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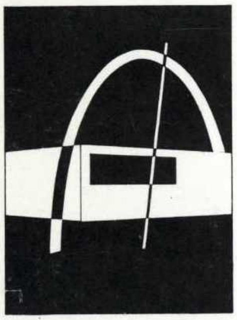

Digital r.m.s multimeter

PM2527

9447 025 270.1

9499 470 12102

760816/03/..

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Instruction Manual

Digital r.m.s multimeter
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IMPORTANT

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

LIST OF FIGURES

I. INTRODUCTION

GENERAL

The PM 2527 is a high class 4½ digit multimeter featuring automatic range selection on all functions.

The instrument can measure:

quantity	lowest range	highest range	max. resolution
- d.c. voltages	200 mV	1000 V	10 µV
- a.c. voltages	20 mV	600 V	10 µV
- d.c. currents	2 µA	2 A	100 pA
- a.c. currents	2 µA	2 A	1 nA
- Resistances	200 Ω	2 GΩ	10 mΩ
- HF voltages	20 mV	200 V	10 µV

Protection of all measurement functions is provided.

RMS measurement makes the accuracy in the a.c. ranges independent of the wave form.
The application of LSI circuits decrease the number of discrete components and guarantee high accuracy and extreme stability.
The isolated inner housing (Guard) enables floating measurements to be made with a high common mode rejection ratio.
In conjunction with the optional Digital Output PM 9237 all information of the PM 2527 such as function, range, polarity, measured value, overload etc. can be supplied to a printer, a parallel to serial converter etc.
The multimeter as such can be used in small data aquisition devices, e.g. the Philips Automatic Measuring System.
Due to its high sensitivity, its great accuracy and the possibility of a digital output the PM 2527 provides a wide range of applications in research and development.

II. TECHNICAL DATA

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

II-1. ELECTRICAL SPECIFICATIONS

Reference conditions: Temperature 23°C ± 1°C; Relative humidity < 70%

II-1.1. D.C. voltage measurement

Range	200 mV; 2 V; 20 V; 200 V; 1000 V
Resolution	10 µV in 200 mV range
Accuracy	± 0.02% of reading ± 0.02% of range (Range-end-value in the 1000 V range is 2000 V)
Temperature coefficient	± 50 ppm of reading/°C
Input resistance	10 MΩ ± 1%
Offset current at the input	Less than 20 pA
Max. input voltage	200 mV and 2 V range: 750 V continuously 1000 V during 1 minute Other ranges: 1000 V continuously

II-1.2. A.C. voltage measurement

Range	20 mV; 200 mV; 2 V; 20 V; 200 V; 600 V
Resolution	10 µV in 20 mV range

Accuracy (between 9% and 100% of range)	Ranges: 20 mV; 200 mV and 2 V Frequency range: 30 Hz ... 100 kHz ± 0.2% of reading ± 0.2% of range
	Ranges: 20 V; 200 V and 600 V (Range-end-value in the 600 V range is 2000 V) Frequency range: 30 Hz ... 1 kHz ± 0.2% of reading ± 0.2% of range
	Frequency range: 1 kHz ... 100 kHz ± 0.4% of reading ± 0.2% of range
Temperature coefficient	± 100 ppm of range/°C
Input impedance	10 MΩ shunted by 100 pF
Max. crest factor, end of range	2.4
Max. V - Hz product	10^7

II-1.3. HF voltage measurements

To be measured with probe PM 9211.

Frequency range	100 kHz ... 700 MHz
Voltage range	20 mV; 200 mV; 2 V; 20 V; 200 V
Resolution	10 µV in 20 mV range
Accuracy (between 9% and 100% of range)	see PM 9211 Chapter III-2.4.

II-1.4. D.C. current measurement

Range	2 µA; 20 µA; 200 µA; 2 mA; 20 mA; 200 mA and 2000 mA
Resolution	100 pA in 2 µA range
Accuracy	± 0.1% of reading ± 0.05% of range
Temperature coefficient	± 100 ppm of reading/°C
Max. voltage drop	2000 mA range: less than 500 mV other rangers : less than 250 mV

II-1.5. A.C. current measurement

Range	2 µA; 20 µA; 200 µA; 2 mA; 20 mA; 200 mA; 2000 mA
Resolution	1 nA in 2 µA range
Accuracy (between 9% and 100% of range)	± 0.3% of reading ± 0.2% of range
Frequency range	30 Hz ... 1 kHz
Temperature coefficient	± 100 ppm of range/°C
Max. voltage drop	2000 mA range: less than 500 mV other ranges : less than 250 mV
Max. crest factor, end of range	2.4

II-1.6. Resistance measurements

Range	0.2 kΩ; 2 kΩ; 20 kΩ; 200 kΩ; 2 MΩ; 20 MΩ; 200 MΩ and 2000 MΩ
Resolution	10 mΩ in 0.2 kΩ range
Accuracy	Range:

Range				
0.2 kΩ	± 0.05%	of reading	± 0.05%	of range
2 kΩ... 200 kΩ	± 0.05%	of reading	± 0.02%	of range
2 MΩ... 20 MΩ:	± 0.1%	of reading	± 0.05%	of range
200 MΩ	± 0.3%	of reading	± 0.2%	of range
2000 MΩ	± 1%	of reading	± 0.5%	of range

Max. measuring voltage	200 MΩ and 2000 MΩ range: 5 V other ranges : 2 V with open input terminals : less than 10 V
Temperature coefficient	Range: 0.2 kΩ ... 20 kΩ ± 100 ppm of reading/°C 200 kΩ ... 20 MΩ ± 200 ppm of reading/°C 200 MΩ ± 500 ppm of reading/°C 2000 MΩ ± 1000 ppm of reading/°C

II-2. GENERAL DATA

Environmental conditions	According to IEC359
Climatic conditions	Group I with extension of the upper temperature limit of + 50°C. Ambient temperature: reference value 23°C ± 1°C Rated range of use 0°C ... 50°C Limit range of storage and transport −40°C ... +70°C Relative humidity 20% ... 80% (exluding condensation)
Mechanical conditions	Group II
Supply conditions	Group II Nominal mains supply 220 V −12% ; +10% *Note: Mains transformer wiring can be altered for mains voltages of 92 V; 110 V; 128 V; 202 V and 238 V.* Mains frequency 50 Hz ± 5% see II-2 series mode rejection *Note: The instrument can be altered for a mains frequency of 60 Hz ± 5%.* Power consumption 30 VA
Safety class	I according to IEC348
Display	7 segments LED, read out max. 19999 *Note: In the A.C. voltage; A.C. current and the 200 MΩ and 2000 MΩ ranges the least significant digit is blanked.*
Decimal point	Depends on range
Indication of polarity	+ and −, automatically
Overrange indication	. 0 0 . . (Position of decimal point depends on range)
Function indication	mV; V; µA; mA; kΩ; MΩ; °C coupled with the function switches
Common mode rejection	140 dB for d.c. signals 100 dB for a.c. signals of 50/60 Hz
Series mode rejection	60 dB (50 Hz/60 Hz ± 0.1%) 40 dB (50 Hz/60 Hz ± 1%)
Analog to digital conversion system	Integrating
Integration time	100 msec.
Conversion rate	3.3 conv./sec (50 Hz setting) 4 conv./sec (60 Hz setting)
Conversion time	300 msec. (50 Hz setting) 250 msec. (60 Hz setting)
Response time	In the D.C. and kΩ ranges: max. 0.5 sec. with ranging: max. 1 sec. In the A.C.; HF and MΩ ranges: max. 1.5 sec. with ranging respectively: max. 6 sec.; 3 sec. and 5 sec. (excluding 2000 MΩ range)
Warming up time	approx. 30 minutes
Recalibration interval	90 days

Max. permissible voltages:

V - 0	1000 V d.c. or a.c. (see II-1.1. and II-1.2.)
A - 0	250 V d.c. or a.c. protected by glass-tube fuse 3.15 A
Ω - 0	250 V d.c. or a.c.
0 - Guard	250 V d.c. or a.c.
Guard - Housing	250 V d.c. or a.c.

II-3. MECHANICAL

Dimensions	Height 88 mm Width 279 mm Depth 328 mm
Weight	approx. 5.6 kg

III. ACCESSORIES

III-1. SUPPLIED WITH THE INSTRUMENT (Fig. 1, page 44)

- Set measuring leads PM 9260
- Shielded measuring cable
- Interconnection strip
- Mains cable
- 2 fuses 400 mA delayed action 92 V - 118 V mains } and sticker 110 V
- 1 fuse 200 mA delayed action 202 V - 238 V mains } and sticker 110 V
- 3 fuses 3.15 A fast
- 2 protection resistors 100 Ω metal film MR25 (R1116)
- 2 covers
- Operating manual

III-2. OPTIONAL

III-2.1. EHT probe PM 9246 (Fig. 2, page 44)

The EHT probe PM 9246 is suitable for measuring direct voltages up to 30 kV.
The PM 9246 may be used for measuring instruments with 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% ... 80%

Note: Pay attention to safe earth connections.

III-2.2. Current transformer PM 9245 (Fig. 3, page 44)

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

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

Before measuring connect the current transformer to the instrument.
Avoid the core-parts, being soiled.

III-2.3. Shunt PM 9244 (Fig. 4, page 44)

With this shunt it is possible to measure d.c. and a.c. (max. 1 kHz) currents up to 31.6 A.

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

III-2.4. HF probe PM 9211 (Fig. 5, page 44)

The HF probe PM 9211 is suitable for measuring HF voltages from 2 mV up to 2 V in combination with digital multimeter PM 2527. For voltages from 2 V up to 200 V a capacitive voltage attenuator with a division ratio of 100 : 1 is provided.

Probe

Voltage range	2 mV~ ... 2 V~
Frquency range	100 kHz ... 1 GHz (with T-piece)
Accuracy	± 3% of range at 100 kHz (23°C)
Input capacitance	less than 2 pF
Frequency characteristics	⩽ 3 dB at 10 kHz and 1 GHz (see graph. Fig. 6, page 48)
Max. input voltage	30 V_{rms} superimposed on 200 V d.c.

100 : 1 Attenuator

Attenuation	100 : 1
Voltage range	2 V~ ... 200 V~
Additional error	⩽ 0.5 dB ⩽ 3 dB at 100 kHz and 1 GHz
Input capacitance	less than 2 pF
Max. input voltage	200 V_{rms} superimposed on 500 V d.c.

50 Ohm T-piece

Impedance	50 Ω
Frequency range	100 kHz ... 1.2 GHz
Standing wave ratio	1.25 at 500 MHz with the probe inserted 1.15 at 1 GHz with attenuator inserted

III-2.5. Digital Output PM 9237 (Fig.'s 7 and 8, page 48)

By application of the PM 9237 it is possible to use the PM 2527 in automatic measuring systems.

Output system	Word parallel-bit parallel
Output code	Positive BCD Zero level 0 ... 0.4 V One level +5 V or, if externally supplied and switched over by an internal jumper +15 V. Isink 5 mA Output resistance 8.2 kΩ
Result	10^0 ... 10^3 in BCD code 10^4

(8)	(4)	(2)	(1)		
0	0	0	0	0	
0	0	0	1	1	
1	0	1	0	*	overrange

Range code	V ⎓	V~	A ⎓	A~	Ω	HF	Temp.	(8)	(4)	(2)	(1)
					0,2 kΩ			1	0	0	0
			2 µA	2 µA	2 kΩ			0	1	1	1
		20 mV	20 µA	20 µA	20 kΩ	20 mV		0	1	1	0
	200 mV	200 mV	200 µA	200 µA	200 kΩ	200 mV		0	1	0	1
	2 V	2 V	2 mA	2 mA	2 MΩ	2 V		0	1	0	0
	20 V	20 V	20 mA	20 mA	20 MΩ			0	0	1	1
	200 V	200 V	200 mA	200 mA	200 MΩ			0	0	1	0
	1000 V	600 V	2000 mA	2000 mA	2000 MΩ		0 - 200°C	0	0	0	1

Function code

	(8)	(4)	(2)	(1)	
Ω	0	0	0	1	1
A~	0	0	1	0	2
A ⎓	0	0	1	1	3
V~	0	1	0	0	4
V ⎓	0	1	0	1	5
Temp	0	1	1	0	6
–	0	1	1	1	7

(all functions switches in off-position)

Polarity indication

	(4)	(2)
+	0	1
–	1	0
~ or Ω	1	1

Print command : 0 negative going pulse; width 500 µs

Start command : 0 negative going pulse; width ⩾ 15 µs < 100 ms

H = + 2,4 V ... + 50 V

L = – 1,5 V ... 1 V

III-2.6. Digital output PM 9238 (IEC busline)

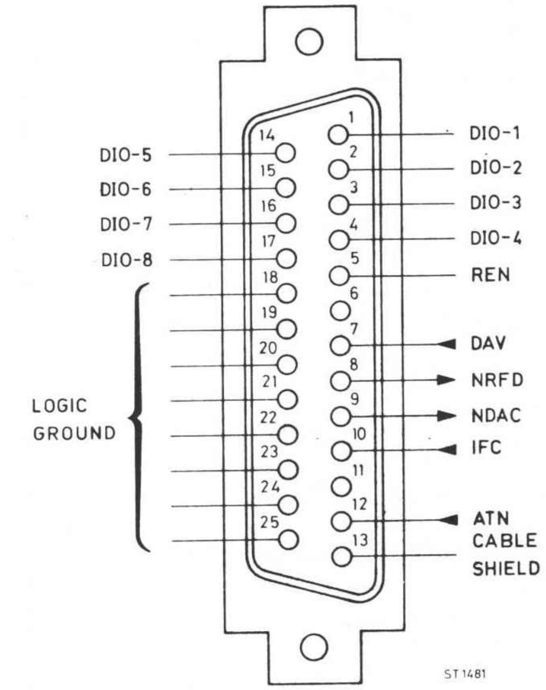
The PM 9238 is an IEC busline output for the PM 2527. The PM 9238 enables the PM 2527 to offer its output information in bit-parallel, word-serial code according the ISO-7 bit code (ISO 646, ASCII).
The PM 9238 can function as TALKER to read out the measuring result and as LISTENER to start the PM 2527.

Technical data

In-/output system	Bit parallel – Character serial
In-/output code	ISO-7 bit code ISO 646 (similar to ASCII)
	In-/output levels
	L = –0.5 V . . . +0.8 V
	H = +2 V . . . +5.5 V
	Logic levels for the DIO-lines
	L ≙ 1
	H ≙ 0
	according IEC-bus, TC66

DIO 4	DIO 3	DIO 2	DIO 1	DIO 8	NOT CONNECTED							
				DIO 7	0	0	0	0	1	1	1	1
				DIO 6	0	0	1	1	0	0	1	1
				DIO 5	0	1	0	1	0	1	0	1
				column / row	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	TC7 (DLE)	SP	0	@	P	`	p
0	0	0	1	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0	0	1	0	2	TC2 (STX)	DC2	"	2	B	R	b	r
0	0	1	1	3	TC3 (ETX)	DC3	#	3	C	S	c	s
0	1	0	0	4	TC4 (EOT)	DC4	$	4	D	T	d	t
0	1	0	1	5	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0	1	1	0	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0	1	1	1	7	BEL	TC10 (ETB)	'	7	G	W	g	w
1	0	0	0	8	FE0 (BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE1 (HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE2 (LF)	SUB	*	:	J	Z	j	z
1	0	1	1	11	FE3 (VT)	ESC	+	;	K	[	k	{
1	1	0	0	12	FE4 (FF)	IS4 (FS)	,	<	L	~	l	|
1	1	0	1	13	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}
1	1	1	0	14	SO	IS2 (RS)	.	>	N	∧	n	‾
1	1	1	1	15	SI	IS1 (US)	/	?	O	–	o	DEL

Input/Output connector ST 1149



ISO 646 Table

Listener function

Listen address — Programmable
At delivery 0110110 (ISO-7 bit code "6")

Start command — 0001000 (ISO-7 bit code "BS")

Talker function

Talker address — Programmable
At delivery 1010110 (ISO-7 bit code "V")

Read out — The measuring results are read out in:

Volts	V
Milliamperes	MA
Mega ohms	MO
Degrees Celsius	DG

Example:

```
V    Ø2156E - 1
V  + Ø3322E - 2
MA + 1Ø272E - 1
MO   15743E - 1
DG   ØØ337E - 1
```

Char. nr.	Char.	Function
1	Space M D	Voltage measurements Current/Resistance measurements Temperature measurements
2	V A O G	Voltage measurements Current measurements Resistance measurements Temperature measurements
3	+ – Space	pos. voltage, current or temperature neg. voltage, current or temperature a.c. voltage, -current and resistance measurements
4	0, 1 *	10^4 overload
5	0/9 *	10^3 overload
6	0/9 *	10^2 overload
7	0/9 *	10^1 overload
8	0/9 *	10^0 overload
9	E	First letter of "EXPONENT"
10	–	Negative sign
11	0/8	Exponent of the base 10
12	ETX	End of string "EOS" Programmable At delivery 0000011 (ISO-7 bit code ETX)

III-2.7. Temperature unit PM 9257

By application of the PM 9257 it is possible to make temperature measurements with the PM 2527.
The temperatures can be measured with a Pt-100 probe or the probe PM 9248. The adaption to the different probes is made internally in the PM 9257 by means of a switch.

Technical data

Range		$-60^{o}C \ldots +200^{o}C$
Accuracy:	After calibration (excl.) for probe Pt-100	$-60^{o}C \ldots 0^{o}C \pm 0.3^{o}C \pm 1\%$ of reading $0^{o}C \ldots +200^{o}C \pm 0.3^{o}C \pm 0.5\%$ of reading
	Including probe PM 9248 after calibration	$\pm 0.5^{o}C \pm 1\%$ of reading $\pm 0.005\%$ of range
Temperature coefficient		± 50 ppm of range ± 150 ppm of reading/^{o}C (reference value $23^{o}C$)

III-2.8. Temperature probe PM 9248 (see page 52)

The resistance thermometer PM 9248 is a contact probe suitable for measurements between $-60^{o}C$ and $+200^{o}C$, used in combination with the PM 2527.

Technical data, combined with PM 2527

Range	$-60^{o}C \ldots +200^{o}C$
Resolution	$0.1^{o}C$
Accuracy	$\pm 1\%$ of reading $\pm 1^{o}C$
Permissible maximum voltage at probe top	60 V

III-2.9. Analog output PM 9255

The PM 9255 is an analog output for the PM 2527.
The PM 9255 gives an analog output voltage in all ranges which is proportional to the signal supplied to the input of the PM 2527.

Technical data

Output impedance	200 Ω
Response time	$<$ 500 msec.
Linearity	0.3%
Resolution	0.05%
Temperature coefficient	500 ppm/^{o}C of range
Output voltage	2 V (end of range)

III-2.10. Rackmounting set PM 9669/03 (see page 52)

The PM 9669/03 is used to mount the PM 2527 into a 19" rack.

IV. PRINCIPLE OF OPERATION (Fig. 9, page 56)

IV-1. INPUT CIRCUIT

The input circuit of the PM 2527 consisting of the input attenuators, d.c. – and a.c. amplifiers supplies a direct voltage of 2 V at end of range to the analog-digital converter.

- d.c. voltage
  The input voltage is applied to the attenuators, which attenuates the unknown d.c. voltage in accordance with the range selected. The attenuated voltage is supplied to the 1x/10x d.c. amplifier. At end of range, the d.c. voltage supplied to the ADC is 2 V.
- d.c. current
  The input is applied to the shunt, which differs dependent to the range selected. The voltage drop across this shunt is applied to the 1x/10x d.c. amplifier. At end of range, the d.c. voltage supplied to the ADC is 2 V.
- a.c. voltage
  The input current is applied to the attenuators, which attenuates the unknown a.c. voltage is accordance with the range selected. This attenuated voltage is applied to the impedance converter, the a.c. amplifiers and the r.m.s. converter. At end of range the output voltage of the r.m.s. converter is 5 V. This voltage is divided by 2.5 and supplied to the ADC.
- a.c. current
  As a.c. voltage, except for the input being applied to the shunt. The voltage drop across the shunt is applied to the impedance converter.
- At resistance measurements the unknown resistance is placed in the feed back circuit of the 1x/10x d.c. amplifier together with a current source. The current flowing through Rx causes a voltage drop which is supplied to the ADC. At end of range the input of the ADC is 2 V.
- HF voltage measurements are based on a compensation principle. For this purpose a 100 kHz oscillator, the amplitude of which is controlled by the d.c. amplifier, is included in the HF circuit. In the probe the unknown HF voltage is compared with the 100 kHz signal. The amplitude of the 100 kHz equals the amplitude of the HF signal, controlled via the d.c. amplifier. This 100 kHz signal is supplied to the impedance converter and a.c. amplifiers and measured.
- Function switching is effected manually.
- Range switching is either manual by means of the "RANGING" up/down switch, or fully automatic.
- Sampling is automatic ($3^1/_3$ samples/second) or manual by means of the "START" switch.

IV-2. ANALOG TO DIGITAL CONVERSION

The conversion of analogue signals into digital form is based on the integration principle.
The analogue input signal is applied to the integrator.
The comparator following the integrator supplies an output pulse, the width of which is proportional to the measuring value.
Fig. 11. page 56 shows a graphical representation of the output voltage of the integrator as function of time during the charging and discharging cycle.
During the integration process two main conditions should be distinguished, namely the ramp-up (first step) and the ramp-down (second step) condition. During the first step (start) a voltage, which is proportional to the input voltage, is applied to the integrator.
The output voltage of the integrator increases linearly as a function of time: its direction depends on the polarity, and its steepness on the value of the input voltage.
The integration time is determined by the duration of 20,000 clock pulses. (100 ms)
During this interval, ramp-up is effected and the integration capacitor is charged.
During the second step the capacitor is discharged to zero by a constant current. The integrator is discharged by connecting a reference voltage to its input, the polarity of which is opposite to the polarity of the input voltage supplied. The discharge rate is determined by the discharge current, and consequently by the references voltage, so that it will be constant. The time $t_1 - t_2$ ramp-down is measured by counting the number of clock pulses; it is directly proportional to the unknown input voltage applied during the first step.
As the same integration elements and clock generator are employed for both upward- and downward integration, temperature variations, long-term drift and absolute values will not affect the measuring accuracy.
The measuring accuracy depends in the first place on the accuracy of the reference voltage.

IV-3. DIGITAL SECTION

- General
  During the ramp-up phase of the ADC, 20,000 clock pulses of CLOCK OSCILLATOR are counted by the COUNTER/MEMORY part of the PM 2527.
  After 20,000 clock pulses the COUNTER/MEMORY gives a status pulse ($t_0 - t_1$) to the ADC via the PROGRAM and the ramp-down phase starts.
  The number of pulses counted during the ramp-down phase ($t_1 - t_2$) is proportional to the height of the signal supplied to the input of the PM 2527.
  At zero passage of the ADC (t_2) the number of clock pulses counted by the COUNTER/MEMORY are transfered to the MEMORY. The output of the MEMORY is scanned by the SCAN OSCILLATOR (1 kHz). The scanned BCD information is supplied to the DISPLAY via the BCD-to-7 segment CODE CONVERTER. At the same time the SCAN OSCILLATOR is driving the anode switches in order to get a sequential display.
- Automatic ranging
  When, during the ramp-down, the number of pulses counted are less than 01800 (down ranging) or more than 20,000 (up ranging) and automatic ranging is switched on, up or down pulses are supplied to the AUTOMATIC RANGE circuit in order to control the RANGE SELECTOR RELAYS.
  Together with function information the reed contacts for the voltage attenuator, the shunts, the current source and the gain factors of the amplifiers are switched by the RANGE SELECTOR CIRCUIT.
- Manual ranging
  By means of ranging switches MAN and UP/DOWN manual control is possible.
  The UP/DOWN information from the switches is supplied to the up/down counter of the AUTOMATIC RANGE circuit, which switches the various ranges.
- Manual or automatic sampling is effected by the PROGRAM circuit. PROGRAM, AUTOMATIC RANGE COUNTER and MEMORY are situated in two LSI circuits viz. OQ052 and GZF1201.

V. INSTALLATION

DIRECTIONS FOR USE

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

V-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. The instrument is wired for operation from a 220 V – 50 Hz mains supply.

V-1.1. Adaption of mains voltage

Adaption of the instrument for other mains voltages is possible by altering the wiring of the mains transformer. (Fig. 12, page 60).

To adapt the instrument from 220 V – 50 Hz to 110 V – 50 Hz mains supply, interchange connections 2 and 14, as well as 3 and 13.

To adapt the instrument from 220 V – 50 Hz or 110 V – 50 Hz to mains voltages of 202 V and 238 V or 92 V and 128 V, proceed as follows:

- Remove the top cover.
- Disconnect the transformer by removing screws A and loosening screws B (Fig. 13, page 60).
- Change the wiring of connections 4, 5, 6 and 14 according to figure 12, page 60.

NOTE: For 110 V mains a sticker is delivered with the instrument. It can be affixed upon "220 V" in the text "CONNECTED FOR 220 V" at the rear.

V-1.2. Fuse

The mains fuse is located at the right-hand side of the mains transformer.
For replacement of the mains fuse remove the top cover after loosening screws A. (Fig. 16, page 64)

Mains voltage	Required fuse VL1
202 V – 238 V	200 mA d.a.
92 V – 128 V	400 mA d.a.

V-1.3. Adaption of mains frequency to obtain max. SMRR at 60 Hz

To adapt the instrument for a mains frequency proceed as follows:

- Remove the bottom cover after loosening screws A
- Make the interconnections as given in figure 14, page 64
- Mount the bottom cover.

V-1.4. General

Adaption to the local mains voltage or the correct mains frequency may be performed only by a skilled person who is aware of the risks involved.
When a fuse is to be replaced or when the instrument is to be adapted to another mains voltage or frequency, the instrument must be disconnected from all voltage sources.

V-2. 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 cord without protective conductor. Replacing the mains plug is at the users own risk.
- via the protective earth terminal at the rear.

WARNING: Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal 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.
Therefore, make sure that the earthing requirements are strictly adhered too.

VI. OPERATION

VI-1. SWITCHING ON

The instrument is ready for use after connection to the mains and earthing.
It is switched on by means of switch "POWER"
A warming up time of approx. 30 minutes should be allowed to obtain full accuracy.

VI-2. CONTROLS

VI-2.1. Front panel (Fig. 15, page 64)

Item	Description		Application
SK1	POWER		Switches on the instrument
SK2	V ⎓; V~; A ⎓; A~; Ω; PROBE		Switches on the required measuring function
SK3	START		
		AUT	Sample rate: 3 1/3 samples/sec.
		EXT	External starting is performed.
		MAN	Manual starting of measurement is performed.
SK4	RANGING		
		AUT	Range selection is automatically carried out.
		MAN	Any range can be selected by the UP-DOWN switch.
SK5	RANGING MAN		
		UP	Select a higher range
		DOWN	Select a lower range
BU1	PROBE		HF input/Temp. probe input (option)
BU2	GUARD		
BU3	0		Common input
BU4	V		Voltage input
BU5	Ω		Resistance input
BU6	A		Current input
R1903	I in		Adjustment input current D.C. amplifier

VI-2.2. Rear panel (Fig. 16, page 64)

Item	Description	Application
BU7	DIGITAL OUTPUT	Output of PM 9237 } Option Output of PM 9238 } Option Output of PM 9255 } Option
BU8	ANALOG OUTPUT	
BU9	EXT. START	To start a measurement externally
VL1	FUSE	Mains fuse 200 mA d.a. 202 V – 238 V 400 mA d.a. 92 V – 128 V (Mounted behind the rear panel inside of the instrument)
	⏚	Earth screw

VI-3. ZERO SETTING

Before carrying out the zero setting a warming-up time of 30 minutes should be allowed.

- Depress button V ⎓
- Adjust with open input the display to minimum value, less than 20 digits, (+ and – sign lights alternately) with potentiometer "I in".
- Short circuit V and 0 terminals
- The display should indicate 000.00 ± 1 digit.

NOTE: For complete adjustments, see chapter X "Checking and adjusting".

VI-4. MEASURING

VI-4.1. Function selection

The measuring function is set by means of the function selector switches and in accordance with the table below.

Function selector	Input terminals	Measuring range
V ⎓	V — 0	10 μV to 1000.0 V d.c.
V~	V — 0	1,8 mV to 600 V a.c. resolution 10 μV
A ⎓	A — 0	100 pA to 2000.0 mA d.c.
A~	A — 0	0,18 μA to 2000 mA a.c. resolution 1 nA
Ω	Ω — 0	10 mΩ to 2000 MΩ
Probe	Probe with use of the HF probe PM 9211	1,8 mV to 200 V a.c. resolution 10 μV Frequency range: 100 kHz ... 700 MHz

VI-4.2. Automatic range selection

Set the RANGING mode switch in position AUT.
Now range selection is automatically performed.
UP level 19999, DOWN level 01800.
To eliminate the hysteresis in the automatic range selection, a higher or lower range can be selected by means of the UP - DOWN switch.

between 18000 and 19999 up-ranging
between 01800 and 01999 down-ranging

VI-4.3. Manual range selection

Set the RANGING mode switch in position MAN.
Select the correct measuring range with the UP - DOWN switch.
1 x depress = 1 range step.

VI-4.4. Starting of measurement

The measurement can be started in three ways:

- *Automatically* with START mode switch in position AUT.
  Measuring speed: 3 1/3 samples/sec. (50 Hz setting)
- *Manual* by pushing the START mode switch from EXT to MAN.
  The instrument measures as long as the switch is held in position MAN.
- *Externally* with START mode switch to EXT.
  A start pulse for each measurement can then be given, via the BNC connector EXT. START (Fig. 16, page 64) or via the digital output.

Start pulse: negative going pulse, width > 15 μs < 100 ms
H = + 2,4 V ... + 20 V
L = – 20 V ... + 1 V

To obtain a d.c. coupling between the EXT. start input and the start circuit, an interconnection must be made between soldering pins A . (Fig. 17, page 68)
In case of external starting (EXT. START) the instrument measures when the input is logic zero.
The external start input (via the BNC connector) is protected against an input voltage of 250 V.
(recovery time approx. 5 minutes).

NOTES:
- Sample hold is effected by setting START mode switch in position EXT. without supplying start pulses.
  Prior to setting the START mode switch or after each start pulse the complete display is held.
- After each start pulse a complete measurement, including ranging, is carried out.

VI-4.5. Examples of measurements with GUARD connection

The digital multimeter PM 2527 is equipped with a GUARD. This guard is an additional shield between low and ground which increases the low-ground leakage impedance.
This increased leakage impedance improves the common mode rejection.
The GUARD may be connected to the circuit via a separate lead.
Proper use of GUARD provides a better common mode rejection and a higher measuring accuracy, especially in the most sensitive ranges.

For a optimum guard connection, the following rules should be taken into account:

- Connect the voltage source to be measured to the PM 2527 by means of a shielded measuring cable.
  This method suppresses interference signals.
- Connect the guard to the same potential as the low input terminal
- Connect the guard in such a way that no common mode current flows through any source impedance.

VI-4.6. D.C. voltage measurement

- Depress switch V ⎓
- Connect the voltage source to the V – 0 terminals

NOTES:
- The maximum permissible input is 1000 V d.c. + a.c. pp continuously on all ranges.
- Voltages from 1 kV up to 30 kV can be measured with the HT probe PM 9246. Set the impedance switch of this probe to 10 MΩ.
- Polarity is indicated automatically.
- Overrange is indicated for voltages exceeding 1000 V d.c..

VI-4.7. A.C. voltage measurement

- Depress switch V~
- Connect the voltage source to the V – 0 terminals

NOTES:
- Using a thermal RMS conversion system a.c. coupled RMS measurements will be carried out. By this system voltages between 9% and 100% of range can be measured with full accuracy. Make sure that, in case of manual range selection, the optimum range is selected.
- The maximum permissible input is 600 V a.c. or d.c.
- Overrange indication is not made for voltages exceeding 600 V_{rms}

VI-4.8. HF voltage measurement with HF probe PM 9211

- Depress switch "PROBE"
- Connect the voltage source to the "PROBE" input via the probe PM 9211
- For voltages between 2 V and 200 V the 100 : 1 divider should be used
- Measurements of voltages at frequencies above 100 MHz should be carried out by using the 50 Ω T-piece.

NOTES:
- Voltages between 9% and 100% of range can only be measured with full accuracy. Make sure that, in case of manual range selection, the optimum range is selected.
- See also directions for use PM 9211.

VI-4.9. D.C. current measurements

- Depress switch A ⎓
- Connect the current to be measured to the A – 0 terminals

NOTES:
- Max. permissible input current is 2 A. Currents up to 31,6 A can be measured with shunt PM 9244.
- Polarity is indicated automatically.

VI-4.10. A.C. current measurements

- Depress switch A~
- Connect the current to be measured to the A – 0 terminals

NOTES:
- Using a thermal RMS conversion system a.c. coupled RMS measurements will be carried out. By this system currents between 9% and 100% of range can be measured with full accuracy. Make sure that, in case of manual range selection the optimum range is selected.
- Max. permissible input current is 2 A. Currents up to 100 A can be measured with the aid of current transformer PM 9245.

VI-4.11. Resistance measurements

- Depress switch Ω
- Connect the unknown resistance to the Ω – 0 terminals

NOTES:
- Maximum permissible voltage at the input terminals is 250 V. The current source is protected by a PTC resistor. If too a high voltage (> 20 V) is applied to the Ω – 0 terminals, wait 5 minutes until PTC resistor has cooled down before starting a new measurement.
- In case of measurements in the 2000 MΩ range zero adjustment (see chapter VI-3. zero setting) should be carried out.

VII. TROUBLE – SHOOTING

Since this multimeter was designed and assembled with utmost care, the risk of breakdowns is small.
If a breakdown should occur, it is at all times possible to contact the nearest Philips Service Organisation.
In case of simple breakdowns, however, and to avoid any loss of time and money, the user may try to locate the defective part and carry out the repair with the aid of the list given below.

Before proceeding to trouble shooting, make sure that the instrument is connected to the correct mains voltage and that this mains voltage is indeed supplied to the instrument.

Breakdown	Possible cause	Measures
The multimeter does not function. Display does not light up.	Fuse VL1. Mains cord defective	Replace VL1 near the mains transformer. Accessible after removal of top cover. Check the mains cord.
Current measurement does not function.	Fuse VL1201.	Replace Fuse VL1201. Accessible after removal of top cover. See figure 18, page 68.
Voltage measurement does not function.	Resistor R1116.	Replace R1116. Accessible after removal of top cover and guard cover (Fig. 19, page 68). Take care that a metal film resistor of 100 Ω is used for replacement.
Resistance measurement does not function. After connecting a too high voltage at the Ω input.	PTC resistor R1311.	Wait for approx. 5 min. to cool down the PTC resistor R1311.
External start via BNC input at the rear does not function. After connecting a too high voltage at the start input.	PTC resistor R2525.	Wait for approx. 5 min. to cool down the PTC resistor R2525.

I. EINLEITUNG

ALLGEMEINES

Das PM 2527 ist ein erstklassiges 4½ stelliges Digital-Multimeter mit automatischer Messbereichswahl für alle Messarten.

Das Gerät hat folgende Messbereiche:

Menge	niedrigster Bereich	höchster Bereich	Auflösung
- Gleichspannung	200 mV	1000 V	10 µV
- Wechselspannung	20 mV	600 V	10 µV
- Gleichstrom	2 µA	2 A	100 pA
- Wechselstrom	2 µA	2 A	1 nA
- Widerstand	200 Ω	2 GΩ	10 mΩ
- HF–Spannungen	20 mV	200 V	10 µV

Alle Messbereiche sind gegen Überlastung geschützt.

Durch Effektivwertmessungen ist die Genauigkeit in den Wechselspannungsbereichen von der Signalform unabhängig.
Durch LSI-Schaltungen wird die Anzahl diskreter Bauteile vermindert und ist die höchste Genauigkeit und äusserste Stabilität, garantiert. Das isolierte Gehäuse gestattet schwebende Messungen bei hoher Gleichtaktunterdrückung.
Zusammen mit dem zusätzlich lieferbaren Digitalausgang PM 9237 lassen sich alle Informationen des PM 2527, wie Funktion, Bereich, Polarität, gemessener Wert und Überlastung einem Drucker, einem Parallel-Serien Umsetzer u.s.w. zuführen um das Gerät für kleine Datenerfassung im Philips System zur automatischen Messwerterfassung zu benutzen.
Durch seine hohe Empfindlichkeit, grosse Genauigkeit und die Möglichkeit eines Digital-Ausganges eignet sich das PM 2527 für Einsatz von Forschung und Entwicklung in einem breiten Gebiet.

II. TECHNISCHE DATEN

Alle hier erwähnten Werte sind Nennwerte; Zahlenwerte mit Toleranzangaben sind bindend und vom Hersteller garantiert.

II-1. ELEKTRISCHE SPEZIFIKATIONEN

Referenzpegel — Umgebungstemperatur 23°C ± 1°C
Relative Luftfeuchtigkeit < 70%

II-1.1. Gleichspannungsmessungen

Messbereiche	200 mV; 2 V; 20 V; 200 V; 1000 V
Auflösung	10 µV im 200 mV Bereich
Genauigkeit	± 0.02% der Anzeige ± 0.02% vom Bereichsendwert (Bereichsendwert im 1000 V Bereich ist 2000 V)
Temperaturkoeffizient	± 50 ppm vom Messwert/°C
Eingangswiderstand	10 MΩ ± 1%
Offset-Strom an Eingang	Kleiner als 20 pA
Max. Eingangsspannung	200 mV und 2 V Bereich: 750 V dauernd 1000 V für 1 Minute Übrige Bereiche: 1000 V dauernd

II-1.2. Wechselspannungsmessungen

Messbereiche	20 mV; 200 mV; 2 V; 20 V; 200 V; 600 V
Auflösung	10 µV im 20 mV Bereich
Genauigkeit (zwischen 9% und 100% des Bereiches)	Bereiche: 20 mV; 200 mV und 2 V Frequenzbereich: 30 Hz ... 100 kHz ± 0.2% der Anzeige ± 0.2% vom Bereichsendwert Bereiche: 20 V; 200 V und 600 V Frequenzbereich: 30 Hz ... 1 kHz ± 0.2% der Anzeige ± 0.2% vom Bereichsendwert (Bereichsendwert im 600 V Bereich ist 2000 V) Frequenzbereich: 1 kHz ... 100 kHz ± 0.4% der Anzeige ± 0.2% vom Bereichsendwert
Temperaturkoeffizient	± 100 ppm vom Messwert/°C
Eingangsimpedanz	100 MΩ // 100 pF
Maximaler Spitzenfaktor, Bereichsende	2,4
Max. V-Hz Produkt	10^7

II-1.3. HF - Spannungsmessungen

Auszuführen mit Messkopf PM 9211.

Frequenzbereich	100 kHz ... 700 MHz
Spannungsbereich	20 mV; 200 mV; 2 V; 20 V; 200 V
Auflösung	10 µV im 20 mV Bereich
Genauigkeit (zwischen 9% und 100% des Bereichs)	siehe PM 9211 Abschnitt III-2.4.

II-1.4. Gleichstrommessungen

Messbereiche	2 µV; 20 µA; 200 µA; 2 mA; 20 mA; 200 mA und 2000 mA
Auflösung	100 pA im 2 µA
Genauigkeit	± 0.1% der Anzeige ± 0.05% vom Bereichsendwert
Temperaturkoeffizient	± 100 ppm vom Messwert/°C
Max. Spannungsabfall	2000 mA Bereich: weniger als 500 mV übrige Bereiche: weniger als 250 mV

II-1.5. Wechselstrommessungen

Messbereiche	2 µA; 20 µA; 200 µA; 2 mA; 20 mA; 200 mA; 2000 mA
Auflösung	1 nA im 2 µA Bereich
Genauigkeit (zwischen 9% und 100% des Bereichs)	± 0.3% der Anzeige ± 0.2% vom Bereichsendwert
Frequenzbereich	30 Hz ... 1 kHz
Temperaturkoeffizient	± 100 ppm vom Messwert/°C
Max. Spannungsabfall	2000 mA Bereich: weniger als 500 mV übrige Bereiche: weniger als 250 mV
Maximaler Spitzenfaktor, Bereichsende	2,4

II-1.6. Widerstandsmessurngen

Messbereiche	0,2 kΩ; 2 kΩ; 20 kΩ; 200 kΩ; 2 MΩ; 20 MΩ; 200 MΩ und 2000 MΩ
Auflösung	10 mΩ im 0,2 kΩ Bereich

Genauigkeit

Bereich:

0,2 kΩ	: ± 0,05%	der Anzeige	± 0,05% vom Bereichsendwert
2 kΩ ... 200 kΩ	: ± 0,05%	der Anzeige	± 0,02% vom Bereichsendwert
2 MΩ ... 20 MΩ	: ± 0,1%	der Anzeige	± 0,05% vom Bereichsendwert
200 MΩ	: ± 0,3%	der Anzeige	± 0,2% vom Bereichsendwert
2000 MΩ	: ± 1%	der Anzeige	± 0,5% vom Bereichsendwert

Maximale Mess-Spannung

200 MΩ und 2000 MΩ : 5 V
übrige Bereiche : 2 V
mit offenem Eingang : less than 10 V

Temperaturkoeffizient

Bereich:
0,2 kΩ ... 20 kΩ ± 100 ppm vom Messwert/°C
200 kΩ ... 20 MΩ ± 200 ppm vom Messwert/°C
200 MΩ ± 500 ppm vom Messwert/°C
2000 MΩ ± 1000 ppm vom Messwert/°C

II-2. ALLGEMEINE ANGABEN

Umgebungsbedingungen — IEC359 entsprechend

Klimatische Bedingungen — Nach Gebrauchsgruppe I mit erweiterter oberer Temperaturgrenze von + 50°C
Umgebungstemperatur: Referenzwert 23°C ± 1°C
Arbeitstemperatur-Nennbereich 0°C ... 50°C
Grenzwert für Lagerung und Transport −40°C ... + 70°C
Relative Luftfeuchtigkeit 20% ... 80%
(ausgsgenommen Kondensation)

Mechanische Bedingungen — Nach Gebrauchsgruppe II

Lieferbedingungen — Nach Gebrauchsgruppe II
Netz-Nennspannung 220 V −12% ; + 10%
Bemerkung: Die Verdrahtung des Netztransformators ist auf 92 V; 110 V; 128 V; 202 V und 238 V umschalter.
Netzfrequenz 50 Hz ± 5% : siehe II-2. Serientaktunterdrückung
Bemerkung: Das Gerät ist für 60 Hz umschaltbar.
Leistungsaufnahme 30 VA

Sicherheitsklasse — I nach IEC348

Anzeige — 7-Segment-Leuchtdiode, maximale Ablesung 19999
Bemerkung: Bei der Wechselspannung; Wechselstrom und den 200 MΩ und 2000 MΩ Bereichen wird die niedrigste Ziffer ausgetastet.

Dezimalzeichen — Hängt vom Bereich ab.

Polaritätsanzeige — + und −, automatisch

Überlaufanzeige — . 0 . . (Stellung des Dezimalzeichens ist abhängig vom Bereich)

Funktionsanzeige — mV; V; μA; mA; kΩ ; MΩ ; °C gekoppelt an die Funktionsschalter

Gleichtaktunterdrückung — 140 dB für Gleichspannung
100 dB für Wechselspannung (50/60 Hz)

Serientaktunterdrückung — 60 dB (50 Hz/60 Hz ± 0.1%)
40 dB (50 Hz/60 Hz ± 1%)

Analog/Digital-Umsetzungssystem — Integrierend

Integrationszeit — 100 msek.

Umsetzrate — 3.3 Ums./sek (50 Hz Einstellung)
4 Ums./sek (60 Hz Einstellung)

Umsetzzeit — 300 msek (50 Hz Einstellung)
250 msek (60 Hz Einstellung)

Ansprechzeit — In den Gleichspannungs- und kΩ Bereichen: max. 1,5 sek
mit Bereichsumschaltung: max. 1 sek
In den Wechselspannungs-; HF- und MΩ Bereichen: max. 1,5 sek
mit Bereichswahl: max. 6 sek; 3 sek und 5 sek bezw.
(Ausgenommen 2000 MΩ Bereich)

Anwärmzeit — ca. 30 Minuten

Neukalibrierungsabstand — 90 Tage

Höchstzulässige Spannungen:

V - 0	1000 V Gleich- oder Wechselspannung (siehe II-1.1. und II-1.2.)
A - 0	250 V Gleich- oder Wechselspannung geschützt durch Sicherung 3.15 A
Ω - 0	250 V Gleich- oder Wechselspannung
0 - Guard	250 V Gleich- oder Wechselspannung
Guard - Gehäuse	250 V Gleich- oder Wechselspannung

II-3. MECHANISCHE DATEN

Abmessungen — Höhe 88 mm
Breite 279 mm
Tiefe 328 mm

Gewicht — ca. 5,6 kg

III. ZUBEHÖREN

III-1. MIT DEM GERÄT WERDEN GELIEFERT (Abb. 1, Seite 44)

- Satz Mess-Schnüre PM 9260
- Abgeschirmtes Messkabel
- Durchverbindungsstreifen
- Netzkabel
- 2 Sicherungen 400 mA, träge 92 V - 118 V Netz } mit Klebezettel 110 V
- 1 Sicherung 200 mA, träge 202 V - 238 V Netz
- 3 Sicherungen 3.15 A, flink
- 2 Schutzwiderstände 100 Ω Metallschicht MR25 (R1116)
- 2 Abdeckhauben
- Gebrauchsanleitung

III-2. ZUSÄTZLICH LIEFERBAR

III-2.1. EHT-Messkopf PM 9246 (Abb. 2, Seite 44)

EHT-Messkopf PM 9246 ist für Gleichspannungsmessungen bis zu 30 kV geeignet.
Der PM 9246 kann an Messgeräte mit einer Eingangsimpedanz von 100 MΩ, 10 MΩ oder 1,2 MΩ (am Messkopf einstellbar) angeschlossen werden.

Max. Spannung	30 kV
Abschwächung	1000 x
Eingangswiderstand	600 MΩ ± 5%
Messfehler	± 3%
Relative Luftfeuchtigkeit	20% ... 80%

Bemerkung: Sicherheit der Erdverbindungen überprüfen.

III-2.2. **Stromwandler PM 9245 (Abb. 3, Seite 44)**

Dieser Stromwandler gestattet Wechselstrommessungen von 10 A bis 100 A.

Übertragungsfaktor	1000 x (100 A = 100 mA)
Übertragungsfehler	± 3%
Frequenzbereich	45 Hz ... 1 kHz
Sek. Spannungsverlust	weniger als 200 mV
Max. Spannung gegen Erde	400 V Wechselspannung

Vor einer Messung den Stromwandler an das Gerät anschliessen.
Kernteile vor Verschmutzung schützen.

III-2.3. **Shunt PM 9244 (Abb. 4, Seite 44)**

Dieser Shunt ermöglicht Messungen von Gleich- und Wechselströmen (max. 1 kHz) bis zu 31,6 A.

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

III-2.4. **Messkopf PM 9211 (Abb. 5, Seite 44)**

Der HF-Messkopf PM 9211 ist zusammen mit Digital-Multimeter PM 2527 für Messungen von 2 mV bis 2 V HF-Spannungen geeignet. Für Spannungen von 2 V bis 200 V ist ein kapazitiver Spannungsabschwächer mit einem Teilungsverhältnis von 100 : 1 vorgesehen.

Messkopf

Spannungsbereich	2 mV~ ... 2 V~
Frequenzbereich	100 kHz ... 1 GHz (mit T-Stück)
Fehlergrenze	± 3% des Bereiches bei 100 kHz (23°C)
Eingangskapazität	weniger als 2 pF
Frequenzverlauf	⩽ 3 dB bei 10 kHz und 1 GHz (siehe graphische Darstellung, Abb. 6 Seite 48)
Max. Eingangsspannung	30 V_{eff} überlagert auf 200 V Gleichspannung

100 : 1 Abschwächer

Abschwächung	100 : 1
Spannungsbereich	2 V~ ... 200 V~
Zusätzlicher Fehler	⩽ 0.5 dB ⩽ 3 dB bei 100 kHz und 1 GHz
Eingangskapazität	weniger als 2 pF
Max. Eingangsspannung	200 V_{eff} überlagert auf 500 V Gleichspannung

50 Ohm T-Stück

Impedanz	50 Ω
Frequenzbereich	100 kHz ... 1,2 GHz
Stehwellenverhältnis	1,25 bei 500 MHz mit angeschlossenem Messkopf 1,15 bei 1 GHz mit angeschlossenem Abschwächer

III-2.5. **Digitaler Ausgang PM 9237 (Abb. 7 und 8, Seite 48)**

Verwendung des PM 9237 ermöglicht Einsatz des PM 2527 in automatischen Mess-Systemen.

