x (100 A = 100 mA)
Erreur de transformation	± 3%
Gamme de fréquence	45 Hz ... 1 kHz
Perte de tension au secondaire	< 200 mV
Tension maximale par rapport à la terre	400 V alternatif

Connecter le transformateur de courant à l'instrument avant d'effecteur la mesure.
Eviter la pollution des composants du circuit magnétique.

3.2.3. Shunt PM 9244 (Fig. 4, page 46)

Ce shunt permet de mesurer des courants continus et alternatifs (1 kHz max) jusque 31,6 A.

Gamme de courant	10 A et 31,6 A
Tension de sortie	100 mV et 31,6 mV
Précision	100 mV : ± 1% 31,6mV : ± 2%
Dissipation de puissance	3,16 W max
Dimensions	Hauteur : 55 mm Largeur : 140 mm Profondeur : 65 mm

3.2.4. Sonde HF PM 9210 (Fig. 5, page 46), Jeu d'accessoires pour sonde PM 9212 (Fig. 6, page 46)

	PM 9210	PM 9210 + PM 9212
Gamme de fréquence	100 kHz à 1 GHz	100 kHz à 1 GHz
Ligne droite dans les 5%	100 kHz à 6 MHz	100 kHz à 6 MHz
Déviation maximale	3 dB	3,5 dB
Gammes de tension	150 mV à 15 V	15 V à 200 V
Tension maximale en alternatifs	30 V	200 V
Tension maximale en continu	200 V	500 V
Capacité d'entrée	2 pF	2 pF
Connecteur en T (inclus dans le PM 9212)		
Gamme de fréquence		100 kHz à 1,2 GHz
Impédance		50 Ω
Rapport d'amplitude		1,25 à 700 MHz et 1,15 à GHz avec atténuateur 100 : 1

La sonde du type PM 9210 combinée avec accessoires (terre réglable et adaptateur Dage) permet d'effecteur des mesures jusqu'à une fréquence de 100 MHz.
Pour des mesures de fréquences supérieures il est recommandé d'utiliser le connecteur T et la terminaison 50 Ω, lesquels sont compris dans le kit d'accessoires pour sonde PM 9212.

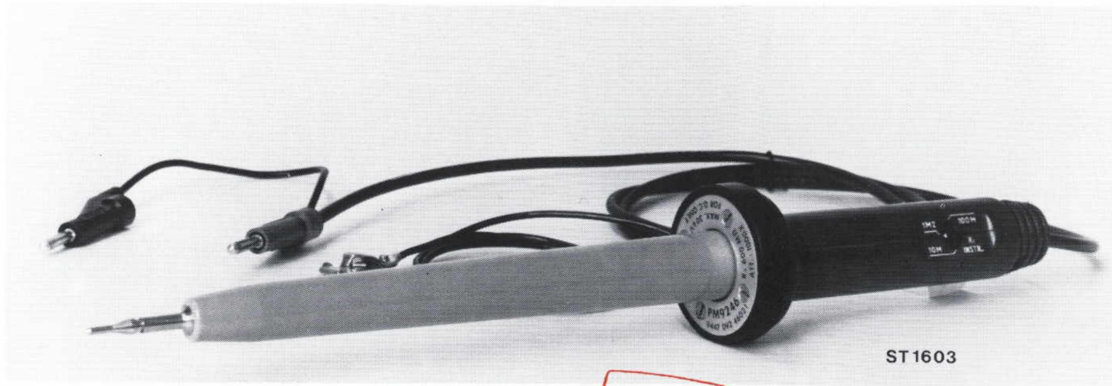


Fig. 1.

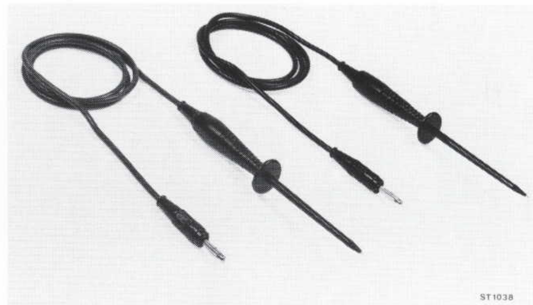


Fig. 2.

Fig. 3.


Fig. 4.

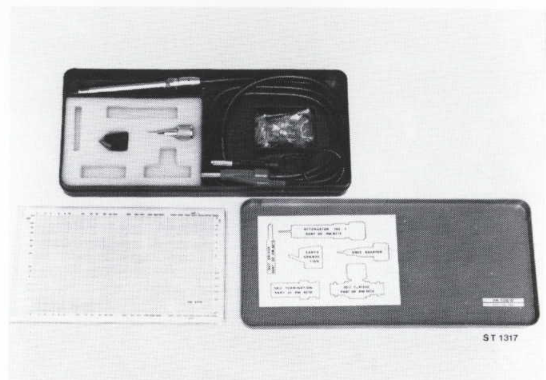


Fig. 5.

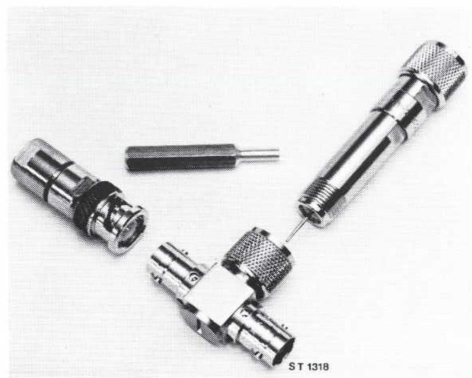


Fig. 6.

Fig. 7.

3.2.5. Bloc de batteries PM 9216

Ce bloc peut être monté à l'arrière de l'appareil et permet l'alimentation par batteries. Les accumulateurs sont rechargeables par l'intermédiaire de l'alimentation de l'appareil.

Caracteristiques:

Tension	5 V
Capacité	3,5 Ah
Courant de charge maximal	350 mA
Courant de compensation maximal	35 mA
Temps de fonctionnement avec PM 2522A	env. 6 heures
Temps de recharge	env. 15 heures (Avec le bouton poussoir "POWER" en position OFF).

L'appareil peut être utilisé pendant la charge.

3.2.6. Sonde de température PM 9248 (Fig. 7, page 46)

Le thermomètre à résistance PM 9248 est une sonde appropriée à la mesure de température de de surface entre -60°C et +200°C.

Gamme	-60 à +200°C
Résolution	0,1°C
Précision (combiné avec PM 2522A)	-60°C + 100°C ± 1% de l'affichage ± 2°C +100°C à +200°C + 1% à -3% de l'affichage ± 2°C
Tension maximale admise à la pointe de la sonde	60 V

3.2.7. Kit de montage en rack PM 9669/01

Le kit de montage en rack PM 9669/01 sert à monter le PM 2522A dans un rack 19".

3.2.8. Sonde maintien d'information PM 9263 (Fig. 8, page 50)

Tension d'entrée maxi	500 V (continue + crête alternatief)
Tension maxi entre 0 (commun) et masse	42 V (continue + crête alternatief)
Fonction de maintien d'information	Les informations affichées sont retenues en mettant le commutateur correspondant de la sonde.

4. PRINCIPE DE FONCTIONNEMENT (Fig. 9, page 50)

4.1. Généralités

Le PM 2522A est formé d'une partie analogique et d'une partie digitale.

La partie analogique est divisée en:
- Cicuit d'entrée
- Amplificateur continu
- Convertisseur analogique-digital

La partie digitale est divisée en:
- Programme
- Mémoire compteur
- Oscillateur d'horloge et oscillateur de trace
- Affichage

4.2. Partie analogique

4.2.1. Circuit d'entrée

Le circuit d'entrée du PM 2522A consistse en:

- Atténuateur continu
- Convertisseur alternatif / continu
- Shunts
- Source de courant

• Mesures de tension continue

La tension d'entrée inconnue est appliquée à l'atténuateur continu, lequel atténue la tension d'entrée conformément à la gamme sélectionnée.
En fin de gamme la tension atténuée est de 2V continu.

• Mesures de tension alternative

La tension d'entrée inconnue est appliquée au convertisseur alternatif-continu. La tension d'entrée est atténuée en fonction de la gamme sélectionnée. En fin de gamme la tension atténuée est de 1V continu.
Le convertisseur alternatif-continu comprend un réseau de facteur de forme, qui permet au PM 2522A de mesurer la valeur efficace de signauz d'entrée sinusoïdaux.

• Mesures de courant continu

La courant inconnu est appliqué aux shunts, lesquels sont commutés en fonction de la gamme sélectionnée. La tension de sortie du shunt est de 0,2 en fin de gamme.

• Mesures de courant alternatif

Le courant inconnu est appliqué aux shunts, lesquels sont commutés en fonction de la gamme sélectionnée. La tension de sortie des shunts (0,2 V fin de gamme) est appliquée au convertisseur alternatif continu. La tension de sortie du convertisseur alternatif-continu est de 1V en fin de gamme. Le convertisseur alternatif-continu comprend un réseau de facteur de forme, lequel permet au PM 2522A de mesurer la valeur efficace de signaux d'entrée sinusoïdaux.

• Mesures de résistance

Pour la mesure de résistance un courant constant par la résistance à mesurer entraîne une chute de tension, laquelle est de 2V en fin de gamme. La source de courant produisant le courant de mesure est commuté en fonction de la gamme sélectionnée.

• Mesures de température

Pour la mesure de températures un courant constant par un thermomètre à résistance cause une chute de tension, laquelle est mesurée.
En fin de gamme (200°C) la tension par le thermomètre à résistance est de 0,2 V.
Pour compenser la résistance à 0°C du thermomètre à résistance, un circuit de compensation de température est incorporé.

4.2.2. Amplificateur continu

L'amplificateur continu présente un facteur de gain x 1.
La sortie de l'amplificateur continu est de 0,2 V, 1 V ou 2 V selon la fonction choisie.

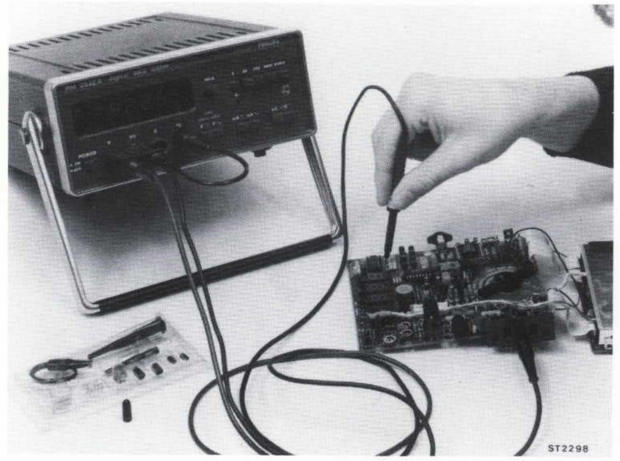


Fig. 8.

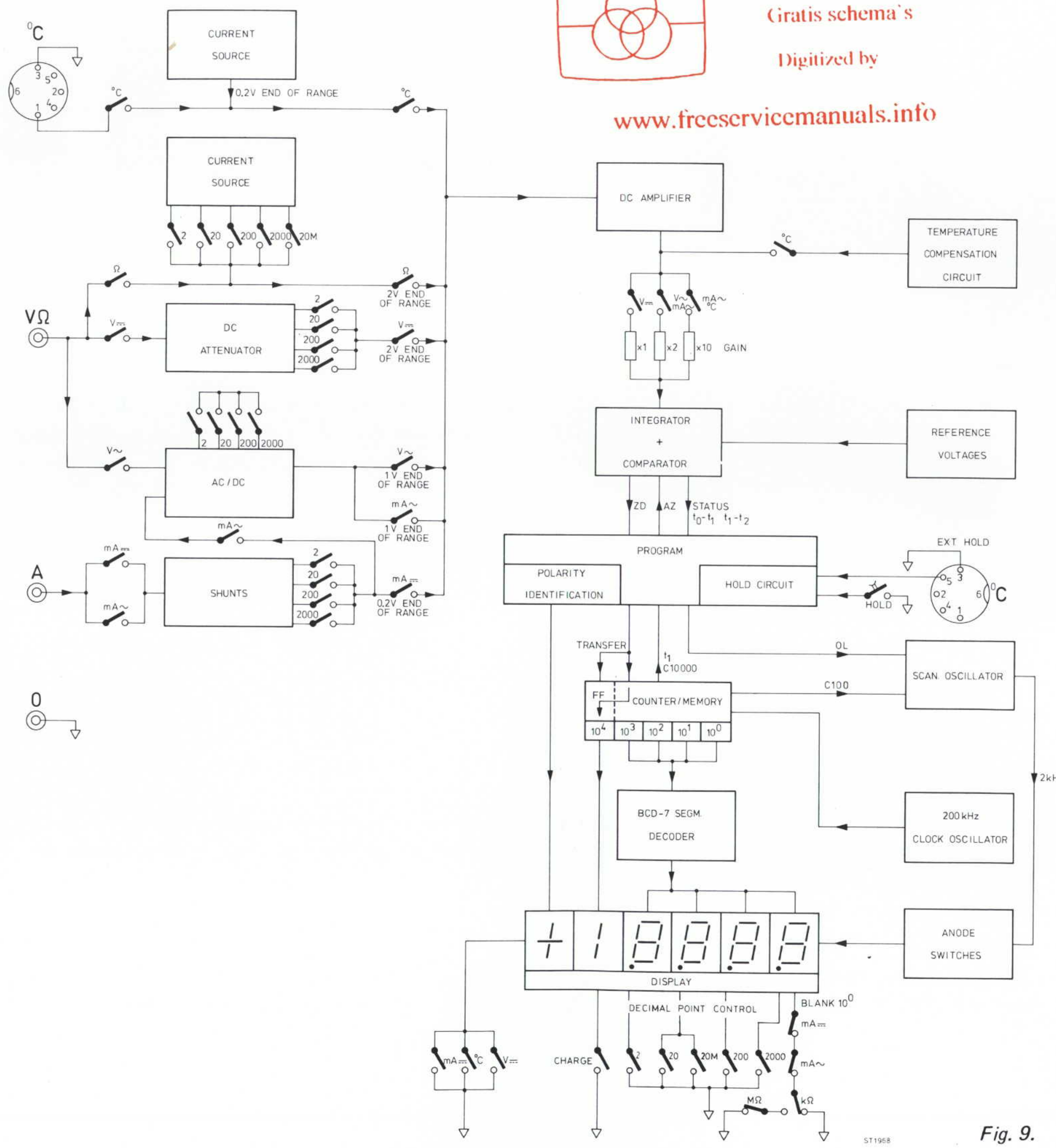


Fig. 9.

4.2.3. Conversion analogique-digital (Fig.'s 10 et 11, page 54)

La conversion des signaux analogiques en signaux digitaux est basée sur le principe de l'intégration. Le signal analogique est appliqué à un intégrateur suivi d'un comparateur.
Le comparateur fournit une impulsion de sortie dont la largeur est proportionnelle à la tension de mesure. Les figures 10 et 11 illustrent graphiquement la tension de sortie dans l'intégrateur en fonction du temps, pendant le cycle de charge et de décharge.
Le convertisseur est muni d'un circuit de mise à zéro automatique.
Le cad a un facteur de gain de 1,2 ou 10 selon la fonction choisie. En fin de gamme la tension intégrée est de 2 V.

4.3. Section digitale

Pendant le cycle de charge du convertisseur analogique-digital 40.000 impulsions d'horloge produites par l'oscillateur d'horloge sont comptées par le compteur-mémoire.
Après le comptage, le compteur fournit une impulsion au programme qui commande le convertisseur pour démarrer le cycle de décharge.
Le nombre d'impulsions comptées pendant le cycle de décharge est proportionnel à la hauteur du signal appliqué à l'entrée du convertisseur. Lorsque le comparateur pass à zéro (t2), le nombre d'impulsions est compté et transmis à la mémoire.
La sortie de la mémoire est analysé par un oscillateur et l'information BCD est appliquée à l'affichage par un décodeur BCD à 7 segments.
Pendant ce temps l'oscillateur de trace commande les comutateurs d'anode afin d'obtenir un affichage séquentiel, et l'amplification du converteur analogique digital.

