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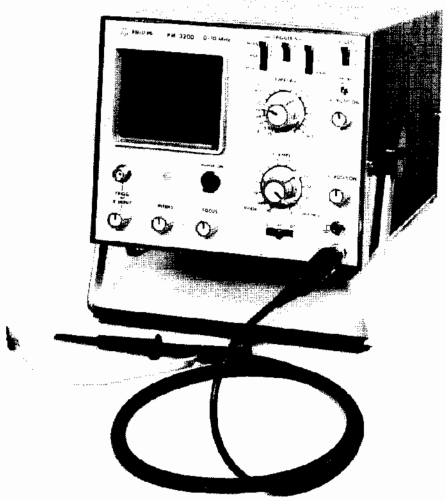

Manual

PORTABLE OSCILLOSCOPE

PM 3200

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Contents

LIST OF FIGURES

GENERAL

I. Introduction

The portable oscilloscope PM 3200 can operate both from the mains and from rechargeable batteries. The Y-amplifier has been provided with a drift compensation network; the internal time base generator operates automatically to a high extent and external triggering is also possible. The PM 3200 can also be used as an X-Y oscilloscope over a certain frequency range.
The instrument is fully transistorised.

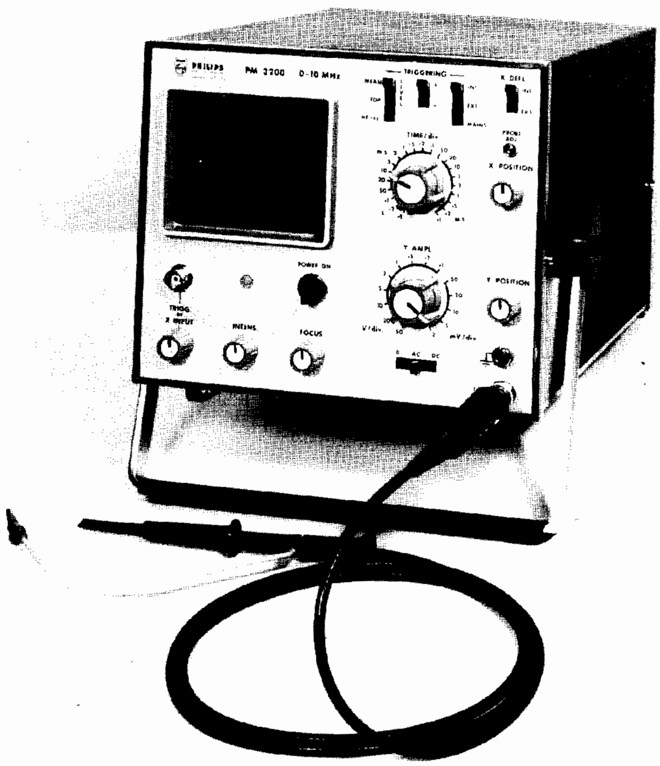


Fig. 1. Front view of PM 3200

II. Technical data

Vertical amplifier

Frequency range	d.c. coupled 0...10 MHz (−3 dB) a.c. coupled 2 Hz...10 MHz (−3 dB)
Rise time	35 ns
Deflection coefficient	2 mV per division to 50 V per division in 14 calibrated steps (sequence 1, 2, 5)
Accuracy (overall)	±5 %
Input impedance	1 MΩ//30 pF
Max. input voltage	400 V (d.c. voltage + peak value of alternating voltage)
Max. deflection	For sinusodial signals with frequencies up to 1 MHz the vertical deflection is undistorted for a total amplitude corresponding to 24 divisions; all the 8 successive divisions can be displayed.
Voltage for adjusting	Squarewave voltage (0.25 V superimposed on approx. 1 V d.c.; non-calibrated)
Drift	¼ div./24 h. at constant environmental temperature

Time base generator

Sweep times and accuracy

0.5 - 0.2 - 0.1 sec/div	(±7 %)
50 - 20 - 10 ms/div	(±5 %)
5 - 2 - 1 ms/div	(±5 %)
0.5 - 0.2 - 0.1 ms/div	(±5 %)
50 - 20 - 10 µs/div.	(±5 %)
5 - 2 - 1 µs/div	(±5 %)
0.5 - 0.2 - 0.1 µs/div.	(±7 %)

Triggering

Trigger facilities	The time base generator operates only in the triggered mode when a signal is present. If no signal is present the time base generator is automatically free-running. The trigger level is derived from the input signal.
Trigger source	To be selected by means of a switch: INT (vertical amplifier) EXT (external source) MAINS (voltage of mains frequency)
Trigger system	Automatic
Trigger sensitivity	INT. 1 divisions from 10 Hz to 1 MHz 2 divisions from 1 MHz to 10 MHz EXT. 1 V_{p-p} from 10 Hz to 1 MHz 2 V_{p-p} from 1 MHz to 10 MHz

Trigger level	Can be selected by means of a switch: MEAN (triggering on mean value of a.c. signal) TOP (triggering on peak value) HF rej. (same as MEAN but via a low-pass filter and a demodulator)
Max. voltage for external trigger input	400 V (d.c. voltage + peak value of alternating voltage)
Impedance of external trigger input	0.1 MΩ//25 pF
External trigger voltage control	continuously variable

Horizontal amplifier

Frequency range	10 Hz...100 kHz (−3 dB)
Deflection coefficient	continuously adjustable between 300 mV/div and 50 V/div
Input impedance	0.1 MΩ//25 pF
Max. input voltage	400 V (d.c. voltage + peak value of alternating voltage)

Cathode ray tube

CRT	10 cm tube with 1.5 kV acceleration voltage
Tube type	D10 - 160 GH (P31) medium-short persistence, green. GM (P7) optionally available. (PM 3200 G)
Max. deflection	vertical up to 8 divisions horizontal up to 10 divisions
Size of 1 division	7.5 x 7.5 mm^2

Power supply

Mains voltages	110 - 125 V or 200 - 250 V (selector switch) 127 V ±10 % 40 - 400 Hz; 20 Watts
For 110 V only:	PM 3200Q (U.S.A. Version) PM 3200R (C.S.A. approved version, file number LR 20891)
External direct voltage source	22 - 30 V; 0.5 A
Battery supply	See accessories
Dimensions	17.5 cm high, 21 cm wide, 33 cm long
Weight	5.3 kg
NATO stock number	6625 - 17 - 804 - 2838

III. Accessories

See also chapter XIII. Information concerning accessories.

Accessories supplied with the instrument:

1x adapter PM 9051 (BNC – 4 mm)
1x contrast plate (green)
1x manual

Optional accessories

Probe set with 1.15 m lead (att. 10:1)	: PM 9326
Probe set with 2 m lead (att. 10:1)	: PM 9327
Battery case (empty)	: PM 9390
Battery case with batteries	: PM 9391
Adapter for external 24 V d.c. supply	: PM 9392
Carrying case	: PM 9393
Rack mount kit	: PM 9360

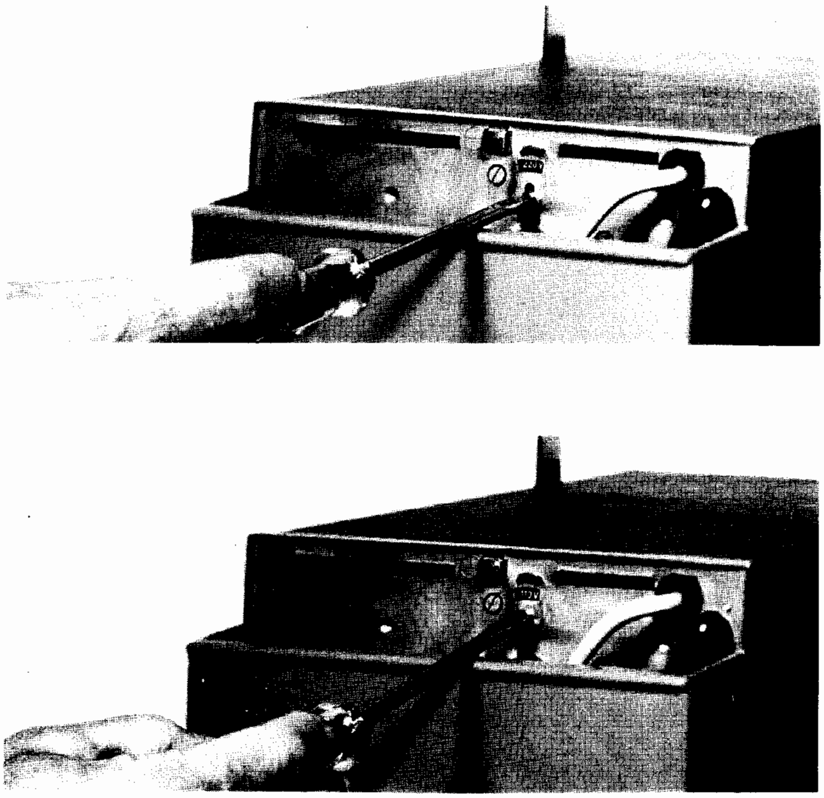


Fig. 2. Mains voltage 220 V and 110 V

DIRECTIONS FOR USE

IV. Installation

A. ADJUSTING TO THE LOCAL MAINS SUPPLY

On delivery the instrument is adjusted to a mains voltage of 200-250 V (220 V nominal). When the mains voltage is 100-125 V (110 V nominal) the mains voltage selector at the rear should be set accordingly Fig. 2.
Additionally a resistor (82 Ω; 10 %; 5 ½ W Ordering no. 4822 112 20078) should be included in the blue wiring when connecting the instrument to a 127 V (±10 V) supply (Fig. 3).
Before connecting to the mains, the protective earth terminal of the instrument must be connected to a protective conductor, see also EARTHING.

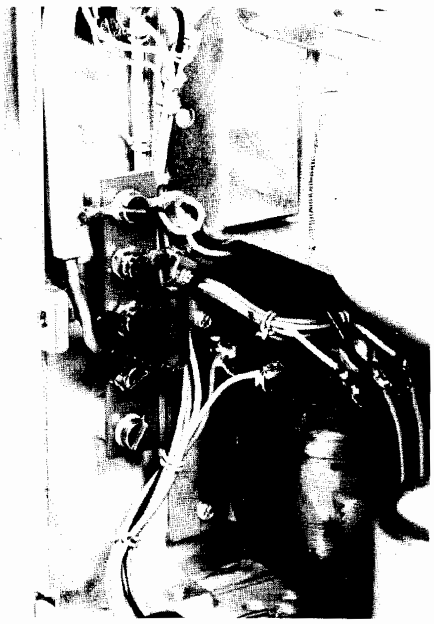


Fig. 3. Preparing for a 127 V mains supply

B. EARTHING

The instrument should be earthed in accordance with local safety regulations.
This may be effected:

1. via the earthing socket at the front of the instrument
2. via the measuring lead (earthing wire with alligator clip)
3. via the earthing screw near the mains voltage selector
4. via the mains lead (3-core). The mains plug should only be inserted in a socket outlet provided with a protective earth contact, the protective action of which is not cancelled by the use of an extension cord or device which does not have a protective conductor.

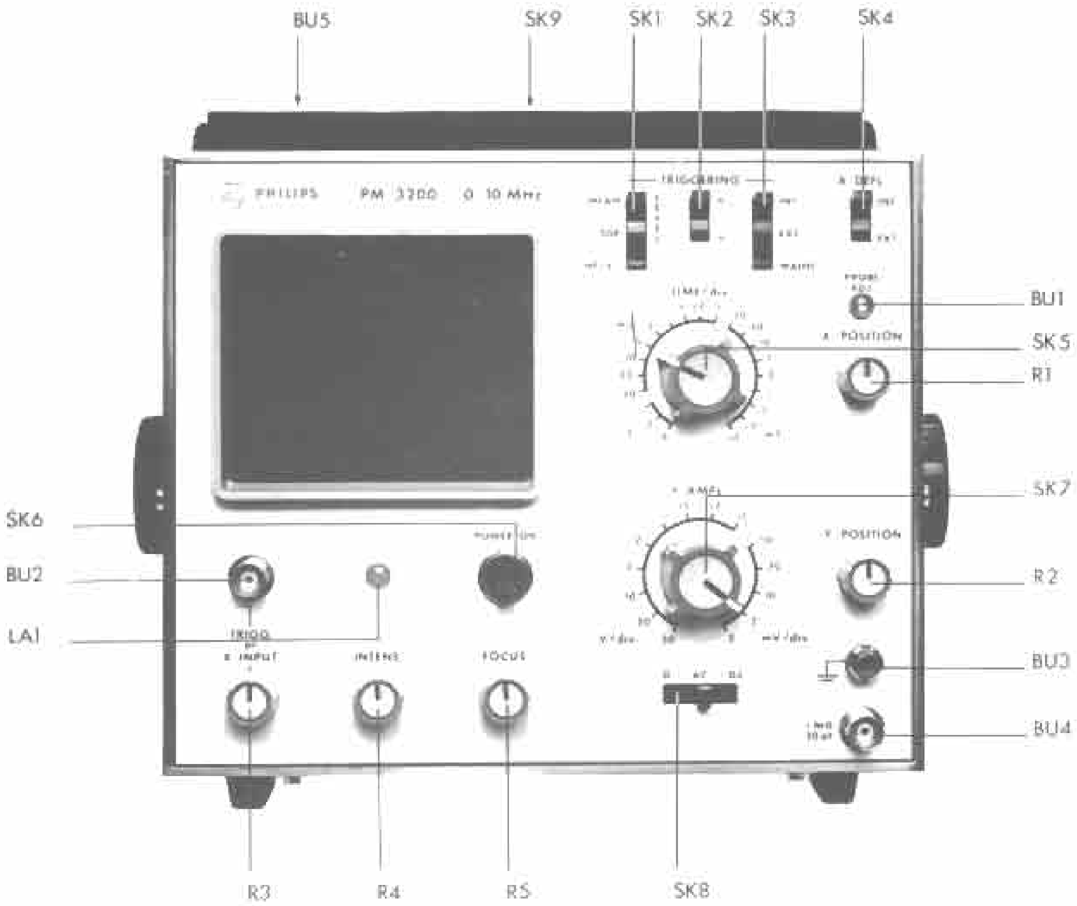


Fig. 4 Controls

V. Operation

A. CONTROLS, SOCKETS AND THEIR FUNCTIONS

For the functions and location of the controls and sockets, see Fig. 4.

BU1	Output terminal for test voltage
BU2	Input socket for external trigger voltage, or X deflection voltage
BU3	Earthing socket
BU4	Input socket for Y deflection voltage
BU5	Input socket for d.c. supply (at the rear of the instrument)
(BU6)	Interconnection plug, when BU5 is not used
LA1	Pilot lamp
R1	Horizontal shift
R2	Vertical shift
R3	Input attenuator for external triggering or X deflection
R4	Brightness control
R5	Focusing of the electron beam
SK1	Selector for trigger level
SK2	Selector for trigger polarity
SK3	Selector for trigger source
SK4	Selector for X deflection
SK5	Selector for sweep times
SK6	Mains switch
SK7	Attenuator switch
SK8	Selector for coupling Y amplifier input
SK9	Mains voltage selector

B. DISPLAYING WAVEFORMS

Note: Before switching-on of the instrument, make sure that the instrument is set to the rated voltage of the mains supply.

1. Time base line

- Set all toggle switches to the upper position.
- Set R1, R2 and R5 to the mid-position.
- Turn R3 and R4 anti-clockwise.
- Switch on the instrument with SK6 (LA1 should light up).
  After approx. 20 sec. the instrument is ready for operation.
- Turn R4 slowly clockwise until the trace has the desired intensity.
- If required, adjust R5 for max. sharpness.

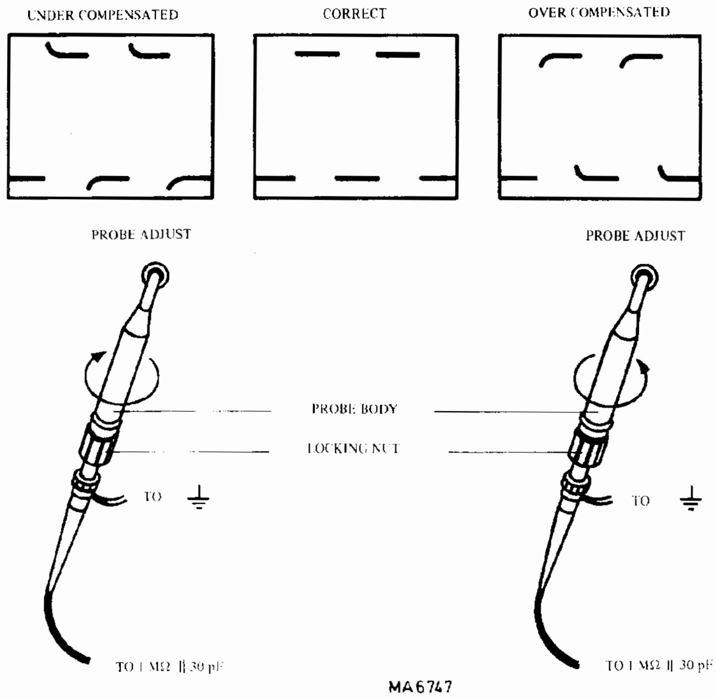


Fig. 5. Adjustment of attenuator probe

2. Adjustment of attenuator probes PM 9326 or PM 9327

- Display a time base line in accordance with B1.
- Set SK3 to position "MAINS" or in case of battery supply, trigger the instrument externally in accordance with D.
- Set SK8 to position "AC", and SK7 to position "5 mV/div."
- Connect the measuring lead to BU4 and place the tip of the attenuator probe on BU1 (see Fig. 5).
- Select a suitable time base value with SK5.
- Loosen the "locking screw" and turn the "probe body" with respect to the cable until correct adjustment is obtained.
- Secure the locking screw without changing the adjustment (check!).

3. Input circuit

The signal to be measured, which is applied to BU4, is applied direct to the Y amplifier (SK8 in position "D.C.") or via a capacitor (SK8 in position "AC") in order to suppress d.c. components.
When SK8 is in position "0", BU4 is disconnected and the input of the Y-amplifier is connected to earth in order to determine the zero level of the screen trace.

C. TRIGGERING (internal)

When the signal to be measured, which is applied to BU4, causes a sufficiently high Y deflection, triggering takes place automatically if SK4 is in position "INT".

- Start with SK1...SK4 in the upper position.
- Select a suitable time base setting with SK5.
- Select the desired trigger moment with SK2; "+" for triggering on a positive-going edge, or "−" for triggering on a negative-going edge.

- If the signal to be measured is locked to the mains frequency, triggering on the mains frequency is possible with SK3 in position "MAINS" (e.g. for comparing phase shift; reversal of the contact plug causes a 180° phase shift).
- Large duty cycles of pulse-shaped signals may sometimes give rise to difficulties. In that case SK1 should be set to position "TOP".
- H.F. components may sometimes give rise to a blurred image (jitter).
  These components can be removed by setting SK1 to position „HF rej".

Note: In case of sinewave signals of a relatively high frequency the transit time of the unblanking amplifier and that of the trigger amplifier will play a part so that in position "MEAN" of SK1 the beginnjng of the trace will be shifted towards the top and in position „TOP" the beginning will be shifted towards the middle of the sinewave.

D. TRIGGERING (external)

- Apply the signal to be measured to BU4.
- Apply the trigger signal to BU2.
- Set SK3 to position "EXT".
- Select a suitable level and polarity with SK1 and SK2.
- Set R3 to a position, as far as possible anti-clockwise, at which triggering is stable.

E. X-Y DEFLECTION

- Apply the signal for X-deflection to BU2 and the signal for Y-deflection to BU4.
- Adjust for suitable deflection with R3 and SK7.

Note: As the X and Y amplifiers are not identical, phase shifts may occur (open loop) at higher frequencies.