Ausgabesystem	Wortparallel - Bitparallel
Ausgabecode	BCD mit positiver Logik Nullpegel 0 ... 0,4 V Ein Pegel + 5 V oder, falls extern zugeführt und mit einer internen Verbindungsbrücke (Jumper) umgeschaltet, + 15 V. Isink 5 mA Ausgangswiderstand 8,2 kΩ
Ergebnis	10^0 ... 10^3 in BCD code 10^4

(8)	(4)	(2)	(1)		
0	0	0	0	0	
0	0	0	1	1	
1	0	1	0	*	überlauf

Bereiche

V⎓	V~	A⎓	A~	Ω	HF	Temp.	(8)	(4)	(2)	(1)
				0,2 kΩ			1	0	0	0
		2 µA	2 µA	2 kΩ			0	1	1	1
	20 mV	20 µA	20 µA	20 kΩ	20 mV		0	1	1	0
200 mV	200 mV	200 µA	200 µA	200 kΩ	200 mV		0	1	0	1
2 V	2 V	2 mA	2 mA	2 MΩ	2 V		0	1	0	0
20 V	20 V	20 mA	20 mA	20 MΩ			0	0	1	1
200 V	200 V	200 mA	200 mA	200 MΩ			0	0	1	0
1000 V	600 V	2000 mA	2000 mA	2000 MΩ		0 - 200°C	0	0	0	1

Funktionscode

	(8)	(4)	(2)	(1)	
Ω	0	0	0	1	1
A~	0	0	1	0	2
A⎓	0	0	1	1	3
V~	0	1	0	0	4
V⎓	0	1	0	1	5
Temp.	0	1	1	0	6
–	0	1	1	1	7

(Alle Funktionsschalter in Stellung "AUS")

Polaritätsanzeige

	(4)	(2)
+	0	1
–	1	0
~ oder Ω	1	1

Printbefehl : 0 negative Impulse; Breite 500 μs

Startbefehl : 0 negative Impulse; Breite $\geqslant 15\ \mu s$ < 100 ms

H = +2,4 V . . . +50 V
L = –1,5 V . . . 1 V

III-2.6. Digitalausgang PM 9238 (IEC-Busline)

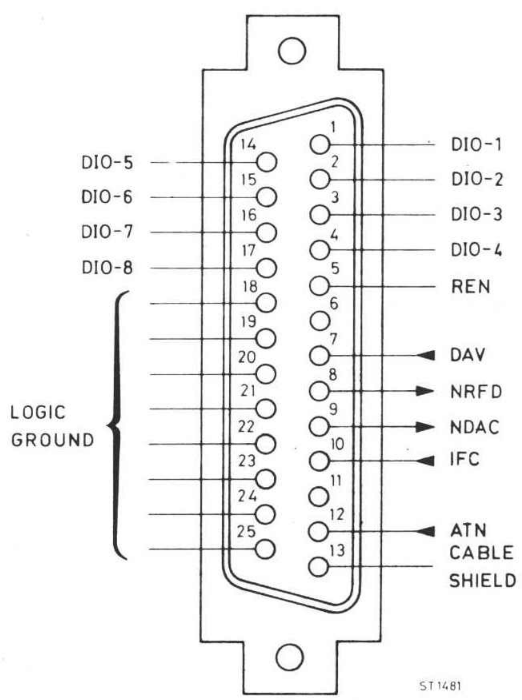
Das PM 9238 ist ein IEC-Busline Ausgang für das PM 2527.
Mit Hilfe des PM 9238 kann die Ausgangsinformation des PM 2527 in bit-parallem, wortseriellem Code, gemäss dem ISO-7-bit Code (ISO 646, ASCII) erfolgen.
Das PM 9238 kann als TALKER zum Auslesen der Messergebnisse und als LISTENER zum Starten des PM 2527 wirksam sein.

Technische Daten

Eingangs/Ausgangs-System	Bit-parallel-Zeichenseriell
Eingangs/Ausgangs-Code	ISO-7-bit Code (ISO 646) (ähnlich ASCII-Code) Eingangs/Ausgangs Pegel L = –0.5 V . . . +0.8 V H = +2 V . . . 5.5 V Logikpegel für die DIO-Leitungen L ≙ 1 H ≙ 0 entsprechend IEC-Bus, TC66

DIO 4	DIO 3	DIO 2	DIO 1									
				DIO 8	NOT CONNECTED							
				DIO 7	0	0	0	0	1	1	1	1
				DIO 6	0	0	1	1	0	0	1	1
				DIO 5	0	1	0	1	0	1	0	1
				row \ column	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	TC7 (DLE)	SP	0	@	P	\`	p
0	0	0	1	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0	0	1	0	2	TC2 (STX)	DC2	"	2	B	R	b	r
0	0	1	1	3	TC3 (ETX)	DC3	#	3	C	S	c	s
0	1	0	0	4	TC4 (EOT)	DC4	$	4	D	T	d	t
0	1	0	1	5	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0	1	1	0	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0	1	1	1	7	BEL	TC10 (ETB)	'	7	G	W	g	w
1	0	0	0	8	FE0 (BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE1 (HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE2 (LF)	SUB	*	:	J	Z	j	z
1	0	1	1	11	FE3 (VT)	ESC	+	;	K	[	k	{
1	1	0	0	12	FE4 (FF)	IS4 (FS)	,	<	L	~	l	|
1	1	0	1	13	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}
1	1	1	0	14	SO	IS2 (RS)	.	>	N	∧	n	‾
1	1	1	1	15	SI	IS1 (US)	/	?	O	—	o	DEL

Eingangs/Ausgangs Steckverbindung ST 1149



ISO 646 Tabelle

Listener Funktion

Listen Adresse	Programmierbar Bei Auslieferung 0110110 (ISO-7-bit Code "6")
Start Befehl	0001000 (ISO-7bit Code "BS")

Talker Funktion

Talker Adresse	Programmierbar Bei Auslieferung 1010110 (ISO-7-bit Code "V")
Auslesung	Die Messergebnisse werden ausgelesen in: Volt V Milliampere MA Megohm MO Grad Celsius DG

Beispiel: V 02156E - 1   MA + 10272E - 1
V + 03322E - 2   MO 15743E - 1
DG 00337E - 1

Zeichen-Nr.	Zeichen	Funktion
1	Leerstelle M D	Spannungsmessungen Strom/Widerstandsmessungen Temperaturmessungen
2	V A O G	Spannungsmessungen Strommessungen Widerstandsmessungen Temperaturmessungen
3	+ – Leerstelle	pos. Spannung, Strom oder Temperatur neg. Spannung, Strom oder Temperatur Wechselspannung, Wechelstrom und Widerstandsmessungen
4	0, 1 *	10^4 überlast
5	0/9 *	10^3 überlast
6	0/9 *	10^2 überlast
7	0/9 *	10^1 überlast
8	0/9 *	10^0 überlast
9	E	Erster Buchstabe von "EXPONENT"
10	–	Negatives Vorzeichen
11	0/8	Exponent der Grundzahl 10
12	ETX	Ende der "EOS" Kette Programmierbar Bei Auslieferung 0000011 (ISO-7-bit Code ETX)

III-2.7. Temperatureinheit PM 9257

Verwendung des PM 9257 ermöglicht Temperaturmessungen mit dem PM 2527.
Die Temperatur kann mit einem Pt-100 Messkopf oder mit Messkopf PM 9248 gemessen werden.
Die Anpassung an die verschiedenen Messköpfe geschieht intern im PM 9257 mit Hilfe eines Schalters.

Technische Daten

Bereich		$-60^oC \ldots +200^oC$
Genauigkeit:	Nach Kalibrierung (Messkopf ausgenommen) für Messkopf Pt-100	$-60^oC \ldots 0^oC$ ± 0.3% ± 1% des Messwerts $0^oC \ldots +200^oC$ ± 0.3% ± 0.5% des Messwerts
	Einschliesslich Messkopf PM 9248 nach Kalibrierung	± 5^oC ± 1% des Messwerts ± 0.005% des Bereichs
Temperaturkoeffizient		± 50 Teil je Million des Bereichs ± 150 Teil je Million des Messwerts/^oC (Bezugswert 23^oC)

III-2.8. Widerstandsthermometer PM 9248 (sieh Seite 52)

Der Widerstandsthermometer PM 9248 ist ein Tastkopf für Messungen von Oberflächentemperaturen zwischen -60^oC und $+200^oC$ in Verbindung mit den Multimetern PM 2527.

Technische Daten in Verbindung mit PM 2527

Arbeitsbereich	$-60^oC \ldots +200^oC$
Auflösung	0.1^oC
Fehlergrenze	± 1% der Ablesung ± 1^oC
Höchstzulässige Spannung an der Tastkopfspitze	60 V

III-2.9. Analogausgang PM 9255

Das PM 9255 ist ein Analogausgang für das PM 2527.
Das PM 9255 liefert in allen Bereichen eine analoge Ausgangsspannung, die dem an den Eingang des PM 2527 gelegten Signal proportional ist.

Technische Daten

Ausgangsimpedanz	200 Ω
Ansprechzeit	< 500 m/s
Linearität	0.3%
Auflösung	0.05%
Temperaturkoeffizient	500 Teil je Million/^oC des Bereichs
Ausgangsspannung	2 V (Bereichsende)

III-2.10. Gestelleinbausatz PM 9669/03 (sieh Seite 52)

Der Einbausatz PM 9669/03 wird zum Einbau des PM 2527 in ein 19" Gestell verwendet.

IV. ARBEITSWEISE (Abb. 9, Seite 56)

IV-1. EINGANGSSCHALTUNG

Die Eingangsschaltung des PM 2527, bestehend aus den Eingangs-Abschwächern, Gleich- und Wechselspannungsverstärker, führt am Ende des Bereichs dem Analog-Digital-Umsetzer eine Gleichspannung von 2 V zu.

- Gleichspannung
  Der Eingang wird mit den Abschwächern verbunden, die die unbekannte Gleichspannung dem Bereich entsprechend herunterteilen. Die abgeschwächte Spannung wird dem 1x/10x Gleichspannungsverstärker zugeführt. Die dem Analog-Digital-Umsetzer zugeführte Gleichspannung ist bei Bereichsende 2 V.
- Gleichstrom
  Der Eingang wird dem Shunt, dessen Wert dem jeweiligen Bereich angepasst ist zugeleitet. Der Spannungsabfall über den Shunt wird dem 1x/10x Gleichspannungsverstärker zugeführt. Am Ende des Bereichs ist die dem Analog-Digital-Umsetzer zugeführte Spannung 2 V.
- Wechselspannung
  Der Eingang wird mit den Abschwächern verbunden, die die unbekannte Wechselspannung dem Bereich entsprechend herunterteilen. Diese abgeschwächte Spannung wird dem Impedanzwandler, dem Wechselspannungsverstärker und dem Effektivwertumsetzer zugeführt. Am Ende des Bereichs ist die Ausgangsspannung des Effektivwertumsetzers 5 V. Diese Spannung wird durch 2,5 geteilt und dem Analog-Digital-Umsetzer zugeleitet.
- Wechselstrom
  Gleich an Wechselspannung, ausgenommen dass der Eingang dem Shunt zugeführt wird. Der Spannungsabfall über den Shunt wird dem Impedanzwandler zugeleitet.
- Bei Widerstandmessungen wird der unbekannte Widerstand zusammen mit einer Stromquelle mit der Rückkopplungsschaltung des 1x/10x Gleichspannungsverstärkers verbunden. Am Bereichsende ist der Eingang des Analog-Digital-Umsetzers 2 V.
- HF-Spannungsmessungen werden nach dem Kompensationsverfahren ausgeführt. Zu diesem Zweck ist ein 100 kHz Oszillator, dessen Amplitude vom Gleichspannungsverstärker geregelt wird, in die HF-Schaltung eingefügt. Im Messkopf wird die unbekannte HF-Spannung mit dem 100 kHz Signal verglichen. Die Amplitude des 100 kHz Signal kommt der Amplitude des über den Gleichspannungsverstärker gesteuerten HF Signals gleich. Dieses 100 kHz Signal wird dem Impedanzwandler und den Wechselspannungsverstärkern zugeführt und gemessen.
- Funktionsschaltung wird von Hand ausgeführt.
- Bereichsschaltung wird entweder von Hand, mit Hilfe der "RANGING" auf/ab Schalter, oder volkommen automatisch ausgeführt.
- Abtastung geschieht automatisch ($3^1/_3$ Messungen/Sekunden) oder manuell mit Hilfe des "START" Schalters.

IV-2. ANALOG-DIGITAL-UMWANDLUNG

Die Umsetzung analoger Signale in digitale Form erfolgt beim PM 2527 nach dem Integrationsprinzip.
Das analoge Eingangssignal gelangt an den Integrator.
Der dem Integrator folgende Komparator liefert einen Ausgangsimpuls, dessen Länge proportional zum Messwert ist. Abb. 11, Seite 56 zeigt eine graphische Darstellung der Ausgangsspannung des Integrators in Abhängigkeit von Zeit während der Lade- und Entladephase.
Bei der Integration sind zwei wichtige Zustände zu unterscheiden, nämlich die Aufwärts-Flanke (erster Schritt) und die Abwärts-Flanke (zweiter Schritt) Zustand.

Beim ersten Schritt (Start) wird dem Integrator ein Strom zugeführt, der der Eingangsspannung proportional ist. Die Ausgangsspannung steigt linear mit der Zeit an. Ihre Richtung ist von der Polarität und ihre Steigung von der Grösse der Eingangsspannung abhängig, Die Integrationszeit wird von der Dauer von 20,000 Taktimpulsen (100 ms) bestimmt.
In dieser Zeit wird die Aufwärtsflanke eingeleitet und wird der Integrationskondensator geladen.
Im zweiten Schritt wird der Kondensator mit einem konstanten Strom gegen Null entladen. Der Integrator wird durch Anschluss einer Referenzspannung an den Eingang entladen. Die Polarität der Referenzspannung ist der Polarität der zugeführten Eingangsspannung entgegengesetzt.
Die Entladung wird vom Entladungsstrom und folglich vom Referenzstrom bestimmt, so dass sie konstant bleibt.
Die Zeit $t_1 - t_2$ Abwärtsflanke wird durch Abzählen von Taktimpulsen gemessen; sie ist direkt proportional, der beim ersten Schritt angelegten unbekannten Eingangsspannung. Da die gleichen Integrationselemente und der Taktgenerator für Aufwärts- und Abwärtsintegration verwendet werden, haben Temperaturänderungen, Langzeitstabilität und Absolutwerte keinerlei Einfluss auf die Messgenauigkeit.
Die Messgenauigkeit ist in erster Linie von der Genauigkeit der Referenzspannung abhängig.

IV-3. DIGITAL TEIL

- Allgemeines
  Während der Aufwärtsintegration des Analog-Digital Umsetzers, werden 20,000 Taktimpulse des CLOCK OSCILLATORS vom COUNTER/MEMORY - Teil des PM 2527 gezählt.
  Nach 20.000 Taktimpulsen liefert der COUNTER/MEMORY einen Zustandsimpuls ($t_o - t_1$) über PROGRAM an den Analog-Digital-Umsetzer und die Abwärtsintegration wird eingeleitet.
  Die Zahl der während der Abwärtsflanke ($t_1 - t_2$) abgezählten Impulse, sind proportional der Höhe des an den Eingang des PM 2527 angelegten Signals.
  Beim Nulldurchgang des Analog-Digital-Umsetzers (t_2) werden die vom COUNTER/MEMORY abgezählten Taktimpulse in den Speicher übertragen. Der Ausgang des SPEICHERS wird vom SCAN OSCILLATOR (1 kHz) abgetastet. Die abgetastete BCD Information gelangt über den BCD - 7 - Segment CODE UMSETZER and die ANZEIGE. Zugleich steuert der SCAN OSCILLATOR die Anodenschalter, um aufeinander folgende Ablesung zu erhalten.
- Automatische Bereichsumschaltung
  Wenn während der Abwärtsflanke die Zahl der abgezählten Impulse weniger als 01800 beträgt (Bereichsänderung nach unten) oder mehr als 20.000 (Bereichsänderung nach oben) und automatische Bereichsumschaltung eingeschaltet ist, dann werden Aufwärts- oder Abwärtsimpulse der AUTOMATIC RANGE-Schaltung zugeführt für Steuerung der RANGE SELECTOR RELAYS.
  Zugleich mit der Funktionsinformation werden die Reedkontakte der Spannungsabschwächer, die Shunts, die Speisequelle und die Gewinnfaktoren der Verstärker von der RANGE SELECTOR Schaltung geschaltet.
- Bereichsumschaltung von Hand
  Die Bereichswahlschalter MAN und UP/DOWN ermöglichen manuelle Bereichsumschaltung.
  Die UP/DOWN Information der Schalter wird dem Aufwärts-/ Abwärtszähler der AUTOMATIC RANGE-Schaltung zugeführt, die die verschiedenen Bereiche einstellt.
- Die PROGRAM-Schaltung bewirkt die manuelle oder automatische Abtastung, PROGRAM AUTOMATIC RANGE COUNTER und MEMORY sind in zwei LSI Schaltungen nämlich OQ052 und GZF1201 untergebracht.

V. INSTALLATION — GEBRAUCHSANWEISUNG

Vor Ausführung irgendeiner Verbindung muss die Erdschutzklemme mit einem Schutzleiter verbunden werden. (siehe Abschnitt Erdung)

V-1. NETZBETRIEB UND SICHERUNG

Vor Anschlusse des Netzsteckers an die Netzspannung, ist darauf zu achten dass das Gerät für die örtliche Netzspannung eingestellt ist.
Das Gerät ist für ein 220 V – 50 Hz Netz eingestellt.

V-1.1. Anpassung der Netzspannung (Abb. 12 und 13, Seite 60)

Anpassungen für andere Netzspannungen ist durch Umschaltung der Verdrahtung des Netztransformators möglich.
Um das Gerät von einem 220 V – 50 Hz Netzbetrieb an ein 100 V – 50 Hz Netz anzupassen ist die Verdrahtung der Verbindungen 2 und 14, sowie 3 und 13 zu verwechseln.

Für Anpassung des Gerätes von 220 V – 50 Hz oder 110 V – 50 Hz an 202 V und 238 V oder 92 V und 128 V Netze ist wie folgt vorzugehen:

- Deckel abnehmen
- Durch Entfernung der Schrauben A und Lockern der Schrauben B den Transformator abmontieren
- Die Verdrahtung der Verbindungen 4, 5, 6 und 14 gemäss ändern
- Transformator wieder montieren.

Bemerkung: Für 110 V Spannung ist ein Klebezettel mitgeliefert. Damit kann "220 V." des Textes "CONNECTED FOR 220 V" an der Rückseite überklebt werden.

V-1.2. Sicherung

Die Netzsicherung befindet sich rechts vom Netztransformator.
Um die Netzsicherung zu ersetzen muss der Deckel, nach Lockern Schraube A abgenommen werden. (Abb. 16, Seite 64).

Netzspannung	Erforderlich Sicherung VL1
202 V – 238 V	200 mA, träge
92 V – 128 V	400 mA, träge

V-1.3. Anpassung der Netzfrequenz für maximales SMMR bei 60 Hz

Anpassung des Gerätes an ein 60 Hz Netzfrequenz ist wie folgt auszuführen:

- Grundplatte entfernen, nach Lockern der Schrauben A
- Die Durchverbindungen zwischen den Lötstellen gemäss den Angaben in Abb. 14, Seite 64, ausführen
- Die Grundplatte wieder montieren.

V-1.4. Allgemeines

Die Anpassung des Gerätes auf die örtliche Netzspannung oder die richtige Netzfrequenz darf nur von geschulten Personen, die sich der möglichen Gefahren bewust sind, vorgenommen werden.
Bei Ersetzen einer Sicherung oder beim Umschalten auf eine andere Netzspannung oder Frequenz darf das Gerät an keine Spannungsquelle angeschlossen sein.

V-2. ERDUNG

Vor dem Einschalten muss das Gerät auf einer der folgenden Weise an eine Erdschutzleitung angeschlossen werden:

- über das 3-polige Netzkabel, Der Netzstecker darf nur an eine Steckdose mit Schutzerdekontakt angeschlossen werden. Ersetzen des Netzkabels geschieht auf eigene Gefahr.
- über die Erdschutzklemme an der Geräterückseite.

VORSICHT: Jede Unterbrechung des Schutzleiters, innerhalb oder ausserhalb des Gerätes, oder Trennung der Erdschutzklemme ist gefährlich.
Absichtliche Unterbrechung ist nicht gestattet.

Wenn ein Gerät aus kalter in warme Umgebung gebracht wird, kann Kondensation einen gefährlichen Zustand verursachen.
Deshalb ist darauf zu achten, dass die Erdungsvorschriften genauesten befolgt werden.

VI. BEDIENUNG

VI-1. EINSCHALTEN

Das Gerät ist nach Verbindung mit dem Netz und nach Erdung betriebsbereit.
Es wird mit dem Netzschalter POWER eingeschaltet.
Um die hohe Genauigkeit des Instrumentes voll auszunutzen, sollten die Messungen erst nach einer Einlaufzeit (Aufheizen) von 30 Minuten begonnen werden.

VI-2. BEDIENUNGSELEMENTE

VI-2.1. Frontplatte (Abb. 15, Seite 64)

Nr.	Bezeichnung		Funktion
SK1	POWER		Einschalten des Gerätes
SK2	V⎓ ; V~; A⎓ ; A~; Ω; PROBE		Einschalten der erforderlichen Messfunktion
SK3	START		
		AUT	Messfolg: $3\,^1/_3$ Messungen/Sek.
		EXT	Start wird extern ausgeführt.
		MAN	Messung wird von Hand gestartet.
SK4	RANGING		
		AUT	Automatische Bereichswahl
		MAN	Jede beliebige Bereichswahl mit UP/DOWN Schalter.
SK5	RANGING MAN		
		UP	Wahl eines höheren Bereichs
		DOWN	Wahl eines niedrigeren Bereichs
BU1	PROBE		HF-Eingang/Temp. Messkopfeingang (auf Wunsch lieferbar)
BU2	GUARD		
BU3	0		Gemeinsamer Eingang
BU4	V		Spannungseingang
BU5	Ω		Widerstandseingang
BU6	A		Stromeingang
R1903	I in		Einstellung Eingangsstrom Gleichstromverstärker

VI-2.2. Rückseite (Abb. 16, Seite 64)

Nr.	Bezeichnung	Funktion
BU7	DIGITAL OUTPUT	Ausgang von PM 9237 } Auf Wunsch lieferbar
		Ausgang von PM 9238 } Auf Wunsch lieferbar
BU8	ANALOG OUTPUT	Ausgang von PM 9255 } Auf Wunsch lieferbar
BU9	EXT. START	Externer Start einer Messung
VL1	FUSE	Netzsicherung 200 mA, träge 202 V – 238 V 400 mA, träge 92 V – 128 V
	⏚	Erdklemme

VI-3. NULLPUNKTEINSTELLUNG

Vor Beginn der Nullpunkteinstellung soll das Gerät 30 Minuten warmgelaufen sein.

- Taste V⎓ eindrücken
- Die Anzeige mit offenem Eingang auf Minimumwert, weniger als 20 digit, (+ und – Vorzeichen leuchtet abwechselnd auf) mit Potentiometer "I in" einstellen.
- V und 0 Buchsen kurzschliessen
- Die Ablesung sollte 000.00 ± 1 Stelle anzeigen.

Bemerkungen: Die vollständigen Einstellangaben sind Kapitel X "Checking and adjusting" zu entnehmen.

VI-4. MESSEN

VI-4.1. Funktionswahl

Die Messfunktion ist mit Hilfe der Funktionswahlschalter laut nachstehender Tabelle einstellbar.

Funktionswähler	Eingangsbuchsen	Messbereiche
V⎓	V —— 0	10 µV bis 1000.0 V Gleichspannung
V~	V —— 0	1,8 mV bis 600 V Wechselspannung Auflösung 10 µV
A⎓	A —— 0	100 pA bis 2000.0 mA Gleichspannung
A~	A —— 0	0,18 µA bis 2000 mA Wechselspannung Auflösung 1 nA
Ω	Ω —— 0	10 mΩ bis 2000 MΩ
Messkopf	Messkopf mit Verwendung von HF Messkopf PM 9211	1,8 mV bis 200 V Wechselspannung Auflösung 10 µV Frequenzbereich: 100 kHz ... 700 MHz

VI-4.2. Automatische Bereichswahl

Schalter RANGING in Stand AUT. bringen.
Bereichswahl geschieht nun automatisch.
UP Pegel 19999, DOWN Pegel 01800.
Um Hysterese bei automatischer Bereichswahl zu beseitigen, kann mit Hilfe des UP-DOWN Schalters ein höherer oder ein niedriger Bereich gewählt werden.

Zwischen 18000 und 19999 Bereichswahl nach oben
Zwischen 01800 und 01999 Bereichswahl nach unten

VI-4.3. Bereichswahl von Hand

Schalter RANGE in Stand MAN bringen.
Den richtigen Messbereich mit Hilfe von Schalter UP-DOWN wählen
1 x eindrücken = 1 Bereichsschritt.

VI-4.4. Starten der Messungen

Die Messungen können auf dreierlei Weise gestartet werden:

- *Automatisch* mit Wahlschalter START in Stand AUT.
  Messgeschwindigkeit: 3 1/3 Messungen/Sek. (50 Hz Einstellung)
- *Von Hand* den Wahlschalter START von EXT auf MAN stellen.
  Das Gerät misst solange der Schalter in Stand MAN gehalten wird.
- *Extern* mit Wahlschalter START auf Stand EXT.
  Uber BNC-Konnektor EXT kann dann für jede Messung ein Startimpuls geliefert werden.
  START (Abb. 16, Seite 64) oder über Digitalausgang.

Startimpulse: negativ gehender Impuls, Breite $> 15\ \mu s$ < 100 ms
H = + 2,4 V ... + 20 V
L = − 20 V ... + 1 V

Um eine Gleichspannungkopplung zwischen EXT. Starteingang und Startschaltung zu erreichen, muss zwischen den Lötstiften A (Abb. 17, Seite 68) eine Durchverbindung ausgeführt werden.
Im Fall eines externen Starts (EXT. START) misst das Gerät wenn der Eingang logisch Null ist.
Der externe Start-Eingang (über den BNC-Konnektor) ist gegen eine Eingangsspannung bis 250 V geschützt (Erholungszeit ca. 5 Minuten).

BEMERKUNGEN:
- Zur Fixierung des Messwertes ist Schalter START auf EXT zu stellen, ohne Startimpulse zu liefern. Dadurch wird die gesamte Anzeige, wie sie vor Einstellung des Schalters START, oder nach jedem Startimpuls vorlag, festgehalten.
- Nach jedem Startimpuls wird eine vollständige Messung, einschl. Bereichswahl, ausgeführt.

VI-4.5. Beispiele von Messungen mit GUARD Verbindung

Das digitale Multimeter PM 2527 ist mit einer Abschirmung (GUARD) ausgerüstet. Sie dient als Zusätzlicher Schirm zwischen Null und Masse (Erdung) wodurch die Leckimpedanz gegen Masse erhöht wird.
Diese erhöhte Lechimpedanz verbessert die Gleichtaktunterdrückung.
Die GUARD kann mit einer gesonderten Schnur mit der Schaltung verbunden werden.
Vorschriftsmässiger Einsatz der Guard ergibt eine bessere Gleichtaktunterdrückung und höhere Messgenauigkeit, vor allem in den empfindlichsten Bereichen.

Für einen wirkungsvollen Anschluss der Abschirmung, sind folgende Regeln zu beachten:

- Die zu messende Spannungsquelle ist mit einem abgeschirmten Messkabel an das PM 2527 anzuschliessen. Dieses Verfahren unterdrückt Störsignale.
- Der Schutzschirm (GUARD) ist mit dem gleichen Potential zu verbinden, wie die Eingangsbuchse "0".
- Die GUARD ist derart anzuschliessen dass kein Gleichtaktstrom durch eine Quellimpedanz fliessen kann.

VI-4.6. Gleichspannungsmessungen

- Schalter V⎓ drücken
- Die Spannungsquelle an Buchsen V − 0 anschliessen

ANMERKUNGEN:
- Die höchstzulässigen Eingangsspannung ist 1000 V Gleichspannung und Wechselspannung, Spitze-Spitze, kontinuierlich in allen Bereichen.
- Spannungen von 1 kV bis 30 kV können mit dem Hochspannungsmesskopf PM 9246 gemessen werden.
- Den Impedanzschalter dieses Messkopfes auf 10 MΩ stellen.
- Die Anzeige der Polarität erfolgt automatisch.
- Für Gleichspannungen höher als 1000 V erfolgt eine Uberlaufanzeige.

VI-4.7. Wechselspannungsmessungen

- Schalter V~ drücken
- Die Spannungsquelle an Buchsen V − 0 anschliessen

ANMERKUNGEN:
- Anwendung eines thermischen Effektivewertumsetzungssystems ermöglicht wechselspannungsgekoppelte Effektivwertmessungen. Nur Spannungen zwischen 9% und 100% des Bereichs, können bei diesem Verfahren mit höchster Genauigkeit gemessen werden. Bei Bereichswahl von Hand muss der optimale Bereich gewählt werden.
- Maximale Eingangsspannung: 600 V Wechsel- oder Gleichstrom.
- Für Spannungen über 600 V_{eff} erfolgt keine Uberlaufanzeige.

VI-4.8. HF-Spannungsmessungen mit HF-Messkopf PM 9211

- Schalter PROBE drücken
- Die Spannungsquelle über den Messkopf PM 9211 mit Eingang "PROBE" verbinden
- Für Spannungen zwischen 2 V und 200 V, ist der 100 : 1 Teiler zu verwenden
- Für Messungen von Spannungen und Frequenzen über 100 MHz ist das 50 Ω T-Stück zu verwenden.

ANMERKUNGEN:
- Nur Spannungen zwischen 9% und 100% des Bereichs, können bei diesem Verfahren mit höchster Genauigkeit gemessen werden.
  Bei Bereichswahl von Hand muss der optimale Bereich gewählt werden.
- Siehe auch Gebrauchsanleitung für PM 9211.

VI-4.9. Gleichstrommessungen

- Schalter A⎓ drücken
- Den zu messenden Strom an Buchsen A − 0 anschliessen

ANMERKUNGEN:
- Maximal zulässiger Eingangsstrom 2 A.
- Ströme bis zu 31,6 A können mit Shunt PM 9244 gemessen werden.
- Polarität wird automatisch angezeigt.

VI-4.10. Wechselstrommessungen

- Schalter A~ drücken
- Den zu messenden Strom an Buchsen A − 0 anschliessen

ANMERKUNGEN:
- Anwendung eines thermischen Effektivwertumsetzungssystems ermöglicht wechselspannungsgekoppelte Effektivwertmessungen. Nur Spannungen zwischen 9% und 100% des Bereichs, können bei diesem Verfahren mit höchster Genauigkeit gemessen werden. Bei Bereichswahl von Hand muss der optimale Bereich gewählt werden.
- Maximal zulässiger Eingangsstrom 2 A.
- Ströme bis 100 A sind mit Hilfe des Stromwandlers PM 9245 zu messen.

VI-4.11. Widerstandsmessungen

- Schalter "R" drücken
- Den unbekannten Widerstand an Buchsen Ω – 0 anschliessen

ANMERKUNGEN:
- Höchstzulässige Spannung an Eingangsbuchsen bei Widerstandsmessungen ist 250 V. Die Stromquelle ist durch einen PTC Widerstand geschützt. Wenn ein zu hoher Strom (> 20 V) an die Buchsen Ω – 0 gelegt wird, können erst nach einer Wartezeit von 5 Minuten, um den PTC Widerstand abkühlen zu lassen, von neuem Widerstandsmessungen ausgeführt werden.
- Bei Messungen im 2000 MΩ Bereich ist Nullpunkteinstellung (siehe Abschnitt VI-3. Nullpunkteinstellung) vorzunehmen.

VII. FEHLERSUCHE

Da dieses Multimeter mit grösster Sorgfalt entwickelt und zusammengesetzt wurde, ist die Gefahr von Funktionsstörungen äusserst gering.
Sollte eine Funktionsstörung eintreten, ist es jederzeit möglich, sich mit der nächsten Philips Service Organisation in Verbindung zu setzen.
Um bei jedoch einfachen Störungen Zeit- und Kostenaufwand zu vermeiden, kann der Gebraucher mit Hilfe nachstehender Liste versuchen den Defekt zu ermitteln und die nötigen Reparaturen ausführen.

Vor jeder Uberprüfung ist darauf zu achten dass das Gerät an die richtige Netzspannung angeschlossen ist und dass diese Spannung auch tatsächlich das Gerät speist.

Funktionsstörung	**Vermutliche Ursache**	**Behebung**
Multimeter funktioniert nicht.	Sicherung VL1. Netzkabel defekt.	VL1 nächst dem Netztransformator ersetzen. Zugänglich nach Abnahme des Deckels. Netzkabel überprüfen.
Strommessung funktioniert nicht.	Sicherung VL1201.	Sicherung VL1201 ersetzen. Zugänglich nach Abnahme des Deckels. Siehe Abb. 18, Seite 68.
Spannungsmessung funktioniert nicht.	Widerstand R1116.	R1116 ersetzen. Zugänglich Abnahme von Deckel und Guardabdeckung (Abb. 19, Seite 68). Es ist zu beachten, dass ein 100 Ω Metallschichtwiderstand verwendet wird.
Widerstandsmessung funktioniert nicht. Nach Anschluss einer zu hohen Spannung an Eingang Ω.	PTC Widerstand R1311.	Etwa 5 Minuten warten, damit der PTC Widerstand R1311 abkühlen kann.
Externer Start über BNC-Eingang an der Rückseite funktioniert nicht, nach Anschluss einer zu hohen Spannung an den Start-Eingang	PTC Widerstand R2525.	Etwa 5 Minuten warten, damit der PTC Widerstand R2525 abkühlen kann.

I. INTRODUCTION

GENERALITES

Le PM 2527 est un multimètre de haute qualité à 4½ chiffres d'affichage et pourvu d'une sélection automatic ue de gammes.

L'appareil peut mesurer:

quantité	gamme inférieure	gamme supérieure	résolution maximale
- tensions continues	200 mV	1000 V	10 μV
- tensions alternatives	20 mV	600 V	10 μV
- courants continus	2 μA	2 A	100 pA
- courants alternatifs	2 μA	2 A	1 nA
- résistances	200 Ω	2 GΩ	10 mΩ
- hautes tensions	20 mV	200 V	10 μV

Toutes les fonctions de mesure sont protégées.

Du fait des mesures efficaces la précision dans les gammes alternatives est indépendante de la forme d'onde.
L'application de circuits LSI diminuent le nombre de composants discrets et garnatissent haute précision et stabilité.
Le boîtier intérieur isolé (guard) permet d'effectuer des mesures flottantes pour forte réjection en mode commun.
Lorsque le PM 2527 est accouplé avec la sortie digitale en option PM 9237, toutes les informations telles que fonction, gamme, polarité, valeur mesurée, surcharge, etc peuvent être transmises à une imprimante, un petit convertisseur parallèle-série, etc. De la sorte, le multimètre PM 2527 peut être utilisé dans des petits dispositifs de collection de données, comme par exemple le Système Automatique de Mesure Philips.
Par sa haute sensibilité, sa grande précision et la possibilité de sortie numérique, le PM 2527 offre une large gamme d'applications dans les domaines de la recherche et du développement.

II. CARACTERISTIQUES TECHNIQUES

Toutes les valuers mentionnées dans la présente notice sont nominales; les valeurs mentionnées avec tolérances sont formelles et garanties par le fabricant.

II-1. CARACTERISTIQUES ELECTRIQUES

Conditions de référence — Température 23°C ± 1°C
Humidité relative < 70%

II-1.1. Mesure de tension continue

Gamme	200 mV; 2 V; 20 V; 200 V; 1000 V
Résolution	10 μV dans la gamme 200 mV
Précision	± 0,02% de l'affichage ± 0,02% de la gamme (Fin de gamme dans la gamme 1000 V est 2000 V)
Coefficient de temperature	± 50 ppm d'affichage/°C
Résistance d'entrée	10 MΩ ± 1%
Courant offset d'entrée	Inférieure à 20 pA
Tension maximale d'entrée	Gammes 200 mV et 2 V: 750 V continue 1000 V pendant 1 min. Autres gammes: 1000 V continue

II-1.2. Mesure de tension alternative

Gamme	20 mV; 200 mV; 2 V; 20 V; 200 V; 600 V
Résolution	10 μV dans la gamme 20 mV
Précision (entre 9% et 100% de gamme)	Gammes 20 mV; 200 mV et 2 V Gamme de fréquence: 30 Hz à 100 kHz ± 0,2% d'affichage ± 0,2% de gamme Gammes 20 V; 200 V et 600 V Gamme de fréquence: 30 à 1 kHz ± 0,2% d'affichage ± 0,2% de gamme (Fin de gamme dans la gamme 600 V est 2000 V) Gamme de fréquence: 1 kHz à 100 kHz ± 0,4% d'affichage ± 0,2% de gamme
Coefficient de température	± 100 ppm de gamme/°C
Impédance d'entrée	10 MΩ shunté par 100 pF
Facteur maximal de crête en fin de gamme	2,4
Produit maxi V – Hz	10^7

II-1.3. Mesures de tension HF

A mesurer avec la sonde PM 9211.

Gamme de fréquence	100 kHz à 700 MHz
Gamme de tension	20 mV 200 mV; 2 V; 20 V; 200 V
Résolution	10 μV dans la gamme 20 mV
Précision (entre 9% et 100% de gamme)	voir PM 9211, chapitre III-2.4.

II-1.4. Mesure de courant continu

Gamme	2 μA; 20 μA; 200 μA; 2 mA; 20 mA; 200 mA et 2000 mA
Résolution	100 pA dans la gamme 2 μA
Précision	± 0,1% d'affichage ± 0,05% de gamme
Coefficient de température	± 100 ppm d'affichage/°C
Chute de tension maximale	gamme 2000 mA: inférieure à 500 mV autres gammes : inférieure à 250 mV

II-1.5. Mesure de courant alternatif

Gamme	2 μA; 20 μA; 200 μA; 2 mA; 20 mA; 200 mA; 2000 mA
Résolution	1 nA dans la gamme 2 μA
Précision (entre 9% et 100% de gamme)	± 0,3% d'affichage ± 0,2% de gamme
Camme de fréquence	30 Hz à 1 kHz
Coefficient de température	± 100 ppm de gamme/°C
Perte de tension maximale	gamme 2000 mA: inférieure à 500 mV autres gammes : inférieure à 250 mV
Facteur maximal de crête en fin de gamme	2,4

II-1.6. Mesures de résistance

Gamme	0,2 kΩ ; 2 kΩ ; 20 kΩ ; 200 kΩ ; 2 MΩ ; 20 MΩ ; 200 MΩ et 2000 MΩ
Résolution	10 mΩ dans la gamme 0,2 kΩ

Précision	Gamme: 0,2 kΩ : ± 0,05% d'affichage ± 0,05% de gamme 2 kΩ à 200 kΩ : ± 0,05% d'affichage ± 0,02% de gamme 2 MΩ à 20 MΩ : ± 0,1% d'affichage ± 0,05% de gamme 200 MΩ : ± 0,3% d'affichage ± 0,2% de gamme 2000 MΩ : ± 1% d'affichage ± 0,5% de gamme
Tension maximale de mesure	Gammes 200 MΩ et 2000 MΩ : 5 V Autres gammes : 2 V avec bornes d'entrée ouvertes : inférieure à 10 V
Coefficient de température	Gamme: 0,2 kΩ à 20 kΩ ± 100 ppm d'affichage/°C 200 kΩ à 20 MΩ ± 200 ppm d'affichage/°C 200 MΩ ± 500 ppm d'affichage/°C 2000 MΩ ± 1000 ppm d'affichage/°C

II-2. CARACTERISTIQUES GENERALES

Conditions d'environnement	Conformément à IEC359
Conditions climatiques	Groupe I avec extension de la limite supérieure de température à + 50°C Température ambiante: valeur de référence 23°C ± 1°C Gamme d'utilisation: 0°C à 50°C Gamme limite d'emmagasinage et de transport –40°C à + 70°C Humidité relative: 20% à 80% (condensation excluse)
Conditions mécaniques	Groupe II
Conditions d'alimentation	Groupe II Secteur nominal 220 V –12% +10% *Remarque: Le câblage du transformateur secteur peut être modifié pour secteurs 92 V; 110 V; 128 V; 202 V et 238 V.* Fréquence secteur: 50 Hz ± 5%, voir II-2. réjection en mode série *Remarque: L'appareil peut être adapté pour fréquence secteur 60 Hz ± 5%.* Consommation de puissance 30 VA
Sécurité	I conforme à IEC348
Affichage	LED à 7 segments, maxi 19999 *Remarque: En tension alternative, courant alternatif, dans les gammes 200 MΩ et 2000 MΩ, le chiffre le moins significatif est supprimé.*
Point décimal	Dépend de la gamme
Indication de polarité	+ et –, automatique
Indication de dépassement	. 0 0 . . (position du point décimal dépend de la gamme)
Indication de fonction	mV, V, μA, mA, kΩ, MΩ, °C couplée aux commutateurs de fonction
Réjection en mode commun	140 dB pour signaux continus 100 dB pour signaux alternatifs de 50/60 Hz
Réjection en mode série	60 dB (50 Hz/60 Hz ± 0,1%) 40 dB (50 Hz/60 Hz ± 1%)
Système de conversion analogique-numérique	Intégrant
Temps d'intégration	100 msec.
Taux de conversion	3,3 conv./sec. (réglage 50 Hz) 4 conv./sec. (réglage 60 Hz)
Temps de conversion	300 msec. (réglage 50 Hz) 250 msec. (réglage 60 Hz)

Temps de réponse	Dans les gammes courant continu et kΩ : 0,5 sec. max. avec réglage en 1 sec. max. Dans les gammes de courant alternatif, haute fréquence et MΩ : 1,5 sec. max. avec réglage maxi respectif en 6 sec.; 3 sec. et 5 sec. (non compris la gamme 2000 MΩ)
Temps de chauffage	environ 30 minutes
Intervalle d'etalonnage	90 jours
Tensions maximales admises:	
V – 0	1000 V en courant continu ou alternatif (voir II-1.1. et II-1.2.)
A – 0	250 V en courant continu ou alternatif protégé par un fusible 3.15 A
Ω – 0	250 V en courant continu ou alternatif
0 – Guard	250 V en courant continu ou alternatif
Guard – Boîtier	250 V en courant continu ou alternatif

II-3. CARACTERISTIQUES MECANIQUES

Dimensions	Hauteur	88 mm
	Largeur	279 mm
	Profondeur	328 mm
Poids	environ 5,6 kg	

III. ACCESSOIRES

III-1. COMPRIS A LA LIVRAISON DE L'APPAREIL (Fig. 1, page 44)

- Jeu de fils de mesure PM 9260
- Câble de mesure blindé
- Barrette d'interconnexion
- Cordon secteur
- 2 fusibles 400 mA action retardée 92 V – 118 V secteur } et 1 etiquette 110 V
- 1 fusible 200 mA action retardée 202 V – 238 V secteur }
- 3 fusibles 3.15 A rapide
- 2 résistances de protection 100 Ω, film métallique MR25 (R1116)
- 2 couvercles
- Notice d'emploi

III-2. EN OPTION

III-2.1. Sonde EHT PM 9246 (Fig. 2, page 44)

La sonde EHT PM 9246 peut être utilisée pour la mesure de tensions continues jusqu'à 30 kV.
La PM 9246 peut être utilisée pour mesurer des appareils avec impédance d'entrée de 100 MΩ, 10 MΩ ou 1,2 MΩ (réglable sur la sonde).

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

Remarque: Veiller à ne pas endommager les connexions.

III-2.2. Transformateur de courant PM 9245 (Fig. 3, page 44)

Ce transformateur permet de mesurer des courants alternatifs de 10 A à plus de 100 A.

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

Avant la mesure, connecter le transformateur de courant à l'appareil. Eviter la souillure des pièces à noyau.

III-2.3. Shunt PM 9244 (Fig. 4, page 44)

Ce shunt permet de mesurer les courants continus et alternatifs (1 kHz max.) jusqu'à 31,6 A.

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

III-2.4. Sonde HF PM 9211 (Fig. 5, page 44)

La sonde HF PM 9211 est apte à la mesure de tensions HF de 2 mV à 2 V, et ce lorsqu'elle est combinée avec le multimètre numérique PM 2527. Pour des tensions de 2 V à 200 V un atténuateur de tension capacitive avec rapport de division 100 : 1 est prévu.

<u>Son de</u>

Gamme de tension	2 mV~ à 200 V~
Gamme de fréquence	100 kHz à 1 GHz (avec connecteur T)
Précision	± 3% de gamme à 100 kHz (23°C)
Capacité d'entrée	inférieure à 2 pF
Caractéristiques de fréquence	⩽ 3 dB à 10 kHz et 1 GHz (voir graphique, Fig. 6 , page 48)
Tension maximale d'entrée	30 V_{eff} superposée à 200 V continu

<u>Atténuateur 100 : 1</u>

Atténuation	100 : 1
Gamme de tension	2 V~ à 200 V~
Erreur supplémentaire	⩽ 0.5 dB ⩽ 3 dB à 100 kHz et 1 GHz
Capacité d'entrée	inférieure à 2 pF
Tension maximale d'entrée	200 V_{eff} superposée à 500 V continu

<u>Connecteur T 50 Ohm</u>

Impédance	50 Ω
Gamme de fréquence	100 kHz à 1,2 GHz
Rapport d'amplitude	1,25 à 500 MHz avec sonde introduite 1,15 à 1 GHz avec atténuateur introduit

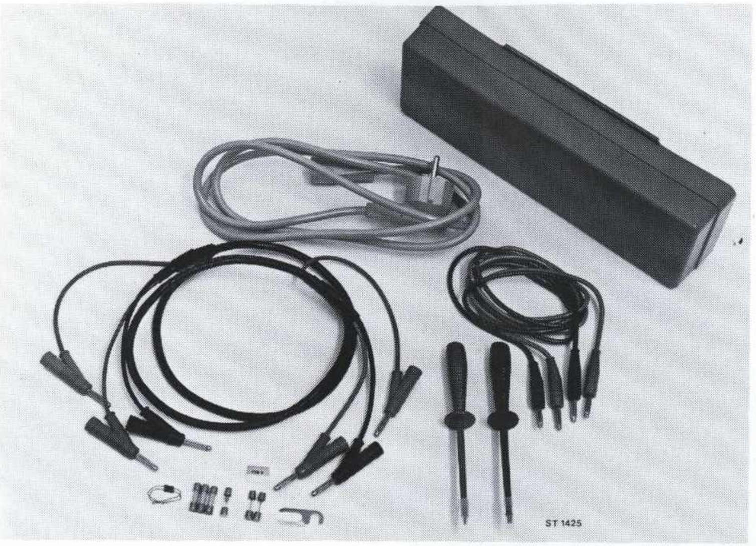


Fig. 1.

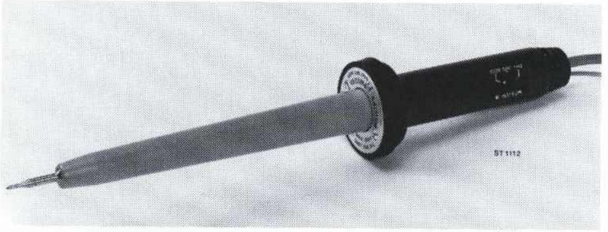


Fig. 2.

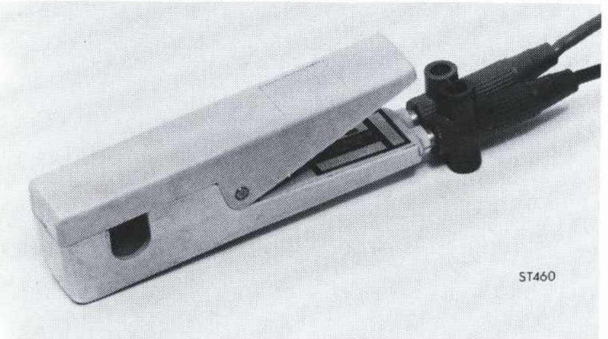


Fig. 3.

Fig. 4.

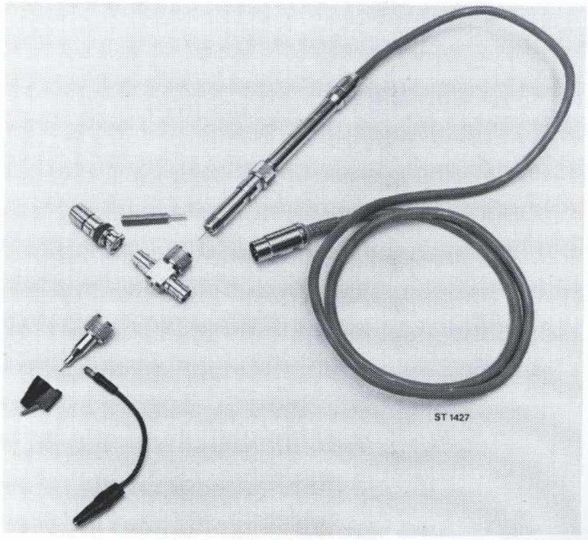


Fig. 5.