4.4. Repérage

Le repérage se fait manuellement à l'aide de boutons-poussoir.
Les commutateurs de gamme commandent les facteurs d'atténuation de l'atténuateurs continu, du convértisseur analogique-digital, des shunts et des courants de mesure de la source de courant.

5. INSTALLATION MODE D'EMPLOI

Avant de procéder à toute autre connextion, la borne de terre de l'appareil doit être reliée à la ligne de terre du réseau (voir 5.3. Mise à la terre).

5.1. Adaptation à la tension secteur et fusibles

Avant de bracher la fiche secteur, s'assurer que l'appareil est régle sur la tension secteur locale.

5.1.1. Généralités

L'appareil ne peut être adapté à la tension secteur que par une personne qualifée, consciente du risque encouru. En cas de remplacement d'un fusible ou de l'adaptation à un autre tension secteur, l'appareil doit être débraché de toutes sources de tension.

5.1.2. Adaptation à la tension secteur (Fig. 12, page 54)

L'appareil est réglé à l'usine pour une tension secteur de 220 V, 50 Hz/60 Hz.
L'adaptation à un tension secteur de 110 V, 50 Hz/60 Hz peut se faire en interconnectant comme illustré à la figure 12, page 54 . Les connexions volantes et le fusible secteur F1001 sont accessibles après dépose du couvercle.
240 V + 5% -20% le fusible F1001 est de 50 mA lent.
110 V ± 15% le fusible F1001 est de 100 mA lent.

5.1.3. Fusibles

Le fusible secteur F1001 se trouve sur l'unité U1 (voir Fig. 12, page 54)
Pour remplacer le fusible secteur, déposer le couvercle.
Pour protéger les gammes de courant, un fusible (F2) de 2,5A est monté dans la borne d'entrée "A" (Fig. 13, page 54).
Veiller à ce que des fusibles correctement calibrés et du modèle convenable sont utilisés en cas de remplacement. Il faut cependant éviter d'utiliser des fusibles réparés et de court-circuiter des portefusibles.

5.2. Alimentation par batteries

L'accessoire en option PM 9216 est recommandé pour l'alimentation par batteries, car il devient partie intégrante de l'appareil.

5.2.1. Montage du PM 9216

- Ouvrir le couvercle du compertiment batteries du multimètre.
- Connecter la fiche de l'alimentation par batteries à la douille appropriée du multimètre.
- Mettre le PM 9216 dans le compartiment batteries.
  Les deux crochets du PM 9216 doivent être introduits dans les encoches "B " (Fig. 15, page 58) du compartiment batteries.
- Fixer l'alimentation à l'aide des deux vis comprises à la livraison.

5.3. Mise à la terre

Avant toute mise sous tension, l'appareil doit être connecté à la terre de l'une des manières suivantes:

- Par la borne de terre de l'appareil
- Par le cordon secteur à trois conducteurs. La fiche secteur ne doit être introduite que dans une prise possédant un contact de terre. La mise à la terre ne doit pas être éliminée par l'emploi d'un câble prolongateur sans conducteur de terre.

> **ATTENTION**
>
> Toute interruption de la ligne de terre, à l'intérieur ou à l'extérieur de l'appareil ou le débrachement de la borne de terre peuvent rendre l'appareil dangereux. L'interruption intentionnelle est formellement interdite.
>
> Lorsqu'un appareil passe d'un endroit froid à un endroit chaud, la condensation peut provoquer un certain risque. En conséquence, il faut appliquer strictement les prescriptions de mise à la terre.

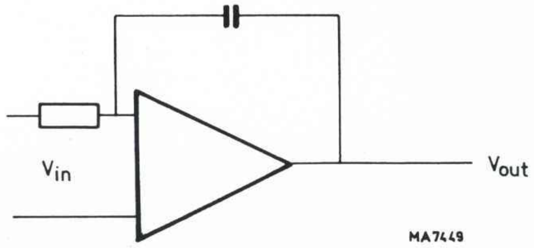


Fig. 10.

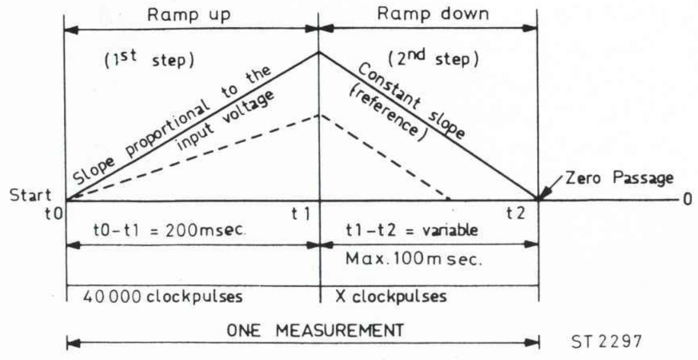


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Fig. 11.

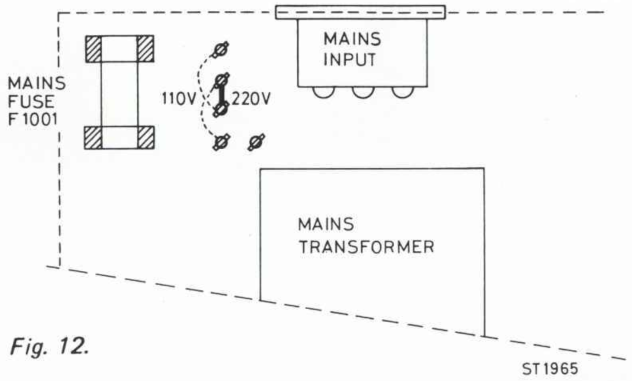


Fig. 12.

Fig. 13.

6. FONCTIONNEMENT

6.1. Enchlenchement

L'appareil est prêt à l'usage aprés brachement au secteur et mise à la terre.
L'appareil est enclenché à l'aide du bouton-poussoir "POWER". (Fig. 14, page 58).

6.2. Commandes

6.2.1. Panneau avant (Fig. 14, page 58)

Pos.	Description	Application
S1001	V⎓, V∼, mA⎓, mA∼, kΩ, °C	Enclenche la fonction de mesure requise.
S1002	POWER	Permet de mettre l'appareil en service
S2001	2, 20, 200, 2000, 20 MΩ	Permet de sélectionner la gamme requise.
S2002	HOLD	Maintien d'affichage
X2	°C	Borne d'entrée pour mesures de température.
X3/F1	A	Borne d'entrée HI pour mesures de courant avec fusible F2 de 2,5A (voir Fig. 13, page 54).
X4	VΩ	Borne d'entrée HI combinée pour mesures de tension et de résistance
X5	0	Borne d'entrée LO
R1	0	Potentiomètre de réglage du zéro.

6.2.2. Panneau arrière (Fig. 15, page 58)

Pos.	Description	Application
X1	-	Entrée alimentation secteur
X1001	-	Entrée alimentation batteries

6.3. Réglage du zéro

Avant de procéder au réglage du zéro, observer un temps de chauffage de 15 minutes.

- Enfoncer le bouton V⎓ et sélectionner la gamme 2V
- Court-circuiter les douilles VΩ et 0.
- Ajuster l'affichage sur .0000 V à l'aide du potentiomètre "0".

Remarque: En vue du réglage complet du PM 2522A, se référer au chapitre 7 "Checking and Adjusting".

6.4. Mesure

6.4.1. Sélection de fonction

La fonction de mesure requise est sélectionné manuellement à l'aide des commutateurs de fonction.

6.4.2. Sélection de gamme

La gamme requise est sélectionnée manuellement à l'aide des commutateurs de gamme.

Fonction	Gamme
V⎓	2V, 20V, 200V et 2000V (tension max. d'entrée 1000V)
V∿	2V, 20V, 200V et 2000V (tension max. d'entrée 600V eff)
mA⎓	2mA, 20mA, 200mA et 2000mA
mA∿	2mA, 20mA, 200mA et 2000mA
kΩ	2kΩ, 20kΩ, 200kΩ, 2000kΩ et 20MΩ
°C	-60°C ... +200°C (avec sonde PM 9248)

- Le dépassement de gamme est indiqué par l'affichage .0...
  Dans ce cas, il faut sélectionner une gamme supérieure.

6.4.3. Maintien

Si le bouton HOLD est enfoncé, l'affichage complet est retenu avant d'enfoncer.

- Lorsque l'on interconnecte les points 5 et 3 de la borne °C (voir Fig. 8 et 13), l'affichage complet est retenu.

6.4.4. Mesures de tension continue

- Enfoncer le bouton-poussoir V⎓
- Sélectionner la gamme de mesure correcte
- Connecter la tension d'essai aux bornes "0" et "VΩ"

Remarques:
- L'indication de polarité indique la polarité à la borne "VΩ" par rapport à la borne "0".
- La tension maximale admise entre les bornes "VΩ" et "0" est:
  Gamme 2V ; 250V continu ou efficace de façon continue
  Gamme 20V... 2000V; 1000V continu, 600Veff de façon continue ou 1400 crête.

6.4.5. Très hautes tension jusqu'à 30 kV avec sonde PM 9246

- Enfoncer le bouton-poussoir V⎓
- Connecter la sonde aux bornes "0" et "VΩ"
- Connecter la borne de terre de la sonde à une terre appropriée
- Choisir la gamme 10 MΩ sur la sonde
- La gamme suivantes peuvent être choisies à l'aide du sélecteur de gammes.

Remarques:
- Tension continue maximale admise 30 kV (fin de gamme 100 kV)
- La position du point décimal doit être observée.

Fig. 14.

Fig. 15.

6.4.6. Mesures de tension alternative

- Enfoncer le bouton-poussoir V∿
- Choisir la gamme de mesure appropriée
- Connecter la tension de test aux bornes "0" et "VΩ"

Remarque : - La tension maximale admise entre les bornes "VΩ" et "0" est 600V efficace, 400V continu de façon continue ou 1400 crête.

6.4.7. Tensions UHF avec sonde PM 9210 et connecteur-T PM 9212

- Enfoncer le bouton-poussoir V⎓
- Connecter la sonde aux bornes "0" et "VΩ", la fiche de terre étant raccordée à "0"
- Sélectionner la gamme 20V.

Remarques:
- La tension maximale admise sur la sonde est de 200Veff superposé sur 500V continu.
- Le facteur de correction sur la courbe d'étalonnage de la sonde doit être pris en considération.

6.4.8. Mesures de courant continu

- Enfoncer le bouton-poussoir mA ⎓
- Sélectionner la gamme de mesure appropriée
- Connecter la source de courant à mesurer aux bornes "0" et "A".

Remarques:
- L'indicateur de polarité désigne la polarité à la borne "A" par rapport à la borne "0"
- Le chiffre 10^0 est supprimé
- Le courant d'entrée maximal admis est de 2000 mA
- La tension d'entrée maximale admise est de 250Veff ou continu, 500V crête.
- Des courants jusqu'à 31,6A peuvent être mesurés avec le shunt PM 9244.

6.4.9. Mesures de courant alternatif

- Enfoncer le bouton-poussoir mA∿
- Sélectionner la gamme de mesure correcte
- Connecter le courant d'essai aux bornes "0" et "A"

Remarques:
- Le chiffre 10^0 est supprimé
- Le courant d'entrée maximal admis est de 2000 mA
- La tension d'entrée maximale admise est de 250Veff ou continu, 500V crête
- Des courants jusqu'à 100 A peuvent être mesurés à l'aide du transformateur de courant PM 9245.

6.4.10. Mesures de résistance

- Enfoncer le bouton-poussoir kΩ
- Sélectionner la gamme correcte

Remarque : - Lorsque la fonction kΩ est sélectionnée, une gamme 20 MΩ supplémentaire est disponible. Dans la gamme 20 MΩ, le chiffre 10^0 est supprimé.

- Connecter la résistance inconnue aux bornes "0" et "VΩ".

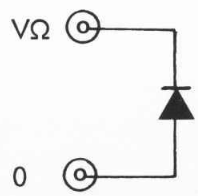
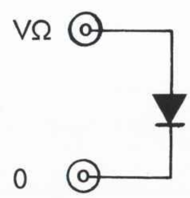
Remarque : - Les courants de mesure sont:

Gamme	Courant
2 kΩ	1 mA
20 kΩ	100 µA
200 kΩ	10 µA
2000 kΩ	1 µA
20 MΩ	100 nA

- La tension d'entrée maximale admise est de 250Veff ou continu, 500V crête.

6.4.11. Mesures de diode

- Enfoncer le bouton-poussoir kΩ
- Sélectionner la gamme 2 kΩ
- Connecter la diode en sens avant aux bornes "0" et "VΩ"
- L'affichage illustre la tension de diode en sens direct pour un courant de 1 mA.

<table>
<tr><td></td><td>FORWARD</td><td>REVERSED</td></tr>
<tr><td></td><td>
</td><td>
</td></tr>
<tr><td>Ge
Si</td><td>0.1000 - 0.3000
0.6000 - 0.9000</td><td>> .0...
> .0...</td></tr>
</table>

6.4.12. Mesures de température

- Enfoncer le bouton-poussoir °C
- Connecter le thermomètre à résistance PM 9248 à l'entrée °C.

Remarques: Si cette sonde est utilisée, les points suivants doivent être observés.
- Déposer tous les autre câbles de mesure du PM 2522A
- Ne pas utiliser la sonde pour des mesures de température de composants au potentiel supérieur à 60 V.
- Avec la pointe de sonde, sélectionner une surface de contact aussi grande que possible. Au besoin, enduire légèrement à la graisse silicone pour améliorer le contact.
- Ne pas immerger la sonde dans un liquide.
- Avant d'effecteur des measures de température il faut régler l'appareil à zéro à l'aide du potentiomètre "0" (voir chapitre 6.3, page 56).

7. CIRCUIT DESCRIPTION

SERVICE DATA

7.1 General

The circuit is logically subdivided into three main sections:
a. analogue section
b. analogue to digital convertor
c. digital section
Each section is described separately with reference to the overall circuit diagram.
Circuit diagram of the various stages are inserted in the text wherever necessary as an aid to the circuit diagram.
For a short description of the working of the instrument see chapter 4. "Principle of operation".

7.2. Analogue section

7.2.1. D.C. Voltage measurements (Fig.16)

The unknown input voltage Vx is applied to the attenuator/divider network R2021, which attenuates the voltage to a suitable level for the DC-amplifier and the analogue to digital convertor. The table below gives the attenuation in the various ranges and the input voltage for the DC-amplifier at end of range.

Range	Attenuation	Input d.c. amplifier (end of range)
2 V	1 x	2 V⎓
20 V	10 x	2 V⎓
200 V	100 x	2 V⎓
2000 V	1000 x	2 V⎓

In the 2000 V⎓ range the maximum input voltage is 1000 V⎓ .
In all ranges the integrated resistance network R2021 is across the input terminals, so an input resistance of 10 MΩ is obtained.

7.2.2. A.C. Voltage measurements (Fig. 17)

The voltage to be measured is directly applied to a half wave rectifier/attenuator, the attenuation factor of which is controlled by the range switch S2001.
The rectified voltage is supplied via a filter to the d.c. amplifier. The attenuation of the AC-DC convertor for the various ranges is given in the table below:
In all ranges the output of the AC-DC convertor is + 1V d.c. at end of range.

Range	Gain
2 V	1.11
20 V	0.111
200 V	0.0111
2000 V	0.00111

Max. input 600 V a.c.
A circuit description of the AC-DC convertor is given in sub chapter 7.2.7.

7.2.3. D.C. current measurements (Fig. 18)

The current to be measured is applied via the front panel "A" terminal to shunt R2018 - R2023, across which a corresponding voltage is developed. This voltage is 0.2 V at end of range.
A fuse of 2,5 A in series with the "A" terminal protects the current range from overload.