SERVICE DATA

VI. Circuit description

A. POWER SUPPLY

1. Rectifier

Transformator T401 has been provided with two primary windings, which, by means of SK9 at the rear of the instrument, can be connected in series or in parallel for mains voltages of 220 V or 110 V nominal. The secondary voltage of approx. 25 V_{rms} supplies the instrument via rectifier GR401 or may be used for charging the accummulator batteries when employing battery case PM 9391.
Via a control circuit the direct voltage, obtained from the rectifier or from the batteries or an other direct voltage source, is applied to a d.c. converter, which provides the various supply voltages.
A potentiometer circuit delivers part of the secondary alternating voltage to the trigger amplifier as a trigger signal.

2. Control circuit

The control circuit has a series regulator TS401, the load of which is included in the collector circuit. The reference voltage is derived from the output voltage via diode GR402 and resistor R407 across zener diodes GR403 and GR404. Transistors TS401 and TS402 form a Darlington pair, so that the differential amplifier TS404, TS406 has to supply little current for the control.
The control circuit is protected against overload by transistor TS403.
This transistor is normally blocked, as the base-emitter voltage across R411 is practically compensated for by voltage division (R408, R409) at the output.
When the current consumption increases, the voltage drop through R411 increases until TS403 opens. This transistor then bypasses zener diodes GR403 and GR404, so that the base voltage of TS404 decreases. TS404 then gives less current and the series regulator TS401 acts virtually as a current source. Then the control circuit finds a stable point with less output voltage and output current, the values of which are determined by the value of the load resistance. Thus, a decreasing characteristic is obtained in which the maximum dissipation of the series regulator is not exceeded. To start the control circuit at switching on, the reference voltage must be present. Then, the voltage is derived from the input via R404 and R407. If the output voltage is sufficiently high, diode GR402 becomes conductive, so that the reference voltage is obtained from the output voltage, which results in a better control.

3. D.C. converter

The d.c. converter with transistors TS407 and TS408 is supplied via self-inductance L401. Owing to L401 the collector current of the alternately conducting transistors is practically constant and the voltage on the transformer T402 sinusoidal, so that the dissipation of the transistors is low and the efficiency high.
The oscillation frequency is determined by the self-inductance of the transformer, and the capacitor C412; it is approximately 18 kHz.
The alternating voltages generated in the secundary windings are taken from different taps, rectified and smoothed. The voltage of −1500 V is obtained with the aid of a voltage doubler.
A separate winding supplies the heater of the CRT.

B. Y-DEFLECTION

1. Introduction (see block diagram, Fig. 6)

Step control of the deflection coefficient is effected both by means of an input attenuator and by controlling the gain factor of the Y amplifier. This permits the application of an input attenuator of a simple design so that a proper transient response can be achieved.
Gain control of the amplifier takes place at low ohmic level so that frequency compensation is not necessary. Moreover, the noise component of the Y amplifier in the less sensitive positions is minimised. If the complete attenuation would take place before the Y amplifier, the noise component of the amplifier would have an unfavourable value in all positions of SK7.

2. The input circuit

The signal to be measured, applied to BU4 (1 MΩ//30 pF), is applied to input attenuator SK7 via SK8 either direct (DC) or via an isolating capacitor (AC).
When changing over from AC to DC the isolating capacitor is discharged.
In position "0" the signal is disconnected and the input of the following circuits is earthed. After passing switch SK8 the signal reaches the input attenuator whose attenuation is as given in the following table.

Position SK7	*Text plate indication*	*Attenuation*
1, 2, 3	50, 20, 10 V/div	1000x
4, 5, 6	5, 2, 1 V/div	100x
7, 8, 9	0.5, 0.2, 0.1 V/div	10x
10, 11, 12, 13, 14	50, 20, 10, 5, 2 mV/div	1x

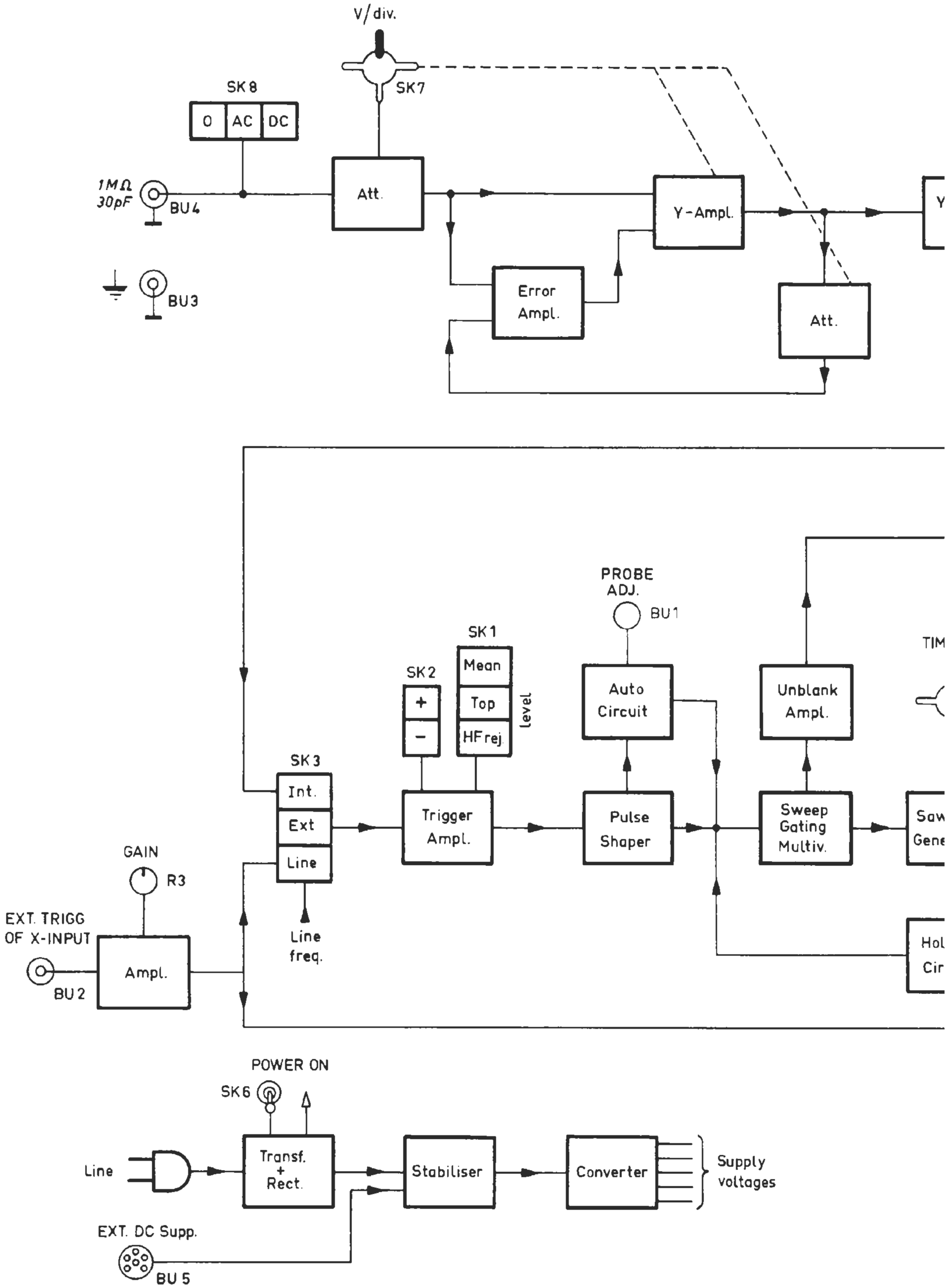
3. Y-amplifier

The input stage is formed by source follower TS231 which, via emitter follower TS26, passes the signal on to the next stage. Four diodes protect the base circuit of TS26 against overloading. The following stage consists of series feed-back transistors TS27 and TS29, whose output current is applied to parallel feed-back transistor TS31.
The overall gain of this stage is mainly given by the ratio of the parallel feed-back resistance and the series feed-back resistance, which can be selected. In position 14 of SK7 the series feed-back resistance is minimum.
R63 should be adjusted in this position. The overall gain up to TS31 is for the various positions:

Position SK7	*Text plate indication*	*Gain*
10	50 mV/div	2x
11	20 mV/div	5x
12	10 mV/div	10x
13	5 mV/div	20x
14	2 mV/div	50x

In combination with the input attenuator the following pattern of deflection coefficients is obtained:

	Gain factors:	*50x*	*20x*	*10x*	*5x*	*2x*
	1x	2 mV/div	5 mV/div	10 mV/div	20 mV/div	50 mV/div
Input attenuation	10x			0.1 V/div	0.2 V/div	0.5 V/div
	100x			1 V/div	2 V/div	5 V/div
	1000x			10 V/div	20 V/div	50 V/div



V/div.
SK7
SK8
0
AC
DC
1MΩ
30pF
BU4
Att.
Y-Ampl.
Error
Ampl.
Att.
Y
BU3
PROBE
ADJ.
BU1
SK1
Mean
Top
HFrej.
level
SK2
+
−
TIM
SK3
Int.
Ext
Line
Trigger
Ampl.
Auto
Circuit
Pulse
Shaper
Unblank
Ampl.
Sweep
Gating
Multiv.
Saw
Gene
GAIN
R3
EXT. TRIGG
OF X-INPUT
BU2
Ampl.
Line
freq.
Hol
Cir
POWER ON
SK6
Line
Transf.
+
Rect.
Stabiliser
Converter
Supply
voltages
EXT. DC Supp.
BU 5

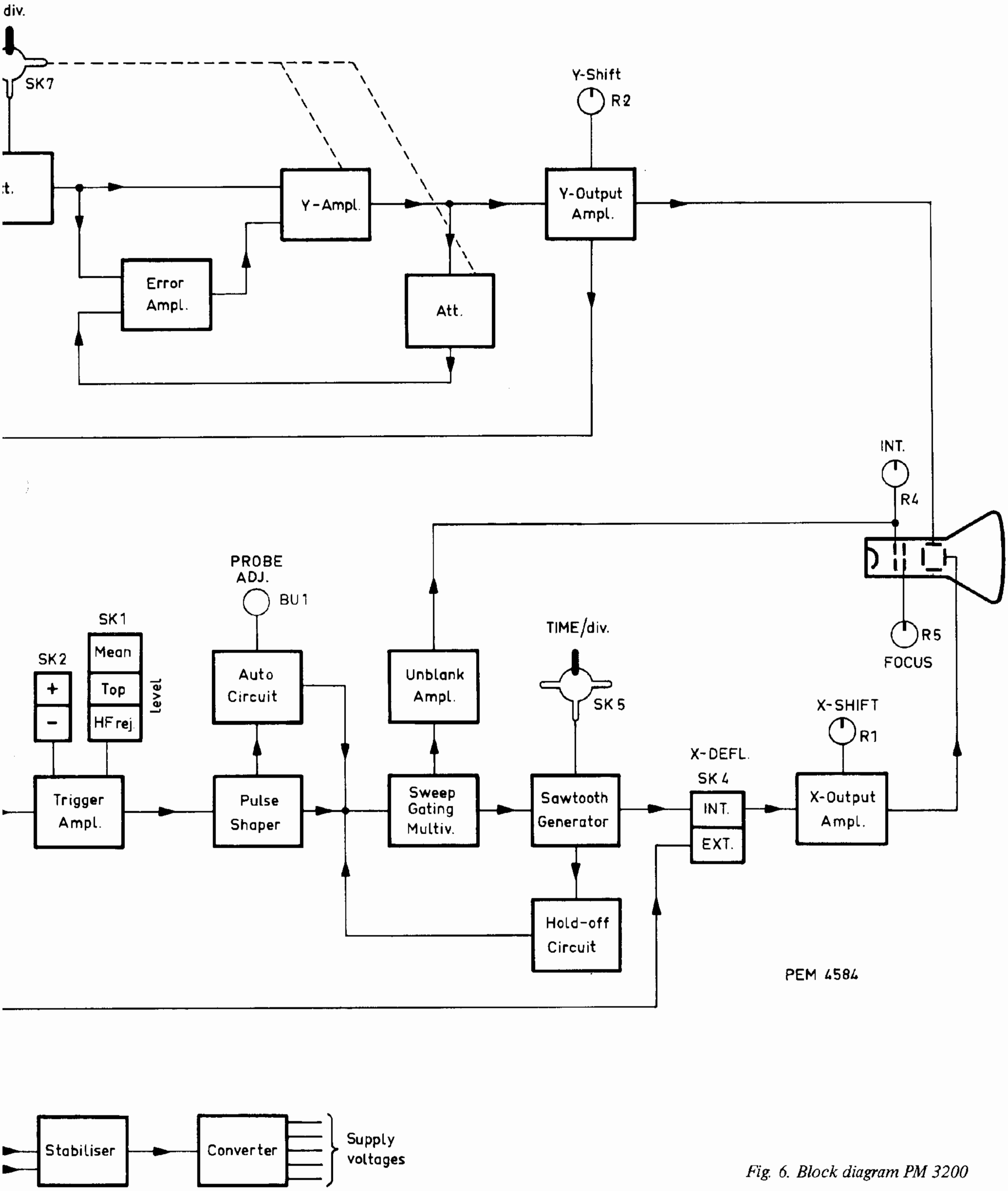


Fig. 6. Block diagram PM 3200

4. Drift compensation

The Y-amplifier described above receives the input signal in the series feed-back stage via TS231 (input I), and the drift compensation voltage via TS229 (input II).
All drift voltages are related to input I; it is assumed that they originate from a voltage source Ud (see Fig. 7).

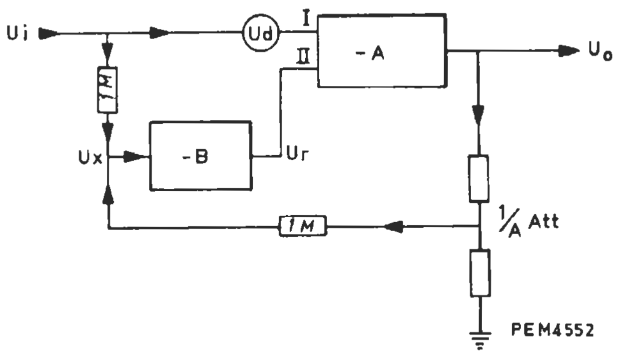


Fig. 7. Block diagram drift compensation circuit

Assume that the Y-amplifier has a gain of −A times and that the drift compensation amplifier has a gain of −B times. The output voltage Uo is then devided by A. In the circuit diagram this 1/A voltage divider consists of R84-R92 with switchable resistors R91, R41, R42, R43.
The output signal from the 1/A voltage divider and the input signal Ui are applied to an adder circuit formed by two 1-MΩ resistors.
Input voltage Ux of the drift compensation amplifier then becomes $Ux = \frac{1}{2}(Ui + Uo/A)$. After this voltage has been amplified, control voltage Ur is obtained: $Ur = \frac{1}{2}B(Ui + Uo/A)$. The difference between input I and input II is amplified −A times, so that $Uo = -A(Ui + Ud) - Ur$. From this it follows that

$$Uo = -A\left(Ui + \frac{Ud}{1 + \frac{1}{2}B}\right)$$

The effect of Ud, the drift voltage, is thus reduced by approx. ½B. In this instrument B is approx. 50x so that the drift voltage is reduced approx. 25 times.
By means of R77 the d.c. balance is adjusted ; R81 serves for adjusting the gate current compensation.

5. Output amplifier

The signal is now applied to the base of TS41 which forms part of the push-pull output amplifier. By varying the series feedback with R113 the overall gain can be adjusted. The frequency dependent element R110-C62 corrects the gain factor at high frequencies. The Y-shift voltage, derived from potentiometer R2, is applied to TS38.
The last stage consists of two "single-ended push-pull" sections, viz. TS34, 36, 37, 39 and TS42, 43, 44, 46 with shunt feed-back via R103, R108 and R122, R123 respectively.
Via voltage divider R128 and R129 and emitter follower TS47 a signal is taken off for internal triggering of the time base generator.

C. X-DEFLECTION

1. Introduction

X-deflection is effected, dependent on the position of SK4 "X-DEFL.", by a signal applied via input socket BU2 and a preamplifier, or by a sawtooth voltage generated in the instrument.
In the latter case the sawtooth generator may be triggered by a signal which is derived from the Y-signal ("INT"), an external signal applied via BU2 ("EXT") or the mains voltage ("MAINS"), dependent on the position of selector switch SK3.
The position of SK2 determines whether triggering takes place on a positive or negative going signal ("+" or "−").
A level circuit permits of triggering on a level which corresponds to the mean value ("MEAN") or the peak value ("TOP") of the trigger signal or e.g. on the envelope of an LF modulated HF signal ("HF reject"). Selection is effected with switch SK1.
The trigger signal controls a bistable multivibrator, the pulse shaper, which supplies a signal with constant rise time and amplitude to the sweep-gating multivibrator. The sweep-gating multivibrator also receives signals from the automatic circuit and the hold-off circuit. If the sum of these signals is sufficiently negative, the sweep-gating multivibrator will be set, thus permitting the sawtooth generator to effect one cycle. The output voltage of the sawtooth generator increases linearly in time, and its speed is determined by the position of SK5 ("Time/div").
At a certain value of the output voltage the sweep-gating multivibrator is reset so that this voltage is restored to its quiescent level. During the time required for this, the sweep-gating multivibrator is blocked in its quiescent position by the hold-off circuit. After this period the multivibrator is set again by the next trigger pulse so that the sawtooth generator can again effect one cycle. **The circuit is now triggered.** However, if no more trigger pulses arrive within approx. 0.5 sec., the automatic circuit becomes operative. This circuit changes the input level of the multivibrator so that the latter changes over to the set condition. This results in a sawtooth cycle at the end of which the multivibrator is reset, etc. This process is repeated as long as the automatic circuit maintains the above-mentioned level. **The circuit is then free-running.**
During the presence of the trigger pulses a squarewave voltage is present in part of the automatic circuit, which is also used as a signal source for adjusting the measuring probe. Triggering should then be effected via the external trigger input (EXT) or with the mains frequency (MAINS). The CRT should only be unblanked during the forward scan of the sawtooth.
This process can be controlled direct from the sweep-gating multivibrator; the control voltage is applied to the Wehnelt-cylinder of the CRT via the unblanking amplifier.

2. Sawtooth generator

A linearly increasing voltage is obtained, amongst others, by charging a capacitor via a constant current source: in this instrument the capacitor is represented by one of the capacitors C229, C231, C232, C234, C235 and/or C236 which can be switched over with SK5 (TIME/div) and the constant current source is TS218. The rate of the voltage increase, which also determines the sweep time, is inversely proportional to the capacitance of the selected capacitor and directly proportional to the current through TS218. This current is determined by the voltage on the base of TS218, the value of which can be adjusted by means of preset potentiometers (settings given in squares in the table below). Moreover, the current is determined by the value of the emitter resistors of TS218, viz. R274...R283 which are also switched over with switch SK5 (TIME/div). The time base speed thus selected can be read in the table given below.

(Capacitors C236/C237 are continually switched in).

Resistors / *Capacitors*	*C229*	*C231*	*C232*	*C234//C235*	
(R280 + R282)	0.5 s/div	5 ms/div			
(R280 + R282)//(R283 + R274)	0.2 s/div	2 ms/div			
(R280 + R282)//(R283 + R276)	0.1 s/div	1 ms/div			
(R280 + R282)//(R283 + R277)	50 ms/div	0.5 ms/div R266	50 μs/div	5 μs/div	0.5 μs/div
(R280 + R282)//(R283 + R278)	20 ms/div	0.2 ms/div	20 μs/div	2 μs/div	0.2 μs/div C237
(R280 + R282)//(R283 + R279)	10 ms/div R271				
(R280 + R282)//(R283 + R281)		0.1 ms/div	10 μs/div	1 μs/div	
(R280 + R282)//R283					0.1 μs/div

After reaching a certain voltage the capacitors are discharged by transistor TS213 which is driven into conduction by the sweep-gating multivibrator TS211, TS212.
The sawtooth starts when the sweep-gating multivibrator is in a position in which TS211 is cut off and TS212 is turned on (TS213 is now off).
In the following this position will be indicated with position "1".
The other position in which TS211 is on, TS212 is off and TS213 is on will be called position "0".
The sawtooth voltage is taken off by a cascade circuit consisting of emitter followers TS219 and TS221. This voltage is applied both to the hold-off circuit and to the X amplifier, via R294, R296.
The sweep-gating multivibrator, whose input level can be adjusted with R295, may be controlled by:

a. trigger pulses derived from pulse shaper TS206, TS207 via differentiating circuit C221, R249, GR206.
b. hold-off signals.
c. a d.c. level derived from the automatic circuit.