III-2.5. Sortie digitale PM 9237 (Fig.'s 7 et 8, page 48)

En cas d'application de la PM 9237, le PM 2527 peut être utilisé dans des systèmes de mesure automatiques.

Système de sortie — Parallèle en mots – parallèle en bits

Code de sortie — BCD positif
Niveau zéro 0 à 0,4 V
Niveau un +5 V ou, si alimenté extérieurement et commuté par une connexion interne +15 V.
Isink 5 mA
Résistance de sortie 8,2 kΩ

Résultat — 10^0 ... 10^3 en code BCD
10^4

(8)	(4)	(2)	(1)	
0	0	0	0	0
0	0	0	1	1
1	0	1	0	* dépassement

Gammes

V ⎓	V~	A ⎓	A~	Ω	HF	Temp.	(8) (4) (2) (1)
				0,2 kΩ			1 0 0 0
		2 μA	2 μA	2 kΩ			0 1 1 1
	20 mV	20 μA	20 μA	20 kΩ	20 mV		0 1 1 0
200 mV	200 mV	200 μA	200 μA	200 kΩ	200 mV		0 1 0 1
2 V	2 V	2 mA	2 mA	2 MΩ	2 V		0 1 0 0
20 V	20 V	20 mA	20 mA	20 MΩ			0 0 1 1
200 V	200 V	200 mA	200 mA	200 MΩ			0 0 1 0
1000 V	600 V	2000 mA	2000 mA	2000 MΩ		0 – 200°C	0 0 0 1

Fonction

	(8) (4) (2) (1)		
Ω	0 0 0 1	1	
A~	0 0 1 0	2	
A ⎓	0 0 1 1	3	
V~	0 1 0 0	4	
V ⎓	0 1 0 1	5	
Temp.	0 1 1 0	6	
–	0 1 1 1	7	(tous commutateurs déclenchés)

Indication de polarité

	(4) (2)
+	0 1
–	1 0
~ ou Ω	1 1

Commande Print : 0 impulsion négative; largeur 500 μs

Commande Start : 0 impulsion négative; largeur $\geqslant 15\ \mu s$ < 100 ms

H = +2,4 V . . . +50 V
L = −1,5 V . . . 1 V

III-2.6. Sortie digitale PM 9238 (ligne bus IEC)

Le PM 9238 est une sortie ligne bus IEC pour PM 2527.
Le PM 9238 permet au PM 2527 de donner l'information de sortie en code bit parallèle, mot série conformément ISO-7 bit (ISO 646, ASCII).
Le PM 9238 peut fonctionner comme TALKER (= orateur) pour afficher le résultat de la mesure et comme LISTENER (= auditeur) pour démarrer le PM 2527.

Caractéristiques techniques

Système d'entrée/de sortie : bit parallèle, mot série
code ISO-7 bit ISO 646
(similaire à ASCII)
Niveaux d'entrée/de sortie
L = −0,5 V . . . +0,8 V
H = +2 V . . . +5,5 V
Niveaux logiques pour lignes DIO
L ≙ 1
H ≙ 0
conformément à bus IEC, TC66

				DIO 8	NOT CONNECTED							
				DIO 7	0	0	0	0	1	1	1	1
				DIO 6	0	0	1	1	0	0	1	1
				DIO 5	0	1	0	1	0	1	0	1
DIO 4	DIO 3	DIO 2	DIO 1	row \ column	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	TC7 (DLE)	SP	0	@	P	\`	p
0	0	0	1	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0	0	1	0	2	TC2 (STX)	DC2	"	2	B	R	b	r
0	0	1	1	3	TC3 (ETX)	DC3	#	3	C	S	c	s
0	1	0	0	4	TC4 (EOT)	DC4	$	4	D	T	d	t
0	1	0	1	5	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0	1	1	0	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0	1	1	1	7	BEL	TC10 (ETB)	'	7	G	W	g	w
1	0	0	0	8	FE0 (BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE1 (HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE2 (LF)	SUB	*	:	J	Z	j	z
1	0	1	1	11	FE3 (VT)	ESC	+	;	K	[	k	{
1	1	0	0	12	FE4 (FF)	IS4 (FS)	,	<	L	~	l	|
1	1	0	1	13	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}
1	1	1	0	14	SO	IS2 (RS)	.	>	N	^	n	‾
1	1	1	1	15	SI	IS1 (US)	/	?	O	—	o	DEL

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Connecteur d'entrée/de Sortie

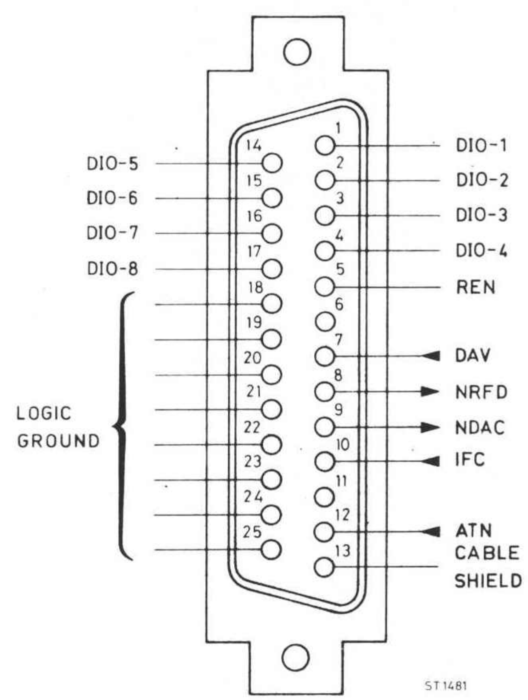


Tableau ISO 646

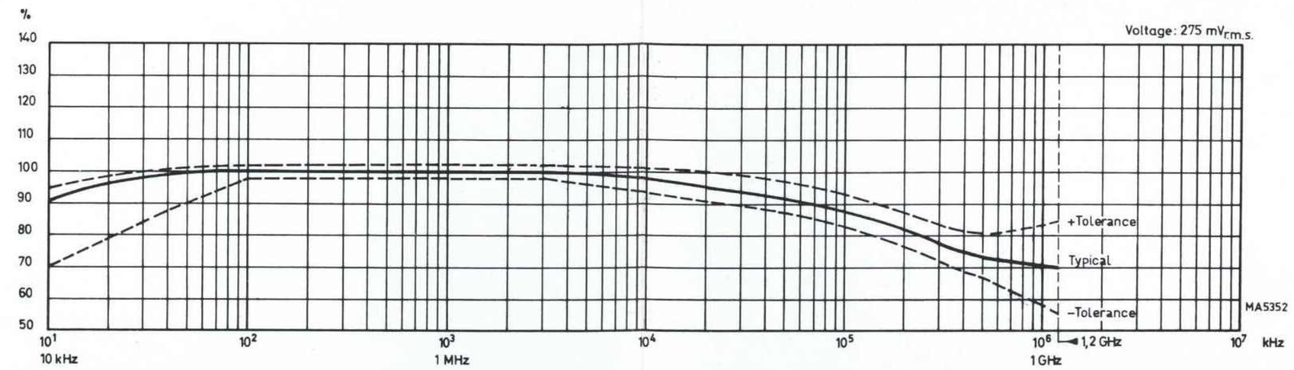


Fig. 6.

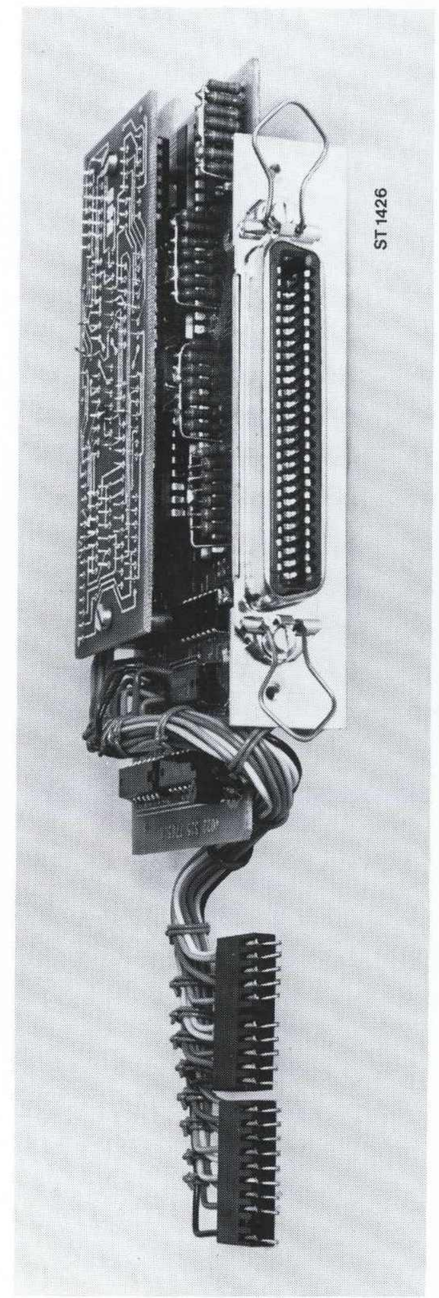


Fig. 7.

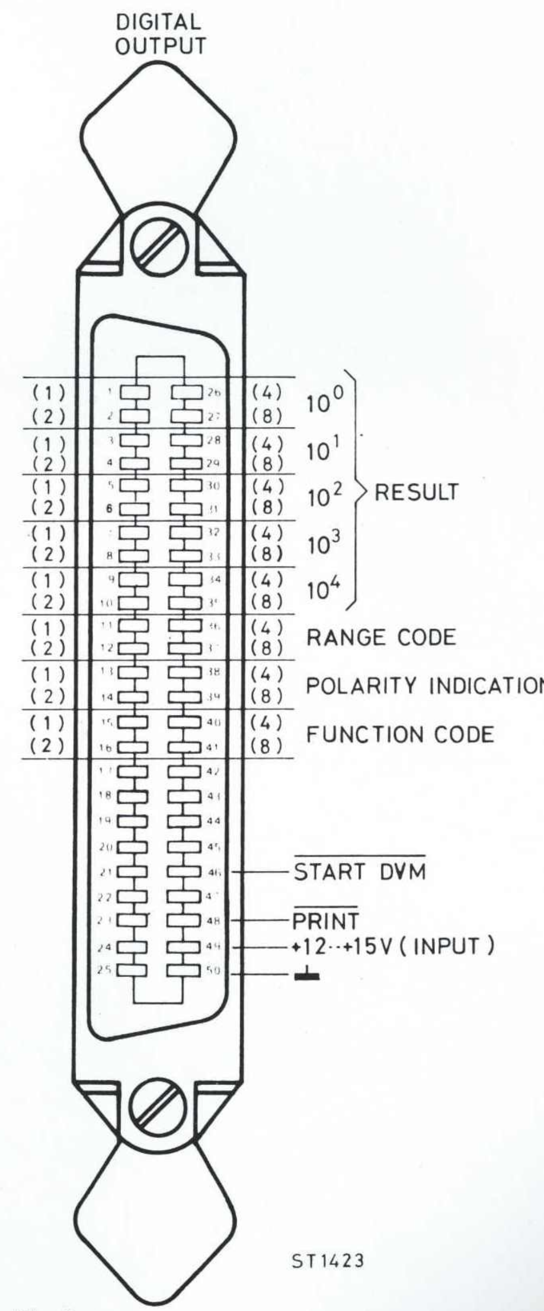


Fig. 8.

Fonction "auditeur"

Adresse auditeur — Programmable
A la livraison 0110110 (code "6" ISO-7 bit)

Commande de démarrage — 0001000 (code "BS" ISO-7 bit)

Fontion "orateur"

Adresse orateur — Programmable
A la livraison 1010110 (code "V" ISO-7 bit)

Affichage — Les résultata de mesure sont affichés en:

volts	V
milliampères	MA
mégaohms	MO
degrés Celsius	DG

Exemples:

V 02156E - 1
V 03322E - 2
MA 10272E - 1
MO 15743E - 1
DG 00337E - 1

Numéro de caractère	Caractère	Fonction
1	Espace M D	Mesures de tension Mesures de courant/résistance Mesures de température
2	V A O G	Mesures de tension Mesures de courant Mesures de résistance Mesures de température
3	+ — Espace	Tension pos. courant ou température Tension nég. courant ou température Tension altern., courant — et résistance
4	0, 1 *	10^4 surcharge
5	0/9 *	10^3 surcharge
6	0/9 *	10^2 surcharge
7	0/9 *	10^1 surcharge
8	0/9 *	10^0 surcharge
9	E	Première lettre de "EXPONENT"
10	—	Signe négatif
11	0/8	Exposant de la basse 10
12	ETX	Fin de série "EOS" programmable A la livraison 0000011 (code ETX ISO-7 bit).

III-2.7. Unité de température PM 9257

L'application du PM 9257 permet de réaliser des mesures de température avec le PM 2527.
Les températures peuvent être mesurées à l'aide d'une sonde PT-100 ou de la sonde PM 9248.
L'adaptation aux différentes sondes se fait à l'aide d'un commutateur à l'intérieur du PM 9257.

Caractéristiques techniques

Gamme		−60°C . . . +200°C
Précision:	après étalonnage (sonde excluse) pour sonde Pt-100	−60°C . . . 0°C ± 0,3°C ± 1% de l'affichage 0°C . . . +200°C ± 0,3°C ± 0,5°C de l'affichage
	Sonde PM 9248 comprise	± 0,5°C ± 1% de l'affichage ± 0,005% de gamme ± 0,5°C ± 1% de l'affichage
Coefficient de température		± 50 ppm de la gamme ± 150 ppm de l'affichage/°C (valeur de référence 23°C)

III-2.8. Thermomètre à résistance PM 9248 (voir page 52

Le thermomètre à résistance PM 9248 est une sonde appropriée à la mesure de températures de surface entre −60°C et +200°C, combiné avec le multimètre PM 2527.

Caracteristiques techniques, combiné avec PM 2527

Gamme	−60°C . . . à +200°C
Résolution	0,1°C
Précision	± 1% de l'affichage ± 1°C
Tension maxi admise à la pointe de la sonde	60 V

III-2.9. Sortie analogique PM 9255

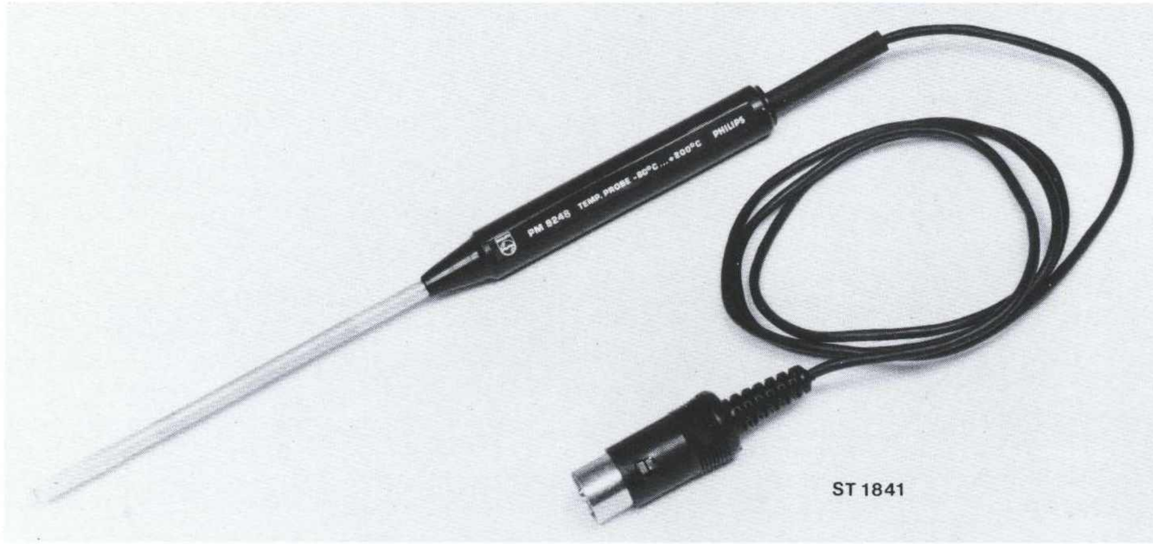
Le PM 9255 est une sortie analogique pour le PM 2527.
Elle permet une tension de sortie analogique dans toutes les gammes, proportionnelle au signal appliqué à l'entrée du PM 2527.

Caractéristiques techniques

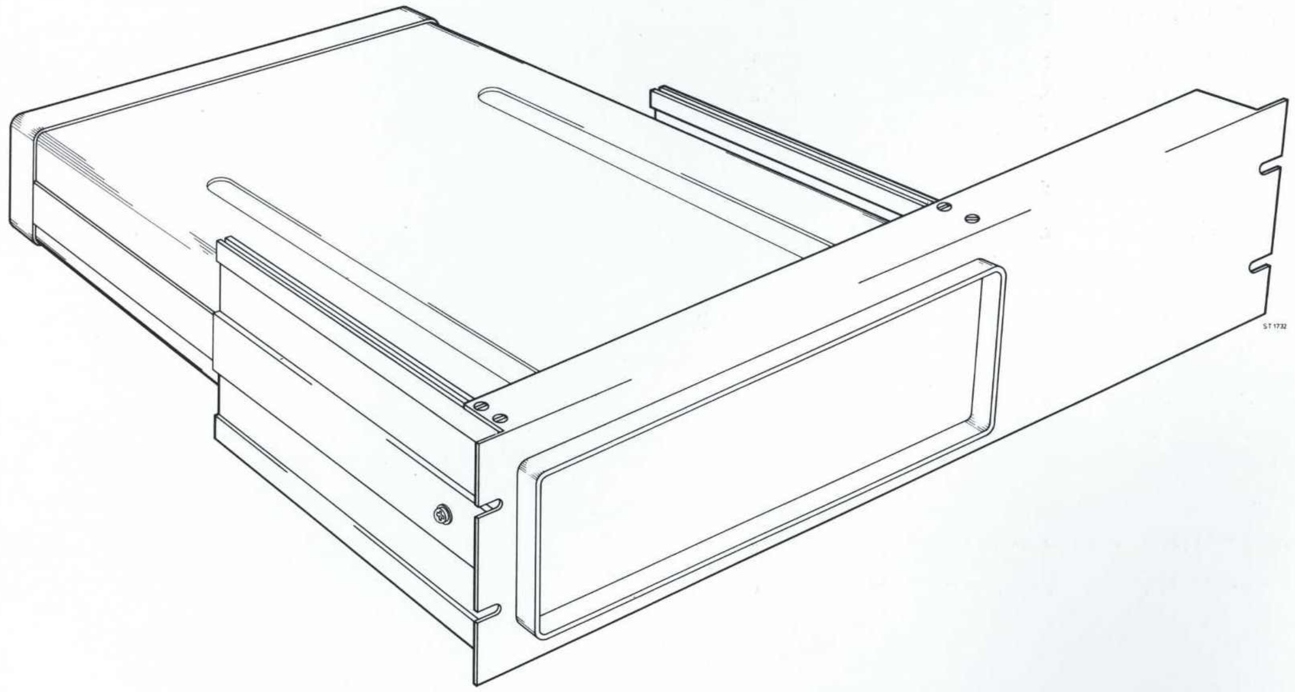
Impédance de sortie	200 Ω
Temps de résponse	< 500 msec
Linéarité	0,3%
Résolution	0,05%
Coefficient de température	500 ppm/°C de la gamme
Tension de sortie	2 V (fin de gamme)

III-2.10. Kit de montage en rack PM 9669/03 (voir page 52)

Le PM 9669/03 sert à monter le PM 2527 dans un rack 19".



PM 9248 Temperature Probe



PM 9669/03 Rack Mounting Set

IV. PRINCIPE DE FONCTIONNEMENT (Fig. 9, page 56)

IV-1. CIRCUIT D'ENTREE

Le circuit d'entrée du PM 2527 est composée des atténuateurs d'entrée, des amplificateurs continus et alternatifs et il fournit une tension continue de 2 V en fin de gamme au convertisseur analogique-digital.

- tension continue
  L'entrée est appliquée aux atténuateurs, ce qui atténue la tension continue inconnue en fonction de la gamme. La tension atténuée est appliquée à l'amplificateur 1x/10x. En fin de gamme, la tension continue appliquée au CAD est de 2 V.
- courant continu
  L'entrée est appliquée au shunt, en fonction de la gamme. La chute de tension par ce shunt est appliquée à l'amplificateur continu 1x/10x. En fin de gamme, la tension continue appliquée au CAD est de 2 V.
- tension alternative
  L'entrée est appliquée aux atténuateurs, ce qui atténue la tension alternative inconnue en fonction de la gamme. Cette tension atténuée est appliquée au convertisseur d'impédance, aux amplificateurs alternatifs et au convertisseur efficace. En fin de gamme, la tension de sortie du convertisseur efficace est de 5 V.
  Cette tension est divisée par 2,5 et appliquée au CAD.
- courant alternatif
  Tout comme pour la tension alternative, si ce n'est que l'entrée est appliquée au shunt. La chute de tension par le shunt est appliquée au convertisseur d'impédance.
- En cas de mesures de résistance, la résistance inconnue est montée dans le circuit de contre-réaction de l'amplificateur continu 1x/10x avec une source de courant. En fin de gamme l'entrée du CAD est de 2 V.
- Les mesures de tension HF sont basées sur le principe de la compensation. A cet effet, un oscillateur 100 kHz, dont l'amplitude est commandée par un amplificateur continu, est présent dans le circuit HF. Dans la sonde la tension HF inconnue est comparée au signal 100 kHz. L'amplitude de 100 kHz est égale à l'amplitude du signal HF, par l'intermédiaire de l'amplificateur continu. Ce signal 100 kHz est appliqué au convertisseur d'impédance et aux amplificateurs alternatifs pour ensuite être mesuré.
- La fonction est réglée manuellement.
- La gamme est réglée soit manuellement à l'aide des commutateurs "RANGING", soit automatiquement.
- L'échantillonnage se fait soit automatiquement ($3\,^1/_3$ échantillons par seconde), soit manuellement à l'aide du commutateur "START", soit externe.

IV-2. CONVERSION ANALOGIQUE–DIGITAL

La conversion de signaux analogiques en signaux numériques est basée sur le principe d'intégration.
Le signal d'entrée analogique est appliqué à l'intégrateur.
Le comparateur suivant l'intégrateur fournit une impulsion de sortie dont la largeur est proportionnelle à la valeur de mesure.
La figure 11 est un graphique de la tension de sortie de l'intégrateur en fonction du temps pendant le cycle de charge et de décharge.
Au cours du processus d'intégration, il est nécessaire de distinguer deux conditions principales, à savoir la pente ascendante (première étape) et la pente descendante (deuxième étape).
Pendant la première étape (démarrage) une tension, proportionnelle à la tension d'entrée, est appliquée à l'intégrateur. La tension de sortie de l'intégrateur croît linéairement en fonction du temps; son sens dépend de la polarité et sa raideur de la valeur de tension. Le temps d'intégration est déterminé par la durée de 20.000 impulsions d'horloge (100 ms). Dans l'intervalle la pente ascendante est réalisée et le condensateur d'intégration (Fig. 11) est chargé.
Pendant la deuxième étape, le condensateur est déchargé à zéro par un courant constant. L'intégrateur est déchargé en connectant une tension de référence à l'entrée, la polarité étant opposée à celle de la tension d'entrée.
Le taux de décharge est déterminé par le courant de décharge et donc par la tension de référence, ce qui explique sa constance. Le temps $t_1 - t_2$ est mesuré par comptage des impulsions d'horloge; il est directement proportionnel à la tension d'entrée inconnue appliquée en cours de première étape. Comme les mêmes éléments d'intégration et le générateur d'impulsions d'horloge sont utilisés pour les deux intégrations (ascendante et descendante), les variations de température, la dérive à long terme et les valeurs absolues n'affectent pas la précision de mesure.
La précision de mesure dépend en premier lieu de la précision de la tension de référence.

IV-3. SECTION DIGITALE

– Généralités
Pendant la pente ascendante du CAD, 20.000 impulsions d'horloge de CLOCK OSCILLATOR sont comptées par le COUNTER/MEMORY.
Après 20.000 impulsions d'horloge le COUNTER/MEMORY produit une impulsion ($t_0 - t_1$) au CAD par l'intermédiaire du PROGRAM et la pente descendante est démarrée.
Le nombre d'impulsions comptées pendant la pente descendante ($t_1 - t_2$) est proportionnel à la hauteur du signal appliqué à l'entrée du PM 2527.
Lors du passage du zéro du CAD (t_2) les impulsions d'horloge comptées par le COUNTER/MEMORY sont transférées vers MEMORY. La sortie de MEMORY est balayée par le SCAN OSCILLATOR (1 kHz).
L'information BCD balayée est transmise à DISPLAY par l'intermédiaire du CODE CONVERTER BCD en 7 segments. Au même moment, le SCAN OSCILLATOR commande les commutateurs d'anode afin d'obtenir un affichage séquentiel.

– Repérage automatique
Si, pendant la pente descendante, le nombre d'impulsions comptées est inférieur à 01800 (intégration descendante) ou supérieur à 20.000 (intégration ascendante) et le repérage automatique est enclenché, les impulsions pour commander le circuit AUTOMATIC RANGE vers le haut et vers le bas sont appliquées pour mettre les RANGE SELECTOR RELAYS en circuit.
Les contacts pour l'atténuateur de tension, les shunts, la source de courant et les facteurs d'amplification sont commutés par le RANGE SELECTOR CIRCUIT.

– Repérage manuel
La commande manuelle peut se faire à l'aide des commutateurs MAN et UP/DOWN. L'information UP/DOWN des commutateurs est appliquée au compteur/décompteur du circuit AUTOMATIC RANGE, lequel permet de commuter les différentes gammes.

– L'étalonnage manuel ou automatique est réalisé par le circuit PROGRAM. PROGRAM, AUTOMATIC RANGE COUNTER et MEMORY se trouvent dans les circuits LSI OQ052 et GZF1201.

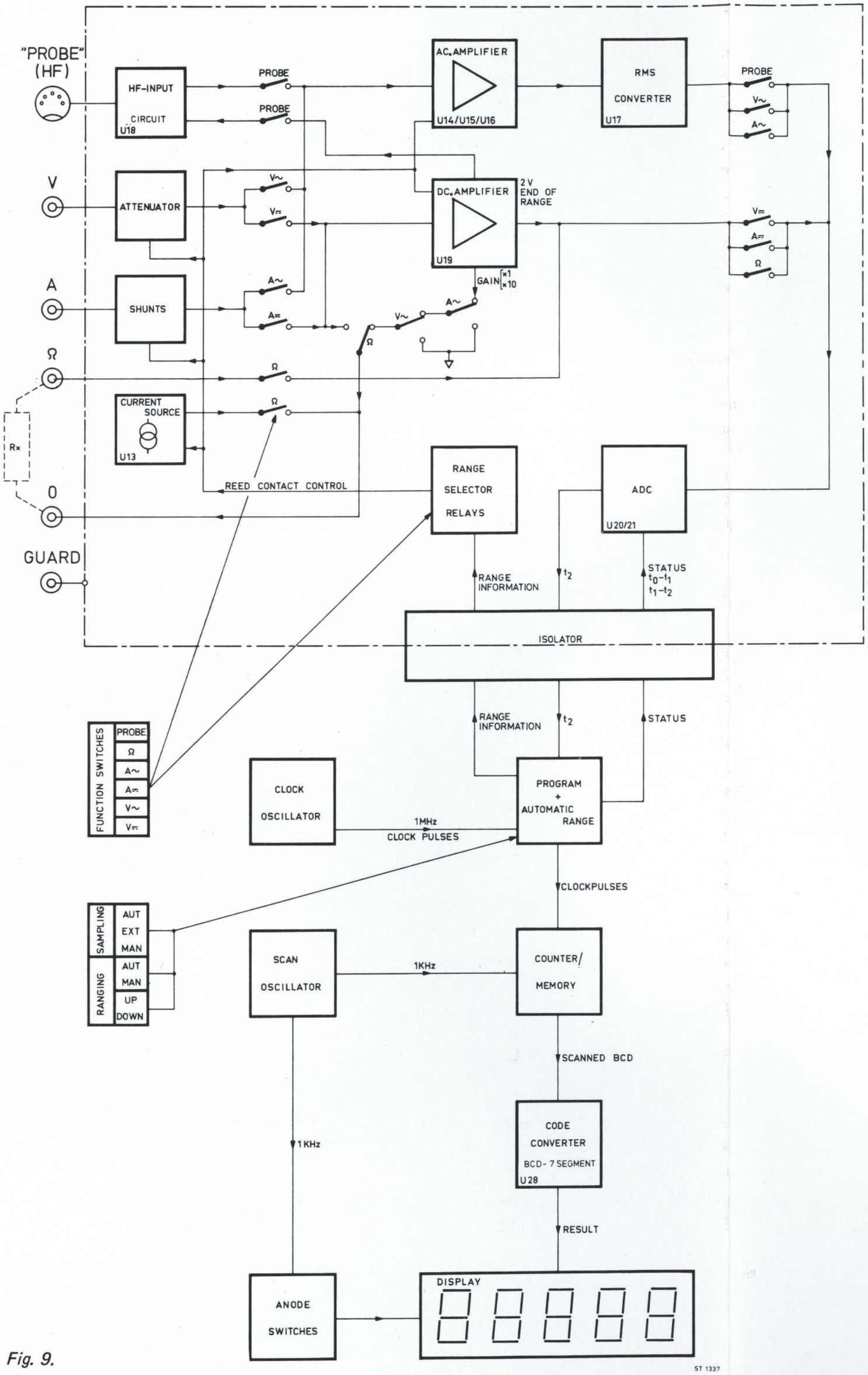


Fig. 9.

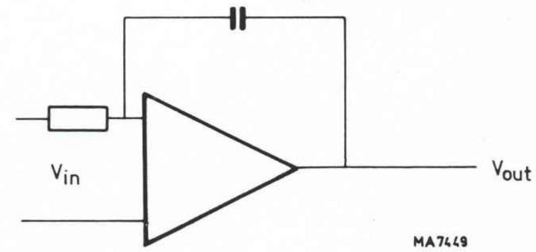


Fig. 10.

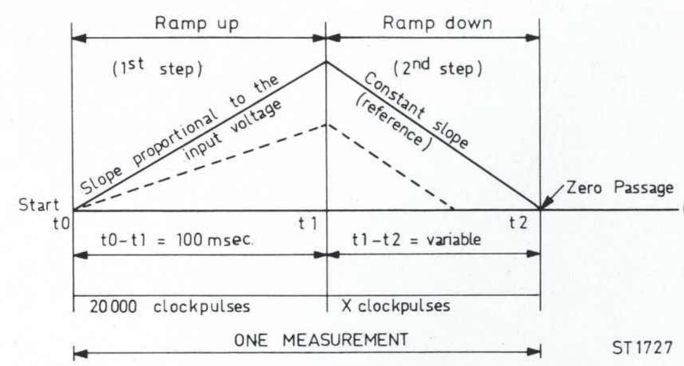


Fig. 11.

V. INSTALLATION

Avant de réaliser une connexion, la protection de terre doit être reliée à une conducteur de protection. (voir mise à la terre).

V-1. ALIMENTATION SECTEUR ET FUSIBLE

Avant de brancher l'appareil au secteur, s'assurer que l'appareil est réglé sur la tension secteur locale. L'appareil tel quel est approprié au fonctionnement sur secteur 220 V -- 50 Hz.

V-1.1. Adaptation à la tension secteur

L'appareil peut être adapté a d'autres tensions secteur par modification du câblage de transformateur secteur (Fig. 12, page 60).
Pour adapter l'appareil de 220 V – 50 Hz en 110 V – 50 Hz, interchanger les connexions 2 et 14 ainsi que 3 et 13.

Pour adapter l'appareil de 220 V – 50 Hz ou 110 V – 50 Hz en tensions secteur 202 V et 238 V ou 92 V et 128 V, procéder comme suit:

- Déposer le couvercle
- Déconnecter le transformateur en déposant les vis A et desserrant les vis B (Fig. 13, page 60).
- Modifier le câblage des connexions 4, 5, 6 et 14 conformément à la figure 12, page 60.
- Monter à nouveau le transformateur.

Remarque: Pour secteur 110 V une étiquette est livrée avec l'appareil. On la colle sur "220 V" du texte "CONNECTED FOR 220 V" à l'arrière.

V-1.2. Fusible

Le fusible secteur se trouve à droite du transformateur.
Pour remplacer le fusible secteur, déposer le couvercle supérieur après avoir desserré les vis A. (Fig. 16, page 64).

Tension secteur	Fusible requis VL1
202 V – 238 V	200 mA action retardée
92 V – 128 V	400 mA action retardée

V-1.3. Adaptation de la fréquence secteur pour SMRR maxi à 60 Hz

Pour adapter l'appareil à la fréquence secteur 60 Hz procéder comme suit:

- Déposer le couvercle supérieure après avoir desserré les vis A
- Réaliser les interconnexions comme mentionné à la figure 14, page 64
- Monter à nouveau le couvercle supérieur.

V-1.4. Généralites

L'adaptation sur la tension secteur locale ou la fréquence secteur ne peut être réalisée que par une personne qu qualifiée consiciente du danger.
Lorsqu'un fusible doit être remplacé ou que l'appareil adapté à une autre tension secteur (ou fréquence), l'appareil doit être débranché de toute source de tension.

V-2. MISE A LA TERRE

Avant son enclenchement, l'appareil doit être connecté à une protection de terre d'une façon ou d'une autre, à savoir:

- Par un cordon secteur à trois conducteurs. La fiche secteur doit être introduite dans une prise à contact de terre. La protection de terre ne peut pas être supprimée, même avec un câble de prolongement inadéquat. Le remplacement de la fiche secteur est aux risques de l'utilisateur.
- Par une borne de protection de terre à l'arrière.

ATTENTION: Toute interruption du conducteur de protection à l'intérieur ou à l'extérieur de l'appareil ainsi que le débranchement de la terre de protection peut rendre l'appareil dangereux. L'interruption intentionnelle est absolument interdite.
Lorsqu'un appareil passe d'un environnement froid dans un endroit chaud, la condensation peut entraîner certains dangers. S'assurrer dès lorsque la mise à la terre réponde aux conditions spécifiées.

VI. OPERATION

VI-1. MISE EN SERVICE

L'appareil est prêt à l'usage après branchement du secteur et de la masse. Il est mis en service par l'interrupteur "POWER"; Une période de chauffage d'environ 30 minutes doit être observée avant d'obtenir la précision complète.

VI-2. ORGANES DE COMMANDE

VI-2.1. Panneau avant (Fig. 15, page 64)

Item	Description		Application
SK1	POWER		Met l'appareil en service
SK2	V⎓ ; V~; A⎓ ; A~; Ω ; PROBE		Permet de choisir la fonction de mesure requise
SK3	START		
		AUT	Taux d'échantillonnage: $3\,^1/_3$ échantillons par sec.
		EXT	Démarrage externe
		MAN	Démarrage manuel
SK4	RANGING		
		AUT	La sélection de gamme se fait automatiquement
		MAN	Toute gamme peut être choisie à l'aide du commutateur UP-DOWN.
SK5	RANGING MAN		
		UP	Sélectionner une gamme supérieure
		DOWN	Sélectionner une gamme inférieure
BU1	PROBE		Entrée HF/entrée de sonde de temp. (en option)
BU2	GUARD		
BU3	0		Entrée commune
BU4	V		Entrée de tension
BU5	Ω		Entrée de résistance
BU6	A		Entrée de courant
R1903	I in		Réglage de courant d'entrée amplificateur continu

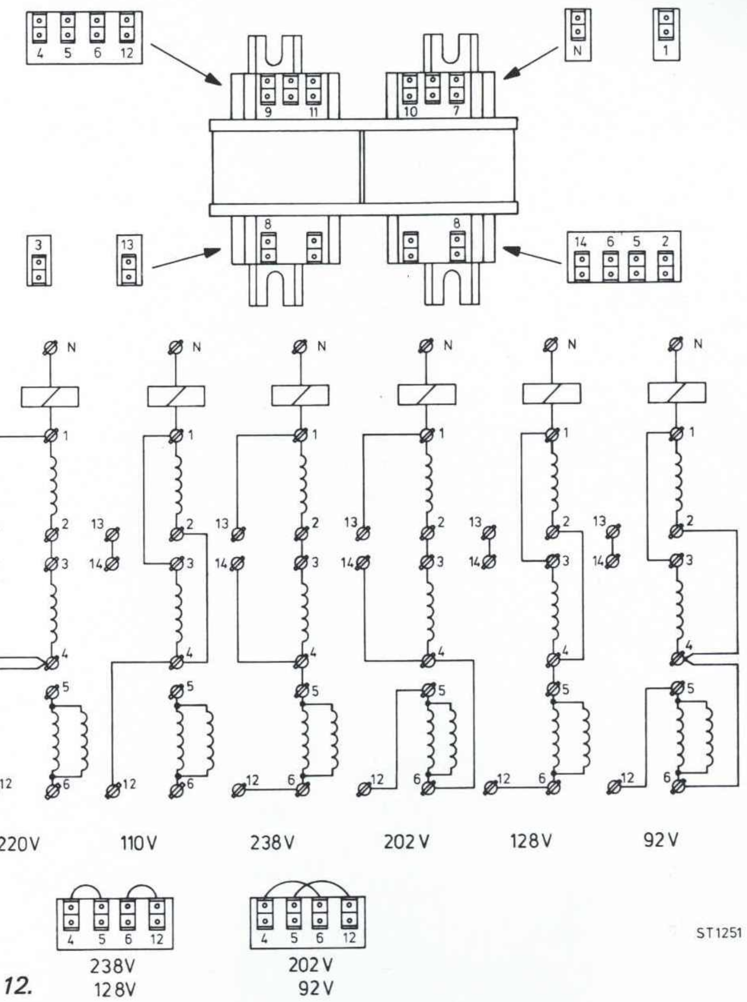


Fig. 12.

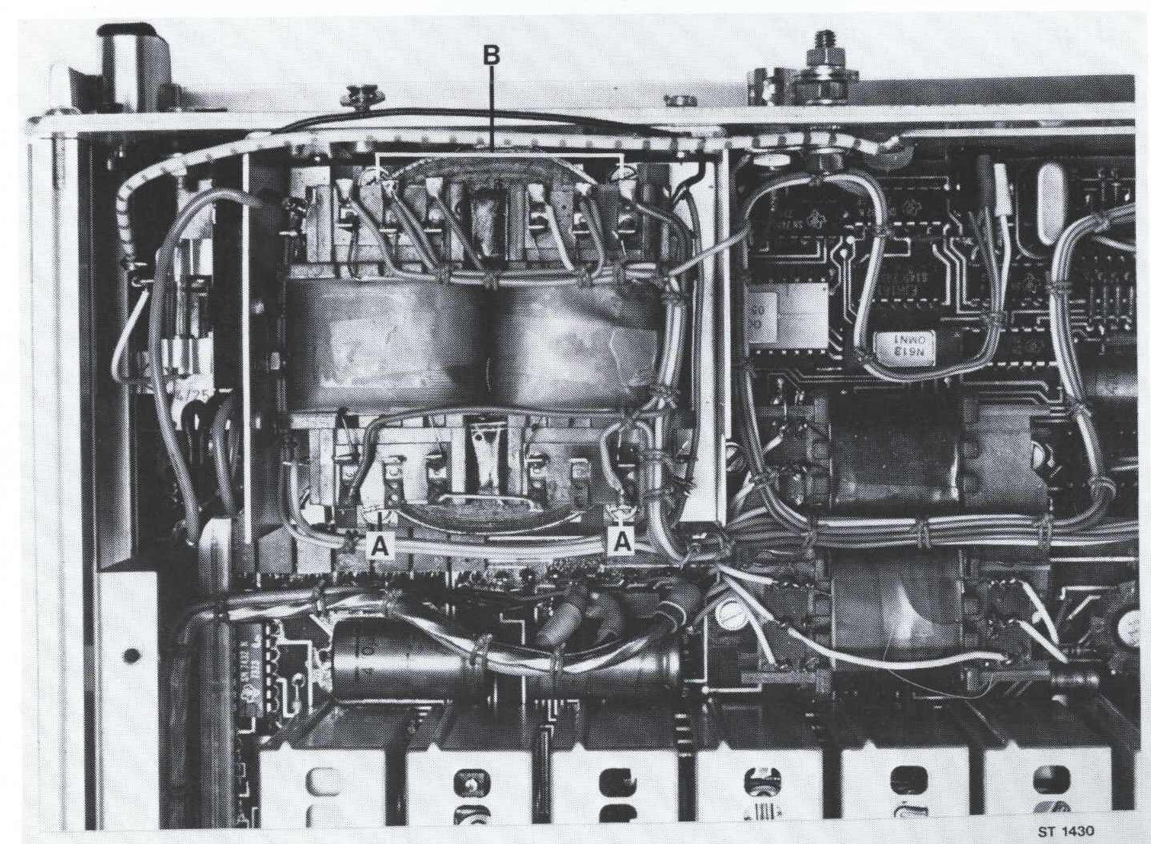


Fig. 13.

VI-2.2. Panneau arrière (Fig. 16, page 64)

Item	Description	Application
BU7	DIGITAL OUTPUT	Sortie de PM 9237 Sortie de PM 9238 } Option Sortie de PM 9235
BU8	ANALOG OUTPUT	
BU9	EXT. START	Pour démarrer une mesure externe
VL1	FUSE	Fusible secteur 200 mA action retardée 202 V – 238 V 400 mA action retardée 92 V – 128 V (à l'intérieur de l'appareil)
	⏚	Vis de terre

VI-3. REGLAGE DU ZERO

Avant de procéder au réglage du zéro, une période de chauffage de 30 minutes doit être observée.

– Enfoncer le bouton V ⎓

– Régler avec entrée ouverte l'affichage sur une valeur minimale, inférieure à 20 digits à l'aide du potentiomètre I in (les signes + et – s'allument alternativement)

– Court-circuiter les bornes V et 0

– L'affichage doit être 000.00 ± 1 digit

Remarque: Pour réglages complets, voir chapitre X "Checking and adjusting".

VI-4. MESURE

VI-4.1. Sélection de fonction

La fonction est sélectionnée à l'aide des sélecteurs de fonction et conformément à la table ci-dessous.

Sélecteur de fonction	Bornes d'entrée	Gamme de mesure
V ⎓	V —— 0	10 µV à 1000.0 V continu
V~	V —— 0	1,8 mV à 600 V alternatif résolution 10 µV
A ⎓	A —— 0	100 pA à 2000.0 mA continu
A~	A —— 0	0,18 µA à 2000 mA alternatif résolution 1 nA
Ω	Ω —— 0	10 mΩ à 2000 MΩ
Sonde	Sonde à l'aide de la Sonde HF PM 9211	1,8 mV à 200 V alternatif résolution 10 µV Gamme de fréquence: 100 kHz ... 700 MHz

VI-4.2. Sélection automatique de gamme

Mettre le commutateur RANGING en position AUT.
La sélection de gamme est alors automatique.
Niveau UP 19999, nieau DOWN 01800.
Pour éliminer l'hystérésis en sélection automatique de gamme, une gamme supérieure ou inférieure peut être sélectionnée à l'aide du commutateur UP-DOWN.

règlage ascendant	entre	18000	et	19999
réglage descandant	entre	01800	et	01999

VI-4.3. Sélection manuelle de gamme

Mettre le commutateur RANGING en position MAN.
Sélectionner la gamme de mesure exacte à l'aide du commutateur UP-DOWN.
1x enfoncer = 1 échelon de gamme.

VI-4.4. Démarrage de la mesure

Les mesures peuvent être démarrées de trois façons:

- *automatique* commutateur START en position AUT.
  Vitesse de mesure: $3^1/_3$ échantillons/sec. (50 Hz)
- *manuelle* en enfonçant le commutateur START en position EXT ou MAN.
  L'appareil mesure tant que le commutateur est en position MAN.
- *externe* commutateur en position EXT.
  Une impulsion de démarrage est alors émise pour chaque mesure par l'intermédiaire du connecteur BNC EXT. START (Fig. 16, page 64) ou d'une sortie digitale.

Impulsion de démarrage: impulsion négative, largeur $> 15\ \mu s$ < 100 ms

$H = +2{,}4\ V \ldots +20\ V$

$L = -20\ V \ldots +1\ V$

Afin d'obtenir un couplage direct entre l'entrée de démarrage EXT. et le circuit de démarrage, les broches A doivent être interconnectées (Fig. 17, page 68).
En cas de démarrage externe (EXT. START), l'appareil mesure lorsque l'entrée est zéro logique.
L'entre de démarrage externe (par connecteur BNC) est protégé contre une tension d'entrée de 250 V (temps de rétablissement d'environ 5 minutes).

REMARQUES:

- Le maintien d'échantillon se fait en position EXT. du commutateur START sans que des impulsions de démarrage ne soient appliquées.
  Avant de régler le commutateur START ou après chaque impulsion de démarrage, l'affichage complet est maintenu.
- Après chaque impulsion de démarrage, une mesure complète y compris la sélection de gamme est réalisé.

VI-4.5. Exemples de mesures avec connexion GUARD

Le multimètre digital PM 2527 est équipé d'une connexion GUARD.
Cell-ci constitue une protection supplémentaire entre zéro et masse, ce qui accroît l'imédance de fuite zéro-masse.
Cette impédance accrue améliore la réjection en mode commun.
GUARD peut être connectée au circuit par un fil séparé. Son utilisation appropriée donne une meilleure réjection en mode commun et une précision de mesure supérieure, particulièrement dans les gammes les plus sensibles.

Pour une connexion GUARD optimale, les règles suivantes doivent être prises en considération:

- Connecter la source de tension à mesurer au PM 2527 à l'aide d'un câble de mesure blindé.
  Cette méthode supprime les signaux d'interférence.
- Connecter GUARD au même potentiel que la borne d'entrée basse
- Connecter GUARD de telle sorte qu'aucun courant en mode commun ne passe par une impédance de source.

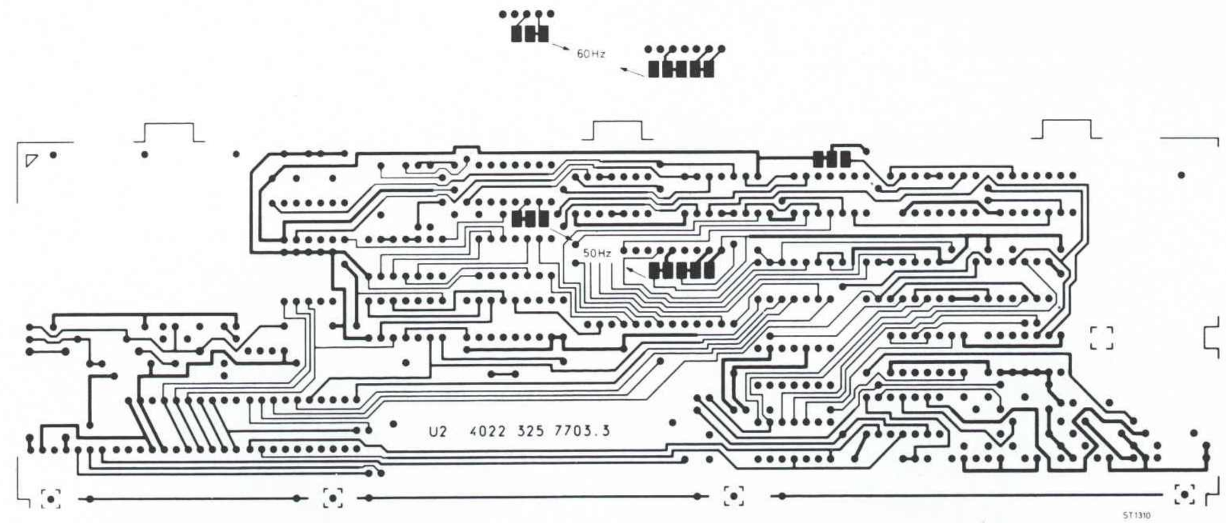


Fig. 14.

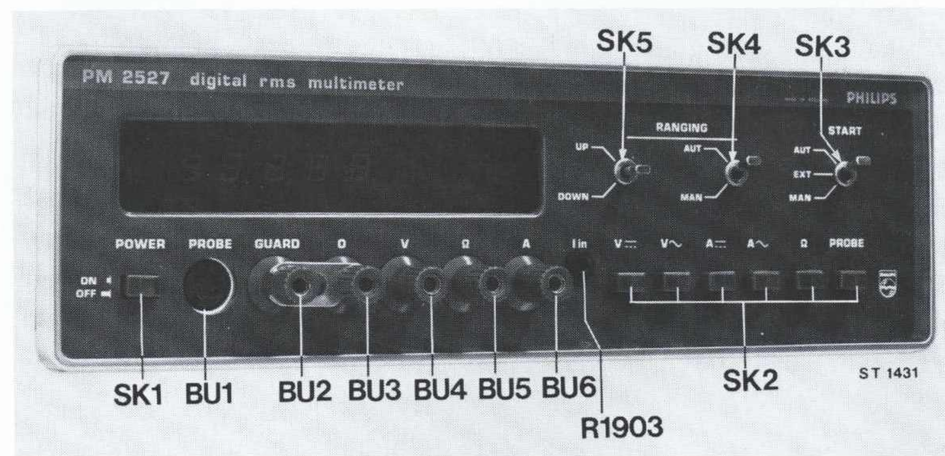


Fig. 15.