Protection

If the voltage at the input terminal A exceeds twice the knee-voltage of diodes V1032 positive or negative, then depending on the polarity, diodes V1032 and V1031 or V1033 and V1034 start to conduct.
The current flowing through NTC-resistor R1112 connected in parallel to resistors R1108 and R1111 will warm-up the NTC resistor. This means that the resistance of this resistor decreases and the current increases until fuse F1 is blown.

7.2.4. A.C. current measurements (Fig. 19)

The input for a.c. current measurement is the front panel terminal "A" as used for d.c. current measurement. The input is similarly applied to the shunt, but the 0,2 V end of range conversion voltage is applied to the AC-DC convertor and then processed as for a.c voltage measurements.
The half wave rectifier has a fixed gain of 10 now.
A circuit description of the AC-DC convertor is given in 7.2.7.
For protection see 7.2.3.

7.2.5. Resistance measurements (Fig. 23)

The measuring current in the various ranges is given in the table below.

Range	Test current
2 kΩ	1 mA
20 kΩ	100 μA
200 kΩ	10 μA
2000 kΩ	1 μA
20MΩ	100 nA

The current mentioned in the table which are supplied by a constant current source (refer to 7.2.9) flow through Rx.
This means that in the appropriate range the voltage across the unknown resistor Rx is 2 V at end of range. This voltage then is supplied to the d.c. amplifier.

Protection of resistance ranges

The input is protected against voltages above approximately 9,5 V by transistors V1036 and V1037. The current source is protected by PTC resistors R1048. R1047 limits the current until the PTC has increased its value.

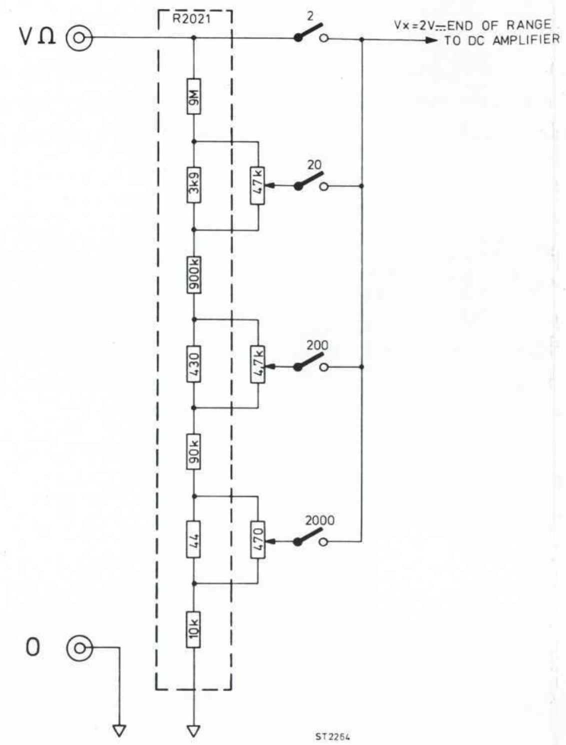


Fig. 16. DC-voltage measurements

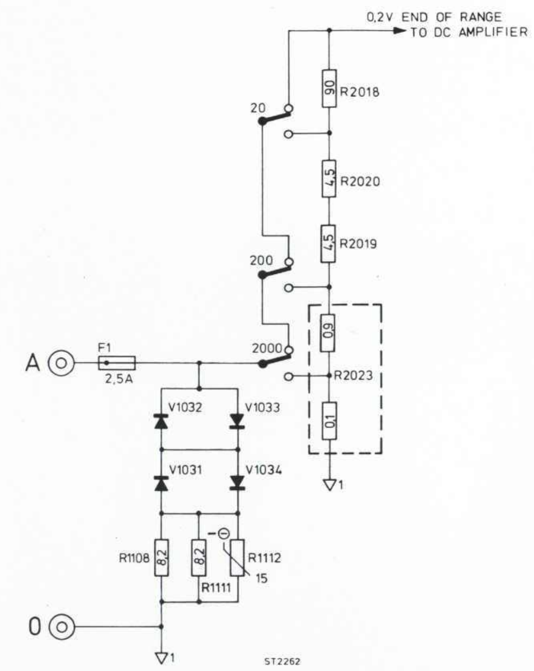


Fig. 18. DC-current measurements

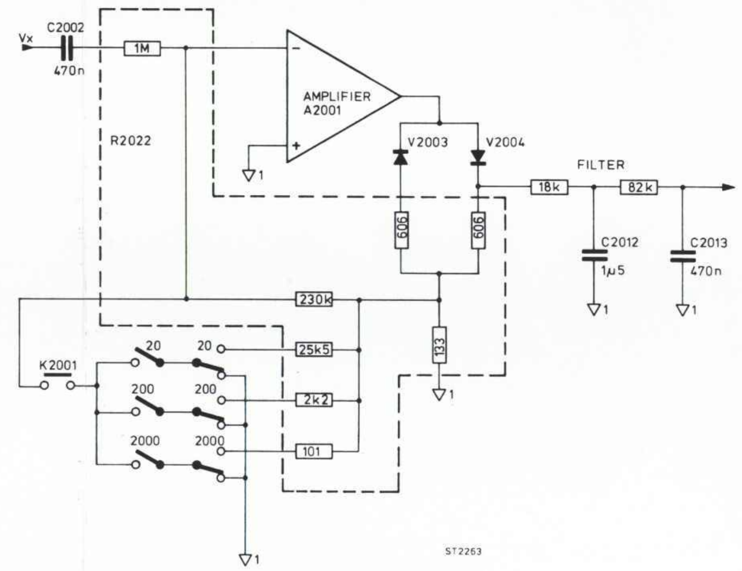


Fig. 17. AC-voltage measurements

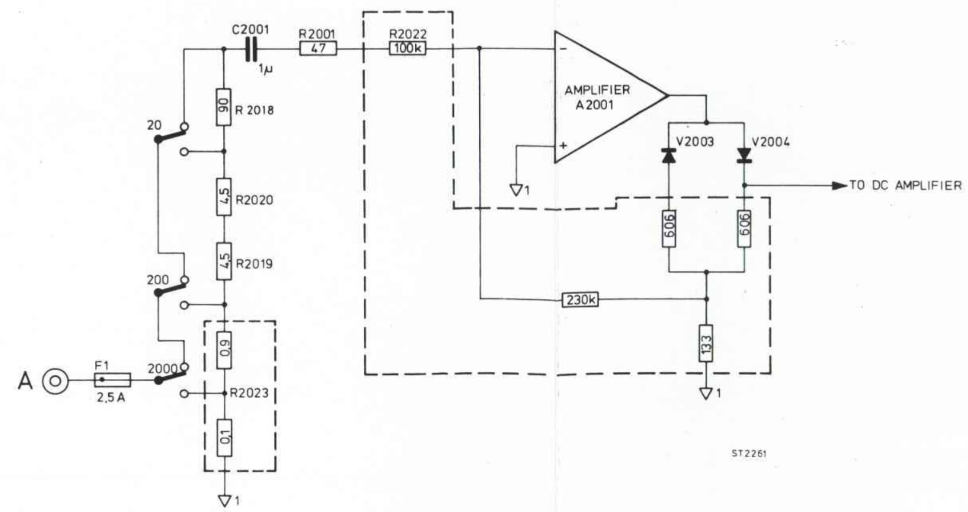


Fig. 19. AC-current measurements

7.2.6. Temperature measurements (Fig. 20)

For temperature measurements a nickel cadmium probe PM 9248 is used.
This probe consists of a temperature depending resistor Rth, the value of which is proportional to the temperature. Because the current through Rth is a constant current the voltage across Rth is proportional to the temperature.
Then the voltage across Rth is supplied to the dc-amplifier.
To compensate for the resistance value of Rth at 0°C the input level of the integrator is increased by means of resistor network R1107, R1110 and R1091, and is adjusted by means of R1107, to the input voltage at 0°C. This means that at 0°C the differential input voltage at the integrator is 0V.

7.2.7. AC-DC convertor (Fig. 21)

The ac-dc convertor/amplifier consists of a half wave rectifier and a filter.
The input voltage at a.c. measurements is coupled capacitively to a linear rectifier.
The rectifier circuit, mainly consists of an operational amplifier with two reversed connected diodes in the feedback path, (A2001; V2003 and V2004) see Fig. 21.
Diode V2004 rectifies the positive going period of the output signal which is supplied to the d.c. amplifier. During this period, via R1; R2 and R1' a voltage equal to the voltage over R2 exists at V2003. Diode V2003 rectifies the negative going period.
During this period, via R1'; R2 and R1 a voltage equal to the voltage over R2 exists at V2004.
The gain of the rectifier is determined approximately by the formula.

$$\frac{R3}{R4} \times \frac{R1 + R2}{R2} \text{ or } \frac{R3}{R4} \times \frac{R1' + R2}{R2}$$

To compensate the voltage drop over R2, the "formfactor" is approximately 1,28.
The voltage drop over R2 (VR2) is about 0,17 Vout, so a real formfactor of 1,28 - 0,17 = 1,11 is obtained.

The value of R3 depends on the selected range. As the negative input of the operational amplifier becomes virtual zero if the amplifier is in balance, we have to calculate with R2 in parallel with R3 instead of R2.
The voltage at diode V2004 is supplied to the dc-amplifier via a filter.
The overall gain of the ac-dc convertor/amplifier in the several ranges is given in the table below:

Range	Gain	Output voltage
2 V	1,11	1 V d.c.
20 V	0,111	1 V d.c.
200 V	0,0111	1 V d.c.
2000 V	0,00111	1 V d.c.

In AC-current measurements the overall gain is fixed to 11.1 caused by an input resistance of 100 kΩ instead of 1 MΩ.

7.2.8. DC amplifier (Fig. 22)

The dc-amplifier mainly consists of the operational amplifier A1004 and dual FET V1051. The gain of the dc-amplifier is x1 and is determined by the feedback of the whole output signal to the input of the amplifier.
The dc-amplifier also acts as a filter to suppress ac signals on the input voltages, mainly 50/60 Hz hum.
This filter is a third-order low pass filter.

The dual FET V1051 is controlled by a current source, consisting of transistor V1048 with set up resistors R1061 and R1062.

To prevent "latch up" of the dc-amplifier stabistor V1009 is switched between the input and the output.

Protection

The input of the dc-amplifier is protected against overvoltage by means of two transistors, V1038 and V1039, in diode configuration. If at the input a voltage of 9.5 V is available these transistors start to conduct, thus limiting the input voltage.

7.2.9. Current source (Fig. 23)

The -8Vref voltage is supplied to a resistor divider network R1001 - R1004. The divided voltage is applied to an amplifier consisting of dual FET V1047 and op.amp. A1003.
The output of op.amp. A1003 controls FET V1046 whose source voltage serves as a feedback signal to the -input of the amplifier. So a constant voltage exists at the source this means that a constant current flows through the series resistors R2006, to R2014 and the unknown resistor Rx.

The current source is protected against overvoltage on the input terminals by transistors V1037 and V1036 which are switched in diode configuration.
This overvoltage causes a current through PTC resistor R1048. This current increases the resistance of R1048 and decreases the current.

7.3. Analogue to digital convertor (ADC) (Fig. 24)

The conversion of analogue signals into digital form is achieved by the integration principle known as dual-slope system.
The quantity to be measured, in the input circuit converted into an unknown voltage Vx, and a precisely known reference voltage are applied via switching circuits to an integrator followed by a comparator.
A graphical representation of the operation is shown in Fig. 24.
The integrator is charged via switches V1058 and V1057 over a fixed time Tm by the unknown voltage Vx and is discharged over a variable time Tx by the reference voltage Vref. For two different input voltages Vx, the charging voltage Vc differs and consequently so does the discharging time. The charging time (Tm) or ramp-up time, is measured by counting a certain number of pulses in a counter. The same counter is used to measure the discharge time (Tx) in what is called the rampdown phase.
The end of the ramp-down phase is detected by the comparator.
This detection occurs as the integrator voltage Vc reaches zero voltage (assuming that Vc = 0 at time t) the charge flowing into the integrator capacitor C1006 is equal to the charge flowing out of this capacitor, i.e. Qin = Qout

$$\text{but } Q_{in} = \frac{V_x}{R_{in}} \cdot T_m \text{ and } Q_{out} = \frac{V_{ref}}{R_{in}} \cdot T_x$$

$$V_x = \frac{T_x}{T_m} \cdot V_{ref}$$

Therefore the counter value Tx at the end of the ramp-down phase is directly proportional to the voltage Vx being measured.
At the end of the ramp-up time the polarity of the output of the comparator determines which reference voltage, +Vref or -Vref has to be chosen in the ramp-down period.
The chosen reference voltage is of opposite polarity to the input signal (Vx).

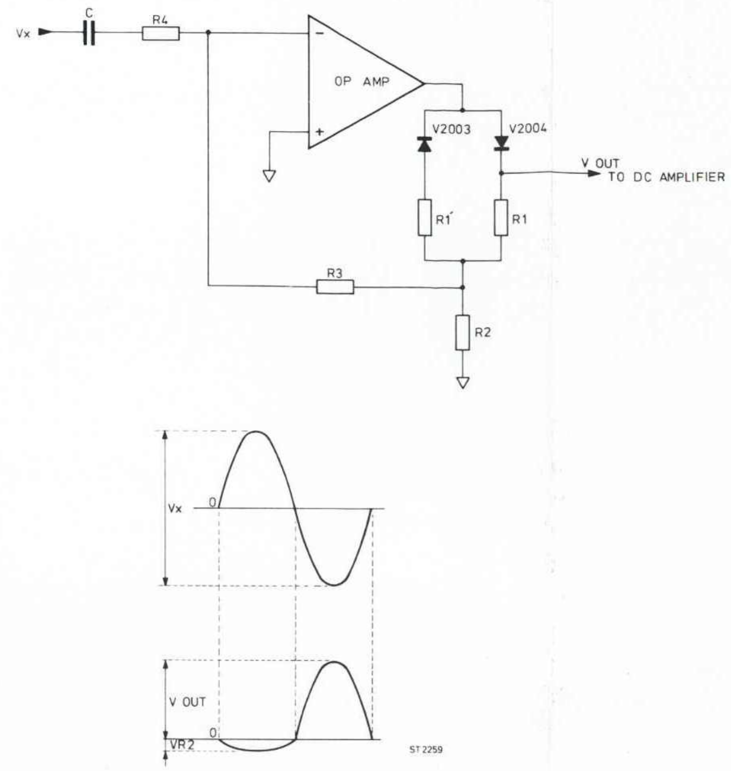


Fig. 21. Principle AC-DC convertor

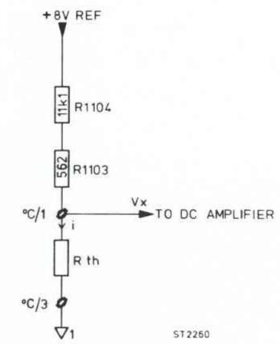


Fig. 20. Temperature measurements

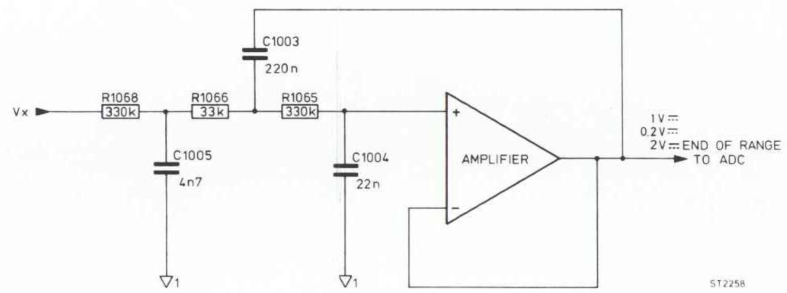


Fig. 22. DC-amplifier

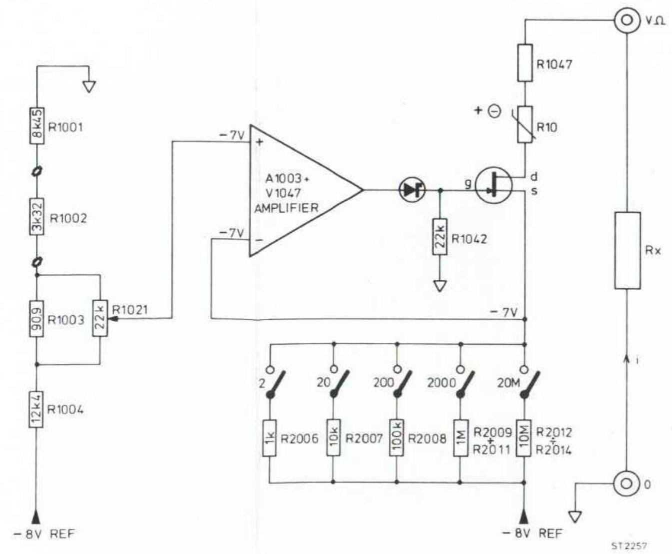


Fig. 23. Current source

At dc-voltage and resistance measurements Rin = R1086 = 442 k.
At dc-current and temperature measurements Rin = (R1102 + R1085// R1086 = 44.2 k.
At ac-voltage and ac-current measurement Rin = (R1106 + R1101 + R1087 // R1086 = 221 k.
From the above appears that depending on the function selected, the input resistance of the integrator is divided by 1, 2 or 10 this means that the output of the integrator is x1, x2 or x10, depending on the function selected.
The table below gives the amplification of the integrator in all functions.