A hold-off signal will set the sweep-gating multivibrator to position "0".
After this signal, position "0" is maintained until the next trigger pulse arrives, unless the automatic signal is present; in that case position "1" is assumed immediately after the hold-off signal.

3. Hold-off circuit

Due to the effect of diode GR208, the charge of capacitor C239 (and if applicable, shunt capacitor C228 or C232 or C233, C234, C235) cannot follow the decay of the sawtooth voltage.
The capacitor voltage will then decrease with an RC time which is sufficiently great to allow the sawtooth voltage to reach its zero level and to ensure the decay of switching phenomena.

Note: If no use is made of the sawtooth generator, viz. with X-deflection switch SK4 in position 2 ("EXT"), a positive voltage is applied via R293 so that position "0" is retained.

4. Automatic circuit

Transistors TS214 and TS216 form a monostable multivibrator which responds to the negative-going edges of the collector signal of TS206 which have been differentiated by C222 and R261. Thus, a squarewave voltage is obtained which is rectified by emitter follower TS217 and capacitor C226.
The output voltage is applied to the sweep-gating multivibrator via R257.
If there are no trigger pulses, the voltage across the capacitor will decrease so that the sawtooth generator starts to free-run after approx. 0.5 sec. This is also the case if the interval between the trigger pulses is more than approx. 0.5 sec.
Part of the collector voltage of TS214 is available at BU1 for adjusting the measuring probe.

5. Trigger amplifier and pulse shaper

The sweep-gating multivibrator and the automatic circuit are controlled via a differentiating circuit by a Schmitt trigger TS206, TS207, operating as a pulse shaper. Fig. 8 shows how the Schmitt trigger changes over when an input signal is applied. (Trigger slope – SK2 in position "–").
From this figure it appears that the input signal should exceed both limits of the hysteresis gap to obtain triggering.

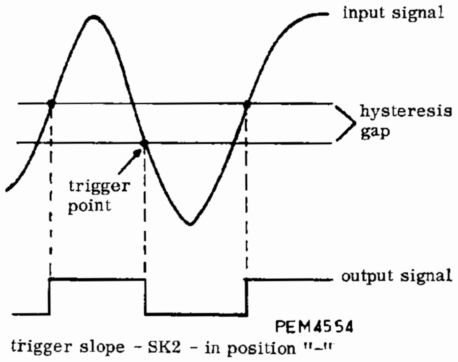


Fig. 8. Working of pulse shaper in the case of triggering (average value)

The relation between the signal level and the location of the hysteresis gap depends on the position of SK1:

a. "MEAN" In this position the average level of the a.c. component of the signal is situated near the hysteresis gap. Triggering then takes place near the zero passages of this signal if the peak-to-peak value of the signal is sufficiently large with respect to the hysteresis gap. In this position of SK1 TS203 and TS204 operate as emitter followers.

b. "TOP" In this position d.c. restorage of the applied a.c. coupled signal takes place, so that triggering is effected as shown in Fig. 9; on the left for negative-going signals, on the right for positive-going signals (trigger slope negative).

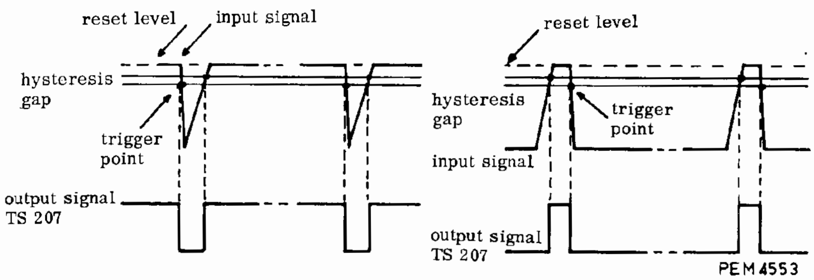


Fig. 9. Working of pulse shaper in the case of triggering (peak value)

If the signal applied is sufficiently large with respect to the hysteresis gap, triggering will take place near the peaks (positive or negative) of the trigger signal in this position of SK1. D.C. restorage is achieved by means of C208 and TS204, which now functions as a diode.

c. **"H.F. reject"** In this position the trigger signal is detected via a detector circuit consisting of diode GR200, capacitor C207 and resistor R216, before it is applied to the pulse shaper via emitter followers TS203 and TS204. In this way the carrier wave of an amplitude modulated signal can be suppressed. The detection time constant has been adapted so, that the oscilloscope can be used for adjusting the PAL delay line of a colour T.V. receiver operating in accordance with the PAL system.
One of the three trigger signals present on points 3, 4 and 5 of SK3 (INT., EXT., MAINS) which are derived from the Y-amplifier, from the external triggering amplifier and from the mains, is passed onto the base of transistor TS202.
This transistor has the same emitter and collector resistance so that the signal at the collector has the same amplitude but is in phase-opposition with respect to the signal at the emitter.
Zener diode GR202 restores the d.c. level of the collector signal to that of the emitter signal. One of these signals is selected with SK2 ("+" or " ").

6. Amplifier for external triggering or X-input

A signal on BU2 for triggering or horizontal deflection, is applied to emitter follower TS201 via a continuous attenuator R3. In order to reduce the effect of parasitic capacitances in the continuous attenuator the potentiometer casing is connected to the output of the emitter follower via C203.

7. X-final amplifier

The signal reaches the base of TS222 of the balance final amplifier via R296. The entire amplification can be adjusted by varying the series feedback with potentiometer R307. The frequency dependent element i.e. C241 corrects the amplification factor at high frequencies. The X-shift voltage coming from potentiometer R1 is supplied to the base of TS226.
The last stage consists of two "single-ended push-pull" sections, namely TS223, TS224 and TS227, TS228 with shunt feedback via R298 and R313 respectively.

D. CATHODE-RAY TUBE

1. CRT circuit

Potentiometers R4 and R5 function as brightness and focusing controls respectively. R332 serves for adjusting the level of max. brightness; R329 serves for adjusting to minimum astigmatism.

2. Unblanking circuit

During the forward scan of the time base the Wehnelt cylinder should receive a positive voltage pulse. This pulse is derived from the sweep-gating multivibrator and amplified by a single-ended push-pull amplifier consisting of transistors TS208 and TS209. The signal reaches the Wehnelt cylinder via C215 after which d.c. restorage takes place in conjunction with R334 and GR336.

VII. Gaining access to the parts

CAUTION

Very high voltages are generated in the instrument, so that when effecting work to the inside of the instrument great care must be taken.

A. REMOVING COVER AND CARRYING HANDLE

- Remove the 4 screws with which the cover has been fixed
- The cover can then be slid off the frame
- The handle is secured to the cover with 2 screws
- Remove the nuts from the screws and take off the handle.

B. REMOVING THE KNOBS

- The 2 switch knobs are clamped onto the spindle. Remove the caps and loosen the nut one turn. The knob can now be pulled off the spindle.
- The other knobs are secured on the spindles by means of a clamping spring (pastic). They can be simply pulled off the spindles.

C. REMOVING THE BEZEL AND THE GRATICULE

- The bezel can be removed by slightly compressing the long sides. The contrast-enhancing filter is fitted to the short sides of the bezel by means of two tags.
- The graticule is fitted loose in the recesses of the front plate.

D. REMOVING THE SUPPLY UNIT (unit 5)

- Remove the CRT according to chapter XI point A.
- Remove the 6 fixing screws and unsolder the relevant wires.
- Pull the knobs of the spindles and loosen the cable clamp; the unit can now be slid out of the instrument together with the tube socket.

E. REMOVING THE AMPLIFIER/TIME BASE UNIT (Unit 4)

- Unplug the wires which lead through the partition.
- Unplug the wires at the input sockets and the "PROBE ADJ" socket.
- Remove the 7 fixing screws.
- Remove the 2 switch knobs and the 2 control knobs.
- Slide the unit backwards and tilt it out of the instrument.

F. REPLACING THE SAFETY FUSE

- Remove the cover (see A) and the plastic case at the rear (2 screws).
- Remove the mains transformer as follows:
  a. Remove the clamping plate directly visible in front of the transformer (2 screws)
  b. Loosen the rear clamping plate enough to remove the transformer (2 screws)
- Replace the safety fuse at the bottom of the mains transformer.

VIII. Adjusting elements and their functions

The correct adjusting sequence and adjusting procedure are given in chapter X.

Adjustment	*Adjusting element*	*Fig.*	*Auxiliary instrument*	*PHILIPS type*	*Chapter X section*
Y-amplifier					
minimum gain	R68	20	Squarewave generator	PM 5711	D4
maximum gain	R63	20			D4
gain calibration	R113	20			D5
d.c. balance	R77	20			D1
gate current compensation	R81	20			D2
square-wave response of attenuators	C27	25	Squarewave generator	PM 5711	D7
	C32	25			
	C37	25			
input capacitance attenuators	C29	25			
	C34	25			
	C39	25			
bandwidth	C62	27	Sinewave generator	PM 5321	D8
X-amplifier and timebase generator					
trace length	R307	20			E1
trigger sensitivity	R220	27	Sinewave generator	PM 5160	E3
trigger stability	R295	20	Sinewave generator	PM 5321	E4
time coefficients	C237	20	Time marking generator		E6
	R266	20			E6
	R271	20			E6
Power supply					
output voltage	R414	21	d.c. voltmeter	PM 2401	B1
CRT					
intensity	R332	21			C
astigmatism	R329	21			C

IX. Brief checking procedure

The checks should be carried out at nominal mains voltage.
1 div. = 7 ½ mm.
Starting positions of the controls:
– Toggle switches to upper position
– Shift controls in centre position
– Focus and intens. controls adjusted for well-defined display
Unless otherwise stated the controls always occupy the same position as in the previous check.

Y-AMPLIFIER

O-AC-DC to 0.
Y-AMPL to 50 mV/div. Centre time-base line with Y-POSITION. Allow a warming-up of 1 hour.
Y-AMPL to 2 mV/div. The time-base line should remain on the same place within 1 div.
Correction possible with R77.
O-AC-DC to DC.
Time-base line should not shift more than 0.5 div.
Correction possible with R81.

position Y-AMPL.	50 mV/div.	2 mV/div.
Y-input signal: square wave	100 Hz, $t_r \approx$ 100 ns 300 mV_{p-p} ±½ %	100 Hz, $t_r \approx$ 100 ns 12 mV_{p-p} ±½ %
Check droop	max. 2 % (corr. with R68)	max. 2 % (corr. with R63)
Check trace height	6 div. ±2 % (corr. with R113)	6 div. ±5 %

Check all the other attenuator positions: accuracy ±5 %, overshoot 2 %.
Input signal: square wave, 2 kHz, $t_r >$ 10 ns.

position Y-AMPL.	50 mV/div.	2 mV/div.
Input signal: sine wave	10 MHz 300 mV_{p-p} ±½ %	10 MHz 12 mV_{p-p} ±½ %
Check trace height, at least	4.2 div.	4.2 div.

TRIGGERING

Y-input signal: sine wave, 2 kHz for trace height of 1 div. resp. sine wave 10 MHz for trace height of 2 div.
Check that the trace is triggered.

X-AMPLIFIER

O-AC-DC to O. potentiometer X-INPUT clockwise. X-DEFL to EXT.
X-input signal: square wave 2 V_{p-p}, 2 kHz, $t_r \approx$ 100 ns.
Check that the deflection amounts to 7 to 10 div. and can be decreased to 0 by potentiometer X-INPUT;

TIME-BASE GENERATOR

O- AC-DC to AC. LEVEL to TOP. +/− to +.
INT-EXT-MAINS to INT. TIME/div. to 0.5 msec/div.
Y-input signal: time markers with a repetition rate of 0.5 ms.
Check that time markers 2...9 occupy a total width of 7 div. ± 5 %.
Check the other TIME/div. settings.
Tolerance ±5 % in all positions except 0.5-0.2-0.1 sec/div. and 0.5-0.2-0.1 μsec/div.
Here the tolerance is ±7 %.
After this, carry out a quick functional check of all controls that are not checked yet.
INT-EXT-MAINS to position MAINS;
Check the presence of a square wave on socket PROBE ADJ.

X. Checking and adjusting

A. GENERAL

The adjusting elements, their functions and location are given in chapter V and VIII. Tolerances given in this chapter apply to a completely re-adjusted instrument. Therefore they may differ from those specified in chapter II.

B. POWER SUPPLY

1. Control circuit

- Connect a voltmeter between earth and point "A" of Unit 5 (Fig. 27) and adjust the voltage to +12,6 V (±0.1 V) by means of potentiometer R414.
- Check the other supply voltages:

Point	*Voltage*
"B"	– 12.8
"C"	+ 90
"D"	+210

Check the proper working of the control circuit by varying the mains voltage. A variation of 10 % should have no effect on the output voltage.

2. Hum and ripple

Check the supply voltages for hum and ripple. The overall peak to peak value should be smaller than 20 mV.

C. PRELIMINARY ADJUSTMENT FOR DISPLAYING A TIME BASE LINE

Set all toggle switches to the upper position, the shift potentiometers to the mid position, turn the intensity control clockwise and set "V/div" to 50 mV/div.

- Turn R295 until a time base line appears.
- Apply a sinewave voltage (approx. 1 kHz) with a trace height of 6 divisions.
- Set R4 to max. intensity and adjust R332 so that the trace is just "blown up".
- Adjust to normal intensity with R4.
- Adjust for min. astigmatism with R329 (readjusting R5 "FOCUS").

D. Y-AMPLIFIER

1. DC balance

- Allow the instrument to warm up for approx. ½ hour (cabinet not removed).
- Set SK7 to position "50 mV/div" and SK8 to position "0".
- Centre the time base line with R2.
- Set SK7 to position "2 mV/div" and (after removing the cabinet) centre the time base line again with R77.

2. GATE current compensation

- Set SK8 to position "DC"; the time base line should not be shifted when switching from "0" to "DC" or vice versa.
- Adjust R81 so that the trace is not shifted any longer.
- Repeat 1) and 2) until an optimum setting is obtained.

3. Checking for hum, noise and microphony

- Set SK7 to position "2 mV/div" and SK8 to position "0".
- The height of the trace arising due to hum and noise should not exceed 0.2 div.
- When changing over SK5 "TIME/div" the pulses arising due to microphony should not have a trace height exceeding 2 divisions.

4. Gain (intermediate stage)

- Set SK3 to position "INT".
  SK4 to position "INT".
  SK5 to position "5 ms/div"
  SK7 to position "50 mV/div"
  SK8 to position "DC".
- Apply a squarewave voltage of 300 mV_{p-p} at 100 Hz.
- Adjust for proper squarewave response with R68
- Set SK7 to position "2 mV/div".
- Reduce the squarewave voltage to 12 mV_{p-p} at 100 Hz.
- Adjust for proper squarewave response with R63.
- Repeat both adjustments until simultaneously a proper squarewave response is obtained.

5. Calibration

- Set the switches as indicated under D4 but SK5 in position "0.2 ms/div".
- Apply a squarewave voltage of 300 mV_{p-p} (±1 %), 2 kHz.
- Accurately adjust R113 to a trace height of 6 divisions.

6. Input RC element

- For adjusting the input capacitance a standard RC element is required consisting of a fixed 1 MΩ (1/8 W, 1 %) resistor shunted by a variable capacitance e.g. a 3-60 pF trimmer.
  This element is adjusted as follows:
- Set the switches as indicated under D4, however, SK5 in position "0.2 ms/div".
- Apply a squarewave voltage of 600 mV_{p-p}, 2 kHz via the input RC element and adjust the trimmer for proper squarewave response.

7. Squarewave response and input capacitance

- Set SK7 to position "0.2 V/div".
- Apply a squarewave voltage of 1.2 V_{p-p} (±1 %), 2 kHz.
- Adjust C37 for proper squarewave response and check the Y-deflection over 6 divisions.
- Connect the adjusted input RC standard element, set SK7 to "0.1 V/div" and adjust for proper squarewave response with C39.
- Remove the input RC standard element.
- Set SK7 to position "2 V/div".
- Apply a squarewave voltage of 12 V_{p-p} (±1 %) 2 kHz.
- Adjust for proper squarewave response with C32 and check the Y deflection.
- Adjust for proper squarewave response with connected input RC standard element and SK7 at "1 V/div" by means of C34.
- Similarily adjust C27 and C29 with SK7 in position "20 V/div" and "10 V/div" respectively.

8. Bandwidth

– Set SK1 to position "MEAN".
SK2 to position "+".
SK3 to position "INT".
SK4 to position "INT".
SK5 to position "1 μs/div".
SK7 to position "2 mV/div".
SK8 to position "DC".
– Apply a sinewave signal of 12 mV_{p-p}, 10 MHz.
– The trace height should not be less than 4.2 div.
– If necessary increase C62 (e.g. after replacing the CRT or transistors of the Y-output amplifier).
– Check the overshoot with a squarewave voltage of 12 mV_{p-p}, 1 MHz, rise time $\leqslant$ 10 ns.

9. Shift control range

– Set SK7 to position "50 mV/div" and apply a sinewave voltage of 1.2 V_{p-p}, 1 MHz.
– It should be possible to display the peaks of the signals undistored within the measuring grid by means of R2.

E. X-AMPLIFIER AND TIME BASE

1. Trace width

– Set all toggle switches to the upper position.
– Set SK5 to position "10 μs/div" and SK8 to position "0".
– Adjust the trace length to 10.5 div with R307.

2. Trigger sensitivity

– Apply a sinewave voltage (1 kHz) to the Y amplifier.
– Set all toggle switches to the upper position.
– At a trace height of 0.9 div. it should still be possible to obtain a triggered trace; if necessary, adapt with R220 (over switch SK1).

3. Stability

– Apply a sinewave voltage of 10 MHz, trace height 2 divisions, SK5 in position 0.1 μs/div.
– Adjust R295 until a triggered picture is obtained.
– Check the correct adjustment by setting SK8 in position "0"; after approx. 0.5 sec. the time base should start to free-run.

4. Triggering with mains frequency + PROBE ADJ. signal

– Set all toggle switches to the upper position.
– Apply a signal of mains frequency to the Y-amplifier. The signal should have such an amplitude that a non-triggered trace is obtained.
– Set SK3 to position MAINS.
– Check whether a triggered trace is obtained.
– Check that a squarewave voltage is available on BU1 with an amplitude of approx. 0.25 V_{p-p}, superimposed on + 1 V d.c.

5. Sweep time

– Apply a time marking signal with a repetition time of 0.5 ms; Trace height max. 3 divisions.
– Set SK5 to position "0.5 ms/div".
– Check the triggering with SK1 in position "TOP" (SK2 in position "+" for positive going signals, and in "–" for negative going signals).
– With R266 adjust the sweep time so that the 2nd...9th pulse accurately coincide with the measuring grid.
– Check the sweep time in positions "5 ms/div...1 μs/div".
– After this, adjust the sweep time 0.1 μs/div, 0.2 μs/div and 0.5 μs/div with C237.

- Set SK5 to position 10 ms/div and apply time markers with a repetition time of 10 ms.
- Adjust R271 so that the 2nd...9th pulse accurately coincide with the measuring grid.
- Check the sweep times at the other positions of SK5.

F. EXTERNAL TRIGGERING

- Set SK1 to position "MEAN".
  SK2 to position "+".
  SK3 to position "EXT".
  SK4 to position "INT".
- Apply a sinewave voltage of 1 kHz to the Y-input.
- Apply a sinewave of the same frequency to BU2; the signals should have an amplitude of 1 V_{p-p}.
  Turn R3 clockwise.
- Check whether a triggered trace is obtained.
- Check this at the same setting and at a frequency of 10 MHz and an amplitude of 2 V_{p-p}.