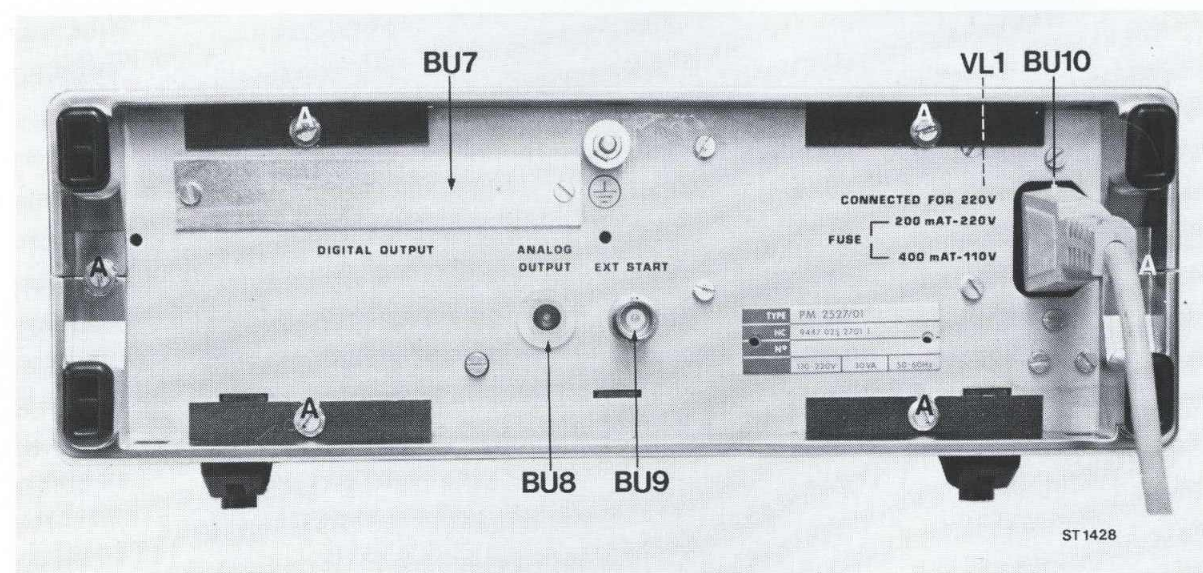


Fig. 16.

VI-4.6. Mesure de tension continue

- Enfoncer le commutateur V ⎓
- Connecter la source de tension aux bornes V – 0

REMARQUES:
- L'entrée maximale admise est de 1000 V continu + crête alternative, continuellement pour toutes les gammes.
- Des tensions de 1 kV à 30 kV peuvent être mesurées avec la sonde HT PM 9246. Régler l'impédance de cette sonde sur 10 MΩ.
- La polarité est indiquée automatiquement.
- Le dépassement de gamme est indiqué pour des tension excédant 1000 V continu.

VI-4.7. Mesure de tension alternative

- Enfoncer le commutateur V~
- Connecter la source de tension aux bornes V – 0.

REMARQUES:
- Des mesures efficaces en couplage capacitif peuvent être réalisées à l'aide du système de conversion thermique efficace. Avec ce système, des tensions entre 9% et 100% de gamme peuvent être mesurées exactement. S'assurer que, dans le cas de sélection manuelle de gamme, la gamme optimale est sélectionnée.
- L'entrée maximale admise est de 600 V continu ou alternatif.
- L'indication de dépassement ne se fait pas pour des tensions excédant 600 V_{eff}.

VI-4.8. Mesure de tension HF avec sonde HF PM 9211

- Enfoncer le commutateur PROBE
- Connecter la source de tension à l'entrée PROBE par l'intermédiaire de la sonde PM 9211
- Pour des tensions entre 2 V et 200 V, le diviseur 100 : 1 doit être utilisé
- Des mesures de tensions à fréquences supérieures à 100 MHz doivent être réalisées à l'aide du connecteur T 50 Ω.

REMARQUES:
- Avec ce système, des tensions entre 9% et 100% de gamme peuvent être mesurées exactement. S'assurer que, dans le cas de sélection manuelle de gamme, la gamme optimale est sélectionnée.
- Voir également mode d'emploi de la PM 9211.

VI-4.9. Mesures de courant continu

- Enfoncer le commutateur A⎓
- Connecter le courant à mesurer aux bornes A – 0

REMARQUES:
- Le courant d'entrée maximale admis est de 2 A. Des courants jusqu'à 31,6 A peuvent être mesurés avec le shunt PM 9244.
- La polarité est indiquée automatiquement.

VI-4.10. Mesures de résistance

- Enfoncer le commutateur A~
- Connecter le courant à mesurer aux bornes A – 0

REMARQUES:
- Des mesures efficaces en couplege capacitif peuvent être réalisées à l'aide du système de conversion thermique efficace. Avec ce système, des tensions entre 9% et 100% de gamme peuvent être mesurées exactement. S'assurer que, dans le cas de sélection manuelle de gamme, la gamme optimale est sélectionnée.
- Le courant d'entrée maximal admis est de 2 A. Des courants jusqu'à 100 A peuvent être mesurés avec le transformateur de courant PM 9245.

VI-4.11. Mesures de résistance

– Enfoncer le commutateur "R"

– Connecter la résistance inconnue aux bornes Ω – 0

REMARQUES: – La tension maximale admise aux bornes d'entrée est de 250 V.
La source de courant est protégée par une résistance PTC. Si une tension trop élévée (> 20 V) est appliquée aux bornes Ω – 0, attendre 5 minutes jusqu'à ce que la résistance PTC ait refroidi avant de démarrer une nouvelle mesure.

– En cas de mesures dans la gamme de 2000 MΩ , réglage du zero doit être exécutée. (voir chapitre VI-3. Réglage du zero)

VII. DEPANNAGE

Etant donné le grand soin apporté au développement et à l'assemblage du présent appareil, le pourcentage de pannes est réduit.
En cas de pannes, il est toujours possible de contacter l'organisation Philips la plus proche.
Cependant, en cas de pannes simples et afin d'éviter des pertes de temps et des frais inutiles, l'utilisateur peut essayer de trouver la panne et de procder à sa réparation suivant la liste ci-dessous.

Avant ce processus, s'assurer que l'appareil est connecté à la tension secteur exacte et que cette tension est appliquée à l'appareil.

Panne	Cause possible	Mesures
Le multimètre ne fonctionne pas. L'affichage ne s'allume pas.	Fusible VL1 Cordon secteur défectueux.	Remplacer VL1 près du transformateur secteur. Accessible après dépose du couvercle. Contrôler le cordon secteur.
La mesure de courant ne fonctionne pas.	Fusible VL1201	Remplacer le fusible VL1201. Accessible après dépose du couvercle. Voir Fig. 18, page 68.
La mesure de tension ne fonctionne pas.	Résistance R1116	Remplacer R1116. Accessible après dépose du couvercle supérieur et du couvercle de GUARD (Fig. 19, page 68). S'assurer qu'une résistance film métallique de 100 Ω est utilisée au remplacement.
La mesure de résistance ne fonctionne pas. Après connexion d'une tension trop élevée à l'entrée Ω.	Résistance PTC R1311	Attendre environ 5 minutes pour que la PTC se refroidisse.
Le démarrage par l'entrée BNC à l'arrière ne fonctionne pas. Après connexion d'une tension trop élevée à l'entrée de démarrage.	Résistance PTC R2525	Attendre environ 5 minutes pour la PTC se refroidisse.

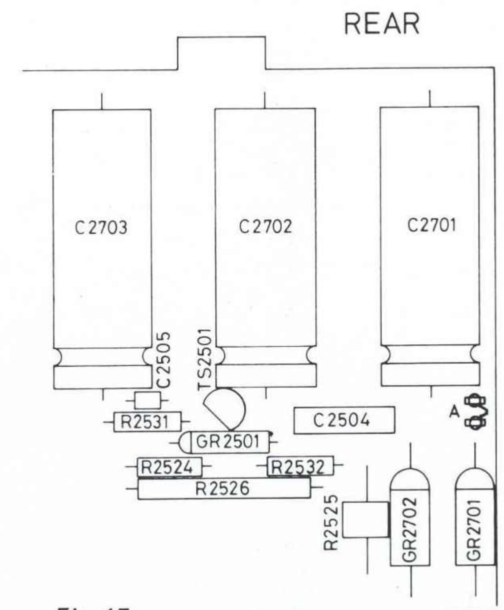


Fig. 17.

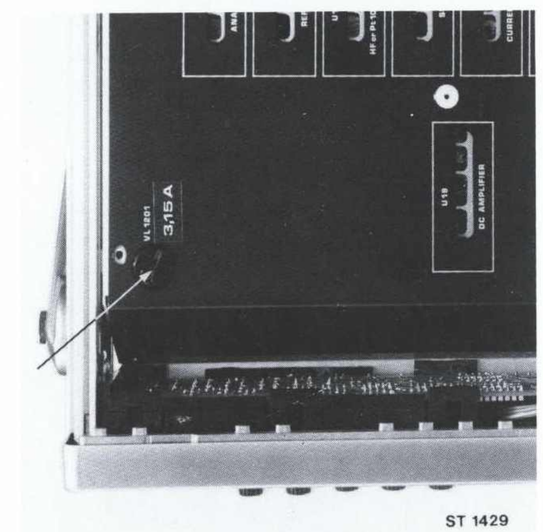


Fig. 18.

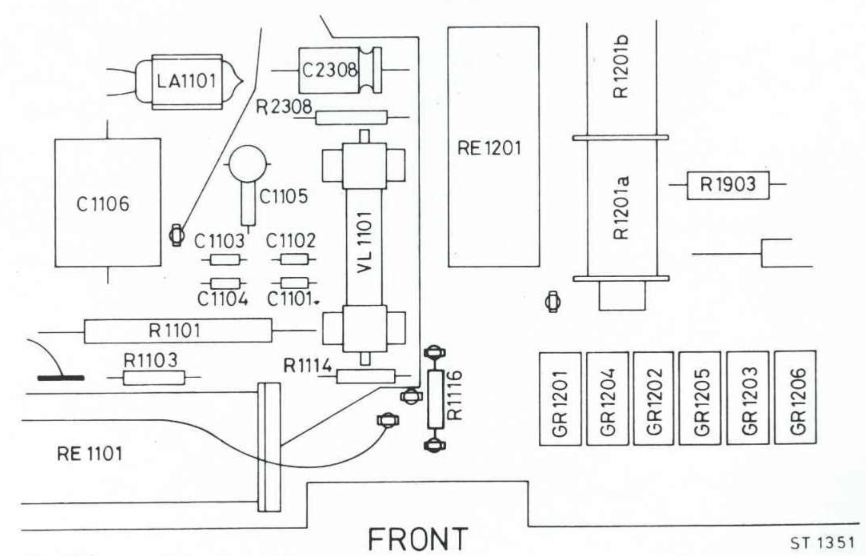


Fig. 19.

VIII. CIRCUIT DESCRIPTION

SERVICE DATA

For a better understanding of the circuit, the basic principles of the conversion technique are first described.

The circuit description subdivides logically into three sections:

- the analog section
- the digital section
- the display unit

Each of these sections is described separately together with its circuit diagram. For convenience, the analog section and the various input measurements are dealt with last.

VIII-1. CONVERSION PRINCIPLE

The conversion of analogue signals into digital form is achieved by the integration principle known as dual-slope analogue-to-digital conversion. The basic circuit blocks are shown in figure 20. The voltage to be measured and a precisely-known reference voltage are applied by switching circuits to an integrating amplifier followed by a comparator.

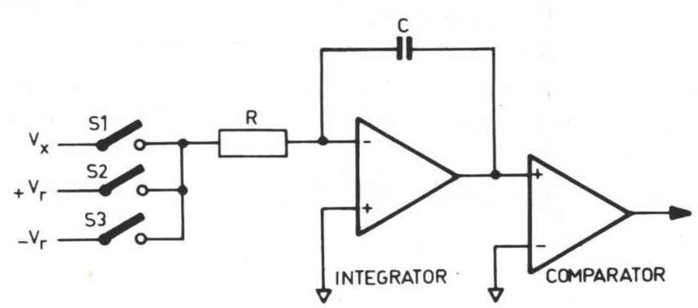


Fig. 20. Integrator

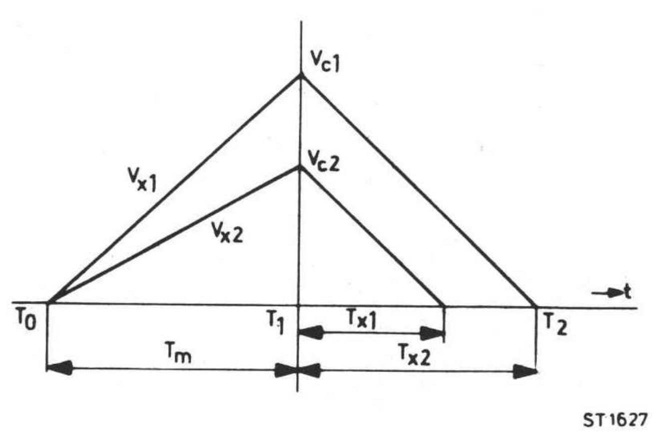


Fig. 21. Intégration process

A graph of the basic circuit operation is shown in figure 21. The integrator is charged via switch S1 over a fixed time T_m by the unknow voltage V_x and is discharged over a variable time T_x by the reference voltage V_r.

As shown, for two different input voltage V_{x1} and V_{x2}, the charging voltage differs (V_{c1} and V_{c2}) and consequently, so does the discharge time (T_{x1} and T_{x2}).
The charging time T_m, or ramp-up time, is measured by counting a certain number of pulses in a timing counter.
The same counter is used to measure the discharge time T_x in what is called the ramp-down phase.
The end of this ramp-down phase is detected by the comparator.
This detection occurs as the integrator voltage V_c reaches zero voltage (assuming that $V_c = 0$ at $t = T_0$).
Under these conditions, it can be said that the charge flowing into the integrator is equal to the charge flowing out of the integrator;

i.e. $Q_{in} = Q_{out}$

but $Q_{in} = \frac{V_x}{R} \cdot T_m$ (ramp-up)

and $Q_{out} = \frac{V_r}{R} \cdot T_x$ (ramp-down)

$$\therefore \quad V_x = \frac{T_x}{T_m} \cdot V_r$$

Therefore, the counter value T_x at the end of the ramp-down time is directly proportional to the voltage V_x being measured.

At the end of the ramp-up time, the polarity of the integrator (and hence the comparator) is opposite to that of the input signal. This polarity determines which reference voltage, $+V_r$ or $-V_r$ has to be chosen in the ramp-down phase. The chosen reference voltage is of opposite polarity to the input signal.

The main advantage of this method of A-D conversion is that the circuit elements of comparison, R and C, do not affect the measuring result. Integrator and comparator accuracy, and therefore the counting result, relies heavily on the stability of the reference voltage.

By choice of the optimum integration time, series mode voltages are filtered out and reading inaccuracies are avoided.

VIII-2. DIGITAL SECTION

A simplified block diagram of the digital section is shown in figure 22.
The overall circuit diagram of the digital section is given in figure 66, page 136.

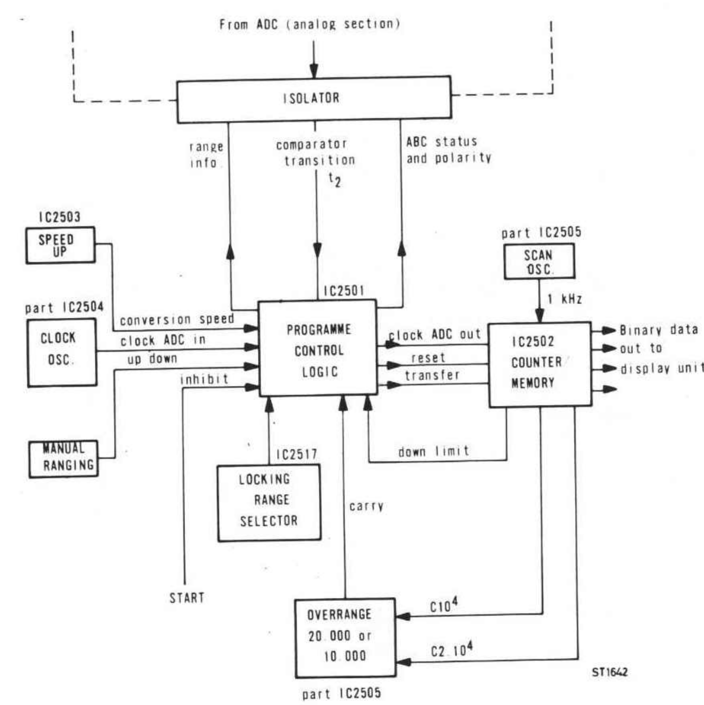


Fig. 22. Blockdiagram digital section

VIII-2.1. Control logic

The control logic, comprising integrated circuit IC2501 (OQ054), is the central processor of the ADC. As shown in the flow chart (Fig. 23), and the pulse diagram (Fig. 24) information is given about the conversion phases and the related conditions.

Changes of state occur on receipt of the following signals:
- INHIBIT during READY
- incoming CARRY signal
- comparator transition during the ramp-down phase
- an external ranging command

When a START pulse is given, a logic "1" is applied to the INHIBIT input (pin 6) and the control logic changes its state from READY to the DC phase.

The CARRY signal uses the C20,000 pulse of the counter.
At an incoming CARRY signal, the A status (A_{st}) output of the control logic becomes "0". This output, together with a logic "1" from the C status (C_{st}) output, starts the ramp-up of the integrator in the analogue section. The counter of the IC2502 (GFZ1201D) starts, and after counting 20,000 pulses it supplies a CARRY signal to the IC2501. The C_{st} output then becomes logic "0". This output, together with the logic "0" of the A_{st} output, switches the integrator from the ramp-up to the ramp-down phase.

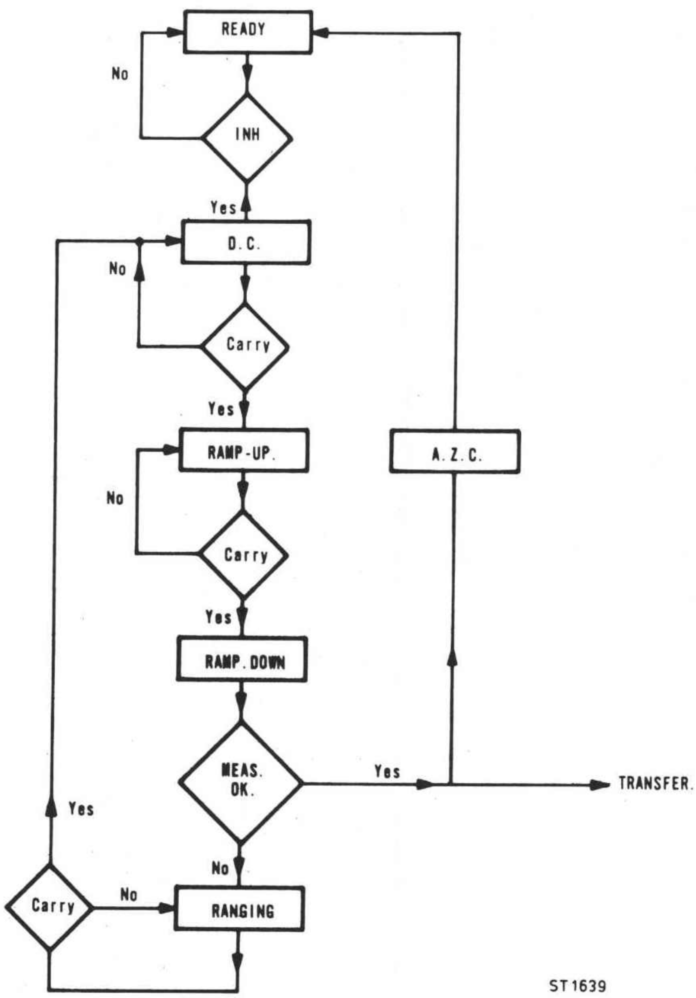


Fig. 23. Control logic flow-chart

A built-in delay of eight counts eliminates the ramp-up/ramp-down switching symptoms. This delay is compensated for by an offset voltage at the comparator.
Normally, during the ramp-down phase there is a comparator transition and after a delay of eight counts a TRANSFER pulse is generated. If a normal measurement is being performed, this pulse is fed to the IC2502 to transfer the counter information to the latches for display. This 8-count delay during which the outgoing clock pulses are inhibited compensates for the delay between the IC2502 and the IC2501.

Automatic ranging

The three counter pulses to effect automatic ranging (C100, C10,000, C20,000) appear on output 5, 7 and 8 respectively of IC2502 and are fed to IC2501 and IC2505.
If there are less than 18 "Carry 100" pulses entered at input 23 of IC2501 and the range selector is not in its lowest permissible range, down-ranging is effected.

Also, if a comparator transition does not occur within 20,000 clock pulses and the highest permissible range has not been chosen, up-ranging is effected. When the range selector is in its highest permissible range, or when operating in the manual ranging mode, the overload signal is activated under these conditions. This produces an indication of . 0 0 . . on the display.

Manual ranging

Manual ranging commands overrule all phases in the control logic. After a manual ranging command, the conversion sequence is stopped immediately and a new measurement performed in the newly programmed range. If conversion was completed and the system was waiting for a new INH command (MAN starting of measurement) no further measurement is performed after a ranging command before starting another conversion by the INH signal.

VIII-2.2. SPEEDING-UP circuit

The cross-coupled gating circuit controls the conversion rate of the IC2501 programme. During ranging, inputs 12 and 13 of gate IC2503 are $B_{st} = 1$ and $\overline{C}_{st} = 0$ respectively. Consequently, the Conversion Rate inputs CR1 and CR2 (inputs 11 and 8 of IC2501) are both at logic "0" and the control logic switches over from 3.3 measurements/sec. to $16^2/_3$ measurements/sec.

The $\overline{\text{SPEED}}$ signal, during MAN starting gives a small INH pulse via the RC network C2505, R2531, R2524 in the base circuit of transistor TS2501, so that after ranging a complete measurement is performed at normal speed.

During ranging, the $\overline{\text{SPEED}}$ signal inhibits the TRANSFER pulse so that no output is fed to the display.

VIII-2.3. LOCKING RANGE SELECTOR circuit

The Locking Range Selector (LRS) signal generated within this circuit with the aid of the function code X, Y, Z) and the binary range code (A_r, B_r, C_r) prevents the range selector having a position outside the specified range.

The function and binary range are gated in IC2512, IC2514, IC2517, IC2507 and IC2516 to produce a logic "1" output (LRS) over the non-correct ranges 0 to 7. Signal LRS is supplied to the OQ051 (IC2501) and selects upper and lower range limits.

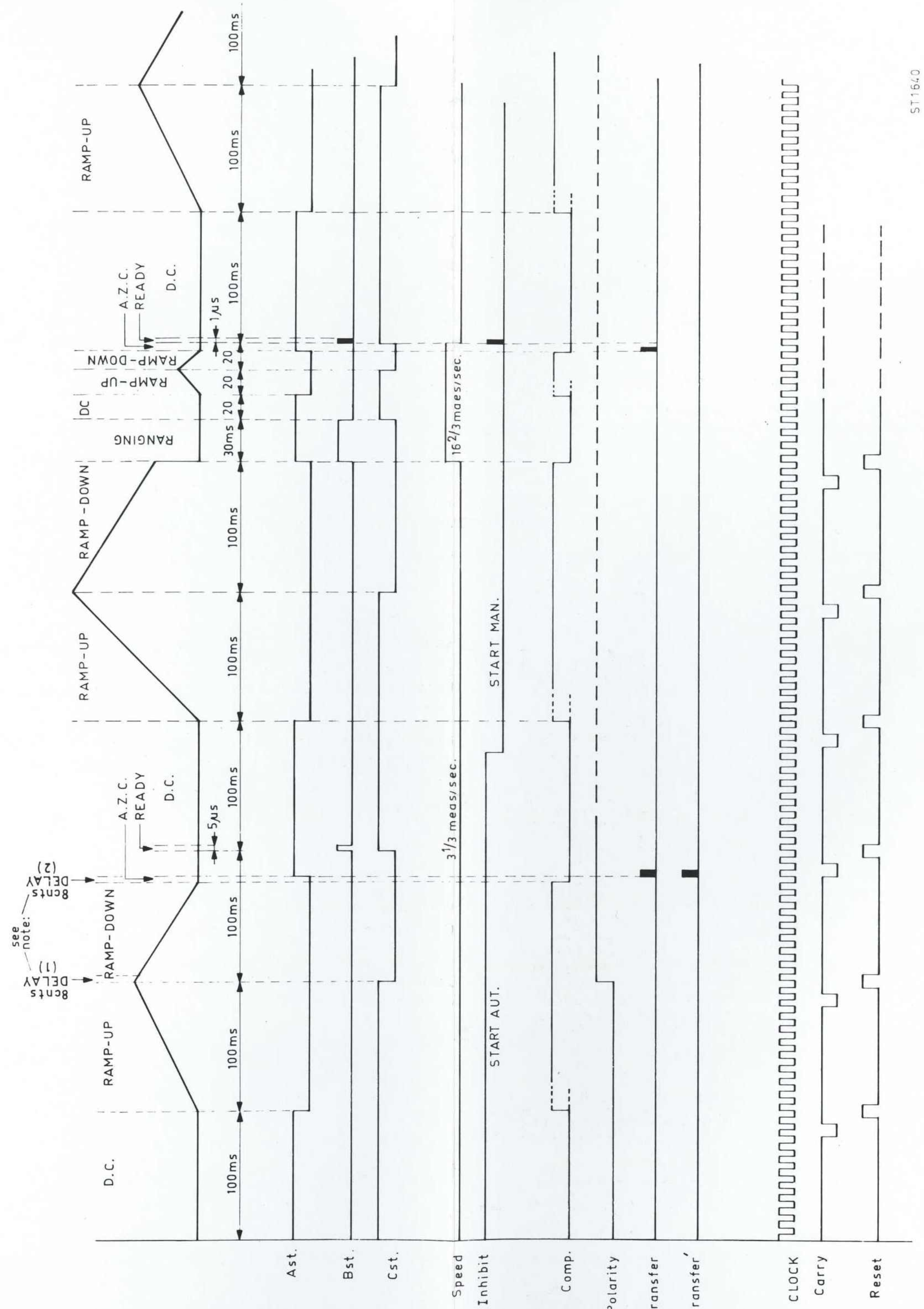


Fig. 24. Control logic pulse diagram

In the table below, the permissible ranges and the codes for the different functions are given.

Cr Br Ar	Range no.	Range codes					Probe		NO FUNCTION SWITCHED ON
		V ⎓	V~	A ⎓	A~	kΩ	HF	Temp.	
0 0 0	0	–	–	–	–	. 2 kΩ	–	–	
0 0 1	1	–	–	2 μA	2 μA	2 kΩ	–	–	
0 1 0	2	–	20 mV	20 μA	20 μA	20 kΩ	20 mV	–	
0 1 1	3	200 mV	200 mV	200 μA	200 μA	200 kΩ	200 mV	–	
1 0 0	4	2 V	2 V	2 mA	2 mA	2 MΩ	2 V	–	
1 0 1	5	20 V	20 V	20 mA	20 mA	20 MΩ	–	–	
1 1 0	6	200 V	200 V	200 mA	200 mA	200 MΩ	–	–	
1 1 1	7	1000 V	600 V	2000 mA	2000 mA	2000 MΩ	–	200°C	
Function code	X	1	0	1	0	0	0	1	1
	Y	0	0	1	1	0	0	1	0
	Z	1	1	0	0	0	1	1	0
PROBE		0	0	0	0	0	1	1	0

VIII-2.4. RANGE TRANSLATOR circuit

The range translator translates the range code from the range counter in the IC2501 to a suitable code for controlling the input relays and the display. The function and binary range codes are gated together with the LRS to form the range translator code. The gate circuits form part of the integrated circuits used in the LRS circuit.

The range translator circuit is necessary, for instance, if the measuring function is changed and the range counter is in a range not used for that function. To prevent unnecessary range changing, this incorrect range number is translated into a correct range number.

Example: If function V ⎓ is selected the lowest range number is 3 (see table). In this case the range translator converts the ranges 0, 1 and 2 from the IC2501 to range 3 for the input relays and the display unit.

VIII-2.5. MANUAL RANGING circuit

Manual ranging commands are given at the inputs RGU (ranging-up) and RGD (ranging-down) of the IC2501. These inputs have a dual-function in that they are also used for programming the ranging mode; i.e. MAN or AUTO. For automatic ranging both inputs are set to logic 1: for manual ranging both inputs are set to logic "0". Up or down ranging is effected by setting the RGU or RGD inputs respectively to logic "1". The logic switching is achieved by logic gates IC2504 and IC2510 under the command of the front panel RANGING controls.

VIII-2.6. CLOCK OSCILLATOR circuit

The clock oscillator comprising quartz crystal KT2501 and part of IC2504 produces clock pulses of 6 MHz frequency. This frequency is applied to a divide-by-six counter, IC2519, to provide 1 MHz clock pulses for the ADC.
For areas using a 60 Hz mains supply frequency, this clock frequency can be obtained via a divide-by-five circuit.
The clock ADC is applied to input 13 on the IC2501 as a 1 MHz squarewave.

VIII-2.7. SCAN OSCILLATOR circuit

The scan oscillator comprises a Schmitt trigger, IC2505, with a frequency of approximately 1 kHz. The output pulses are applied to a divide-by-five counter from which the A_{scan} (A_s), B_{scan} (B_s) and C_{scan} (C_s) signals are derived.
These signals are used in the IC2502 to select the digits and to control the anode switches in the display unit.
The C_s signal and the oscillator pulse are used in the DIGITAL OUTPUT PM 9237 unit for the serial-to-parallel converter.

VIII-3. DISPLAY UNIT U28

A simplified block diagram of the display unit section is shown in figure 25 below.
The overall circuit diagram of the display unit is given in figure 69, page 140.

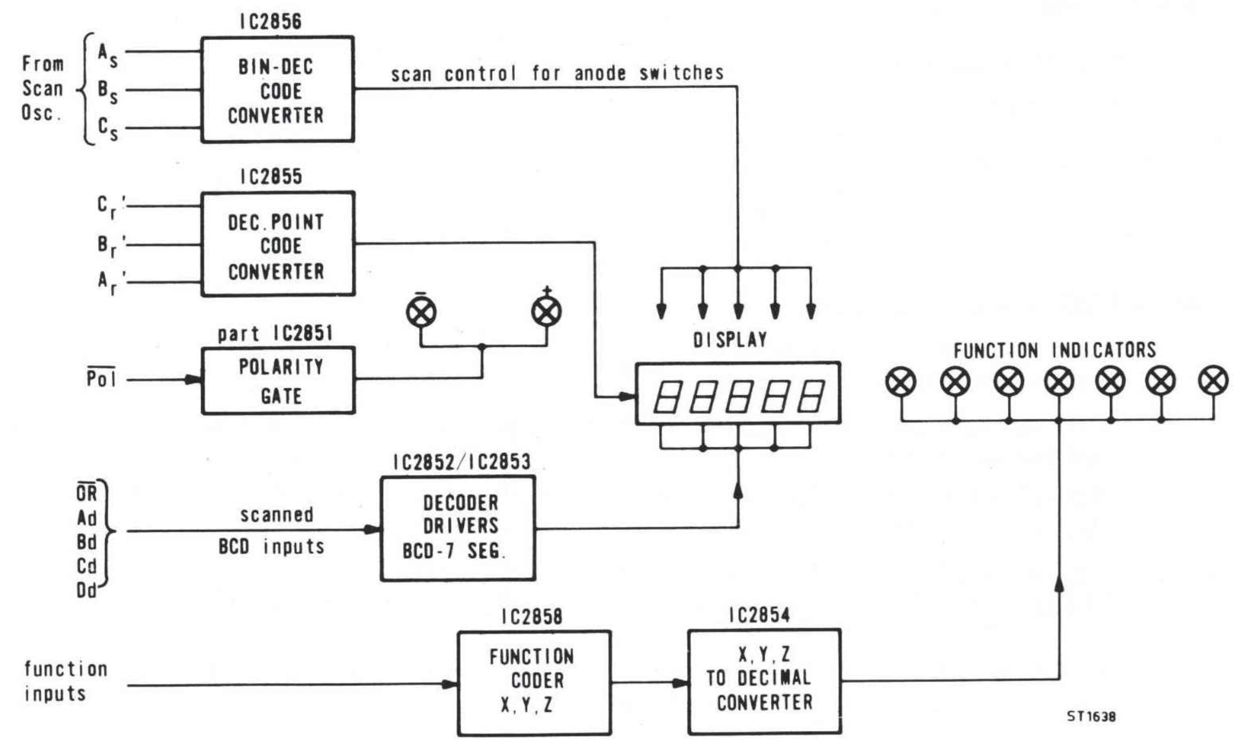


Fig. 25. Blockdiagram display unit U28

VIII-3.1. Decoder drivers

The BCD information supplied by the counter IC2502 in the digital section is applied to decoder drivers IC2852 and IC2853 where it is converted into a seven-segment code for the display.

The X, Y and Br' signals via gating circuit IC2857 control blanking of the least significant digit in the a.c. voltage, a.c. current, 200 MΩ and the 2000 MΩ ranges.

The 10^0, 10^1 and 10^4 information is decoded by IC2852; the 10^2 and 10^3 information is decoded by IC2853. The B_s signal selects the correct decoder via inverter IC2851 (pins 11, 12, 13) by controlling the OFF inputs of the decoders.

VIII-3.2. Anode switches

The binary scan information from the scan oscillator in the digital part is converted into a decimal code by IC2856, which controls the anode switches of the display. By this means the correct display is illuminated when the relevant seven-segment information is applied from the decoder drivers to the parallel display inputs (a-g).

VIII-3.3. Decimal point

The binary code of the decimal point is similarly converted into a decimal code by IC2855, which controls the decimal points of the displays via pin 6.

VIII-3.4. Polarity

Polarity is indicated by the illumination of one of two lamps (– or +).
These are controlled by the polarity input signal ($\overline{\text{Pol}}$) via two NAND gates (part of IC2851).

VIII-3.5. Function indication

The various instrument functions are coded by IC2858 into an X, Y, Z code which, in turn, is converted into a decimal code by IC2854. This output of IC2854 controls the lamps for function indication.

VIII-4. ANALOGUE SECTION

The analogue section of the PM 2527 consists of:

- the input circuit attenuators and amplifiers, which provide the correct voltage input to the ADC
- the range selector relays controlled by range information from the control logic
- the ADC.

The analogue section is described according to various input measurement functions.
An overall circuit diagram is shown in figure 63, page 131.

VIII-4.1. D.C. voltage measurement

The input voltage to be measured is applied to the front panel V socket, overload protection against voltages above 1700 V being made by spark-gap VL1101 and resistor R1116.

The applied voltage is attenuated in accordance with the range by the range selector relays under the control of the logic circuits.

The attenuated voltage is amplified 10 times in the 200 mV range and by unity in all other ranges by the d.c. amplifier (U19). At the upper end of a range, the d.c. voltage supplied to the ADC (pin 11 and U21) is 2 V.

Various resistors of the input attenuator chain R1101 to R1111 are connected in circuit by the range selector relays in accordance with the following table:

RANGE	RELAYS OPERATED
200.00 mV	RE1101
2.0000 V	RE1101 and RE1901
20.000 V	RE1102 and RE1901
200.00 V	RE1103 and RE1901
1000.0 V	RE1104 and RE1901

The output of the attenuator is limited to approximately 80 V by resistors R1112 to R1115 together with the neon LA1101.

D.C. Amplifier (U19)

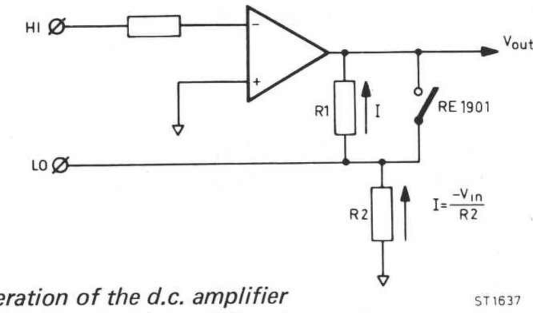


Fig. 26. Principle of operation of the d.c. amplifier

A simplified diagram of the d.c. amplifier (U19) is shown above.
Part of the feedback voltage (across R2) is applied in series with the + input.

When a d.c. voltage is applied across the HI and LO input terminals, the amplifier will be in balance; i.e. the +ve input of the amplifier will assume approximately the same potential as the –ve input with respect to the LO input. For example, if the HI input is –2 V then both the – and + inputs will be at –2 V. Offset balance is adjustable by potentiometer R1913. A feedback current flows through feedback resistors R1 and R2 to given a reduced closed loop gain.

The gain factor is $\dfrac{-V_{out}}{V_{in}}$

Since $V_{in} = I \, . \, R2$

and $-V_{out} = I\,(R1 + R2)$

the gain factor is $\dfrac{I\,(R1 + R2)}{I\,.\,R2} = \dfrac{R1 + R2}{R2} = \dfrac{R1}{R2} + 1$

Since R1 = 9R2 the gain is 10 with R1 + R2 in circuit (RE1901), and unity with only R2 in circuit (RE1901 closed).

The output voltage $V_{out} = \dfrac{-V_{in}}{R2} \; . \; (R1 + R2)$

In the overall circuit diagram, R1 = R1907 + R1908 + R1909 and R2 = R1910.

The output from the DC amplifier, developed across R2002, is passed to the reference unit U21 referred to the 0 V reference line.

Protection of DC amplifier

Limiter networks at the output of the d.c. amplifier prevent the output exceeding a predetermined value of approximately 10 V. Should the output exceed the zener voltage and the knee voltages of the diodes, the low forward resistance of these diodes is included to increase the feedback and thus limit the gain of the amplifier.

The limited output voltage also ensures correct working of the chopper stabilisation circuit, which would have difficulty in starting if the output voltage approached the 15 V supply potential.

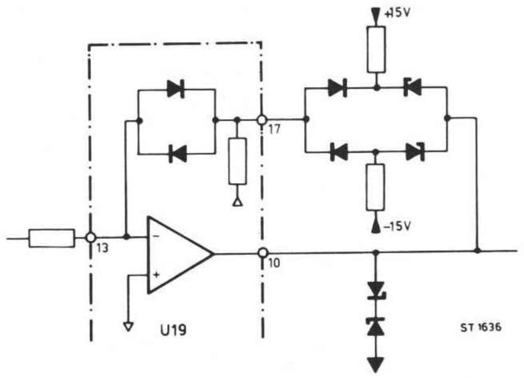


Fig. 27. Protection of the d.c. amplifier

Reference circuit (U21)

The reference circuit accepts the output voltage V_x from the DC amplifier on pin 11. It is then compared with a positive or negative reference voltage depending on the polarity of the voltage being measured in order to establish a 0 V reference.

Polarity signals from the control logic are routed via the isolator circuit to provide logic inputs on pin 15 (RD–) and pin 16 (RD+) of U21. These inputs control the gate circuits of field-effect transistors to provide either a positive or a negative reference level for the incoming signal, which is then routed via pin 13 to the ADC input.

VIII-4.2. D.C. current measurement

The current to be measured is applied via the front panel "A" terminal to a series of shunts, R1201 to R1207, across which a corresponding voltage is developed. Relay contacts RE1201 to RE1207 switch the appropriate shunts in accordance with range information from the control logic.

The conversion voltage across the shunt is 200 mV for the end of range; thus the DC amplifier is set to a gain of 10x for all current ranges to give 2 V at the ADC input.

The relays for the various ranges are as follows:

RANGE	RELAY CONTACTS OPERATED
2.0000 μA	RE1207
20.000 μA	RE1206
200.00 μA	RE1205
2.0000 mA	RE1204
20.000 mA	RE1203
200.00 mA	RE1202
2000.0 mA	RE1201

Current range protection

The current ranges are protected from overload by a 3.15 A fuse (VL1201) in series with the "A" input terminal. If the voltage developed across the shunts is larger than 2.1 V, due to an excessive current or voltage input, diodes GR1201 to GR1203 or diodes GR1204 to GR1206 (depending on the polarity) conduct. The current through the diodes is restricted by R1208.

To avoid measuring errors caused by current flowing through these diodes, the voltage developed across the shunt is applied to a 1x differential amplifier consisting of the dual field-effect transistor TS1201 and IC1201. The output of this circuit biases off the protection diodes during normal measurement.

The protection circuits are also effective for a.c. current measurement.

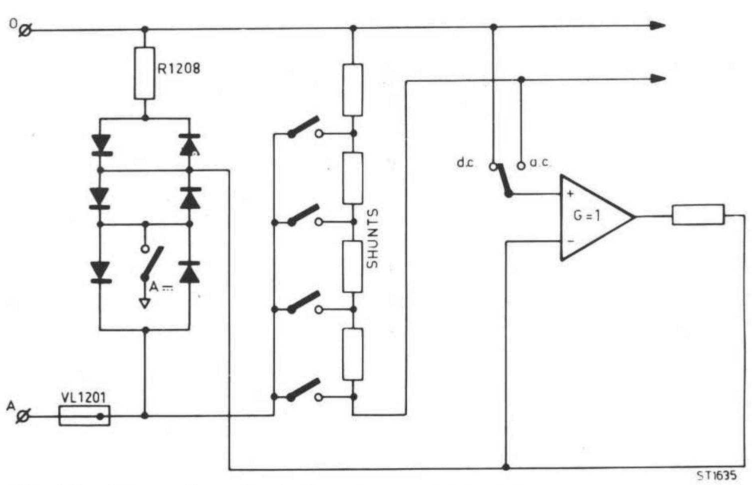


Fig. 28. Protection circuit for the current ranges

VIII-4.3. A.C. voltage measurement

In the 20 mV to 2 V ranges, the a.c. input voltage is switched directly to the impedance transformer U14.
In the 20 V to 600 V ranges, the input voltage is first attenuated by 1000 by the input attenuator (RE1104 closed) and then applied to the impedance transformer.
The transformer circuit has unity gain and provides a low impedance output, which is then attenuated according to the range to supply an end-of-range input of 20 mV to the AC pre-amplifier U15.
The AC pre-amplifier has a gain of 25x and consists of three longtailed pair stages in cascade.
The output of this pre-amplifier is capacitively coupled to AC amplifier U16 with a gain of 10x.
The resulting end-of-range voltage applied to the RMS converter is therefore 5 V.

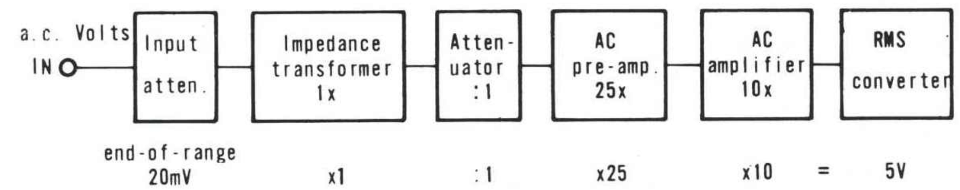


Fig. 29. Blockdiagram a.c. voltage measurements ST1634

RMS converter

The RMS converter consists of two identical circuits, TS1 + R1 and TS2 + R2 as shown in the basic diagram. The principle of conversion is as follows:

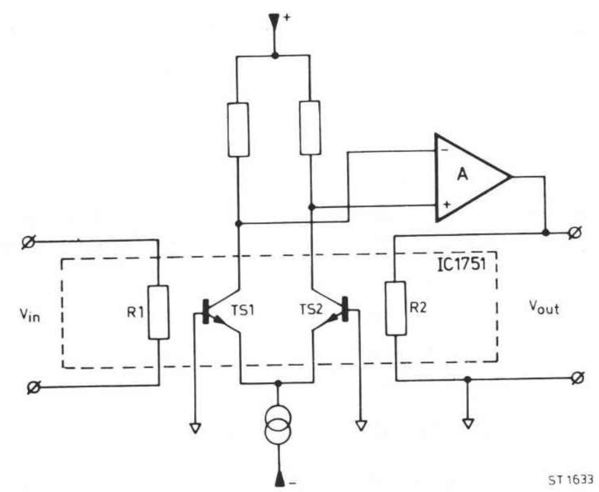


Fig. 30. Principle of RMS conversion

Resistor R1 is heated up by the input voltage V_{in}. As the preceding amplifiers are a.c. coupled, only the a.c. component of the input to the PM 2527 is measured.

In turn, resistor R2 is heated up by the output voltage of amplifier A. The temperature rise of each resistor is measured by its associated transistor and is equalised by amplifier A. When the amplifier is in balance, i.e. the – and + inputs are at the same potential, the d.c. output voltage of this amplifier across R2 is equal to the r.m.s. input voltage across R1 (since R1 = R2).

As the RMS converter is non-linear at the low end of the range, only measurements between 9% and 100% of the range are valid for full accuracy. To avoid reading errors, the output of the RMS converter remains at zero below approximately 6% of the range as shown.

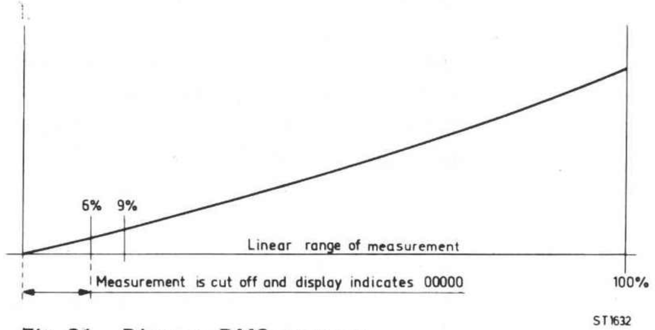


Fig. 31. Diagram RMS accuracy

The converter end-of-range output of 5 V is divided 2.5x by potential divider R2001 and R2002//R2003 to give the appropriate 2 V at the input of reference unit U21.

The state of the relays for the a.c. voltage ranges are as follows:

RANGE	RELAY CONTACTS OPERATED
20.00 mV	RE1101 and RE1401
200.0 mV	RE1101 and RE1402
2.000 V	RE1101 and RE1403
20.00 V	RE1104 and RE1401
200.0 V	RE1104 and RE1402
600.0 V	RE1104 and RE1403

VIII-4.4. A.C. current measurement

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 shunts, but the 200 mV end-of-range conversion voltage is applied to the impedance transformer and then processed as for a.c. voltage measurements.

The state of the range relays for a.c. current measurements is as follows:

RANGE	RELAY CONTACTS OPERATED
2.000 µA	RE1402 and RE1207
20.00 µA	RE1402 and RE1206
200.0 µA	RE1402 and RE1205
2.000 mA	RE1402 and RE1204
20.00 mA	RE1402 and RE1203
200.0 mA	RE1402 and RE1202
2000. mA	RE1402 and RE1201

VIII-4.5. Resistance measurements

The principles of resistance measurements in the various ranges are shown in figures 32, 33 and 34.
The measuring current source is derived from U13 which supplies currents of 10 mA, 1 mA and 0.1 mA depending on the range.
In the three lowest ranges (Fig. 32), these currents flow directly through the unknown resistance to be measured Rx. When the DC amplifier is in balance, the − and + inputs of the amplifier will be at approximately the same potential and the voltage developed across Rx will be applied directly to the ADC. Before measurements in these range, time must be allowed for the temperature of the PTC resistor R1311 to stabilise.

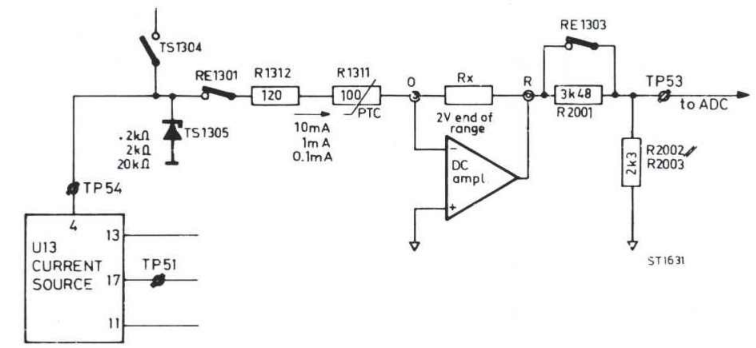


Fig. 32. Resistance measurements ranges 0.2 kΩ, 2 kΩ and 20 kΩ

In the 200 kΩ and 2 MΩ ranges, the measuring currents of 10 mA and 1 mA respectively are divided by 1000 by potential divider network R1303 to R1305 (TS1303, TS1304 switched on) to give inputs of 10 µA and 1 µA respectively to the DC amplifier input.