Function	Input resistance	Amplification
V ⎓	442 kΩ	x 1
mA ⎓	44,2 kΩ	x 10
V ~	221 kΩ	x 2
mA ~	221 kΩ	x 2
Ω	442 kΩ	x 1
°C	44,2 kΩ	x 10

The input of the comparator is protected from overvoltage by means of zenerdiodes V1022 and V1023.
If the voltage from the integrator has reached + or - 5.3 V the zenerdiodes start to conduct thus limiting the ijput voltage to the comparator.

7.3.1. Automatic zero (Fig. 25)

Offset voltages of the integrator and the comparator can cause incorrect zero-passing of the comparator output after the ramp-down period.
To compensate this, automatic zero correction is performed before each measurement.
The principle of operation is shown in Fig. 25. During the automatic zero period V1053 and V1054 are conducting. The integrator and comparator offset voltages are charged then into C1008.
This means that integration (ramp-up) starts at zero level added with the offset voltages.
By this the effect of the offset voltage of each operational amplifier is eliminated.

7.3.2. Reference voltages (Fig. 26)

For the ADC two reference voltages are required namely: +8Vref and -8Vref.
Via R1025 and R1013 a current of 2 mA flows through zenerdiode V1001.
The zener voltage of + 6.5 V is supplied to the positive input of the operational amplifier A1002.
The gain of this amplifier is determined by the ratio $\frac{R1026 \ldots R1019}{R1015 \ldots R1019}$
The output voltage is adjusted to +8V with R1017 + R1018 (coarse) and R1028 (fine).
By the very small temperature coefficient of the zenerdiode and the gain control resistors, the output voltage of A1002 is kept constant at the adjusted value.
To obtain the negative reference voltage, the output of A1002 is inverted by A1001 and adjusted to -8V by R1006, R1007 (coarse) and R1027 (fine).

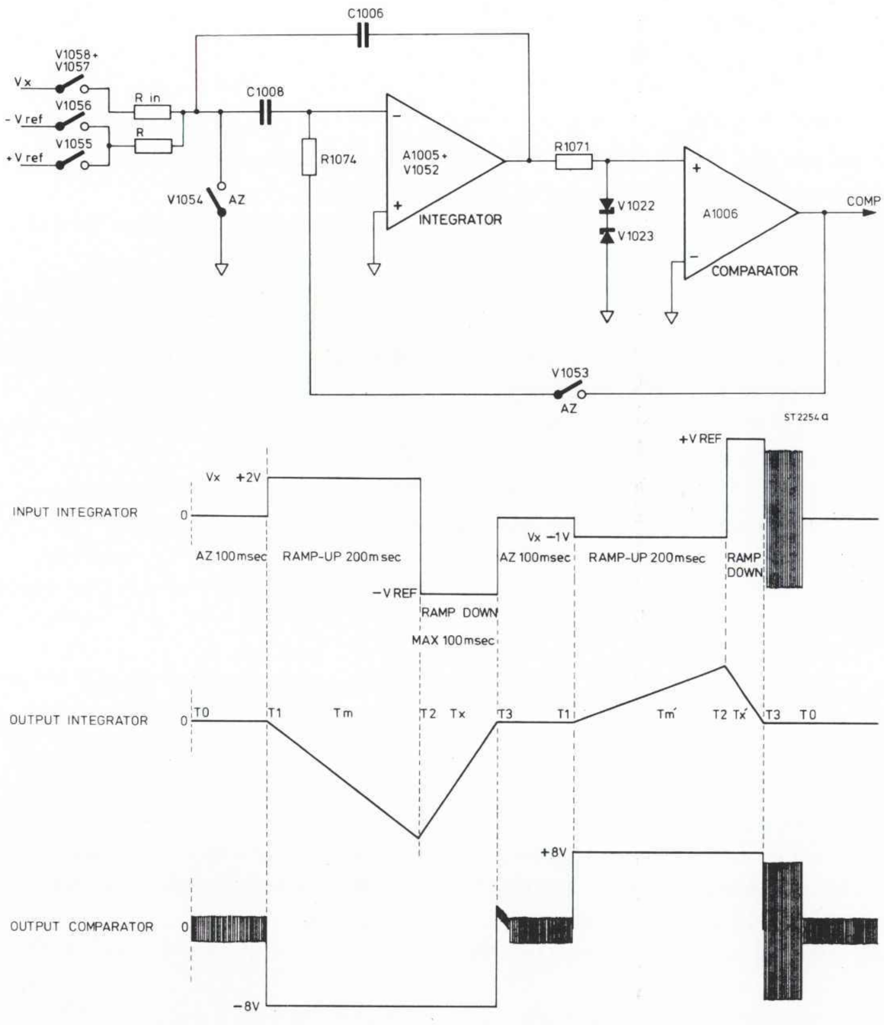


Fig. 24. Analogue to digital convertor

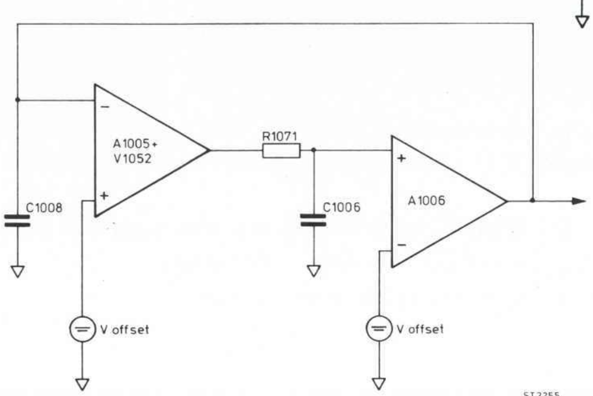


Fig. 25. Automatic zero

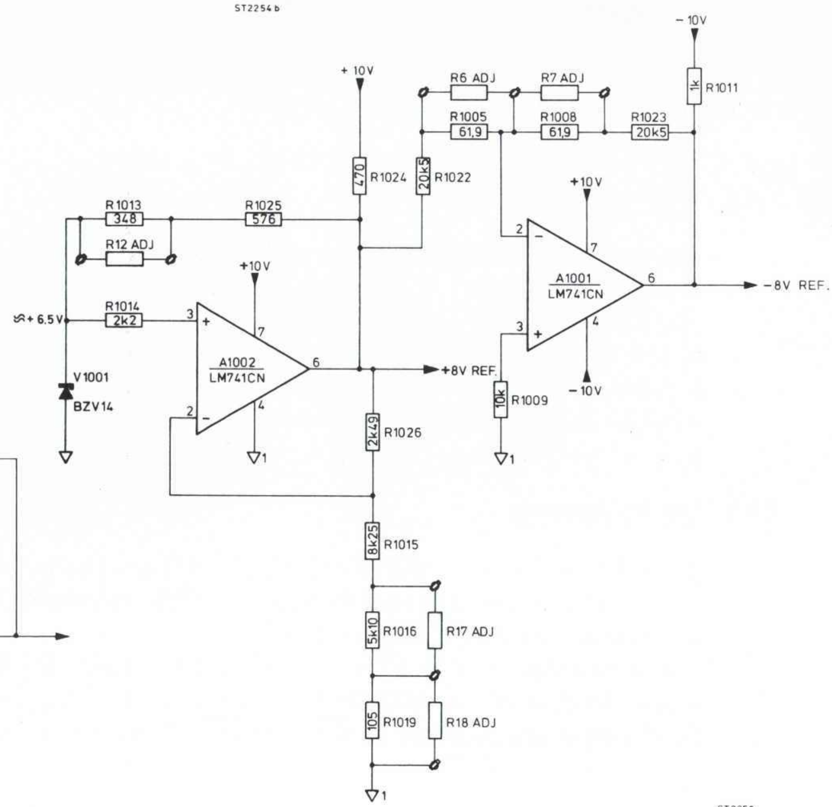


Fig. 26. Reference voltages

7.4. Digital section (Fig. 39, overall circuit diagram)

7.4.1. Control and timing (Fig. 27)

After pressing the power-on switch the clock starts and the quad-decade counter D1013 starts counting. At each 10000 clock pulses the C10000 signal becomes logic 0.
The C10000 signal is supplied to 16-counter D1012 which control BCD⟶DEC. decoder D1011.
This decoder generates the ADC control signals AZ, UP and DOWN respectively.
During automatic zero (AZ) the input of the integrator is switched to zero and via D-flip flop D1019/13 transfer pulses are inhibited.
After the AZ signal $\overline{\text{UP}}$ becomes logic 0 (= -5V) via exclusive OR gate D1018. During this period the unknown voltage Vx is switched to the integrator input.
The low to high transition of the $\overline{\text{UP}}$ signal triggers the mono stable multivibrator D1015, the output of which stops the clock for about 35 µsec; (stop pulse) i.e. for 7 clock pulses.
This is done to avoid switch symptoms when the integrator is switched from the UP integration to the DOWN integration. To compensate the 7 clock pulses the + input of the integrator is increased by means of the "dead band zero" (see Fig. 36), depending on the polarity, with a part of the +8Vref or the -8Vref. With the stop pulse the GZF1201 is reset, after which the counter starts real counting (data) during the down period.

The comparator detects zero passing of the DOWN integration. Via invertor D1017/12 the comparator signal is supplied to the exclusive OR gate D1018/2. The first pulse from this gate triggers the mono stable multivibrator D1015/5 thus generating the transfer pulse.
The inverted output D1015/7 triggers D-flip flop D1019. The output of the flip flop is fed back to D1015/4 to inhibit more transfer pulses.
The transfer pulse is fed to the GZF1201 and the contents of the counter is shifted to the output latches. According to the state of the scan code the output of the latches are supplied to the BCD ⟶ 7 segment decoder which controls the display.
During the down integration, depending on the polarity, the +8Vref or -8Vref is switched to the input of the integrator.
The polarity is determined by the state of the comparator output as well as the signals $\overline{\text{DOWN+}}$ and $\overline{\text{DOWN-}}$ which select the +8Vref or -8Vref respectively.
$\overline{\text{DOWN+}}$ is selected if comparator signal is logic 1 together with the DOWN signal (D1011/7)
If comparator signal is logic 0 together with the DOWN signal (D1011/7, $\overline{\text{DOWN-}}$ is selected.

7.4.2. 1.10^4 indication

The carry out C20000 from the GZF1201 becomes logic 0 when the content of the counter is 10000 and becomes logic 1 if the content is 0 (20000).
The C20000 output is supplied to the set input of D-flip flop D1014/9. At a high to low transition of the inverted transfer pulse D1015/7 the D-flip flop is set: D1014/13 is logic 0 and D1014/12 is logic 1. The output D1014/12 is supplied to an invertor D3002 which controls anode switch V3013. This anode switch controls the indication 1 on display H3005.

7.4.3. Display scanning

The C100 pulses from the GZF1201 (2 kHz) are fed to 16-counter D1012/10. The outputs D1012/13 and D1012/14 are supplied to BCD⟶ DEC decoder D1011. The outputs of this decoder control the anode switches V3008 to V3011.
The scan order is 10^0; 10^1; 10^2; 10^3 respectively. D1012/13 and D1012/4 are also supplied to the output latches of the GZF1201 the input of which is also a BCD⟶ DEC. decoder.
So the data are supplied to the display with the same sequence as the scan pulses.

7.4.4. Overload indication (Fig.28)

The overload signal OL (D1014/2) is set by means of D1012/4 and the inverted transfer pulse D1015/7. If the GZF1201 has reached 20000 the transfer pulse comes together with the AZ signal, this means D1012/4 is logic 0. In this case OL (D1014/2) is set to logic 1.
Signal OL together with a logic 1 on D1012/13, 14 which means scan signal 10^3 is selected and blocks the BCD ⟶ DEC. decoder D1011.
Because only anode switch V3008 is selected and the content of the GZF1201 is 20000, LED display H3004 shows 0, overload.
The BCD ⟶ DEC. decoder selects scan signal 10^3 as long as the OL signal is reset by means of ranging.

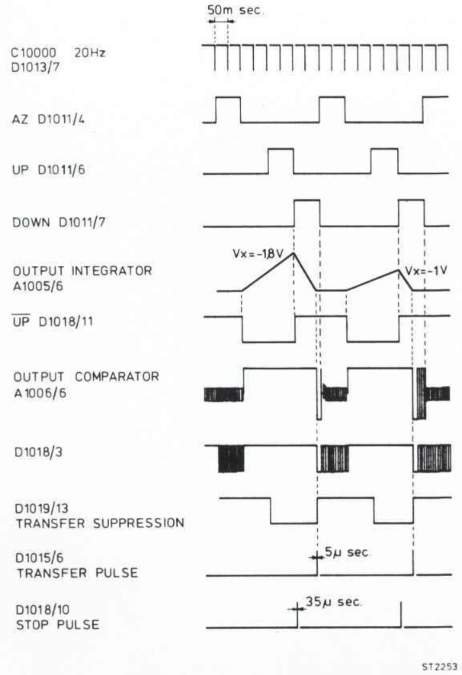


Fig. 27. Control and timing

7.4.5. Polarity indication

Polarity is determined by the state of the comparator output. Via invertor D1017 the comparator output is supplied to D-flip flop D1019/5. If the comparator signal is low (-8V) the D-flip flop D1019/5 is set by the low to high transition of the $\overline{\text{UP}}$ signal.
This means that D1019/2 is logic 0 (= + $\overline{\text{POL}}$).
Via invertor D3002 the plus polarity indicator is selected. The negative polarity indicator is continuously lit. The polarity indication is active only in the functions °C, V⎓ and mA⎓ and is controlled by the function switches.

7.4.6. Hold (Ext. hold)

If the "HOLD" switch is pressed or if ext. Hold via °C socket is connected to common, transistor V1064 starts to conduct and via NOR gate D1017 the 16-counter is reset by means of the automatic zero signal AZ. So a new measurement is inhibited and the data in the quad decade counter and on the display are held.

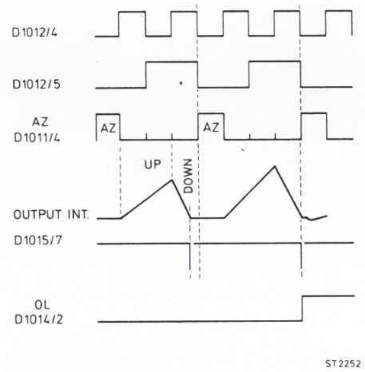


Fig. 28. Overload indication

7.4.7. Display

The data from the GZF1201 in binairy form is supplied to BCD ⟶ 7 segment decoder D3001 which transfers the data into a form suitable for the 7 segment displays.

Decimal point

The table below shows the relation between the various ranges and the decimal point which is controlled by the range switch.