G. X-DEFLECTION

- Set SK4 in position "EXT".
- Apply a squarewave voltage of 3 V_{p-p} 2 kHz to BU2.
- The trace width should be more than 10 div with R3 fully clockwise.

XI. Replacing parts

During the replacement of parts, the instrument should be switched off.

A. REPLACING THE CRT

Remove the cover.
Remove clamping screw "A" (Fig. 21) and screw "B".
Remove the bezel and the graticule.
Slide the CRT slightly backwards and detach the tube socket. The CRT can now be removed from the mu-metal screen.

B. REPLACING THE SWITCH TURRET OF THE TIME BASE (Unit 2) AND THE ATTENUATOR (Unit 3)

Detach the stop springs.
- Mark the position of the switch knob with respect to the switch turret.
- Loosen the Allen bolt with a 1/16" Allen key.

Remove the spindle and lift the switch turret from the printed circuit board.
When fitting a new switch turret the contact pressure of the switch springs should be 20 to 60 g.
The contact tracks should be lightly lubricated with Synthesin M (Kluber).

C. REPLACING THE SLIDE SWITCHES

Remove Unit 4 in accordance with Chapter VII point E.
Remove the U-shaped coupling springs and remove the coupling rods.
- The toggle lever can now be removed by pressing together the metal casing and sliding it out of the front plate.
- The slide switch can be removed after unsoldering (suction soldering iron) the contacts at the wiring side of the printed circuit board.
- After refitting, the toggle levers should be placed in the upper position (extreme right) so that the cursor of the switch protrudes as far as possible into the switch casing.

Place the coupling spring in its original position and slide the cursor slightly outwards so that the metal band around the cursor completely protrudes from the housing (also see the mark on the narrow side of the cursor).

D. REPLACING THE TRANSISTORS OF THE VOLTAGE CONVERTER

- Remove the bottom plate (7 screws).
- The 2 transistors can now be unsoldered and pulled out with their heat sinks.

E. REPLACING TRANSISTORS TS32' AND TS32"

In case of interference in the drift-compensating amplifier (measure at high impedance), it can be necessary to replace the transistors TS32' and TS32". If combination 2x BC109C (5322 130 40662) is not available, it can be replaced by a double transistor BCY87.
The connection must be effected as shown in figure 10.

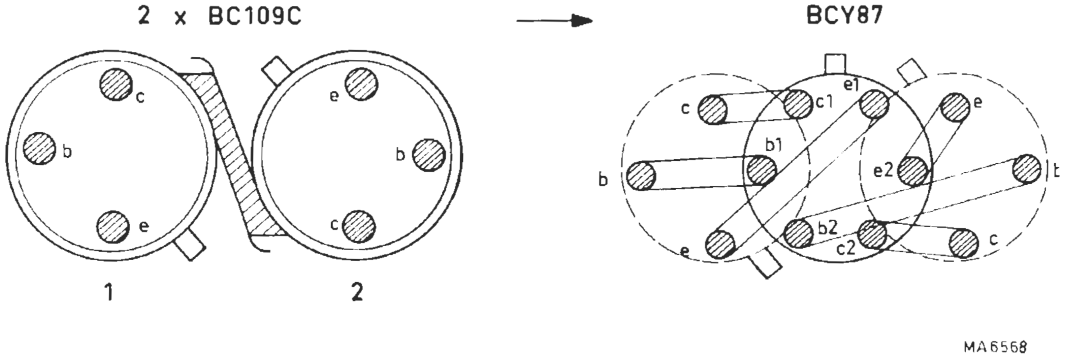


Fig. 10. Lay-out of transistor mounting BC109C and BCY87

XII. Fault finding

A. VOLTAGES AND VOLTAGE WAVEFORMS

The voltages and voltage waveforms indicated in the circuit diagram and the wiring diagrams have been measured under the following conditions:

- a squarewave signal (½ T) of 1 kHz, 250 $mV_{p\text{-}p}$ applied to BU4
- switch SK5 in position "5 ms/div"
- switch SK7 in position "50 mV/div"
- all toggle switches in the upper position.

The direct voltages have been measured with a PHILIPS d.c. voltmeter PM 2401. These values may slightly differ per instrument and should therefore be considered as target values.

B. NOTES

1. Various sub-circuits can be simply disconnected, as in the printed circuits interruptions have been made which are interconnected with soldering tin. In the circuit diagram these interruptions are indicated by means of encircled capacitor symbols.
2. For carrying out measurements to the unblanking circuit, capacitor C215 (−1500 V!) should first be discharged by means of a resistor of some tens of kΩ, so that the test pins can be applied in the discharged condition.
3. When the instrument is to be forwarded to a PHILIPS service workshop the following points should be observed:
   - Carefully pack the instrument in the original packing or, if this is no longer available, in a wooden box.
   - Give a complete description of the fault symptom(s).
   - Attach a label to the instrument bearing your name and address.
   - Forward the instrument direct to the PHILIPS address provided by the local organisation.

XIII. Information concerning accessories

A. ADAPTOR PM 9051

This is an adapter to make a BNC socket suitable for the connection of two 4 mm plugs.

Fig. 11. Adapter PM 9051

B. ATTENUATOR PROBE SETS PM 9326 AND PM 9327

These passive probe sets for a.o. the PM 3200 are equal but for the length for the probe cable, which is 1.15 m (3.8 ft) for the PM 9326 and 2 m (6.5 ft) for the PM 9327.

The sets consist of:

1 probe cable	Fig. 12a
1 earthing flex 30 cm (1')	Fig. 12b
1 earthing flex 15 cm (6")	Fig. 12c
1 measuring probe 1:1 (black)	Fig. 12d
1 measuring pin	Fig. 12e
1 measuring hook	Fig. 12f
1 attenuator probe 1:10 (grey)	Fig. 12g
1 measuring clip	Fig. 12h
1 box	Fig. 12i

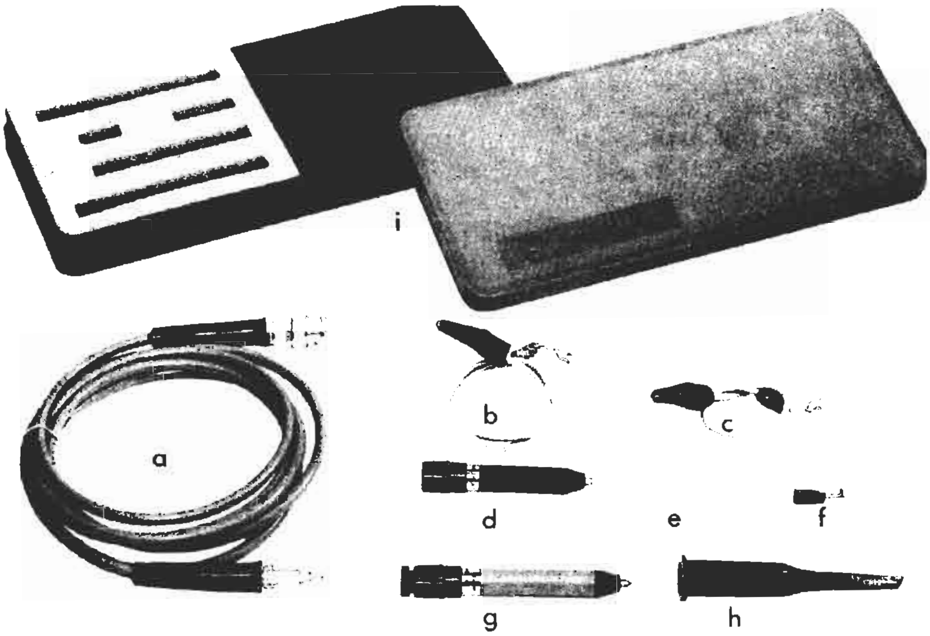


Fig. 12. Probe set

Technical data

Attenuation : 1:10 ±3 %
Input impedance : 10 MΩ//8 pF
Max. permissible : 1,000 V_{p-p} input voltage.

Maximum d.c. component 500 V with the blocking capacitor included into the circuit.

Note: – The adjustment of the 10:1 attenuator probe is described in chapter V, B2.
– The measuring probe and the earthing wire can be simply pulled from the cable.
The measuring clip, 4-mm plug and the measuring hook are screwed onto the measuring probe.

C BATTERY CASE PM 9390; PM 9391

INTRODUCTION

Battery case PM 9391 is designed to make portable oscilloscope PM 3200 independent of the mains voltage.
The PM 9391 contains 20 Ni-Cd accumulator cells, supplying a voltage of 24 Volts.
For replacement purposes an empty battery case is available under type number PM 9390.

1. Technical date PM 9391

Operation time	: 5 ½ hours (continuous operation)
Charging time	: 14 hours
Batteries	: 20 DEAC RS 3,5 types
Dimensions	: 17.5 cm (6.8") x 21 cm (8.3") x 7.3 cm (2.9")
Weight	: 4 ½ kg (10 lbs)

2. Installation (see Fig. 13)

- Remove the plastic case (2 screws "A").
- Remove interconnection plug "B" and insert plug "C" into the socket.
- Secure the battery case with three screws "D".

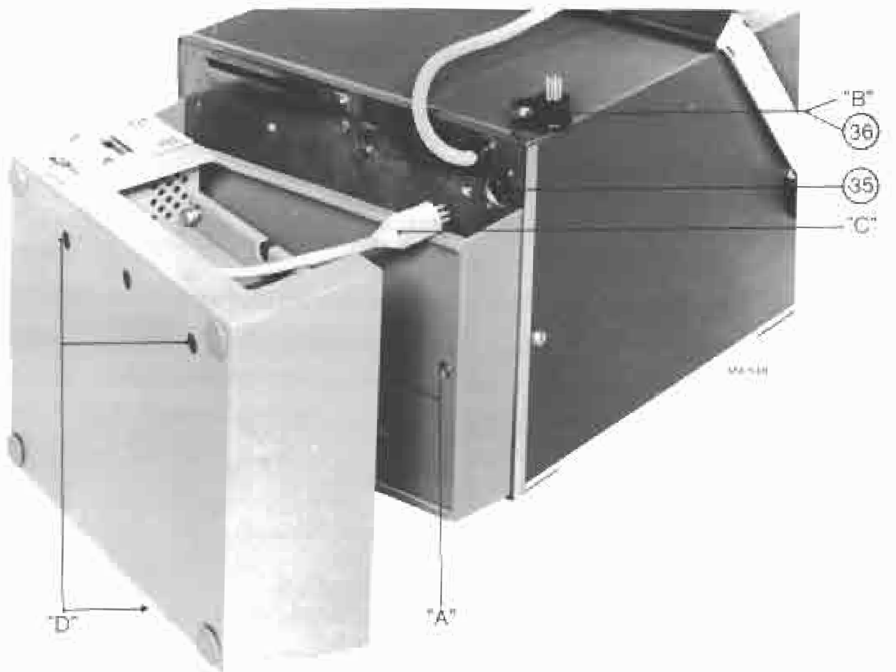


Fig. 13. Installation of battery case + rear view with indication of parts

3. Operation (see Fig. 16)

a. Set switch SK10 to position "OFF".
The battery supply is now switched off.
Mains supply is possible (mains switch in the upper position).
During mains supply the batteries remain charged via the mains rectifier (trickle charging).

b. Set switch SK10 to position "BATT. ON".
The mains supply is now inoperative.
The instrument then operates on the battery supply.
Meter M1 indicates after a few minutes the actual charging condition of the cells:
GREEN – full deflection – the batteries are fully charged.
RED– half deflection – charging is desirable.
BLACK – less than half deflection – charging is necessary.

c. Set switch SK10 to position "CHARGE".
The instrument is out of operation.
The cells are charged by the mains rectifier.
Lamps "LA" should light up, meter M1 is inoperative.
As stabilising circuits have been employed, the charging current is practically constant. Therefore it is possible to temporarily interrupt the charging process. However, it will be noticed that meter M1 will show full-scale deflection immediately after changing over from "CHARGE" to "BATT. ON". Only after a few minutes the meter will indicate the actual charging condition.
When the cells are accidentally overcharged, this will not affect their service life (provided this does not take place regularly).

Note: – When it is expected that the instrument should operate on the mains supply for a prolonged period, it is advisable to fully charge the batteries. This will prolong their service life.
– When the battery case is removed, switch SK10 should be set to position "OFF" to prevent short-circuiting via the plug pins.

4. Circuit description (Fig. 14)

The circuit will be described on the basis of the positions of switch CHARGE-OFF-BATT.ON (SK10).

CHARGE: Two groups of 10 batteries in series, are charged in parallel circuit. The charging current is provided by the mains rectifier of the PM 3200 when its mains switch is closed.
The charging current flows from point 5 of BU7 via current limiting resistor R5 to both groups of batteries and the loop is closed at point 2 of BU7.
R1 and R2 are PTC resistors which, together with LA1 and LA2, keep the charging current practically constant during the charging process. Lamps LA1 and LA2 moreover indicate the charging condition. Diodes GR1 and GR2 serve to protect the batteries from reverse currents and mutual discharge.

OFF: The PM 3200 operates on the mains supply, keeping the batteries trickle charged via R3. The circuit is the same as in the former position with exception of resistor R3 and the connection between points 5 and 6 of BU7 that is effected to supply the PM 3200.
Due to the minute charging current, lamps LA1 and LA2 will not light up.

BATT. ON: In this position the battery pack supplies the PM 3200, independent of the position of the mains switch of the latter.
The 2 groups of batteries are connected in series.
Meter M1 indicates the actual charge condition of the batteries.

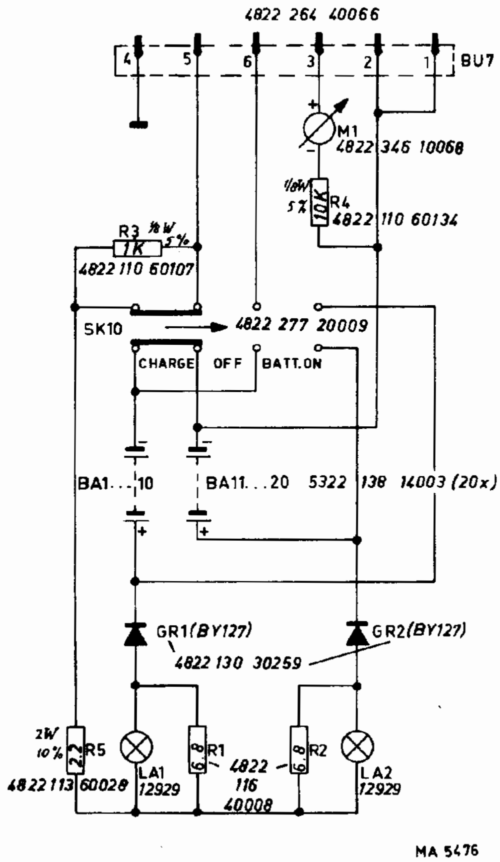


Fig. 14. Circuit diagram of PM 9391 (battery case)

5. Mounting prescription for PM 9390

- Remove the 5 screws S (Fig. 15).
- Remove the lid and the upper rubber mat.
- Fit the 20 batteries in the case in the way shown in Fig. 16.
  (First fit the outer ones and afterwards fill up the room in the centre).
- Interconnect the batteries exactly as indicated in Fig. 16.
  Connecting material as wires and grommets are supplied with the PM 9390.
- Fit the rubber mat over the batteries.
- Replace the lid and secure it with the 5 screws S.

Note: To avoid short circuiting of the batteries during the mounting, leave the rubber cover over the plug of the battery pack.
Only use batteries with a diameter of 33 mm, an overall height of 61 mm and the connecting terminals (soldering tags) at the upper side. The voltage of a fully charged battery should amount to 1.2 volts.

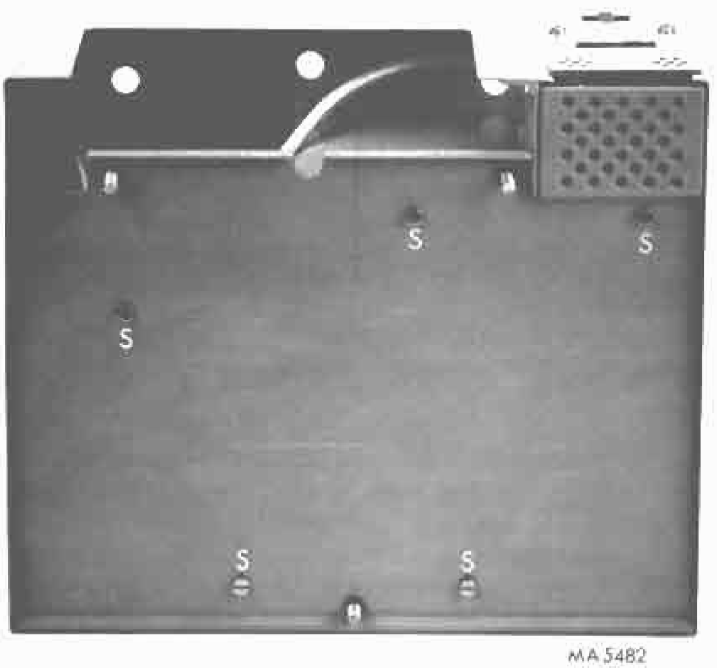


Fig. 15. View of battery case

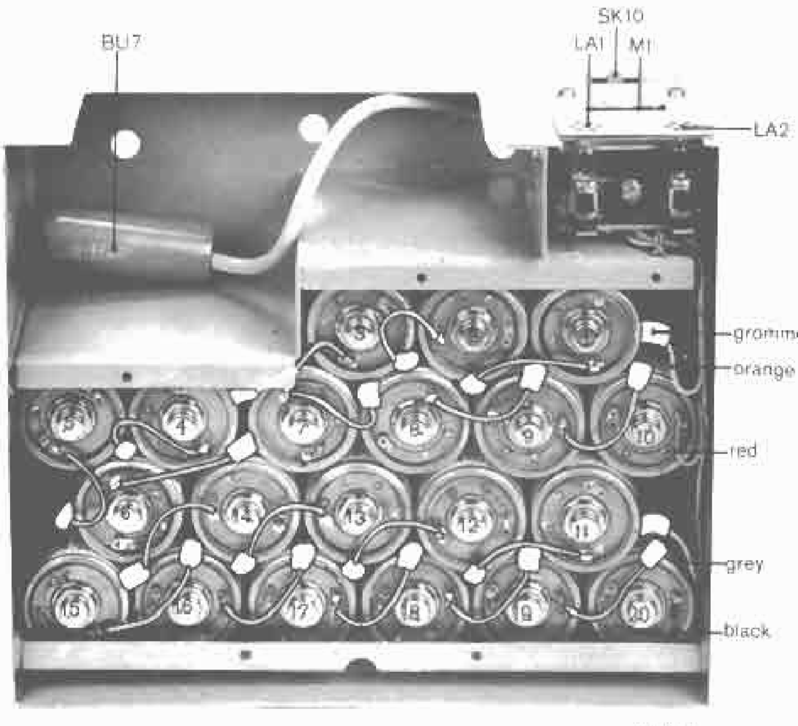


Fig. 16. View of opened battery case

D. ADAPTER PM 9392 FOR EXTERNAL 24 V D.C. SUPPLY

Introduction

This adapter has been designed to facilitate switching over from mains supply to battery supply and vice versa.

Installation

- Remove interconnection plug BU6 (item 36, Fig. 13) and insert plug BU8 of adapter in socket BU5 (item 35, Fig. 13)
- Connect BU9 (−) and BU10 (+) to CORRECT points of external voltage source.

Operation (Fig. 17) and circuit-diagram description (Fig. 18)

a. Switch SK11 in position OFF.
   d.c. voltage supply is switched off. Mains supply is possible (mains switch in position POWER ON). In this position SK11 has the same function as interconnection plug BU6.

b. Switch SK11 in position 24 V
   The mains voltage is out of operation. The instrument works on the external supply source. Diode GR1 acts as protection for oscilloscope if supply is not connected with correct polarity.

External voltage source

This voltage must be 22 to 30 V and be able to supply a current of approx. 0.5 A.