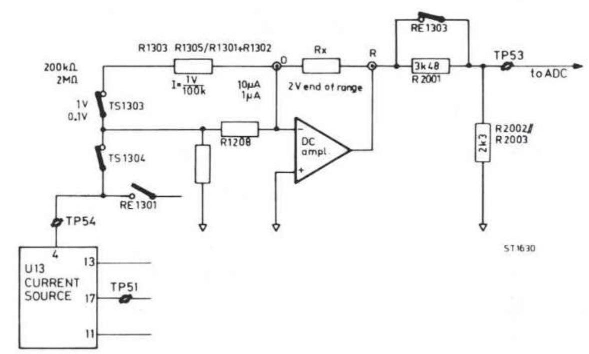


Fig. 33. Resistance measurements ranges 200 kΩ and 2 MΩ

In the highest ohmic ranges, 20 MΩ, 200 MΩ and 2000 MΩ, the current of 10 mA, 1 mA and 0.1 mA from the current source are divided by 40,000 in resistors R1301, R1302 via TS1304 to obtain measuring currents of 250 mA, 25 mA and 2.5 mA. The end-of-range voltage developed across the unknown resistance Rx is now 5 V and is divided by 2.5 by R2001 (RE1303 open) to obtain the correct input voltage for the ADC.

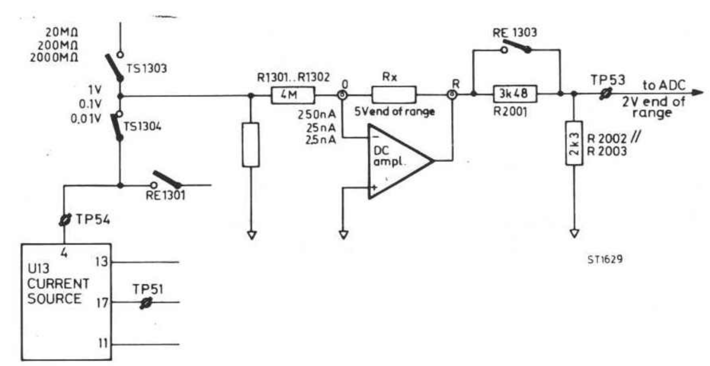


Fig. 34. Resistance measurements ranges 200 MΩ, 200 MΩ and 2000 MΩ

The state of the relay contacts, FET switches and the activated inputs of the current source for the various ranges is shown in the table below.

RANGE	RELAY CONTACTS & FET SWITCHES OPERATED			ACTIVATED INPUT U13
.20000 kΩ	RE1301		RE1303	U13/17
2.0000 kΩ	RE1301		RE1303	U13/13
20.000 kΩ	RE1301		RE1303	U13/11
200.00 kΩ	TS1303	TS1304	RE1303	U13/17
2.0000 MΩ	TS1303	TS1304	RE1303	U13/13
20.000 MΩ		TS1304		U13/17
200.00 MΩ		TS1304		U13/13
2000.0 MΩ		TS1304		U13/11

Protection of resistance ranges

For all ranges, the input of the ADC is protected against voltages above approximately 10 V by the feedback protection circuit of the DC amplifier.

Furthermore, in the .2 kΩ, 2 kΩ and 20 kΩ ranges, the current source is protected against excessive voltages by PTC resistor R1311 and transistor TS1305, connected as a zener diode. The use of a transistor in place of a zener diode has the advantage that its lower leakage current will not influence measuring accuracy.

In the three highest resistance ranges the FET switch TS1303 is non-conductive, and is therefore protected from excessive voltages by transistors TS1301 and TS1302 connected as zener diodes.

VIII-4.6. HF voltage measurements

HF voltage measurements are made using the compensation principle.
The amplitude of a 100 kHz oscillator is controlled by the DC amplifier output and used as a compensation voltage having the same amplitude as the voltage to be measured. A simplified circuit is shown below.

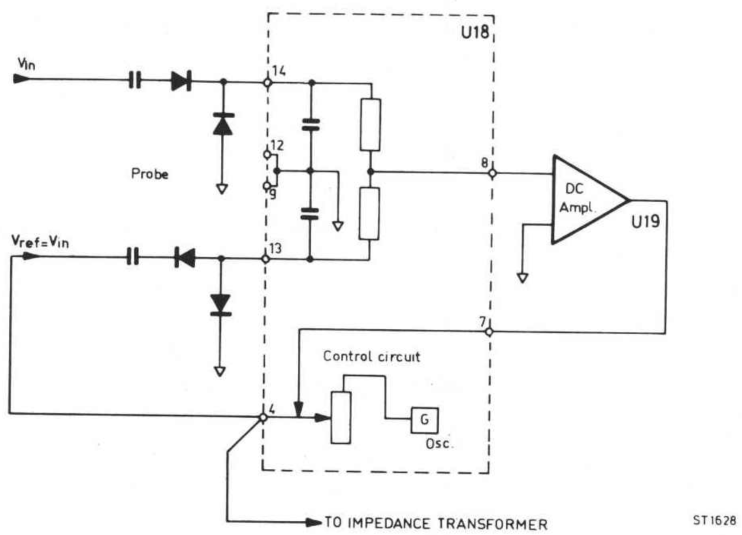


Fig. 35. Principle of H.F. voltage measurements

The measuring probe contains two pairs of diodes, one pair in the h.f. input circuit and the other pair in the compensation circuit. The measuring probe contains two pairs of diodes, one pair in the h.f. input circuit and the other pair in the compensation circuit.
The direct current supplied by the diodes controls the DC amplifier (U19), which has a very high gain without negative feedback. The output voltage of the DC amplifier is connected to the control circuit of the oscillator and governs the output compensation voltage so that it equals the h.f. input voltage. When these voltages equalise ($V_{in} = V_{ref}$) the resulting d.c. output voltage will be zero. The controlled compensation voltage, i.e. the equivalent of the h.f. input voltage, appears at pin 4 of U18 and is switched to the impedance converter circuit U14.
It is then processed in the same way as the a.c. voltages.

IX. ACCESS

IX-1. REMOVING THE TOP AND BOTTOM COVER

The top- and bottom cover can be removed by loosening the six screws "A" (refer to figure 16, page 64).

IX-2. REMOVING THE TOP- AND BOTTOM GUARD COVER

Remove the top- and bottom cover.
The top guard cover can be lifted off the PM 2527 after removing the four screws "B" (refer to figure 60, page 119).
The bottom guard cover can be lifted off the PM 2527 after removing the nine fixing screws.

IX-3. REPLACING THE PARTS ATTACHED TO THE REAR PANEL

(Power switch, Mains transformer, IC1, and Mains filter C1)

- Remove the top- and bottom cover
- Remove the four screws "C" (refer to figure 60, page 119)
- The rear panel can be lifted off the PM 2527 and all parts are accessible.

NOTE: The POWER switch knob is attached to the POWER switch by means of a long shaft.

IX-4. REPLACING THE PLUG-IN UNITS

- Remove the top- and bottom cover
- Remove the top- and bottom guard cover
- The plug-in units are now accessible and can be lifted off the PM 2527.

IX-5. REPLACING THE DISPLAY UNIT U28

- Remove the top cover
- Bend out the three hooks of the display unit frame (refer to figure 60, item 28, page 119)
- Pull the top of the display unit backwards and lift the display unit out off the PM 2527
- When the display unit is placed back into the PM 2527, take care that the indication lamps are not damaged when the display unit is placed in its frame.

IX-6. REPLACING THE FRONTRIM AND TEXTPLATE

- Remove the top- and bottom cover
- Place a screwdriver between the protrusions of the frontrim and the recesses of the frame of the PM 2527 and ease the frontrim off of the PM 2527.
- When the frontrim is removed the textplate can be lifted off the PM 2527.

IX-7. REPLACING FRONT PANEL AND THE PARTS ATTACHED TO IT

(Input terminals and Ranging/Start switches and display unit frame)

- Remove the top- and bottom cover
- Remove the frontrim and the textplate
- Remove the four fixing screws of the front panel
- Lift the front panel off the PM 2527, taking care that the wires do not break
- All parts on the front panel are now accessible.

IX-8. REPLACING THE CONTACT SPRINGS FROM THE FUNCTION SWITCHES (Fig. 61, item 25, page 119)

- Remove the front panel
- The contact springs can now be lifted off the function switches.

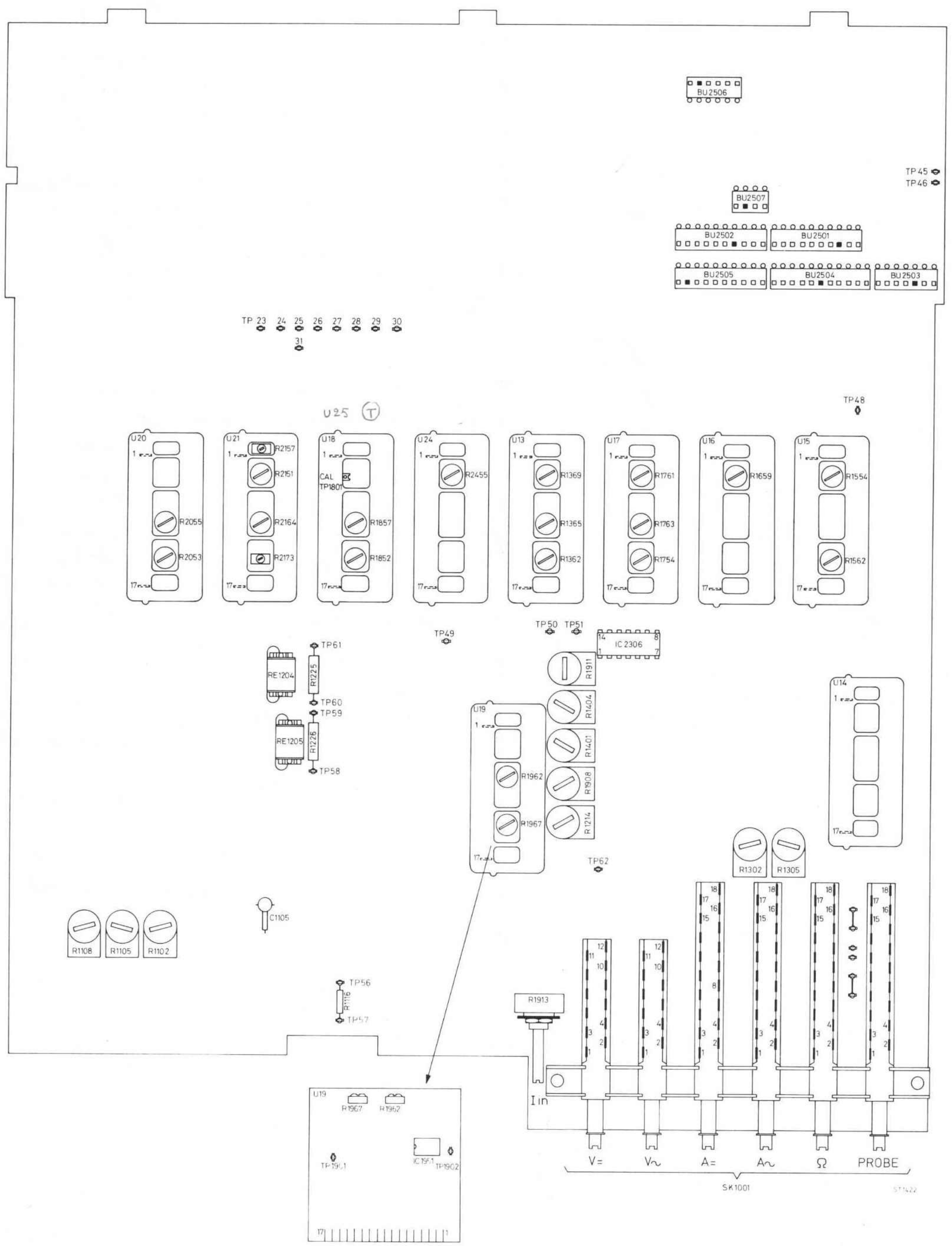


Fig. 36. Test points and adjustments

IX-9. REPLACING THE HANDLE AND PARTS OF IT (Fig. 57, items 5, 6, 7, 8, 9 and 10, page 118)

- Pull the knob off the handle arm (item 9) 2x
- Remove the crosshead screw which is situated under the knob 2x
- The handle can be lifted off the PM 2527 and all parts are accessible now.

X. CHECKING AND ADJUSTING

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

For a complete re-adjustment of the instrument the sequence in this chapter should be adhered to.
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 2527. 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 aerials so that the measuring instrument will measure HF voltage values or hum voltages.

Before checking and adjusting remove top cover and guard cover.

No.	Adjustment	Adjusting element	Preparations	Input signals	Adjusting data	Measuring points	Remarks
1	+15 Vref	R2455	U21 removed. Extension card fitted in BU21.		+15.000 V ± 0.002 V	U21/2 A ⎓ switch/8	
	Check				−15.000 V ± 0.160 V	U21/4 A ⎓ switch/8	
	Check				−10.000 V ± 0.150 V	IC2306/14 A ⎓ switch/8	
2	+Vref ADC	R2151	Fit U21 with use of extension card.		+8.100 V ± 0.010 V	U21/7 - U21/8	
	−Vref ADC	R2164	START switch in pos. EXT. Fit U21 with cover.		−8.100 V ± 0.010 V	U21/9 - U21/10	
3	Zero ADC	R2055	Remove U19. Depress V ⎓ START switch in pos. AUT. Short circuit A ⎓ switch/8 and test pin 49.		±00000	Display	Independent of range.
4	Calibration ADC	R2053	Remove short circuiting and apply +1 mV and −1 mV ±10 μV to A ⎓ switch/8 and TP49.	−1 mV +1 mV	+00010 −00010	Display	Independent of range.
5	Chopper frequency d.c. amplifier	R1967	Fit U19 with use of extension card.		220 Hz ± 1 Hz	TP1901 A ⎓ switch/8	TP1901 is located on unit U19.
6	Spikes minimizing d.c. amplifier	R1962	Fit U19 with use of extension card.		Minimum spikes visible at oscilloscoop.	TP1902	TP1902 is located on unit U19.
7	Input current d.c. amplifier	I in (front)	Range 200 mV (man setting) START switch in pos. AUT. Depress V ⎓	Open input terminals.	Less than 20 digits.	Display	
8	Zero d.c. amplifier	R1911	Fit U19 with cover. START switch in pos. AUT. Range: 200 mV (man setting) Depress V ⎓	Short - circuited V - 0 terminals	000.00 mV ± 1 digit	Display	
	Check		Range: 2.0000 V	Short - circuited V - 0 terminals	0.0000 V ± 1 digit	Display	
9	End of range ADC	R2157	Adjustment 9 up to and including 13 are carried out with START switch in pos. AUT. RANGING switch in pos. MAN. with correct range selected. Input signals to V - 0 terminals. Function switch V ⎓ depressed.	−1.9000 V ⎓ ±0.005%	+1.9000 V ± 1 digit	Display	
	End of range ADC	R2173		+1.9000 V ⎓ ±0.005%	−1.9000 V ± 1 digit	Display	
10	200.00 mV d.c.	R1908		+190.00 mV ⎓ ±0.005%	+190.00 mV ± 1 digit	Display	
				−190.00 mV ⎓ ±0.005%	−190.00 mV ± 1 digit	Display	
11	20.000 V d.c.	R1102		+19.000 V ⎓ ±0.005%	+19.000 V ± 1 digit	Display	
	Check			−19.000 V ⎓ ±0.005%	−19.000 V ± 1 digit	Display	
12	200.00 V d.c.	R1105		+190.00 V ⎓ ±0.005%	+190.00 V ± 1 digit	Display	
	Check			−190.00 V ⎓ ±0.005%	−190.00 V ± 1 digit	Display	
13	1000.0 V d.c.	R1108		+900.0 V ⎓ ±0.005%	+900.0 V ± 1 digit	Display	
	Check			−900.0 V ⎓ ±0.005%	−900.0 V ± 1 digit	Display	
14	Zero resistance ranges Check		RANGING switch in pos. AUT. START switch in pos. AUT. Function switch Ω depressed.	Short - circuited Ω - 0 terminals	.00000 kΩ ± 5 digits deviation	Display	
15	0.2 kΩ	R1369	Adjustment 15 up to and including 22 are carried out with START switch in pos. AUT. RANGING switch in pos. MAN. with correct range selected. Input signals to Ω - 0 terminals.	190 Ω ±0.01%	0.19000 kΩ ± 1 digit ± 5 digits deviation	Display	
16	2 kΩ	R1362		1.9 kΩ ±0.01%	1.9000 kΩ ± 1 digit	Display	
17	20 kΩ	R1365		19 kΩ ±0.01%	19.000 kΩ ± 1 digit	Display	
18	20 MΩ	R1302		19 MΩ ±0.02%	19.000 MΩ ± 1 digit	Display	
19	200 MΩ			190 MΩ ±0.05%	190 MΩ ± 2 digits	Display	Before checking the 200 MΩ and 2000 MΩ ranges, repeat adjustment 9.
20	2000 MΩ			1900 MΩ ±0.2%	1900 MΩ ± 20 digits	Display	
21	200 kΩ	R1305	Function switch Ω depressed.	190 kΩ ±0.01%	190.00 kΩ ± 1 digit	Display	
22	2 MΩ			1.9 MΩ ±0.01%	1.9000 MΩ ± 6 digits	Display	

No.	Adjustment	Adjusting element	Preparations	Input signals	Adjusting data	Measuring points	Remarks
23	Zero current ranges	R1214	START switch in pos. AUT. Function switch A ⎓ depressed.	Open input	0 mV ± 1 mV	TP62 A ⎓ switch/8	After adjustment check all current ranges. The display should indicate 00000 ± 3 digits.
24	2 mA d.c.	R1215	As adjustment 23 select 2 mA range	1,9 mA ⎓ ±0.02%	1.9000 mA ± 5 digits	Display	
25	200 μA d.c.	R1216	As adjustment 23 select 200 μA range	190 μA ⎓ ±0.02%	190.00 μA ± 5 digits	Display	After adjustment check all d.c. current ranges. Max. tolerance: ± 20 digits at end of range.
26	Zero a.c. pre-amplifier	R1554	Adjustment 26 up to and including 37 are carried out with START switch in pos. AUT. RANGING switch in pos. MAN. with correct range selected. Input signals to V - 0 terminals. Function switch V~ depressed. Select 20 mV range.	Short - circuited V - 0 terminals	+10 mV ± 5 mV	TP48 0 terminal	
27	Zero a.c. amplifier	R1659	Select 20 mV range	Short - circuited V - 0 terminals	Less than 1 mV d.c.	TP50 0 terminal	Use an analog voltmeter.
28	Zero RMS converter	R1754	Fit U17 with use of extension card. Select 20 mV range.	Short - circuited V - 0 terminals	0 ± 1 mV	A~/17 0 terminal	
29		R1763	Select 20 mV range.	10 mV ±0.05% / 10 kHz to V - 0 terminals	Less than 0.5 mV d.c.	BU17/4 - BU17/17	
30	20.00 mV a.c.	R1761	Fit U17 with cover. Select 20 mV range.	19 mV ± 0.05% / 10 kHz to V - 0 terminals	19.00 mV ± 1 digit	Display	
31	Linearity RMS converter	R1754	Select 20 mV range.	1.9 mV +0.05% / 10 kHz to V - 0 terminals	01.90 mV ± 1 digit	Display	Wait for approx. 30 sec. before reading out the result. Repeat adj. 30 and 31 until the correct value is reached.
32	Check of safety circuit RMS converter		Select 20 mV range.	10 V/10 kHz	Less than +6.5 V	A~ /17 - A ⎓ /8	
33	Linearity check a.c. measurement			10 mV ±0.05% / 10 kHz to V - 0 terminals	10.00 mV ± 2 digits	Display	
34	Frequency characteristic	R1562	Select 20 mV range.	10 mV ±0.05% / 100 kHz to V - 0 terminals	10.00 mV ± 2 digits	Display	
35	2.000 V a.c.	R1401	Select 2 V range.	1.9 V ±0.05% / 10 kHz to V - 0 terminals	1.900 V ± 1 digit	Display	
36	200.0 mV a.c.	R1404	Select 200 mV range.	190 mV ±0.05% / 10 kHz to V - 0 terminals	190.0 mV ± 1 digit	Display	
37	20.00 V a.c.	C1105	Select 20 V range.	19 V ±0.05% / 10 kHz to V - 0 terminals	19.00 V ± 1 digit	Display	
38	Check of HF oscillator				100 kHz / 3 mV (10 mV p.p.)	TP1801 Switch A ⎓ /8	TP1801 is located on unit U18.
39	Calibration Probe / Instrument	R1857	Depress "PROBE"	5 mV ±0.05% / 100 kHz at "PROBE" input.	05.00 mV ± 2 digits	Display	
		R1852		1.5 V ± 0.05% / 100 kHz at "PROBE" input.	1.500 V ± 2 digits	Display	

XI. FAULTFINDING

CONTENTS

XI-1. GENERAL

XI-1.1. Service hints

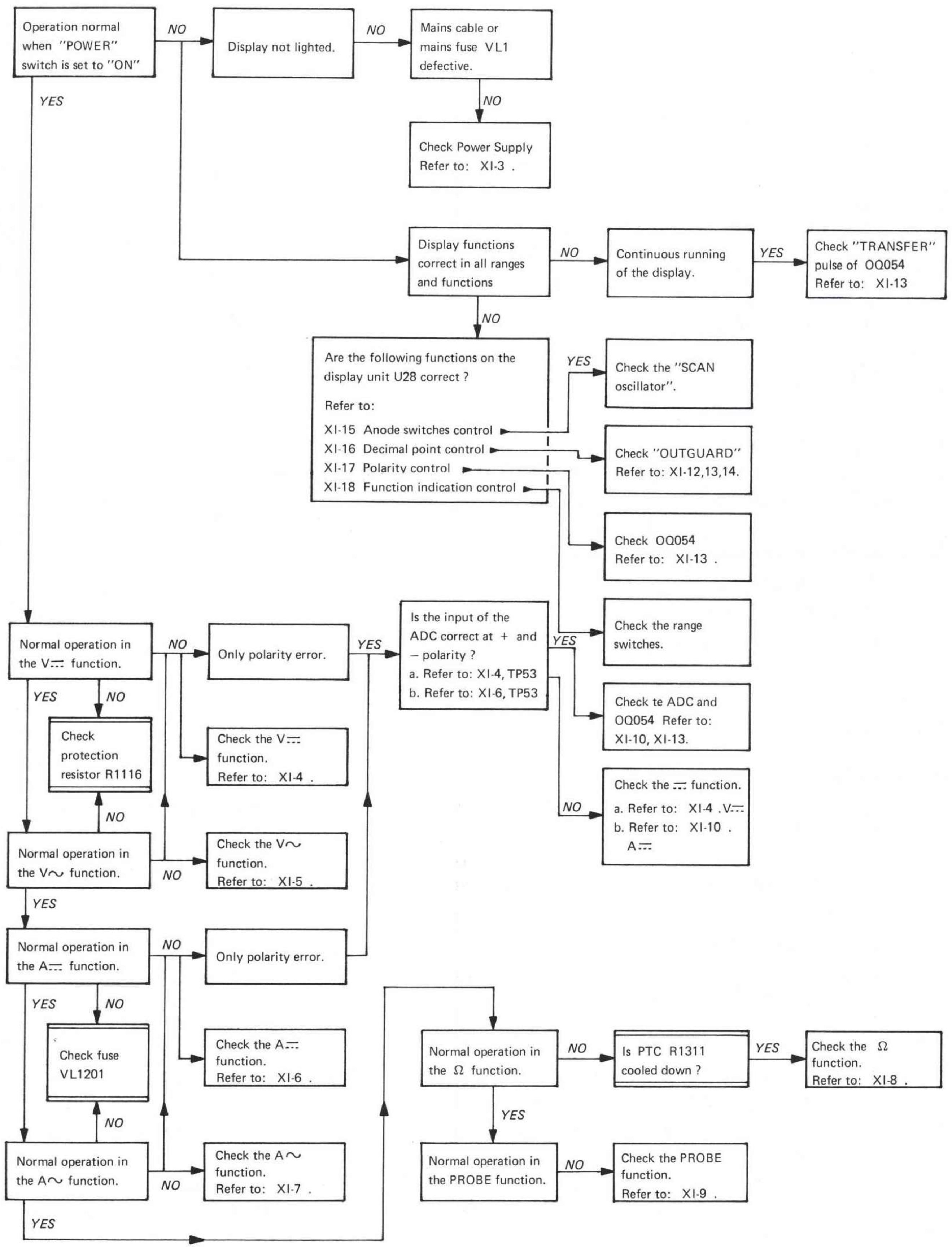
If servicing has to be carried out the following points should be taken into account in order to avoid damaging the instrument.

- Take care to avoid short-circuits with measuring clips and hooks if the instrument is switched-on, especially near the input terminals when high voltages are present.
- Use miniature soldering iron (35 W max.) with a tin cleaner or a vacuum soldering iron.
- Use an acid-free solder.
- When measuring on the units use an extension board, code number 5322 263 74094, which is especially developed for these purposes.

IX-1.2. Tests

- In this chapter a General Trouble Shooting List (XI-2.) is given by which not functiong parts such as, Inguard Outguard, Display or Power Supply can be found.
- When the not functioning part is found, with the different faultfinding tables the not functioning e.g. units can be found.
- The faultfinding tables are provided as an aid for, rather than the means of, faultfinding.
  With the help of the tables the location of a fault can be found. The circuit description can be a help to find the exact error.
- The location of the test points mentioned in the faultfinding tables are shown in wiring diagram figure 62, page .

XI-2. TROUBLE SHOOTING GENERAL



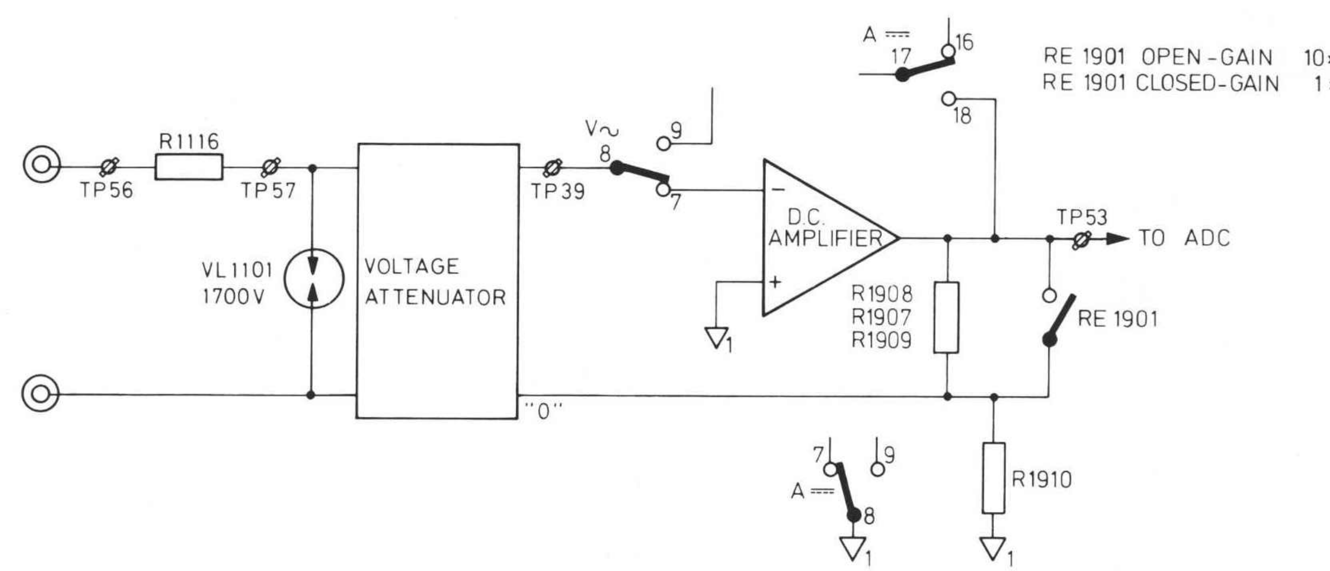
XI-3. POWER SUPPLY CHECK

MEASURING POINTS		MEASURING DATA	Refer to fig.'s	REMARKS
T1/1	T1/4	220 ~	66	OUTGUARD
BU2503/ 7	BU2503/ 6	≈ 8.2 V~		
BU2503/ 4	BU2503/ 6	≈ 8.2 V~		Varies at other mains voltage
BU2503/10	BU2503/11	≈ 35 V~		
BU2507/ 1	BU2503/ 6	+ 5 V		
T1001/3	T1001/4	≈ 26.2 V ~	63	INGUARD
T1001/5	T1001/4	≈ 26.2 V ~		
T1001/6	T1001/7	≈ 11.4 V ~		
U24/ 9	U24/5	+15 V		Place U24 on extension board.
U24/14	U24/5	-15 V		U24/5/4/2 are interconnected.
U24/ 7	U24/5	-10 V		U24/14/3 are interconnected.
				U24/9/6/1 are interconnected.

XI-4. V ⎓ FUNCTION CHECK

CHECKING THE V⎓ FUNCTION

RANGE SELECTED	INPUT VOLTAGE SUPPLIED TO TERMINALS "V" AND "0"	ATTENUATION FACTOR	OUTPUT VOLTAGE ATTENUATOR TESTPOINTS SWITCH V~/8 TERMINAL "0"	GAIN DC AMPLIFIER	OUTPUT DC AMPLIFIER TESTPOINTS SWITCH A⎓/18 SWITCH A⎓/8	REFERENCE VOLTAGE OF ADC CONNECTED
200 mV	+ 100 mV	1	+ 100 mV	10	− 1 V	+ Vref
2 V	+ 1 V	1	+ 1 V	1	− 1 V	
20 V	+ 10 V	10	+ 1 V	1	− 1 V	
200 V	+ 100 V	100	+ 1 V	1	− 1 V	
1000 V	+ 1000 V	1000	+ 1 V	1	− 1 V	
200 mV	− 100 mV	1	− 100 mV	10	+ 1 V	− Vref
2 V	− 1 V	1	− 1 V	1	+ 1 V	
20 V	− 10 V	10	− 1 V	1	+ 1 V	
200 V	− 100 V	100	− 1 V	1	+ 1 V	
1000 V	− 1000 V	1000	− 1 V	1	+ 1 V	



NOTE : FOR THE RELAYS ENERGIZED IN THE VARIOUS RANGES REFER TO THE RELAY SWITCHING TABLE

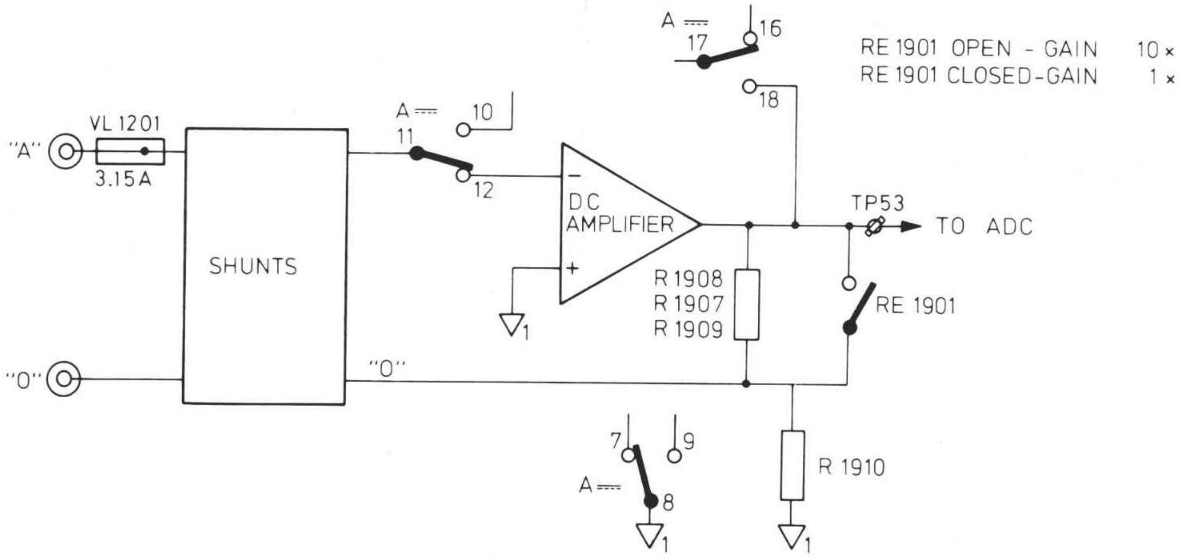
ST 1721

Fig. 37. Checking the V d.c. function

XI-6. A ⎓ FUNCTION CHECK

CHECKING THE A ⎓ FUNCTION

RANGE SELECTED	INPUT CURRENT SUPPLIED TO TERMINALS "A" AND "O"	SHUNTS	OUTPUT CURRENT ATTENUATOR TESTPOINTS SWITCH A⎓/11 SWITCH A⎓/8	GAIN DC AMPLIFIER	OUTPUT DC AMPLIFIER TESTPOINTS SWITCH A⎓/18 SWITCH A⎓/8	REFERENCE VOLTAGE OF ADC CONNECTED
2 μA	+ 1 μA	100 kΩ	+ 100 mV	10	− 1V	
20 μA	+ 10 μA	10 kΩ	+ 100 mV	10	− 1V	
200 μA	+ 100 μA	1 kΩ	+ 100 mV	10	− 1V	
2 mA	+ 1 mA	100 Ω	+ 100 mV	10	− 1V	+ Vref
20 mA	+ 10 mA	10 Ω	+ 100 mV	10	− 1V	
200 mA	+ 100 mA	1 Ω	+ 100 mV	10	− 1V	
2000 mA	+ 1000 mA	0.1 Ω	+ 100 mV	10	− 1V	
2 μA	− 1 μA	100 kΩ	− 100 mV	10	+ 1V	
20 μA	− 10 μA	10 kΩ	− 100 mV	10	+ 1V	
200 μA	− 100 μA	1 kΩ	− 100 mV	10	+ 1V	
2 mA	− 1 mA	100 Ω	− 100 mV	10	+ 1V	− Vref
20 mA	− 10 mA	10 Ω	− 100 mV	10	+ 1V	
200 mA	− 100 mA	1 Ω	− 100 mV	10	+ 1V	
2000 mA	− 1000 mA	0.1 Ω	− 100 mV	10	+ 1V	



NOTE: FOR THE RELAYS ENERGIZED IN THE VARIOUS RANGES REFER TO THE RELAY SWITCHING TABLE

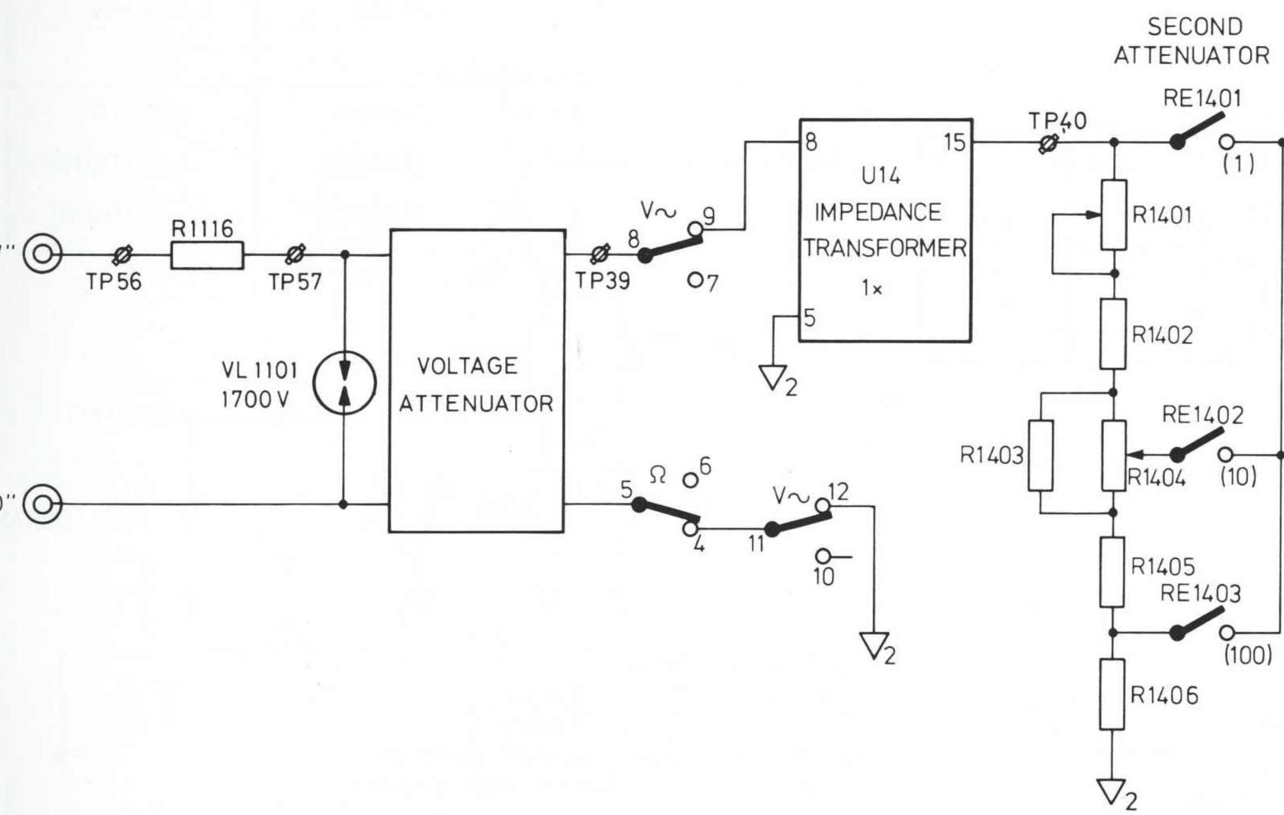
ST 1722

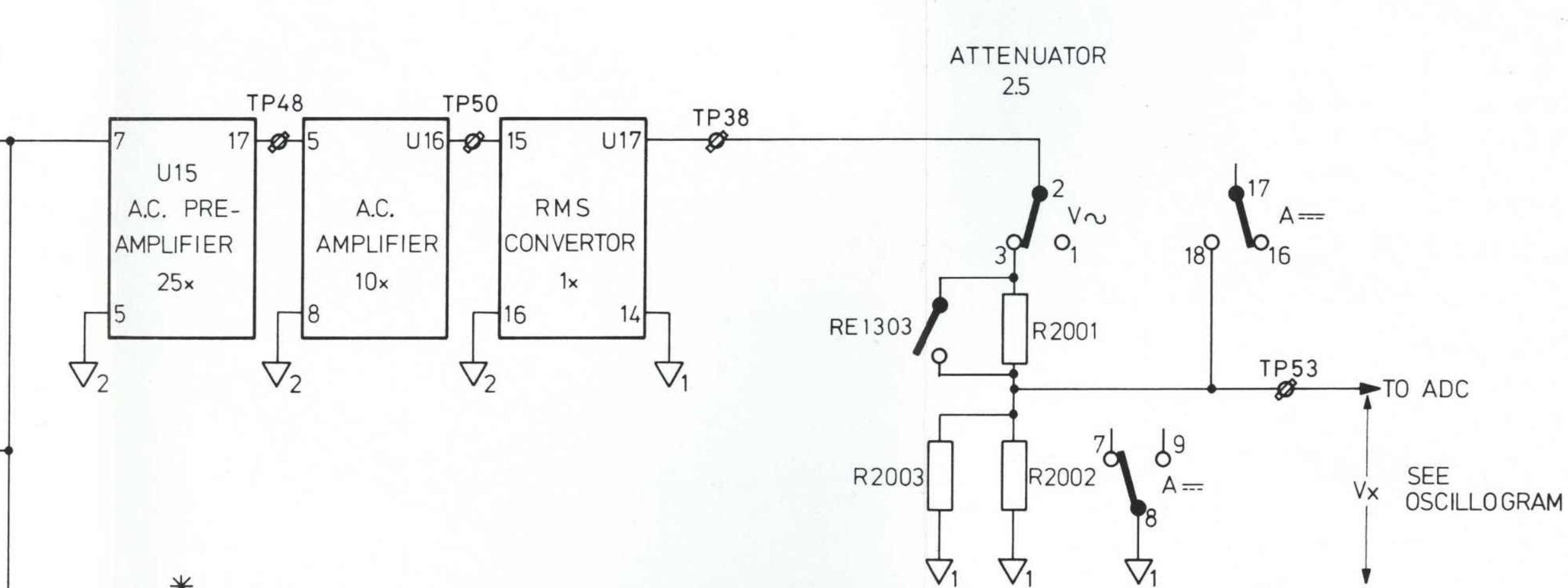
Fig. 39. Checking the A d.c. function

XI-5. V∼ FUNCTION CHECK

CHECKING THE V∼FUNCTION

RANGE SELECTED	INPUT VOLTAGE SUPPLIED TO TARMINALS "V" AND "O"	ATTENUATION FACTOR	OUTPUT VOLTAGE ATTENUATOR TESTPOINTS SWITCH V∼/8 TARMINAL "O"	OUTPUT IMPEDANCE TRANSFORMER GAIN (1×) TESTPOINTS U14 PIN 15 SWITCH V∼/12	ATTENUATION FACTOR OF SECOND ATTENUATOR	OUTPUT SECOND ATTENUATOR TESTPOINTS U15 PIN 7 SWITCH V∼/12	OUTPUT A.C. PRE-AMPLIFIER GAIN (25×) TESTPOINTS U15 PIN 17 SWITCH V∼/12	OUTPUT A.C. AMPLIFIER GAIN (10×) TESTPOINTS U16 PIN 16 SWITCH V∼/12	OUTPUT RMS CONVERTOR TESTPOINTS U17 PIN 7 SWITCH A⎓/18	ATTENUATION FACTOR OF THE RMS OUTPUT SIGNAL	Vx * TESTPOINTS SWITCH A⎓/18 SWITCH A⎓/8	REFERENCE VOLTAGE OF ADC CONNECTED
20mV	10mV	1	10mV	10mV	1	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
200mV	100mV	1	100mV	100mV	10	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
2V	1V 10kHz RMS	1	1V 10kHz	1V 10kHz	100	10mV 10kHz	250mV 10kHz	2.5V 10kHz	+ 2.5V ⎓	2.5	+ 1V ⎓	- Vref
20V	10V	1000	10mV	10mV	1	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
200V	100V	1000	100mV	100mV	10	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
600V	600V	1000	600mV	600mV	100	6mV	150mV	1.5V	+ 1.5V ⎓	2.5	+ 1V ⎓	





NOTE: FOR THE RELAYS ENERGIZED IN THE VARIOUS RANGES REFER TO THE RELAY SWITCHING TABLE

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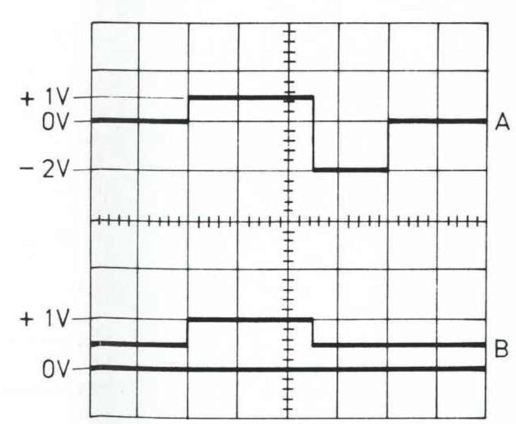


OSCILLOSCOPE SETTINGS
TIME : 50ms/div.
VOLTS : A. 2V/div.
B. 1V/div.
SIGNALS : A. INPUT ADC U20/17 0=U20/16
B. Vx U21/11 0=U20/6

NOTE: THE OSCILLOGRAM SHOWS THE INPUT OF THE ADC AND THE UNKNOWN VOLTAGE Vx (+1V). DURING THE RAMP DOWN PHASE Vx IS DISCONNECTED FROM THE ADC BY SIGNAL RAMP UP (Ru). AT THE SAME TIME THE RMS CONVERTOR IS OVERLOADED BY THE REFERENCE UNIT. THE OVERLOADING CAUSES A VOLTAGE DROP OF Vx. THIS ONLY HAPPENS IN THE A.C. VOLTS AND CURRENT RANGES. THIS ALSO OCCURS DURING THE D.C. PHASE.