Range	Display
2 V mA kΩ	8.8 8 8 8
20 V mA kΩ	8 8.8 8 8
200 V mA kΩ	8 8 8.8 8
2000 V mA kΩ	8 8 8 8.8
20 MΩ	8 8.8 8 8
-60°C ... +200°C	8 8 8 8.8

In the functions mA⎓, mA∿ and in the kΩ range 20 MΩ the last digit 10^0 is blanked.

7.5. Power supply (Fig. 36 overall circuit diagram analogue section)

The AC voltage from the secundary side of the transformer is rectified by a fullwave bridge rectifier V1007.
The voltage from this rectifier is fed to series transistor V1045 which is controlled by zenerdiode V1011. The emitter is connected to zero, so a voltage -5V is obtained. The -5V is supplied to a blocking oscillator consisting of transistors V1042, V1041 and transformer T1002. The square wave form from this transformer is rectified and so the +10V ⎓ and -10V ⎓ is obtained.
The voltage of the oscillator is limited by zenerdiode V1002.
The +10V and the -5V are supplied to a zenerdiode V1006, thus providing the +4V supply voltage.

8. ACCESS

The opening of parts, or removal of covers, is likely to expose live conductors.
The instrument should therefore be disconnected from all voltage sources before any opening of parts or removal of covers is started.
During and after dismantling, bear in mind that capacitors in the instrument may be still charged even if it has been separated from all voltage sources.

USE A WELL FITTING CROSSHEAD SCREWDRIVER TO PREVENT DAMAGE TO THE CROSS-SLOTTED SCREWS, WHEN DISMANTLING THE INSTRUMENT.

8.1. Dismantling

8.1.1. Top cover

- Loosen both screws "A" (Fig. 15, page 58)
- Lift the cover at the rear and pull it out of the front panel (Fig. 29, page
- To refit the cover press the snaps in the front panel (Fig. 29, page
- Keep pressing in the direction of the front panel and smoothly push it down at the rear

Attention:
- First place the bearing handle into the bottom cover
- Pay attention that the snaps fit properly into the front panel.

8.1.2. Bottom cover

The bottom cover is removed and refitted in the same way as the top cover.

8.2. Removing p.c.b. N2

- Remove screw "C" (Fig. 30, page
- Remove screw "B" and "B'" (Fig. 30) out of the front panel.
- Screws "B" and "B'" are situated under U2 in the front panel and they are fixed to the mounting rail of the range switches by means of a flat fiber washer.
  Screw "B'" can be removed by means of a cross-slotted screwdriver with shaft length of 12,5 cm.
- Lift U2 at the rear and pull it backwards
- Bend U2 sidewards.

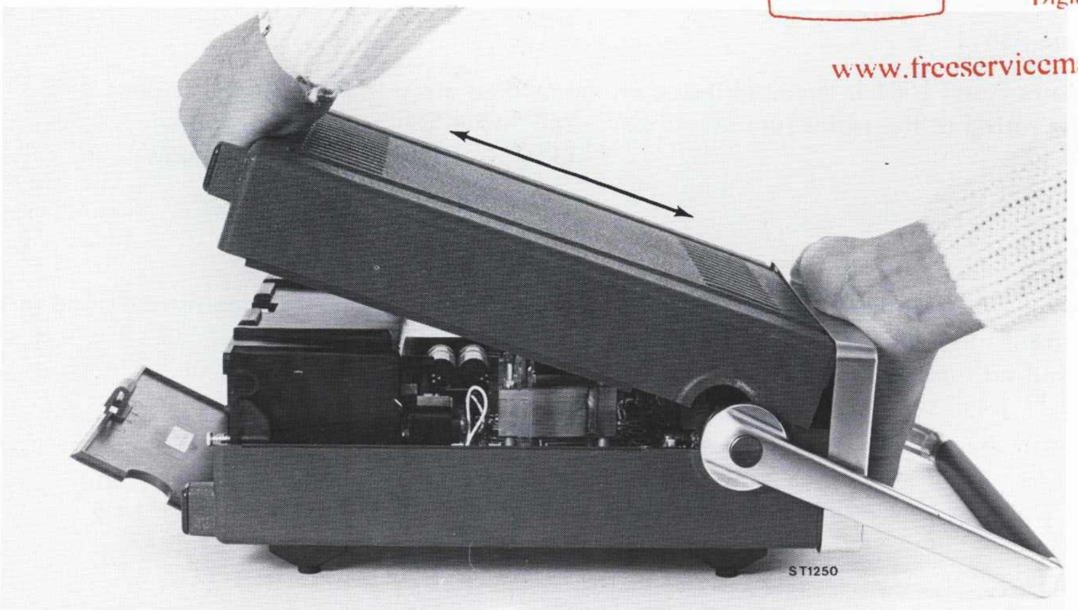


Fig. 29. Removing top cover

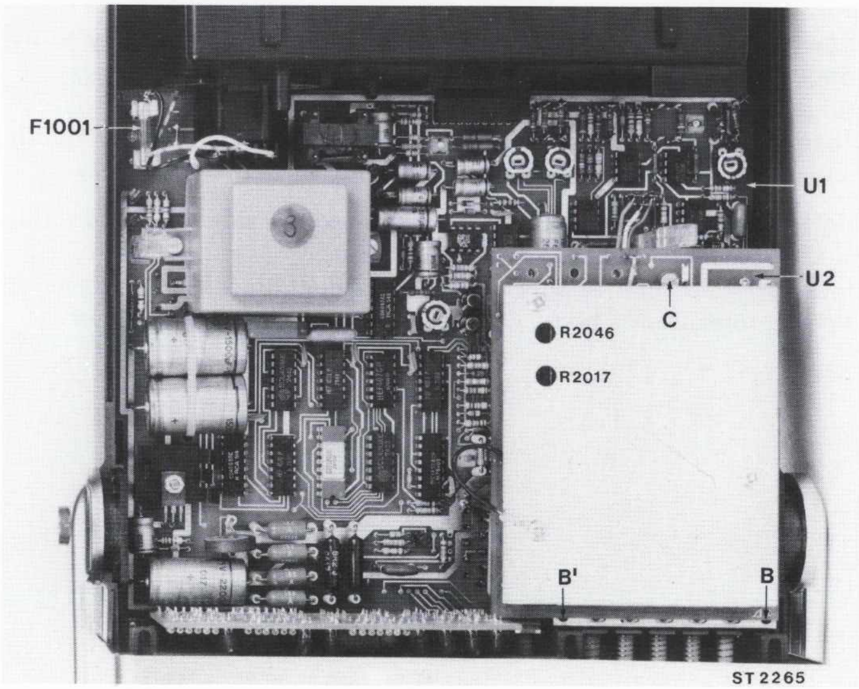


Fig. 30. Removing printed circuit board U2

8.3. Fuses

Make sure that only fuses with the required current rating and of the specified type are used. The use of repaired fuses and the short-circuiting of fuseholders is prohibited.

8.3.1. Fuse F1001

Mains fuse F1001 is mounted inside on the printed circuit board (Fig. 12, page 54).
The rating of the mains fuse should be: -240V +5 -20% 50 mA slow blow
-115V ±15% 100 mA slow blow

8.3.2. Fuse F1

Fuse F1 is mounted in input terminal "A" to protect the instrument against overload in the current range (Fig. 12, page 54).
Required fuse: 2,5 A slow blow.

9. FAULT FINDING

9.1. General

9.1.1. Hints for repair

If repairs must be performed, the following points should be taken into account to avoid damaging the instrument:

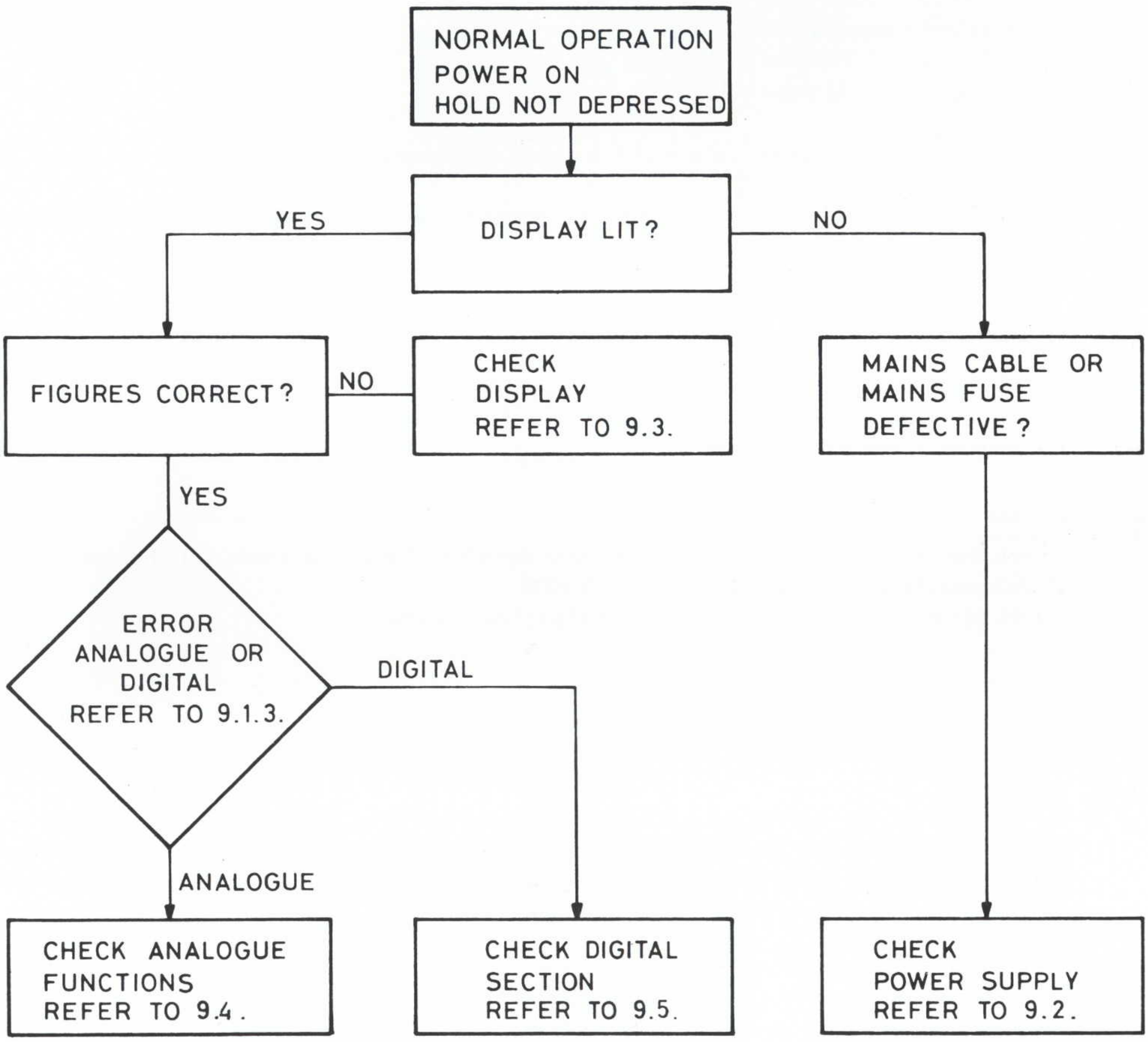
- In case of measurements on a switched-on instrument proceed carefully to avoid short-circuits by measuring clips or measuring hooks.
- For soldering use absolutely acid-free soldering tin.
- For all soldering work on the printed circuits boards, use a miniature soldering iron. (35 W max) with a tin-cleaner, or a vacuum soldering iron.

Remark: Digital multimeter PM 2522A requires no maintenance because the instrument contains no components which are subject to wear.
However, to ensure reliable and faultless operation, the instrument should not be exposed to moisture, heat, corrosive vapours and excessive dust.

9.1.2. Procedure

When investigating any fault, the following Flow Chart is meant as an aid to locate this fault roughly. The rough indication in the Flow Chart refers to more detailed circuit parts.

Note: All mentioned voltages in this chapter are measured with respect to the low input "0".



ST 2331

9.1.3. Analogue or Digital

To check if the error is in the analogue or in the digital section proceed as follows:

a. - Select range 2V ═══
   - Supply + 1.900V ═══ to A1004/6
   - Display should show + 1.900

b. - Select range 2V ∿ and 2mA ∿ respectively
   - Supply + 0.950V ═══ to A1004/6
   - Display should show 1.900

c. - Select range 2 mA ═══
   - Supply + 0.190V ═══ to A1004/6
   - Display should show + 1.900

If the display is not correct in one of the above mentioned functions the error lies in one of the function switches of the ADC.
If the display is not correct in all above functions the error is most likely in the digital section.
When a correct display occurs in all functions the error lies in the analogue section.

9.2. Power supply

Check the power supply according to the signals mentioned in the circuit diagram. If these signals are not present check mains fuse, secundary voltage of the transformer and the semi-conductors in the power supply.

9.3. Display

Check the code from the BCD ⟶ 7 segment decoder D3001, the anode switches transistors V1008-V1013 and the driver transistor V3001 - V3007.
Check for the decimal point the appropriate range switches.

9.4. Analogue section

9.4.1. General

Before carrying out any measurement on the p.c. boards check first in what function the fault occurs. This means that only that part of the analogue section has to be checked in which the fault occurs. The following method refers to the several functions:

9.4.2. D.C. voltage

V ═══ depressed.
The table below gives the correct values of various meauring points in the various ranges.

Range	Input voltage VΩ - 0	Output att. Range switch 2/3	Output DC-ampl. A1004/6
2	+ 1V ═══	+ 1V ═══	+ 1V ═══
20	+ 10V ═══	+ 1V ═══	+ 1V ═══
200	+ 100V ═══	+ 1V ═══	+ 1V ═══
2000	+ 100V ═══	+ 0,1V ═══	+ 0,1V ═══
2	- 1V ═══	- 1V ═══	- 1V ═══

If the measured values are not correct:
1. check the function switch V⎓
2. check the range switches
3. check V1038, V1039 and V1009
4. replace V1051
5. replace A2004.

9.4.3. A.C. voltage

V ∼ depressed.
Measure the signals according to the table below:

Range	Input voltage VΩ - 0	Output AC-DC conv. cathode V2004	Output DC-ampl. A2004/6
2	1V ∼	wave	+ 0,5V
20	10V ∼	form	+ 0,5V
200	100V ∼	refer to Fig.21	+ 0,5V
2000	100V ∼		+ 0,5V

If the measured values are not correct:
1. check relay K2001 (must be activated)
2. check range switches
3. check diodes V2003 and V2004
4. replace V2001
5. replace A2001

9.4.4. D.C. current

mA⎓ depressed.
Check the following table.

Range	Input current A-0	Output shunt Range switch 20/16	Output DC ampl. A2004/6
2	+ 1mA ⎓	+ 0,1V ⎓	+ 0,1V ⎓
20	+ 10mA ⎓	+ 0,1V ⎓	+ 0,1V ⎓
200	+ 100mA ⎓	+ 0,1V ⎓	+ 0,1V ⎓
2000	+ 1000mA ⎓	+ 0,1V ⎓	+ 0,1V ⎓

If the measured values are not correct:
1. check the shunts
2. check the range switches.

9.4.5. A.C. current

mA ∿ depressed.
Check the following table.

Range	Input current	Output shunts Range switch 20/16	Output AC-DC conv. cathode V2004	Output DC ampl. A1004/6
2	1 mA ∿	0,1 V ∿	wave	+ 0,5V
20	10 mA ∿	0,1 V∿	form	+ 0,5V
200	100 mA ∿	0,1 V∿	refer to	+ 0,5V
2000	1000 mA ∿	0,1 V∿	Fig. 21.	+ 0,5V

Note: The gain of the AC-DC convertor is x11.1
Relay K2001 is not activated.

If measured values are not correct: see AC - voltage.

9.4.6. Resistance

kΩ depressed.
Check the following table.

Range	Input resistance VΩ - 0	Voltage across Rx input VΩ - 0	Output DC ampl. A1004/6
2	1 kΩ	- 1 V	- 1 V
20	10 kΩ	- 1 V	- 1 V
200	100 kΩ	- 1 V	- 1 V
2000	100 kΩ	- 0,1 V	- 0,1 V
20MΩ	100 kΩ	- 0,01 V	- 0,01 V

If measured values are not correct:
Check current source
The voltage at the source FET V1046 should be -7V in all ranges. If this voltage is not present:
1. replace V1047
2. replace A1003
Check also the range switches.