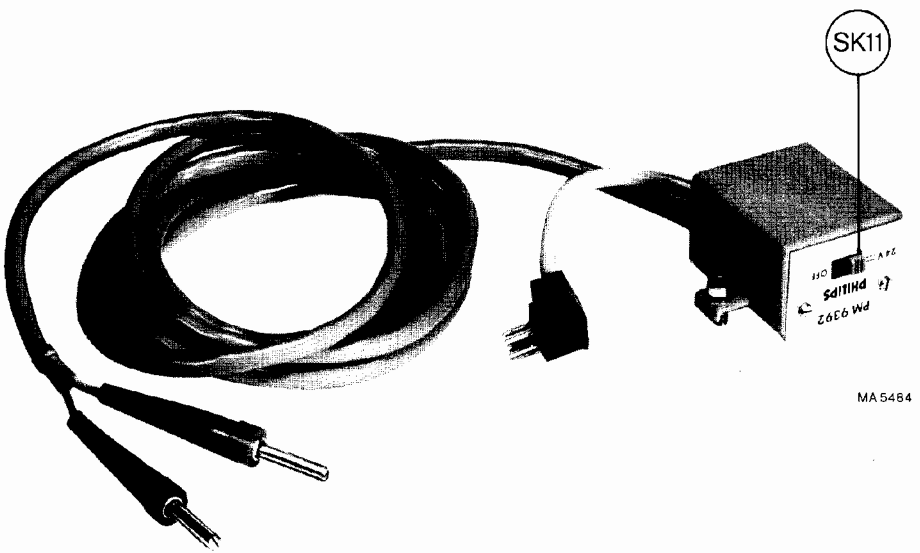


Fig. 17. View of adapter PM 9392

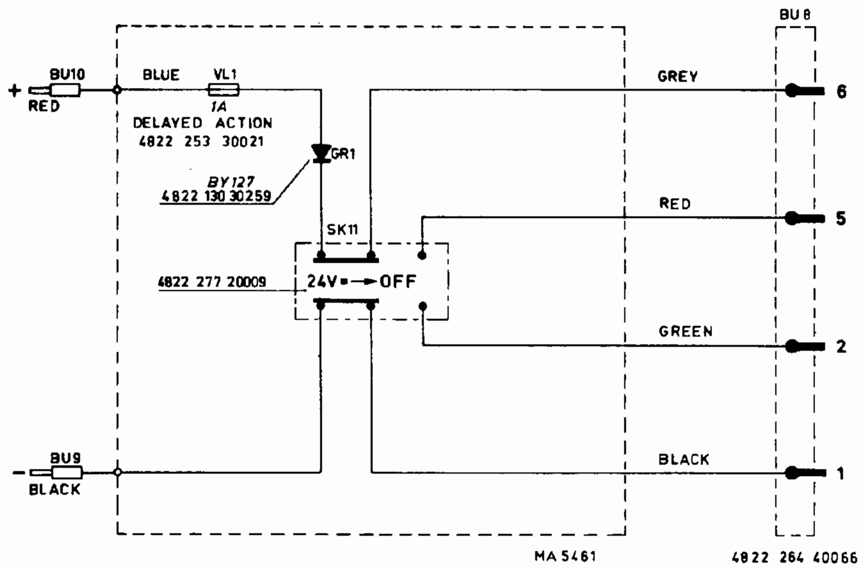


Fig. 18. Circuit diagram of adapter PM 9392

E. CARRYING CASE PM 9393

This is a artificial-leather carrying case large enough for a PM 3200 with battery case and accessories, such as probe set and measuring cables.
The case is so constructed that the PM 3200 can be used with mains supply, battery supply or an external voltage supply without removing it from the case.

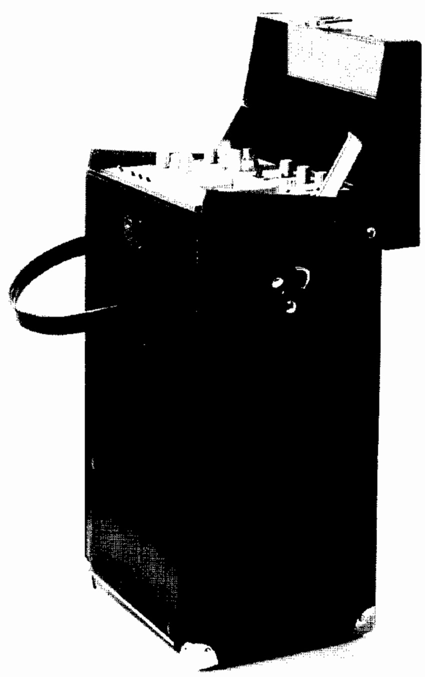


Fig. 19. Carrying case PM 9393

XIV. List of parts

A. MECHANICAL

Item	*Fig.*	*Qty*	*Ordering number*	*Description*
1	22	1	5322 455 80052	Text plate
2	21	4	5322 262 40201	Foot
3	21	1	5322 462 70553	Mains cord container
4	22	1	5322 450 10028	Graticule
5	22	1	5322 480 30072	Contrast plate (grey)
6	22	1	5322 459 40199	Window
7	22	1	5322 268 10031	AMP contact pin (BU1)
8	22	1	5322 492 60799	Spring for BU1
9	22	1	5322 267 10004	Connector BNC (BU2)
10	22	1	5322 535 20023	Earthing terminal (BU3)
11	22	1	5322 506 40016	Nut for BU3
12	20	1	5322 267 10004	Connector BNC (BU4)
13	22	1	5322 277 10226	Mains switch (SK6)
14	21	1	5322 277 20014	Mains selector switch (SK9)
15	21	1	5322 321 10073	Mains flex
16	22	2	5322 413 40112	Knob 23 ∅ (SK5, SK7)
17	22	2	5322 413 70037	Cover (SK5, SK7)
18	22	2	5322 413 30346	Knob 14 ∅ (R1...R5)
19	22	5	5322 413 70038	Cover (R...R5)
20	22	5	5322 411 50169	Knob for SK1-2-3-4-8
21	20	1	5322 277 30408	Slide switch (SK1)
22	20	1	5322 277 30409	Slide switch (SK2)
23	20	2	5322 277 30411	Slide switch (SK3, SK8)
24	20	1	5322 277 30412	Slide switch (SK4)
25	20	1	5322 105 30046	Switch (time base: U2)
26	20	1	5322 105 30047	Switch (attenuator: U3)
27	21	1	5322 145 40088	Mains transformer (T401)
28	21	1	5322 142 64002	Oscillator coil (T407)
29*	20	1	5322 216 54055	Printed circuit (Unit 4)
30	21	1	5322 216 54056	Printed circuit (Unit 5)
32	22	1	5322 325 80058	Insulating ring (BU1)
33	22	1	5322 381 10166	Lens
34	21	1	5322 404 50258	Valve holder (CRT)
35	13	1	5322 267 40127	Socket 6 cont (BU5)
36	13	1	5322 264 40066	Plug 6 cont (BU6)
37	22	1	5322 498 40285	Carrying handle
38	20	4	5322 705 15163	Ratchet spring
39	22	2	5322 498 70043	Cap
40	21	1	5322 252 20001	Fuse
41	22	1	5322 480 34012	Contrast plate (green)
42	–	1	5322 462 70827	Cap for TS32
29*	20	1	5322 216 54057	Printed circuit (Unit 4) for /07 version

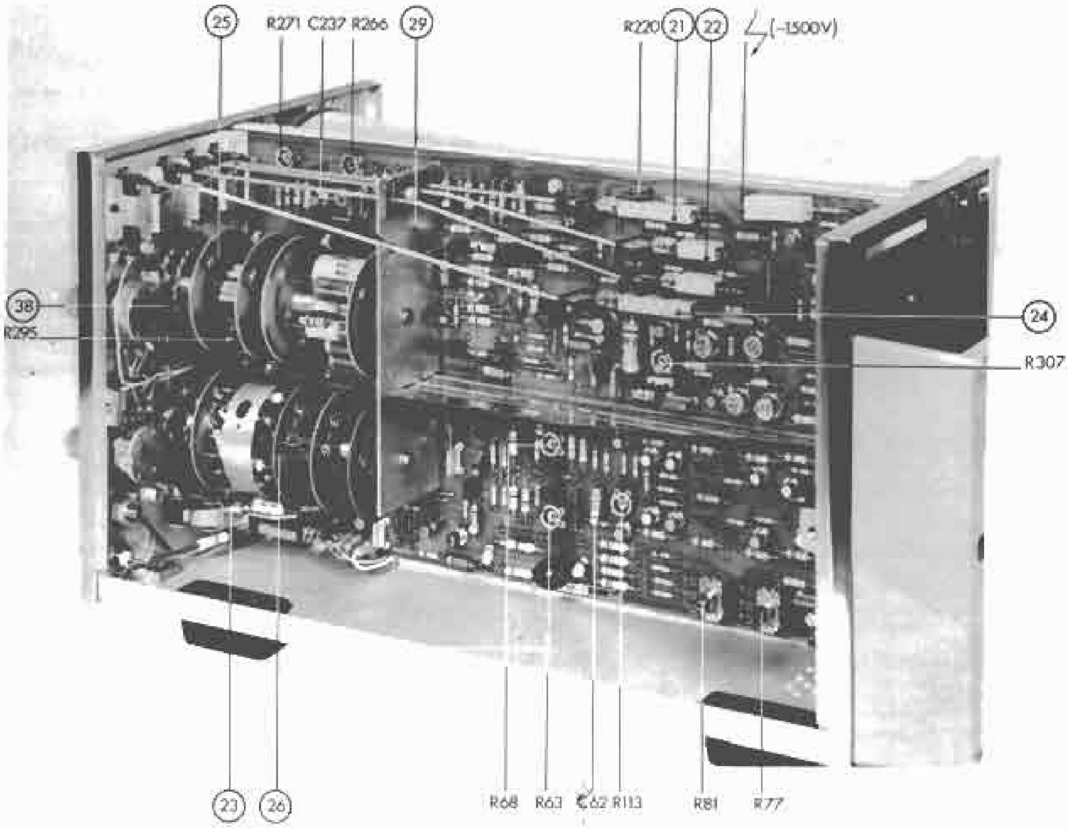


Fig. 20. View of unit 4 with indication of adjusting elements

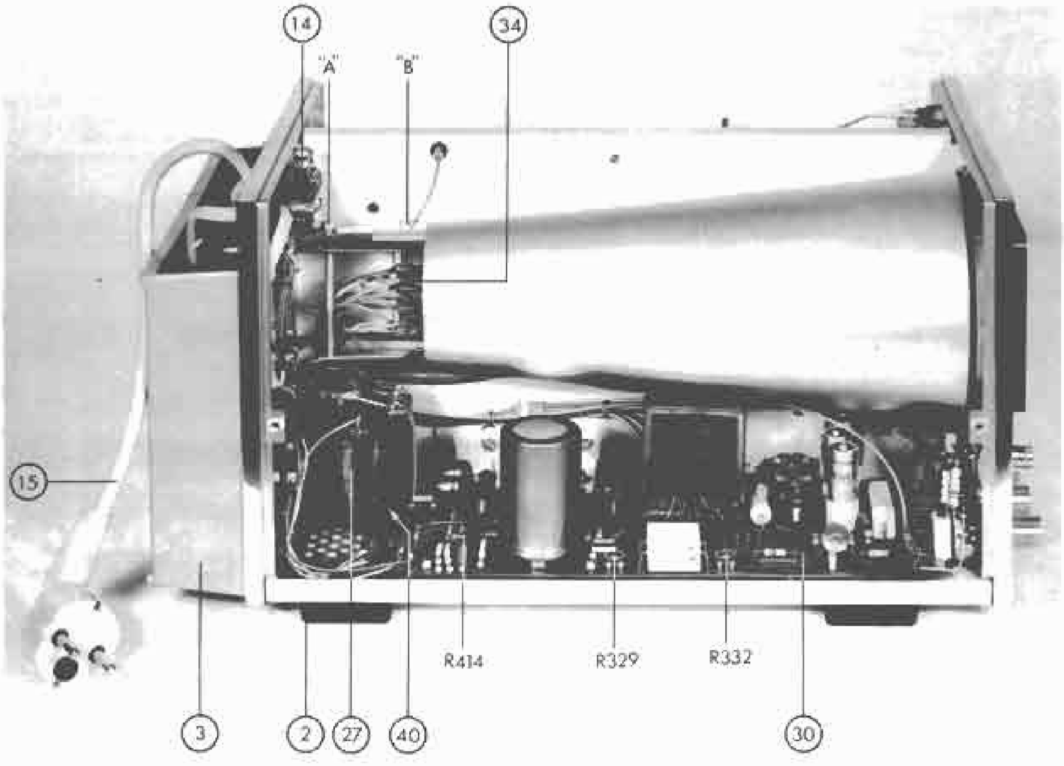


Fig. 21. View of unit 5 with indication of adjusting elements

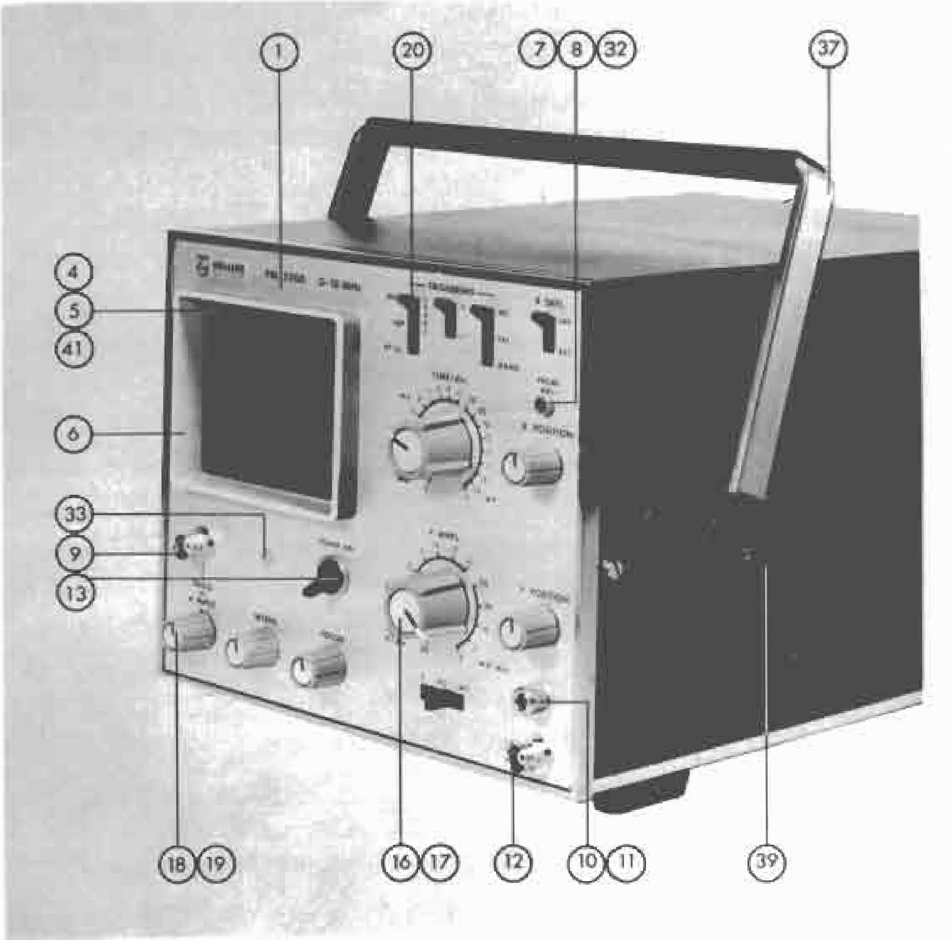


Fig. 22. Front view with indication of parts

B. ELECTRICAL — ELEKTRISCH — ELEKTRISCH — ELECTRIQUE — ELECTRICOS

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

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

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

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

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

Carbon resistor E24 series Kohleschichtwiderstand, Reihe E24 Koolweerstand E24 reeks Résistance au carbone, série E24 Resistencia de carbón, serie E24	0,125 W 5%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	1 W ≦ 2,2 MΩ, 5% >2,2 MΩ, 10%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	0,25 W ≦ 1 MΩ, 5% > 1 MΩ, 10%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	2 W 5%
Carbon resistor E24 series Kohleschichtwiderstand, Reihe E24 Koolweerstand E24 reeks Résistance au carbone, série E24 Resistencia de carbón, serie E24	0,5 W ≦ 5 MΩ, 1% > 5 ≦ 10 MΩ, 2% > 10 MΩ, 5%
Wire-wound resistor Drahtwiderstand Draadgewonden weerstand Résistance bobinée Resistencia bobinada	0,4 - 1,8 W 0,5%
Carbon resistor E12 series Kohleschichtwiderstand, Reihe E12 Koolweerstand E12 reeks Résistance au carbone, série E12 Resistencia de carbón, serie E12	0,5 W ≦1,5MΩ, 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.

RESISTORS

Item	*Ordering number*	*Value*		*%*	*W*	*Description*
R1	5322 101 20341	4.7	kΩ			Potentiometer lin.
R2	5322 101 20273	1	kΩ			Potentiometer lin.
R3	5322 101 20274	220	kΩ			Potentiometer lin.
R4	5322 101 20275	100	kΩ			Potentiometer lin.
R5	5322 101 20276	1	MΩ			Potentiometer lin.
R28	4822 116 50279	999	kΩ	1	1/8	Carbon
R29	4822 111 20018	1	kΩ	1	1/4	Carbon
R31	5322 111 20331	990	kΩ	1	1/8	Carbon
R32	5322 116 50463	10.1	kΩ	1	1/4	Carbon
R33	5322 116 51019	900	kΩ	1	1/8	Carbon
R34	5322 116 50017	111	kΩ	1	1/8	Carbon
R37	5322 116 50431	1.44	kΩ	1/4	1/8	Metal film
R38	5322 116 50432	480	Ω	1/4	1/8	Metal film
R39	5322 116 50153	160	Ω	1/4	1/8	Metal film
R41	5322 116 50433	3.39	kΩ	1/4	1/8	Metal film
R42	5322 116 50383	1.13	kΩ	1/4	1/8	Metal film
R43	5322 116 50434	377	Ω	1/4	1/8	Metal film
R53, R64	5322 116 50463	10	kΩ	1	1/8	Carbon
R57	5322 116 50157	2.4	kΩ	1/4	1/8	Metal film
R61	5322 116 50539	68	Ω	1	1/8	Carbon
R63	4822 100 10019	220	Ω		0.1	Potentiometer lin.
R68	4822 100 10038	470	Ω		0.1	Potentiometer lin.
R69	5322 113 10122	4.9	kΩ	1	1/8	Carbon
R77	5322 101 20242	100	kΩ		0.1	Potentiometer lin.
R81	5322 101 20277	2.2	kΩ		0.1	Potentiometer lin.
R84	5322 116 50463	10	kΩ	1/4	1/8	Metal film
R91	5322 116 50435	226	Ω	1/4	1/8	Metal film
R92	5322 116 50119	12	kΩ	1/4	1/8	Metal film
R113	5322 100 10037	1	kΩ		0.1	Potentiometer lin.
R203	5322 116 20093		Ω	10	0.8	Volt. dep. resistor
R220	5322 100 10023	470	Ω	20	0.1	Potentiometer lin.
R226	5322 116 50119	12	kΩ	1/4	1/8	Metal film
R229	5322 116 50003	120	Ω	1	1/8	Carbon
R231	5322 116 50463	10	kΩ	1	1/8	Carbon
R233, R234	5322 116 50102	2.2	kΩ	1	1/8	Carbon
R243	5322 116 50079	680	Ω	1	1/8	Carbon
R244	5322 111 20296	16	kΩ	1	1/8	Carbon
R247	5322 116 50704	6.2	kΩ	1	1/8	Carbon
R251	5322 111 20019	3	kΩ	1	1/8	Carbon
R257	5322 116 50009	11	kΩ	1	1/8	Carbon
R266, R307	4822 100 10029	2.2	kΩ		0.1	Potentiometer lin.
R270	5322 116 30018	1.3	kΩ		1	Neg. temp. coeff.
R271	5322 100 10036	4.7	kΩ		0.1	Potentiometer lin.
R274	5322 111 20275	137	kΩ	1	1/8	Carbon
R276	5322 111 20297	49	kΩ	1	1/8	Carbon

Item	*Ordering number*	*Value*		*%*	*W*	*Description*
R277	5322 111 20298	19.5	kΩ	1	1/8	Carbon
R278	5322 116 50385	4.8	kΩ	1	1/8	Carbon
R279	5322 111 20231	406	Ω	1	1/8	Carbon
R282	5322 111 20302	211	kΩ	1	1/8	Carbon
R283	4822 111 20022	3.9	kΩ	1	1/8	Carbon
R289	5322 116 50463	10	kΩ	1	1/8	Carbon
R291	5322 116 50463	10	kΩ	1	1/8	Carbon
R299, R314	4822 116 20083		Ω			Volt. dep. resistor
R329	5322 100 10079	47	kΩ		0.1	Potentiometer lin.
R295, R332	5322 100 10052	100	kΩ		0.1	Potentiometer lin.
R411	5322 113 60097	1.8	Ω	10	1	Wire wound
R414	5322 100 10037	1	kΩ	20	0.1	Potentiometer lin.