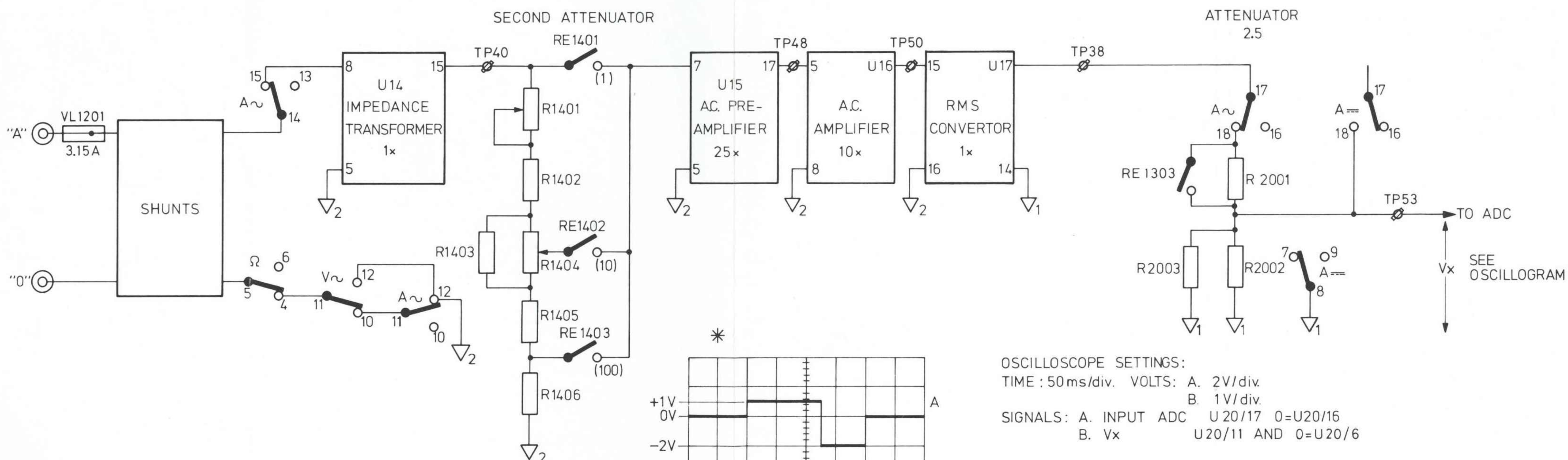
ST 1720

Fig. 38. Checking the V a.c. function

XI-7. A~ FUNCTION CHECK

CHECKING THE A ~ FUNCTION

RANGE SELECTED	INPUT CURRENT (SUPPLIED TO TERMINALS "A" AND "0")	SHUNTS	OUTPUT VOLTAGE OF THE SHUNTS (TESTPOINTS SWITCH A~/14 TERMINAL "0")	OUTPUT IMPEDANCE TRANSFORMER (GAIN 1×) (TESTPOINTS U14 PIN 15 SWITCH V~/12)	ATTENUATION FACTOR OF THE SECOND ATTENUATOR	OUTPUT SECOND ATTENUATOR (TESTPOINTS U15 PIN 7 SWITCH V~/12)	OUTPUT A.C. PRE-AMPLIFIER (GAIN 25×) (TESTPOINTS U15 PIN 17 SWITCH V~/12)	OUTPUT A.C. AMPLIFIER (GAIN 10×) (TESTPOINTS U16 PIN 16 SWITCH V~/12)	OUTPUT RMS CONVERTOR (TESTPOINTS U17 PIN 7 SWITCH A⎓/8)	ATTENUATION FACTOR OF THE RMS OUTPUT SIGNAL	Vx * (TESTPOINTS SWITCH A⎓/18 SWITCH A⎓/8)	REFERENCE VOLTAGE OF ADC CONNECTED
2 μA	1 μA	100 kΩ	100 mV	100 mV	10	10 mV	250 mV	2.5 V	+ 2.5 V ⎓	2.5	+ 1V ⎓	
20 μA	10 μA	10 kΩ	100 mV	100 mV	10	10 mV	250 mV	2.5 V	+ 2.5 V ⎓	2.5	+ 1V ⎓	
200 μA	100 μA	1 kΩ	100 mV	100 mV	10	10 mV	250 mV	2.5 V	+ 2.5 V ⎓	2.5	+ 1V ⎓	
2 mA	1 mA (10kHz RMS)	100 Ω	100 mV (>10kHz)	100 mV (>10kHz)	10	10 mV (>10kHz)	250 mV (>10kHz)	2.5 V (>10kHz)	+ 2.5 V ⎓	2.5	+ 1V ⎓	– Vref
20 mA	10 mA	10 Ω	100 mV	100 mV	10	10 mV	250 mV	2.5 V	+ 2.5 V ⎓	2.5	+ 1V ⎓	
200 mA	100 mA	1 Ω	100 mV	100 mV	10	10 mV	250 mV	2.5 V	+ 2.5 V ⎓	2.5	+ 1V ⎓	
2000 mA	1000 mA	0.1 Ω	100 mV	100 mV	10	10 mV	250 mV	2.5 V	+ 2.5 V ⎓	2.5	+ 1V ⎓	



NOTE : FOR THE RELAYS ENERGIZED IN THE VARIOUS RANGES REFER TO THE RELAY SWITCHING TABLE

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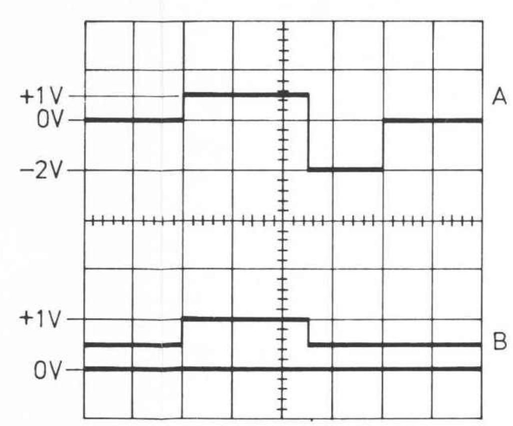


OSCILLOSCOPE SETTINGS:
TIME : 50 ms/div. VOLTS: A. 2V/div.
B. 1V/div.
SIGNALS: A. INPUT ADC U 20/17 0=U20/16
B. Vx U20/11 AND 0=U20/6

NOTE: THE OSCILLOGRAM SHOWS THE INPUT OF THE ADC AND THE UNKNOWN VOLTAGE Vx (+1V). DURING THE RAMP DOWN PHASE AND THE D.C. PHASE Vx IS DISCONNECTED FROM THE ADC BY SIGNAL RAMP UP (Ru). AT THE SAME TIME THE RMS CONVERTOR IS OVERLOADED BY THE REFERENCE UNIT. THE OVERLOADING CAUSES A VOLTAGE DROP OF Vx. THIS ONLY HAPPENS IN THE A.C. VOLTS AND CURRENT RANGES. THIS ALSO OCCURS DURING THE D.C. PHASE

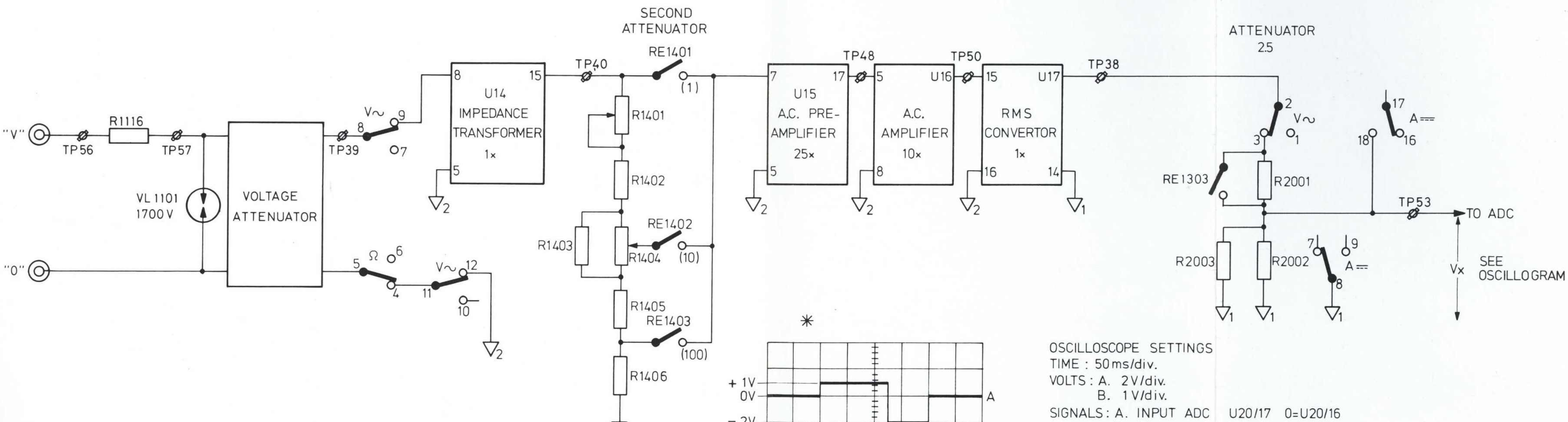
ST 1723

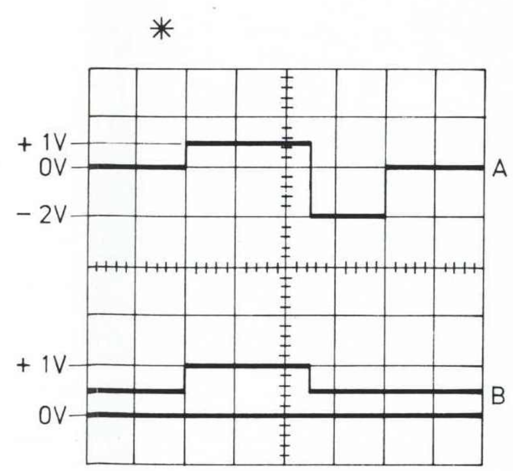
Fig. 40. Checking the A a.c. function

XI-5. V~ FUNCTION CHECK

CHECKING THE V~FUNCTION

RANGE SELECTED	INPUT VOLTAGE SUPPLIED TO TARMINALS "V" AND "0"	ATTENUATION FACTOR	OUTPUT VOLTAGE ATTENUATOR TESTPOINTS SWITCH V~/8 TARMINAL "0"	OUTPUT IMPEDANCE TRANSFORMER GAIN (1×) TESTPOINTS U14 PIN 15 SWITCH V~/12	ATTENUATION FACTOR OF SECOND ATTENUATOR	OUTPUT SECOND ATTENUATOR TESTPOINTS U15 PIN 7 SWITCH V~/12	OUTPUT A.C. PRE-AMPLIFIER GAIN (25×) TESTPOINTS U15 PIN 17 SWITCH V~/12	OUTPUT A.C. AMPLIFIER GAIN (10×) TESTPOINTS U16 PIN 16 SWITCH V~/12	OUTPUT RMS CONVERTOR TESTPOINTS U17 PIN 7 SWITCH A⎓/18	ATTENUATION FACTOR OF THE RMS OUTPUT SIGNAL	Vx * TESTPOINTS SWITCH A⎓/18 SWITCH A⎓/8	REFERENCE VOLTAGE OF ADC CONNECTED
20mV	10mV	1	10mV	10mV	1	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
200mV	100mV	1	100mV	100mV	10	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
2V	1V 10kHz	1	1V 10kHz	1V 10kHz	100	10mV 10kHz	250mV 10kHz	2.5V 10kHz	+ 2.5V ⎓	2.5	+ 1V ⎓	- Vref
20V	10V RMS	1000	10mV	10mV	1	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
200V	100V	1000	100mV	100mV	10	10mV	250mV	2.5V	+ 2.5V ⎓	2.5	+ 1V ⎓	
600V	600V	1000	600mV	600mV	100	6mV	150mV	1.5V	+ 1.5V ⎓	2.5	+ 1V ⎓	





NOTE: FOR THE RELAYS ENERGIZED IN THE VARIOUS RANGES REFER TO THE RELAY SWITCHING TABLE

OSCILLOSCOPE SETTINGS
TIME : 50ms/div.
VOLTS : A. 2V/div.
B. 1V/div.
SIGNALS : A. INPUT ADC U20/17 0=U20/16
B. Vx U21/11 0=U20/6

NOTE: THE OSCILLOGRAM SHOWS THE INPUT OF THE ADC AND THE UNKNOWN VOLTAGE Vx (+1V). DURING THE RAMP DOWN PHASE Vx IS DISCONNECTED FROM THE ADC BY SIGNAL RAMP UP (Ru). AT THE SAME TIME THE RMS CONVERTOR IS OVERLOADED BY THE REFERENCE UNIT. THE OVERLOADING CAUSES A VOLTAGE DROP OF Vx. THIS ONLY HAPPENS IN THE A.C. VOLTS AND CURRENT RANGES. THIS ALSO OCCURS DURING THE D.C. PHASE.

ST 1720

Fig. 38. Checking the V a.c. function

XI-8. Ω FUNCTION CHECK

CHECKING THE Ω FUNCTION

RANGE SELECTED	INPUT RESISTANCE SUPPLIED TO TERMINALS "Ω" AND "0"	MEASURING CURRENT THROUGH Rx	MEASURING VOLTAGE TESTPOINTS TERMINALS "Ω" AND "0"	RELAYS AND FET SWITCHES ACTIVATED RE 1301	RE 1303	TS 1303	TS 1304	ACTIVATED INPUTS OF CURRENT SOURCE U13 0 = NONACTIVE −15 V 1 = ACTIVE +15 V 17	13	11	ATTENUATION FACTOR RE 1303	Vx (TO ADC) TESTPOINTS TP 53 - A⎓/18 SWITCH A⎓/8	REFERENCE VOLTAGE OF ADC CONNECTED
.2 kΩ	100 Ω	10 mA	+1 V⎓	X	X			1	0	0	1	−1 V⎓	
2 kΩ	1 k Ω	1 mA	+1 V⎓	X	X			0	1	0	1	−1 V⎓	
20 kΩ	10 k Ω	0.1 mA	+1 V⎓	X	X			0	0	1	1	−1 V⎓	
200 kΩ	100 k Ω	10 μA	+1 V⎓		X	X	X	1	0	0	1	−1 V⎓	+ Vref
2 MΩ	1 M Ω	1 μA	+1 V⎓		X	X	X	0	1	0	1	−1 V⎓	
20 MΩ	10 M Ω	250 nA	+ 2.5 V⎓				X	1	0	0	2.5	−1 V⎓	
200 MΩ	100 M Ω	25 nA	+ 2.5 V⎓				X	0	1	0	2.5	−1 V⎓	
2000 MΩ	1000 M Ω	2.5 nA	+ 2.5 V⎓				X	0	0	1	2.5	−1 V⎓	

ST 1834

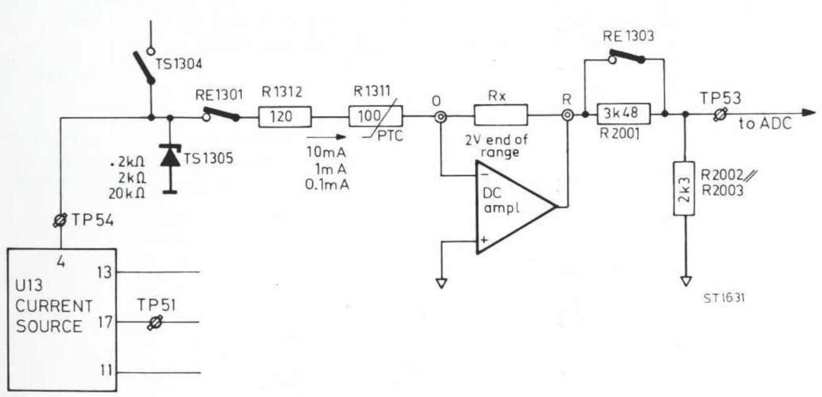


Fig. 41a. Checking the ranges .2 kΩ, 2 kΩ and 20 kΩ

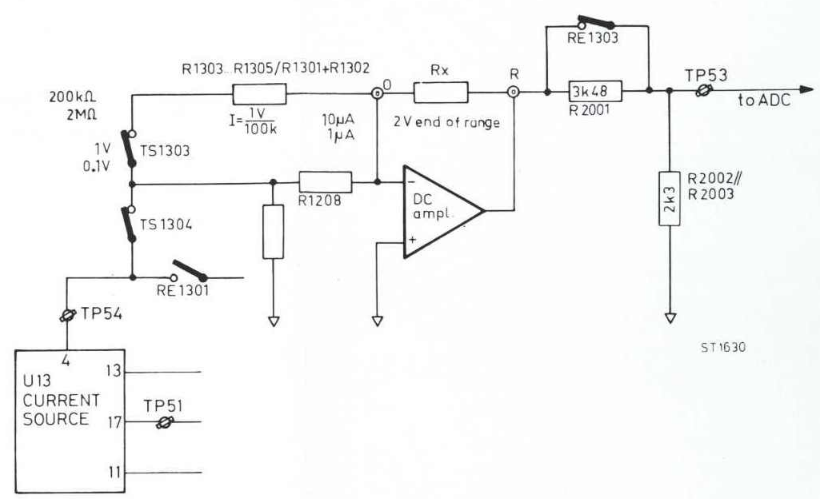


Fig. 41b. Checking the ranges 200 kΩ and 2 MΩ

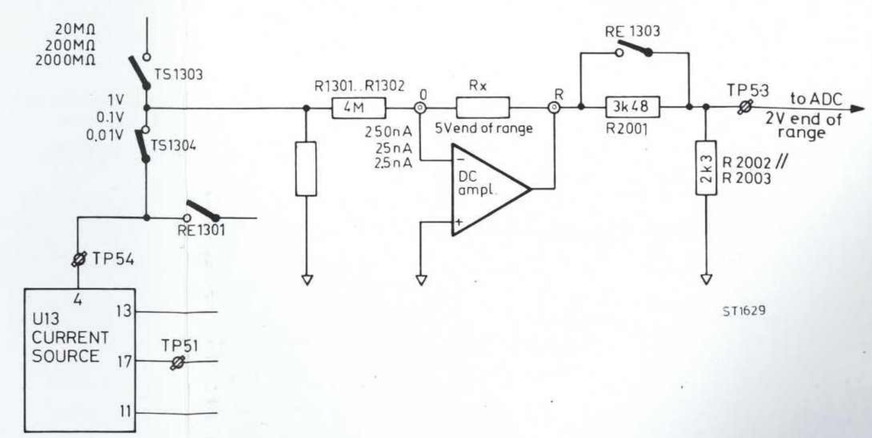


Fig. 42. Checking the ranges 20 MΩ, 200 MΩ and 2000 MΩ

XI-9. PROBE FUNCTION CHECK

CHECKING THE PROBE FUNCTION

INPUT VOLTAGE ON PROBE PM 9211	D.C. AMPLIFIER	OUTPUT HF PROBE (REFER TO FIG. 35)	INPUT IMPEDANCE TRANSFORMER	OUTPUT IMPEDANCE TRANSFORMER (GAIN 1×)	ATTENUATION FACTOR OF SECOND ATTENUATOR	OUTPUT SECOND ATTENUATOR	OUTPUT A.C. PRE-AMPLIFIER (GAIN 25×)	OUTPUT A.C. AMPLIFIER (GAIN 10×)	OUTPUT RMS CONVERTOR	ATTENUATION FACTOR OF THE RMS OUTPUT SIGNAL RE 1303 OPEN	Vx ✳	REFERENCE VOLTAGE OF ADC CONNECTED
SUPPLIED TO TO THE PROBE INPUT	TESTPOINTS TP 30 TP 29	TESTPOINTS TP 26 TP 23	TESTPOINTS TP 41 SWITCH A∼/12	TESTPOINTS U14 PIN15 (TP40) SWITCH V∼/12		TESTPOINTS U15 PIN 7 SWITCH V∼/12	TESTPOINTS U15 PIN 17 (TP48) SWITCH V∼/12	TESTPOINTS U16 PIN 16 (TP50) SWITCH V∼/12	TESTPOINTS U17 PIN 7 (TP38) SWITCH A⎓/8		TESTPOINTS SWITCH A⎓/18 (TP53) SWITCH A⎓/8	
10mV } 1MHz	0V ⎓	10mV } 100kHz	10mV } 100kHz	10mV } 100kHz	1	10mV } 100kHz	250mV } 100kHz	2.5V	+2.5V ⎓	2.5	+1V ⎓	– Vref
100mV } 1MHz	0V ⎓	100mV } 100kHz	100mV } 100kHz	100mV } 100kHz	10	10mV } 100kHz	250mV } 100kHz	2.5V	+2.5V ⎓	2.5	+1V ⎓	
1 V } 1MHz	0V ⎓	1 V } 100kHz	1 V } 100kHz	1 V } 100kHz	100	10mV } 100kHz	250mV } 100kHz	2.5V	+2.5V ⎓	2.5	+1V ⎓	

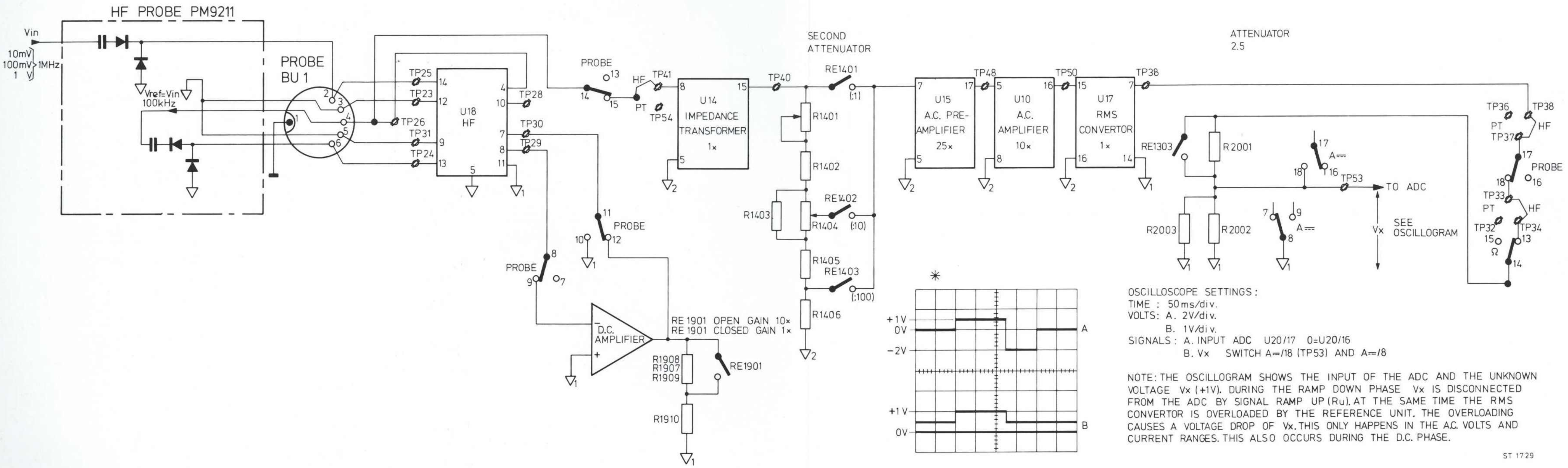


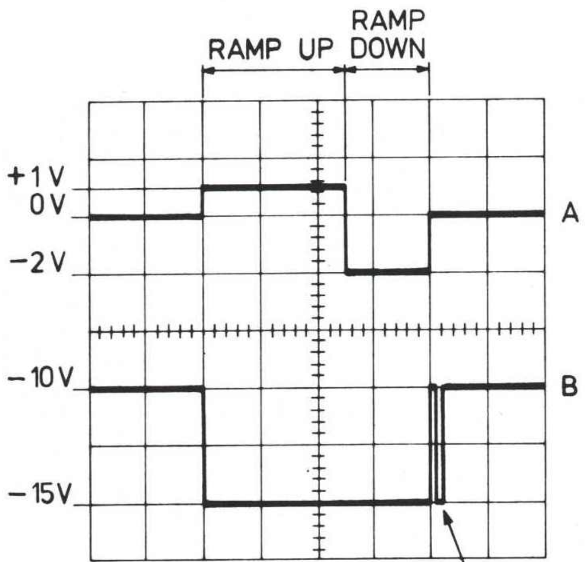
Fig. 43. Checking the probe function

XI-10. ADC AND REFERENCE UNIT CHECK

TEST POINT	FUNCTION	CONDITION	VALUE	COMMENTS
U20/17 U20/15 U20/16 = zero	Input ADC Comparator	Select: Range 2 V⎓ Supply: + or − 1 V⎓ to the "V" and "O" terminals	Oscillogram Fig's 44 and 45	The oscillograms show the input of the ADC and the comparator signal at the end of the ramp down face the comparator signal is active for 1 m sec.
U20/17 U20/11 U20/16 = zero	Input ADC Automatic zero control AZC	Select: Range 2 V⎓ Supply: + or - 1 V⎓ to the "V" and "O" terminals	Oscillogram Fig's 46 and 47	The oscillograms show the input of the ADC and the AZC signal at + and - polarity. Signal AZC is not active during the ramp up and ramp down fase.
U21/17 U21/15 U21/ 5 = zero	Ramp up (Ru) Ramp down (Rd-)	Select: Range 2 V⎓ Supply: - 1 V⎓ to the "V" and "O" terminals	Oscillogram Fig. 48	The oscillogram shows the Ramp up control signal and the Ramp down- (Rd-) control signals during the ramp up- and the ramp down fase. At - polarity signal Ramp down + (Rd+) is not active. Signal Ramp up (Ru) switches the input signal Vx to the ADC. Signal Ramp down - (Rd-) switches the - 15 V reference voltage to the ADC.
U21/17 U21/15 U21/ 5 = zero	Ramp up (Ru) Ramp down + (Rd+)	Select: Range 2 V⎓ Supply: + 1 V⎓ to the "V" and "O" terminals	Oscillogram Fig. 49	The oscillogram shows the Ramp up control signal and the Ramp down + (Rd+) control signal during the the ramp up- and ramp down fase. At + polarity signal Ramp down- (Rd-) is not active. Signal Ramp up (Ru) switches the input signal Vx to the ADC. Signal Ramp down + (Rd+) switches the + 15 V reference voltage to the ADC.
U20/17 U20/16 = zero U21/11 (TP53) U21/ 5 = zero	Input ADC Vx	Select: Range 2 V⎓ Supply: + or - 1 V to the "V" and "O" terminals	Oscillogram Fig's 50 and 51	The oscillograms show the input of the ADC and the unknown input voltage Vx (= 1V). At + polarity of the input voltage (supplied to the "V" and "O" sockets) the polarity of Vx is -. With signal ramp down+(Rd+) the +15 V reference is switched to the ADC during the ramp down fase. At- polarity of the input voltage (supplied to the "V" and "O" socket) the polarity of Vx is +. With signal ramp down₋ (Rd₋) the −15 V reference is switched to the ADC.
U20/17 U20/16 = zero	Input ADC	Select: Range 2 V∿ Supply: 1 V∿ to the "V" and "O" socket	Oscillogram Fig. 52	The oscillogram shows the input of the ADC and the unknown voltage Vx (= + 1V). During the ramp downfase Vx is disconnected from the ADC by signal ramp up (Ru). At the same time the RMS convertor is overloaded by the reference unit. The loading of the RMS convertor causes a voltage drop of Vx (output of the RMS convertor. This only happens in the a.c. volt and current ranges <u>Note:</u> For the a.c. volts- and current ranges, the ADC and the reference unit function as for d.c. volts and current with -polarity.

Note: For the resistance ranges the ADC functions as for + polarity.
For the a.c. volts and - currents the ADC functions as for − polarity.

– Polarity



OSCILLOSCOPE SETTINGS:

TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

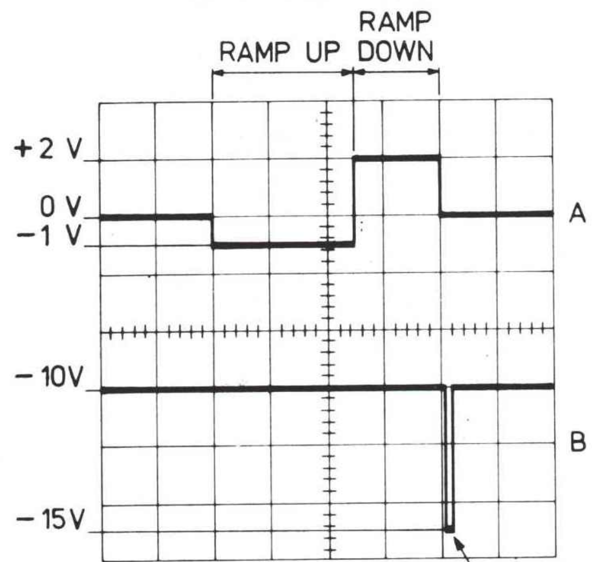
SIGNAL: A INPUT ADC U20/17] 0=U20/16
B COMPARTOR U20/15]

NOTE: THE SIGNALS ARE MEASURED AT –POLARITY 1VOLT INPUT. THE COMPARATOR SIGNAL IS ACTIVE FOR 1msec AT THE END OF THE MEASURED CYCLE

ST1715

Fig. 44. Oscillogram of ADC and Comparator signal at + polarity

+ Polarity



OSCILLOSCOPE SETTINGS:

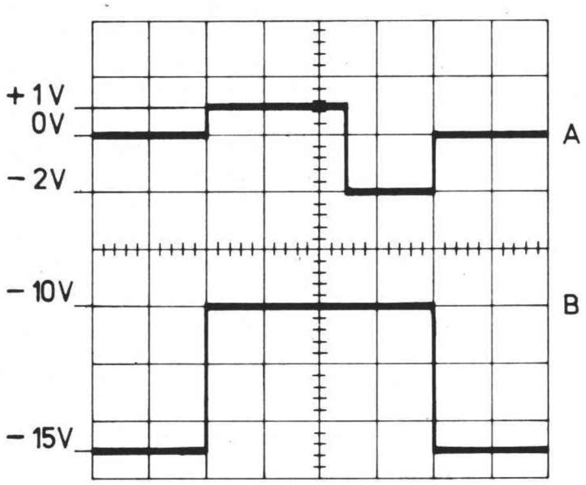
TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

SIGNAL: A INPUT ADC U20/17] 0=U20/16
B COMPARATOR U20/15]

NOTE: THE SIGNALS ARE MEASURED AT +POLARITY 1VOLT INPUT. THE COMPARATOR SIGNAL IS ACTIVE FOR 1msec AT THE END OF THE MEASURING CYCLE

ST 1716

Fig. 45. Oscillogram of ADC and Comparator signal at – polarity



OSCILLOSCOPE SETTINGS:

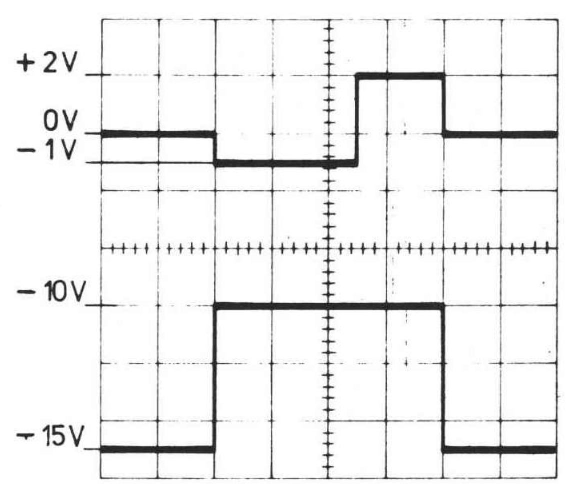
TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

SIGNAL: A INPUT ADC U20/17] 0=U20/16
B AZC U20/11]

NOTE: THE SIGNALS ARE MEASURED AT –POLARITY 1VOLT INPUT

ST1717

Fig. 46. Oscillogram of ADC and AZC signal at + polarity



OSCILLOSCOPE SETTINGS:

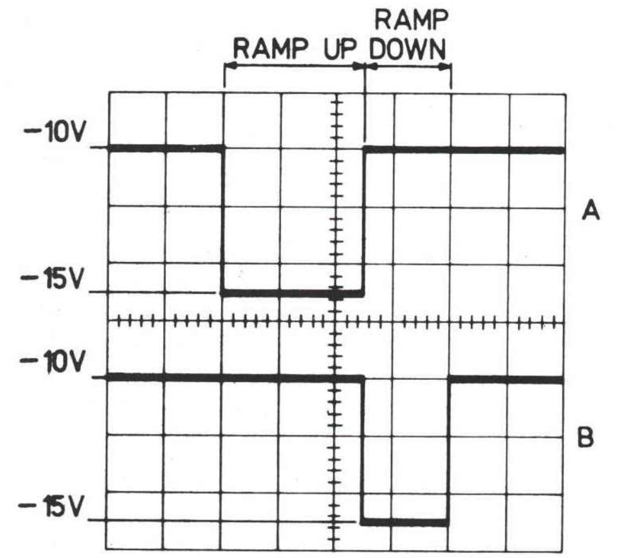
TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

SIGNAL: A INPUT ADC U20/17] 0=U20/16
B AZC U20/11]

NOTE: THE SIGNALS ARE MEASURED AT +POLARITY 1VOLT INPUT

ST1718

Fig. 47. Oscillogram of ADC and AZC signal at – polarity



OSCILLOSCOPE SETTINGS:

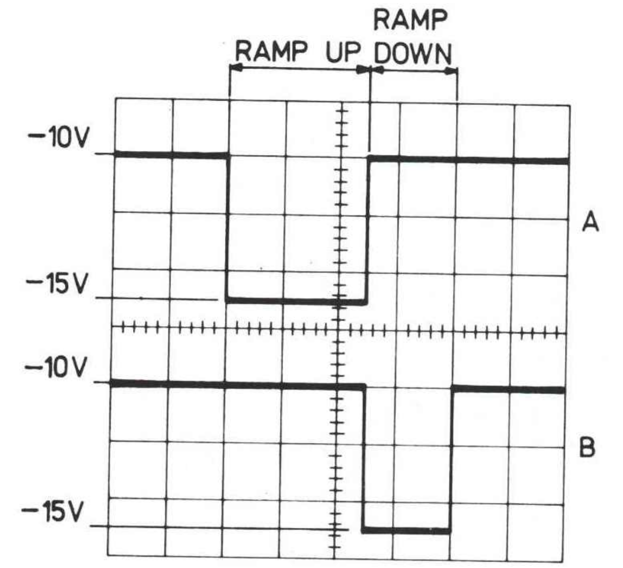
TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

SIGNAL: A RAMP UP Ru U21/17] 0=U21/5
B RAMP DOWN Rd–U21/11]

NOTE: THE SIGNALS ARE MEASURED AT –POLARITY 1VOLT INPUT

ST1711

Fig. 48. Oscillogram of Ru and Rd– signal at + polarity



OSCILLOSCOPE SETTINGS:

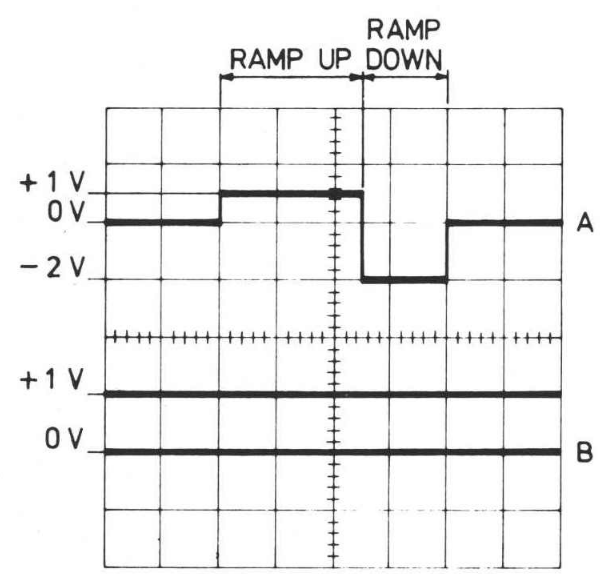
TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

SIGNAL: A RAMP UP Ru U21/17] 0=U21/5
B RAMP DOWN Rd+U21/15]

NOTE: THE SIGNALS ARE MEASURED AT +POLARITY 1VOLT INPUT

ST1712

Fig. 49. Oscillogram of Ru and Rd+ signal at – polarity



OSCILLOSCOPE SETTINGS:

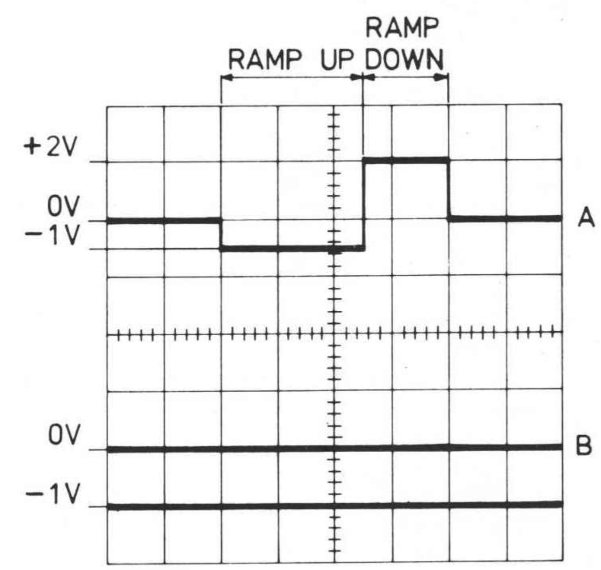
TIME: 50ms/div VOLTS: A 2V/div
B 2V/div

SIGNALS: A INPUT ADC U20/17 0=U20/16
B Vx U21/11 0=U21/6

NOTE: THE SIGNALS ARE MEASURED AT –POLARITY 1VOLT INPUT

ST1713

Fig. 50. Oscillogram of ADC and Vx signal at + polarity



OSCILLOSCOPE SETTINGS:

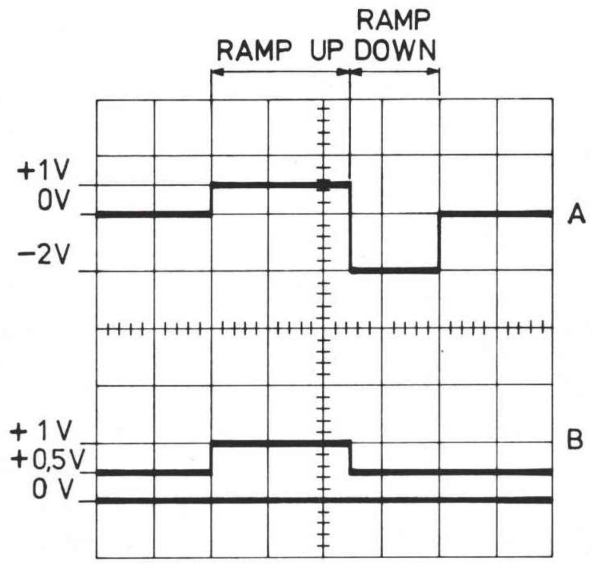
TIME: 50ms/div VOLTS: A 2V/div
B 1V/div

SIGNALS: A INPUT ADC U20/17 0=U20/16
B Vx U21/11 0 U21/6

NOTE: THE SIGNALS ARE MEASURED AT +POLARITY 1VOLT INPUT

ST1714

Fig. 51. Oscillogram of ADC and Vx signal at – polarity



OSCILLOSCOPE SETTINGS:

TIME: 50 ms/div VOLTS: A 2 V/div
B 1 V/div

SIGNALS: A INPUT ADC U20/17 0=U20/16
B Vx U21/11 0=U21/6

NOTE: THE SIGNALS ARE MEASURED IN THE 2V∼ RANGE. INPUT VOLTAGE IS 1V∼

ST 1719

Fig. 52. Oscillogram of ADC and Vx signal at a.c. function

XI-11. RELAY SWITCHING TABLE

RELAY SWITCHING TABLE

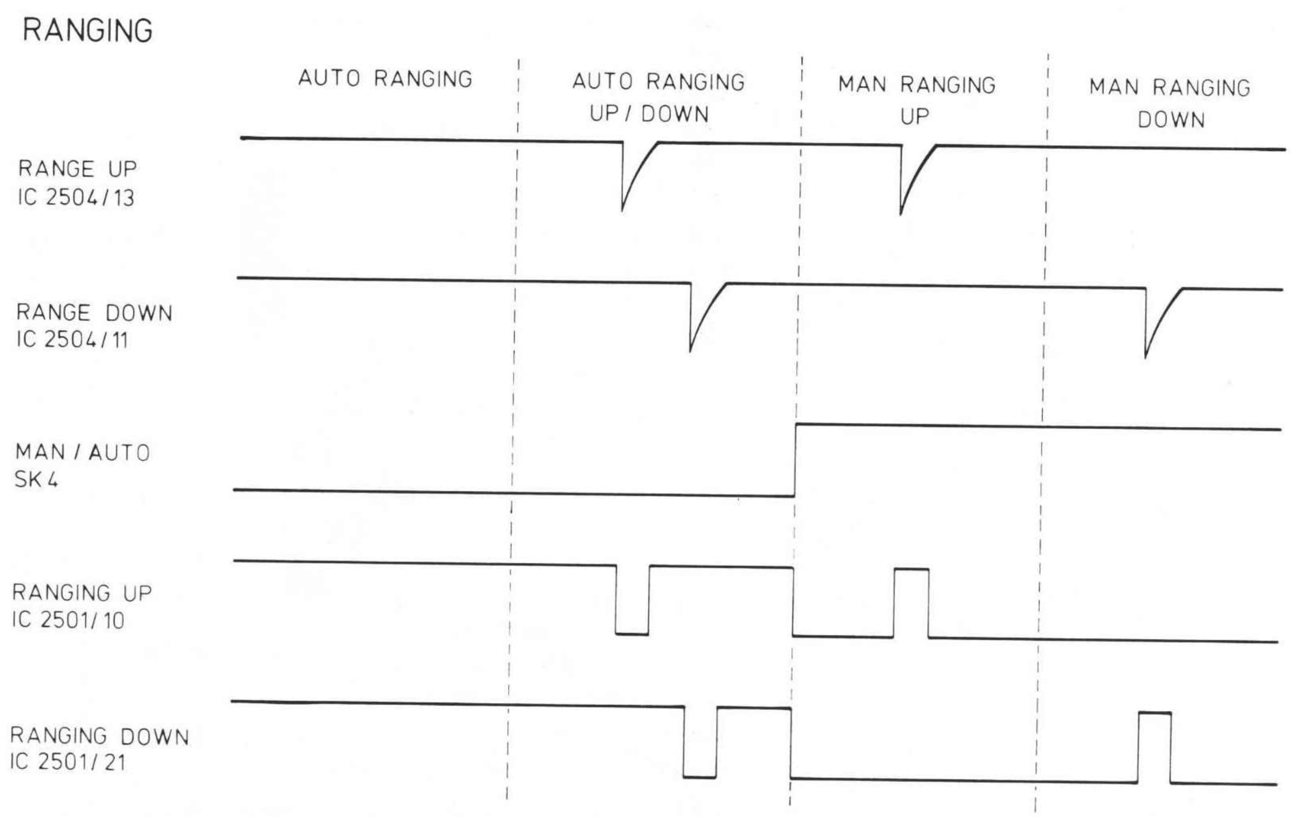
■ ENERGIZED

RANGE		RE 1101	RE 1102	RE 1103	RE 1104	RE 1201	RE 1202	RE 1203	RE 1204	RE 1205	RE 1206	RE 1207	RE 1301	RE 1303	RE 1401	RE 1402	RE 1403	RE 1901	FET SWITHES OPERATED: TS 1303	FET SWITHES OPERATED: TS 1304	INPUTS CURRENT SOURCE ACTIVATED: U13/17	INPUTS CURRENT SOURCE ACTIVATED: U13/13	INPUTS CURRENT SOURCE ACTIVATED: U13/11
V⎓	200 mV	■																					
	2 V	■																■					
	20 V		■															■					
	200 V			■														■					
	1000 V				■													■					
V∼	20 mV	■													■								
	200 mV	■														■							
	2 V	■															■						
	20 V				■										■								
	200 V				■											■							
	600 V				■												■						
A⎓	2 µA											■											
	20 µA										■												
	200 µA									■													
	2 mA								■														
	20 mA							■															
	200 mA						■																
	2000 mA					■																	
A∼	2 µA											■					■						
	20 µA										■						■						
	200 µA									■							■						
	2 mA								■								■						
	20 mA							■									■						
	200 mA						■										■						
	2000 mA					■											■						
Ω	.2 kΩ												■	■							■		
	2 kΩ												■	■								■	
	20 kΩ												■	■									■
	200 kΩ													■					■	■	■		
	2 MΩ													■					■	■		■	
	20 MΩ																			■			■
	200 MΩ																			■		■	
	2000 MΩ																			■			■
HF	20 mV													■									
	200 mV														■								
	2 V															■							
TEMP 200°C																						■	

ST 1710

Fig. 53. Relay switching table

XI-12. MANUAL RANGING CHECK



NOTE: IN AUTO RANGING MODE IT IS POSSIBLE TO SELECT A LOWER OR HIGHER RANGE,
BY MEANS OF THE RANGING UP/DOWN SWITCH SK5, THEN THE RANGE AUTOMATICALLY SELECTED.

EXAMPLE: INDICATION 1.9000 V (2 V RANGE) → RANGE DOWN
01.900 V (20 V RANGE) → RANGE UP
1.9000 V (2 V RANGE)

INCASE OF AN INDICATION LOWER THAN 01800 OR HIGHER THAN 20000, THE ORIGINAL RANGE IS SELECTED AUTOMATICALLY AGAIN.

ST 1709

Fig. 54. Pulse diagram of ranging

XI-13. SPECIFICATION OF INPUTS AND OUTPUTS OF THE IC2501 (OQ054)

Inputs	*No.*	
CPi	(13)	Clock in: externally generated clock pulses of 1 MHz.
COMP	(15)	Comparator: a change of polarity of the comparator during the RAMP-DOWN phase indicates the end of that phase.
CR1 CR2	(11) (8)	Conversion rate: at these two terminals the conversion rate is determined. For normal measurements the conversion rate is $3^1/_3$ meas./sec. In the case of RANGING, the conversion rate is $16^2/_3$ meas./sec. To obtain a good SMR, for both 50 Hz and 60 Hz mains frequency, for 60 Hz the conversion rate can be adapted to 4 meas./sec..
LRS	(4)	Locking range selector: locking prevents the range selector having a position outside the specified range. Independent of the LRS, UP or DOWN ranging is inhibited if the selector is in its highest or lowest range.

LRS	*RANGE*	
1	0-3	All down-range commands neglected
1	4-7	All up-range commands neglected
0	-	No locking

RGU RGD	(20) (21)	Ranging up, Ranging down: these two terminals determine automatic or remote controlled ranging.

RGU	*RGD*		
0	0	No range commands	
1	0	Up-ranging command	remotely controlled
0	1	Down-ranging command	remotely controlled
1	1	Automatic ranging	

INH	(6)	Inhibit: with this signal it is possible to start a new measurement when the IC2501 is in READY phase. Starting occurs when INH is high.
CAR	(18)	Carry: overload of the IC2502, command signal for the IC2501 to change its state to the following phase.
C100	(23)	Carry 100: this signal will be divided by 18 to perform a signal which indicates whether the IC2502 has reached the position 1800. This will be used for automatic ranging.
C9	(20)	(Not used in PM 2527).

Outputs	*No.*	
Ar Br Cr	(1) (3) (2)	The binary code on these terminals gives the position of the range counter.

Cr	Br	Ar	Range no.	V⎓	V~	A⎓	A~	kΩ	HF	Temp.
0	0	0	0	–	–	–	–	2 kΩ	–	–
0	0	1	1	–	–	2 μA	2 μA	2 kΩ	–	–
0	1	0	2	–	20 mV	20 μA	20 μA	20 kΩ	20 mV	–
0	1	1	3	200 mV	200 mV	200 μA	200 μA	200 kΩ	200 mV	–
1	0	0	4	2 V	2 V	2 mA	2 mA	2 MΩ	2 V	–
1	0	1	5	20 V	20 V	20 mA	20 mA	20 MΩ	–	–
1	1	0	6	200 V	200 V	200 mA	200 mA	200 MΩ	–	–
1	1	1	7	1000 V	600 V	2000 mA	2000 mA	2000 MΩ	–	200°C

CPO	(16)	Clock pulse out: this clock pulse is connected to the counting terminal of the IC2502. The frequency of this clock pulse is determined by the conversion rate and conversion phase.
A_{st} B_{st} C_{st}	(10) (9) (7)	State signals: the code at these terminals selects the conversion phase. The switches for the ADC control are activated by these signals.

A_{st}	B_{st}	C_{st}		Conversion phase
1	0	1	DC	- stabilizing period for pre-amplifier
0	0	1	RPU	- ramp-up phase
0	0	0	RPD	- ramp-down phase
1	0	0	AZC	- automatic zero control
1	1	1	RD	- ready
1	1	0	RG	- ranging

RES	(5)	Reset: this signal resets the IC2502 counter to zero at the beginning of every phase (except AZC).
TR	(19)	Transfer: on command of this signal the state of the counting section of the IC2502 is transferred into the latches. While the transfer command is "on", no clock pulses are supplied to the counter.
OR	(17)	Overflow: in the event of overload this signal is logic "1".
POL	(14)	Polarity: this signal agrees with the polarity of the output of the comparator at the end of the ramp-up phase.

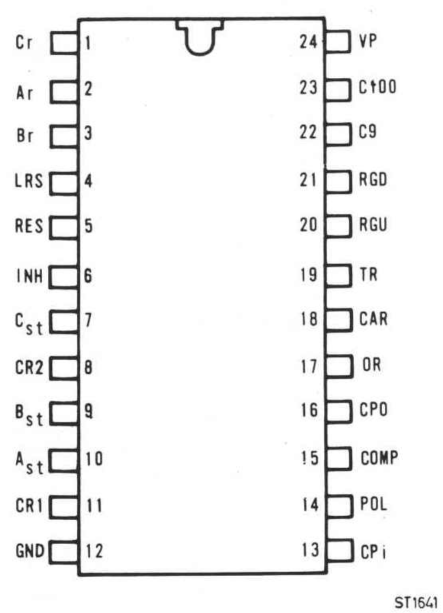


Fig. 55. OQ 054

XI-14. LOCKING RANGE SELECTOR AND RANGE TRANSLATOR CHECK

FUNCTION V⎓																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
-	0	1	0	1	0	1	0	0	0	0	1	1	1	1	0	0	1	1
-	1	1	0	1	0	1	0	0	0	1	1	1	0	1	0	0	1	1
-	2	1	0	1	0	1	0	0	1	0	1	0	1	1	0	0	1	1
200 mV	3	1	0	1	0	1	0	0	1	1	1	0	0	1	0	0	1	1
2 V	4	1	0	1	0	1	0	1	0	0	0	1	1	0	1	1	0	0
20 V	5	1	0	1	0	1	0	1	0	1	0	1	0	0	1	1	0	1
200 V	6	1	0	1	0	1	0	1	1	0	0	0	1	0	1	1	1	0
1000 V	7	1	0	1	0	1	0	1	1	1	0	0	0	0	1	1	1	1

FUNCTION V∼																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
-	0	1	0	0	0	1	0	0	0	0	1	1	1	1	0	0	1	0
-	1	1	0	0	0	1	0	0	0	1	1	1	0	1	0	0	1	0
20 mV	2	1	0	0	0	1	0	0	1	0	1	0	1	1	0	0	1	0
200 mV	3	1	0	0	0	1	0	0	1	1	1	0	0	0	1	0	1	1
2 V	4	1	0	0	0	1	0	1	0	0	0	1	1	0	1	1	0	0
20 V	5	1	0	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1
200 V	6	1	0	0	0	1	0	1	1	0	0	0	1	0	1	1	1	0
600 V	7	1	0	0	0	1	0	1	1	1	0	0	0	0	1	1	1	1

FUNCTION A⎓																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
-	0	0	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	1
2 μA	1	0	1	1	1	0	0	0	0	1	1	1	0	1	0	0	0	1
20 μA	2	0	1	1	1	0	0	0	1	0	1	0	1	0	1	0	1	0
200 μA	3	0	1	1	1	0	0	0	1	1	1	0	0	0	1	0	1	1
2 mA	4	0	1	1	1	0	0	1	0	0	0	1	1	0	1	1	0	0
20 mA	5	0	1	1	1	0	0	1	0	1	0	1	0	0	1	1	0	1
200 mA	6	0	1	1	1	0	0	1	1	0	0	0	1	0	1	1	1	0
2000 mA	7	0	1	1	1	0	0	1	1	1	0	0	0	0	1	1	1	1

FUNCTION A∼																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
-	0	0	1	0	1	0	0	0	0	0	1	1	1	1	0	0	0	1
2 µA	1	0	1	0	1	0	0	0	0	1	1	1	0	1	0	0	0	1
20 µA	2	0	1	0	1	0	0	0	1	0	1	0	1	0	1	0	1	0
200 µA	3	0	1	0	1	0	0	0	1	1	1	0	0	0	1	0	1	1
2 mA	4	0	1	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0
20 mA	5	0	1	0	1	0	0	1	0	1	0	1	0	0	1	1	0	1
200 mA	6	0	1	0	1	0	0	1	1	0	0	0	1	0	1	1	1	0
2000 mA	7	0	1	0	1	0	0	1	1	1	0	0	0	0	1	1	1	1

FUNCTION kΩ																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
•2 kΩ	0	0	0	0	1	1	0	0	0	0	1	1	1	0	1	0	0	0
2 kΩ	1	0	0	0	1	1	0	0	0	1	1	1	0	0	1	0	0	1
20 kΩ	2	0	0	0	1	1	0	0	1	0	1	0	1	0	1	0	1	0
200 kΩ	3	0	0	0	1	1	0	0	1	1	1	0	0	0	1	0	1	1
2 MΩ	4	0	0	0	1	1	0	1	0	0	0	1	1	0	1	1	0	0
20 MΩ	5	0	0	0	1	1	0	1	0	1	0	1	0	0	1	1	0	1
200 MΩ	6	0	0	0	1	1	0	1	1	0	0	0	1	0	1	1	1	0
2000 MΩ	7	0	0	0	1	1	0	1	1	1	0	0	0	0	1	1	1	1

FUNCTION HF																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
-	0	1	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	0
-	1	1	0	0	0	1	1	0	0	1	1	1	0	1	0	0	1	0
20 mV	2	1	0	0	0	1	1	0	1	0	1	0	1	1	0	0	1	0
200 mV	3	1	0	0	0	1	1	0	1	1	1	0	0	0	1	0	1	1
2 V	4	1	0	0	0	1	1	1	0	0	0	1	1	1	0	1	0	0
-	5	1	0	0	0	1	1	1	0	1	0	1	0	1	0	1	0	0
-	6	1	0	0	0	1	1	1	1	0	0	0	1	1	0	1	0	0
-	7	1	0	0	0	1	1	1	1	1	0	0	0	1	0	1	0	0

FUNCTION TEMP.																		
Range	Range no.	Function code						Range code OQ 054						LRS		Range Output		
		Z	Y	X	$\overline{Z}$	$\overline{Y}$	Probe	Cr	Br	Ar	$\overline{Cr}$	$\overline{Br}$	$\overline{Ar}$	LRS	$\overline{LRS}$	Cr'	Br'	Ar'
-	0	1	1	1	0	0	1	0	0	0	1	1	1	1	0	1	1	1
-	1	1	1	1	0	0	1	0	0	1	1	1	0	1	0	1	1	1
-	2	1	1	1	0	0	1	0	1	0	1	0	1	1	0	1	1	1
-	3	1	1	1	0	0	1	0	1	1	1	0	0	1	0	1	1	1
-	4	1	1	1	0	0	1	1	0	0	0	1	1	1	0	1	1	1
-	5	1	1	1	0	0	1	1	0	1	0	1	0	1	0	1	1	1
-	6	1	1	1	0	0	1	1	1	0	0	0	1	1	0	1	1	1
200°C	7	1	1	1	0	0	1	1	1	1	0	0	0	0	1	1	1	1

NOTE: Jumper HF/TEMP. is switched in position TEMP. (1–2).