9.4.7. Temperature

Depress °C
Connect between point 1 and point 3 of the °C socket a resistor of 35,3 Ω. The output of the DC amplifier must be ≈ 24 mV (A1004/6).
Connect between point 1 and point 3 of the °C socket a resistor of 50,0 Ω. The output of the DC amplifier must be ≈ 34 mV. If measured values are not correct, check °C socket and function switch °C.
Display shows ≈ 0°C at 35,3 Ω and ≈ 100°C at 50,0 Ω between point 1 and 3 of °C socket.
If these values are not correct 0°C must be adjusted by means of R1107.

9.4.8. Reference voltages

First check the +8Vref and -8Vref.
The +8V can be measured at A1002/6 and the -8V at A1001/6. If one of these voltages is not present proceed as follows:

a. -8V not present, replace A1001
b. +8V not present, then -8V is not present either.
   measure voltage at cathode V1001 ≈ 6,5V
   measure output A1002/6; A1001/6 must be of the same value but only inverted.
   If this is correct replace A1002.

9.4.9. Analogue-digital convertor

Measure the wave forms according to Fig. 24 with +1,9V at the input terminals VΩ - 0.
If these wave forms are not correct or not present check if the control signals from the digital part are correct. Check function switches.
Check FET switches V1058, V1057, V1056, V1055, V1054, V1053 which switch the signals to the input of the integrator controlled by the control signals:
AZ , $\overline{\text{UP}}$, $\overline{\text{DOWN+}}$ or $\overline{\text{DOWN-}}$.

9.5. Digital section

The digital section can be checked according to timing diagram Fig. 27 and the circuit description of the digital section, refer to 7.4.

10. CHECKING AND ADJUSTING

The tolerances in this chapter corresponds to the factory data, which only apply to a completely re-adjusted intrument. 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 semiconductors 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 2526. 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 coaxial leads should be used.
Non-screened measuring cables act as serials so that the measuring instrument will measure HF voltage values or hum voltages.

Before checking and adjusting remove top cover.
The top and bottom cover can be removed by loosening the two screws "A" (Fig. 29.)
For adjusting the screening plates do not need to be removed.

NO.	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATION	INPUT SIGNALS	ADJUSTING DATA	MEASURING POINTS
	GENERAL					
1.	Power supply	-	Instrument switched-on	-	+ 10V - 10V + 4V - 5V	L1002 right side L1001 left side C1022 C1022
2.	Clock-frequency	R1114 potentiometer	Instrument switched-on	-	200 kHz ± 0.5%	D1020-13 Note: 0 = screening unit N2
3.	Reference voltage	R1012 Adjusting resistor (Metal film MR25 1%)	Instrument switched-on	-	1.52V ± 0.5%	Voltage across resistor R1025
4.	Zero d.c. amplifier	R1069 potentiometer	Select range 2V⎓	Short circuit the VΩ and 0 input terminal	0 mV ± 0.1 mV	A1004-6
5.	Electrical zero	R1 potentiometer "0"	Select range 2V⎓	Short circuit the VΩ and 0 input terminal	.0000 ± 0 digit	Display
	D.C. VOLT RANGES					
6.	Dead band zero	R1084 potentiometer	Select range 2V⎓	Supply alternately + 1mV ± 1% and - 1mV ± 1%	+.0009V and -.0009V	Display
7.	-2V calibration course	R1017 adjusting resistor R1018 adjusting resistor (Metal film MR25 1%)	Select range 2V⎓ -Place potentiometers R1027, R1028 in its mid position	- 1.9000V ± 0.01%	-1.9000V ± 10 digits Note: R1017 course adjustment R1018 fine adjustment	Display
8.	+2V calibration course	R1006 adjusting resistor R1007 adjusting resistor (Metal film MR25 1%)	-Select range 2V⎓	+ 1.9000V ± 0.01%	+1.9000V ± 10 digits Note: R1006 course adjustment R1007 fine adjustment	Display
9.	+2V calibration fine	R1027 potentiometer	Select range 2V⎓	+ 1.9000V ± 0.001%	+1.9000V ± 1 digit	Display
10.	-2V calibration fine	R1028 potentiometer	Select range 2V⎓	- 1.9000V ± 0.01%	-1.9000V ± 1 digit	Display
11.	+20V calibration	R2015 potentiometer	Select range 20V⎓	+ 19.000V ± 0.001%	+ 19.000V ± 1 digit	Display
12.	+200V calibration	R2016 potentiometer	Select range 200V⎓	+ 190.00V ± 0.001%	+ 190.00V ± 1 digit	Display
13.	+1000V calibration	R2017 potentiometer	Select range 2000V⎓	+ 1000.0V ± 0.001%	+ 1000.0V ± 1 digit	Display
	A.C. VOLT RANGES					
14.	Ac linearisation	R2026 potentiometer	Select range 2 V~	600 mV ± 0.01 % 100 Hz	0.6000 ± 7 digits	Display
15.	2V~ calibration	R1101 potentiometer	Select range 2 V~	1.9000 mV ± 0.005% 100 Hz	1.9000 ± 10 digits	Display
16.	Check	-	Select range 2 V~	1.9000V { ± 0.02 % 35 Hz ± 0.02 % 500 Hz ± 0.05 % 1 kHz ± 0.05 % 10 kHz ± 0.05 % 30 kHz	1.9000 ± 40 digits 1.9000 ± 40 digits 1.9000 ± 100 digits 1.9000 ± 100 digits 1.9000 ± 100 digits }	Display
			Select range 20 V~ Select range 200 V~ Select range 2000 V~	19.000V ± 0.02 % 100 Hz 190.00V ± 0.02 % 100 Hz 600.00V ± 0.03 % 100 Hz	1.9000 ± 40 digits 190.00 ± 40 digits 600.0 ± 20 digits	Display Display Display
17.	2 kΩ calibration	R1002 COARSE adjusting resistor (Metal film MR25 1%) R1021 FINE potentiometer	Select range 2 kΩ	1.9000 kΩ ± 0.1%	1.9000 ± 5 digits	Display
18.	Check	-	Select range 20 kΩ Select range 200 kΩ Select range 2000 kΩ	19.000 kΩ ± 0.1% 190.00 kΩ ± 0.1% 1900.0 kΩ ± 0.1%	19.000 ± 40 digits 190.00 ± 40 digits 1900.0 ± 40 digits	Display Display Display
19.	20 MΩ calibration	R2014 potentiometer	Select range 20 MΩ	19.00 MΩ ± 0.2%	19.00 ± 1 digit	Display
	CURRENT RANGES					
20.	2 mA⎓ calibration	R1102 potentiometer	Select range 2 mA⎓	+ 1.900 mA ± 0.1%	+ 1.900 ± 1 digit	Display
23.	Check	-	Select range 20 mA⎓ Select range 200 mA⎓ Select range 2000 mA⎓	+ 19.00 mA ± 0.1% + 190.0 mA ± 0.1% + 1900 mA ± 0.1%	+ 19.00 ± 4 digits + 190.0 ± 4 digits + 1900 ± 4 digits	} Display
			Select range 2 mA~ Select range 20 mA~	1.900 mA ± 0.1% 19.00 mA ± 0.1%	1.900 ± 4 digits 19.00 ± 4 digits	} Display
	TEMPERATURE RANGE					
24.	0°C calibration	R1107 potentiometer	Select function °C	35.34 Ω ± 0.1%	000.0 ± 5 digits	Display
25.	Check + 100°C - 50°C	-	Select function °C Select function °C	49.99 Ω ± 0.1% 27.84 Ω ± 0.1% Note: the resistance should be connected to points 1 and 3 of the 5 pole °C input terminal Front view	+ 100.0 ± 10 digits - 050.0 ± 10 digits	Display Display
26.	Check External HOLD function	-	Select range 2 V⎓	a. + 1.9 V Depress HOLD switch b. + 0.19 V Release HOLD switch c. + 1.9 V short circuit terminal °C point 3 and 5 d. + 0.19 V remove short circuiting	+ 1.9000 V + 1.9000 V + 0.19000 V + 1.9000 V + 1.9000 V + 0.1900 V	Display Display Display Display Display

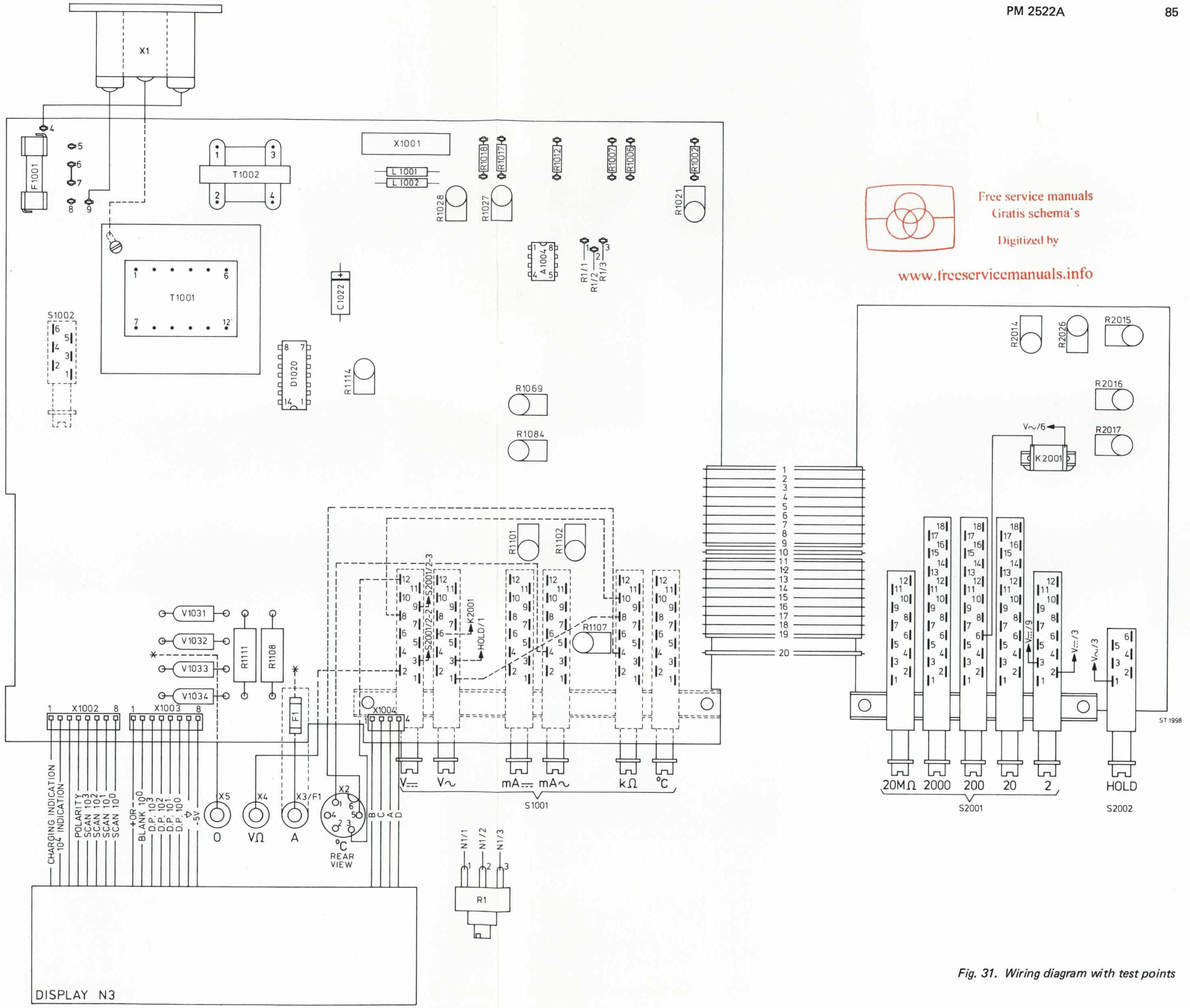


Fig. 31. Wiring diagram with test points

8. LIST OF PARTS

8.1. Mechanical

Item	Fig.	Qty.	Ordering number	Description
1	32	1	5322 498 54055	Handle assy
2	32	2	5322 447 94192	Top or bottom cover
-	15	1	5322 447 94193	Battery container
-	15	1	5322 447 94194	Battery container cover
3	32	1	5322 456 14064	Textplate
-	14	4	5322 462 44181	Rear foot
4	32	1	5322 466 85335	Front rim
5	32	4	5322 462 44179	Foot
6	32	4	5322 462 70497	Plug for foot
7	32	1	5322 450 64085	Window
-	-	1	5322 447 84642	Front cover
-	-	1	5322 121 10071	Mains cable
-	-	1	5322 264 24013	Testpin red
-	-	1	5322 264 24014	Testpin black
-	13	1	5322 256 34036	Fuse holder assy
8	32	13	5322 414 14011	Pushbutton knob
9	33	1	5322 405 94087	Extension spindle
S1001	14	1	5322 276 64026	Function switch assy
S1002	14	1	5322 276 14305	Power switch
S2001	14	1	5322 276 54029	Range switch assy
S2002	14	1	5322 276 14305	Hold switch
X1	15	1	5322 265 30066	Mains input socket
X2	14	1	4822 267 40195	5 pole °C socket
X1001	15	1	5322 267 64027	Connector CIS 10 pole
X1002	-	1	5322 267 54006	Connector CIS 8 pole
X1003	-	1	5322 267 54006	Connector CIS 8 pole
X1004	-	1	5322 267 54006	Connector CIS 4 pole

8.2. Miscellaneous

Item	Fig.	Qty.	Ordering number	Description
F1	14	1	4822 253 20024	Fuse 2.5 A s.b.
F1001	12	1	4822 253 30003	Fuse 50 mA s.b. 220 V mains
F1001	12	1	4822 253 30006	Fuse 100 mA s.b. 110 V mains
H3001	37	1	5322 130 34579	LED HP5082 - 7750
H3002	37	1	5322 130 34579	LED HP5082 - 7750
H3003	37	1	5322 130 34579	LED HP5082 - 7750
H3004	37	1	5322 130 34579	LED HP5082 - 7750
H3005	37	1	5322 130 34629	LED HP5082 - 7752
K2001	34	1	4822 280 20062	Reed relay
L1001	34	1	5322 158 14034	Micro choke
L1002	34	1	5322 158 14034	Micro choke

Item	Fig.	Qty.	Ordering number	Description
N2	18	1	5322 216 74052	Range unit N2
N3	21	1	5322 216 74048	Display unit N3
T1001	18	1	5322 146 14131	Mains transformer
T1002	18	1	5322 142 64065	Transformer