CAPACITORS

Item	*Ordering number*	*Value*		*%*	*V*	*Description*
C26	5322 121 40145	0.1	μF	10	630	Plate
C27, C29 C32, C34 C37, C39	4822 125 60027	6	pF		400	Trimmer
C31	4822 120 60107	1000	pF	1	500	Mica
C36	5322 121 50508	180	pF	1	500	Mica
C52	4822 124 20362	20	μF		16	Electrolytic
C53	4822 124 20373	50	μF		64	Electrolytic
C54	4822 122 30099	3300	pF	10	100	Plate
C59	4822 124 20402	250	μF		16	Electrolytic
C63	4822 124 20362	20	μF		16	Electrolytic
C66	4822 124 20032	4	μF		250	Electrolytic
C67	4822 124 20402	250	μF		16	Electrolytic
C68	4822 124 20403	400	μF		10	Electrolytic
C200	4822 124 20362	20	μF		16	Electrolytic
C202	5322 121 40061	0.22	μF		250	Polyester
C203	4822 124 20362	20	μF		16	Electrolytic
C204, C228	4822 124 20203	2.5	μF		16	Electrolytic
C206	4822 124 20402	250	μF		16	Electrolytic
C208, C209, C210	4822 124 20362	20	μF		16	Electrolytic
C212, C218	4822 124 20362	20	μF		16	Electrolytic
C215	5322 121 40123	0.015	μF	10	1600	Polyester
C226	5322 124 20395	200	μF		10	Electrolytic
C229	5322 124 10087	15	μF		35	Tantalum
C231	5322 121 50275	0.15	μF	1	63	Polyester
C232	5322 121 50502	0.015	μF	1	63	Polyester
C234	4822 121 50189	1300	pF	1	250	Polyester

Item	*Ordering number*	*Value*		*%*	*V*	*Description*
C236	5322 121 50463	110	pF	1	125	Polystyrene
C237	5322 125 50045	18.5	pF		50	Trimmer
C239	4822 121 50371	220	pF	5	125	Polystyrene
C244	4822 124 20362	20	μF		16	Electrolytic
C326	5322 121 40195	0.033	μF	10	1600	Polyester
C327	5322 121 40088	0.01	μF	10	400	Polyester
C403	5322 124 40003	1600	μF		40	Electrolytic
C409	5322 124 20488	80	μF		25	Electrolytic
C416	5322 121 40196	0.022	μF	10	1600	Polyester
C417, C419	4822 124 20406	400	μF		16	Electrolytic
C421	4822 124 20042	32	μF		100	Electrolytic
C422	4822 124 20029	25	μF		300	Electrolytic

COILS

L27, L202	5322 526 10025		Ferroxcube bead
L201	5322 158 10052		Coil
L401	5322 158 30132	2x0.73 mH	Coil
L403	5322 158 20234	427 mH	Coil
L404	5322 158 20235	50 mH	Coil
L406	5322 158 20237	8.5 mH	Coil
L407	5322 158 20236	2.23 mH	Coil

DIODES

Type	*Ordering number*
AAZ13	5322 130 30231
BA114	5322 130 30189
BA148	5322 130 30256
BAX13	5322 130 40182
BAX16	5322 130 30273
BY164	5322 130 30414
BYX10	5322 130 30195
BZY88/C5V6	5322 130 30193
BZY88/C6V2	5322 130 30286
OA95	5322 130 30191
OA202	5322 130 30239

TRANSISTORS

Type	*Ordering number*
AC187	5322 130 40314
BC107B	5322 130 40332
BC109C* (selected pair)	5322 130 40662
BC149	5322 130 40313
BC157	5322 130 40525
BC158A	5322 130 40614
BC178	5322 130 40355
BDY38	5322 130 40524
BF115	5322 130 40308
BF173	5322 130 40326
BF179	5322 130 40661
BF194	5322 130 40303
BFW11	5322 130 40408
BSW66	5322 130 40747
BSX20	5322 130 40417

* When replacing this pair, see also chapter XI point E.

MISCELLANEOUS

Type	*Ordering number*	*Description*
D10 - 160 GH	5322 131 20022	Cathode ray tube
GL8	5322 134 20016	Neon lamp

C. PARTS OF THE PROBES (Fig. 12)
PM 9326 AND PM 9327

Item	*Qty*	*Ordering number*	*Description*
a	1	4822 320 10042	Probe cable 2 m (6.5') for PM 9327
	1	4822 321 20087	Probe cable 1.15 m (3.8') for PM 9326
b	1	4822 321 20096	Earthing flex 15 cm (6")
c	1	4822 321 20134	Earthing flex 30 cm (12")
d	1	4822 266 20015	Measuring probe 1:1 (black)
e	1	4822 268 10029	Measuring pin
f	1	4822 268 10039	Measuring hook
g	1	4822 210 70044	Attenuator probe 1:10 (grey)
h	1	4822 264 20016	Measuring clip
	1	4822 111 20155	Resistor

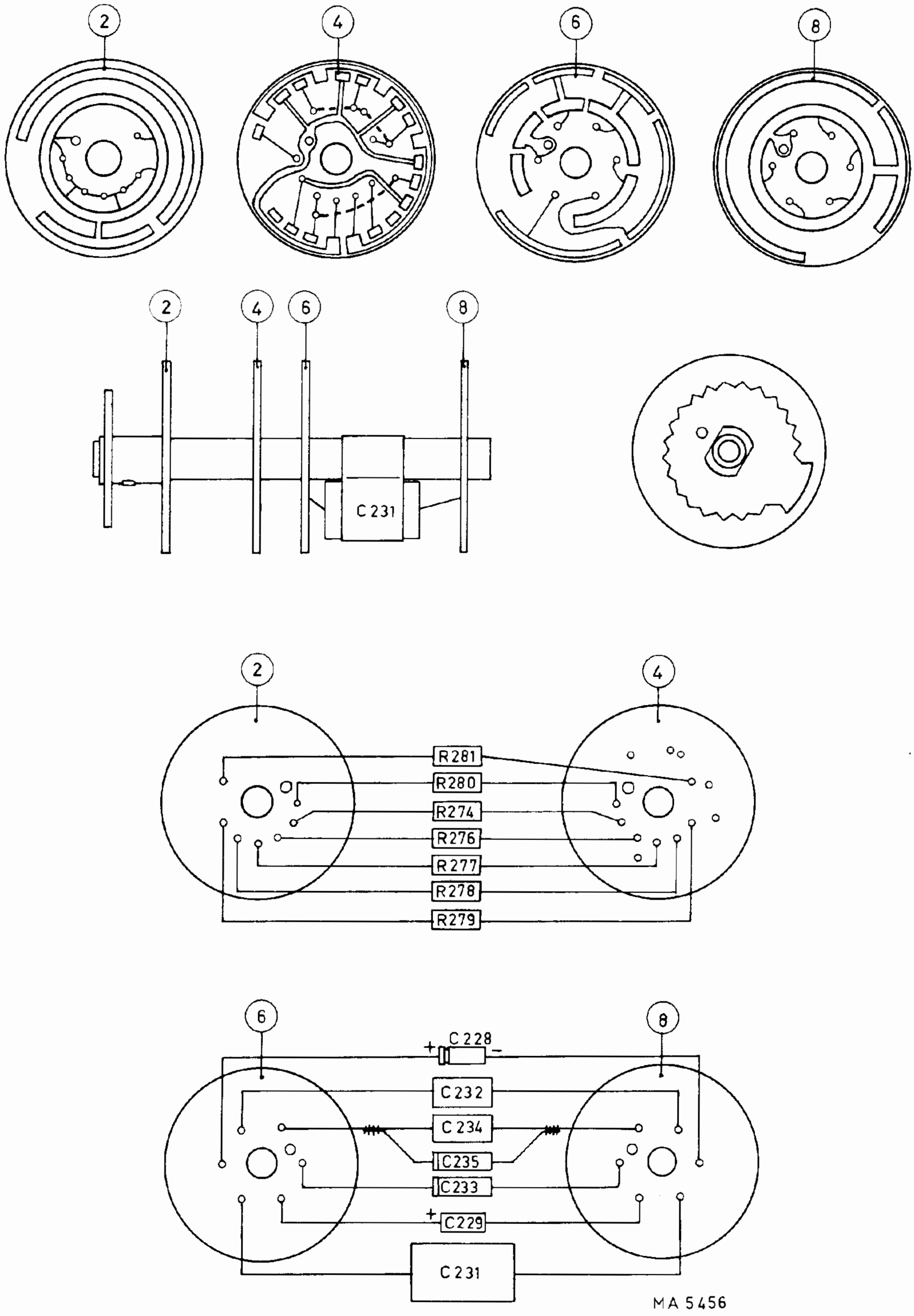
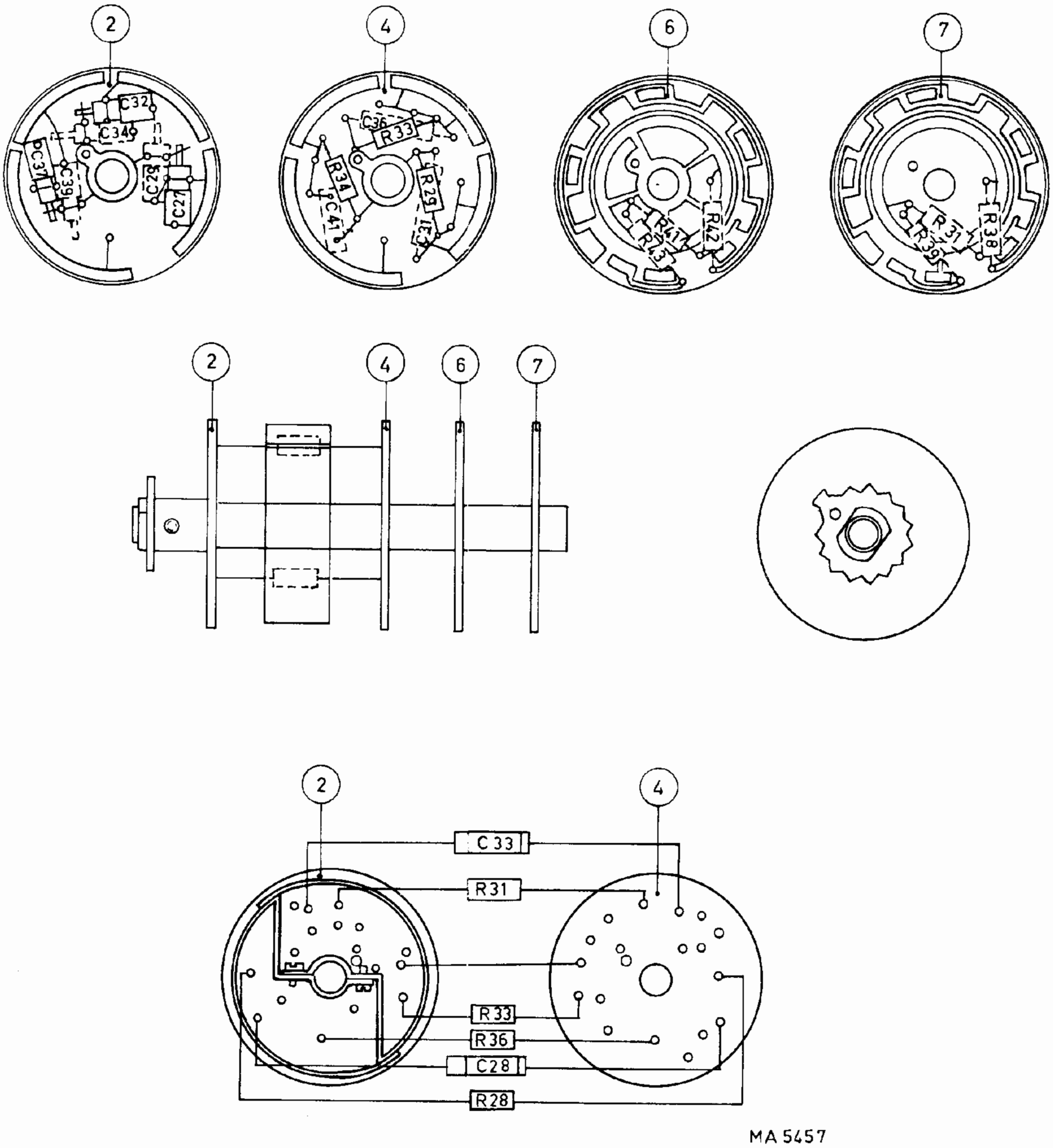
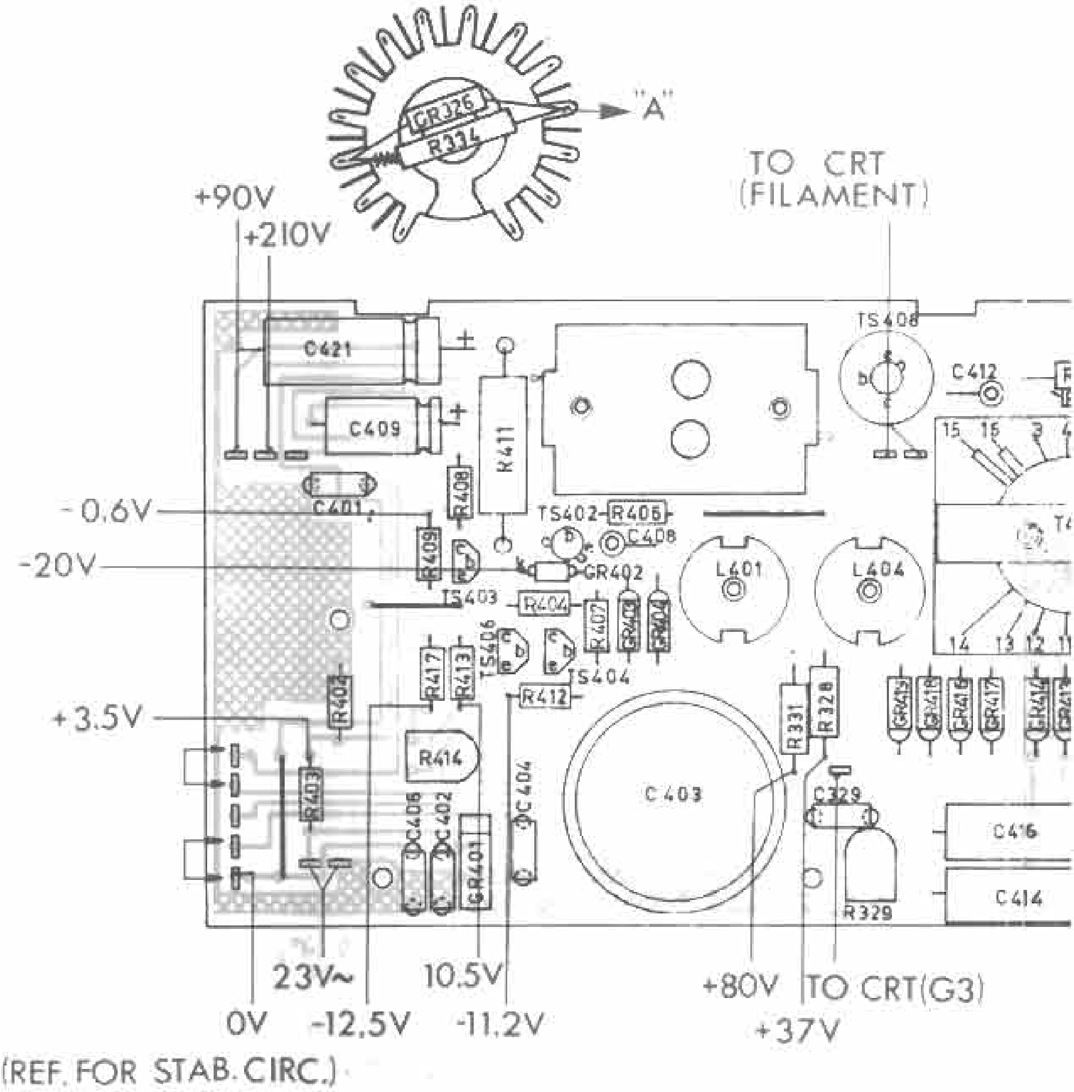


Fig. 23. Switch turret, unit 2 (Time/div)
Schalttrommel Einheit 2 (Time/div)
Schakelaarwals Unit 2 (Time/div.)
Ensemble commutateur bloc 2 (TIME/DIV)



MA 5457

Fig. 24. Switch turret, unit 3 (Volt/div)
Schalttrommel Einheit 3 (Volt/div)
Schakelaarwals Unit 3 (Volt/div.)
Ensemble commutateur bloc 3 (VOLT/DIV)



"A"
GR326
R334
TO CRT (FILAMENT)
+90V
+210V
C421
C409
R411
R408
TS408
C412
-0.6V
-20V
C401
R409
TS402
R406
C408
GR402
TS403
R404
R407
GR403
GR404
L401
L404
TS406
R417
R413
TS404
R412
R402
+3.5V
R414
R403
C406
C402
GR401
C404
C403
R331
R328
C329
R329
C416
C414
23V~
10.5V
+80V
TO CRT(G3)
0V
-12,5V
-11,2V
+37V
(REF. FOR STAB. CIRC.)