XI-15. ANODE SWITCHES CONTROL CHECK

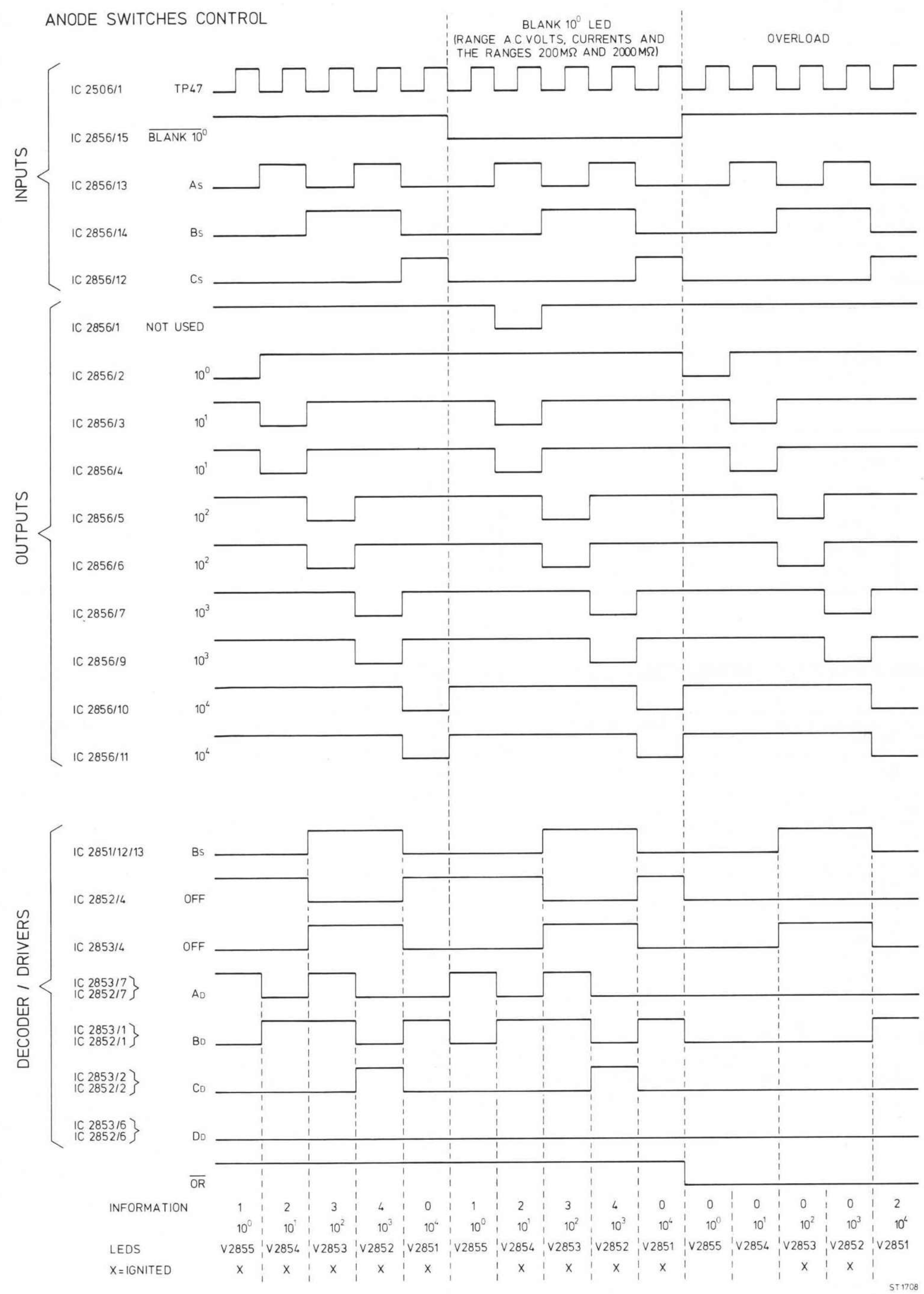


Fig. 56. Pulse diagram anode switches control

XI-16. DECIMAL POINT CONTROL CHECK

	RANGE INPUT IC 2855				RANGE OUTPUT IC 2855								DISPLAY Decimal point pos.				
Range No.	12	Cr' 13	Br' 14	Ar' 15	1	2	3	4	5	6	7	9	10^4	10^3	10^2	10^1	10^0
0	0	0	0	0	0	1	1	1	1	1	1	1	•0	0	0	0	0
1	0	0	0	1	1	0	1	1	0	1	1	1	0	•0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1	1	0	0	•0	0	0
3	0	0	1	1	1	1	1	0	1	1	0	1	0	0	0	•0	0
4	0	1	0	0	1	0	1	1	0	1	1	1	0	•0	0	0	0
5	0	1	0	1	1	1	0	1	1	0	1	1	0	0	•0	0	0
6	0	1	1	0	1	1	1	0	1	1	0	1	0	0	0	•0	0
7	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	•0

XI-17. POLARITY CONTROL CHECK

FUNCTION			IC 2851		DISPLAY LA2852	LA2851	No sign.
			X	$\overline{Pol}$	−	+	
V∼	HF		0	1			X
	A∼	Ω	0	0			X
V⎓	A⎓	Temp.	1	1	X		
			1	0		X	

XI-18. FUNCTION INDICATION CHECK

FUNCTION INPUT						INPUT IC 2854				FUNCTION INDICATION							BLANK 10^0
Funct.	Range no.	Probe III	Z	Y	X	(8) 12	Cr' 13	Z 14	Y 15	LA2857 °C	LA2856 V	LA2855 mA	LA2859 MΩ	LA2854 mV	LA2853 µA	LA2858 kΩ	$\overline{\text{Blank } 10^0}$
V⎓	3	1	1	0	1	0	0	1	0					X			1
V⎓	4-7	1	1	0	1	0	1	1	0		X						1
V∼	2-3	1	1	0	0	0	0	1	0					X			0
V∼	4-7	1	1	0	0	0	1	1	0		X						0
A⎓	1-3	1	0	1	1	0	0	0	1						X		1
A⎓	4-7	1	0	1	1	0	1	0	1			X					1
A∼	1-3	1	0	1	0	0	0	0	1						X		0
A∼	4-7	1	0	1	0	0	1	0	1			X					0
Ω	0-3	1	0	0	0	0	0	0	0							X	1
Ω	4-5	1	0	0	0	0	1	0	0				X				1
Ω	6-7	1	0	0	0	0	1	0	0				X				0
HF	2-3	0	1	0	0	0	0	1	0					X			1
HF	4	0	1	0	0	0	1	1	0		X						1
Temp.	7	0	1	1	1	0	1	1	1	X							1

Range no.	Br'
1-2	0
3-4	1
5-6	0
7-8	1

XII. LIST OF PARTS

XII-1. MECHANICAL

Item	*Fig.*	*Qty.*	*Ordering number*	*Description*
1	57	4	5322 462 44179	Foot
2	58	4	5322 462 44181	Rear foot
3	57	1	5322 459 24056	Front rim
4	57	4	4822 462 70497	Foot plug
5	57	1	5322 498 54058	Handle profile
6	57	2	5322 498 54048	Handle arm
7	57	2	5322 528 34101	Stop plate
8	57	2	5322 530 84075	Spring
9	57	2	5322 414 64053	Knob
10	57	2	5322 520 34164	Bearing bush
11	57	1	5322 447 94234	Top cover
12	57	1	5322 447 94235	Bottom cover
13	57	1	5322 456 14051	Text plate
14	57	1	5322 450 64063	Window
15	57	5	5322 325 24002	Distance piece BU2/BU6
16	57	5	5322 532 24393	Ring BU2/BU6
17	57/58	1	5322 290 30001	Interconnection strip
18	59	1	5322 321 10071	Mains cable
19	59	1	5322 321 24376	Measuring cable
20	59	1	5322 264 24013	Testpin red
21	59	1	5322 264 24014	Testpin black
23	59	2	5322 447 94362	Cover
24	60	12	5322 325 64071	Insulating plug
25	61	6	5322 290 44019	Contact spring SK2
26	65	1	5322 405 94128	Mounting plate SK1101
27	57	3	5322 505 14143	Nut for switch SK3/SK5
28	57	1	5322 460 64012	Frame display unit
BU1	57	1	4822 267 40039	Terminal 5 pole
BU2	57	1	5322 267 34058	Terminal blue
BU3	57	1	5322 267 34059	Terminal grey
BU4	57	1	5322 267 34057	Terminal red
BU5	57	1	5322 267 34059	Terminal grey
BU6	57	1	5322 267 34059	Terminal grey
BU8	58	1	5322 462 44273	Stop
BU9	58	1	5322 267 10004	Terminal BNC
BU10	58	1	5322 265 30066	Interconnection strip
BU2501/	65	7	5322 267 54006	Connector 20 pole top-entry
BU2507	65	7	5322 267 64007	Connector housing 20 pole
BU2851			5322 268 14013	Contact pin for connector housing 1 piece
C1	–	–	5322 121 44161	Mains filter
IC2502	65	1	5322 255 44112	IC-foot 18 pin IC2502
IC2501	65	1	5322 255 44171	IC-foot 24 pin IC2501
lin	57	1	5322 532 64119	Socket lin
SK1	57	1	4822 276 10554	"POWER" switch SK1
SK2	57	1	5322 276 64017	Function switch assy SK2
SK1/SK2	57	7	5322 414 14011	Pushbutton knob
SK3	57	1	5322 277 10269	Toggle switch AUT/EXT/MAN
SK4	57	1	5322 277 10214	Toggle switch AUT/MAN
SK5	57	1	5322 277 14111	Toggle switch UP/DOWN
TS2401/2403	65	3	5322 255 40079	Heatsink TS1201/TS1203

Item	*Fig.*	*Qty.*	*Ordering number*	*Description*
V2851/2855	67	5	5322 255 44073	IC-foot 14 pin LED display
VL1	60	1	5322 256 34057	Fuse holder
VL1201	60	1	5322 256 40044	Fuse holder VL1201
–	–	1	5322 255 44172	Heatsink for RMS converter IC1752
–	–	1	5322 255 44173	Clip for heatsink IC1752
–	–	1	5322 456 14051	Film μA, mA, ^{o}C, mV, V, kΩ, MΩ
–	–	1	5322 456 14052	Film +, –
–	–	10	5322 447 94232	Unit housing U14/U25
–	–	10	4822 267 50189	Unit socket assy U14/U25
–	–	10	5322 447 94231	Unit socket cover U14/U25
–	–	1	5322 405 94093	Extension spindle "POWER" switch
–	–	1	5322 263 74094	Extension card
–	–	50	5322 290 34004	Soldering pin 1 mm

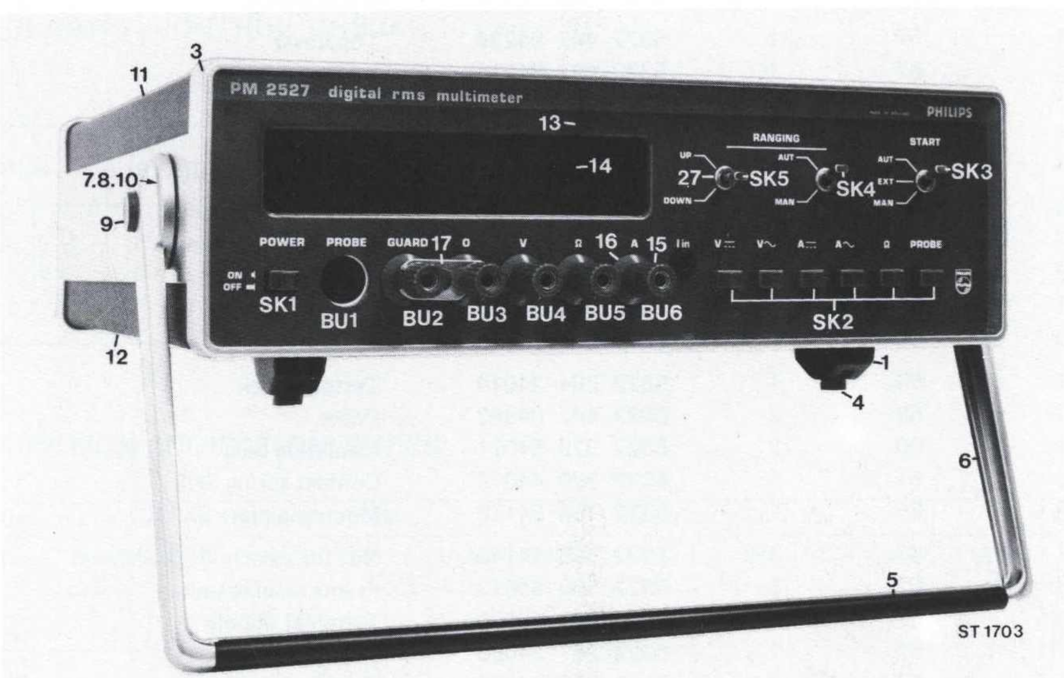


Fig. 57. Front view with item numbers

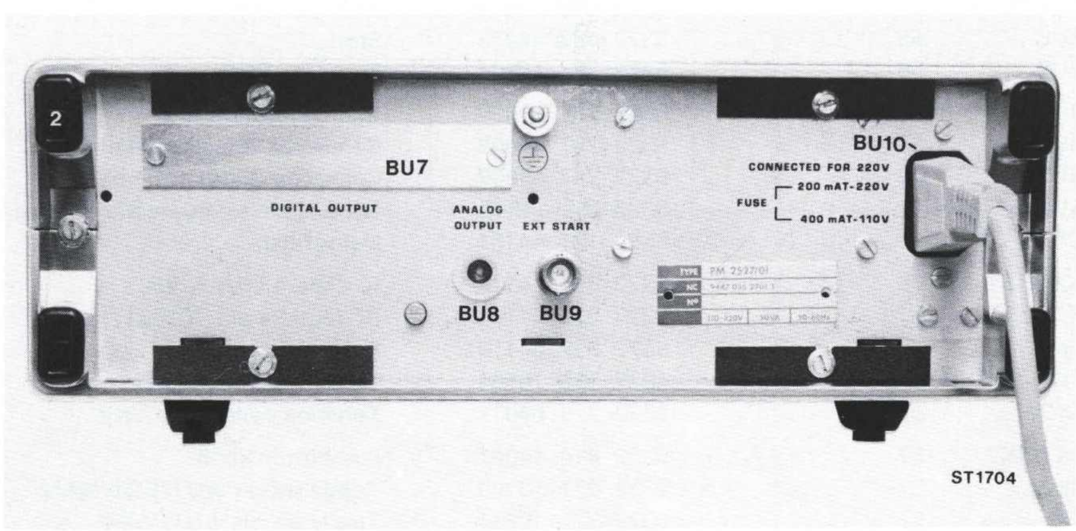


Fig. 58. Rear view with item numbers

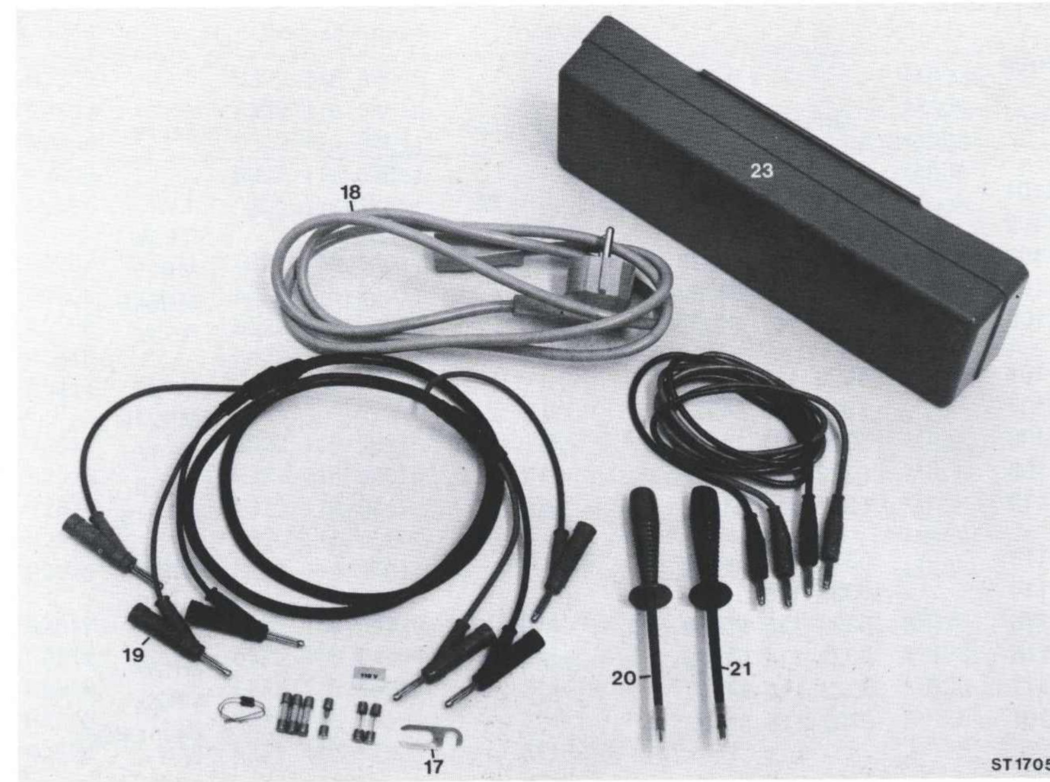


Fig. 59. Accessories with item numbers

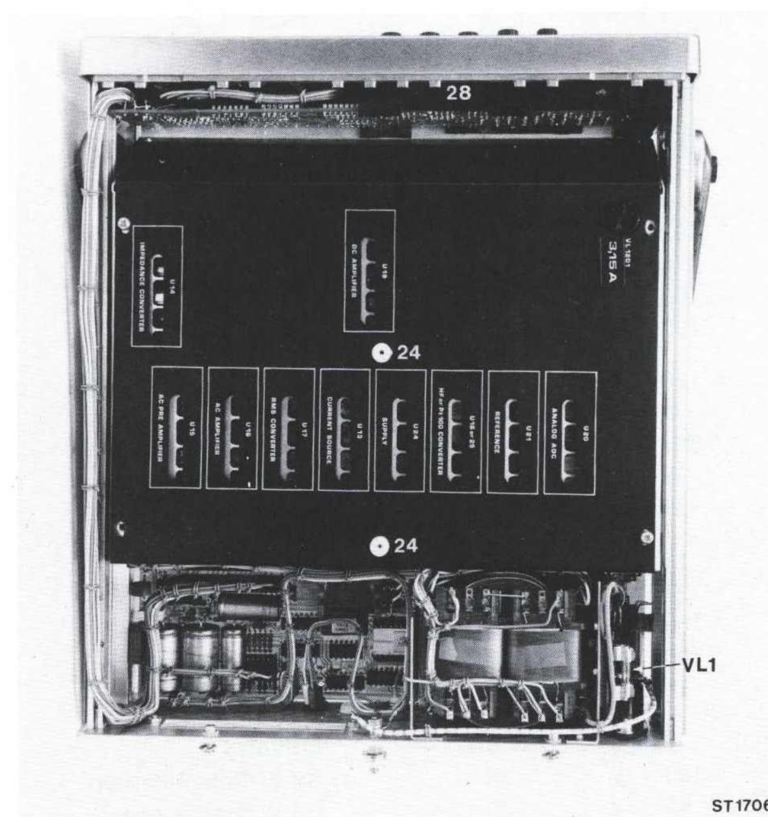


Fig. 60. Topview inside with item numbers

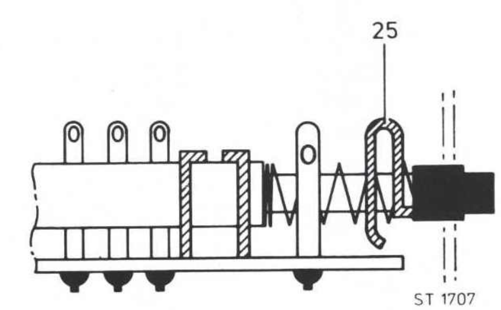


Fig. 61. Contact spring for function switch

XII-2. ELECTRICAL

Resistors

Item	Ordering number	Value (Ω)	%	Series
R1101	5322 116 54972	9 M	0.1	1 W
R1102	5322 101 14008	2.5 k	20	0.5 W
R1103	5322 116 54228	1.78 k	1	MR25
R1104	5322 116 54982	898 k	0.1	MR54E
R1105	5322 101 14009	250	20	0.5 W
R1106	5322 116 54492	178	1	MR25
R1107	5322 116 54977	89.8 k	0.1	MR24E
R1108	5322 101 14105	25	20	0.5 W
R1109	5322 116 50418	17.8	1	MR25
R1110	5322 116 54978	9.88 k	0.1	MR24E
R1111	5322 116 54469	100	1	MR25
R1114	5322 116 54469	100	1	MR25
R1115	5322 116 50608	6.19 k	1	MR25
R1116	5322 116 54469	100	1	MR25
R1117	5322 116 54417	5.7	1	MR25
R1201	5322 115 84022			Shunt assy
R1202	5322 113 24141	90.9	0.25	0.6 W
R1203	5322 113 24139	909	0.25	0.6 W
R1204	5322 116 54981	8.87 k	0.1	MR34E
R1205	5322 116 54481	130	1	MR25
R1206	5322 116 54976	88.7 k	0.1	MR24E
R1207	5322 116 50526	1.3 k	1	MR25
R1208	5322 113 60064	2.7	10	2 W
R1214	5322 101 14069	22 k	20	0.5 W Potentiometer
R1301	5322 116 54971	3.92 M	0.5	
R1302	5322 101 14071	100 k	20	0.5 W Potentiometer
R1303	5322 116 54511	316	1	MR25
R1304	5322 116 54979	102 k	0.1	MR34E
R1305	5322 101 14047	470	20	0.5 W Potentiometer
R1308	5322 116 50746	100	0.1	MR24E
R1311	4822 116 40006	100	20	250 V PTC
R1312	4822 112 21083	120	5	4.2 W
R1401	5322 101 14105	25	20	0.5 W
R1402	5322 116 54898	887	0.5	MR24E
R1404	5322 101 14105	25	20	0.5 W
R1405	5322 116 54973	88.7	0.5	MR24E
R1406	5322 113 10125	10	0.25	0.4 W
R1901	5322 116 54983	27 k	5	PR52
R1907	5322 116 54489	169	1	MR25
R1908	5322 101 14011	100	20	0.5 W Potentiometer
R1909	5322 116 54974	15 k	0.1	MR24E
R1910	5322 116 54292	1.69 k	0.1	MR24E
R1911	5322 101 14071	100 k	20	0.1 W Potentiometer
R1913	5322 101 24057	47 k	20	0.1 W Potentiometer
R1914	5322 116 54469	100	1	MR25
R2001	5322 116 54225	3.48 k	0.1	MR24E

Item	Ordering number	Value (Ω)	%	Series
R2002	5322 116 54975	2.37 k	0.1	MR24E
R2503	5322 116 54518	383	1	MR25
R2504	5322 116 54011	5.62 k	1	MR25
R2505	5322 116 54011	5.62 k	1	MR25
R2506	5322 116 54011	5.62 k	1	MR25
R2507	5322 116 54011	5.62 k	1	MR25
R2508	5322 116 54011	5.62 k	1	MR25
R2509	5322 116 54525	511	1	MR25
R2510	5322 116 54492	178	1	MR25
R2511	5322 116 54525	511	1	MR25
R2512	5322 116 54426	121	1	MR25
R2513	5322 116 54525	511	1	MR25
R2514	5322 116 54492	178	1	MR25
R2515	5322 116 50509	4.87 k	1	MR25
R2516	5322 116 54011	5.62 k	1	MR25
R2517	5322 116 54525	511	1	MR25
R2518	5322 116 54504	274	1	MR25
R2519	5322 116 54525	511	1	MR25
R2520	5322 116 54504	274	1	MR25
R2521	5322 116 54525	511	1	MR25
R2522	5322 116 54504	274	1	MR25
R2523	5322 116 54619	10 k	1	MR25
R2524	5322 116 54619	10 k	1	MR25
R2525	4822 116 40006	100	20	265 V PTC
R2526	4822 112 21089	220	5	4.2 W
R2527	5322 116 50509	4.87 k	1	MR25
R2528	5322 116 50559	27.4 k	1	MR25
R2529	5322 116 50509	4.87 k	1	MR25
R2530	5322 116 50559	27.4 k	1	MR25
R2531	5322 116 50484	4.64 k	1	MR25
R2532	5322 116 54743	301 k	1	MR25
R2533	5322 116 54619	10 k	1	MR25
R2856/R2862	5322 116 54453	64.9	1	MR25
R2864/R2868	5322 116 54446	56.2	1	MR25

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

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

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

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

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

Carbon resistor E24 series Kohleschichtwiderstand, Reihe E24 Koolweerstand E24 reeks Résistance au carbone, série E24 Resistencia de carbón, serie E24	0,125 W 5%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	1 W ≦ 2,2 MΩ, 5% > 2,2 MΩ, 10%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	0,25 W ≦ 1 MΩ, 5% > 1 MΩ, 10%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	2 W 5%
Carbon resistor E24 series Kohleschichtwiderstand, Reihe E24 Koolweerstand E24 reeks Résistance au carbone, série E24 Resistencia de carbón, serie E24	0,5 W ≦ 5 MΩ, 1% > 5 ≦ 10 MΩ, 2% > 10 MΩ, 5%
Wire-wound resistor Drahtwiderstand Draadgewonden weerstand Résistance bobinée Resistencia bobinada	0,4 – 1,8 W 0,5%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	0,5 W ≦ 1,5MΩ, 5% > 1,5MΩ, 10%
Wire-wound resistor Drahtwiderstand Draadgewonden weerstand Résistance bobinée Resistencia bobinada	5,5 W ≦ 200 Ω, 10% > 200 Ω, 5%
Wire-wound resistor Drahtwiderstand Draadgewonden weerstand Résistance bobinée Resistencia bobinada	10 W 5%
Tubular ceramic capacitor Rohrkondensator Keramische kondensator, buistype Condensateur céramique tubulaire Condensador cerámico tubular	500 V
Polyester capacitor Polyesterkondensator Polyesterkondensator Condensateur au polyester Condensador polyester	400 V
Tubular ceramic capacitor Rohrkondensator Keramische kondensator, buistype Condensateur céramique tubulaire Condensador cerámico tubular	700 V
Flat-foil polyester capacitor Miniatur-Polyesterkondensator (flach) Platte miniatuur polyesterkondensator Condensateur au polyester, type plat Condensador polyester, tipo de placas planas	250 V
Ceramic capacitor, "pin-up" Keramikkondensator "Pin-up" (Perltyp) Keramische kondensator "Pin-up" type Condensateur céramique, type perle Condensador cerámico, versión "colgable"	500 V
Paper capacitor Papierkondensator Papierkondensator Condensateur au papier Condensador de papel	1000 V
"Microplate" ceramic capacitor Miniatur-Scheibenkondensator "Microplate" keramische kondensator Condensateur céramique "microplate" Condensador cerámico "microplaca"	30 V
Wire-wound trimmer Drahttrimmer Draadgewonden trimmer Trimmer à fil Trimmer bobinado	
Mica capacitor Glimmerkondensator Micakondensator Condensateur au mica Condensador de mica	500 V
Tubular ceramic trimmer Rohrtrimmer Buisvormige keramische trimmer Trimmer céramique tubulaire Trimmer cerámico tubular	

SERVICE

For multi-purpose and standard parts, please see PHILIPS' Service Catalogue.
Für die Universal- und Standard-Teile siehe den PHILIPS Service-Katalog.
Voor universele en standaardonderdelen raadplege men de PHILIPS Service Catalogus.
Pour les pièces universelles et standard veuillez consulter le Catalogue Service PHILIPS.
Para piezas universales y standard consulte el Catálogo de Servicio PHILIPS.

Capacitors

Item	Ordering number	Value (F)	%	V	Description
C1101	4822 122 31203	39 p	2	500	Ceramic
C1102	4822 122 31203	39 p	2	500	Ceramic
C1103	4822 122 31203	39 p	2	500	Ceramic
C1104	4822 122 31203	39 p	2	500	Ceramic
C1105	5322 125 54037	10 p		500	Trimmer
C1106	4822 121 50604	39 n	1	63	Polystryrene
C1107	4822 121 40278	22 n	10	630	Polyester
C1108	4822 121 40278	22 n	10	630	Polyester
C1109	4822 121 40278	22 n	10	630	Polyester
C1201	4822 122 30128	4.7 n	10	100	Ceramic
C1301	5322 121 54135	1.2 n	5	500	Polystyrene
C1601	5322 124 14091	15 μ		6.3	Tantal
C1602	4822 124 20586	150 μ		16	Electrolytic
C1603	4822 124 20586	150 μ		16	Electrolytic
C1701	4822 124 20468	33 μ		16	Electrolytic
C1702	4822 124 20468	33 μ		16	Electrolytic
C1901	4822 121 40452	1.5 μ	10	100	Polyester
C2301	4822 124 20483	6.8 μ		10	Electrolytic
C2302	4822 124 20474	3.3 μ		25	Electrolytic
C2303	4822 124 20474	3.3 μ		25	Electrolytic
C2304	4822 124 20474	3.3 μ		25	Electrolytic
C2305	4822 124 20474	3.3 μ		25	Electrolytic
C2306	4822 124 20474	3.3 μ		25	Electrolytic
C2308	4822 124 20461	47 μ		10	Electrolytic
C2309	4822 124 20461	47 μ		10	Electrolytic
C2311	4822 124 20474	3.3 μ		25	Electrolytic
C2312	4822 124 20474	3.3 μ		25	Electrolytic
C2315	4822 124 20474	3.3 μ		25	Electrolytic
C2316	4822 124 20474	3.3 μ		25	Electrolytic
C2318	4822 124 20474	3.3 μ		25	Electrolytic
C2319	4822 124 20454	150 μ		6.3	Electrolytic
C2401	4822 124 20533	470 μ		40	Electrolytic
C2402	4822 124 20533	470 μ		40	Electrolytic
C2403	4822 124 20523	680 μ		16	Electrolytic
C2501	4822 122 31058	15 p	2	100	Ceramic
C2502	4822 122 30043	10 n	−20 + 80	63	Ceramic
C2503	5322 124 14023	3.3 μ		10	Tantal
C2504	4822 121 40088	10 n	10	400	Polyester
C2505	4822 122 30103	22 n	−20 + 100	40	Ceramic
C2506	4822 122 30103	22 n	−20 + 80	63	Ceramic
C2507	4822 122 30103	22 n	−20 + 80	63	Ceramic
C2508	4822 122 30103	22 n	−20 + 80	63	Ceramic
C2509	4822 122 30103	22 n	−20 + 80	63	Ceramic
C2510	4822 122 30103	22 n	−20 + 80	63	Ceramic
C2701	4822 124 20525	1500 μ		16	Electrolytic
C2702	4822 124 20525	1500 μ		16	Electrolytic
C2703	4822 124 20525	1500 μ		16	Electrolytic
C2704	4822 124 20457	470 μ		6.3	Electrolytic

Diodes

Item	Ordering number	Description
GR1201	5322 130 34388	BYX72 – 500
GR1202	5322 130 34388	BYX72 – 500
GR1203	5322 130 34388	BYX72 – 500
GR1204	5322 130 34388	BYX72 – 500
GR1205	5322 130 34388	BYX72 – 500
GR1206	5322 130 34388	BYX72 – 500
GR1301	5322 130 34167	BZX79 – C6V2
GR1302	5322 130 34167	BZX79 – C6V2
GR1303	5322 130 30613	BAW62
GR1304	5322 130 34024	BZX61 – C10
GR1305	5322 130 34024	BZX61 – C10
GR1901	5322 130 30613	BAW62
GR1902	5322 130 30613	BAW62
GR1905	5322 130 34382	BZX79 – C8V2
GR1906	5322 130 34382	BZX79 – C8V2
GR2301	5322 130 30613	BAW62
GR2302	5322 130 30613	BAW62
GR2303	5322 130 30613	BAW62
GR2304	5322 130 30613	BAW62
GR2305	5322 130 30613	BAW62
GR2306	5322 130 30613	BAW62
GR2307	5322 130 30613	BAW62
GR2308	5322 130 30613	BAW62
GR2309	5322 130 30613	BAW62
GR2310	5322 130 30613	BAW62
GR2311	5322 130 30613	BAW62
GR2312	5322 130 30613	BAW62
GR2313	5322 130 30613	BAW62
GR2314	5322 130 30613	BAW62
GR2315	5322 130 30613	BAW62
GR2316	5322 130 30613	BAW62
GR2318	5322 130 30613	BAW62
GR2319	5322 130 30613	BAW62
GR2320	5322 130 30613	BAW62
GR2321	5322 130 30613	BAW62
GR2322	5322 130 30613	BAW62
GR2323	5322 130 30613	BAW62
GR2324	5322 130 30613	BAW62
GR2325	5322 130 30613	BAW62
GR2326	5322 130 30613	BAW62
GR2327	5322 130 30191	OA95
GR2401	5322 130 30414	BY164
GR2402	5322 130 30414	BY164
GR2501	5322 130 34425	BZX87 – C5V1
GR2701	5322 130 30259	BY127
GR2702	5322 130 30259	BY127
GR2851	5322 130 30191	OA95
GR2852	5322 130 30191	OA95
GR2853	5322 130 30191	OA95

Transistors

Item	Ordering number	Description
TS1201	5322 130 44304	BFQ14
TS1301	4822 130 40965	BC547
TS1302	4822 130 40965	BC547
TS1303	5322 130 44041	BSV81
TS1304	5322 130 44093	BSV78
TS1305	5322 130 40854	BC327
TS1306	5322 130 40854	BC327
TS2401	5322 130 40294	BFY50
TS2402	5322 130 40468	2N2905A
TS2403	5322 130 40294	BFY50
TS2501	4822 130 40965	BC547
TS2851	5322 130 44283	BC636
TS2852	5322 130 44283	BC636
TS2853	5322 130 44283	BC636
TS2854	5322 130 44283	BC636
TS2855	5322 130 44283	BC636
TS2856	5322 130 40965	BC547

Integrated circuits

Item	Ordering number	Description
IC1	5322 209 84841	7805 UC
IC1201	5322 209 84598	LM741CN
IC1751	5322 209 85075	OQ052 RMS converter
IC2201	5322 209 84513	SN7432N – 00
IC2202	5322 209 80148	SN7404N – 00
IC2203	5322 209 84522	CNY42
IC2204	5322 209 84522	CNY42
IC2205	5322 209 84522	CNY42
IC2206	5322 209 84522	CNY42
IC2301	5322 209 84528	SN7400N – 00
IC2302	5322 209 84227	SN7402N – 00
IC2303	5322 209 84227	SN7402N – 00
IC2304	5322 209 84761	SN7407N – 00
IC2305	5322 209 84761	SN7407N – 00
IC2306	5322 209 84761	SN7407N – 00
IC2307	5322 209 84761	SN7407N – 00
IC2308	5322 209 80151	SN7408N – 00
IC2309	5322 209 80151	SN7408N – 00
IC2310	5322 209 80077	SN7410N – 00
IC2311	5322 209 80142	SN7442N – 00
IC2312	5322 209 84522	CNY42
IC2313	5322 209 84522	CNY42
IC2314	5322 209 84522	CNY42
IC2501	5322 209 84758	OQ054
IC2502	5322 209 84759	GZF1201D
IC2503	5322 209 84528	SN7400N – 00
IC2504	5322 209 80148	SN7404N – 00
IC2505	5322 209 84049	SN7413N – 00
IC2506	5322 209 80072	SN7490N – 00
IC2507	5322 209 84227	SN7402N – 00
IC2508	5322 209 84528	SN7400N – 00
IC2509	5322 209 84761	SN7407N – 00
IC2510	5322 209 84286	SN7451N – 00

Item	Ordering number	Description
IC2511	5322 209 84286	SN7451N – 00
IC2512	5322 209 84513	SN7432N – 00
IC2513	5322 209 80148	SN7404N – 00
IC2514	5322 209 84528	SN7400N – 00
IC2515	5322 209 84761	SN7407N – 00
IC2516	5322 209 80148	SN7404N – 00
IC2517	5322 209 84286	SN7451N – 00
IC2518	5322 209 80148	SN7404N – 00
IC2851	5322 209 84285	SN7438N – 00
IC2852	5322 209 84681	SN7447N – 00
IC2853	5322 209 84681	SN7447N – 00
IC2854	5322 209 84267	SN7445N – 00
IC2856	5322 209 84267	SN7445N – 00
IC2857	5322 209 84227	SN7402N – 00
IC2858	5322 209 80077	SN7410N – 00

Miscellaneous

Item	Ordering number	Description
U13	5322 216 64162	Current source
U14	5322 216 64163	Imp. converter
U15	5322 216 64164	A.C. pre-amplifier
U16	5322 216 64165	A.C. amplifier
U17	5322 216 64166	RMS converter without OQ052
U18	5322 216 64167	HF converter
U19	5322 216 64168	D.C. amplifier
U20	5322 216 64169	A.D.C.
U21	5322 216 64171	Reference unit
U24	5322 216 64172	Inguard supply
U28	5322 216 64173	Display unit
RE1101	5322 280 24068	Relay assy
RE1102	5322 280 24047	Reed relay
RE1103	5322 280 24047	Reed relay
RE1104	5322 280 24047	Reed relay
RE1201	5322 280 74077	Relay – RG011 – 14 – 100 V
RE1202	5322 280 74077	Relay – RG011 – 14 – 100 V
RE1204	5322 280 74077	Relay – RG011 – 14 – 100 V
RE1204	5322 280 24047	Reed relay
RE1205	5322 280 24047	Reed relay
RE1206	5322 280 24047	Reed relay
RE1207	5322 280 24047	Reed relay
RE1301	5322 280 24047	Reed relay
RE1302	5322 280 24047	Reed relay
RE1303	5322 280 24047	Reed relay
RE1401	5322 280 24047	Reed relay
RE1402	5322 280 24047	Reed relay
RE1403	5322 280 24047	Reed relay
RE1901	5322 280 24047	Reed relay

Item	Ordering number	Description
VL1	4822 253 30012	Fuse 220 V mains slow blow
	4822 253 30016	Fuse 110 V mains slow blow
VL1101	5322 252 60019	Spark gap 1700 V 0.1 A
VL1201	4822 253 20025	Fuse 3.15 A
T1	5322 146 24153	Mains transformer
T1001	5322 142 64042	Transformer Inguard supply
LA1101	5322 134 24023	Neon lamp GL9
LA2851/LA2859	4822 134 40167	Indication lamp 5 V 60 mA
V2851/V2855	5322 130 34579	LED display HP5082 – 7750

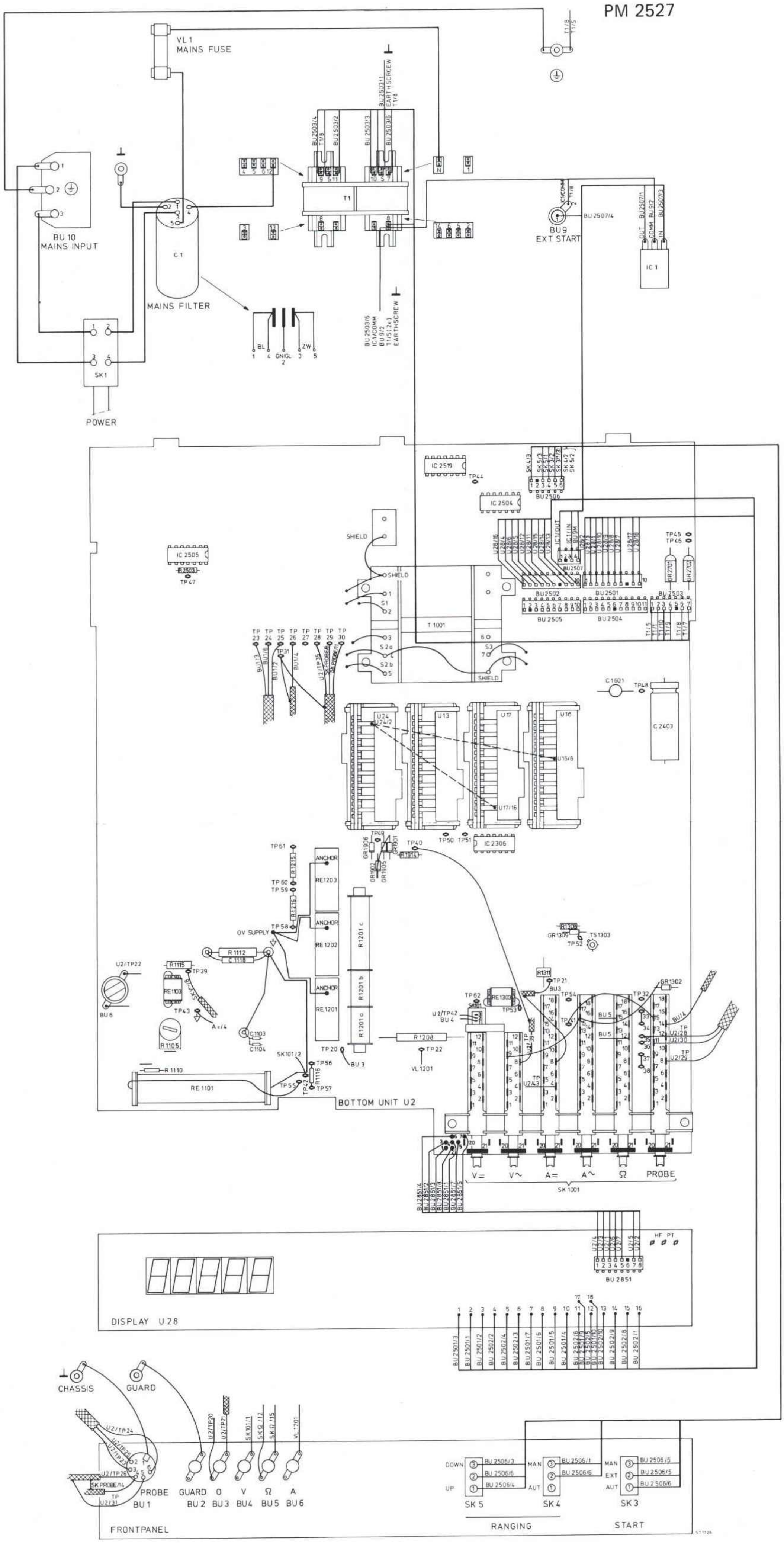
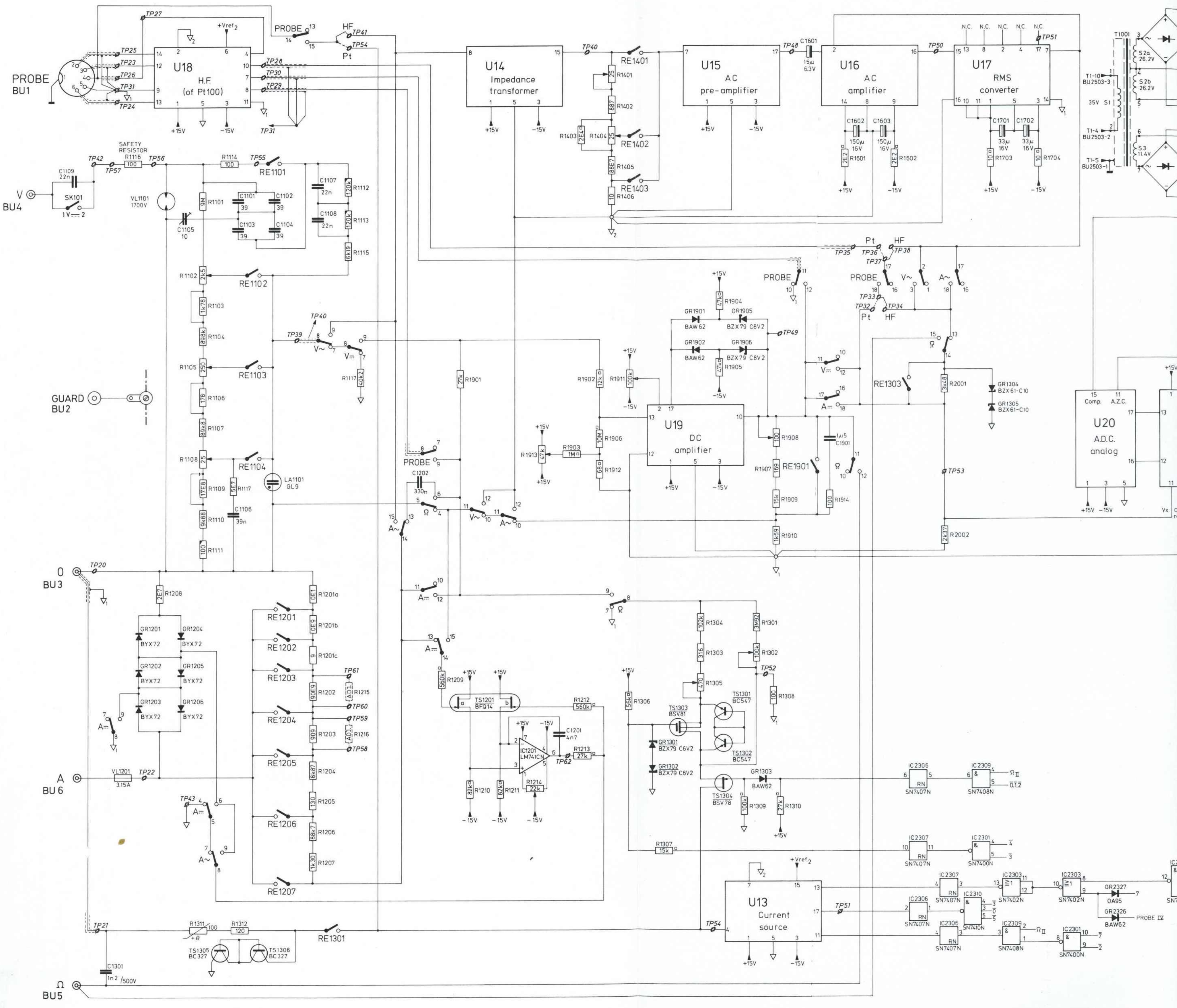