Fig. 32. Front view with item numbers

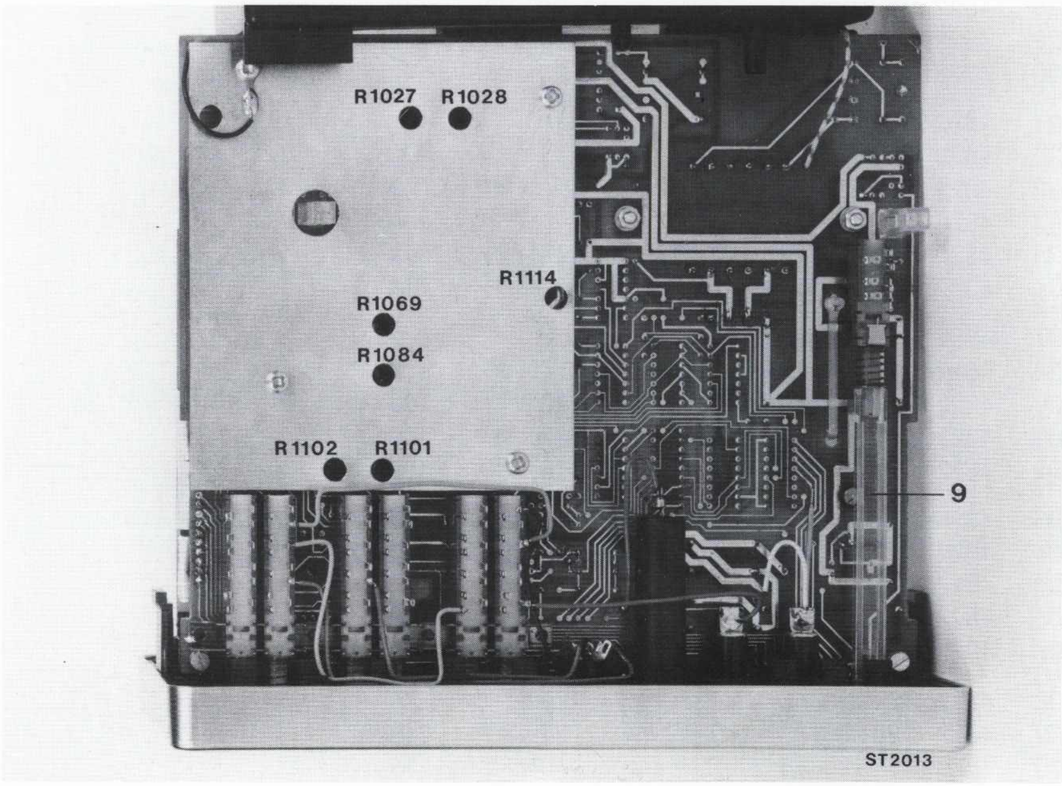


Fig. 33. Inside bottom view with item numbers

8.3. Electrical

8.3.1. Capacitors

Item	Ordering number	Value (F)		%	V
C1001	4822 121 40427	220	n	10	100
C1002	4822 121 40423	150	n	10	100
C1003	4822 121 40428	22	n	10	400
C1004	4822 121 40407	22	n	10	250
C1005	4822 121 50592	4.7	n	1	500
C1006	5322 121 54116	160	n	1	63
C1007	4822 122 31078	82	p	2	100
C1008	4822 121 40438	470	n	10	100
C1009	5322 122 34083	33	p	2	100
C1011	4822 122 30045	27	p	2	100
C1012	4822 122 30103	22	n	-20 +80	40
C1013	4822 122 30103	22	n	-20 +80	40
C1014	4822 124 20468	33	μ	-10 +50	16
C1015	4822 124 20468	33	μ	-10 +50	16
C1016	4822 124 20468	33	μ	-10 +50	16
C1017	4822 124 20468	33	μ	-10 +50	16
C1018	4822 124 20589	220	μ	-10 +50	10
C1021	4822 124 20454	150	μ	-10 +50	6.3
C1022	4822 124 20462	100	μ	-10 +50	10
C1024	4822 122 31078	82	p	2	100
C1025	4822 122 30103	22	n	-20 +80	40
C1026	4822 122 30103	22	n	-20 +80	40
C1027	4822 122 30103	22	n	-20 +80	40
C1028	4822 122 30103	22	n	-20 +80	40
C1029	4822 122 30103	22	n	-20 +80	40
C1030	4822 122 30103	22	n	-20 +80	40
C1031	4822 122 31221	1.5	n	10	100
C1032	4822 122 31085	150	p	2	100
C1033	4822 122 31125	4.7	n	-20 +80	40
C1034	4822 121 41161	100	n	10	100
C1035	4822 124 20525	1500	μ	-10 +50	16
C1036	4822 124 20525	1500	μ	-10 +50	16
C1037	4822 124 20454	150	μ	-10 +50	6.3
C1038	4822 124 20515	2200	μ	-10 +50	6.3
C1039	4822 121 40434	330	n	10	100
C2001	4822 121 40447	1	μ	10	100
C2002	4822 121 40439	470	n	10	400
C2003	4822 124 20467	15	μ	-10 +50	16
C2004	4822 122 31085	150	p	2	100
C2005	4822 122 30027	1	n	-20 +80	40
C2006	4822 122 31043	3.9	p	0,25 p	100
C2007	4822 124 20482	2.2	μ	-10 +50	40
C2008	4822 124 20468	33	μ	-10 +50	16
C2009	4822 122 30103	22	n	-20 +80	40
C2010	4822 124 20468	33	μ	-10 +50	16
C2011	4822 122 30103	22	n	-20 +80	40
C2012	4822 121 40452	1.5	μ	10	100
C2013	4822 121 40438	470	n	10	100
C2014	4822 121 40452	1.5	n	10	100

8.3.2. Resistors

Item	Ordering number	Value (Ω)	%	Series	
R1	4822 101 20416	4.7 k	20	0.1 W	Potentiometer
R1001	5322 116 55184	84.5 k	0.1	MR24E	
R1003	5322 116 54466	90.9	1	MR25	
R1004	5322 116 55182	12.4 k	0.1	MR24E	
R1005	5322 116 54451	61.9	1	MR25	
R1008	5322 116 54451	61.9	1	MR25	
R1013	5322 116 54515	348	1	MR25	
R1015	5322 116 54558	8.25 k	1	MR25	
R1016	5322 116 50608	6.19 k	1	MR25	
R1019	5322 116 50676	196	1	MR25	
R1021	4822 100 10051	22 k	20	0.05 W	Potentiometer
R1022	5322 116 55183	20.5 k	0.1	MR24E	
R1023	5322 116 55183	20.5 k	0.1	MR24E	
R1025	5322 116 54527	576	1	MR25	
R1026	5322 116 50581	2.49 k	1	MR25	
R1027	4822 100 10029	2.2 k	20	0.05 W	Potentiometer
R1028	4822 100 10029	2.2 k	20	0.05 W	Potentiometer
R1030	5322 116 50954	38.3	1	MR25	
R1047	4822 112 41103	680	5	7 W	
R1048	4822 116 40006	100	20	265 V	PTC
R1056	5322 116 54889	22.6	0.1	MR24C	
R1057	5322 116 54889	22.6	0.1	MR24C	
R1069	4822 100 10075	100	20	0.05 W	Potentiometer
R1084	4822 100 10173	2.2 M	20	0.05 W	Potentiometer
R1085	5322 116 55068	48.1 k	0.1	MR24E	
R1086	5322 116 55185	442 k	0.1	MR34E	
R1087	5322 116 55143	432 k	0.1	MR34E	
R1088	5322 116 55185	442 k	0.1	MR34E	
R1091	5322 116 54472	105	1	MR25	
R1101	4822 100 10036	4.7 k	20	0.05 W	Potentiometer
R1102	4822 100 10037	1 k	20	0.05 W	Potentiometer
R1103	5322 116 54009	562	1	MR25	
R1104	5322 116 55049	11.1 k	0.1	MR24C	
R1105	5322 116 54657	31.6 k	1	MR25	
R1107	4822 100 10029	2.2 k	20	0.05 W	Potentiometer
R1108	4822 112 21052	8.2	10	4.2 W	
R1110	5322 116 50728	1.87 k	1	MR25	
R1111	4822 112 21052	8.2	10	4.2 W	
R1112	5322 116 34035	15		NTC	
R1113	5322 116 50481	22.6 k	1	MR25	
R1114	4822 100 10036	4.7 k	20	0.05 W	Potentiometer
R2006	5322 116 50747	1 k	0.1	MR24E	
R2007	5322 116 50748	10 k	0.1	MR24E	
R2008	5322 116 54155	100 k	0.1	MR34E	
R2009	5322 116 55126	499 k	0.1	MR34E	

Item	Ordering number	Value (Ω)	%	Series	
R2010	5322 116 55126	499 k	0.1	MR34E	
R2012	5322 116 64036	9.76 M	1	VR37	
R2014	4822 100 10088	220 k	20	0.05 W	Potentiometer
R2015	4822 100 10079	47 k	20	0.05 W	Potentiometer
R2016	4822 100 10036	4.7 k	20	0.05 W	Potentiometer
R2017	4822 100 10038	470	20	0.05 W	Potentiometer
R2018	5322 113 24096	90	0.25	0.6 W	
R2019	5322 113 24095	4.5	0.25	0.6 W	
R2020	5322 113 24095	4.5	0.25	0.6 W	
R2021	5322 111 94044	Integrated resistance			
R2022	5322 111 94045	Integrated resistance			
R2023	5322 115 80099	01/09		Shunt	
R2026	5322 101 14099	4.7 M	20	0.05 W	Potentiometer

8.3.3. Semiconductors

Item	Ordering number	Description
V1001	5322 130 34568	BZV14
V1002	5322 130 34197	BZX79-B12
V1003	5322 130 30613	BAW62
V1004	5322 130 30613	BAW62
V1005	5322 130 30613	BAW62
V1006	4822 130 30862	BZX79-C9V1
V1007	5322 130 30414	BY164
V1008	5322 130 34049	BZX75-C2V1
V1009	5322 130 30765	BZX75-C3V6
V1011	5322 130 34278	BZX79-B6V8
V1012	5322 130 34048	BZX75-C2V8
V1022	5322 130 30773	BZX79-C4V7
V1023	5322 130 30773	BZX79-C4V7
V1024	5322 130 30613	BAW62
V1025	5322 130 30768	BZX79-C6V8
V1026	5322 130 30613	BAW62
V1027	5322 130 30613	BAW62
V1028	5322 130 30613	BAW62
V1031	4822 130 30829	BY188A
V1032	4822 130 30829	BY188A
V1033	4822 130 30829	BY188A
V1034	4822 130 30829	BY188A
V1036	5322 130 44104	BC328
V1037	5322 130 44104	BC328
V1038	5322 130 44257	BC547
V1039	5322 130 44257	BC547
V1041	5322 130 44647	BC368
V1042	5322 130 44256	BC557
V1043	5322 130 44593	BC369
V1044	5322 130 44256	BC557
V1045	5322 130 44604	BD675
V1046	5322 130 44231	BFW12

Item	Ordering number	Description
V1047	5322 130 44248	BFQ12
V1048	5322 130 44257	BC547
V1051	5322 130 44528	ON527
V1052	5322 130 44509	BFQ16
V1053	5322 130 40516	BFW13
V1054	5322 130 40516	BFW13
V1055	5322 130 40516	BFW13
V1056	5322 130 40516	BFW13
V1057	5322 130 40516	BFW13
V1058	5322 130 40516	BFW13
V1061	5322 130 44257	BC547
V1062	5322 130 44256	BC557
V1063	5322 130 44256	BC557
V1064	5322 130 44257	BC547
V2001	5322 130 44418	BF256A
V2002	5322 130 30613	BAW62
V2003	5322 130 30613	BAW62
V2004	5322 130 30613	BAW62
V3001	5322 130 44121	BC338
V3002	5322 130 44121	BC338
V3003	5322 130 44121	BC338
V3004	5322 130 44121	BC338
V3005	5322 130 44121	BC338
V3006	5322 130 44121	BC338
V3007	5322 130 44121	BC338
V3008	5322 130 44104	BC328
V3009	5322 130 44104	BC328
V3010	5322 130 44104	BC328
V3011	5322 130 44104	BC328
V3012	5322 130 44121	BC338
V3013	5322 130 44104	BC328

8.3.4. Integrated circuits

D1011	5322 209 14188	HEF4555BP
D1012	5322 209 14189	HEF4520BP
D1013	5322 209 84722	GZF1201P
D1014	4822 209 10002	HEF4013BP
D1015	5322 209 14191	HEF4528BP
D1016	5322 209 14046	HEF4011BP
D1017	5322 209 14045	HEF4001BP
D1018	5322 209 14073	HEF4070BP
D1019	4822 209 10002	HEF4013BP
D3001	5322 209 14122	HEF4511P
D3002	5322 209 14049	HEF4049P
A1001	5322 209 85254	LM741CN
A1002	5322 209 85254	LM741CN
A1003	5322 209 85254	LM741CN
A1004	5322 209 85254	LM741CN
A1005	5322 209 85254	LM741CN
A1006	5322 209 85073	TCA520B
A2001	5322 209 84679	LM301AN