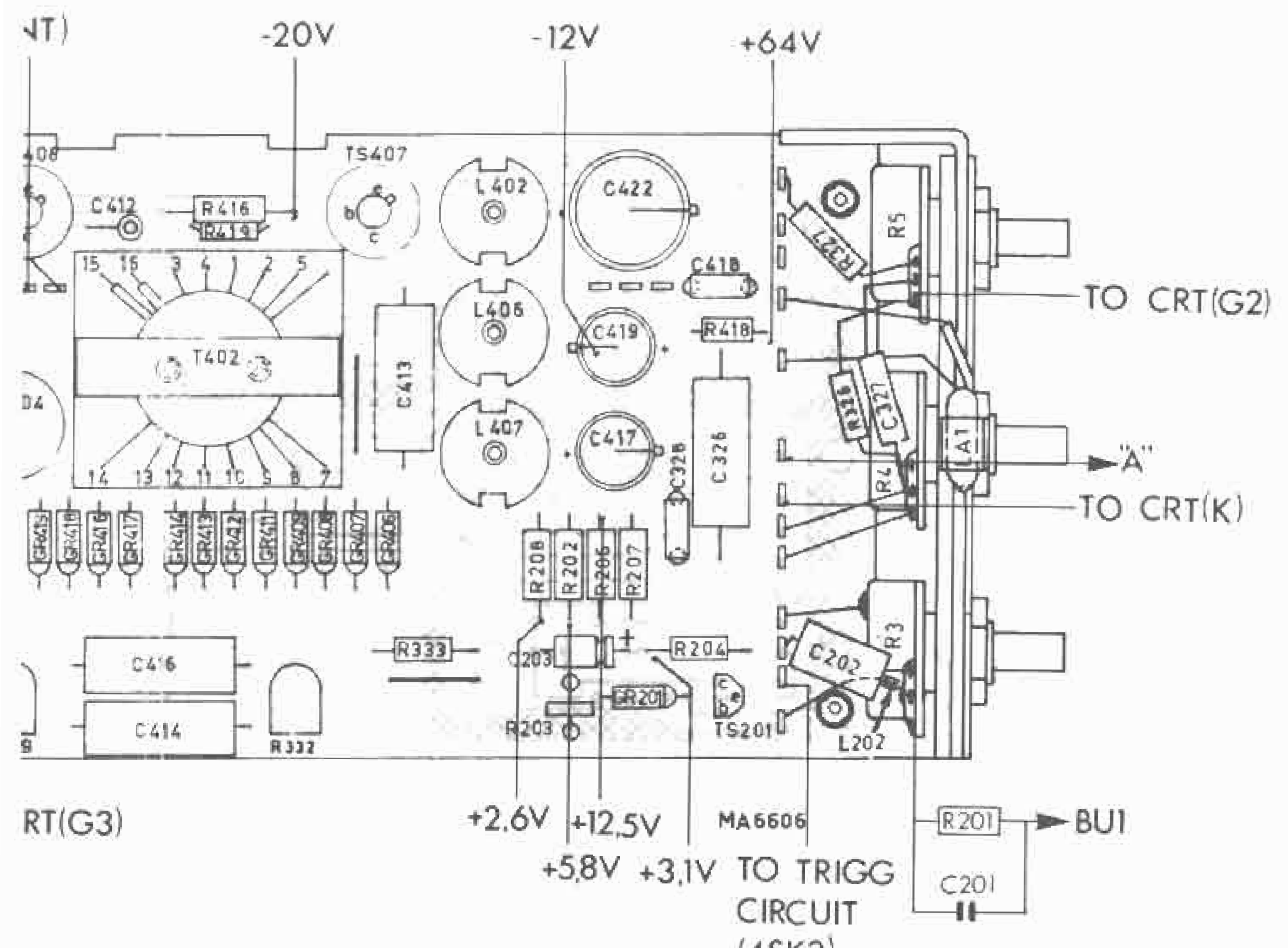
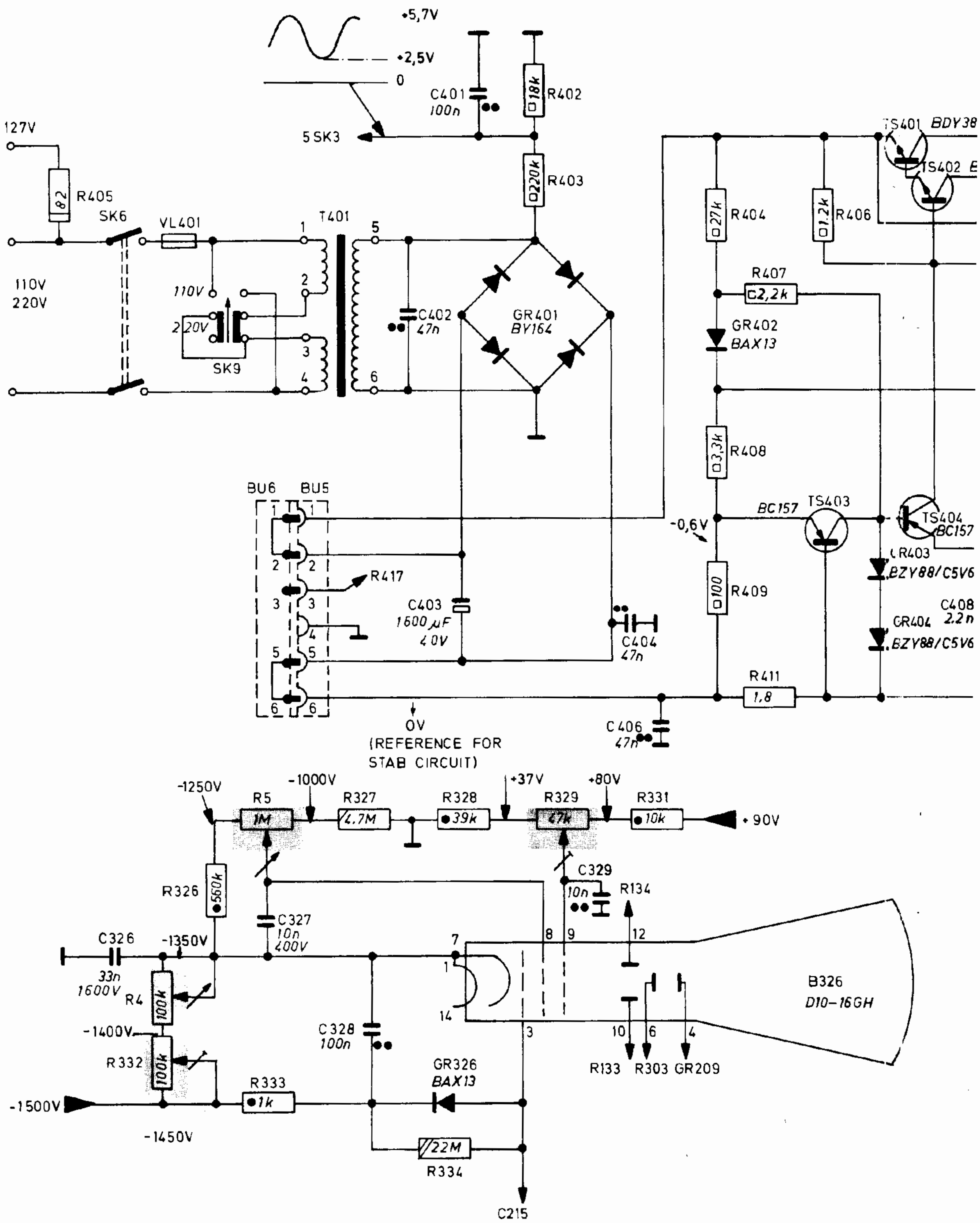


Fig. 25. Printed circuit board, unit 5 (power supply)
Printplatte Einheit 5 (Speiseteil)
Printplaat Unit 5 (voeding)
Platine imprimée bloc 5 (alimentation)



+5,7V
+2,5V
0
5 SK3
C401
100n
R402
18k
R403
220k
127V
R405
82
SK6
VL401
T401
110V
220V
110V
220V
SK9
C402
47n
GR401
BY164
TS401 BDY38
TS402
R404
27k
R406
1,2k
R407
2,2k
GR402
BAX13
R408
3,3k
BU6
BU5
R417
C403
1600 µF
40V
C404
47n
-0,6V
BC157
TS403
TS404
BC157
GR403
BZY88/C5V6
GR404
BZY88/C5V6
C408
2,2n
R409
100
R411
1,8
C406
47n
0V
(REFERENCE FOR
STAB CIRCUIT)
-1250V
-1000V
+37V
+80V
R5
1M
R327
4,7M
R328
39k
R329
47k
R331
10k
+90V
R326
560k
C329
10n
R134
C327
10n
400V
C326
33n
1600V
-1350V
R4
100k
-1400V
R332
100k
C328
100n
B326
D10-16GH
R133
R303
GR209
GR326
BAX13
R333
1k
-1500V
-1450V
R334
22M
C215

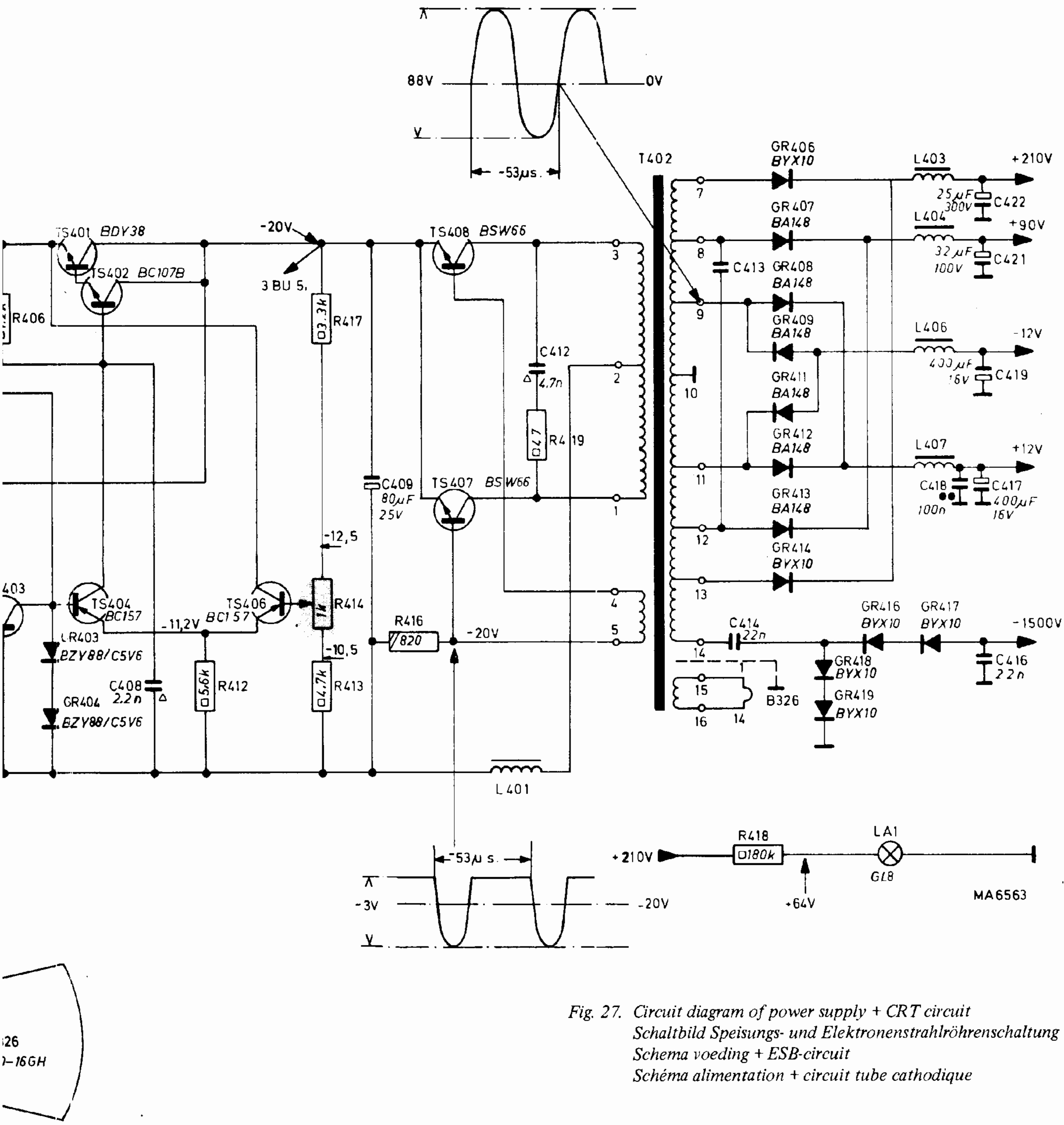
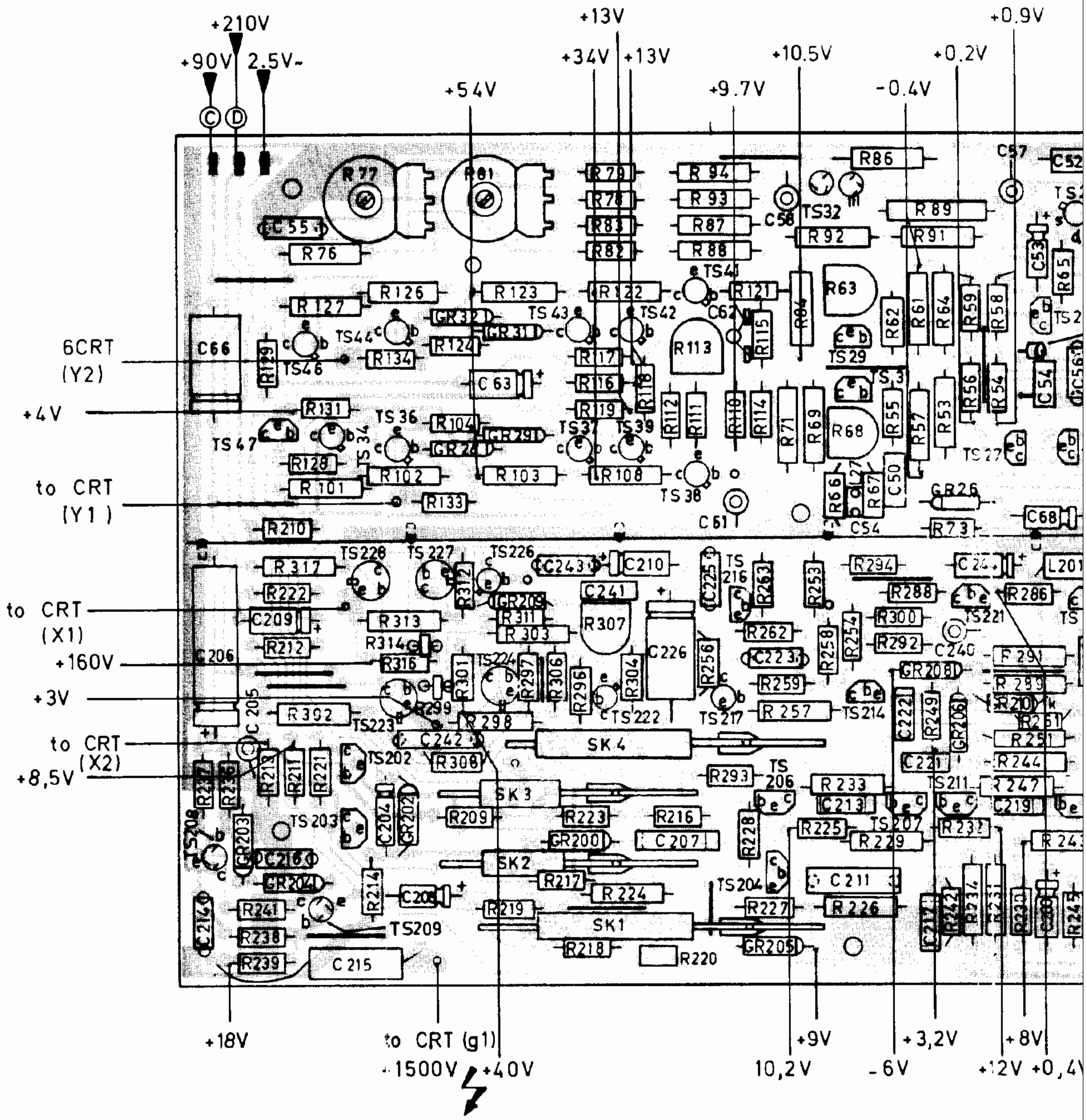


Fig. 27. Circuit diagram of power supply + CRT circuit
Schaltbild Speisungs- und Elektronenstrahlröhrenschaltung
Schema voeding + ESB-circuit
Schéma alimentation + circuit tube cathodique



+210V
+90V
2.5V~
+54V
+13V
+34V
+13V
+10.5V
+9.7V
-0.4V
+0.2V
+0.9V
6CRT
(Y2)
+4V
to CRT
(Y1)
to CRT
(X1)
+160V
+3V
to CRT
(X2)
+8,5V
+18V
to CRT (g1)
+1500V
+40V
+9V
10,2V
-6V
+3,2V
+8V
+12V

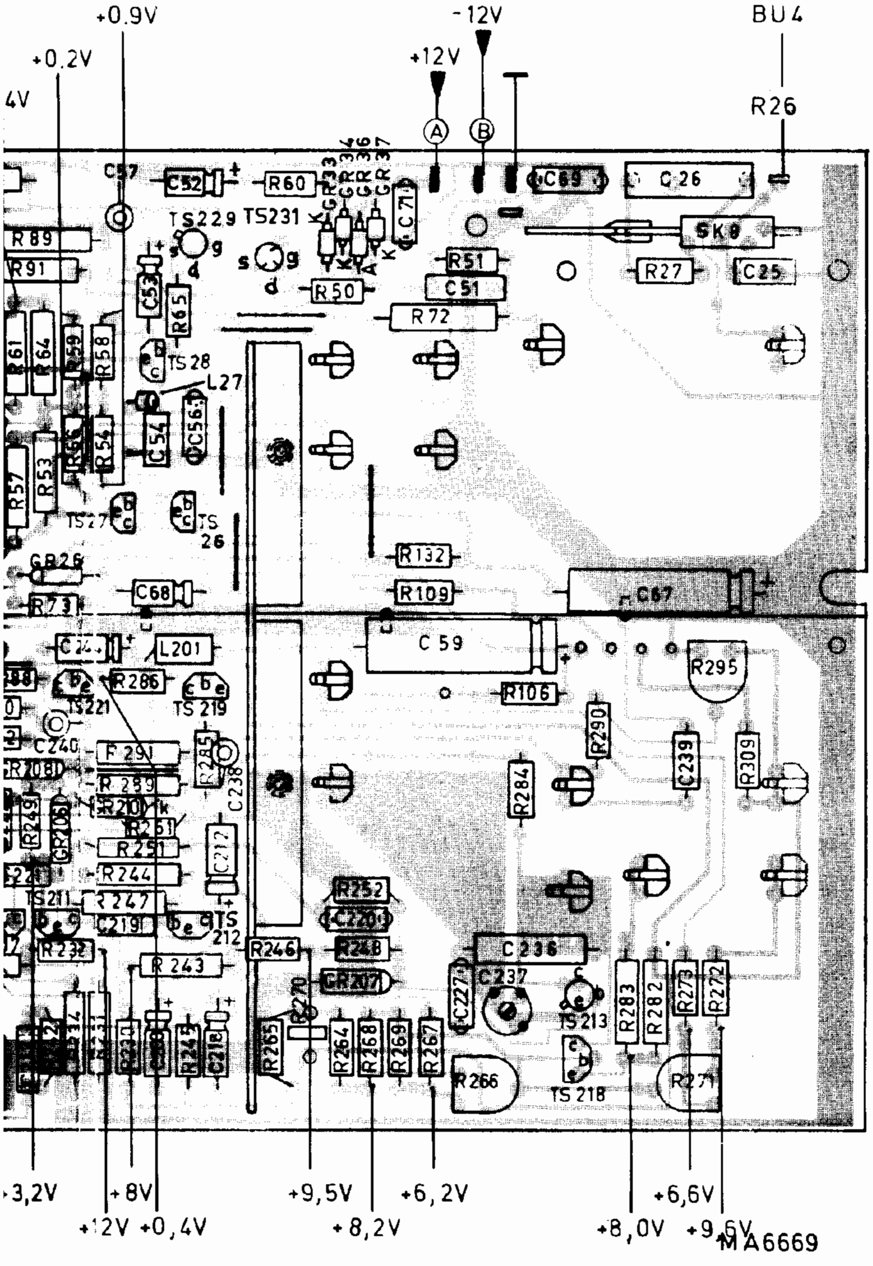
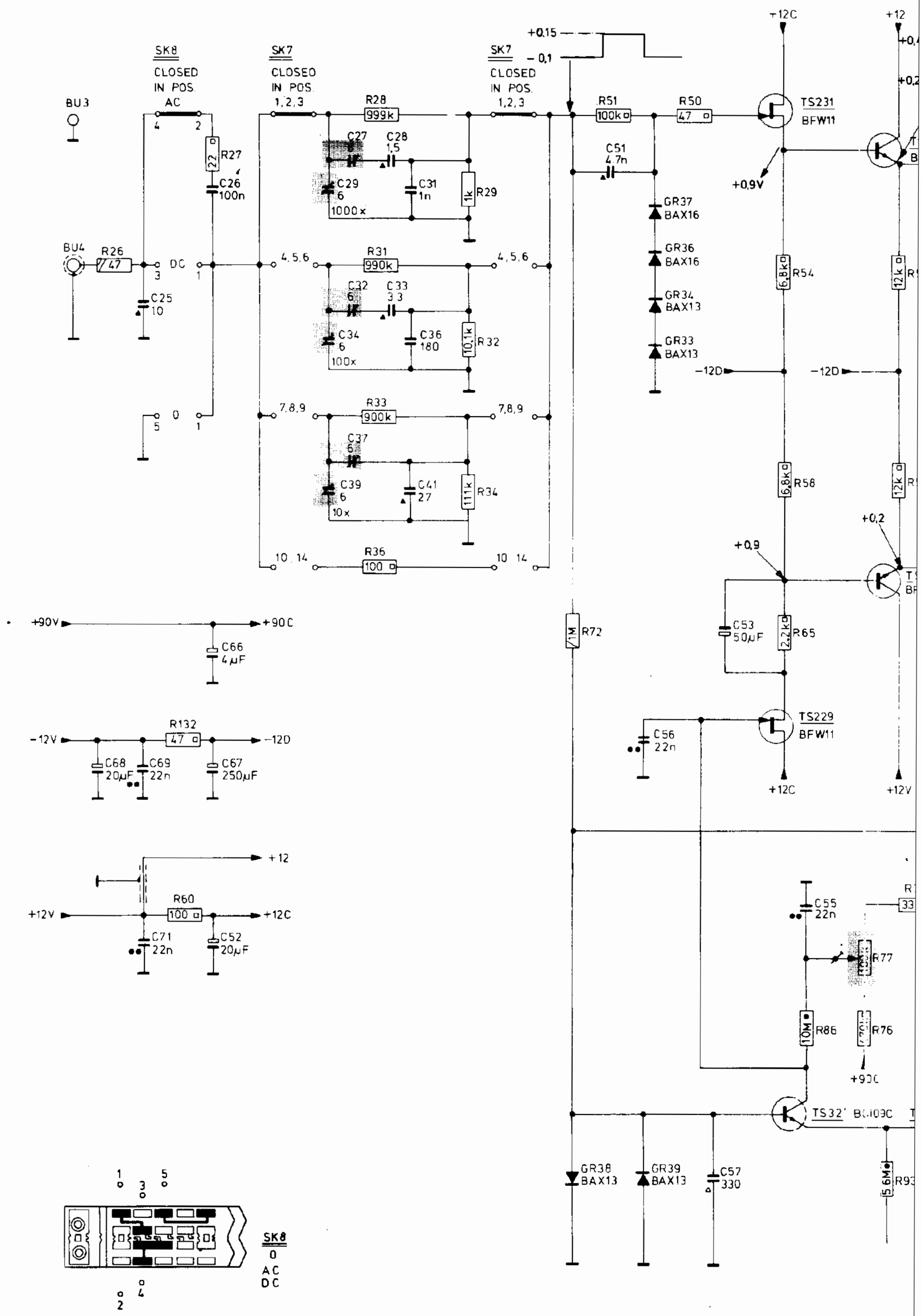