Fig. 62. Wiring diagram with test points



PROBE
BU1
U18
H.F.
(of Pt100)
+Vref2
TP27
TP25
TP23
TP26
TP31
TP24
TP28
TP30
TP29
PROBE
HF
TP41
TP54
Pt
U14
Impedance
transformer
TP40
RE1401
R1401
R1402
R1403
R1404
RE1402
R1405
RE1403
R1406
U15
AC
pre-amplifier
TP48
C1601
U16
AC
amplifier
C1602
C1603
R1601
R1602
TP50
U17
RMS
converter
N.C.
TP51
C1701
C1702
R1703
R1704
T1001
S2a
26.2V
S2b
26.2V
35V S1
S3
11.4V
SAFETY
RESISTOR
R1116
TP42
TP56
TP57
R1114
TP55
RE1101
C1109
22n
V
BU4
SK101
VL1101
1700V
R1101
C1101
C1102
C1103
C1104
C1105
C1107
C1108
R1112
R1113
R1115
R1102
RE1102
R1103
R1104
TP39
TP40
R1117
R1105
RE1103
R1106
GUARD
BU2
R1107
R1108
RE1104
R1109
R1110
R1111
C1106
LA1101
GL9
PROBE
C1202
R1901
R1902
R1911
R1913
R1903
R1906
R1912
GR1901
BAW62
GR1902
GR1905
BZX79 C8V2
GR1906
R1904
R1905
TP49
U19
DC
amplifier
R1908
C1901
RE1901
R1907
R1909
R1914
R1910
TP35
TP36
TP37
TP38
TP33
TP32
TP34
RE1303
R2001
GR1304
BZX61-C10
GR1305
TP53
R2002
U20
A.D.C.
analog
Comp.
A.Z.C.
0
BU3
TP20
R1208
GR1201
GR1202
GR1203
GR1204
GR1205
GR1206
BYX72
R1201a
R1201b
R1201c
RE1201
RE1202
RE1203
RE1204
RE1205
RE1206
RE1207
R1202
R1203
R1204
R1205
R1206
R1207
TP61
TP60
TP59
TP58
R1215
R1216
A
BU6
VL1201
3.15A
TP22
TP43
R1209
TS1201
BFQ14
R1212
IC1201
LM741CN
C1201
R1213
TP62
R1214
R1210
R1211
R1304
R1303
R1305
R1301
R1302
TP52
R1308
TS1301
BC547
TS1302
TS1303
BSV81
GR1301
GR1302
BZX79 C6V2
R1306
TS1304
BSV78
GR1303
R1309
R1310
R1307
U13
Current
source
TP51
TP54
TP21
R1311
R1312
RE1301
TS1305
BC327
TS1306
C1301
1n2 /500V
Ω
BU5
IC2306
IC2307
IC2309
IC2301
IC2303
IC2310
SN7407N
SN7408N
SN7400N
SN7402N
SN7410N
GR2327
OA95
GR2326
PROBE IV

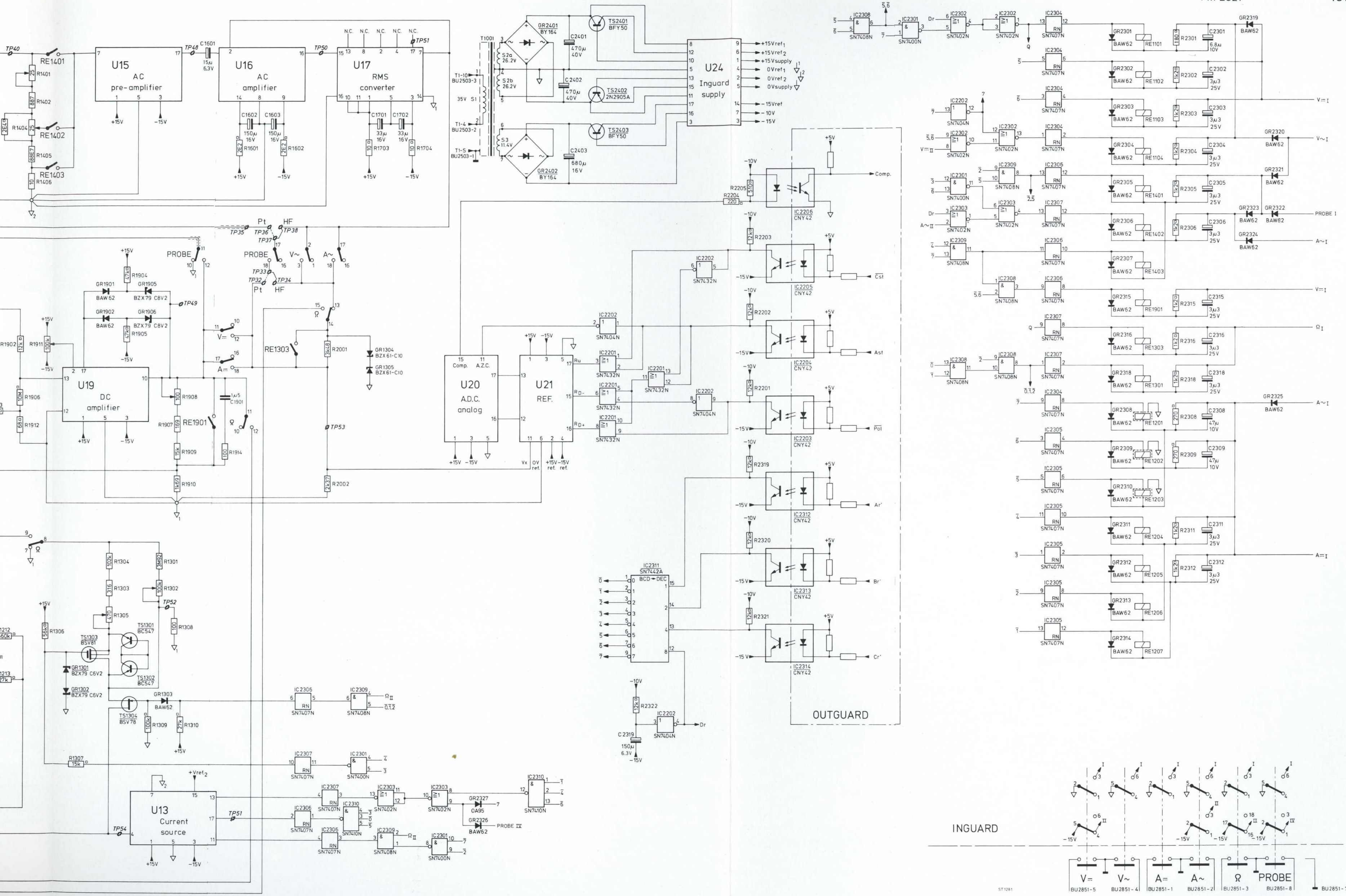


Fig. 63. Circuit diagram U2 Inguard

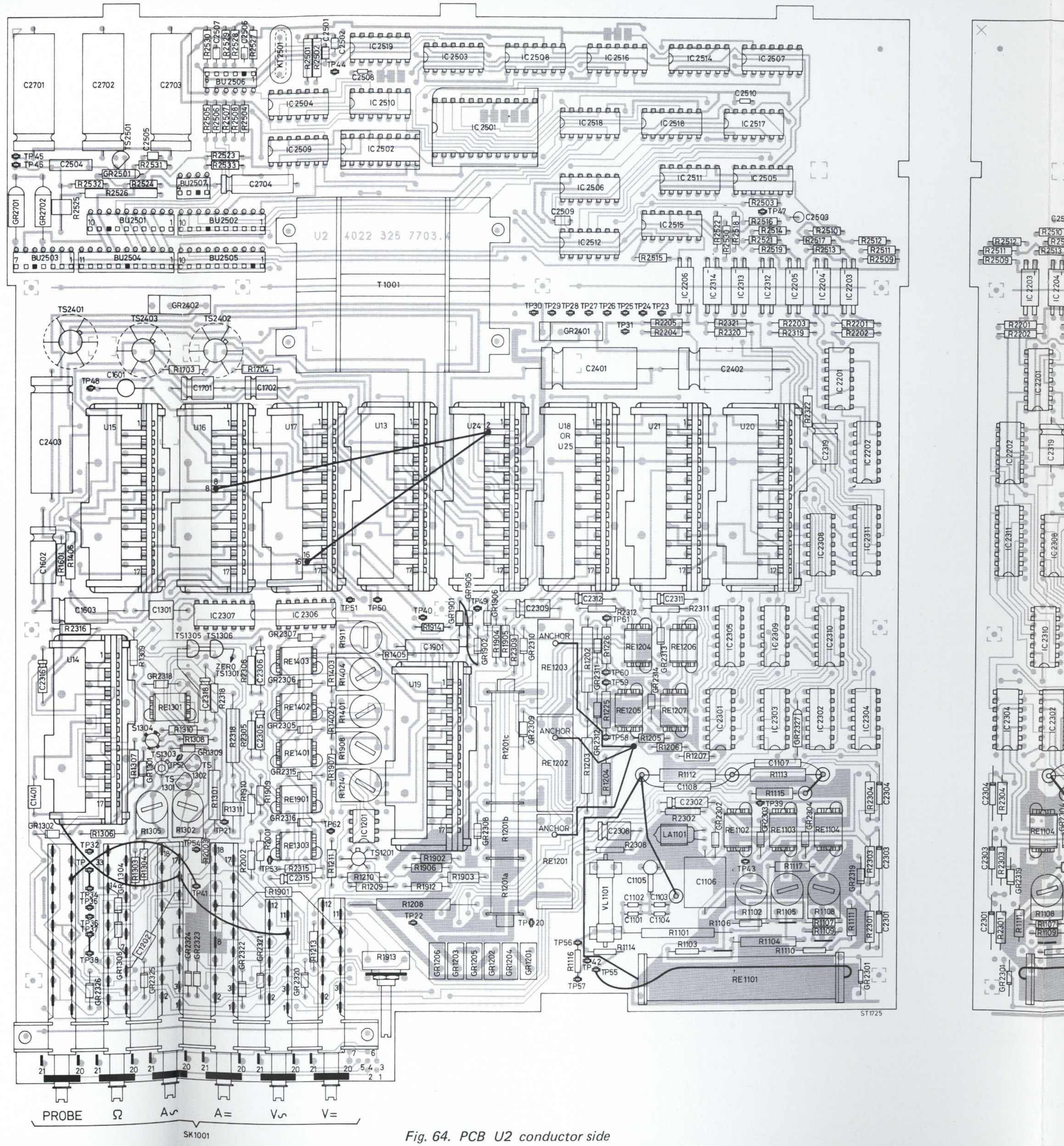


Fig. 64. PCB U2 conductor side

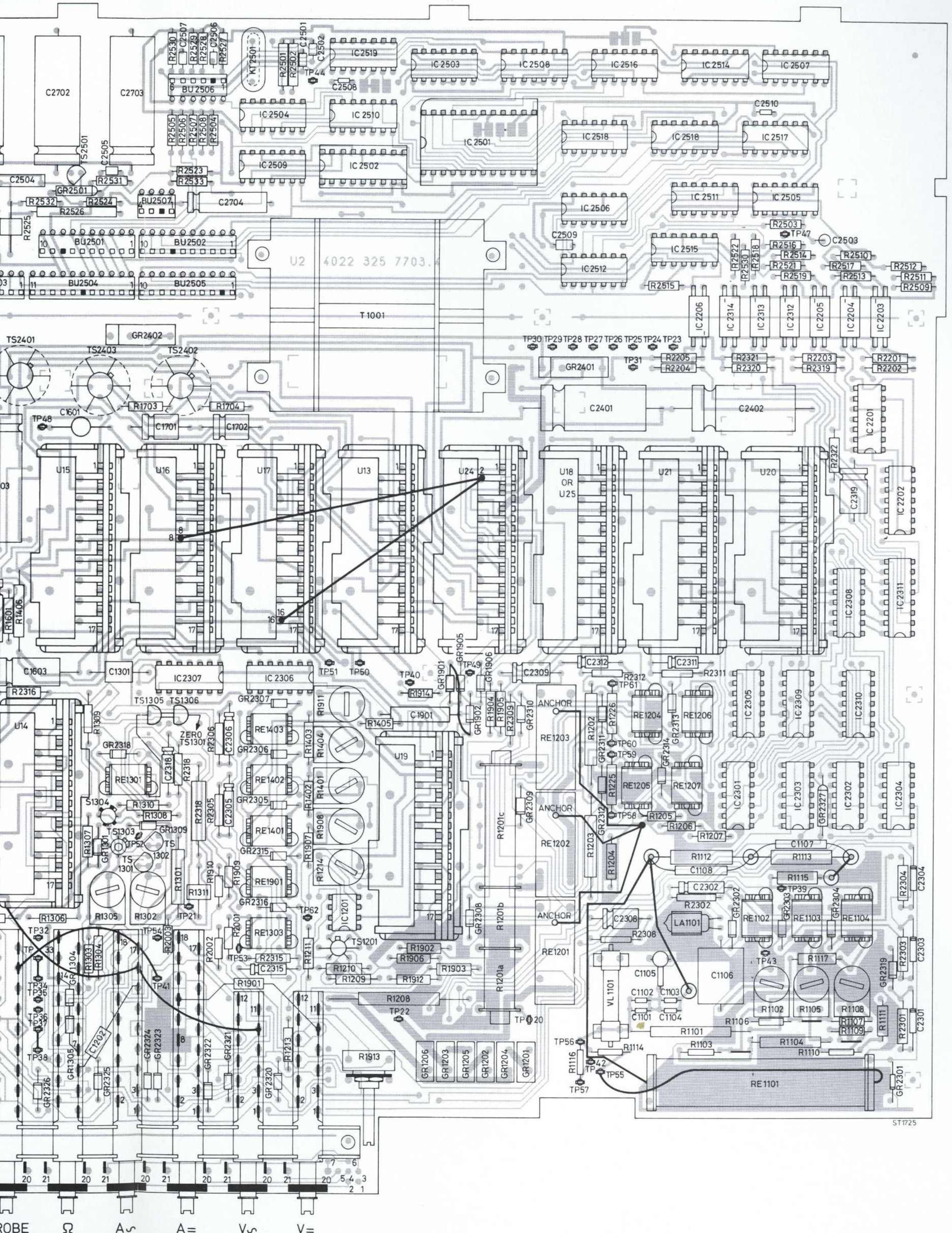


Fig. 64. PCB U2 conductor side

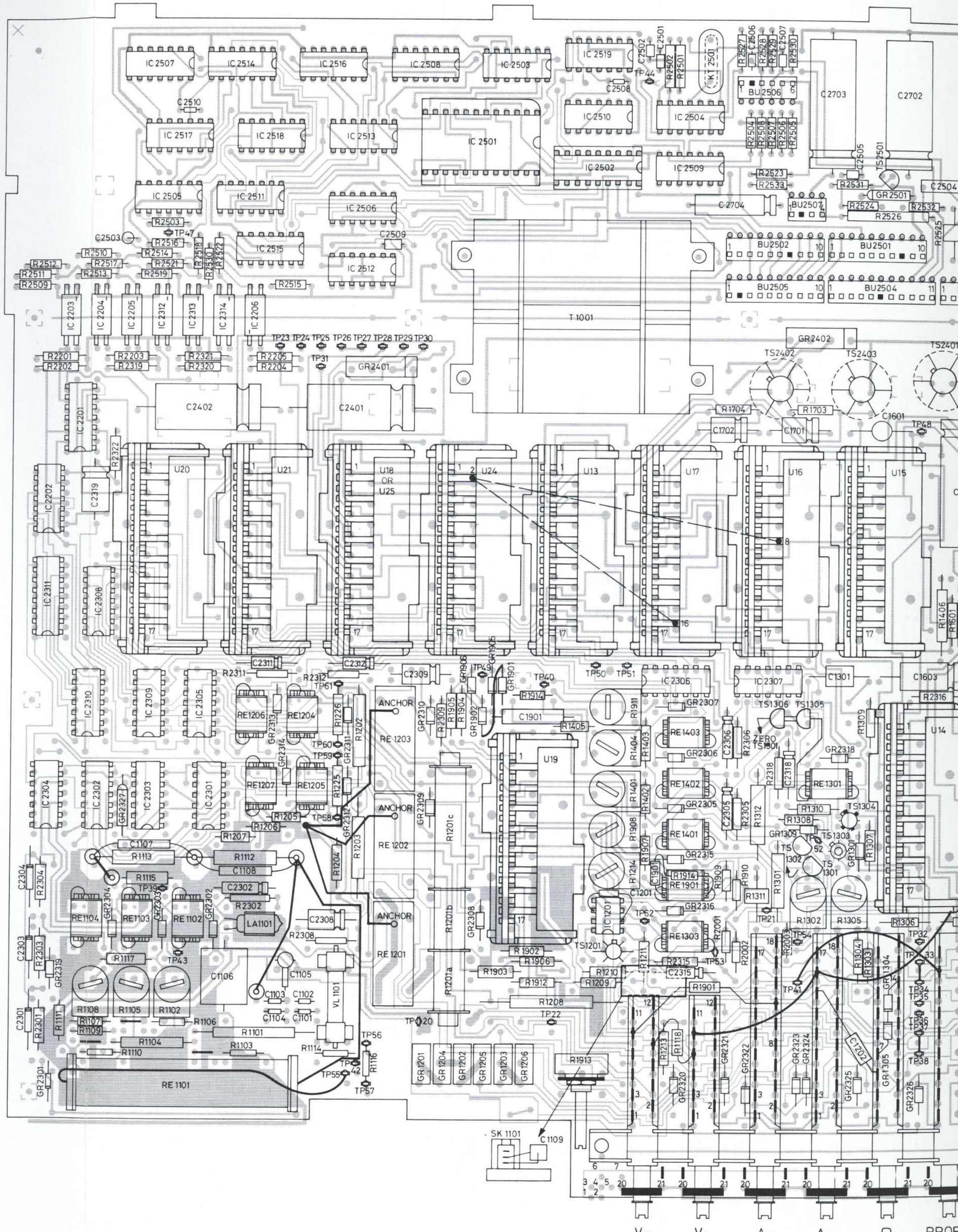


Fig. 65. PCB U2 component side

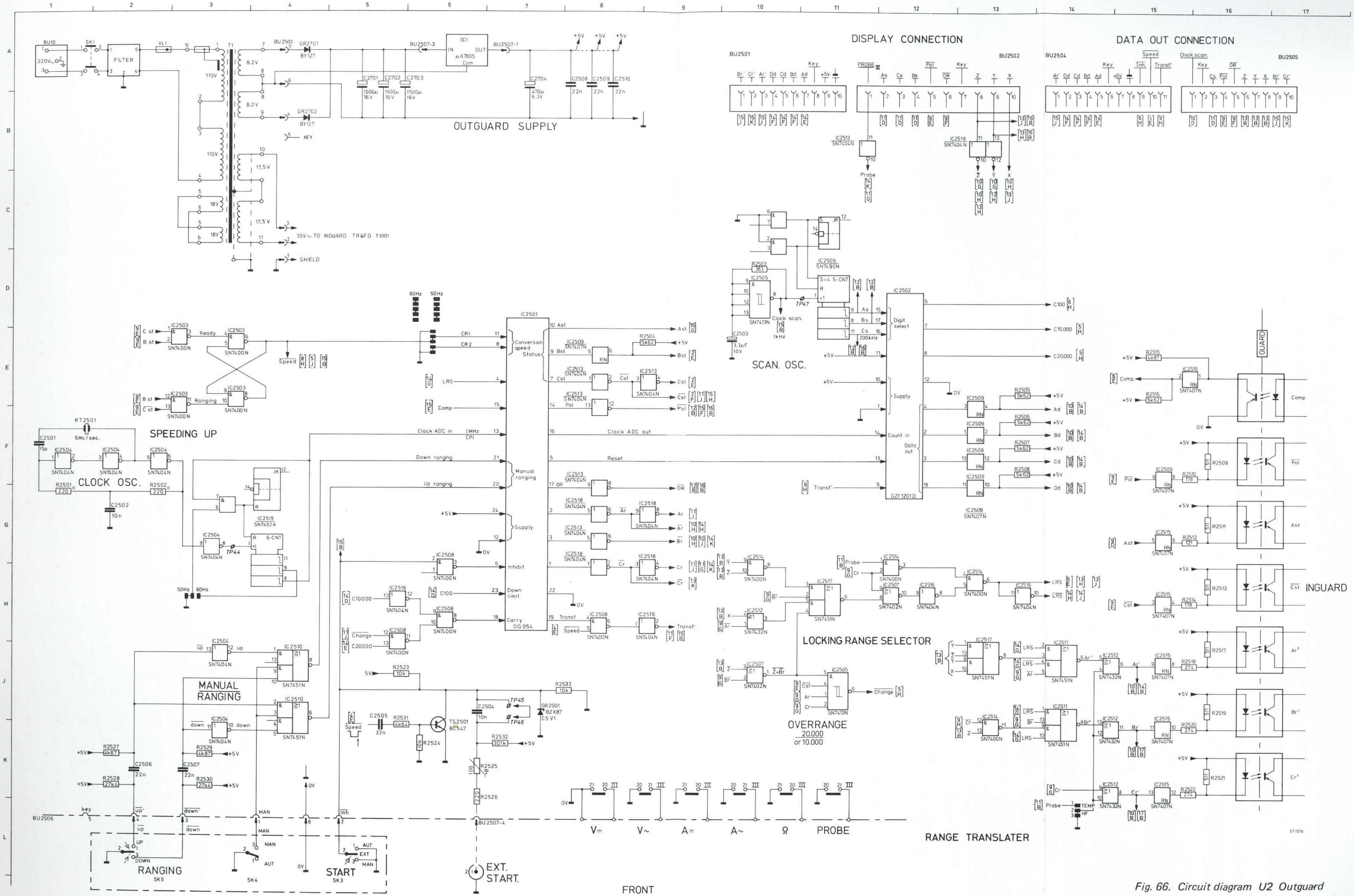


Fig. 66. Circuit diagram U2 Outguard

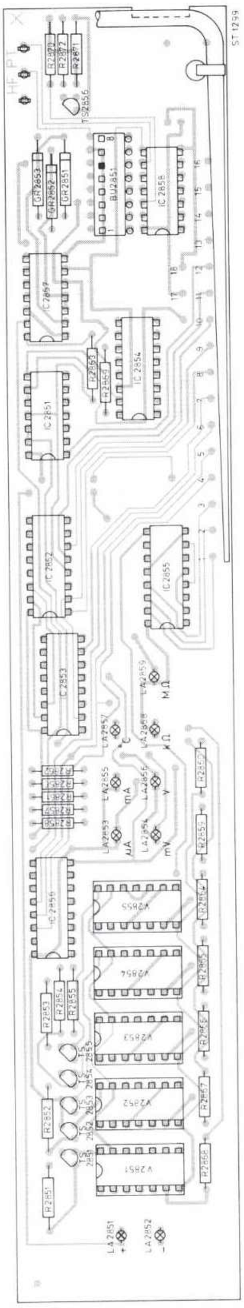


Fig. 67. PCB U28 component side

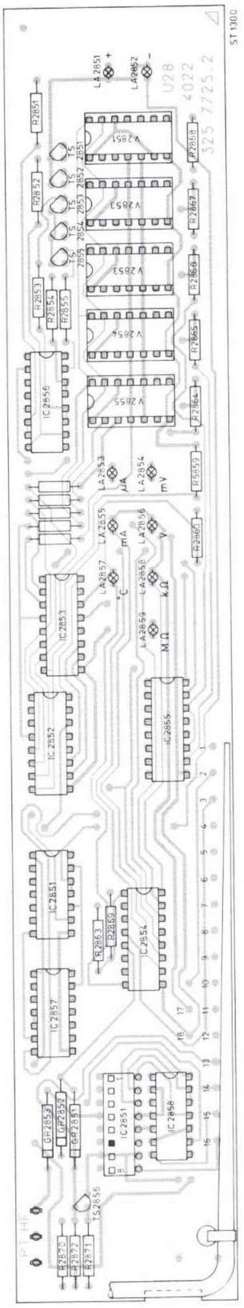


Fig. 68. PCB U28 conductor side

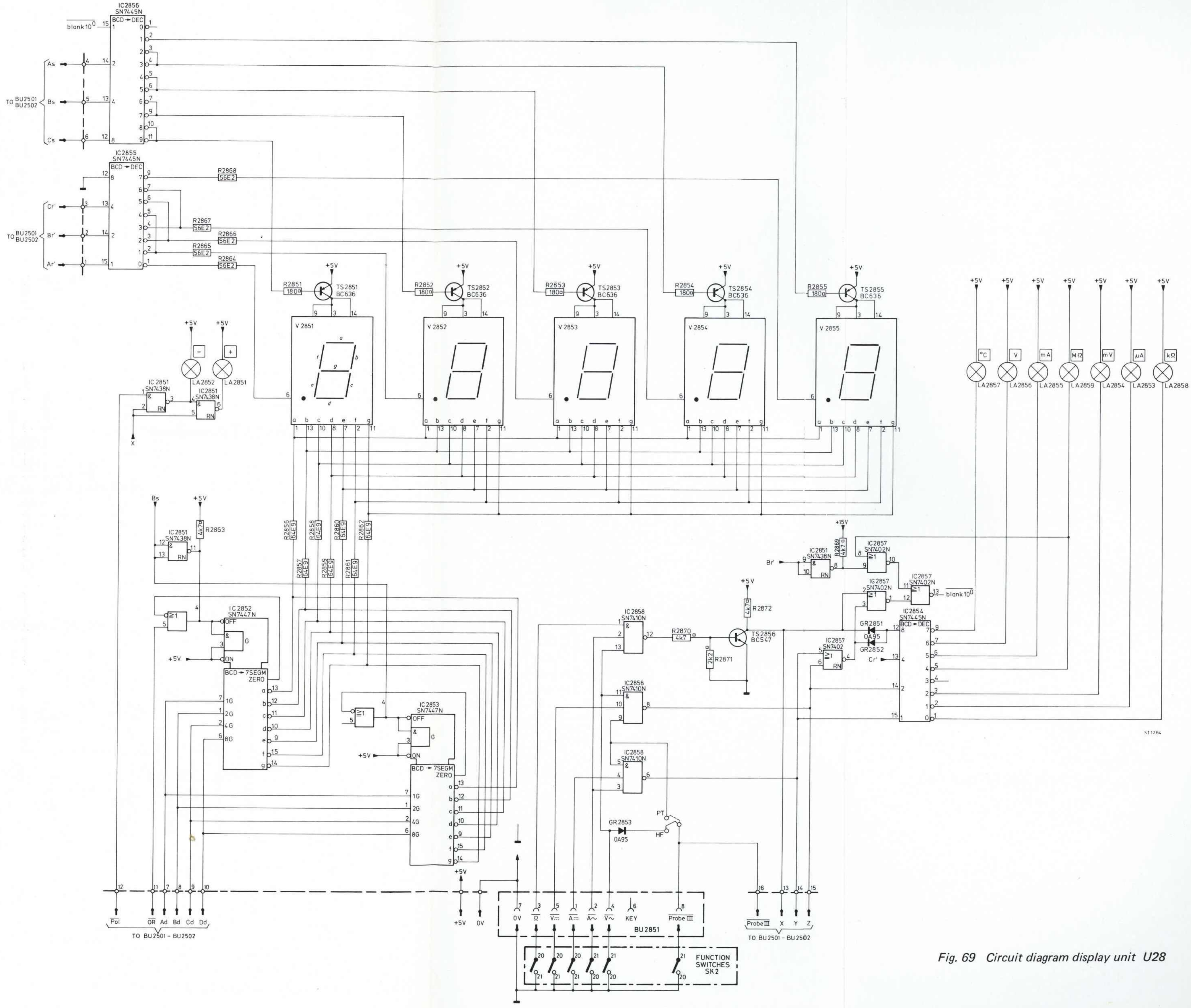


Fig. 69 Circuit diagram display unit U28

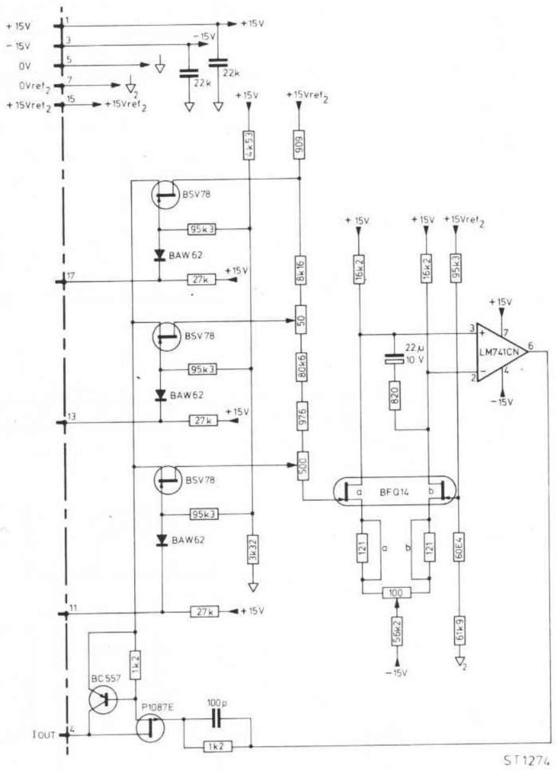


Fig. 70. Circuit diagram U13 Current source

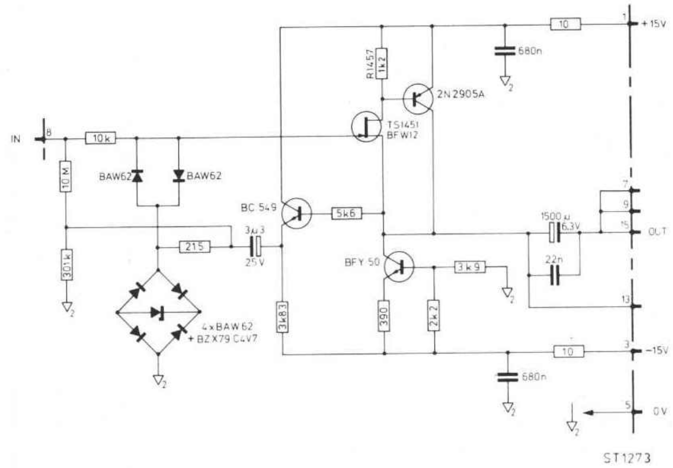


Fig. 71. Circuit diagram U14 Impedance transformer

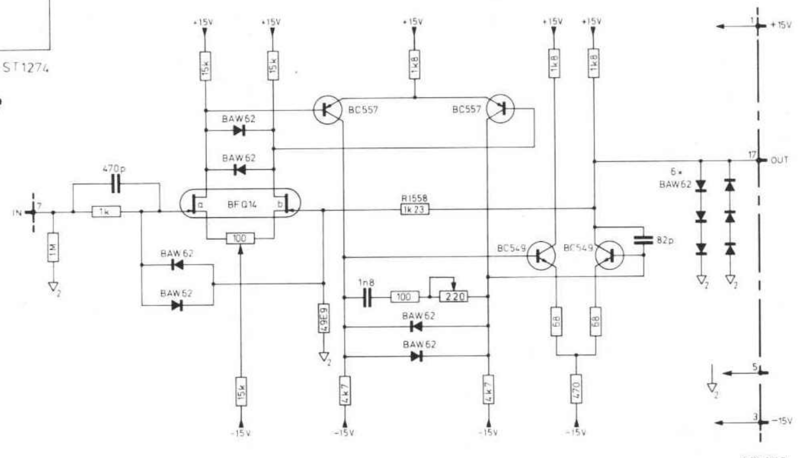


Fig. 72. Circuit diagram U15 AC pre-amplifier

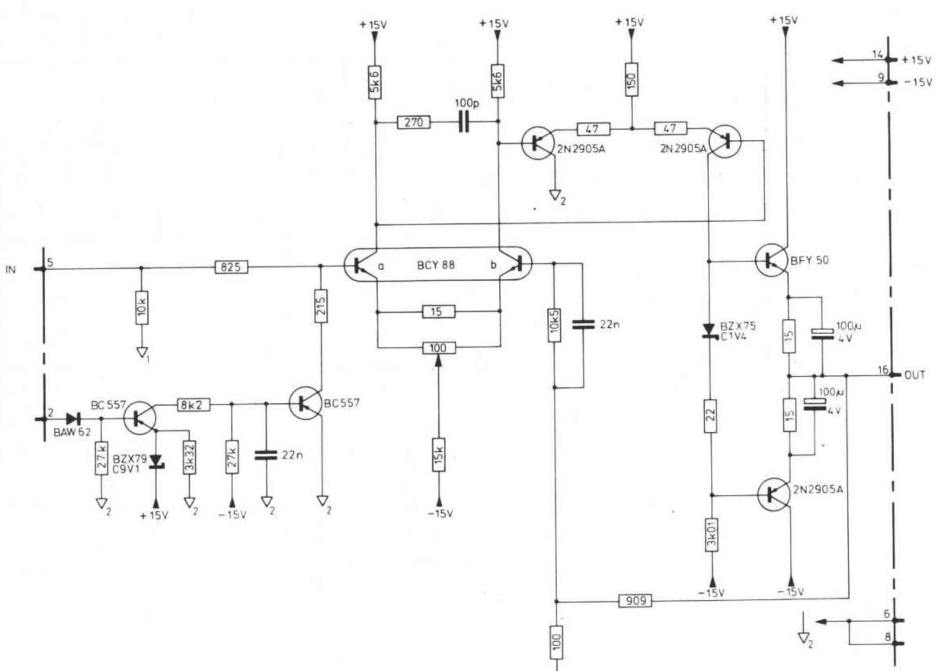


Fig. 73. Circuit diagram U16 AC amplifier

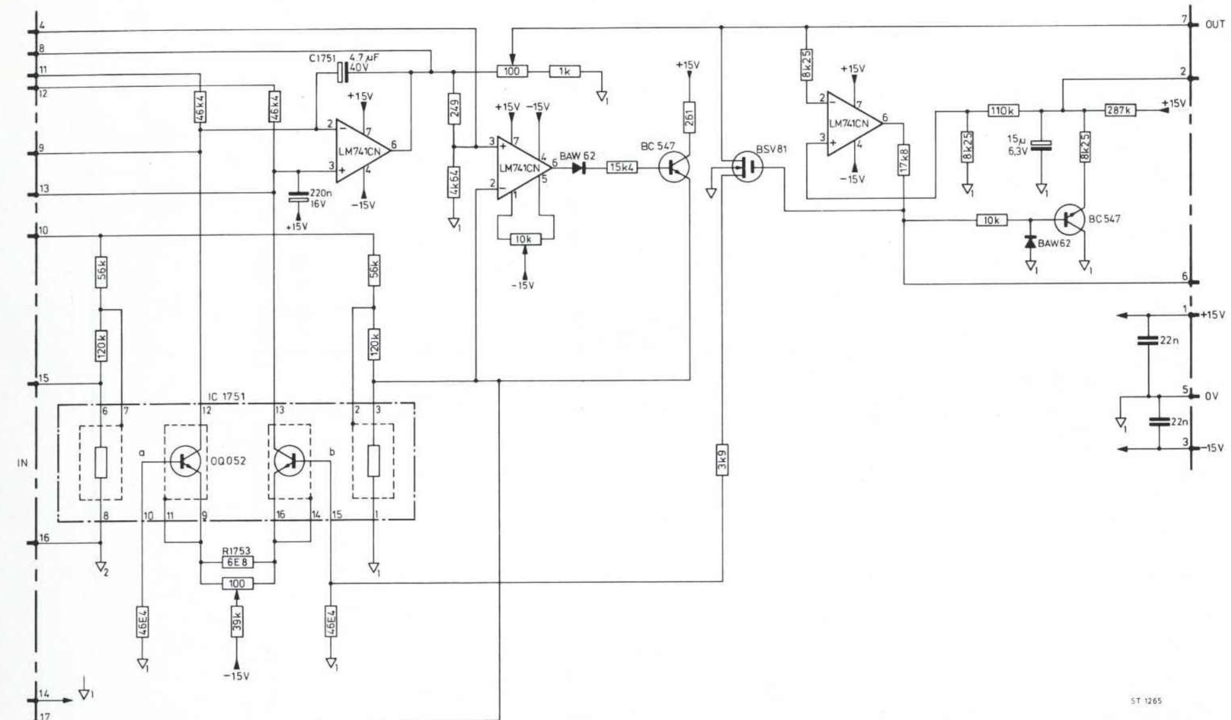


Fig. 74. Circuit diagram U17 RMS converter

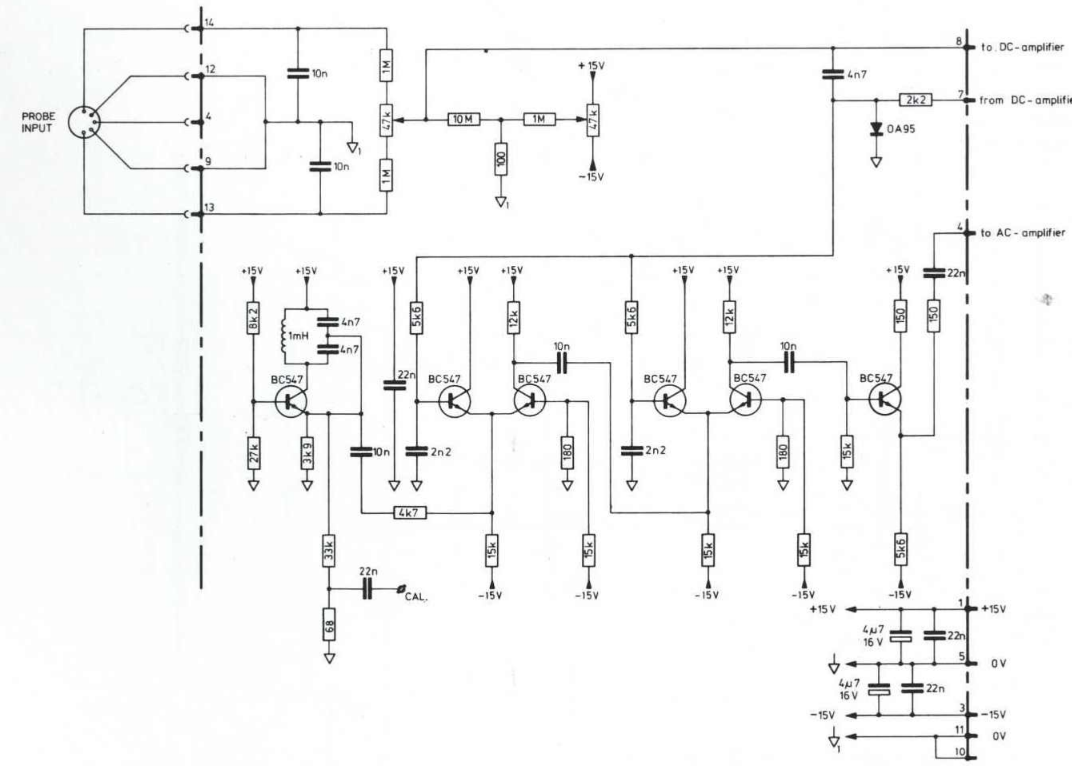


Fig. 75. Circuit diagram U18 H.F. unit

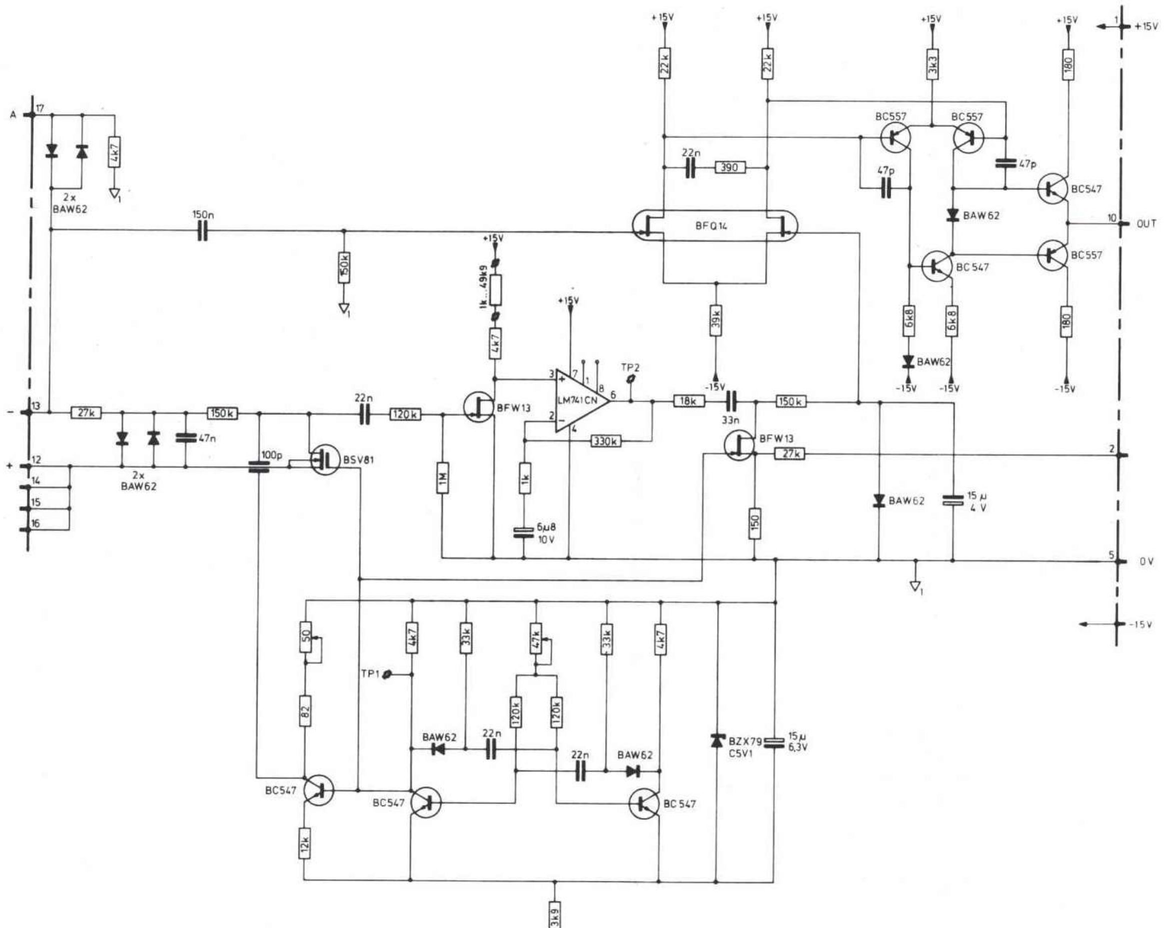


Fig. 76. Circuit diagram U19 DC amplifier

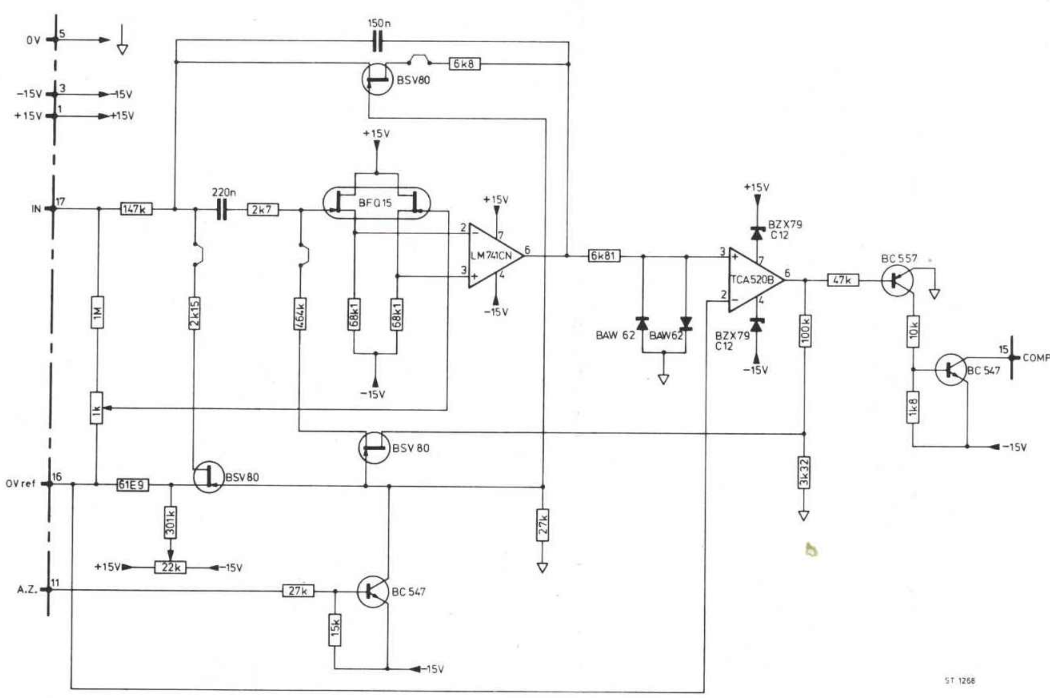


Fig. 77. Circuit diagram U20 A.D.C.

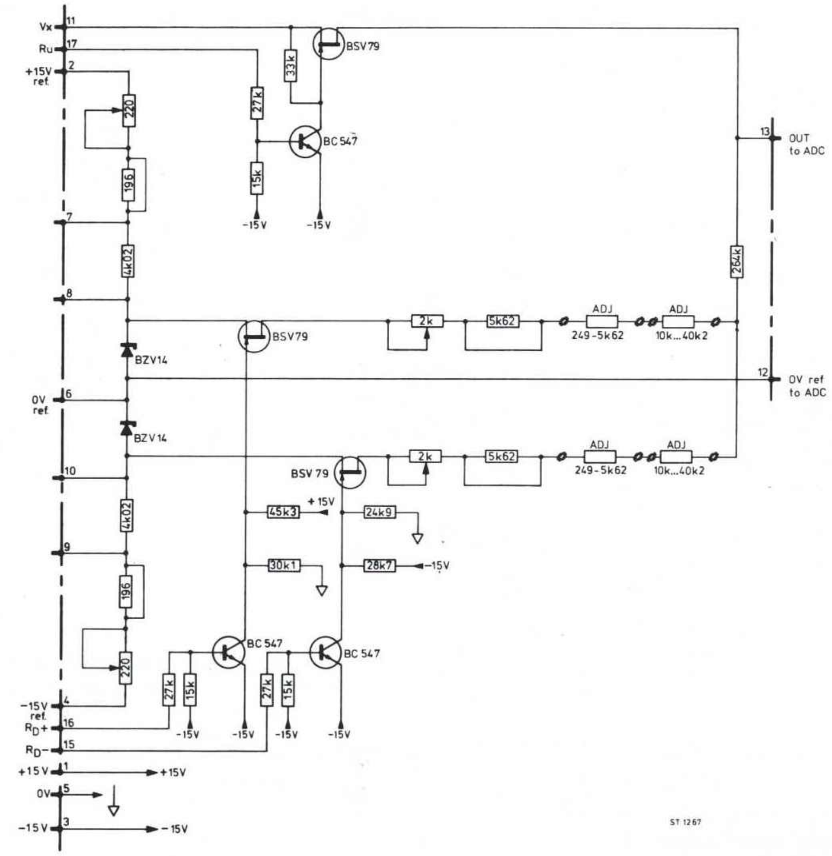


Fig. 78. Circuit diagram U21 Reference unit

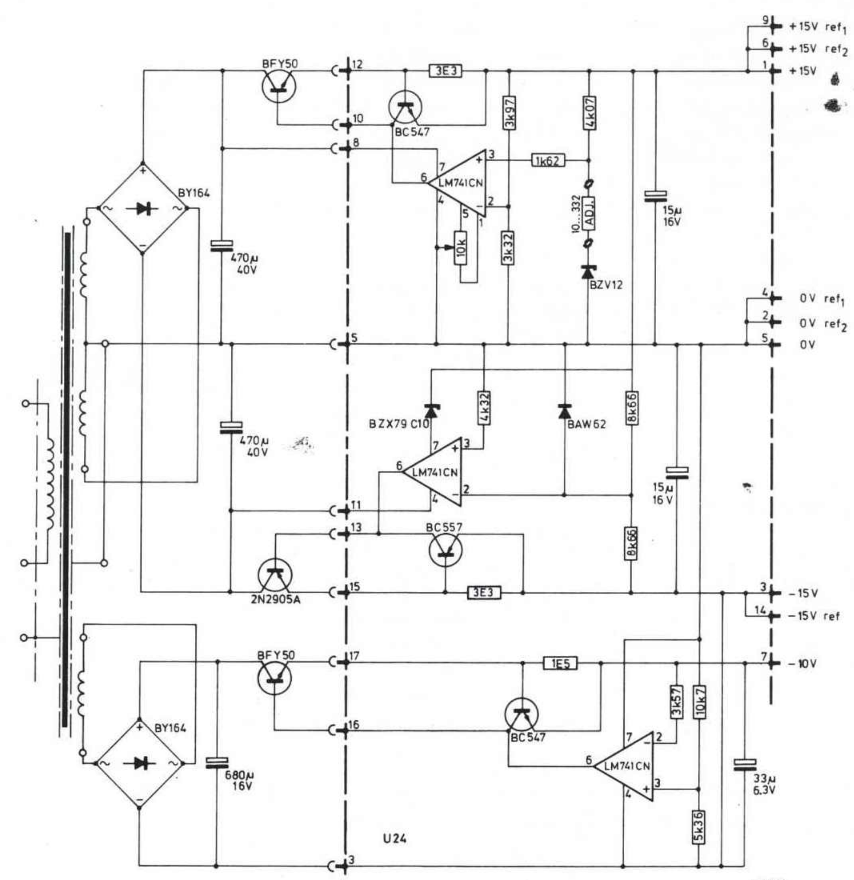


Fig. 79. Circuit diagram U24 Inguard supply

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 O 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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