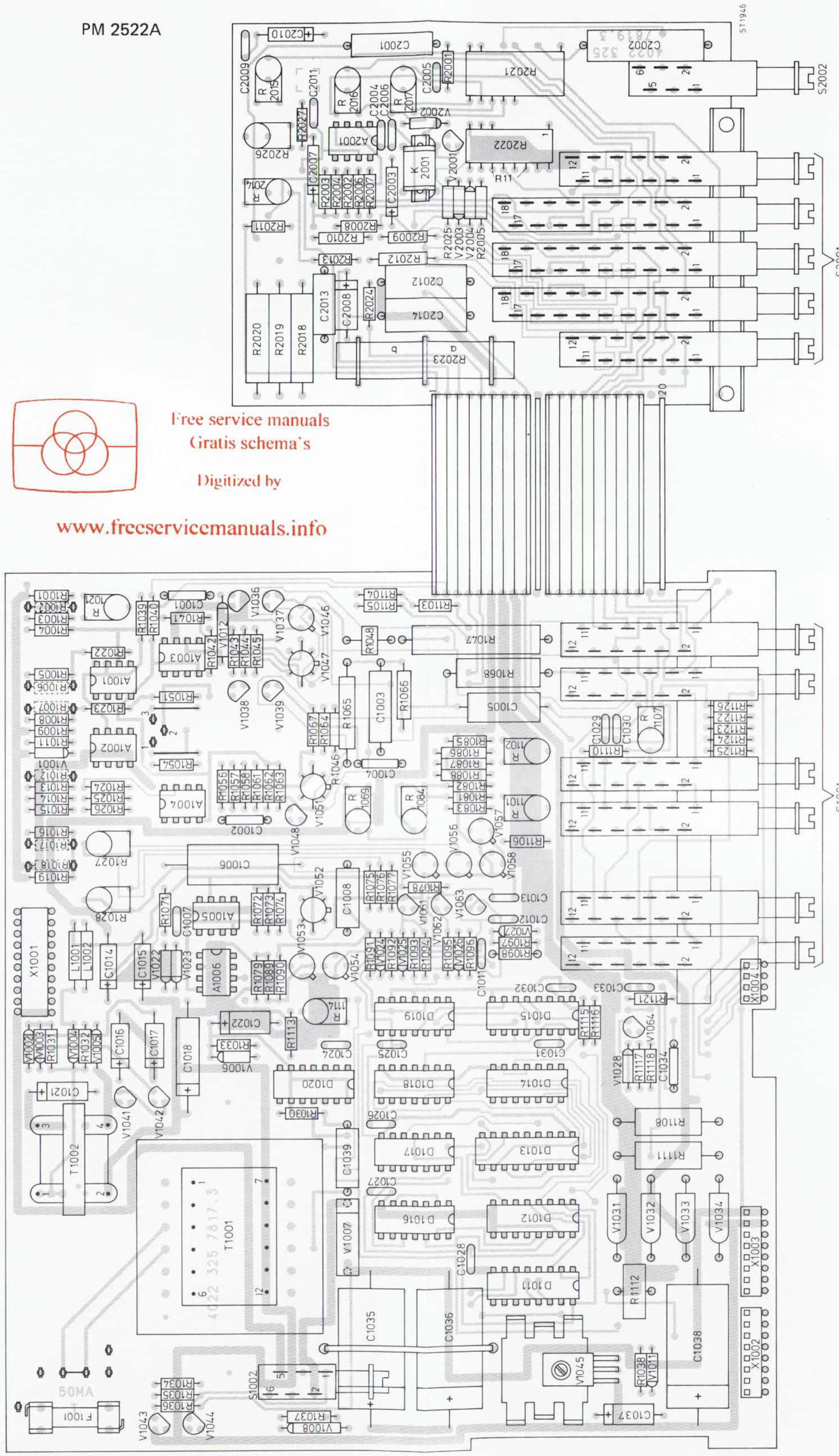


Fig. 34. PCB N1 and N2 component side

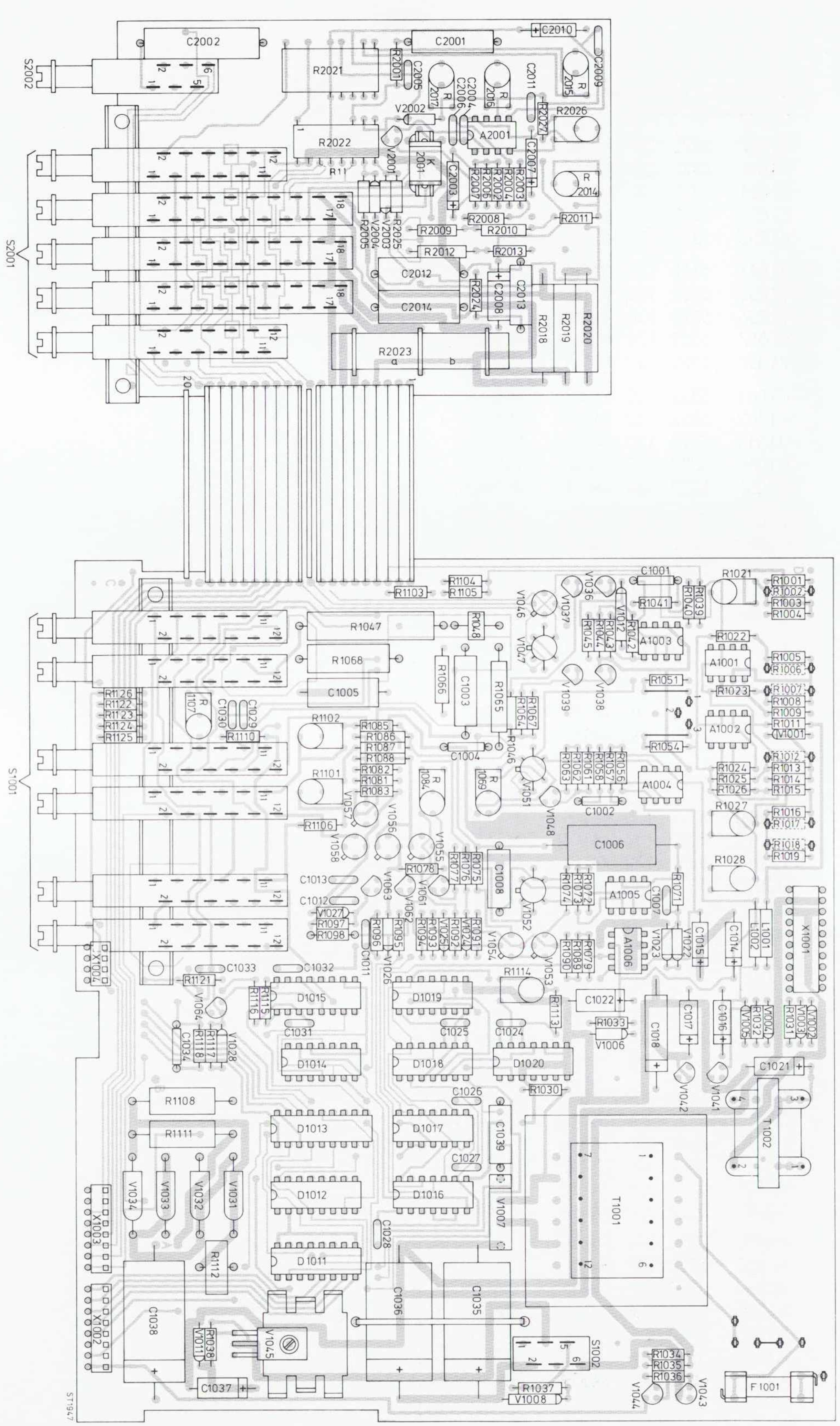


Fig. 35. PCB N1 and N2 conductor side

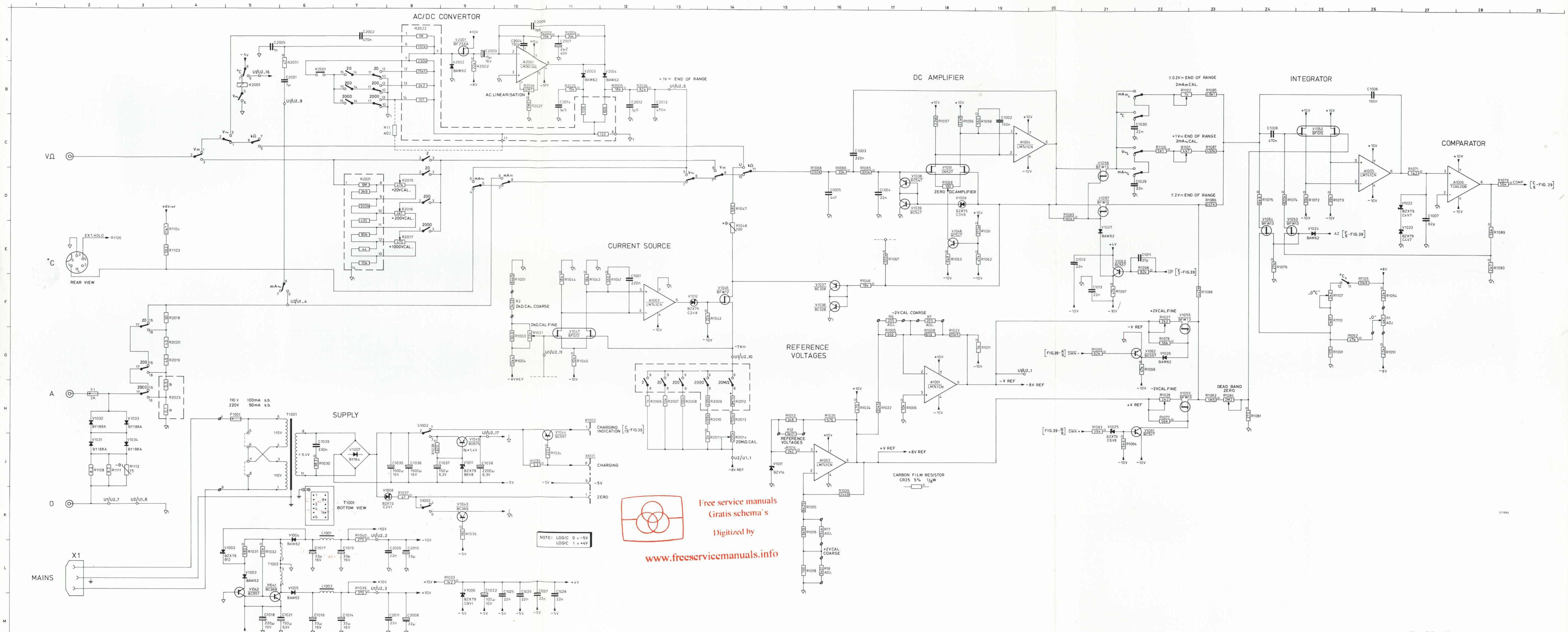


Fig. 36. Circuit diagram analogue section

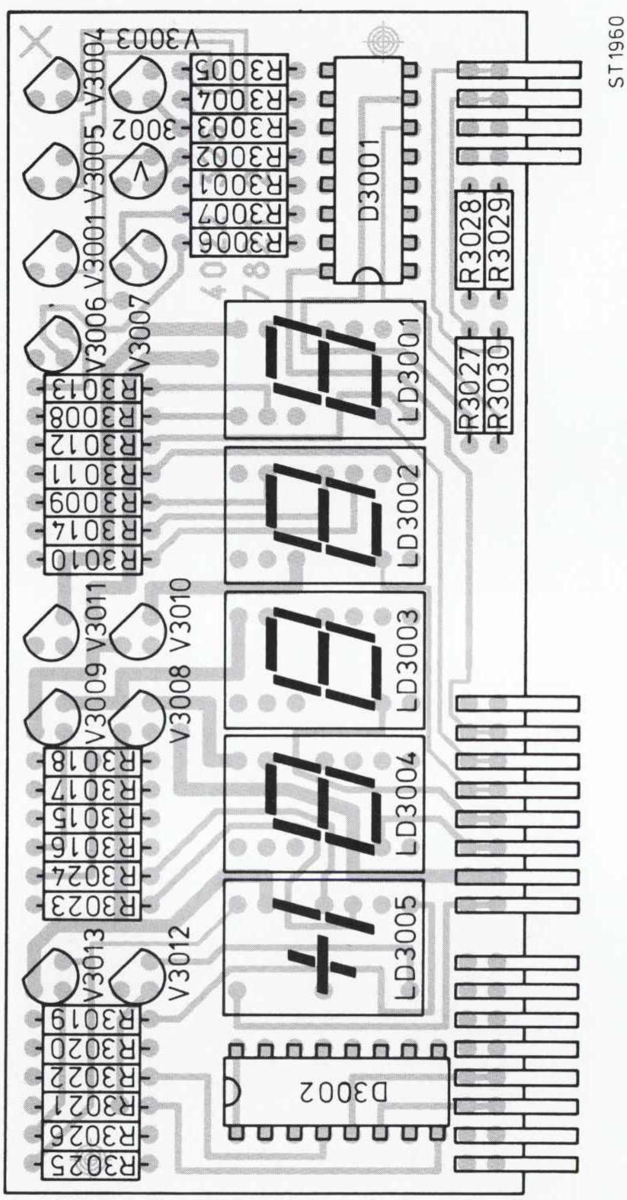


Fig. 37. PCB N3 component side

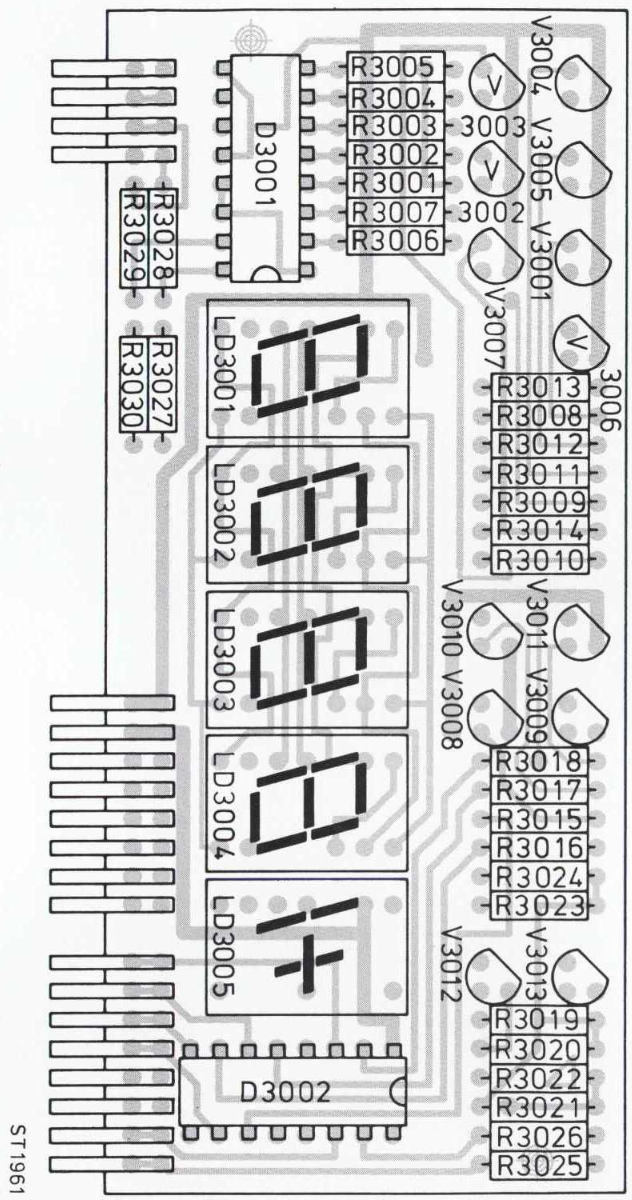


Fig. 38. PCB N3 conductor side

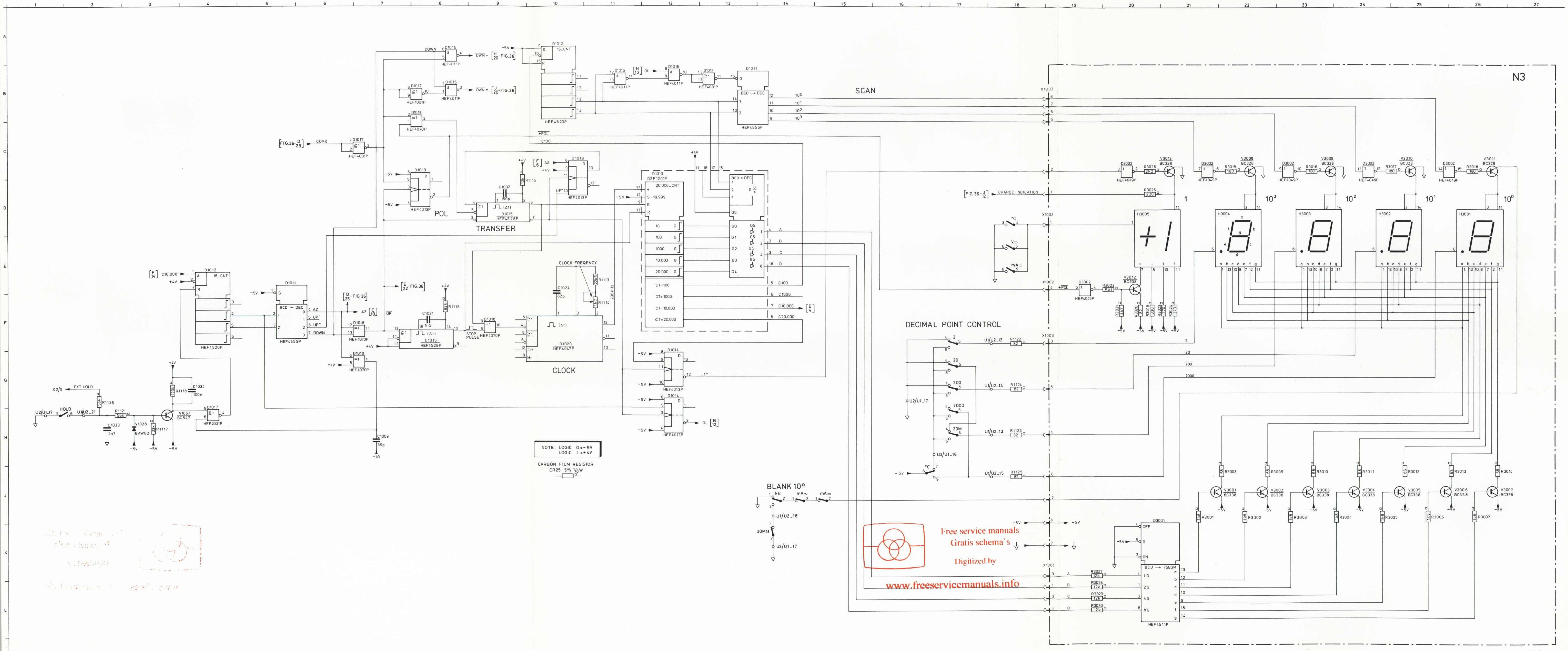


Fig. 39. Circuit diagram digital section

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 *Country*	② *Day Month Year*	③ *Typenumber /Version*	④ *Factory/Serial no.*
3 2	1 5 0 4 7 5	0 P M 3 2 6 0 0 2	D 0 0 0 7 8 3

CODED FAILURE DESCRIPTION ⑥

⑤ *Nature of call*	*Location*	*Component/sequence no.*	*Category*
☐ Installation		T S 0 6 0 7	5
☐ Pre sale repair		R 0 0 6 3 1	2
☐ Preventive maintenance	0 0 2 1	9 9 0 0 0 1	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ 1 2 Hrs

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

①Country: 3 2 = Switzerland

②Day Month Year 1 5 0 4 7 5 = 15 April 1975

③Type number/Version 0 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)

④Factory/Serial number D O 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤Nature of call: Enter a cross in the relevant box

⑥Coded failure description

Location

☐☐☐☐

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

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

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

Category

☐

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

⑦Job completed: Enter a cross when the job has been completed.

⑧Working 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.)

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