Fig. 26. Printed circuit board, unit 4 (Y-amplifier; time base)
Printplatte Einheit 4 (Y-Verstärker; Zeitablenkung)
Printplaat Unit 4 (Y-versterker; tijdbasis)
Platine imprimée bloc 4 (amplificateur Y; base de temps)



SK8
CLOSED
IN POS.
AC
SK7
CLOSED
IN POS.
1,2,3
BU3
BU4
R26
47
C25
10
R27
22
C26
100n
DC
R28
999k
C27
C28
1,5
C29
6
1000 x
C31
1n
R29
1k
4,5,6
R31
990k
C32
6
C33
3,3
C34
6
100x
C36
180
R32
10,1k
7,8,9
R33
900k
C37
6
C39
6
10x
C41
27
R34
111k
10 14
R36
100
+0,15
- 0,1
R51
100k
R50
47
C51
4,7n
GR37
BAX16
GR36
BAX16
GR34
BAX13
GR33
BAX13
TS231
BFW11
+12C
+12
+0,9V
R54
6,8k
12k
-12D
R58
6,8k
+0,2
+0,9
C53
50µF
R65
2,2k
TS229
BFW11
C56
22n
+12V
R72
1M
+90V
+90C
C66
4µF
-12V
R132
47
-12D
C68
20µF
C69
22n
C67
250µF
+12
+12V
R60
100
+12C
C71
22n
C52
20µF
C55
22n
R77
R86
10M
R76
+90C
TS32
GR38
BAX13
GR39
BAX13
C57
330
R93
5,6M
SK8
0
AC
DC

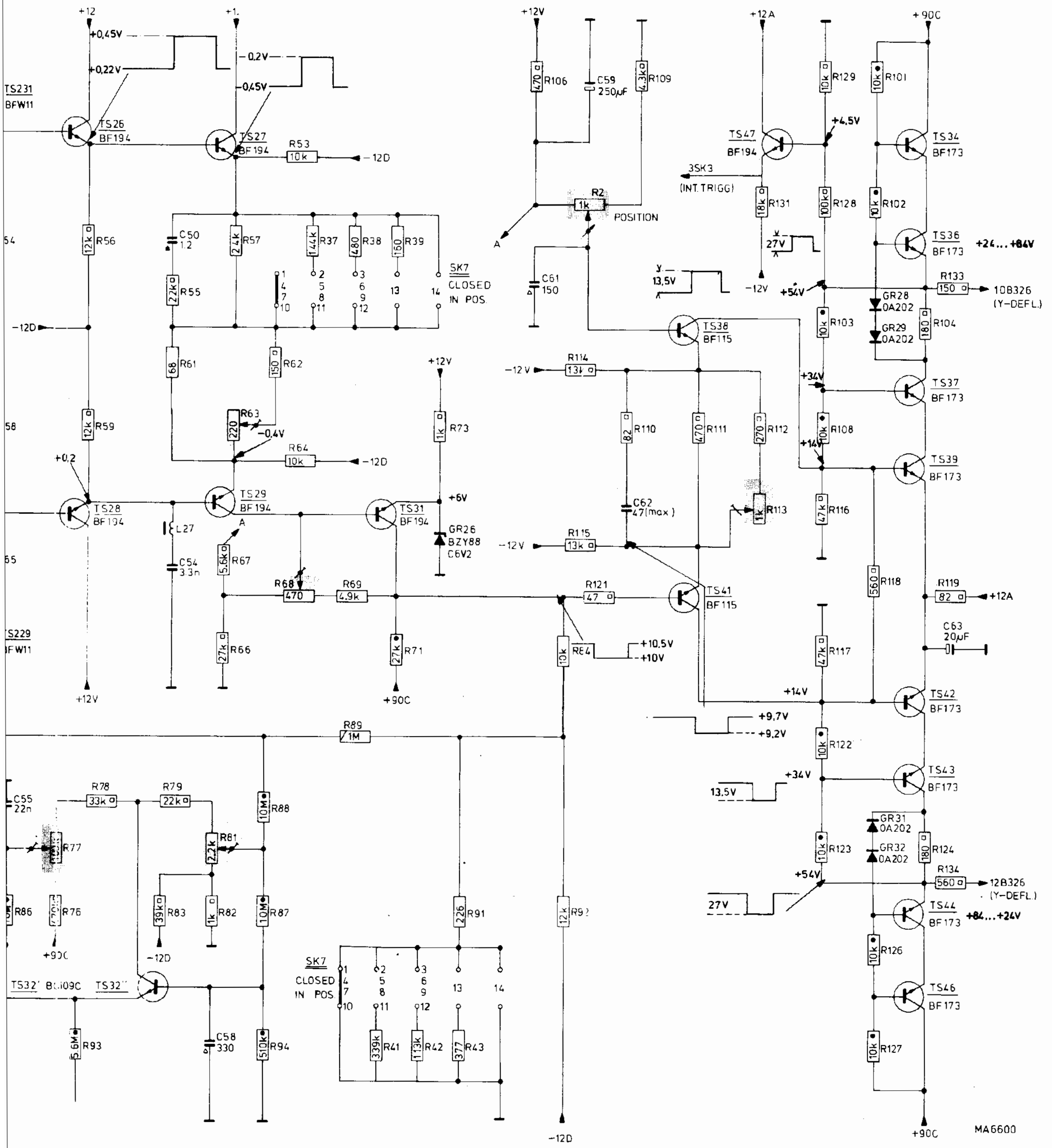
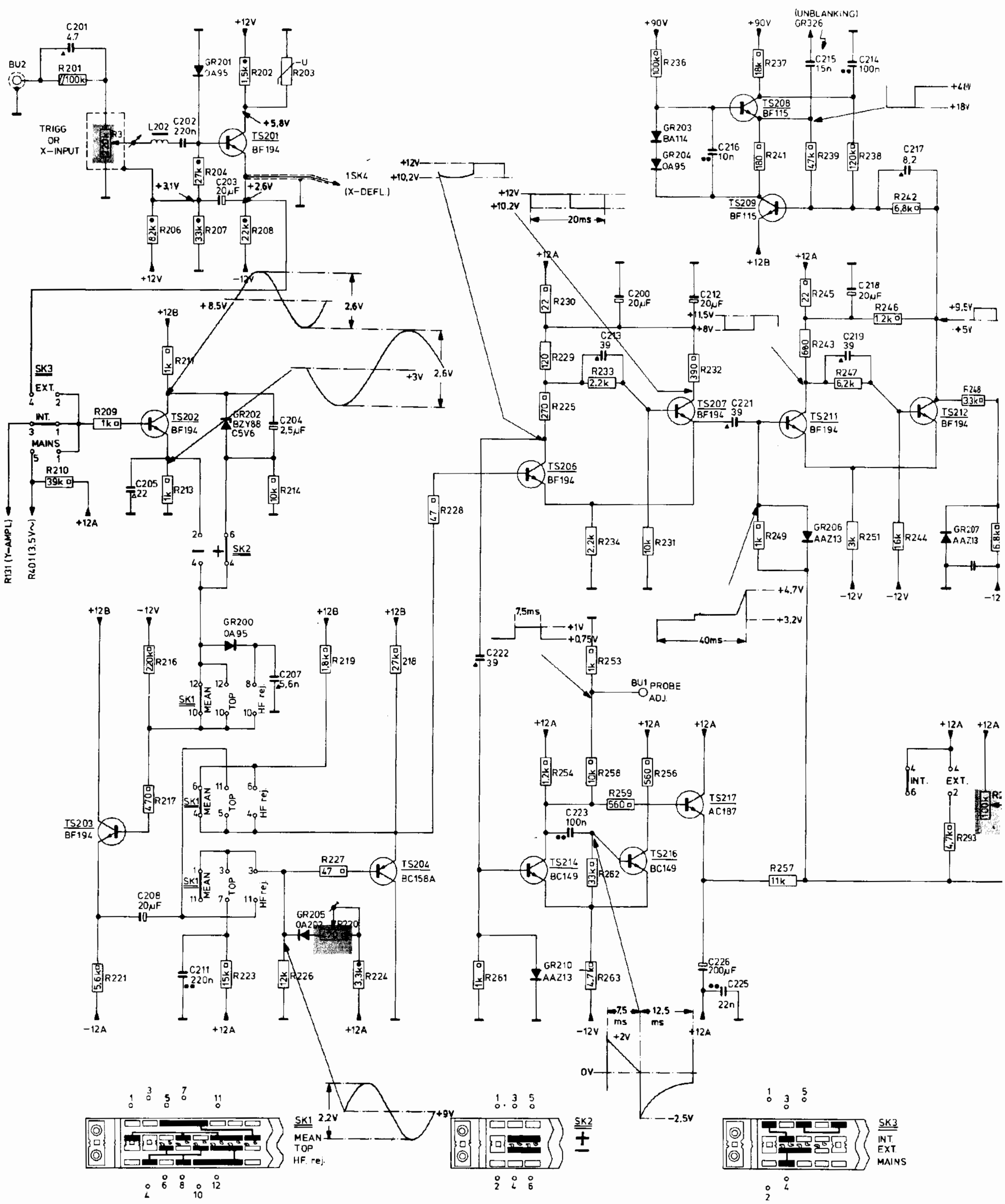


Fig. 28. Circuit diagram of attenuator + Y-amplifier
Schaltbild Spannungsteiler und Y-Verstärker
Schema verzwakker + Y-versterker
Schéma atténuateur + amplificateur Y


BU2
C201
4.7
R201
100k
TRIGG
OR
X-INPUT
R3
L202
C202
220n
+12V
GR201
OA95
R202
1.5k
-U
R203
+5.8V
TS201
BF194
R204
27k
+3.1V
C203
20µF
+2.6V
1SK4
(X-DEFL.)
R206
82k
R207
33k
R208
22k
+12V
-12V
+8.5V
2.6V
+3V
2.6V
+12B
R211
1k
SK3
EXT.
INT.
MAINS
R209
1k
TS202
BF194
GR202
BZY88
C5V6
C204
2.5µF
R210
39k
C205
22
R213
1k
R214
10k
+12A
R131 (Y-AMPL)
R401 (3.5V~)
SK2
GR200
OA95
C207
5.6n
R216
220k
-12V
R219
1.8k
218
27k
SK1
MEAN
TOP
HF rej.
TS203
BF194
R217
470
C208
20µF
R227
47
TS204
BC158A
GR205
OA202
R220
C211
220n
R221
5.6k
R223
15k
R226
12k
R224
3.3k
-12A
+12A
R228
47
+12V
+10.2V
20ms
R230
22
C200
20µF
C212
20µF
+11.5V
+8V
C213
39
R229
120
R233
2.2k
R232
390
R225
270
TS207
BF194
C221
39
TS206
BF194
R234
2.2k
R231
10k
C222
39
7.5ms
+1V
+0.75V
R253
1k
BU1
PROBE
ADJ.
R254
1.2k
R258
10k
R256
560
R259
560
TS217
AC187
C223
100n
TS214
BC149
TS216
BC149
R262
33k
R261
1k
GR210
AAZ13
R263
4.7k
C226
200µF
C225
22n
7.5 ms
12.5 ms
+2V
0V
-2.5V
R257
11k
+90V
R236
100k
GR203
BA114
GR204
OA95
C216
10n
R237
18k
(UNBLANKING)
GR326
C215
15n
C214
100n
TS208
BF115
+41V
+18V
R241
180
R239
47k
R238
120k
C217
8.2
TS209
BF115
R242
6.8k
+12B
R245
22
C218
20µF
R246
1.2k
+9.5V
+5V
R243
680
C219
39
R247
6.2k
R248
33k
TS211
BF194
TS212
BF194
R249
1k
GR206
AAZ13
R251
3k
R244
16k
GR207
AAZ13
6.8k
+4.7V
+3.2V
40ms
INT.
EXT.
R293
4.7k
100k
SK1
2.2V
+9V
MEAN
TOP
HF. rej.
SK2
SK3
INT
EXT
MAINS

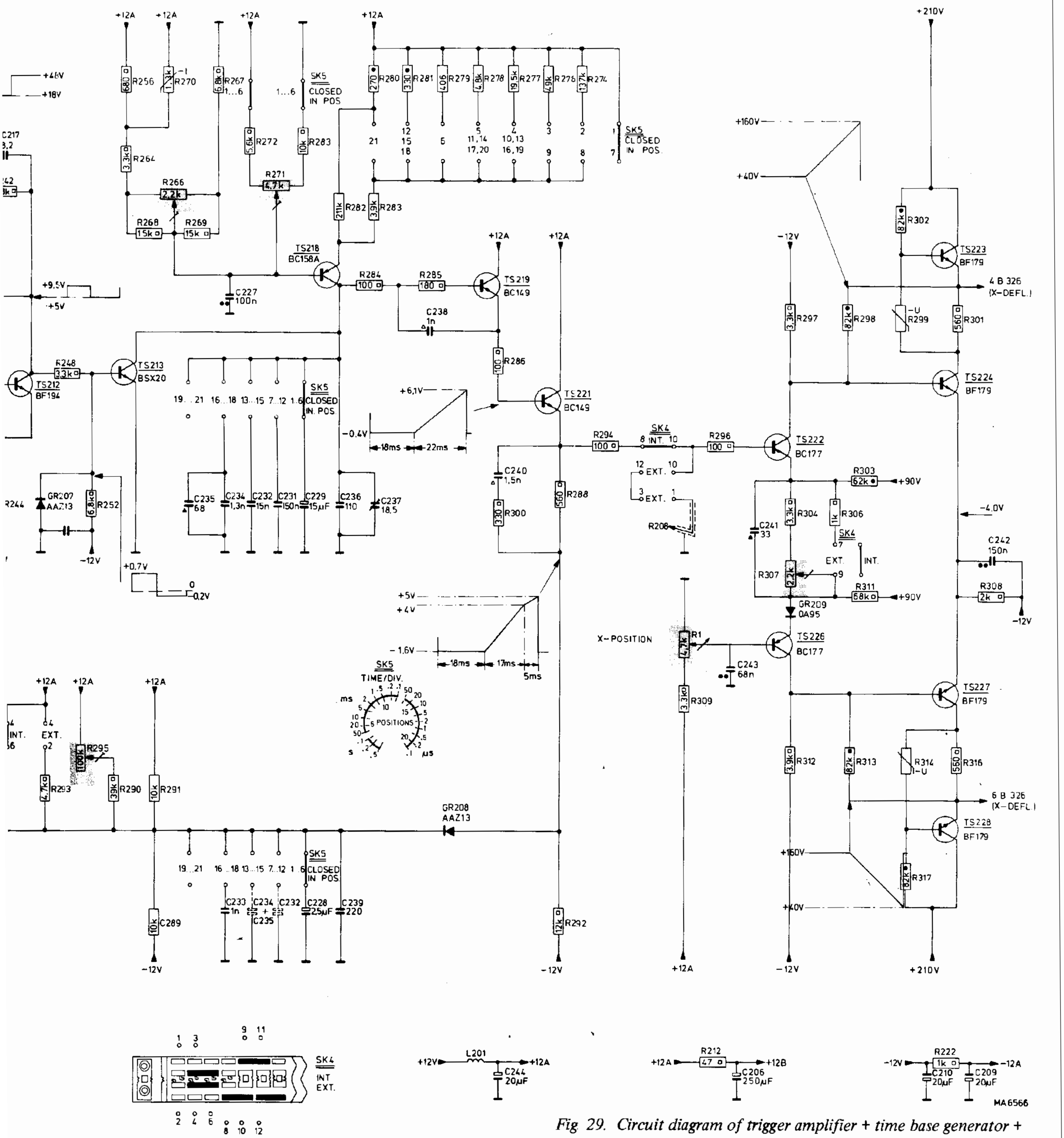


Fig. 29. Circuit diagram of trigger amplifier + time base generator + beam control + X-amplifier (PM 3200)
Schaltbild Triggerverstärker und Zeitablenkgenerator und Strahlsteuerung und X-Verstärker
Schema triggerversterker + tijdbasisgenerator + straalsturing + X-versterker
Schéma amplificateur de déclenchement + générateur base de temps + commande de rayon + amplificateur X

QUALITY REPORTING

CODING SYSTEM FOR FAILURE DESCRIPTION

The following information is meant for Philips service workshops only and serves as a guide for exact reporting of service repairs and maintenance routines on the workshop charts.
For full details reference is made to Information G1 (Introduction) and Information Cd 689 (Specific information for Test and Measuring Instruments).

LOCATION

☐☐☐☐
Unit number
e.g. 000A or 0001 (for unit A or 1; not 00UA or 00U1)

or: Type number of an accessory (only if delivered with the equipment)
e.g. 9051 or 9532 (for PM 9051 or PM 9532)

or: Unknown/Not applicable
0000

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
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

COMPONENT/SEQUENCE NUMBER

☐☐☐☐☐☐
Enter the identification as used in the circuit diagram, e.g.:

GR1003	Diode GR1003
TS0023	Transistor TS23
IC0101	Integrated circuit IC101
R0....	Resistor, potentiometer
C0....	Capacitor, variable capacitor
B0....	Tube, valve
LA....	Lamp
VL...	Fuse
SK....	Switch
BU....	Connector, socket, terminal
T0....	Transformer
L0....	Coil
X0....	Crystal
CB....	Circuit block
RE....	Relay
ME....	Meter, indicator
BA....	Battery
TR....	Chopper

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

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